TSTF
TECHNICAL SPECIFICATIONS TASK FORCE
A JOINT OWNERS GROUP ACTIVITY

March 6, 2014

TSTF-14-06
PROJ0753

Attn: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: Transmittal of TSTF-547, Revision 0, "Clarification of Rod Position Requirements"

Enclosed for NRC review is Revision 0 of TSTF-547, "Clarification of Rod Position Requirements." TSTF-547 is applicable to Westinghouse plants.

The TSTF requests that the NRC bill the Pressurized Water Reactor Owners Group for the review of this Traveler.

Should you have any questions, please contact us.

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Enclosure

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PWROG
PWR Owners Group

BWR
OWNERS' GROUP

Technical Specifications Task Force
Improved Standard Technical Specifications Change Traveler

Clarification of Rod Position Requirements

NUREGs Affected: ☐ 1430 ☑ 1431 ☐ 1432 ☐ 1433 ☐ 1434

Classification: 1) Technical Change

Correction or Improvement: Improvement

Recommended for CLIIP?: Yes

NRC Fee Status: Not Exempt

Changes Marked on ISTS Rev 4.0

See attached justification.

Revision History

OG Revision 0 Revision Status: Closed

Revision Proposed by: PWROG

Revision Description:
Original Issue

Owners Group Review Information

Date Originated by OG: 14-Nov-12

Owners Group Comments
Following PWROG LSC review, the PWROG forwarded the draft Traveler to the Rod Control Working Group for review.

Owners Group Resolution: Superceeded Date: 29-May-13

OG Revision 1 Revision Status: Active

Revision Proposed by: WOG

Revision Description:
TSTF-547 was revised to reflect the comments of the Rod Control Working Group, as well as other changes.

Owners Group Review Information

Date Originated by OG: 22-Jan-14

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 18-Feb-14

TSTF Review Information

TSTF Received Date: 21-Feb-14 Date Distributed for Review 21-Feb-14

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

TSTF Comments:

OG Revision 1 Revision Status: Active

(No Comments)

TSTF Resolution: Approved Date: 06-Mar-14

NRC Review Information

NRC Received Date: 06-Mar-14

Affected Technical Specifications

Action 3.1.4.B	Rod Group Alignment Limits
Action 3.1.4.B Bases	Rod Group Alignment Limits
SR 3.1.4.1	Rod Group Alignment Limits
SR 3.1.4.1 Bases	Rod Group Alignment Limits
LCO 3.1.5	Shutdown Bank Insertion Limits
LCO 3.1.5 Bases	Shutdown Bank Insertion Limits
Appl. 3.1.5	Shutdown Bank Insertion Limits
Appl. 3.1.5 Bases	Shutdown Bank Insertion Limits
Action 3.1.5.A	Shutdown Bank Insertion Limits Change Description: New Action
Action 3.1.5.A	Shutdown Bank Insertion Limits Change Description: Renamed B and revised
Action 3.1.5.A Bases	Shutdown Bank Insertion Limits Change Description: New Action
Action 3.1.5.A Bases	Shutdown Bank Insertion Limits Change Description: Renamed B and revised
Action 3.1.5.B	Shutdown Bank Insertion Limits Change Description: Renamed C and revised.
Action 3.1.5.B Bases	Shutdown Bank Insertion Limits Change Description: Renamed C and revised.
SR 3.1.5.1	Shutdown Bank Insertion Limits

SR 3.1.5.1 Bases	Shutdown Bank Insertion Limits
LCO 3.1.6	Control Bank Insertion Limits
LCO 3.1.6 Bases	Control Bank Insertion Limits
Appl. 3.1.6	Control Bank Insertion Limits
Appl. 3.1.6 Bases	Control Bank Insertion Limits
Action 3.1.6.A	Control Bank Insertion Limits Change Description: Renamed B and revised
Action 3.1.6.A	Control Bank Insertion Limits Change Description: New Action
Action 3.1.6.A Bases	Control Bank Insertion Limits Change Description: New Action
Action 3.1.6.A Bases	Control Bank Insertion Limits Change Description: Renamed B and revised
Action 3.1.6.B	Control Bank Insertion Limits Change Description: Renamed C
Action 3.1.6.B Bases	Control Bank Insertion Limits Change Description: Renamed C
Action 3.1.6.C	Control Bank Insertion Limits Change Description: Renamed D
Action 3.1.6.C Bases	Control Bank Insertion Limits Change Description: Renamed D
SR 3.1.6.2	Control Bank Insertion Limits
SR 3.1.6.2 Bases	Control Bank Insertion Limits
SR 3.1.6.3	Control Bank Insertion Limits
SR 3.1.6.3 Bases	Control Bank Insertion Limits
LCO 3.1.7	Rod Position Indication
LCO 3.1.7 Bases	Rod Position Indication
Action 3.1.7	Rod Position Indication Change Description: Action Note
Action 3.1.7.A	Rod Position Indication
Action 3.1.7.A Bases	Rod Position Indication

Action 3.1.7.B	Rod Position Indication
Action 3.1.7.B Bases	Rod Position Indication
Action 3.1.7.C	Rod Position Indication
Action 3.1.7.C Bases	Rod Position Indication
Action 3.1.7.D	Rod Position Indication
Action 3.1.7.D Bases	Rod Position Indication

1. SUMMARY DESCRIPTION

The Westinghouse plant Standard Technical Specifications (STS) contain four specifications related to rod cluster control assemblies (herein referred to as "rods"). There are two specifications on rod bank insertion limits, one on rod insertion time and alignment, and one on rod position indication. Operating experience has identified several issues related to the interaction of these requirements, internal consistency, and system hardware. Individual licensees have requested license amendments to address some of these issues. This proposed change addresses these issues in an integrated fashion in order to improve plant safety, improve the consistency and presentation of the Technical Specifications (TS), to remove unnecessary operational impediments.

The proposed change makes the following revisions to the TS:

1. TS 3.1.5, "Shutdown Bank Insertion Limits," and TS 3.1.6, "Control Bank Insertion Limits," are revised to provide time to repair rod movement failures that do not affect rod Operability;

2. TS 3.1.7, "Rod Position Indication," is revised to provide an alternative to frequent use of the movable incore detector system when position indication for a rod is inoperable;

3. TS 3.1.4, "Rod Group Alignment Limits," TS 3.1.5, TS 3.1.6, and TS 3.1.7 are revised to provide time for analog position indication instruments to read accurately after rod movement;

4. TS 3.1.4 and TS 3.1.7 are revised to correct conflict between the requirements of the two TS;

5. TS 3.1.7 is revised to eliminate an unnecessary action; and

6. TS 3.1.4, TS 3.1.5, TS 3.1.6, and TS 3.1.7 are revised to increase consistency and to improve the presentation.

The TS Bases are revised to reflect the proposed changes.

A model application is included at Attachment 1. The model may be used by licensees adopting the proposed change following NRC approval.

2. DETAILED DESCRIPTION

Background

The rod cluster control assemblies (herein referred to as "rods") are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control. When a bank of rods consists of two groups they are moved in a staggered fashion, but always within one step of each other. All Westinghouse-design plants have four control banks and at least two shutdown banks.

The control banks are used for precise reactivity control of the reactor. The positions of the control banks are normally automatically controlled by the Rod Control System, but they can also be manually controlled. They are capable of adding negative reactivity very quickly (compared to adding soluble boron). The control banks must be maintained above the design insertion limits and three of the four control banks are typically near the fully withdrawn position during full power operations.

During a startup, the shutdown banks are withdrawn first. The shutdown banks are designed to be fully withdrawn without the core going critical. The shutdown banks are controlled manually by the control room operator. The shutdown banks must be completely withdrawn from the core prior to withdrawing any control banks during an approach to criticality. The shutdown banks are then left in this position until the reactor is shut down.

The rod insertion limits of the shutdown and control rods are initial assumptions in all safety analyses that assume rod insertion upon reactor trip. The insertion limits ensure sufficient shutdown margin (SDM) is available when required for a reactor shutdown. The sequence and overlap limits on the control rods govern the withdrawal sequence and overlap of the control rod banks to ensure consistent reactivity changes due to rod movement. The alignment limits govern the position of individual rods with respect to each other to maintain a consistent power distribution across the reactor core.

The shutdown and control bank insertion and alignment limits, axial flux difference (AFD), and quadrant power tilt ratio (QPTR) are process variables that are used to monitor and control the three dimensional power distribution of the reactor core. Additionally, the control bank insertion limits control the reactivity that could be added in the event of a rod ejection accident.

The TS requirements on rod alignment ensure that the assumptions in the safety analyses will remain valid. Mechanical or electrical failures may cause a rod to become inoperable (i.e., not trippable), unable to be moved, or to become misaligned from its group. The requirements on rod Operability ensure that on a reactor trip, the assumed reactivity will be inserted. Rod Operability requirements (i.e., trippability) are not dependent upon the alignment requirements, which ensure that the rods and banks maintain the correct power distribution and rod alignment. The rod Operability requirement is satisfied if the rod will fully insert in the required rod drop time assumed in the safety analyses. Rod control malfunctions that result in the inability to move a rod (e.g., rod lift coil failures), but that do not impact trippability, do not result in rod inoperability. The associated Limiting Condition for Operation (LCO) require both rod Operability (i.e., trippability) and rod alignment, and provide appropriate Required Actions when the LCO is not met.

The axial position of rods is indicated by two separate and independent systems, which are the Bank Demand Position Indication System (also called group step counters) and the Rod Position Indication System. There are two types of Rod Position Indication Systems and both are capable of monitoring rod position within at least ± 12 steps. Older plants use an analog system (RPI) and newer plants use a digital RPI system (DRPI).

When referring to either system, the acronym "[D]RPI" is used. The brackets surrounding the letter "D" indicate it is plant-specific.

The analog RPI system takes advantage of the fact that a transformer output will change if a piece of conducting metal is placed between the coils of the primary and secondary windings. The detector is a linear transformer that is mounted outside of the rod drive pressure housing. The rod drive shaft acts as the movable armature of the transformer and the position of the rod drive shaft within the rod position detector determines the amount of coupling between the primary and secondary windings. When a rod is withdrawn from the core, the relative permeability of the rod shaft causes an increase in the magnetic coupling between the primary and secondary windings. The magnitude of this secondary output is proportional to the actual rod position.

The digital RPI system consists of a stack of individual coils mounted outside the rod drive shaft. When the top of the rod drive shaft is located within a coil, the current flow through that coil increases and is greater than that of the adjacent coil. The voltages across the coils are continuously sampled.

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 highly precise (± 1 step), however, 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.

Description of Proposed Change & Technical Evaluation

1. Provide Time to Correct Rod Movement Failures that Do Not Affect Operability

This proposed change would add a new Condition A to LCO 3.1.5 and LCO 3.1.6 (shutdown and control bank insertion limits) that is applicable when one bank is inserted ≤ [16] steps below the insertion limits specified in the Core Operating Limits Report (COLR). As stated in a proposed Reviewer's Note in the associated Bases, "The bracketed number [16] in Condition A should be replaced with the plant-specific minimum number of steps that the rods must be moved to ensure correct performance of Surveillance Requirement (SR) 3.1.4.2." The Condition provides 24 hours to restore the single bank to within the insertion limit. Use of the limited period would be dependent on confirming that all other banks are within their insertion limits, and SDM is maintained or established.

LCO 3.1.5, Condition A, is renamed Condition B and the Condition is revised to append, "for reasons other than Condition A."

LCO 3.1.6, Conditions A and B, are renamed Conditions B and C, and the Conditions are revised to append, "for reasons other than Condition A."

Technical Evaluation

The control and shutdown rods' primary function is to provide negative reactivity on a reactor trip. To verify that the rods are Operable (i.e., capable of being tripped), SR 3.1.4.2 requires movement of the control and shutdown rods a minimum of 10 steps in either direction. For all control and shutdown banks other than Control Bank D, performance of the SR may be the only movement of the banks during a fuel cycle and, therefore, is the most likely occurrence of a rod control failure. Plants have occasionally experienced failures of the rod control system that result in an inability to move one or more rods via the rod control system, yet do not affect the rod's ability to trip. An electrical rod controller failure (e.g., rod urgent failure) is a failure in the rod control equipment that can affect the ability of the system to move rods. Automatic rod motion and overlapped rod motion are stopped on receipt of an urgent failure alarm. The failure may occur in either the power cabinet or in the system logic cabinet. Such failures do not affect the ability of the rods to trip. In other words, the rods remain Operable.

