4300 Winfield Road
Warrenville, IL 60555
630 657 2000 Office

Exelon Generation

RS-17-058 10 CFR 50.90

June 30, 2017

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

Braidwood Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Byron Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Subject: License Amendment Request to Incorporate Changes Supported by TSTF-547, "Clarification of Rod Position Requirements"

Reference: Letter from K. Hsueh (NRC) to Technical Specification Task Force, "Final Safety Evaluation of Technical Specification Task Force Traveler TSTF-547, Revision 1, "Clarification of Rod Position Requirements" (TAC No. MF3570), March 4, 2016

In accordance with 10 CFR 50.90, "Application for amendment of license, construction permit or early site permit," Exelon Generation Company, LLC, (EGC) requests amendments to Facility Operating License Nos. NPF-72 and NPF-77 for Braidwood Station, Units 1 and 2, and Facility Operating License Nos. NPF-37 and NPF-66 for Byron Station, Units 1 and 2. This amendment request proposes to revise 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," consistent with the changes approved by the NRC in the referenced letter. In general, these changes will 1) provide time to repair rod movement failures that do not affect rod Operability; 2) correct conflicts between the TS; and 3) increase consistency between the subject TS and improve the format and presentation.

Please note that EGC is not adopting the TSTF-547 verbiage in its entirety due to variations from TSTF-547 that already exist in the current Braidwood Station and Byron Station TS as discussed in Attachment 1; therefore, this amendment request is not considered part of the Consolidated Line Item Improvement Process. No other changes, in addition to the changes supported by TSTF-547, are being proposed in this license amendment request.

The attached request is subdivided as follows:

- Attachment 1 provides a description and assessment of the proposed changes.
- Attachment 2A provides the markup of the affected Braidwood Station TS pages.
- Attachment 2B provides the markup of the affected Byron Station TS pages.

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- Attachment 3A provides the markup of the affected Braidwood Station Bases pages (for information only).
- Attachment 3B provides the markup of the affected Byron Station Bases pages (for information only).

The proposed amendment has been reviewed by the Braidwood Station and Byron Station Plant Operations Review Committees in accordance with the requirements of the EGC Quality Assurance Program.

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," paragraph (b), EGC is notifying the State of Illinois of this application for license amendment by transmitting a copy of this letter and its attachments to the designated State of Illinois official.

EGC requests approval of the proposed license amendment request within one year of this submittal date; i.e., by June 30, 2018. Once approved, the amendment shall be implemented within 30 days.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Joseph A. Bauer at (630) 657-2804.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 30th day of June 2017.

Respectfully,

David M. Gullott
Manager – Licensing
Exelon Generation Company, LLC

Attachments:

Attachment 1	Evaluation of Proposed Changes
Attachment 2A	Markup of Technical Specifications Pages – Braidwood Station
Attachment 2B	Markup of Technical Specifications Pages – Byron Station
Attachment 3A	Markup of Bases Pages – Braidwood Station (for information only)
Attachment 3B	Markup of Bases Pages – Byron Station (for information only)

cc: NRC Regional Administrator, Region III
NRC Senior Resident Inspector, Braidwood Station
NRC Senior Resident Inspector, Byron Station
Illinois Emergency Management Agency – Division of Nuclear Safety

ATTACHMENT 1
Evaluation of Proposed Changes

Subject: License Amendment Request to Incorporate Changes Supported by TSTF-547, "Clarification of Rod Position Requirements"

ATTACHMENT 1
Evaluation of Proposed Changes

1.0 SUMMARY DESCRIPTION

In accordance with 10 CFR 50.90, "Application for amendment of license, construction permit or early site permit," Exelon Generation Company, LLC, (EGC) requests amendments to Facility Operating License Nos. NPF-72 and NPF-77 for Braidwood Station, Units 1 and 2, and Facility Operating License Nos. NPF-37 and NPF-66 for Byron Station, Units 1 and 2. This amendment request proposes to revise 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," consistent with the changes approved by the NRC in Reference 1; i.e., Letter from K. Hsueh (NRC) to the Technical Specification Task Force, "Final Safety Evaluation of Technical Specification Task Force Traveler TSTF-547, Revision 1, "Clarification of Rod Position Requirements" (TAC No. MF3570), dated March 4, 2016. In general, these changes will 1) provide time to repair rod movement failures that do not affect rod Operability; 2) correct conflicts between the TS; and 3) increase consistency between the subject TS and improve the format and presentation.

Please note that EGC is not "adopting" the TSTF-547 verbiage in its entirety (i.e., not a verbatim incorporation) due to variations that already exist between TSTF-547 the current Braidwood Station and Byron Station TS; therefore, this amendment request is not considered part of the Consolidated Line Item Improvement Process. These variations are primarily due to the following:

a. TSTF-547, Revision 1 is based on NUREG-1431, "Standard Technical Specifications, Westinghouse Plants," Revision 4. The Braidwood Station and Byron Station TS are based on NUREG-1431, Revision 1. There are a number of differences between these two documents.

b. A number of intentional deviations from NUREG-1431, Revision 1 were previously approved by the NRC during the Braidwood Station and Byron Station TS transition from Current Technical Specifications (CTS) to NUREG-1431, Revision 1 (Reference 2).

c. Amendments implementing the Best Estimate Analyzer for Core Operations Nuclear (BEACON) Power Distribution Monitoring System (PDMS) (referred to as PDMS) were previously approved in Amendment 110 (Braidwood Station) and Amendment 116 (Byron Station) on February 13, 2001 (Reference 3). These amendments impacted TS 3.1.4 and TS 3.1.7.

The TS revisions proposed in this license amendment request, as shown below, are based on TSTF-547; no additional technical changes are being proposed. All variations between TSTF-547 and the Braidwood Station and Byron Station TS do not affect the applicability of TSTF-547, Revision 1 or the NRC Staff's Safety Evaluation of the TSTF. The order and format of the below discussion parallels TSTF-547 and the associated Safety Evaluation (Reference 1) for ease of review.

The following TS changes are proposed:

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 verification of rod position when position indication for a rod is inoperable;

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

4. 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 associated TS Bases are also revised to reflect the proposed changes as shown in Attachments 3A and 3B for Braidwood Station and Byron Station, respectively. Note that the Bases are provided for information only.

Note that Braidwood Station and Byron Station both have a digital rod position indication system.

2.0 DETAILED DESCRIPTION

As noted above, this amendment request proposes to revise 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." The proposed changes are based on TSTF-547 (approved by the NRC in Reference 1); no additional technical changes are being proposed. In general, these changes will 1) provide time to repair rod movement failures that do not affect rod Operability; 2) correct conflicts between the TS; and 3) increase consistency between the subject TS and improve the format and presentation.

The order and format of the below discussion parallels TSTF-547 and the associated Safety Evaluation (Reference 1) for ease of review.

The following specific TS changes are proposed:

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

The limiting condition for operation (LCO) 3.1.5 requires that each shutdown bank be within required insertion limits. The current Condition A for one or more shutdown banks not within the limits, requires:

A.1.1	Verify SDM [shutdown margin] is within the limits specified in the COLR (within 1 hour).
<u>OR</u>	
A.1.2	Initiate boration to restore SDM to within limit (within 1 hour).
<u>AND</u>	
A.2	Restore shutdown bank(s) to within limits (within 2 hours).

LCO 3.1.6 requires that each control bank be within required insertion limits. The current Condition A for control bank insertion limits not met requires:

A.1.1	Verify SDM is within the limits specified in the COLR (within 1 hour).
<u>OR</u>	
A.1.2	Initiate boration to restore SDM to within limit (within 1 hour).
<u>AND</u>	
A.2	Restore control bank(s) to within limits (within 2 hours).

The proposed change would add a new Condition A to LCO 3.1.5 that would require, with 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 (within one hour).
<u>AND</u>	
A.2.1	Verify SDM is within the limits specified in the COLR (within one hour).
<u>OR</u>	
A.2.2	Initiate boration to restore SDM to within the limit (within one hour).
<u>AND</u>	
A.3	Restore the shutdown bank to within the insertion limits specified in the COLR (within 24 hours).

The existing Condition A would be renumbered as Condition B and would be modified to apply for one or more shutdown banks not within limits *for reasons other than Condition A.* The existing Required Actions (RAs) A.1.1, A.1 .2, and A.2 would be renumbered B.1.1, B.1.2, and B.2. The existing Condition B and RA B.1 would be renumbered to Condition C and RA C.1.

The proposed change would add a new Condition A to LCO 3.1.6 that would require, if control bank A, B, or C is inserted ≤ 16 steps beyond the insertion, sequence, and overlap limits specified in the COLR, that:

A.1	Verify all shutdown banks are within the insertion limits specified in the COLR (within one hour).
<u>AND</u>	
A.2.1	Verify SDM is within the limits specified in the COLR (within one hour).
<u>OR</u>	
A.2.2.	Initiate boration to restore SDM to within the limit (within one hour).
<u>AND</u>	
A.3	Restore the control bank to within the insertion, sequence, and overlap limits specified in the COLR (within 24 hours).

The existing Condition A would be renumbered as Condition B and would be modified to apply for control bank insertion limits not met for reasons other than Condition A. The existing RAs A.1.1, A.1.2, and A.2 would be renumbered to B.1.1, B.1.2, and B.2.

The existing Condition B would apply when control bank sequence or overlap limits are not met. Condition B would be modified to apply when control bank sequence or overlap limits are not met *for reasons other than Condition A.* Existing Condition B and RAs B.1.1, B.1.2, and B.2 would be renumbered as Condition C and RAs C.1.1, C.1.2, and C.2. Existing Condition C and

RA C.1 would be renumbered to Condition D and RA D.1.

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 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.

2.2 Provide an Alternative to Frequent Verification of Rod Position

LCO 3.1.7, "Rod Position Indication," requires that the DRPI and the Demand Positon Indication System be operable during Startup and Power Operation. Condition A applies for one DRPI per group of rods inoperable for one or more groups of rods. The associated RAs are:

A.1 Verify the position of the rods with inoperable DRPIs (once per 8 hours).
OR
A.2 Reduce thermal power to ≤ 50 percent rated thermal power (within 8 hours).

As noted in the TS Bases 3.1.7, verification of rod position can be determined by use of either the moveable incore detectors or PDMS.

The proposed change would add two new RAs to Condition A as alternatives to the once-per-8-hour verification of rod position. The revised RAs would be:

A.1 Verify the position of rods with inoperable DRPIs (once per 8 hours).
OR
A.2.1 Verify the position of rods with inoperable DRPIs (within 8 hours, once per 31 days of full power operation thereafter, within 8 hours after discovery of each unintended rod movement, within 8 hours after each movement of rods with inoperable DRPI > 12 steps, prior to exceeding 50 percent rated thermal power and within 8 hours after reaching rated thermal power).
AND
A.2.2 Restore inoperable DRPIs to operable status (prior to entering Mode 2 from Mode 3).
OR
A.3 Reduce thermal power to ≤ 50 percent rated thermal power (within 8 hours).

The 12-step agreement limit between the Bank Demand Position Indication System and the DRPI 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. When one DRPI per group fails, the position of the rod may still be determined indirectly by use of either the movable incore detectors or PDMS.

Surveillance Requirement (SR) 3.1.4.1 requires verification that the individual rods are within the alignment limit in accordance with the Surveillance Frequency Control Program (i.e., 12 hours). This SR is proposed to be modified by a Note to indicate that the SR is not applicable for rods with an inoperable rod position indicator or demand position indicator.

Verification that individual rod positions are within alignment limits at a Frequency of 12 hours provides a history that allows the operator to detect a rod that is beginning to deviate from its expected position. The specified Frequency takes into account other rod position information that is continuously available to the operator in the control room, so that during actual rod motion, deviations can immediately be detected.

2.3 Allow Time for Thermal Equilibrium of Analog RPI

This section of the TSTF is not applicable to Braidwood Station and Byron Station as both stations have a digital rod position indication system.

2.4 Correct Conflicts Between TS 3.1.4 and TS 3.1.7

SR 3.1.4.1 requires verification of individual rod positions are within the alignment limits in accordance with the Surveillance Frequency Control Program (i.e., once per 12 hours). The proposed change is the addition of a Note to SR 3.1.4.1 stating that the SR is not required to be performed for rods associated with an inoperable demand position indicator. This Note is being added because SR 3.1.4.1 cannot be performed for rods with an inoperable demand position indicator.

LCO 3.1.4 specifies that 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. SR 3.1.7.1 requires verification that each DRPI agrees within the required steps of the group demand position for the full indicated range of rod travel. The proposed change is the addition of a Note to SR 3.1.7.1 stating that the SR would not be required to be met for rods known not to meet LCO 3.1.4.

2.5 Eliminate an Unnecessary Required Action from TS 3.1.7

LCO 3.1.7, "Rod Position Indication," requires that the DRPI and the Demand Positon Indication System be operable during Startup and Power Operation. In TSTF-547, TS 3.1.7 Condition B states: "More than one DRPI per group inoperable in one or more groups." The Braidwood Station and Byron Station TS were based on NUREG-1431 Revision 1 which did not have a Condition for more than one DRPI per group inoperable. This new Condition B, associated RAs and associated Bases (as shown in TSTF-547) will be incorporated into the Braidwood Station and Byron Station TS and Bases. The existing Conditions B, C and D (and associated RAs) will be renumbered to C, D and E accordingly.

TSTF-547 deletes TS 3.1.7 Required Action B.2, "Monitor and Record Reactor Coolant System Tavg." Since the Braidwood Station and Byron Station TS do not currently contain the subject Condition B, deletion of the associated RA B.2 is not applicable.

2.6 Other Proposed Changes

The proposed changes described in this section are editorial and do not change the technical content.

1. TSTF-547 proposes to eliminate LCO 3.1.4, Condition B, RA B.1 and to combine RAs B.2.4 and B.2.5. RA B.1 was previously eliminated during the Braidwood Station and Byron Station TS transition from Current Technical Specifications (CTS) to NUREG-1431, Revision 1 (Reference 2). RAs B.2.4 and B.2.5 were previously combined in Amendment 110 (Braidwood Station) and Amendment 116 (Byron Station) (Reference 3).

2. LCO 3.1.5 and LCO 3.1 .6 contain a Note modifying their Applicability that states "This LCO is not applicable while performing SR 3.1.4.2." The proposed change 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. This change clarifies the note and does not alter its meaning.

3. In TSTF-547, TS 3.1 .7 is revised to consistently use the defined abbreviation "DRPI." This affects the Actions Note, RA A.1, RA B.2, and RA C.1. Consistent use of the defined abbreviation "DRPI" was previously adopted during the Braidwood Station and Byron Station TS transition from Current Technical Specifications (CTS) to NUREG-1431, Revision 1 (Reference 2); therefore, this change is not applicable to the Braidwood Station and Byron Station TS.

4. TS 3.1. 7, Condition A, is revised from "for one or more groups" to the more standard terminology "in one or more groups." This change does not alter the meaning.

5. TSTF-547 proposes to delete TS 3.1.7 RA B.3 as it is redundant to RA A.1. As noted above in Section 2.5, the Braidwood Station and Byron Station TS were based on NUREG-1431 Revision 1 which did not have a Condition for more than one DRPI per group inoperable (i.e., no TS 3.1.7 Condition B). The new Condition B and associated RAs (as shown in TSTF-547) will be incorporated into the Braidwood Station and Byron Station TS; therefore, deletion of RA B.3 is not applicable to the Braidwood Station and Byron Station TS.

6. The existing TS 3.1.7, Condition B (renumbered to Condition C) is revised to contain similar terminology to Condition A and the new Condition B for consistency. The current wording of the existing Condition B states, "One or more rods with inoperable DRPIs have been moved in excess of 24 steps in one direction since the last determination of the rod's position." The proposed change rewords the renumbered Condition C to state, "One or more DRPI inoperable in one or more groups and associated rod has been moved > 24 steps in one direction since the last position determination."

7. The existing LCO 3.1.7, Condition C (renumbered to Condition D) is revised 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 terminology consistent with the Note modifying the RAs as discussed in the following paragraph.

The current TS 3.1.7 is modified by a Note which states, "Separate Condition entry is allowed for each inoperable DRPI and each demand position indicator." The Bases for the Note states that the Note is acceptable because the RAs for each Condition provide appropriate compensatory actions for each inoperable indicator. There is one demand position indicator per group of rods. For banks with two groups of rods, there are two demand indicators per bank. The separate condition entry Note modifying the TS 3.1. 7 Actions states that separate condition entry is allowed for each inoperable demand position indicator which means that the renumbered Condition D is applicable to more than one inoperable demand position indicator per bank. The proposed change makes the renumbered Condition D terminology consistent with the Note.

3.0 TECHNICAL EVALUATION

3.1 Applicability of Safety Evaluation

Exelon Generation Company, LLC, (EGC) has reviewed the safety evaluation for TSTF-547, "Clarification of Rod Position Requirements," Revision 1 provided to the Technical Specifications Task Force in a letter dated March 4, 2016 (Reference 1). This review included a review of the NRC staff's evaluation, as well as the information provided in TSTF-547. As shown below, EGC has concluded that the justifications presented in the TSTF-547 proposal and the safety evaluation prepared by the NRC staff are applicable to Braidwood Station, Units 1 and 2 and Byron Station, Units 1 and 2 and justify this amendment for the incorporation of the changes into the Braidwood Station and Byron Station TS.

The TS revisions proposed in this license amendment request are based on TSTF-547; no additional technical changes are being proposed. All variations between TSTF-547 and the Braidwood Station and Byron Station TS do not affect the applicability of TSTF-547, Revision 1 or the NRC staff's safety evaluation of the TSTF. The order and format of the below discussion parallels TSTF-547 and the associated Safety Evaluation (Reference 1) for ease of review. Note that the majority of information presented in this section was excerpted from TSTF-547 with some plant-specific revisions/additions.

3.2 Rod Cluster Control Assemblies Description

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

The 53 RCCAs are divided among four control banks and five shutdown banks. A bank of RCCAs consists of either one group or two groups that are moved in a staggered fashion to provide for precise reactivity control but which are always within one step of each other. Each of the control banks are divided into two groups, for a total of 25 control bank rods. Shutdown banks A and B are also divided into two groups, however, shutdown banks C, D and E have only one group each, for a total of 28 shutdown bank rods. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously.

The shutdown banks are maintained either in the fully inserted or fully withdrawn position. The control banks are moved in an overlap pattern, using the following withdrawal sequence: When control bank A reaches a predetermined height in the core, control bank B begins to move out with control bank A. Control bank A stops at the fully withdrawn position, 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 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 shutdown rods and control rods is indicated by two separate and independent systems, 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 ± 5/8 inch) but not very reliable because it is a demanded position indication, not an actual position indication. For example, 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 with a center to center distance of 3.75 inches, which is six steps. To increase the reliability of the system, the inductive coils are connected alternately to Data Channel A or Data Channel B. Thus, if one data channel fails, the DRPI system can be placed in "half accuracy" mode with an effective coil spacing of 7.5 inches, which is 12 steps. Therefore, the design indication accuracy of the DRPI 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 DRPI, the maximum deviation between actual rod position and the demand position could be 24 steps, or 15 inches.

3.3 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). 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. The 24 hour period is sufficient to repair most rod control failures.

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 LCO section of TS 3.1.5 and TS 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 LCO Note 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.

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.

3.4 Provide an Alternative to Frequent Verification of Rod Position

If one or more DRPIs are inoperable, TS 3.1.7, Required Action A.1 requires verification of the position of the associated rods using either the movable incore detector system or PDMS once per 8 hours as discussed in TS Bases 3.1.7. The proposed change revises TS 3.1.7 to provide an alternative to monitoring the associated rods every 8 hours (approximately 90 times per month) by utilizing a different monitoring method. This alternative method reduces potential wear on the movable incore detector system when PDMS is inoperable and also reduces the time required to perform the frequent rod position verifications. The potential wear of the movable incore detector system does not pose a reduction in the margin of safety; however, 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 (i.e., A.2.1 and A.2.2) as an alternative to the 8 hour monitoring in the existing Condition A Required Actions.