To permit performance of SR 3.1.4.2, the Applicability section of LCO 3.1.5 and LCO 3.1.6 currently contain a Note stating that the LCO is not applicable during performance of the SR. The most likely occurrence of a failure that prevents movement of the rods is during performance of SR 3.1.4.2, when one or more rods may be outside the LCO 3.1.5 or LCO 3.1.6 insertion limits. Because the failure may preclude continued performance of SR 3.1.4.2, the allowance provided by the existing Applicability Notes no longer applies and existing Condition A of either LCO 3.1.5 or LCO 3.1.6 would require the bank to be restored to within limits in two hours. The failure may not be correctable within the two hour Completion Time, which would necessitate a TS-required shutdown even though the rods remained Operable (i.e., trippable) and the automatic bank overlap may not be available during the power reduction leading to shutdown. Providing a reasonable time to restore the ability to move the rods prior to initiating a plant shutdown prevents power changes without automatic rod overlap protection.

This proposed change would add a new Condition A to LCO 3.1.5 and LCO 3.1.6 that is applicable when one bank is inserted ≤ [16] steps below the insertion limit. The specific number of steps is bracketed and will be replaced with the plant-specific minimum number of steps that the rods must be moved to perform SR 3.1.4.2. The Condition provides 24 hours to restore the bank to within the insertion limits. The 24 hour period is sufficient to repair most rod control failures.

The shutdown and control rods, including the rods in the bank that do not meet the insertion limits specified in the COLR (as would be allowed by the proposed change), must remain Operable (i.e., trippable) or a plant shutdown is required by LCO 3.1.4.

During the limited 24 hour period, adequate SDM is required to be verified or established by the Condition A Required Actions. In addition, if the LCO is not met for a shutdown bank, the control banks must be within the insertion limits. If the LCO is not met for a control bank, the shutdown banks must be within the insertion limits. These requirements ensure that the SDM assumed in the accident analyses is available and minimize the effect on core power distribution. While in the Condition, the TS

requirements on core power distribution (AFD, QPTR, nuclear enthalpy rise hot channel factor, and heat flux hot channel factor) continue to apply to ensure the core power distribution remains within the assumptions of the accident analysis.

The proposed change protects the assumptions in the safety analysis and reduces the likelihood of a plant shutdown without automatic rod bank overlap control, while providing a reasonable amount of time to repair a rod bank that cannot be moved.

2. Provide an Alternative to Frequent Verification of Rod Position Using the Movable Incore Detectors

The rod control system and the [D]RPI system are used to ensure that rod alignment and insertion limits are maintained. Operators utilize the [D]RPI system to monitor the position of the rods to establish that the plant is operating within the bounds of the accident analysis assumptions. Operability (i.e., trippability) and position of the rods are an initial condition assumption in all safety analyses that assume rod insertion upon a reactor trip.

If one or more [D]RPIs are inoperable, TS 3.1.7 requires verification of the position of the associated rods using the movable incore detector system once per 8 hours. The proposed change revises TS 3.1.7 to provide an alternative to using the moveable incore detectors every 8 hours (approximately 90 times per month) by utilizing a different monitoring method. This reduces the wear on the movable incore detector system. Wear of the movable incore detector system does not pose a reduction in the margin of safety, but excessive wear could result in a loss of functionality of the system. This could lead to the inability to complete required Surveillances and a plant shutdown.

The proposed change adds two new Required Actions to LCO 3.1.7 as an alternative to the 8 hour monitoring in the existing Condition A Required Actions. Proposed Required Actions A.2.1 requires verification of the position of rods associated with an inoperable [D]RPI using the moveable incore detector system and includes six Completion Times:

a. Initial verification within 8 hours of the inoperability of the [D]RPI;

b. Re-verification once every 31 Effective Full Power Days (EFPD) thereafter;

c. Verification within 8 hours if rod control system parameters indicate unintended rod movement;

d. Verification within 8 hours if the rod with an inoperable [D]RPI is intentionally moved greater than 12 steps;

e. Verification prior to exceeding 50% RTP if power is reduced below 50% RTP; and

f. Verification within 8 hours after reaching RTP.

Required Action A.2.2 states that the inoperable [D]RPI must be restored to Operable status prior to entering MODE 2 from MODE 3. Existing Required Action A.2 is relabeled A.3.

A Note is added to SR 3.1.4.1 to accommodate the proposed alternative for verifying rod position.

Technical Evaluation

New Required Action A.2.1 continues to use the movable detector system to monitor the position of the rod with the inoperable [D]RPI. Periodic verification is less frequent and additional verification is made following circumstances in which the rod may have moved. The initial position of the rod is determined within 8 hours and every 31 EFPD thereafter. The 8 hour initial Completion Time is the same as existing Required Action A.1 and the 31 EFPD period coincides with the typical Frequency of power distribution Surveillances that utilize the movable incore detector system. If there is unintended movement of a rod or if a rod with an inoperable [D]RPI is moved more than 12 steps, the movable incore detectors are used to verify the rod position within 8 hours. If there are changes in core power, which could result in changes in rod position, the rod position must be verified before exceeding 50% RTP and within 8 hours of reaching full power. This confirms the position of the rod with an inoperable [D]RPI to ensure that power distribution requirements are not violated and to establish a starting point for the proposed alternate monitoring actions.

New Required Action A.2.2 requires the inoperable [D]RPI to be restored to Operable status prior to entering Mode 2 from Mode 3. This allows use of the alternative monitoring scheme until the next shutdown, after which the [D]RPI must be restored to Operable status.

The ability to immediately detect a rod drop or misalignment is not directly provided by the movable incore detectors used in current Required Action A.1, or by the alternate monitoring method proposed in Required Actions A.2.1 and A.2.2. However, should there be a drop of a rod, it will typically be detectable by the excore power range detectors. Additionally, a negative reactivity insertion corresponding to the reactivity worth of the dropped rod may cause a change in core parameters, such AFD and QPTR. Note that the proposed Required Actions provide an alternative to the existing rod position indication requirements. The rod group alignment limits and the bank insertion limits of LCO 3.1.4, LCO 3.1.5, and LCO 3.1.6 continue to require the rods to be Operable and within the insertion limits.

SR 3.1.4.1 requires verification that the rods are within the alignment limit every 12 hours. If a [D]RPI is inoperable, LCO 3.1.7, Conditions A and C, require verification of rod position and under the proposed Required Action A.2.1, this verification may not be performed every 12 hours. Therefore, a Note is proposed to SR 3.1.4.1 to not require performance of the SR for rods associated with an inoperable rod position indicator. However, LCO 3.1.4 requires rods to be within the alignment limit and is unchanged.

The TS 3.1.7 Required Actions to determine the position of rods with inoperable [D]RPIs will be used to verify LCO 3.1.4 continues to be met.

3. Allow Time for Thermal Equilibrium of Analog RPI

Rod temperature affects the accuracy of the analog RPI system. As a result, analog RPI indications may not be accurate following movement of the associated rod. The proposed change provides a 1 hour period for the drive shaft to reach thermal equilibrium following rod movement to ensure the accuracy of the indication prior to using the analog RPI to verify TS limits.

The proposed change makes the following revisions to the TS:

- SR 3.1.4.1 requires verification that individual rod positions are within the alignment limit. The proposed change adds a Note to the Surveillance which states, "[Not required to be performed until 1 hour after rod motion.]"

- SR 3.1.5.1 requires verification that each shutdown bank is within the insertion limits specified in the COLR. The proposed change adds a Note to the Surveillance which states, "[Not required to be performed until 1 hour after associated rod motion.]"

- SR 3.1.6.2 requires verification that each control bank is within the insertion limits specified in the COLR. The proposed change adds a Note to the Surveillance which states, "[Not required to be performed until 1 hour after associated rod motion.]"

- SR 3.1.6.3 requires verification that each control bank that is not fully withdrawn from the core is within the sequence and overlap limits specified in the COLR. The proposed change adds a Note to the Surveillance which states, "[Not required to be performed until 1 hour after associated rod motion.]"

- LCO 3.1.7 requires the RPI and the Demand Position Indication System to be Operable. The proposed change adds an LCO Note that states that individual RPIs are not required to be Operable for 1 hour following movement of the associated rods.

The proposed change is only applicable to analog RPI systems. Plants with analog RPI systems may adopt the bracketed wording. Plants with digital RPI systems omit the bracketed wording. The use of brackets to indicate plant-specific information is a convention in the ISTS.

Technical Evaluation

The analog RPI system derives the rod position signal from measurements using a linear variable differential transmitter (LVDT). An analog signal is produced for each rod by the associated LVDT. The rod drive shaft varies the amount of magnetic coupling between the primary and secondary windings of the coils and generates an analog signal proportional to the rod position. As a rod is raised by its magnetic jacks, the magnetic permeability of the rod drive shaft causes an increase in magnetic coupling. Thus, an analog signal that is proportional to the rod position is derived.

Rod temperature affects the accuracy of the analog RPI System. Due to changes in the magnetic permeability of the drive shaft as a function of its temperature, the indicated position is expected to change with time as the drive shaft temperature changes. As a result, RPI indications may not be accurate following movement of the associated rod. This occurs most often when the rod movement is associated with a reactor thermal power change. The proposed change provides a 1 hour period for the drive shaft to reach thermal equilibrium following rod movement to ensure accuracy of the indication prior to the RPI being used to verify TS limits. During this period (commonly referred to as a "thermal soak"), the demand rod position is available using the Demand Position Indictor system.

The 1 hour allowance is based on the time necessary to allow the rod drive shaft to reach thermal equilibrium. In the vast majority of cases, the rods are not actually misaligned (only the indication is incorrect) and the risk of an accident occurring during this 1 hour period is small. During the 1 hour period, the Demand Position Indication system is available to indicate the demand position of the rods. The 1 hour allowance has been approved by the NRC for several plants with Westinghouse analog rod position indication systems. For example Salem Units 1 and 2 (Amendment No. 73/48 dated March 19, 1986) and Point Beach Units 1 and 2 (Amendment No. 200/205 dated May 8, 2001.) As stated previously in the discussion of proposed changes, this allowance does not apply to plants with digital RPI systems.

The proposed change to SR 3.1.4.1, SR 3.1.5.1, SR 3.1.6.2, and SR 3.1.6.3 states that the SRs are not required to be performed. These SRs are still required to be met. The difference between "met" and "performed" is explained in Section 1.4 of the TS, which states:

> The use of "met" or "performed" in these instances conveys specific meanings. A Surveillance is "met" only when the acceptance criteria are satisfied. Known failure of the requirements of a Surveillance, even without a Surveillance specifically being "performed," constitutes a Surveillance not "met." "Performance" refers only to the requirement to specifically determine the ability to meet the acceptance criteria.

Therefore, if a rod is known to not meet the SR acceptance criteria, the SR is declared not met even though performance of the SR is not required.

SR 3.1.4.1 requires verification that individual rods are within the alignment limits. The SR is revised to add a Note which states, "[Not required to be performed until 1 hour after associated rod motion.]" The proposed change provides time for the rod drive shaft to reach thermal equilibrium before performing the SR on the moved rod, in order to ensure the indicated positions are accurate.

SR 3.1.5.1 requires verification that each shutdown bank is within the insertion limits specified in the COLR. The proposed change adds a Note to the Surveillance which states, "[Not required to be performed until 1 hour after associated rod motion.]" The shutdown banks are not typically moved during power operation, but are required to be

inserted at least 10 steps for performance of SR 3.1.4.2. LCO 3.1.5 contains a Note which exempts the application of the LCO during performance of SR 3.1.4.2. However, following withdrawal of the shutdown rods following performance of SR 3.1.4.2, indicated position may be inaccurate and may incorrectly indicate some rods in the bank are below the insertion limits. As performance of SR 3.1.4.2 will have been completed, the exception Note would no longer apply. Without proposed the SR Note, the LCO may be declared not met when the rods are actually within the insertion limits.

SR 3.1.6.2 requires verification that each control bank is within the insertion limits specified in the COLR. The proposed change adds a Note to the Surveillance which states, "[Not required to be performed until 1 hour after associated rod motion.]" When the control banks are moved (for example, for performance of SR 3.1.4.2), the indicated position may be inaccurate and may indicate some rods in the bank are below the insertion limits. LCO 3.1.6 contains a Note which exempts the application of the LCO during performance of SR 3.1.4.2. As performance of SR 3.1.4.2 will have been completed, the exception Note would no longer apply. Without proposed the SR Note, the LCO may be declared not met when the rods are actually within the insertion limits.