Proposed Required Action A.2.1 requires verification of the position of rods associated with an inoperable DRPI and includes six Completion Times as summarized in Section 2.2 above. 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 Frequency of power distribution surveillances (specified in the Surveillance Frequency Control Program) that utilize the movable incore detector system when PDMS is inoperable. If there is unintended movement of a rod or if a rod with an inoperable DRPI is moved more than 12 steps, the movable incore detectors or PDMS 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 DRPI 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 DRPI 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 DRPI 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 or PDMS 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 DRPI is inoperable, LCO 3.1.7, Conditions A and C, require verification of rod position; however, 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 DRPIs will be used to verify LCO 3.1.4 continues to be met.

3.5 Correct Conflicts Between TS 3.1.4 and TS 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 indictors inoperable if compensatory Required Actions are taken; i.e., the renumbered

Condition D and associated Required Actions. These compensatory Required Actions are to verify the DRPIs 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. 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 DRPI 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 (i.e., 75% as noted in RA B.2), but there is no applicable Condition in TS 3.1.7. The TS 3.1.7 Actions only apply to inoperable DRPIs 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.

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 DRPIs 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 (i.e., the shutdown and control rods in LCO 3.1.4; and the DRPI System and Demand Position Indication System in LCO 3.1.7) is Operable; therefore, 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.

3.6 Eliminate an Unnecessary Required Action from TS 3.1.7

TSTF-547 deletes TS 3.1.7 Required Action B.2, "Monitor and Record Reactor Coolant System Tavg." TSTF-547 is based on NUREG-1431, Revision 4 which contains the subject Condition B; however, the Braidwood Station and Byron Station TS were based on NUREG-1431 Revision 1 which did not have a Condition for more than one DRPI per group inoperable. Since the Braidwood Station and Byron Station TS do not currently contain the subject Condition B, deletion of the associated RA B.2 is not applicable.

3.7 Other Proposed Changes

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

a. TSTF-547 proposes to eliminate LCO 3.1.4, Condition B, RA B.1 and to combine RAs B.2.4 and B.2.5. RA B.1 was previously eliminated from the Braidwood Station and Byron Station TS during the transition from Current Technical Specifications (CTS) to NUREG-1431, Revision 1 (Reference 2). Note that the associated Bases for the former RA B.1 is being deleted as shown in Attachment 3A and 3B (page B 3.1.4-7) consistent with TSTF-547. This text was mistakenly not deleted during the transition to NUREG-1431, Revision 1. RAs B.2.4 and B.2.5 were previously combined in Amendment 110 (Braidwood Station) and

Amendment 116 (Byron Station) (Reference 3). Therefore, these changes are not applicable to the Braidwood Station and Byron Station TS.

b. LCO 3.1.5 and LCO 3.1.6 contain a Note modifying their Applicability that states, "This LCO is not applicable while performing SR 3.1.4.2." The proposed change 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 proposed change does not alter the intent or application of the exception.

   TSTF-547 also relocated the subject Note from an Applicability Note to an LCO Note; however, this Note had previously been correctly relocated in the Braidwood Station and Byron Station TS during the transition from Current Technical Specifications (CTS) to NUREG-1431, Revision 1 (Reference 2).

c. In TSTF-547, TS 3.1.7 is revised to consistently use the defined abbreviation "DRPI." This affects the Actions Note, RA A.1, RA B.2, and RA C.1. Consistent use of the defined abbreviation "DRPI" was previously adopted in the Braidwood Station and Byron Station TS during the transition from Current Technical Specifications (CTS) to NUREG-1431, Revision 1 (Reference 2); therefore, this change is not applicable to the Braidwood Station and Byron Station TS.

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." This change is simply an editorial improvement.

   In TSTF-547, the existing TS 3.1.7 Condition B states, "More than one DRPI 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. TSTF-547 is based on NUREG-1431, Revision 4 which contains the subject Condition B; however, the Braidwood Station and Byron Station TS were based on NUREG-1431 Revision 1 which did not have a Condition for more than one DRPI per group inoperable. This new Condition B, associated RAs and associated Bases (as shown in TSTF-547) will be incorporated into the Braidwood Station and Byron Station TS and Bases. The existing Conditions B, C and D (and associated RAs) will be renumbered to C, D and E accordingly.

e. TSTF-547 proposes to delete TS 3.1.7 RA B.3 as it is redundant to RA A.1. As noted above in Item d, the Braidwood Station and Byron Station TS were based on NUREG-1431 Revision 1 which did not have a Condition for more than one DRPI per group inoperable (i.e., no TS 3.1.7 Condition B); therefore, deletion of RA B.3 is not applicable to the Braidwood Station and Byron Station TS. The new Condition B and associated RAs (as shown in TSTF-547) will be incorporated into the Braidwood Station and Byron Station TS.

f. The existing TS 3.1.7, Condition B (renumbered to Condition C) is inconsistently worded and is revised to contain similar terminology used in Condition A and the new Condition B. The current wording of the existing Condition B states, "One or more rods with inoperable DRPIs have been moved in excess of 24 steps in one direction since the last determination of the rod's position." The proposed change rewords the renumbered Condition C to state, "One or more DRPIs inoperable in one or more groups and associated rod has been moved > 24 steps in one direction since the last determination of the rod's position." The proposed change does not change the intent and makes the Conditions more consistent.

g. The existing TS 3.1.7, Condition C (renumbered to Condition D) is revised to be consistent with the existing separate Condition entry Note without changing the intent.

The proposed change revises the renumbered 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 Note modifying the Actions (i.e., the "Separate Condition entry" Note) and does not alter the intent of renumbered Condition D. Specifically, 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. The current LCO 3.1.7, Condition C (renumbered to 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 TS 3.1.7 Actions clearly states that separate Condition entry is allowed for inoperable demand position indicators which means that the renumbered Condition D is applicable to more than one inoperable demand position indicator per bank. However, the existing 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 the renumbered Condition D provide appropriate compensatory measures for one or more inoperable demand position indicators. Required Action D.1.1 requires administrative verification that the DRPIs 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 in accordance with Required Action D.2. 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 inoperable demand position indicators in the same bank. 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 for two inoperable demand position indicators in a single bank as they are for two inoperable demand position indicators in separate banks.

4.0 REGULATORY ANALYSIS

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 DRPI 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

In accordance with 10 CFR 50.90, "Application for amendment of license, construction permit or early site permit," Exelon Generation Company, LLC, (EGC) requests amendments to Facility Operating License Nos. NPF-72 and NPF-77 for Braidwood Station, Units 1 and 2, and Facility Operating License Nos. NPF-37 and NPF-66 for Byron Station, Units 1 and 2. This amendment request proposes to revise 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," consistent with the changes approved by the NRC in a letter from K. Hsueh (NRC) to the Technical Specification Task Force, "Final Safety Evaluation of Technical Specification Task Force Traveler TSTF-547, Revision 1, "Clarification of Rod Position Requirements" (TAC No. MF3570), dated March 4. In general, these changes will: 1) provide time to repair rod movement failures that do not affect rod Operability; 2) correct conflicts between the TS; and 3) increase consistency between the subject TS and improve the format and presentation.

ATTACHMENT 1
Evaluation of Proposed Changes

According to 10 CFR 50.92, "Issuance of amendment," paragraph (c), a proposed amendment to an operating license involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not:

(1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or

(2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or

(3) Involve a significant reduction in a margin of safety.

EGC has evaluated the proposed change for Braidwood Station and Byron Station, using the criteria in 10 CFR 50.92, and has determined that the proposed change does not involve a significant hazards consideration. The following information is provided to support a finding of no significant hazards consideration.

Criteria

1. Does the proposed change 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 changes do not change the limiting conditions for operation pertaining to 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 Actions 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 or the Power Distribution Monitoring 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 proposed change resolves conflicts within the TS to ensure that the intended Actions are followed when equipment is inoperable. Actions taken for inoperable equipment are not assumptions in the accidents previously evaluated and have no significant effect on the accident consequences.

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 change create the possibility of a new or different kind of accident from any accident 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 the assumptions made in the safety analyses. The proposed change does not alter the limiting conditions for operation pertaining to the rods or make any technical changes to the SRs governing the rods. The proposed change to the TS Required Actions maintains safety when equipment is inoperable and does not introduce any 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 change involve a significant reduction in a margin of safety?

   Response: No

   The proposed change to provide sufficient 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 rod banks must be within the insertion limits. The remaining proposed changes to make the requirements internally consistent 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, EGC 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.

5.0 ENVIRONMENTAL CONSIDERATION

EGC has evaluated this proposed operating license amendment consistent with the criteria for identification of licensing and regulatory actions requiring environmental assessment in accordance with 10 CFR 51.21, "Criteria for and identification of licensing and regulatory actions requiring environmental assessments." EGC has determined that these proposed changes to: 1) provide time to repair rod movement failures that do not affect rod Operability; 2) correct conflicts between the Technical Specifications; and 3) increase consistency between the subject Technical Specifications and improve the format and presentation, meet the criteria for a categorical exclusion set forth in paragraph (c)(9) of 10 CFR 51.22, "Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review," and as such, has determined that no irreversible consequences exist in accordance with paragraph (b) of 10 CFR 50.92, "Issuance of amendment." This determination is based on the fact that these changes are being proposed as an amendment to the license issued pursuant to 10 CFR 50, "Domestic Licensing of Production and Utilization Facilities," which changes a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, "Standards for Protection Against Radiation," or which changes an inspection or a surveillance requirement, and the amendment meets the following specific criteria:

(i) The amendment involves no significant hazards consideration.

As demonstrated in Section 4.2, "No Significant Hazards Consideration," the proposed change does not involve any significant hazards consideration.

(ii) There is no significant change in the types or significant increase in the amounts of any effluent that may be released offsite.

The proposed change does not result in an increase in power level, does not increase the production nor alter the flow path or method of disposal of radioactive waste or byproducts. It is expected that all plant equipment would operate as designed in the event of an accident to minimize the potential for any leakage of radioactive effluents. The proposed changes will have no impact on the amounts of radiological effluents released offsite during normal at-power operations or during the accident scenarios.

Based on the above evaluation, the proposed change will not result in a significant change in the types or significant increase in the amounts of any effluent released offsite.

(iii) There is no significant increase in individual or cumulative occupational radiation exposure.