SR 3.1.6.3 requires verification that each control bank that is not fully withdrawn from the core is within the sequence and overlap limits specified in the COLR. The proposed change adds a Note to the Surveillance which states, "[Not required to be performed until 1 hour after associated rod motion.]" When the control banks are inserted or withdrawn, the indicated rod positions may not be accurate following movement and may inaccurately indicate that the sequence or overlap limit are not met for some rods. Without proposed the SR Note, the LCO may be declared not met when the rods are actually within the sequence and overlap limits.

LCO 3.1.4, LCO 3.1.5, and LCO 3.1.6 place requirements on actual rod position. LCO 3.1.7 requires the RPI system and the Demand Position Indication System to be Operable (i.e., LCO 3.1.7 governs the measurement system and LCO 3.1.4, LCO 3.1.5, and LCO 3.1.6 govern the parameters being measured). LCO 3.1.7 is revised to add an LCO Note that states that individual RPIs are not required to be Operable for 1 hour following movement of the associated rods. The LCO Note is required because the analog RPI may not be capable of performing its function during the 1 hour following rod movement.

4. Correct Conflicts Between LCO 3.1.4 and LCO 3.1.7

LCO 3.1.4 requires individual indicated rod positions to be within 12 steps of their group step counter demand position, and SR 3.1.4.1 requires verification of the individual rod positions within the alignment limit (i.e., the demand bank position) every 12 hours. If a bank demand position indication is inoperable, SR 3.1.4.1 cannot be performed and the TS 3.1.4 Action for more than one rod not within the alignment limit applies, which requires the plant to be in Mode 3 within 6 hours. However, TS 3.1.7, which requires the bank demand position indication to be Operable, allows continued full power operation with one or more demand position indicators inoperable if compensatory Required Actions are taken. These compensatory Required Actions are to verify the [D]RPIs

associated with the affected banks are Operable and the associated rod are ≤ 12 steps apart. This satisfies the intent of SR 3.1.4.1. To correct this conflict, a Note is added to SR 3.1.4.1 which states that the SR is not required to be performed for rods associated with an inoperable demand position indicator. The Note is an exception to performing the SR, but not to meeting the SR. The TS 3.1.7 Required Actions verify that the acceptance criteria of SR 3.1.4.1 continue to be met.

Similarly, SR 3.1.7.1 requires verification that each [D]RPI agrees within [12] steps of the group demand position for the [full indicated range] of rod travel. The SR is performed prior to reactor criticality after each removal of the reactor head. However, SR 3.0.1 states that SRs must be met between performances. Therefore, if a control or shutdown rod is not within [12] steps of the group demand position, LCO 3.1.4 is not met and LCO 3.1.7 is not met. TS 3.1.4, Condition B, allows continued plant operation at reduced power, but there is no applicable Condition in TS 3.1.7. The TS 3.1.7 Actions only apply to inoperable [D]RPIs and demand position indicators, and in this situation both are Operable and accurately reflecting the actual position of the rod. With no applicable Condition in TS 3.1.7, LCO 3.0.3 requires a plant shutdown. To address this conflict, a Note is proposed to be added to SR 3.1.7.1 which states that the SR is not required to be met for rods known not to meet LCO 3.1.4.

Technical Evaluation

The Actions of TS 3.1.4 are intended to address misaligned or inoperable rods. The Actions of TS 3.1.7 are intended to address inoperable [D]RPIs or inoperable demand position indicators. SR 3.0.1 states that SRs do not have to be performed on inoperable equipment, but in the cited situations, the equipment described in the associated LCO is Operable so the exception does not apply.

The proposed change clarifies the intent of TS 3.1.4 and TS 3.1.7 by ensuring that the appropriate Actions are followed when equipment is inoperable and eliminates unintended conflicts between the two specifications.

5. Eliminate an Unnecessary Action from TS 3.1.7

TS 3.1.7, Condition B, applies when more than one [D]RPI is inoperable per bank in one or more banks. Required Action B.2 states, "Monitor and record Reactor Coolant System Tavg."

The Bases of Required Action B.2 states:

> "Monitoring and recording reactor coolant T_{avg} helps assure that significant changes in power distribution and SDM are avoided. The once per hour Completion Time is acceptable because only minor fluctuations in RCS temperature are expected at steady state plant operating conditions."

Required Action B.2 imposes an administrative burden with no safety benefit because there are no acceptance criteria associated with the T_{avg} values that are recorded and there are no actions associated with any trends identified. Monitoring T_{avg} provides no power

distribution information for unmonitored rods that isn't better provided by the existing requirements in Condition A and average coolant temperature provides no indication of changes in SDM. Therefore, the proposed Required Action is proposed to be deleted.

6. Other Proposed Changes

The following changes are made to improve the presentation of the requirements:

a. LCO 3.1.4, Condition B, is revised to eliminate Required Action B.1 and to combine Required Actions B.2.4 and B.2.5. Condition B applies when one rod is not within the alignment limits and Required Action B.1 requires restoring the rod to within limits within 1 hour. The Writer's Guide (Ref. 1), Section 4.1.6.g, states:

> "A Required Action which requires restoration, such that the Condition is no longer met, is considered superfluous. It is only included if it would be the only Required Action for the Condition or it is needed for presentation clarity."

Required Action B.1 is an action that requires restoration and is not the only Required Action. Further, elimination of the unnecessary Required Action B.1 simplifies the Required Actions by eliminating a level of indenting (e.g., B.2.3 becomes B.3). Therefore, the Required Action is eliminated. Similarly, both Required Action B.2.4 and B.2.5 require performing Surveillances every 72 hours. Combining the Required Actions simplifies the presentation.

b. LCO 3.1.5 and LCO 3.1.6 contain a Note modifying the Applicability that states, "This LCO is not applicable while performing SR 3.1.4.2." The proposed change moves the LCO 3.1.5 and LCO 3.1.6 Applicability Notes to LCO Notes and revises the Notes to state, "Not applicable to shutdown banks inserted while performing SR 3.1.4.2" for LCO 3.1.5 and "Not applicable to control banks inserted while performing SR 3.1.4.2" for LCO 3.1.6. The current Note is improperly placed and worded.

The existing Note is not an exception to the Applicability of Modes 1 and 2. The allowance is an exception to the LCO. Further, the wording, "This LCO is not applicable while performing SR 3.1.4.2," is in direct conflict with the Writer's Guide (Ref. 1), Section 4.1.4.d, which states:

> "Notes associated with the LCO will always follow the LCO. LCO Notes may allow a limited exception to the LCO requirement stated above the Note. Their use should be minimized. It is inherently understood what requirement the Note is referring to, based on the format used. It is therefore not appropriate to add clarifying clauses such as 'For this LCO..'." (emphasis added)

The proposed change does not alter the intent or application of the exception, while correcting an error in the placement and wording of the Notes.

c. Specification 3.1.7 is revised to consistently use the defined abbreviation "[D]RPI." This affects the Actions Note, Required Action A.1, Required Action B.2, and Required Action C.1.

d. TS 3.1.7, Condition A is revised from "for one or more groups" to the more standard terminology "in one or more groups," and TS 3.1.7, Condition B is revised to include the phrase "in one or more groups" to be more consistent with the wording of Condition A.

The existing Condition A states, "One [D]RPI per group inoperable for one or more groups." As an editorial improvement, Condition A is revised from "for one or more groups" to the more standard "in one or more groups." The existing Condition B states, "More than one [D]RPI per group inoperable." Condition B is revised to include the phrase "in one or more groups." This is a clarification to improve consistency with the existing Condition A and does not change the intent of Condition B, but increases consistency in the presentation.

e. TS 3.1.7, Required Action B.3 is redundant to Required Action A.1. This Required Action is proposed to be deleted. Condition A applies when one [D]RPI per group is inoperable and Condition B applies when more than one [D]RPI per group is inoperable. The Actions are modified by a separate condition entry Note. Therefore, under the TS usage rules, every entry into Condition B is accompanied by separate entry into Condition A for the inoperable [D]RPI. Both Condition A and Condition B contain a Required Action (A.1 and B.3) to verify the position of the rods with inoperable [D]RPI indirectly by using the movable incore detectors. Therefore, Required Action B.3, is redundant and unnecessary because Required Action A.1 is always applicable. Therefore, Required Action B.3 is proposed to be eliminated. This change has no effect on the actions performed when a [D]RPI is inoperable and improves the presentation of the requirements.

f. TS 3.1.7, Condition C is inconsistently worded and is revised without changing the intent. The existing Condition C states, "One or more rods with inoperable position indicators have been moved > 24 steps in one direction since the last determination of the rod's position." This Condition is poorly worded and inconsistent with Conditions A and B, which start the Condition describing the inoperable equipment (e.g., "One [D]RPI per group inoperable..."). The proposed change rewords the Condition to state, "One or more [D]RPI inoperable in one or more groups and associated rods have been moved > 24 steps in one direction since the last position determination." The proposed change does not change the intent and makes the Conditions more consistent.

g. TS 3.1.7, Condition D is revised to be consistent with the existing separate Condition entry note without changing the intent. It is proposed to state, "One or more demand position indicators per bank inoperable in one or more banks."

The proposed change revises Condition D from "One demand position indicator per bank inoperable for one or more banks" to "One or more demand position

indicators per bank inoperable in one or more banks." The proposed change makes the Condition wording consistent with the separate Condition entry Note modifying the Actions and does not alter the intent of Condition D. The current TS 3.1.7 is modified by an ACTIONS Note which states, "Separate Condition entry is allowed for each inoperable rod position indicator and each demand position indicator." The Bases for the Note state that the Note is acceptable because the Required Actions for each Condition provide appropriate compensatory actions for each inoperable indicator. LCO 3.1.7, Condition D, states "One demand position indicator per bank inoperable for one or more banks." There is one demand position indicator per group of rods, two demand indicators per bank in those banks with two groups. The separate Condition entry Note modifying the 3.1.7 ACTIONS clearly states that separate Condition entry is allowed for inoperable demand position indicators which means that the Condition D is applicable to more than one inoperable demand position indicator per bank. However, the existing Condition D wording is inconsistent with the separate Condition entry Note and could lead to the misapplication of the TS. The proposed change does not alter the intent of the TS, but eliminates a potential misinterpretation that could lead to an unnecessary plant shutdown.

The Required Actions of Condition D provide appropriate compensatory measures for one or more inoperable demand position indicator. Required Action D.1.1 requires administrative verification that the [D]RPIs for the affected banks are Operable, thus providing indication of the rod position. Required Action D.1.2 also requires periodic verification that the most withdrawn and least withdrawn rods in the affected banks are within 12 steps apart. If these Actions cannot be performed, power is reduced to $< 50\%$ RTP. Without the proposed clarification to Condition D, and despite the separate Condition entry Note, it could be construed that Condition D cannot be entered for two demand position indicators in the same bank inoperable. Under this misinterpretation, two inoperable demand position indicators in the same bank would lead to an LCO 3.0.3 entry. This is inappropriate and is not what is intended under the separate Condition entry Note. The Required Actions provided in Condition D are equally applicable to two inoperable demand position indicators in a bank as to two inoperable demand position indicators in separate banks.

Technical Evaluation

The other proposed changes affect only the presentation without changing the intent. As the changes are not technical in nature, no additional technical evaluation is provided.

4. REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

The following lists the regulatory requirements and plant-specific design bases related to the proposed change.

10 CFR 50, Appendix A, General Design Criteria (GDC) 13 specifies that instrumentation shall be provided to monitor variables and systems over their operating ranges during normal operation, anticipated operational occurrences, and accident conditions. LCO 3.1.7 requires Operability of the [D]RPI system and the bank demand position indication system, to allow verification of compliance with the rod alignment and insertion limits.

10 CFR 50, Appendix A, GDC 26, "Reactivity control system redundancy and capability," states that control rods, preferably including a positive means for inserting the rods, shall be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as stuck rods, specified acceptable fuel design limits are not exceeded.

10 CFR 50, Appendix A, GDC 28, "Reactivity Limits," states that the reactivity control systems shall be designed with appropriate limits on the potential amount and rate of reactivity increase to assure that the effects of postulated reactivity accidents can neither (1) result in damage to the reactor coolant pressure boundary greater than limited local yielding nor (2) sufficiently disturb the core, its support structures or other reactor pressure vessel internals to impair significantly the capability to cool the core.

Limits on control and shutdown rod insertion 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.

The proposed change does not affect the ability to satisfy these design criteria.