There is no change in individual or cumulative occupational radiation exposure due to the proposed changes. Specifically, the changes to: 1) provide time to repair rod movement failures that do not affect rod Operability; 2) correct conflicts between the TS; and 3) increase consistency between the subject TS and improve the format and presentation, have no impact on any radiation monitoring system setpoints. The proposed action will not change the level of controls or methodology used for processing of radioactive effluents or handling of solid radioactive waste, nor will the proposed action result in any change in the normal radiation levels within the plant.

Therefore, in accordance with 10 CFR 51.22, paragraph (b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. Letter from K. Hsueh (NRC) to the Technical Specification Task Force, "Final Safety Evaluation of Technical Specification Task Force Traveler TSTF-547, Revision 1, "Clarification of Rod Position Requirements" (TAC No. MF3570), March 4, 2016

2. Letter form R. R. Assa (NRC) to O. D. Kingsley (EGC), "Issuance of Amendments," dated December 22, 1998

3. Letter form G. F. Dick (NRC) to O. D. Kingsley (EGC), "Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2 – Issuance of Amendments to Technical Specifications for Implementation of the Best Estimate Analyzer for Core Operations Nuclear Power Distribution Monitoring System," February 13, 2001

4. Letter from R. M. Krich (ComEd (now EGC)) to NRC, "Response to Request for Additional Information Related to the Review of the Best Estimate Analyzer for Core Operations Nuclear Core Monitoring and Support System, Byron Station, Units 1 and 2, and Braidwood Station, Units 1and 2," July 26, 2000

ATTACHMENT 2A

Markup of Technical Specifications Pages

BRAIDWOOD STATION
UNITS 1 AND 2

Docket Nos. 50-456 and 50-457

Facility Operating License Nos. NPF-72 and NPF-77

<u>MARKED-UP TS PAGES</u>

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 is within the limits specified in the COLR.	1 hour
	OR		
	A.1.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	A.2	Be in MODE 3.	6 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. One rod not within alignment limit.	B.1.1	Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>		
	B.1.2	Initiate boration to restore SDM to within limit.	1 hour
	<u>AND</u>		
	B.2	Reduce THERMAL POWER to ≤ 75% RTP.	2 hours from discovery of Condition B concurrent with inoperability of Power Distribution Monitoring System (PDMS)
	<u>AND</u>		
	B.3	Verify SDM is within the limits specified in the COLR.	Once per 12 hours
	<u>AND</u>		
	B.4	Determine Heat Flux Hot Channel Factor ($F_Q(Z)$) and Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$).	72 hours
	<u>AND</u>		
			(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. (continued)	B.5	Re-evaluate safety analyses and confirm results remain valid for duration of operation under these conditions.	5 days
C. More than one rod not within alignment limit.	C.1.1	Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>		
	C.1.2	Initiate boration to restore required SDM to within limit.	1 hour
	<u>AND</u>		
	C.2	Be in MODE 3.	6 hours from discovery of Condition C concurrent with inoperability of PDMS
	<u>AND</u>		
	C.3	--------NOTE--------- Only required to be performed when PDMS is OPERABLE. ---------------------	
		Restore rod(s) to within alignment limit.	72 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. Required Action and associated Completion Time of Condition B or Required Action C.3 not met.	D.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.4.1	-------------------NOTE-------------------- Not required to be performed for rods associated with inoperable rod position indicator or demand position indicator. -- Verify position of individual rods ~~positions~~ within alignment limit.	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.	In accordance with the Surveillance Frequency Control Program
SR 3.1.4.3	Verify rod drop time of each rod, from the fully withdrawn position, is ≤ 2.7 seconds from the beginning of decay of stationary gripper coil voltage to dashpot entry, with: a. T_{avg} ≥ 550°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 the insertion limits specified in the COLR.

-----NOTE-----
~~This LCO is n~~Not applicable to shutdown banks inserted while performing SR 3.1.4.2.

APPLICABILITY: MODES 1 and 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.	1 hour
	AND		
	A.2.1	Verify SDM is within the limits specified in the COLR.	1 hour
	OR		
	A.2.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	A.3	Restore the shutdown bank to within the insertion limits specified in the COLR.	24 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B~~A~~. One or more shutdown banks not within limits for reasons other than Condition A.	B~~A~~.1.1	Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>		
	B~~A~~.1.2	Initiate boration to restore SDM to within limit.	1 hour
	<u>AND</u>		
	B~~A~~.2	Restore shutdown bank(s) to within limits.	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	Verify each shutdown bank is within the insertion limits specified in the COLR.	In accordance with the Surveillance Frequency Control Program

3.1 REACTIVITY CONTROL SYSTEMS

3.1.6 Control Bank Insertion Limits

LCO 3.1.6 Each control bank shall be within the insertion, sequence, and overlap limits specified in the COLR.

-----------------------------NOTE-----------------------------
~~This LCO is n~~Not applicable to control banks inserted while performing SR 3.1.4.2.

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

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.	1 hour
	AND		
	A.2.1	Verify SDM is within the limits specified in the COLR.	1 hour
	OR		
	A.2.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	A.3	Restore the control bank to within the insertion, sequence, and overlap limits specified in the COLR.	24 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B~~A~~. Control bank insertion limits not met for reasons other than Condition A.	B~~A~~.1.1	Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>		
	B~~A~~.1.2	Initiate boration to restore SDM to within limit.	1 hour
	<u>AND</u>		
	B~~A~~.2	Restore control bank(s) to within limits.	2 hours
C~~B~~. Control bank sequence or overlap limits not met for reasons other than Condition A.	C~~B~~.1.1	Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>		
	C~~B~~.1.2	Initiate boration to restore SDM to within limit.	1 hour
	<u>AND</u>		
	C~~B~~.2	Restore control bank sequence and overlap to within limits.	2 hours
D~~C~~. Required Action and associated Completion Time not met.	D~~C~~.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 criticality
SR 3.1.6.2	Verify each control bank is within the insertion limits specified in the COLR.	In accordance with the Surveillance Frequency Control Program
SR 3.1.6.3	Verify each control bank not fully withdrawn from the core is within the sequence and overlap limits specified in the COLR.	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 (DRPI) System and the Demand Position Indication System shall be OPERABLE.

APPLICABILITY: MODES 1 and 2.

ACTIONS

-----------------------------------NOTE-----------------------------------
Separate Condition entry is allowed for each inoperable DRPI and each demand position indicator.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One DRPI per group inoperable ~~for~~ in one or more groups.	A.1	Verify the position of the rods with inoperable DRPIs.	Once per 8 hours
	OR		
	A.2.1	Verify the position of the rods with inoperable DRPIs.	8 hours AND Once per 31 EFPD thereafter AND 8 hours after discovery of each unintended rod movement AND (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)		8 hours after each movement of rod with inoperable DRPI > 12 steps AND Prior to THERMAL POWER exceeding 50% RTP AND 8 hours after reaching RTP
	AND A.2.2 Restore inoperable DRPIs 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 DRPI per group inoperable in one or more groups.	B.1 Place the control rods under manual control.	Immediately
	AND B.2 Restore inoperable DRPIs to OPERABLE status such that a maximum of one DRPI per group is inoperable.	24 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
C~~B~~. One or more ~~rods with inoperable~~ DRPIs inoperable in one or more groups and associated rod has ~~have~~ been moved ~~in excess of~~ > 24 steps in one direction since the last determination of the rod's position.	C~~B~~.1	Initiate action to verify the position of the rods with inoperable DRPIs.	Immediately
	<u>OR</u>		
	C~~B~~.2	Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
D~~C~~. One or more demand position indicators per bank inoperable ~~for~~ in one or more banks.	D~~C~~.1.1	Verify by administrative means all DRPIs for the affected bank(s) are OPERABLE.	Once per 8 hours
	<u>AND</u>		
	D~~C~~.1.2	Verify the most withdrawn rod and the least withdrawn rod of the affected bank(s) are ≤ 12 steps apart.	Once per 8 hours
	<u>OR</u>		
	D~~C~~.2	Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
E~~D~~. Required Action and associated Completion Time not met.	E~~D~~.1	Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.7.1	-------------------NOTE-------------------- Not required to be met for DRPIs associated with rods that do not meet LCO 3.1.4. --- Verify each DRPI agrees within 12 steps of the group demand position for the full indicated range of rod travel.	Prior to criticality after each removal of the reactor head~~.~~

ATTACHMENT 2B

Markup of Technical Specifications Pages

BYRON STATION
UNITS 1 AND 2

Docket Nos. 50-454 and 50-455

Facility Operating License Nos. NPF-37 and NPF-66

MARKED-UP TS PAGES

3.1.4-1 (no changes, included for continuity)
3.1.4-2 (no changes, included for continuity)
3.1.4-3 (no changes, included for continuity)
3.1.4-4
3.1.5-1
3.1.5-2
3.1.6-1
3.1.6-2
3.1.6-3
3.1.7-1
3.1.7-2
3.1.7-3
3.1.7-4

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 is within the limits specified in the COLR.	1 hour
	OR		
	A.1.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	A.2	Be in MODE 3.	6 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. One rod not within alignment limit.	B.1.1	Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>		
	B.1.2	Initiate boration to restore SDM to within limit.	1 hour
	<u>AND</u>		
	B.2	Reduce THERMAL POWER to ≤ 75% RTP.	2 hours from discovery of Condition B concurrent with inoperability of Power Distribution Monitoring System (PDMS)
	<u>AND</u>		
	B.3	Verify SDM is within the limits specified in the COLR.	Once per 12 hours
	<u>AND</u>		
	B.4	Determine Heat Flux Hot Channel Factor ($F_Q(Z)$) and Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$).	72 hours
	<u>AND</u>		
			(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. (continued)	B.5	Re-evaluate safety analyses and confirm results remain valid for duration of operation under these conditions.	5 days
C. More than one rod not within alignment limit.	C.1.1	Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>		
	C.1.2	Initiate boration to restore required SDM to within limit.	1 hour
	<u>AND</u>		
	C.2	Be in MODE 3.	6 hours from discovery of Condition C concurrent with inoperability of PDMS
	<u>AND</u>		
	C.3	--------NOTE--------- Only required to be performed when PDMS is OPERABLE. ---------------------	
		Restore rod(s) to within alignment limit.	72 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. Required Action and associated Completion Time of Condition B or Required Action C.3 not met.	D.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.1.4.1	-------------------NOTE------------------- Not required to be performed for rods associated with inoperable rod position indicator or demand position indicator. -- Verify position of individual rods ~~positions~~ within alignment limit.	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.	In accordance with the Surveillance Frequency Control Program
SR 3.1.4.3	Verify rod drop time of each rod, from the fully withdrawn position, is ≤ 2.7 seconds from the beginning of decay of stationary gripper coil voltage to dashpot entry, with: a. T_{avg} ≥ 550°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 the insertion limits specified in the COLR.

--------------------------NOTE--------------------------
~~This LCO is n~~Not applicable to shutdown banks inserted while performing SR 3.1.4.2.

APPLICABILITY: MODES 1 and 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.	1 hour
	AND		
	A.2.1	Verify SDM is within the limits specified in the COLR.	1 hour
	OR		
	A.2.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	A.3	Restore the shutdown bank to within the insertion limits specified in the COLR.	24 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B~~A~~. One or more shutdown banks not within limits for reasons other than Condition A.	B~~A~~.1.1 Verify SDM is within the limits specified in the COLR.	1 hour
	OR	
	B~~A~~.1.2 Initiate boration to restore SDM to within limit.	1 hour
	AND	
	B~~A~~.2 Restore shutdown bank(s) to within limits.	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	Verify each shutdown bank is within the insertion limits specified in the COLR.	In accordance with the Surveillance Frequency Control Program

3.1 REACTIVITY CONTROL SYSTEMS

3.1.6 Control Bank Insertion Limits

LCO 3.1.6 Each control bank shall be within the insertion, sequence, and overlap limits specified in the COLR.

---------------------------NOTE---------------------------
~~This LCO is n~~Not applicable to control banks inserted while performing SR 3.1.4.2.

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

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.	1 hour
	AND		
	A.2.1	Verify SDM is within the limits specified in the COLR.	1 hour
	OR		
	A.2.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	A.3	Restore the control bank to within the insertion, sequence, and overlap limits specified in the COLR.	24 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B~~A~~. Control bank insertion limits not met for reasons other than Condition A.	B~~A~~.1.1 Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>	
	B~~A~~.1.2 Initiate boration to restore SDM to within limit.	1 hour
	<u>AND</u>	
	B~~A~~.2 Restore control bank(s) to within limits.	2 hours
C~~B~~. Control bank sequence or overlap limits not met for reasons other than Condition A.	C~~B~~.1.1 Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>	
	C~~B~~.1.2 Initiate boration to restore SDM to within limit.	1 hour
	<u>AND</u>	
	C~~B~~.2 Restore control bank sequence and overlap to within limits.	2 hours
D~~C~~. Required Action and associated Completion Time not met.	D~~C~~.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 criticality
SR 3.1.6.2	Verify each control bank is within the insertion limits specified in the COLR.	In accordance with the Surveillance Frequency Control Program
SR 3.1.6.3	Verify each control bank not fully withdrawn from the core is within the sequence and overlap limits specified in the COLR.	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 (DRPI) System and the Demand Position Indication System shall be OPERABLE.

APPLICABILITY: MODES 1 and 2.

ACTIONS

------------------------------------NOTE------------------------------------
Separate Condition entry is allowed for each inoperable DRPI and each demand position indicator.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One DRPI per group inoperable ~~for~~ in one or more groups.	A.1	Verify the position of the rods with inoperable DRPIs.	Once per 8 hours
	<u>OR</u>		
	A.2.1	Verify the position of the rods with inoperable DRPIs.	8 hours <u>AND</u> Once per 31 EFPD thereafter <u>AND</u> 8 hours after discovery of each unintended rod movement <u>AND</u> (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. (continued)			8 hours after each movement of rod with inoperable DRPI > 12 steps AND Prior to THERMAL POWER exceeding 50% RTP AND 8 hours after reaching RTP
	AND		
	A.2.2	Restore inoperable DRPIs to OPERABLE status.	Prior to entering MODE 2 from MODE 3
	OR		
	A.3~~2~~	Reduce THERMAL POWER to $\leq$ 50% RTP.	8 hours
B. More than one DRPI per group inoperable in one or more groups.	B.1	Place the control rods under manual control.	Immediately
	AND		
	B.2	Restore inoperable DRPIs to OPERABLE status such that a maximum of one DRPI per group is inoperable.	24 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
C~~B~~. One or more ~~rods with inoperable~~ DRPIs inoperable in one or more groups and associated rod has ~~have~~ been moved ~~in excess of~~ > 24 steps in one direction since the last determination of the rod's position.	C~~B~~.1	Initiate action to verify the position of the rods with inoperable DRPIs.	Immediately
	<u>OR</u>		
	C~~B~~.2	Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
D~~C~~. One or more demand position indicators per bank inoperable ~~for~~ in one or more banks.	D~~C~~.1.1	Verify by administrative means all DRPIs for the affected bank(s) are OPERABLE.	Once per 8 hours
	<u>AND</u>		
	D~~C~~.1.2	Verify the most withdrawn rod and the least withdrawn rod of the affected bank(s) are ≤ 12 steps apart.	Once per 8 hours
	<u>OR</u>		
	D~~C~~.2	Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
E~~D~~. Required Action and associated Completion Time not met.	E~~D~~.1	Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.7.1	-------------------NOTE-------------------- Not required to be met for DRPIs associated with rods that do not meet LCO 3.1.4. --- Verify each DRPI agrees within 12 steps of the group demand position for the full indicated range of rod travel.	Prior to criticality after each removal of the reactor head~~.~~

ATTACHMENT 3A

Markup of Bases Pages

BRAIDWOOD STATION
UNITS 1 AND 2

Docket Nos. 50-454 and 50-455

Facility Operating License Nos. NPF-37 and NPF-66

<u>REVISED BASES PAGES</u>

B3.1.4 (all); changes on pages 7 and 12 only
B3.1.5 (all); changes on pages 4, 5 and 6 only
B3.1.6 (all); changes on pages 4, 5, 6 and 7 only
B3.1.7 (all); changes on pages 6, 7, 8, 9, and 10 only

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.4 Rod Group Alignment Limits

BASES

BACKGROUND

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

The applicable criteria for these reactivity and power distribution design requirements are 10 CFR 50, Appendix A, GDC 10, "Reactor Design," GDC 26, "Reactivity Control System Redundancy and Protection" (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 5/8 inch) at a time, but at varying rates (steps per minute) depending on the signal output from the Rod Control System.

BASES

BACKGROUND (continued)

The 53 RCCAs are divided among four control banks and five shutdown banks. A bank of RCCAs consists of either one group, or, two groups that are moved in a staggered fashion to provide for precise reactivity control but which are always within one step of each other. Each of the control banks are divided into two groups, for a total of 25 control bank rods. Shutdown banks A and B are also divided into two groups, however, shutdown banks C, D and E have only one group each, for a total of 28 shutdown bank rods. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously.

The shutdown banks are maintained either in the fully inserted or fully withdrawn position. The control banks are moved in an overlap pattern, using the following withdrawal sequence: When control bank A reaches a predetermined height in the core, control bank B begins to move out with control bank A. Control bank A stops at the fully withdrawn position, 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, the Bank Demand Position Indication System (commonly called group step counters) and the Digital Rod Position Indication (DRPI) System.

BASES

BACKGROUND (continued)

The Bank Demand Position Indication System counts the pulses from the rod control system that moves the rods. There is one step counter for each group of rods. Individual rods in a group all receive the same signal to move and should, therefore, all be at the same position indicated by the group step counter for that group. The Bank Demand Position Indication System is considered highly precise (± 1 step or ± 5/8 inch) but not very reliable because it is a demanded position indication, not an actual position indication. For example, 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 with a center to center distance of 3.75 inches, which is six steps. To increase the reliability of the system, the inductive coils are connected alternately to Data Channel A or Data Channel B. Thus, if one data channel fails, the DRPI system can be placed in "half accuracy" mode with an effective coil spacing of 7.5 inches, which is 12 steps. Therefore, the design indication accuracy of the DRPI 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 DRPI, the maximum deviation between actual rod position and the demand position could be 24 steps, or 15 inches.

BASES

APPLICABLE SAFETY ANALYSES

Rod misalignment accidents are analyzed in the safety analysis (Ref. 3). The acceptance criteria for addressing rod inoperability or misalignment are that:

a. There be no violations of:

   1. specified acceptable fuel design limits, or

   2. Reactor Coolant System (RCS) pressure boundary integrity; and

b. The core remains subcritical after accident transients.

Two types of misalignment are distinguished. During movement of a control rod group, one rod may stop moving, while the other rods in the group continue (i.e., statically misaligned RCCA). 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 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 with control bank D inserted to its full power insertion limit and one RCCA fully withdrawn. 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 fully withdrawn (Ref. 5).

BASES

APPLICABLE SAFETY ANALYSES (continued)

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 rod is allowed if the heat flux hot channel factor ($F_Q(Z)$) and the nuclear enthalpy rise 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 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).

LCO

The limits on shutdown or control rod alignments ensure that the assumptions in the safety analysis will remain valid. The requirements on OPERABILITY ensure that upon reactor trip, the assumed reactivity will be available and will be inserted. The OPERABILITY requirements (i.e. trippability to meet SDM) 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 rods (e.g. rod urgent failures), but do not impact trippability, do not result in rod inoperability provided proper alignment.

BASES

LCO (continued)

The requirement to maintain individual indicated rod positions within 12 steps of their group step counter demand position 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 fully inserted 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 for MODE 6.

BASES

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 specified in the COLR, initiate boration until the required SDM is recovered. The Completion Time of 1 hour is adequate for determining SDM and, if necessary, for initiating boration to restore SDM to within limit.

In this situation, SDM verification must account for the worth of the untrippable rod(s), as well as the rod of maximum worth.

A.2

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

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

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 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." ~~One hour gives the operator sufficient time to adjust the rod positions in an orderly manner.~~

BASES

ACTIONS (continued)

However, 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 fully inserted and control bank C must be partially inserted.

With a misaligned rod, SDM must be verified to be within limit (specified in the COLR) or boration must be initiated to restore SDM to within limit.

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 to restore SDM to within limit.