4.2 No Significant Hazards Consideration Determination

The proposed change revises the requirements on control and shutdown rods, and rod and bank position indication to allow time for analog position indication instruments to read accurately after rod movement, to provide time to correct rod control system failures that do not affect Operability, to correct the rod position indication Technical Specifications (TS) to be internally consistent and eliminate actions that provide no safety benefit, to correct a conflict between the requirements of LCO 3.1.4 and LCO 3.1.7, and to provide an alternative to frequent use of the movable incore detector system.

The TSTF has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, Issuance of Amendment:

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

   Response: No

   Control and shutdown rods are assumed to insert into the core to shut down the reactor in evaluated accidents. Rod insertion limits ensure that adequate negative

reactivity is available to provide the assumed shutdown margin (SDM). Rod alignment and overlap limits maintain an appropriate power distribution and reactivity insertion profile.

Control and shutdown rods are initiators to several accidents previously evaluated, such as rod ejection. The proposed change does not change the limiting conditions for operation for the rods or make any technical changes to the Surveillance Requirements (SRs) governing the rods. Therefore, the proposed change has no significant effect on the probability of any accident previously evaluated.

Revising the TS Actions to provide a limited time to repair rod control system failures has no effect on the SDM assumed in the accident analysis as the proposed Action require verification that SDM is maintained. The effects on power distribution will not cause a significant increase in the consequences of any accident previously evaluated as all TS requirements on power distribution continue to be applicable.

Revising the TS Actions to provide an alternative to frequent use of the moveable incore detector system to verify the position of rods with inoperable rod position indicator does not change the requirement for the rods to be aligned and within the insertion limits. Therefore, the assumptions used in any accidents previously evaluated are unchanged and there is no significant increase in the consequences.

The consequences of an accident that might occur during the 1 hour period provided for the analog rod position indication to stabilize after rod movement are no different than the consequences of the accident under the existing actions with the rod declared inoperable.

The proposed change to resolve the conflicts in the TS ensure that the intended Actions are followed when equipment is inoperable. Actions taken with inoperable equipment are not assumptions in the accidents previously evaluated and have no significant effect on the consequences.

The proposed change to eliminate an unnecessary action has no effect on the consequences of accidents previously evaluated as the analysis of those accidents did not consider the use of the action.

The proposed change to increase consistency within the TS has no effect on the consequences of accidents previously evaluated as the proposed change clarifies the application of the existing requirements and does not change the intent.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

   Response: No

   The proposed change does not involve a physical alteration of the plant (i.e., no new or different type of equipment will be installed).. The change does not alter assumptions made in the safety analyses. The proposed change does not alter the limiting conditions for operation for the rods or make any technical changes to the SRs governing the rods. The proposed change to actions maintains or improves safety when equipment is inoperable and does not introduce new failure modes.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

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

   Response: No

   The proposed change to allow time for rod position indication to stabilize after rod movement and to allow an alternative method of verifying rod position has no effect on the safety margin as actual rod position is not affected. The proposed change to provide time to repair rods that are Operable but immovable does not result in a significant reduction in the margin of safety because all rods must be verified to be Operable, and all other banks must be within the insertion limits. The remaining proposed changes to make the requirements internally consistent and to eliminate unnecessary actions do not affect the margin of safety as the changes do not affect the ability of the rods to perform their specified safety function.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, the TSTF concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

4.3 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission’s regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5. ENVIRONMENTAL CONSIDERATION

Evaluation of the proposed change has determined that the change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in the individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental assessment of the proposed change is not required.

6. REFERENCES

1. TSTF-GG-05-01, "Writer's Guide for Plant-Specific Improved Technical Specifications, TSTF-GG-05-01," Revision 1, August 2010.

Attachment 1

Model Application

[DATE] 10 CFR 50.90

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: PLANT NAME
DOCKET NO. 50-[xxx]
APPLICATION TO REVISE TECHNICAL SPECIFICATIONS TO ADOPT TSTF-XXX, "CLARIFICATION OF ROD POSITION REQUIREMENTS"

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, [LICENSEE] is submitting a request for an amendment to the Technical Specifications (TS) for [PLANT NAME, UNIT NOS.].

The proposed amendment revises the requirements on control and shutdown rods, and rod and bank position indication. Attachment 1 provides a description and assessment of the proposed changes. Attachment 2 provides the existing TS pages marked up to show the proposed changes. Attachment 3 provides revised (clean) TS pages. Attachment 4 provides existing TS Bases pages marked to show the proposed changes for information only.

Approval of the proposed amendment is requested by [date]. Once approved, the amendment shall be implemented within [ ] days.

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

[In accordance with 10 CFR 50.30(b), a license amendment request must be executed in a signed original under oath or affirmation. This can be accomplished by attaching a notarized affidavit confirming the signature authority of the signatory, or by including the following statement in the cover letter: "I declare under penalty of perjury that the foregoing is true and correct. Executed on (date)." The alternative statement is pursuant to 28 USC 1746. It does not require notarization.]

If you should have any questions regarding this submittal, please contact [NAME, TELEPHONE NUMBER].

Sincerely,

[Name, Title]

Attachments:
1. Description and Assessment
2. Proposed Technical Specification Changes (Mark-Up)
3. Revised Technical Specification Pages
4. Proposed Technical Specification Bases Changes (Mark-Up)

cc: NRC Project Manager
NRC Regional Office
NRC Resident Inspector
State Contact

ATTACHMENT 1 - DESCRIPTION AND ASSESSMENT

1.0 DESCRIPTION

The proposed amendment revises the requirements on control and shutdown rods, and rod and bank position indication in Technical Specification (TS) 3.1.4, "Rod Group Alignment Limits," TS 3.1.5, "Shutdown Bank Insertion Limits," TS 3.1.6, "Control Bank Insertion Limits," and TS 3.1.7, "Rod Position Indication," [to provide time to repair rod movement failures that do not affect rod Operability, to provide an alternative to frequent use of the movable incore detector system when position indication for a rod is inoperable, to provide time for analog position indication instruments to read accurately after rod movement, to correct conflicts between the TS, to eliminate an unnecessary action, and to increase consistency and to improve the presentation.]

2.0 ASSESSMENT

2.1 Applicability of Published Safety Evaluation

[LICENSEE] has reviewed the model safety evaluation dated [DATE] as part of the Federal Register Notice of Availability. This review included a review of the NRC staff's evaluation, as well as the information provided in TSTF-547. [As described in the subsequent paragraphs,] [LICENSEE] has concluded that the justifications presented in the TSTF-547 proposal and the model safety evaluation prepared by the NRC staff are applicable to [PLANT, UNIT NOS.] and justify this amendment for the incorporation of the changes to the [PLANT] TS.

2.2 Optional Changes and Variations

[LICENSEE is not proposing any variations or deviations from the TS changes described in the TSTF-547, or the applicable parts of the NRC staff's model safety evaluation dated [DATE].] [LICENSEE is proposing the following variations from the TS changes described in the TSTF-547, or the applicable parts of the NRC staff's model safety evaluation dated [DATE].]

[The [PLANT] TS utilize different [numbering] [and titles] than the Standard Technical Specifications on which TSTF-547 was based. Specifically, [describe differences between the plant-specific TS numbering and/or titles and the TSTF-547 numbering and titles.] These differences are administrative and do not affect the applicability of TSTF-547 to the [PLANT] TS.]

[The Traveler and model Safety Evaluation discuss the applicable regulatory requirements and guidance, including the 10 CFR 50, Appendix A, General Design Criteria (GDC). [PLANT] was not licensed to the 10 CFR 50, Appendix A, GDC. The [PLANT] equivalent of the referenced GDC are [REFERENCE INCLUDING UFSAR LOCATION, IF APPLICABLE]. [DISCUSS THE EQUIVALENCE OF THE REFERENCED PLANT-SPECIFIC REQUIREMENTS TO THE APPENDIX A GDC AS RELATED TO THE PROPOSED CHANGE.] This difference does not alter the conclusion that the proposed change is applicable to [PLANT].]

3.0 REGULATORY ANALYSIS

3.1 No Significant Hazards Consideration Determination

[LICENSEE] requests adoption of TSTF-547, "Clarification of Rod Position Requirements," which is an approved change to the Standard Technical Specifications, into the [PLANT NAME, UNIT NOS] Technical Specifications (TS). The proposed change revises the requirements on control and shutdown rods, and rod and bank position indication to provide time to repair rod movement failures that do not affect rod Operability, to provide an alternative to frequent use of the movable incore detector system when position indication for a rod is inoperable, to provide time for analog position indication instruments to read accurately after rod movement, to correct conflicts between the TS, to eliminate an unnecessary action, and to increase consistency and to improve the presentation.

[LICENSEE] has evaluated whether or not a significant hazards consideration is involved with the proposed amendment(s) by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

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

   Response: No

   Control and shutdown rods are assumed to insert into the core to shut down the reactor in evaluated accidents. Rod insertion limits ensure that adequate negative reactivity is available to provide the assumed shutdown margin (SDM). Rod alignment and overlap limits maintain an appropriate power distribution and reactivity insertion profile.

   Control and shutdown rods are initiators to several accidents previously evaluated, such as rod ejection. The proposed change does not change the limiting conditions for operation for the rods or make any technical changes to the Surveillance Requirements (SRs) governing the rods. Therefore, the proposed change has no significant effect on the probability of any accident previously evaluated.

   Revising the TS Actions to provide a limited time to repair rod movement control has no effect on the SDM assumed in the accident analysis as the proposed Action require verification that SDM is maintained. The effects on power distribution will not cause a significant increase in the consequences of any accident previously evaluated as all TS requirements on power distribution continue to be applicable.

   Revising the TS Actions to provide an alternative to frequent use of the moveable incore detector system to verify the position of rods with inoperable rod position indicator does not change the requirement for the rods to be aligned and within the insertion limits. Therefore, the assumptions used in any accidents previously evaluated are unchanged and there is no significant increase in the consequences.

The consequences of an accident that might occur during the 1 hour period provided for the analog rod position indication to stabilize after rod movement are no different than the consequences of the accident under the existing actions with the rod declared inoperable.

The proposed change to resolve the conflicts in the TS ensure that the intended Actions are followed when equipment is inoperable. Actions taken with inoperable equipment are not assumptions in the accidents previously evaluated and have no significant effect on the consequences.

The proposed change to eliminate an unnecessary action has no effect on the consequences of accidents previously evaluated as the analysis of those accidents did not consider the use of the action.

The proposed change to increase consistency within the TS has no effect on the consequences of accidents previously evaluated as the proposed change clarifies the application of the existing requirements and does not change the intent.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

Response: No

The proposed change does not involve a physical alteration of the plant (i.e., no new or different type of equipment will be installed).. The change does not alter assumptions made in the safety analyses. The proposed change does not alter the limiting conditions for operation for the rods or make any technical changes to the SRs governing the rods. The proposed change to actions maintains or improves safety when equipment is inoperable and does not introduce new failure modes.

Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

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

Response: No

The proposed change to allow time for rod position indication to stabilize after rod movement and to allow an alternative method of verifying rod position has no effect on the safety margin as actual rod position is not affected. The proposed change to provide time to repair rods that are Operable but immovable does not result in a significant reduction in the margin of safety because all rods must be verified to be Operable, and all other banks must be within the insertion limits. The remaining proposed changes to make the requirements internally consistent and to eliminate unnecessary actions do not

affect the margin of safety as the changes do not affect the ability of the rods to perform their specified safety function.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, [LICENSEE] concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

3.2 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

4.0 ENVIRONMENTAL EVALUATION

The proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

{Note: Attachments 2, 3, and 4 are not included in the model application and will be provided by the licensee.}

3.1 REACTIVITY CONTROL SYSTEMS

3.1.4 Rod Group Alignment Limits

LCO 3.1.4 All shutdown and control rods shall be OPERABLE.