B.2, B.3, B.4, and B.5

For continued operation with a misaligned rod, THERMAL POWER must be reduced when Power Distribution Monitoring System (PDMS) is inoperable, SDM must periodically be verified within limits (specified in the COLR), 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 when PDMS is inoperable, ensures that local LHR increases due to a misaligned RCCA will not cause the core design criteria to be exceeded (Ref. 4). The Completion Time of 2 hours gives the operator sufficient time to accomplish an orderly power reduction without challenging the Reactor Protection System. This Completion Time also allows for an exception to the normal "time zero" for beginning the allowed outage time "clock." In this Required Action, the Completion Time only begins on discovery that both:

a. One rod is not within alignment limit; and

b. PDMS is inoperable.

BASES

ACTIONS (continued)

Discovering one rod not within alignment limit coincident with PDMS inoperable results in starting the Completion Time for the Required Action. During power operation when PDMS is OPERABLE, LHR is measured continuously. Therefore, a reduction of power to 75% RTP is not necessary to ensure that local LHR increases due to a misaligned RCCA will not cause the core design criteria to be exceeded.

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 $F_Q(Z)$ and $F^N_{\Delta H}$ are within the required limits ensures that current operation, at ≤ 75% RTP with PDMS inoperable and > 75% RTP with PDMS OPERABLE, 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 the core power distribution using the incore flux mapping system or PDMS 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 Accident for the duration of operation under these conditions. A Completion Time of 5 days is sufficient time to obtain the required input data and to perform the analysis.

Accident analyses (Ref. 3) requiring re-evaluation for continued operation with a misaligned rod include:

1. Increase in heat removal by the secondary system:

    a. Excessive increase in secondary steam flow,

    b. Inadvertent opening of a steam generator power operated relief or safety valve, and

    c. Steam system piping failure;

ACTIONS (continued)

2. Uncontrolled RCCA bank withdrawal at power;

3. RCCA misoperation:

    a. One or more dropped RCCAs within the same group,

    b. A dropped RCCA bank,

    c. Statically misaligned RCCA, and

    d. Withdrawal of a single RCCA;

4. RCCA ejection accidents; and

5. Loss of coolant accidents resulting from postulated piping breaks within the reactor coolant pressure boundary.

C.1.1 and C.1.2

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

BASES

ACTIONS (continued)

C.2

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

The allowed Completion Time is reasonable, based on operating experience, for reaching MODE 3 from full power conditions in an orderly manner and without challenging plant systems. This Completion Time also allows for an exception to the normal "time zero" for beginning the allowed outage time "clock." In this Required Action, the Completion Time only begins on discovery that both:

a. More than one rod is not within alignment limit; and

b. PDMS is inoperable.

Discovering more than one rod not within alignment limit coincident with PDMS inoperable results in starting the Completion Time for the Required Action.

C.3

If more than one rod is found to be misaligned or becomes misaligned because of bank movement when PDMS is OPERABLE, operation may continue in Condition C for a period that should not exceed 72 hours. The allowed Completion Time is reasonable, based on the available information on power distributions (Ref. 6). This Required Action is modified by a Note that requires the performance of Required Action C.3 only when PDMS is OPERABLE.

BASES

ACTIONS (continued)

D.1

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

SURVEILLANCE REQUIREMENTS

SR 3.1.4.1

Verification that the position of individual rods ~~positions~~ ~~are~~is within alignment limits provides a history that allows the operator to detect a rod that is beginning to deviate from its expected position. When a rod's alignment cannot be verified due to a DRPI failure, the position of the rod can be determined by use of the movable incore detectors and/or PDMS. The position of the rod may be determined from the difference between the measured core power distribution and the core power distribution expected to exist based on the position of the rod indicated by the group step counter demand position.

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

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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.1.4.2

Verifying each control rod is OPERABLE would require that each rod be tripped. However, in MODES 1 and 2, tripping each control rod would result in radial or axial power tilts, or oscillations. Exercising each individual control rod 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 Surveillance Frequency is controlled under the Surveillance Frequency Control Program. 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 (e.g., as a result of excessive friction, mechanical interference, or rod control system failure), a determination of the trippability (OPERABILITY) of the control rod(s) must be made, and appropriate action taken.

SR 3.1.4.3

Verification of rod drop times allows the operator to determine that the maximum rod drop time permitted is consistent with the assumed rod drop time used in the safety analysis. Measuring rod drop times once 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 Reactor Coolant Pumps (RCPs) operating and the average moderator temperature ≥ 550°F to ensure that the measured drop times will be representative of insertion times experienced during a reactor trip at operating conditions.

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

BASES

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10 and GDC 26.
2. 10 CFR 50.46.
3. UFSAR, Chapter 15.
4. UFSAR, Section 15.4.3.
5. UFSAR, Section 15.1.5.
6. WCAP-12472-P-A, "BEACON Core Monitoring and Operations Support System," August 1994.

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 53 Rod Cluster Control Assemblies (RCCAs) are divided among 4 control banks and 5 shutdown banks. A bank of RCCAs consists of either one group, or, two groups that are moved in a staggered fashion to provide for precise reactivity control but which are always within one step of each other. Each of the control banks are divided into two groups, for a total of 25 control bank rods. Shutdown banks A and B are also divided into two groups, however, shutdown banks C, D, and E have only one group each, for a total of 28 shutdown bank rods. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously (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).

BASES

BACKGROUND (continued)

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 shutdown banks are controlled manually by the control room operator. During normal unit operation, the shutdown banks are either above the insertion limits specified in the COLR or fully inserted. The shutdown banks must be above the insertion limits specified in the COLR prior to withdrawing any control banks during an approach to criticality, and 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.

BASES

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 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 has been modified by a Note indicating that the LCO requirement is not applicable to shutdown banks being inserted while performing ~~suspended during the performance of~~ SR 3.1.4.2. This SR verifies the freedom of the rods to move, and may require~~s~~ 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. In MODE 3, 4, 5, or 6, the shutdown banks may be fully inserted in the core. 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.

ACTIONS

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

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

BASES

ACTIONS (continued)

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 the insertion limits for reasons other than Condition A, 2 hours is allowed to restore the shutdown banks to within the 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 unit to remain in an unacceptable condition for an extended period of time.

C~~B~~.1

If the Required Actions ~~A.1 and A.2~~ and ~~their~~ associated Completion Times are not met, 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.

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 above the insertion limits specified in the COLR before the control banks are withdrawn during a unit startup.

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

BASES

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10, GDC 26, and GDC 28.
2. 10 CFR 50.46.
3. UFSAR, 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 53 Rod Cluster Control Assemblies (RCCAs) are divided among 4 control banks and 5 shutdown banks. A bank of RCCAs consists of either one group, or, two groups that are moved in a staggered fashion to provide for precise reactivity control but which are always within one step of each other. Each of the control banks are divided into two groups, for a total of 25 control bank rods. Shutdown banks A and B are also divided into two groups, however, shutdown banks C, D, and E have only one group each, for a total of 28 shutdown bank rods. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously (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 a figure in the COLR. The control banks are required to be at or above the insertion limit lines.

BACKGROUND (continued)

The insertion limits figure also indicates how the control banks are moved in an overlap pattern. Overlap is the distance travelled together by two control banks. This predetermined distance is defined in the COLR.

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, "Rod Group Alignment Limits," LCO 3.1.5, "Shutdown Bank Insertion Limits," LCO 3.1.6, "Control Bank Insertion Limits," 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 shutdown and control bank insertion and alignment, AFD, and QPTR 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.

BASES

APPLICABLE SAFETY ANALYSIS

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.

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. 3).

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 and alignment, AFD, and QPTR limits ensure that safety analyses assumptions for SDM, ejected rod worth, and power distribution peaking factors are preserved (Ref. 3).

BASES

APPLICABLE SAFETY ANALYSES (continued)

The control bank insertion, sequence, and overlap 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 bank insertion, sequence, and overlap, 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 has been modified by a Note indicating that the LCO requirement is not applicable to control banks being inserted while performing ~~suspended during the performance of~~ SR 3.1.4.2. This SR verifies the freedom of the rods to move, and may require~~s~~ 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 insertion, sequence, and overlap 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 MODE 2 with $k_{eff} < 1.0$ or MODES 3, 4, and 5 is not required, since neither the power distribution nor ejected rod worth assumptions would be exceeded in these MODES.

BASES

ACTIONS

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

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 control 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 MODE 1 and MODE 2 with $k_{eff} \geq 1.0$ 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.

BASES

ACTIONS (continued)

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 overlap limits provides an acceptable time for evaluating and repairing minor problems without allowing the unit to remain in an unacceptable condition for an extended period of time.

D~~C~~.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 unit 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

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

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

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10, GDC 26, GDC 28.
2. 10 CFR 50.46.
3. UFSAR, Chapter 15.

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B 3.1 REACTIVITY CONTROL SYSTEM

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 and shutdown rod position indicators to determine rod positions and thereby ensure compliance with the 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 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 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.

BASES

BACKGROUND (continued)

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 53 RCCAs are divided among 4 control banks and 5 shutdown banks. A bank of RCCAs consists of either one group, or, two groups that are moved in a staggered fashion to provide for precise reactivity control but which are always within one step of each other. Each of the control banks are divided into two groups, for a total of 25 control bank rods. Shutdown banks A and B are also divided into two groups, however, shutdown banks C, D, and E have only one group each, for a total of 28 shutdown bank rods. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously.

The axial position of shutdown rods and control rods is indicated by two separate and independent systems, 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 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 ± 5/8 inch) but not very reliable because it is a demanded position indication, not an actual position indication. For example, 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.

BASES

BACKGROUND (continued)

The DRPI System provides a highly accurate indication of actual rod position, but at a lower precision than the step counters. The DRPI System determines the actual position of each control bank and shutdown bank rod by using individual coils that are mounted concentrically along the outside boundaries of the rod drive pressure housings. Each control bank rod has 42 coil assemblies evenly spaced along its length at 3.75 inch (6 step) intervals from rod bottom to the fully withdrawn position. Each shutdown bank rod has 20 coil assemblies evenly spaced along its length at 3.75 inch intervals from rod bottom to 18 steps and from 210 steps to the fully withdrawn position, with a transition LED representing shutdown bank rod position between 18 steps and the fully withdrawn position. The coils magnetically sense the presence or absence of a rod drive shaft and send this information to two Data Cabinets located in the containment building. To prevent total loss of position indication due to a single failure, the outputs of the coils are connected alternately to Data Channel A or Data Channel B. Thus, if one data channel fails, the DRPI System can be placed in "half accuracy" mode. The DRPI System is capable of monitoring rod position within the required band of ± 12 steps in either full accuracy mode or "half accuracy" mode.