AND

Individual indicated rod positions shall be within 12 steps of their group step counter demand position.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more rod(s) inoperable.	A.1.1 Verify SDM to be within the limits specified in the COLR. OR A.1.2 Initiate boration to restore SDM to within limit. AND A.2 Be in MODE 3.	1 hour 1 hour 6 hours
B. One rod not within alignment limits.	~~B.1 Restore rod to within alignment limits.~~ ~~OR~~ B.~~2.~~1.1 Verify SDM to be within the limits specified in the COLR. ~~OR~~	~~1 hour~~ 1 hour

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
	B.~~2.~~1.2 Initiate boration to restore SDM to within limit. ~~—~~AND B.~~2.~~2 Reduce THERMAL POWER to ≤ 75% RTP. ~~—~~AND B.~~2.~~3 Verify SDM is within the limits specified in the COLR. ~~—~~AND B.~~2.~~4 Perform SR 3.2.1.1, ~~and~~ SR 3.2.1.2, *and SR 3.2.2.1*. ~~—AND~~ ~~B.2.5 Perform SR 3.2.2.1.~~ ~~—~~AND B.~~2.6~~*5* Re-evaluate safety analyses and confirm results remain valid for duration of operation under these conditions.	1 hour 2 hours Once per 12 hours 72 hours ~~72 hours~~ 5 days
C. Required Action and associated Completion Time of Condition B not met.	C.1 Be in MODE 3.	6 hours
D. More than one rod not within alignment limit.	D.1.1 Verify SDM is within the limits specified in the COLR. OR	1 hour

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
	D.1.2 Initiate boration to restore required SDM to within limit. AND D.2 Be in MODE 3.	1 hour 6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.4.1	---------- *NOTES*---------- *1. Not required to be performed for rods associated with inoperable rod position indicator or demand position indicator.* *[2. Not required to be performed until 1 hour after associated rod motion.]* ---------- Verify *position of* individual rod*s* ~~positions~~ within alignment limit.	[12 hours OR In accordance with the Surveillance Frequency Control Program]
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 OR In accordance with the Surveillance Frequency Control Program]

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
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 criticality after each removal of the reactor head

3.1 REACTIVITY CONTROL SYSTEMS

3.1.5 Shutdown Bank Insertion Limits

LCO 3.1.5 Each shutdown bank shall be within insertion limits specified in the COLR.

---NOTE---
Not applicable to shutdown banks inserted while performing SR 3.1.4.2.

APPLICABILITY: MODES 1 and 2.

~~---NOTE---~~
~~This LCO is not applicable while performing SR 3.1.4.2.~~
~~---~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One shutdown bank inserted ≤ [16] steps beyond the insertion limits specified in the COLR.	*A.1 Verify all control banks are within the insertion limits specified in the COLR.* *AND* *A.2.1 Verify SDM is within the limits specified in the COLR.* *OR* *A.2.2 Initiate boration to restore SDM to within limit.* *AND* *A.3 Restore the shutdown bank to within the insertion limits specified in the COLR.*	*1 hour* *1 hour* *1 hour* *24 hours*
~~*BA.*~~ One or more shutdown banks not within limits *for reasons other than Condition A*.	~~*BA.*~~1.1 Verify SDM is within the limits specified in the COLR. OR	1 hour

CONDITION	REQUIRED ACTION	COMPLETION TIME
	B~~A~~.1.2 Initiate boration to restore SDM to within limit. AND ~~A~~*B*.2 Restore shutdown banks to within limits.	1 hour 2 hours
~~C~~*B*. Required Action and associated Completion Time not met.	~~C~~*B*.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.5.1	*[---------- NOTE ----------* *Not required to be performed until 1 hour after associated rod motion.* *----------]* Verify each shutdown bank is within the insertion limits specified in the COLR.	[12 hours OR In accordance with the Surveillance Frequency Control Program]

3.1 REACTIVITY CONTROL SYSTEMS

3.1.6 Control Bank Insertion Limits

LCO 3.1.6 Control banks shall be within the insertion, sequence, and overlap limits specified in the COLR.

---NOTE---
Not applicable to control banks inserted while performing SR 3.1.4.2.

APPLICABILITY: MODE 1,
MODE 2 with $k_{eff} \geq 1.0$.

~~---NOTE---~~
~~This LCO is not applicable while performing SR 3.1.4.2.~~
~~---~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Control bank A, B, or C inserted ≤ [16] steps beyond the insertion, sequence, or overlap limits specified in the COLR.	*A.1 Verify all shutdown banks are within the insertion limits specified in the COLR.* *AND* *A.2.1 Verify SDM is within the limits specified in the COLR.* *OR* *A.2.2 Initiate boration to restore SDM to within limit.* *AND* *A.3 Restore the control bank to within the insertion, sequence, and limits specified in the COLR.*	*1 hour* *1 hour* *1 hour* *24 hours*
~~*B*~~*A*. Control bank insertion limits not met	~~*B*~~*A*.1.1 Verify SDM is within the limits specified in the	1 hour

CONDITION	REQUIRED ACTION	COMPLETION TIME
for reasons other than Condition A.	COLR. OR	
	BA.1.2 Initiate boration to restore SDM to within limit. AND	1 hour
	BA.2 Restore control bank(s) to within limits.	2 hours
CB.Control bank sequence or overlap limits not met *for reasons other than Condition A*.	*CB*.1.1 Verify SDM is within the limits specified in the COLR. OR	1 hour
	CB.1.2 Initiate boration to restore SDM to within limit. AND	1 hour

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
	CB.2 Restore control bank sequence and overlap to within limits.	2 hours
DC. Required Action and associated Completion Time not met.	DC.1 Be in MODE 2 with k_{eff} < 1.0.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.6.1	Verify estimated critical control bank position is within the limits specified in the COLR.	Within 4 hours prior to achieving criticality
SR 3.1.6.2	*[---------- NOTE ---------- Not required to be performed until 1 hour after associated rod motion. ----------]* Verify each control bank insertion is within the insertion limits specified in the COLR.	[12 hours OR In accordance with the Surveillance Frequency Control Program]
SR 3.1.6.3	*[---------- NOTE ---------- Not required to be performed until 1 hour after associated rod motion. ----------]* Verify sequence and overlap limits specified in the COLR are met for control banks not fully withdrawn from the core.	[12 hours OR In accordance with the Surveillance Frequency Control Program]

3.1 REACTIVITY CONTROL SYSTEMS

3.1.7 Rod Position Indication

LCO 3.1.7 The [Digital] Rod Position Indication ([D]RPI) System and the Demand Position Indication System shall be OPERABLE.

---------- NOTE ----------
[Individual RPIs are not required to be OPERABLE for 1 hour following movement of the associated rods.]

APPLICABILITY: MODES 1 and 2.

ACTIONS

----------NOTE----------
Separate Condition entry is allowed for each inoperable *[D]RPI* ~~rod position indicator~~ and each demand position indicator.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One [D]RPI per group inoperable *in*~~for~~ one or more groups.	A.1 Verify the position of the rod~~s~~ with inoperable *[D]RPI* ~~position indicators~~ indirectly by using movable incore detectors.	Once per 8 hours
	OR	
	A.2.1 Verify the position of the rods with inoperable [D]RPI indirectly by using the moveable incore detectors.	*8 hours*
	AND	*AND*
		Once per 31 EFPD thereafter
	AND	*AND*
		8 hours after discovery of each unintended rod movement
		AND

CONDITION	REQUIRED ACTION		COMPLETION TIME
			8 hours after each movement of rod with inoperable [D]RPI > 12 steps *AND* *Prior to THERMAL POWER exceeding 50% RTP* *AND* *8 hours after reaching RTP*
	A.2.2	*Restore inoperable [D]RPI to OPERABLE status.*	*Prior to entering MODE 2 from MODE 3*
	OR		
	A.~~3~~2	Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
B. More than one [D]RPI per group inoperable *in one or more groups*.	B.1	Place the control rods under manual control.	Immediately
	AND		
	~~B.2~~	~~Monitor and record Reactor Coolant System T_{avg}.~~	~~Once per 1 hour~~
	~~AND~~		

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
	~~B.3 Verify the position of the rods with inoperable position indicators indirectly by using the movable incore detectors.~~ ~~AND~~ B.~~2~~4 Restore inoperable *[D]RPIs* ~~position indicators~~ to OPERABLE status such that a maximum of one [D]RPI per group is inoperable.	~~Once per 8 hours~~ 24 hours
C. *One or more [D]RPI inoperable in one or more groups and associated rod has* ~~One or more rods with inoperable position indicators have~~ been moved > ~~in excess of~~ 24 steps in one direction since the last determination of the rod's position.	C.1 Verify the position of the rods with inoperable *[D]RPIs* ~~position indicators~~ indirectly by using movable incore detectors. OR C.2 Reduce THERMAL POWER to ≤ 50% RTP.	[4] hours 8 hours
D. One *or more* demand position indicator*s* per bank inoperable ~~for~~ *in* one or more banks.	D.1.1 Verify by administrative means all [D]RPIs for the affected banks are OPERABLE. AND D.1.2 Verify the most withdrawn rod and the least withdrawn rod of the affected banks are ≤ 12 steps apart. OR	Once per 8 hours Once per 8 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
	D.2 Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
E. Required Action and associated Completion Time not met.	E.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.7.1	---------- *NOTE*---------- *Not required to be met for [D]RPIs associated with rods that do not meet LCO 3.1.4.* ---------- Verify each [D]RPI agrees within [12] steps of the group demand position for the [full indicated range] of rod travel.	Once prior to criticality after each removal of the reactor head

B 3.3 INSTRUMENTATION

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 10 CFR 50, Appendix A, GDC 10, "Reactor Design," GDC 26, "Reactivity Control System Redundancy and Capability" (Ref. 1), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Plants" (Ref. 2).

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 $\frac{5}{8}$ 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. If a bank of RCCAs consists of two groups, the groups are moved in a staggered fashion, but always within one step of each other. All units have four control banks and at least two shutdown banks.

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

BASES

BACKGROUND (continued)

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 Digital Rod Position Indication (DRPI) 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 ± ∈ 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 DRPI System provides a highly accurate indication of actual rod position, but at a lower precision than the step counters. This system is based on inductive analog signals from a series of coils spaced along a hollow tube. To increase the reliability of the system, the inductive coils are connected alternately to data system A or B. Thus, if one data system fails, the DRPI will go on half accuracy. The DRPI System is capable of monitoring rod position within at least ± 12 steps with either full accuracy or half accuracy.

APPLICABLE SAFETY ANALYSES

Control rod misalignment accidents are analyzed in the safety analysis (Ref. 3). 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.

BASES

APPLICABLE SAFETY ANALYSES (continued)

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 12 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. 5).

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 factor ($F_Q(Z)$) and the nuclear enthalpy hot channel factor ($F^N_{\Delta H}$) 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 $F_Q(Z)$ 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 $F_Q(Z)$ 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 10 CFR 50.36(c)(2)(ii).

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 requirements (i.e., trippability) are separate from the alignment requirements, which ensure that the RCCAs and banks maintain the correct power distribution and rod alignment. The rod OPERABILITY requirement is satisfied provided the rod will fully insert in the required rod drop time assumed in the safety analysis. Rod control malfunctions that result in the inability to move a rod (e.g., rod lift coil failures), but that do not impact trippability, do not result in rod inoperability.

The requirement to maintain the rod alignment to within plus or minus 12 steps is conservative. The minimum misalignment assumed in safety analysis is 24 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 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 MODES 3, 4, and 5 and LCO 3.9.1, "Boron Concentration," for boron concentration requirements during refueling.

ACTIONS

A.1.1 and A.1.2

When one or more rods are inoperable (i.e., untrippable), 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.

BASES

ACTIONS (continued)

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*.1 and B.1.2*

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 15 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 trippable but 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.

BASES

ACTIONS (continued)

B.2.2, B.2.3, B.2.4, ~~B.2.5,~~ and B.~~2.5~~6

For continued operation with a misaligned rod, RTP must be reduced, SDM must periodically be verified within limits, hot channel factors ($F_Q(Z)$ and $F^N_{\Delta H}$) 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. 7). 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 $F_Q(Z)$, as approximated by $F^C_Q(Z)$ and $F^W_Q(Z)$, and $F^N_{\Delta H}$ 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 $F_Q(Z)$ and $F^N_{\Delta H}$.

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 FSAR Chapter 15 (Ref. 5) 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 2 with $K_{eff} < 1.0$ within 6 hours, which

BASES

ACTIONS (continued)

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 or 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 2 with K_{eff} < 1.0 within 6 hours.

The allowed Completion Time is reasonable, based on operating experience, for reaching MODE 2 with K_{eff} < 1.0 from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.1.4.1

[Verification that *the position of* individual rod*s* ~~positions are~~ *is* 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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

OR

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

----------REVIEWER'S NOTE----------
Plants controlling Surveillance Frequencies under a Surveillance Frequency Control Program should utilize the appropriate Frequency description, given above, and the appropriate choice of Frequency in the Surveillance Requirement.
----------]

The SR is modified by a Note that permits it to not be performed for rods associated with an inoperable demand position indicator or an inoperable rod position indicator. The alignment limit is based on the demand position indicator which is not available if the indicator is inoperable. LCO 3.1.7, "Rod Position Indication," provides Actions to verify the rods are in alignment when one or more rod position indicators are inoperable.

---------- Reviewer's Note ----------
The bracketed SR Note is only applicable to plants with an analog rod position indication system.