Normal system accuracy is ± 4 steps (± 3 steps with an additional step added for coil placement and thermal expansion). If a data error occurs, the system is shifted to the "half accuracy" mode. As a rod is moved under "half accuracy" conditions, only every other LED will light (i.e., the LEDs associated with the operable data system) since the effective coil spacing is 7.5 inches (12 steps). Under "half accuracy" conditions with data A bad, the system accuracy is + 10 steps, - 4 steps. Under "half accuracy" conditions with data B bad, the system accuracy is + 4 steps, - 10 steps. Therefore, the normal indication accuracy of the DRPI System is ± 4 steps, and the maximum uncertainty is 10 steps. With an indicated deviation of 12 steps between the group step counter and DRPI, the maximum deviation between actual rod position and the demand position could be 22 steps.

BASES

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, ejected rod worth, and with minimum SDM limits (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"). 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 rod position indicator channels satisfy Criterion 2 of 10 CFR 50.36(c)(2)(ii). The rod position indicators monitor rod position, which is an initial condition of the accident.

LCO

LCO 3.1.7 specifies that the DRPI System for each rod and the Bank Demand Position Indication System for each group be OPERABLE. For the rod position indicators to be OPERABLE the following requirements must be met:

a. The DRPI System consisting of either Data Channel A, Data Channel B, or both data channels indicates within 12 steps of the group step counter demand position as required by LCO 3.1.4, "Rod Group Alignment Limits;" and

b. The Bank Demand Indication System has been calibrated either in the fully inserted position or to the DRPI System.

BASES

LCO (continued)

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

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

These requirements ensure that 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 rods can be detected. Therefore, power peaking, ejected rod worth, and SDM can be controlled within acceptable limits.

APPLICABILITY

The requirements on the DRPI 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.

ACTIONS

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

BASES

ACTIONS (continued)

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

When one DRPI per group in one or more groups fails, (i.e., one rod position per group can not be determined by the DRPI System) the position of the rod can still be determined by use of the movable incore detectors or Power Distribution Monitoring System (PDMS). When PDMS is OPERABLE, the position of the rod may be determined from the difference between the measured core power distribution and the core power distribution expected to exist based on the position of the rod indicated by the group step counter demand position. 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~~B~~.1 or C~~B~~.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 DRPI once per 8 hours which may put excessive wear and tear on the moveable incore detector system when PDMS is inoperable; Required Action A.2.1 provides an alternative. Required Action A.2.1 requires verification of rod position every 31 EFPD, which coincides with the normal surveillance frequency for verification of core power distribution.

Required Action A.2.1 includes six distinct requirements for verification of the position of rods associated with an inoperable DRPI:

a. Initial verification within 8 hours of the inoperability of the DRPI;

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

BASES

ACTIONS (continued)

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 DRPI 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 DRPI be moved more than 12 steps, or if reactor power is changed, the position of the rod with the inoperable DRPI must be verified.

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

A.3~~2~~

Reduction of THERMAL POWER to ≤ 50% RTP puts the core into a condition where rod position will not cause core peaking factors to approach the core peaking factor limits.

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.

BASES

ACTIONS (continued)

B.1 and B.2

When more than one DRPI per group in one or more groups fail, additional actions are necessary. Placing the Rod Control System in manual assures unplanned rod motion will not occur. 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.

The inoperable DRPIs must be restored, such that a maximum of one DRPI per group is inoperable, within 24 hours. The 24 hour Completion Time provides sufficient time to troubleshoot and restore the DRPI 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~~B~~.1 and C~~B~~.2

~~These Required Actions clarify that when one or more rods with inoperable DRPIs 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 are still appropriate but must be initiated promptly under Required Action B.1 to begin verifying that~~ With one DRPI 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 with an inoperable DRPI. Action must be initiated immediately to verify these rods are still properly positioned, relative to their group positions.

If immediate actions have not been initiated to verify the rod's position, 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.

BASES

ACTIONS (continued)

D~~C~~.1.1 and D~~C~~.1.2

With one or more demand position indicators per bank inoperable in one or more banks, the rod positions can be determined by the DRPI System. Since normal power operation does not require excessive movement of rods, verification by administrative means that the DRPIs for the affected banks are OPERABLE and the most withdrawn rod and the least withdrawn rod of the affected banks are ≤ 12 steps apart within the allowed Completion Time of once every 8 hours is adequate. This verification can be an examination of logs, administrative controls, or other information that shows that all DRPIs in the affected bank are OPERABLE.

D~~C~~.2

Reduction of THERMAL POWER to ≤ 50% RTP puts the core into a condition where rod position will not cause core peaking to approach the core peaking factor limits. The allowed Completion Time of 8 hours provides an acceptable period of time to verify the rod positions per Required Actions D~~C~~.1.1 and D~~C~~.1.2 or reduce power to ≤ 50% RTP.

E~~D~~.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.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.7.1

Verification that the DRPI agrees with the demand position within 12 steps ensures that the DRPI is operating correctly. Since the DRPI 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, since there is 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 DRPIs 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.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 13.
2. UFSAR, Chapter 15.

ATTACHMENT 3B

Markup of Bases Pages

BYRON STATION
UNITS 1 AND 2

Docket Nos. 50-454 and 50-455

Facility Operating License Nos. NPF-37 and NPF-66

<u>REVISED BASES PAGES</u>

B3.1.4 (all); changes on pages 7 and 12 only
B3.1.5 (all); changes on pages 4, 5 and 6 only
B3.1.6 (all); changes on pages 4, 5, 6 and 7 only
B3.1.7 (all); changes on pages 6, 7, 8, 9, and 10 only

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.4 Rod Group Alignment Limits

BASES

BACKGROUND

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

The applicable criteria for these reactivity and power distribution design requirements are 10 CFR 50, Appendix A, GDC 10, "Reactor Design," GDC 26, "Reactivity Control System Redundancy and Protection" (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 5/8 inch) at a time, but at varying rates (steps per minute) depending on the signal output from the Rod Control System.

BASES

BACKGROUND (continued)

The 53 RCCAs are divided among four control banks and five shutdown banks. A bank of RCCAs consists of either one group, or, two groups that are moved in a staggered fashion to provide for precise reactivity control but which are always within one step of each other. Each of the control banks are divided into two groups, for a total of 25 control bank rods. Shutdown banks A and B are also divided into two groups, however, shutdown banks C, D and E have only one group each, for a total of 28 shutdown bank rods. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously.

The shutdown banks are maintained either in the fully inserted or fully withdrawn position. The control banks are moved in an overlap pattern, using the following withdrawal sequence: When control bank A reaches a predetermined height in the core, control bank B begins to move out with control bank A. Control bank A stops at the fully withdrawn position, 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, the Bank Demand Position Indication System (commonly called group step counters) and the Digital Rod Position Indication (DRPI) System.

BASES

BACKGROUND (continued)

The Bank Demand Position Indication System counts the pulses from the rod control system that moves the rods. There is one step counter for each group of rods. Individual rods in a group all receive the same signal to move and should, therefore, all be at the same position indicated by the group step counter for that group. The Bank Demand Position Indication System is considered highly precise (± 1 step or ± 5/8 inch) but not very reliable because it is a demanded position indication, not an actual position indication. For example, 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 with a center to center distance of 3.75 inches, which is six steps. To increase the reliability of the system, the inductive coils are connected alternately to Data Channel A or Data Channel B. Thus, if one data channel fails, the DRPI system can be placed in "half accuracy" mode with an effective coil spacing of 7.5 inches, which is 12 steps. Therefore, the design indication accuracy of the DRPI 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 DRPI, the maximum deviation between actual rod position and the demand position could be 24 steps, or 15 inches.

BASES

APPLICABLE SAFETY ANALYSES

Rod misalignment accidents are analyzed in the safety analysis (Ref. 3). The acceptance criteria for addressing rod inoperability or misalignment are that:

a. There be no violations of:

   1. specified acceptable fuel design limits, or

   2. Reactor Coolant System (RCS) pressure boundary integrity; and

b. The core remains subcritical after accident transients.

Two types of misalignment are distinguished. During movement of a control rod group, one rod may stop moving, while the other rods in the group continue (i.e., statically misaligned RCCA). 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 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 with control bank D inserted to its full power insertion limit and one RCCA fully withdrawn. 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 fully withdrawn (Ref. 5).

BASES

APPLICABLE SAFETY ANALYSES (continued)

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 rod is allowed if the heat flux hot channel factor ($F_Q(Z)$) and the nuclear enthalpy rise 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 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).

LCO

The limits on shutdown or control rod alignments ensure that the assumptions in the safety analysis will remain valid. The requirements on OPERABILITY ensure that upon reactor trip, the assumed reactivity will be available and will be inserted. The OPERABILITY requirements (i.e. trippability to meet SDM) 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 rods (e.g. rod urgent failures), but do not impact trippability, do not result in rod inoperability provided proper alignment.

BASES

LCO (continued)

The requirement to maintain individual indicated rod positions within 12 steps of their group step counter demand position 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 fully inserted 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 for MODE 6.

BASES

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 specified in the COLR, initiate boration until the required SDM is recovered. The Completion Time of 1 hour is adequate for determining SDM and, if necessary, for initiating boration to restore SDM to within limit.

In this situation, SDM verification must account for the worth of the untrippable rod(s), as well as the rod of maximum worth.

A.2

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

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

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 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." ~~One hour gives the operator sufficient time to adjust the rod positions in an orderly manner.~~

BASES

ACTIONS (continued)

However, 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 fully inserted and control bank C must be partially inserted.

With a misaligned rod, SDM must be verified to be within limit (specified in the COLR) or boration must be initiated to restore SDM to within limit.

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 to restore SDM to within limit.