[The Surveillance is modified by a Note which states that the SR is not required to be performed until 1 hour after associated rod motion. Control rod temperature affects the accuracy of the rod position indication system. 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 temperature changes. The one hour period allows control rod temperature to stabilize following rod movement in order to ensure the indicated rod position is accurate.]

SR 3.1.4.2

Verifying each control rod is OPERABLE would require that each rod be tripped. However, in MODES 1 and 2 with $K_{eff} \geq 1.0$, tripping each control rod would result in radial or axial power tilts, or oscillations. Exercising each individual control rod 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.

OR

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

----------REVIEWER'S NOTE----------
Plants controlling Surveillance Frequencies under a Surveillance Frequency Control Program should utilize the appropriate Frequency description, given above, and the appropriate choice of Frequency in the Surveillance Requirement.
----------]

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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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. 10 CFR 50, Appendix A, GDC 10 and GDC 26.
2. 10 CFR 50.46.
3. FSAR, Chapter [15].
4. FSAR, Chapter [15].
5. FSAR, Chapter [15].
6. FSAR, Chapter [15].
7. FSAR, Chapter [15].

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.5 Shutdown Bank Insertion Limits

BASES

BACKGROUND

The insertion limits of the shutdown and control rods are initial assumptions in all safety analyses that assume rod insertion upon reactor trip. The insertion limits directly affect core power and fuel burnup distributions and assumptions of available ejected rod worth, SDM and initial reactivity insertion rate.

The applicable criteria for these reactivity and power distribution design requirements are 10 CFR 50, Appendix A, GDC 10, "Reactor Design," GDC 26, "Reactivity Control System Redundancy and Protection," GDC 28, "Reactivity Limits" (Ref. 1), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors" (Ref. 2). Limits on control rod insertion 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.

The rod cluster control assemblies (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 consists of two groups that are moved in a staggered fashion, but always within one step of each other. All plants have four control banks and at least two shutdown banks. See LCO 3.1.4, "Rod Group Alignment Limits," for control and shutdown rod OPERABILITY and alignment requirements, and LCO 3.1.7, "Rod Position Indication," for position indication requirements.

The control banks are used for precise reactivity control of the reactor. The positions of the control banks are normally automatically controlled by the Rod Control System, but they can also be manually controlled. They are capable of adding negative reactivity very quickly (compared to borating). The control banks must be maintained above designed insertion limits and are typically near the fully withdrawn position during normal full power operations.

Hence, they are not capable of adding a large amount of positive reactivity. Boration or dilution of the Reactor Coolant System (RCS) compensates for the reactivity changes associated with large changes in RCS temperature. The design calculations are performed with the assumption that the shutdown banks are withdrawn first. The shutdown banks can be fully withdrawn without the core going critical. This provides available negative reactivity in the event of boration errors. The

BASES

BACKGROUND (continued)

shutdown banks are controlled manually by the control room operator. During normal unit operation, the shutdown banks are either fully withdrawn or fully inserted. The shutdown banks must be completely withdrawn from the core, prior to withdrawing any control banks during an approach to criticality. The shutdown banks are then left in this position until the reactor is shut down. They affect core power and burnup distribution, and add negative reactivity to shut down the reactor upon receipt of a reactor trip signal.

APPLICABLE SAFETY ANALYSES

On a reactor trip, all RCCAs (shutdown banks and control banks), except the most reactive RCCA, are assumed to insert into the core. The shutdown banks shall be at or above their insertion limits and available to insert the maximum amount of negative reactivity on a reactor trip signal. The control banks may be partially inserted in the core, as allowed by LCO 3.1.6, "Control Bank Insertion Limits." The shutdown bank and control bank insertion limits are established to ensure that a sufficient amount of negative reactivity is available to shut down the reactor and maintain the required SDM (see LCO 3.1.1, "SHUTDOWN MARGIN (SDM)") following a reactor trip from full power. The combination of control banks and shutdown banks (less the most reactive RCCA, which is assumed to be fully withdrawn) is sufficient to take the reactor from full power conditions at rated temperature to zero power, and to maintain the required SDM at rated no load temperature (Ref. 3). The shutdown bank insertion limit also limits the reactivity worth of an ejected shutdown rod.

The acceptance criteria for addressing shutdown and control rod bank insertion limits and inoperability or misalignment is that:

a. There be no violations of:

   1. Specified acceptable fuel design limits or

   2. RCS pressure boundary integrity and

b. The core remains subcritical after accident transients.

As such, the shutdown bank insertion limits affect safety analysis involving core reactivity and SDM (Ref. 3).

The shutdown bank insertion limits preserve an initial condition assumed in the safety analyses and, as such, satisfy Criterion 2 of 10 CFR 50.36(c)(2)(ii).

BASES

LCO

The shutdown banks must be within their insertion limits any time the reactor is critical or approaching criticality. This ensures that a sufficient amount of negative reactivity is available to shut down the reactor and maintain the required SDM following a reactor trip.

The shutdown bank insertion limits are defined in the COLR.

The LCO is modified by a Note indicating the LCO requirement is not applicable to shutdown banks being inserted while performing SR 3.1.4.2. This SR verifies the freedom of the rods to move, and may require the shutdown bank to move below the LCO limits, which would normally violate the LCO. This Note applies to each shutdown bank as it is moved below the insertion limit to perform the SR. This Note is not applicable should a malfunction stop performance of the SR.

APPLICABILITY

The shutdown banks must be within their insertion limits, with the reactor in MODES 1 and 2. This ensures that a sufficient amount of negative reactivity is available to shut down the reactor and maintain the required SDM following a reactor trip. The shutdown banks do not have to be within their insertion limits in MODE 3, unless an approach to criticality is being made. In MODE 3, 4, 5, or 6, the shutdown banks are fully inserted in the core and contribute to the SDM. Refer to LCO 3.1.1 for SDM requirements in MODES 3, 4, and 5. LCO 3.9.1, "Boron Concentration," ensures adequate SDM in MODE 6.

~~The Applicability requirements have been modified by a Note indicating the LCO requirement is suspended during SR 3.1.4.2. This SR verifies the freedom of the rods to move, and requires the shutdown bank to move below the LCO limits, which would normally violate the LCO.~~

ACTIONS

A.1, A.2.1, A.2.2, and A.3

---------- Reviewer's Note ----------
The bracketed number [16] in Condition A should be replaced with the plant-specific minimum number of steps that the rods must be moved to ensure correct performance of SR 3.1.4.2.

If one shutdown bank is inserted less than or equal to [16] steps below the insertion limit, 24 hours is allowed to restore the shutdown bank to within the limit. This is necessary because the available SDM may be reduced with a shutdown bank not within its insertion limit. Also, verification of SDM or initiation of boration within 1 hour is required, since the SDM in MODES 1 and 2 is ensured by adhering to the control and shutdown bank insertion limits (see LCO 3.1.1). If a shutdown bank is not within its insertion limit, SDM will be verified by performing a reactivity balance calculation, considering the effects listed in the BASES for SR 3.1.1.1.

While the shutdown bank is outside the insertion limit, all control banks must be within their insertion limits to ensure sufficient shutdown margin is available. The 24 hour Completion Time is sufficient to repair most rod control failures that would prevent movement of a shutdown bank.

B~~A~~.1.1, *B~~A~~*.1.2, and *B~~A~~*.2

When one or more shutdown banks is not within insertion limits *for reasons other than Condition A*, 2 hours is allowed to restore the shutdown banks to within the insertion limits. This is necessary because the available SDM may be significantly reduced, with one or more of the shutdown banks not within their insertion limits. Also, verification of SDM or initiation of boration within 1 hour is required, since the SDM in MODES 1 and 2 is ensured by adhering to the control and shutdown bank insertion limits (see LCO 3.1.1). If shutdown banks are not within their insertion limits, then SDM will be verified by performing a reactivity balance calculation, considering the effects listed in the BASES for SR 3.1.1.1.

The allowed Completion Time of 2 hours provides an acceptable time for evaluating and repairing minor problems without allowing the plant to remain in an unacceptable condition for an extended period of time.

C~~B~~.1

If the *Required Actions and associated Completion Times are not met,* ~~shutdown banks cannot be restored to within their insertion limits within 2 hours~~, the unit must be brought to a MODE where the LCO is not applicable. The allowed Completion Time of 6 hours is reasonable, based on operating experience, for reaching the required MODE from full power conditions in an orderly manner and without challenging plant systems.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.5.1

Verification that the shutdown banks are within their insertion limits prior to an approach to criticality ensures that when the reactor is critical, or being taken critical, the shutdown banks will be available to shut down the reactor, and the required SDM will be maintained following a reactor trip. This SR and Frequency ensure that the shutdown banks are withdrawn before the control banks are withdrawn during a unit startup.

---------- Reviewer's Note ----------
The bracketed SR Note is only applicable to plants with an analog rod position indication system.

[The Surveillance is modified by a Note which states that the SR is not required to be performed for shutdown banks until 1 hour after motion of rods in those banks. Rod temperature affects the accuracy of the rod position indication system. 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 temperature changes. The one hour period allows rod temperature to stabilize following rod movement in order to ensure the indicated position is accurate.]

[Since the shutdown banks are positioned manually by the control room operator, a verification of shutdown bank position at a Frequency of 12 hours, after the reactor is taken critical, is adequate to ensure that they are within their insertion limits. Also, the 12 hour Frequency takes into account other information available in the control room for the purpose of monitoring the status of shutdown rods.

OR

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

----------REVIEWER'S NOTE----------
Plants controlling Surveillance Frequencies under a Surveillance Frequency Control Program should utilize the appropriate Frequency description, given above, and the appropriate choice of Frequency in the Surveillance Requirement.
----------]

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10, GDC 26, and GDC 28.
2. 10 CFR 50.46.
3. FSAR, Chapter [15].

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.6 Control Bank Insertion Limits

BASES

BACKGROUND

The insertion limits of the shutdown and control rods are initial assumptions in all safety analyses that assume rod insertion upon reactor trip. The insertion limits directly affect core power and fuel burnup distributions and assumptions of available SDM, and initial reactivity insertion rate.

The applicable criteria for these reactivity and power distribution design requirements are 10 CFR 50, Appendix A, GDC 10, "Reactor Design," GDC 26, "Reactivity Control System Redundancy and Protection," GDC 28, "Reactivity Limits" (Ref. 1), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors" (Ref. 2). Limits on control rod insertion 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.

The rod cluster control assemblies (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 consists of two groups that are moved in a staggered fashion, but always within one step of each other. All plants have four control banks and at least two shutdown banks. See LCO 3.1.4, "Rod Group Alignment Limits," for control and shutdown rod OPERABILITY and alignment requirements, and LCO 3.1.7, "Rod Position Indication," for position indication requirements.

The control bank insertion limits are specified in the COLR. An example is provided for information only in Figure B 3.1.6-1. The control banks are required to be at or above the insertion limit lines.

Figure B 3.1.6-1 also indicates how the control banks are moved in an overlap pattern. Overlap is the distance travelled together by two control banks. The predetermined position of control bank C, at which control bank D will begin to move with bank C on a withdrawal, will be at 118 steps for a fully withdrawn position of 231 steps. The fully withdrawn position is defined in the COLR.

BASES

BACKGROUND (continued)

The control banks are used for precise reactivity control of the reactor. The positions of the control banks are normally controlled automatically by the Rod Control System, but can also be manually controlled. They are capable of adding reactivity very quickly (compared to borating or diluting).

The power density at any point in the core must be limited, so that the fuel design criteria are maintained. Together, LCO 3.1.4, LCO 3.1.5, "Shutdown Bank Insertion Limits," LCO 3.1.6, LCO 3.2.3, "AXIAL FLUX DIFFERENCE (AFD)," and LCO 3.2.4, "QUADRANT POWER TILT RATIO (QPTR)," provide limits on control component operation and on monitored process variables, which ensure that the core operates within the fuel design criteria.

The shutdown and control bank insertion and alignment limits, AFD, and QPTR are process variables that together characterize and control the three dimensional power distribution of the reactor core. Additionally, the control bank insertion limits control the reactivity that could be added in the event of a rod ejection accident, and the shutdown and control bank insertion limits ensure the required SDM is maintained.

Operation within the subject LCO limits will prevent fuel cladding failures that would breach the primary fission product barrier and release fission products to the reactor coolant in the event of a loss of coolant accident (LOCA), loss of flow, ejected rod, or other accident requiring termination by a Reactor Trip System (RTS) trip function.

APPLICABLE SAFETY ANALYSES

The shutdown and control bank insertion limits, AFD, and QPTR LCOs are required to prevent power distributions that could result in fuel cladding failures in the event of a LOCA, loss of flow, ejected rod, or other accident requiring termination by an RTS trip function.

The acceptance criteria for addressing shutdown and control bank insertion limits and inoperability or misalignment are that:

a. There be no violations of:

   1. Specified acceptable fuel design limits or

   2. Reactor Coolant System pressure boundary integrity and

b. The core remains subcritical after accident transients.

BASES

APPLICABLE SAFETY ANALYSES (continued)

As such, the shutdown and control bank insertion limits affect safety analysis involving core reactivity and power distributions (Ref. 3).

The SDM requirement is ensured by limiting the control and shutdown bank insertion limits so that allowable inserted worth of the RCCAs is such that sufficient reactivity is available in the rods to shut down the reactor to hot zero power with a reactivity margin that assumes the maximum worth RCCA remains fully withdrawn upon trip (Ref. 4).

Operation at the insertion limits or AFD limits may approach the maximum allowable linear heat generation rate or peaking factor with the allowed QPTR present. Operation at the insertion limit may also indicate the maximum ejected RCCA worth could be equal to the limiting value in fuel cycles that have sufficiently high ejected RCCA worths.

The control and shutdown bank insertion limits ensure that safety analyses assumptions for SDM, ejected rod worth, and power distribution peaking factors are preserved (Ref. 5).

The insertion limits satisfy Criterion 2 of 10 CFR 50.36(c)(2)(ii), in that they are initial conditions assumed in the safety analysis.

LCO

The limits on control banks sequence, overlap, and physical insertion, as defined in the COLR, must be maintained because they serve the function of preserving power distribution, ensuring that the SDM is maintained, ensuring that ejected rod worth is maintained, and ensuring adequate negative reactivity insertion is available on trip. The overlap between control banks provides more uniform rates of reactivity insertion and withdrawal and is imposed to maintain acceptable power peaking during control bank motion.

The LCO is modified by a Note indicating the LCO requirement is not applicable to control banks being inserted while performing SR 3.1.4.2. This SR verifies the freedom of the rods to move, and may require the control bank to move below the LCO limits, which would normally violate the LCO. This Note applies to each control bank as it is moved below the insertion limit to perform the SR. This Note is not applicable should a malfunction stop performance of the SR.

APPLICABILITY

The control bank sequence, overlap, and physical insertion limits shall be maintained with the reactor in MODES 1 and 2 with $k_{eff} \geq 1.0$. These limits must be maintained, since they preserve the assumed power distribution, ejected rod worth, SDM, and reactivity rate insertion assumptions. Applicability in MODES 3, 4, and 5 is not required, since neither the power distribution nor ejected rod worth assumptions would be exceeded in these MODES.

~~The applicability requirements have been modified by a Note indicating the LCO requirements are suspended during the performance of SR 3.1.4.2. This SR verifies the freedom of the rods to move, and requires the control bank to move below the LCO limits, which would violate the LCO.~~

BASES

ACTIONS

A.1, A.2.1, A.2.2, and A.3

---------- Reviewer's Note ----------
The bracketed number [16] in Condition A should be replaced with the plant-specific minimum number of steps that encompasses the rod positions during performance of SR 3.1.4.2.

If Control Bank A, B, or C is inserted less than or equal to [16] steps below the insertion, sequence, or overlap limits, 24 hours is allowed to restore the control bank to within the limits. Verification of SDM or initiation of boration within 1 hour is required, since the SDM in MODES 1 and 2 is ensured by adhering to the control and shutdown bank insertion limits (see LCO 3.1.1). If a control bank is not within its insertion limit, SDM will be verified by performing a reactivity balance calculation, considering the effects listed in the BASES for SR 3.1.1.1.

While the control bank is outside the insertion, sequence, or overlap limits, all shutdown banks must be within their insertion limits to ensure sufficient shutdown margin is available and that power distribution is controlled. The 24 hour Completion Time is sufficient to repair most rod control failures that would prevent movement of a shutdown bank.

Condition A is limited to Control banks A, B, or C. The allowance is not required for Control Bank D because the full power bank insertion limit can be met during performance of the SR 3.1.4.2 control rod freedom of movement (trippability) testing.

B~~A~~.1.1, *B~~A~~*.1.2, *B~~A~~*.2, *C~~B~~*.1.1, *C~~B~~*.1.2, and *C~~B~~*.2

When the control banks are outside the acceptable insertion limits *for reasons other than Condition A*, they must be restored to within those limits. This restoration can occur in two ways:

a. Reducing power to be consistent with rod position or

b. Moving rods to be consistent with power.

Also, verification of SDM or initiation of boration to regain SDM is required within 1 hour, since the SDM in MODES 1 and 2 normally ensured by adhering to the control and shutdown bank insertion limits (see LCO 3.1.1, "SHUTDOWN MARGIN (SDM)") has been upset. If control banks are not within their insertion limits, then SDM will be verified by performing a reactivity balance calculation, considering the effects listed in the BASES for SR 3.1.1.1.

Similarly, if the control banks are found to be out of sequence or in the wrong overlap configuration *for reasons other than Condition A*, they must be restored to meet the limits.

Operation beyond the LCO limits is allowed for a short time period in order to take conservative action because the simultaneous occurrence of either a LOCA, loss of flow accident, ejected rod accident, or other accident during this short time period, together with an inadequate power distribution or reactivity capability, has an acceptably low probability.

The allowed Completion Time of 2 hours for restoring the banks to within the insertion, sequence, and overlaps limits provides an acceptable time for evaluating and repairing minor problems without allowing the plant to remain in an unacceptable condition for an extended period of time.

DC.1

If *the* Required Actions ~~A.1 and A.2, or B.1 and B.2~~ cannot be completed within the associated Completion Times, the plant must be brought to MODE 2 with $k_{eff} < 1.0$, where the LCO is not applicable. The allowed Completion Time of 6 hours is reasonable, based on operating experience, for reaching the required MODE from full power conditions in an orderly manner and without challenging plant systems.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.6.1

This Surveillance is required to ensure that the reactor does not achieve criticality with the control banks below their insertion limits.

The estimated critical position (ECP) depends upon a number of factors, one of which is xenon concentration. If the ECP was calculated long before criticality, xenon concentration could change to make the ECP substantially in error. Conversely, determining the ECP immediately before criticality could be an unnecessary burden. There are a number of unit parameters requiring operator attention at that point. Performing the ECP calculation within 4 hours prior to criticality avoids a large error from changes in xenon concentration, but allows the operator some flexibility to schedule the ECP calculation with other startup activities.

SR 3.1.6.2

[Verification of the control bank insertion limits at a Frequency of 12 hours is sufficient to detect control banks that may be approaching the insertion limits since, normally, very little rod motion occurs in 12 hours.

OR

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

----------REVIEWER'S NOTE----------
Plants controlling Surveillance Frequencies under a Surveillance Frequency Control Program should utilize the appropriate Frequency description, given above, and the appropriate choice of Frequency in the Surveillance Requirement.
----------]

---------- Reviewer's Note ----------
The bracketed SR Note is only applicable to plants with an analog rod position indication system.

[The Surveillance is modified by a Note stating that the SR is not required to be performed for control banks until 1 hour after motion of rods in those banks. Control rod temperature affects the accuracy of the rod position indication system. 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 temperature changes. The one hour period allows control rod temperature to stabilize following rod movement in order to ensure the indicated rod position is accurate.]

SR 3.1.6.3

When control banks are maintained within their insertion limits as checked by SR 3.1.6.2 above, it is unlikely that their sequence and overlap will not be in accordance with requirements provided in the COLR.

---------- Reviewer's Note ----------
The bracketed SR Note is only applicable to plants with an analog rod position indication system.

[The Surveillance is modified by a Note stating that the SR is not required to be performed for control banks until 1 hour after motion of rods in those banks. Control rod temperature affects the accuracy of the rod position indication system. 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 temperature changes. The one hour period allows control rod temperature to stabilize following rod movement in order to ensure the indicated rod position is accurate.]

[A Frequency of 12 hours is consistent with the insertion limit check above in SR 3.1.6.2.

BASES

SURVEILLANCE REQUIREMENTS (continued)

OR

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

----------REVIEWER'S NOTE----------
Plants controlling Surveillance Frequencies under a Surveillance Frequency Control Program should utilize the appropriate Frequency description, given above, and the appropriate choice of Frequency in the Surveillance Requirement.
----------]

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10, GDC 26, GDC 28.

2. 10 CFR 50.46.

3. FSAR, Chapter [15].

4. FSAR, Chapter [15].

5. FSAR, Chapter [15].

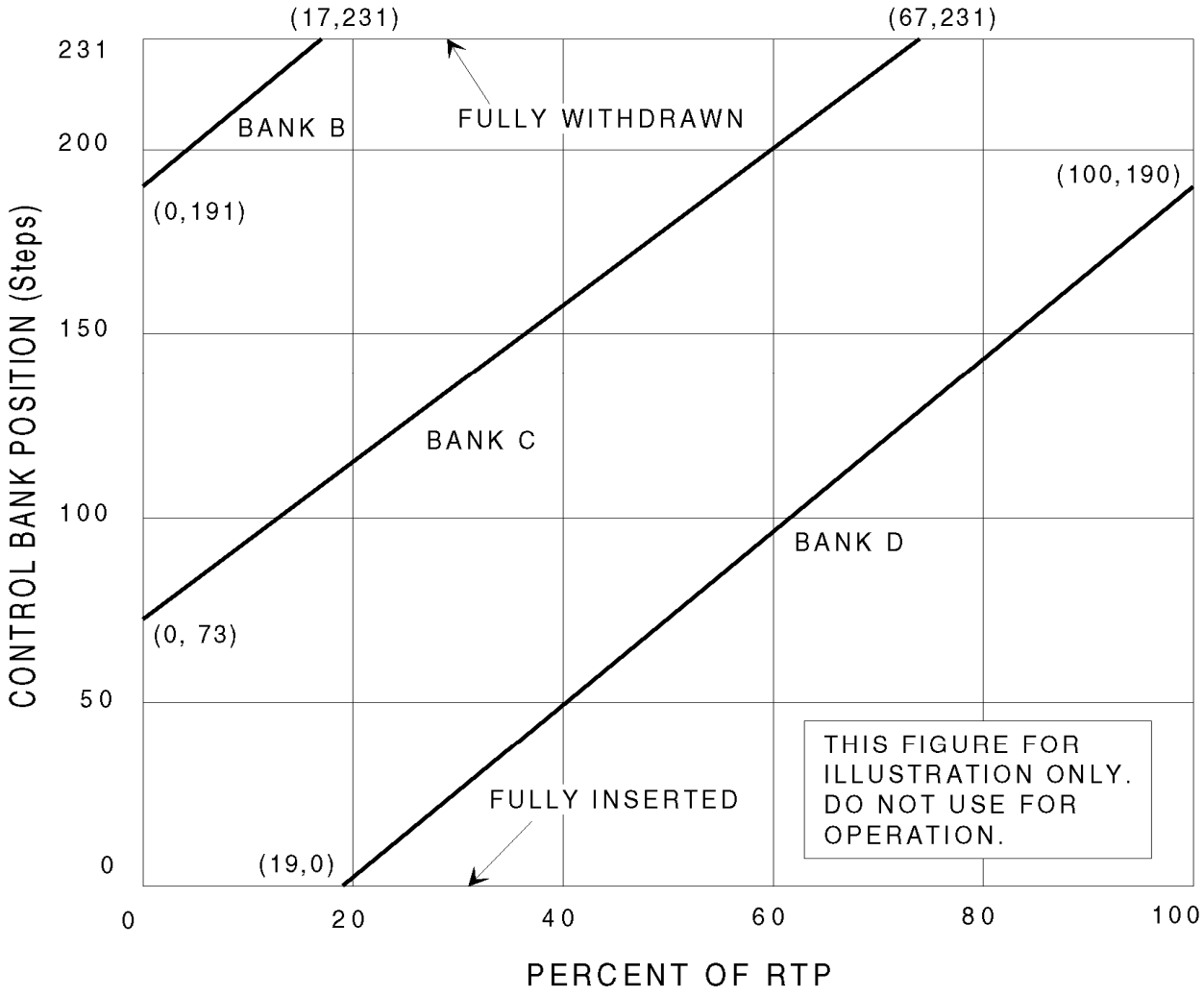

Figure B 3.1.6 (page 1 of 1)
Control Bank Insertion vs. Percent RTP

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.7 Rod Position Indication

BASES

BACKGROUND

According to GDC 13 (Ref. 1), instrumentation to monitor variables and systems over their operating ranges during normal operation, anticipated operational occurrences, and accident conditions must be OPERABLE. LCO 3.1.7 is required to ensure OPERABILITY of the control rod position indicators to determine control rod positions and thereby ensure compliance with the control rod alignment and insertion limits.

The OPERABILITY, including position indication, 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. Rod position indication is required to assess OPERABILITY and misalignment.

Mechanical or electrical failures may cause a control rod to become inoperable or to become misaligned from its group. Control 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, control 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 control rod alignment and OPERABILITY 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 out of the core (up or withdrawn) or into the core (down or inserted) by their control rod drive mechanisms. 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.

The axial position of shutdown rods and control rods are determined by two separate and independent systems: the Bank Demand Position Indication System (commonly called group step counters) and the [Digital] Rod Position Indication ([D]RPI) System.

BASES

BACKGROUND (continued)

The Bank Demand Position Indication System counts the pulses from the Rod Control System that move 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 ± ∈ 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 [D]RPI System provides a highly accurate indication of actual control rod position, but at a lower precision than the step counters. This system is based on inductive analog signals from a series of coils spaced along a hollow tube with a center to center distance of 3.75 inches, which is 6 steps. To increase the reliability of the system, the inductive coils are connected alternately to data system A or B. Thus, if one system fails, the [D]RPI will go on half accuracy with an effective coil spacing of 7.5 inches, which is 12 steps. Therefore, the normal indication accuracy of the [D]RPI System is ± 6 steps (± 3.75 inches), and the maximum uncertainty is ± 12 steps (± 7.5 inches). With an indicated deviation of 12 steps between the group step counter and [D]RPI, the maximum deviation between actual rod position and the demand position could be 24 steps, or 15 inches.

APPLICABLE SAFETY ANALYSES

Control and shutdown rod position accuracy is essential during power operation. Power peaking, ejected rod worth, or SDM limits may be violated in the event of a Design Basis Accident (Ref. 2), with control or shutdown rods operating outside their limits undetected. Therefore, the acceptance criteria for rod position indication is that rod positions must be known with sufficient accuracy in order to verify the core is operating within the group sequence, overlap, design peaking limits, ejected rod worth, and with minimum SDM (LCO 3.1.5, "Shutdown Bank Insertion Limits," and LCO 3.1.6, "Control Bank Insertion Limits"). The rod positions must also be known in order to verify the alignment limits are preserved (LCO 3.1.4, "Rod Group Alignment Limits"). Control rod positions are continuously monitored to provide operators with information that ensures the plant is operating within the bounds of the accident analysis assumptions.

The control rod position indicator channels satisfy Criterion 2 of 10 CFR 50.36(c)(2)(ii). The control rod position indicators monitor control rod position, which is an initial condition of the accident.

BASES

LCO

LCO 3.1.7 specifies that one [D]RPI System and one Bank Demand Position Indication System be OPERABLE for each control rod. For the control rod position indicators to be OPERABLE requires meeting the SR of the LCO and the following:

a. The [D]RPI System indicates within 12 steps of the group step counter demand position as required by LCO 3.1.4, "Rod Group Alignment Limits,"

b. For the [D]RPI System there are no failed coils, and

c. The Bank Demand Indication System has been calibrated either in the fully inserted position or to the [D]RPI System.

The 12 step agreement limit between the Bank Demand Position Indication System and the [D]RPI System indicates that the Bank Demand Position Indication System is adequately calibrated, and can be used for indication of the measurement of control rod bank position.

A deviation of less than the allowable limit, given in LCO 3.1.4, in position indication for a single control rod, ensures high confidence that the position uncertainty of the corresponding control rod group is within the assumed values used in the analysis (that specified control rod group insertion limits).

These requirements ensure that control rod position indication during power operation and PHYSICS TESTS is accurate, and that design assumptions are not challenged.

OPERABILITY of the position indicator channels ensures that inoperable, misaligned, or mispositioned control rods can be detected. Therefore, power peaking, ejected rod worth, and SDM can be controlled within acceptable limits.

---------- Reviewer's Note ----------
The bracketed LCO Note is only applicable to plants with an analog rod position indication system.

[The LCO is modified by a Note stating that the RPI system is not required to be met OPERABLE for 1 hour following movement of the associated rods. Control and shutdown rod temperature affects the accuracy of the RPI System. 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 temperature changes. The one hour period allows temperature to stabilize following rod movement in order to ensure the indicated position is accurate.]

APPLICABILITY The requirements on the [D]RPI and step counters are only applicable in MODES 1 and 2 (consistent with LCO 3.1.4, LCO 3.1.5, and LCO 3.1.6), because these are the only MODES in which power is generated, and the OPERABILITY and alignment of rods have the potential to affect the safety of the plant. In the shutdown MODES, the OPERABILITY of the shutdown and control banks has the potential to affect the required SDM, but this effect can be compensated for by an increase in the boron concentration of the Reactor Coolant System.

BASES

ACTIONS

The ACTIONS Table is modified by a Note indicating that a separate Condition entry is allowed for each inoperable rod position indicator and each demand position indicator. This is acceptable because the Required Actions for each Condition provide appropriate compensatory actions for each inoperable position indicator.

A.1, *A.2.1, and A.2.2*

When one [D]RPI channel per group *in one or more groups* fails, the position of the rod may still be determined indirectly by use of the movable incore detectors. The Required Action may also be satisfied by ensuring at least once per 8 hours that F_Q satisfies LCO 3.2.1, $F^N_{\Delta H}$ satisfies LCO 3.2.2, and SHUTDOWN MARGIN is within the limits provided in the COLR, provided the nonindicating rods have not been moved. Based on experience, normal power operation does not require excessive movement of banks. If a bank has been significantly moved, the Required Action of C.1 or C.2 below is required. Therefore, verification of RCCA position within the Completion Time of 8 hours is adequate for allowing continued full power operation, since the probability of simultaneously having a rod significantly out of position and an event sensitive to that rod position is small.

Required Action A.1 requires verification of the position of a rod with an inoperable [D]RPI once per 8 hours which may put excessive wear and tear on the moveable incore detector system, Required Action A.2.1 provides an alternative. Required Action A.2.1 requires verification of rod position using the moveable incore detectors every 31 EFPD, which coincides with the normal use of the system to verify core power distribution.

Required Action A.2.1 includes six distinct requirements for verification of the position of rods associated with an inoperable [D]RPI using the movable incore detectors:

a. Initial verification within 8 hours of the inoperability of the [D]RPI;

b. Re-verification once every 31 Effective Full Power Days (EFPD) thereafter;

c. Verification within 8 hours if rod control system parameters indicate unintended rod movement. An unintended rod movement is defined as the release of the rod's stationary gripper when no action was demanded either manually or automatically from the rod control system, or a rod motion in a direction other than the direction demanded by the rod control system. Verifying that no unintended rod movement has occurred is performed by monitoring the rod

control system stationary gripper coil current for indications of rod movement;

d. Verification within 8 hours if the rod with an inoperable [D]RPI is intentionally moved greater than 12 steps;

e. Verification prior to exceeding 50% RTP if power is reduced below 50% RTP; and

f. Verification within 8 hours of reaching 100% RTP if power is reduced to less than 100% RTP.

Should the rod with the inoperable [D]RPI be moved more than 12 steps, or if reactor power is changed, the position of the rod with the inoperable [D]RPI must be verified.

Required Action A.2.2 states that the inoperable [D]RPI must be restored to OPERABLE status prior to entering MODE 2 from MODE 3. The repair of the inoperable RPI must be performed prior to returning to power operation following a shutdown.

A.~~2~~*3*

Reduction of THERMAL POWER to ≤ 50% RTP puts the core into a condition where rod position is not significantly affecting core peaking factors (Ref. 3).

The allowed Completion Time of 8 hours is reasonable, based on operating experience, for reducing power to ≤ 50% RTP from full power conditions without challenging plant systems and allowing for rod position determination by Required Action A.1 above.

B.1~~, B.2, B.3,~~ and B.~~2~~4

When more than one [D]RPI per group *in one or more groups* fail, additional actions are necessary~~. to ensure that acceptable power distribution limits are maintained, minimum SDM is maintained, and the potential effects of rod misalignment on associated accident analyses are limited.~~ Placing the Rod Control System in manual assures unplanned rod motion will not occur. ~~Together with the indirect position determination available via~~

BASES

ACTIONS (continued)

~~movable incore detectors will minimize the potential for rod misalignment.~~ The immediate Completion Time for placing the Rod Control System in manual reflects the urgency with which unplanned rod motion must be prevented while in this Condition.

~~Monitoring and recording reactor coolant T_{avg} help assure that significant changes in power distribution and SDM are avoided. The once per hour Completion Time is acceptable because only minor fluctuations in RCS temperature are expected at steady state plant operating conditions.~~

~~The position of the rods may be determined indirectly by use of the movable incore detectors. The Required Action may also be satisfied by ensuring at least once per 8 hours that F_Q satisfies LCO 3.2.1, $F^N_{\Delta H}$ satisfies LCO 3.2.2, and SHUTDOWN MARGIN is within the limits provided in the COLR, provided the nonindicating rods have not been moved. Verification of control rod position once per 8 hours is adequate for allowing continued full power operation for a limited, 24 hour period, since the probability of simultaneously having a rod significantly out of position and an event sensitive to that rod position is small~~. *The inoperable [D]RPIs must be restored, such that a maximum of one [D]RPI per group is inoperable, within 24 hours.* The 24 hour Completion Time provides sufficient time to troubleshoot and restore the [D]RPI system to operation while avoiding the plant challenges associated with the shutdown without full rod position indication.

Based on operating experience, normal power operation does not require excessive rod movement. If one or more rods has been significantly moved, the Required Action of C.1 or C.2 below is required.

C.1 and C.2

With one [D]RPI inoperable in one or more groups and the affected groups have moved greater than 24 steps in one direction since the last determination of rod position, additional actions are needed to verify the position of rods within inoperable [D]RPI. Within 4 hours, the position of the rods with inoperable position indication must be determined using the moveable incore detectors to verify ~~These Required Actions clarify that when one or more rods with inoperable position indicators have been moved in excess of 24 steps in one direction, since the position was last determined, the Required Actions of A.1 and A.2, [or B.1, as applicable] are still appropriate but must be initiated promptly under Required Action C.1 to begin verifying that~~ these rods are still properly positioned, relative to their group positions.

If, within [4] hours, the rod positions have not been determined, THERMAL POWER must be reduced to ≤ 50% RTP within 8 hours to avoid undesirable power distributions that could result from continued operation at > 50% RTP, if one or more rods are misaligned by more than 24 steps. The allowed Completion Time of [4] hours provides an acceptable period of time to verify the rod positions.

BASES

ACTIONS (continued)

D.1.1 and D.1.2

With one *or more* demand position indicator*s* per bank inoperable *in one or more banks*, the rod positions can be determined by the [D]RPI System. Since normal power operation does not require excessive movement of rods, verification by administrative means that the rod position indicators are OPERABLE and the most withdrawn rod and the least withdrawn rod are ≤ 12 steps apart within the allowed Completion Time of once every 8 hours is adequate.

D.2

Reduction of THERMAL POWER to ≤ 50% RTP puts the core into a condition where rod position is not significantly affecting core peaking factor limits (Ref. 3). The allowed Completion Time of 8 hours provides an acceptable period of time to verify the rod positions per Required Actions C.1.1 and C.1.2 or reduce power to ≤ 50% RTP.

E.1

If the Required Actions cannot be completed within the associated Completion Time, the plant must be brought to a MODE in which the requirement does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours. The allowed Completion Time is reasonable, based on operating experience, for reaching the required MODE from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.1.7.1

Verification that the [D]RPI agrees with the demand position within [12] steps ensures that the [D]RPI is operating correctly. Since the [D]RPI does not display the actual shutdown rod positions between 18 and 210 steps, only points within the indicated ranges are required in comparison.

This Surveillance is performed prior to reactor criticality after each removal of the reactor head, as there is the potential for unnecessary plant transients if the SR were performed with the reactor at power.

The Surveillance is modified by a Note which states it is not required to be met for [D]RPIs associated with rods that do not meet LCO 3.1.4. If a rod is known to not to be within [12] steps of the group demand position, the ACTIONS of LCO 3.1.4 provide the appropriate Actions.

BASES

REFERENCES

1. 10 CFR 50, Appendix A, GDC 13.

2. FSAR, Chapter [15].

3. FSAR, Chapter [15].