B.2, B.3, B.4, and B.5

For continued operation with a misaligned rod, THERMAL POWER must be reduced when Power Distribution Monitoring System (PDMS) is inoperable, SDM must periodically be verified within limits (specified in the COLR), 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 when PDMS is inoperable, ensures that local LHR increases due to a misaligned RCCA will not cause the core design criteria to be exceeded (Ref. 4). The Completion Time of 2 hours gives the operator sufficient time to accomplish an orderly power reduction without challenging the Reactor Protection System. This Completion Time also allows for an exception to the normal "time zero" for beginning the allowed outage time "clock." In this Required Action, the Completion Time only begins on discovery that both:

a. One rod is not within alignment limit; and

b. PDMS is inoperable.

BASES

ACTIONS (continued)

Discovering one rod not within alignment limit coincident with PDMS inoperable results in starting the Completion Time for the Required Action. During power operation when PDMS is OPERABLE, LHR is measured continuously. Therefore, a reduction of power to 75% RTP is not necessary to ensure that local LHR increases due to a misaligned RCCA will not cause the core design criteria to be exceeded.

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 $F_Q(Z)$ and $F^N_{\Delta H}$ are within the required limits ensures that current operation, at $\leq$ 75% RTP with PDMS inoperable and > 75% RTP with PDMS OPERABLE, 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 the core power distribution using the incore flux mapping system or PDMS 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 Accident for the duration of operation under these conditions. A Completion Time of 5 days is sufficient time to obtain the required input data and to perform the analysis.

Accident analyses (Ref. 3) requiring re-evaluation for continued operation with a misaligned rod include:

1. Increase in heat removal by the secondary system:

    a. Excessive increase in secondary steam flow,

    b. Inadvertent opening of a steam generator power operated relief or safety valve, and

    c. Steam system piping failure;

BASES

ACTIONS (continued)

2. Uncontrolled RCCA bank withdrawal at power;

3. RCCA misoperation:

   a. One or more dropped RCCAs within the same group,

   b. A dropped RCCA bank,

   c. Statically misaligned RCCA, and

   d. Withdrawal of a single RCCA;

4. RCCA ejection accidents; and

5. Loss of coolant accidents resulting from postulated piping breaks within the reactor coolant pressure boundary.

C.1.1 and C.1.2

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

BASES

ACTIONS (continued)

C.2

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

The allowed Completion Time is reasonable, based on operating experience, for reaching MODE 3 from full power conditions in an orderly manner and without challenging plant systems. This Completion Time also allows for an exception to the normal "time zero" for beginning the allowed outage time "clock." In this Required Action, the Completion Time only begins on discovery that both:

a. More than one rod is not within alignment limit; and

b. PDMS is inoperable.

Discovering more than one rod not within alignment limit coincident with PDMS inoperable results in starting the Completion Time for the Required Action.

C.3

If more than one rod is found to be misaligned or becomes misaligned because of bank movement when PDMS is OPERABLE, operation may continue in Condition C for a period that should not exceed 72 hours. The allowed Completion Time is reasonable, based on the available information on power distributions (Ref. 6). This Required Action is modified by a Note that requires the performance of Required Action C.3 only when PDMS is OPERABLE.

BASES

ACTIONS (continued)

D.1

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

SURVEILLANCE REQUIREMENTS

SR 3.1.4.1

Verification that the position of individual rods ~~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. When a rod's alignment cannot be verified due to a DRPI failure, the position of the rod can be determined by use of the movable incore detectors and/or PDMS. The position of the rod may be determined from the difference between the measured core power distribution and the core power distribution expected to exist based on the position of the rod indicated by the group step counter demand position.

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

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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.1.4.2

Verifying each control rod is OPERABLE would require that each rod be tripped. However, in MODES 1 and 2, tripping each control rod would result in radial or axial power tilts, or oscillations. Exercising each individual control rod 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 Surveillance Frequency is controlled under the Surveillance Frequency Control Program. 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 (e.g., as a result of excessive friction, mechanical interference, or rod control system failure), a determination of the trippability (OPERABILITY) of the control rod(s) must be made, and appropriate action taken.

SR 3.1.4.3

Verification of rod drop times allows the operator to determine that the maximum rod drop time permitted is consistent with the assumed rod drop time used in the safety analysis. Measuring rod drop times once 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 Reactor Coolant Pumps (RCPs) operating and the average moderator temperature ≥ 550°F to ensure that the measured drop times will be representative of insertion times experienced during a reactor trip at operating conditions.

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

BASES

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10 and GDC 26.
2. 10 CFR 50.46.
3. UFSAR, Chapter 15.
4. UFSAR, Section 15.4.3.
5. UFSAR, Section 15.1.5.
6. WCAP-12472-P-A, "BEACON Core Monitoring and Operations Support System," August 1994.

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 53 Rod Cluster Control Assemblies (RCCAs) are divided among 4 control banks and 5 shutdown banks. A bank of RCCAs consists of either one group, or, two groups that are moved in a staggered fashion to provide for precise reactivity control but which are always within one step of each other. Each of the control banks are divided into two groups, for a total of 25 control bank rods. Shutdown banks A and B are also divided into two groups, however, shutdown banks C, D, and E have only one group each, for a total of 28 shutdown bank rods. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously (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).

BASES

BACKGROUND (continued)

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 shutdown banks are controlled manually by the control room operator. During normal unit operation, the shutdown banks are either above the insertion limits specified in the COLR or fully inserted. The shutdown banks must be above the insertion limits specified in the COLR prior to withdrawing any control banks during an approach to criticality, and 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.

BASES

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 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 has been modified by a Note indicating that the LCO requirement is not applicable to shutdown banks being inserted while performing ~~suspended during the performance of~~ SR 3.1.4.2. This SR verifies the freedom of the rods to move, and may require~~s~~ 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. In MODE 3, 4, 5, or 6, the shutdown banks may be fully inserted in the core. 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.

ACTIONS

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

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

BASES

ACTIONS (continued)

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 the insertion limits for reasons other than Condition A, 2 hours is allowed to restore the shutdown banks to within the 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 unit to remain in an unacceptable condition for an extended period of time.

C~~B~~.1

If the Required Actions ~~A.1 and A.2~~ and ~~their~~ associated Completion Times are not met, 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.

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 above the insertion limits specified in the COLR before the control banks are withdrawn during a unit startup.

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

BASES

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10, GDC 26, and GDC 28.
2. 10 CFR 50.46.
3. UFSAR, 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 53 Rod Cluster Control Assemblies (RCCAs) are divided among 4 control banks and 5 shutdown banks. A bank of RCCAs consists of either one group, or, two groups that are moved in a staggered fashion to provide for precise reactivity control but which are always within one step of each other. Each of the control banks are divided into two groups, for a total of 25 control bank rods. Shutdown banks A and B are also divided into two groups, however, shutdown banks C, D, and E have only one group each, for a total of 28 shutdown bank rods. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously (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 a figure in the COLR. The control banks are required to be at or above the insertion limit lines.

BASES

BACKGROUND (continued)

The insertion limits figure also indicates how the control banks are moved in an overlap pattern. Overlap is the distance travelled together by two control banks. This predetermined distance is defined in the COLR.

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, "Rod Group Alignment Limits," LCO 3.1.5, "Shutdown Bank Insertion Limits," LCO 3.1.6, "Control Bank Insertion Limits," 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 shutdown and control bank insertion and alignment, AFD, and QPTR 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.

BASES

APPLICABLE SAFETY ANALYSIS

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.

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. 3).

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 and alignment, AFD, and QPTR limits ensure that safety analyses assumptions for SDM, ejected rod worth, and power distribution peaking factors are preserved (Ref. 3).

BASES

APPLICABLE SAFETY ANALYSES (continued)

The control bank insertion, sequence, and overlap 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 bank insertion, sequence, and overlap, 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 has been modified by a Note indicating that the LCO requirement is not applicable to control banks being inserted while performing ~~suspended during the performance of~~ SR 3.1.4.2. This SR verifies the freedom of the rods to move, and may require~~s~~ 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 insertion, sequence, and overlap 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 MODE 2 with $k_{eff} < 1.0$ or MODES 3, 4, and 5 is not required, since neither the power distribution nor ejected rod worth assumptions would be exceeded in these MODES.

BASES

ACTIONS

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

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 control 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.

ACTIONS

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 MODE 1 and MODE 2 with $k_{eff} \geq 1.0$ 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.

BASES

ACTIONS (continued)

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 overlap limits provides an acceptable time for evaluating and repairing minor problems without allowing the unit to remain in an unacceptable condition for an extended period of time.

D~~C~~.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 unit 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

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

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

REFERENCES

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

2. 10 CFR 50.46.

3. UFSAR, Chapter 15.

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B 3.1 REACTIVITY CONTROL SYSTEM

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 and shutdown rod position indicators to determine rod positions and thereby ensure compliance with the 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 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 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.

BASES

BACKGROUND (continued)

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 53 RCCAs are divided among 4 control banks and 5 shutdown banks. A bank of RCCAs consists of either one group, or, two groups that are moved in a staggered fashion to provide for precise reactivity control but which are always within one step of each other. Each of the control banks are divided into two groups, for a total of 25 control bank rods. Shutdown banks A and B are also divided into two groups, however, shutdown banks C, D, and E have only one group each, for a total of 28 shutdown bank rods. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously.

The axial position of shutdown rods and control rods is indicated by two separate and independent systems, 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 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 ± 5/8 inch) but not very reliable because it is a demanded position indication, not an actual position indication. For example, 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.

BACKGROUND (continued)

The DRPI System provides a highly accurate indication of actual rod position, but at a lower precision than the step counters. The DRPI System determines the actual position of each control bank and shutdown bank rod by using individual coils that are mounted concentrically along the outside boundaries of the rod drive pressure housings. Each control bank rod has 42 coil assemblies evenly spaced along its length at 3.75 inch (6 step) intervals from rod bottom to the fully withdrawn position. Each shutdown bank rod has 20 coil assemblies evenly spaced along its length at 3.75 inch intervals from rod bottom to 18 steps and from 210 steps to the fully withdrawn position, with a transition LED representing shutdown bank rod position between 18 steps and the fully withdrawn position. The coils magnetically sense the presence or absence of a rod drive shaft and send this information to two Data Cabinets located in the containment building. To prevent total loss of position indication due to a single failure, the outputs of the coils are connected alternately to Data Channel A or Data Channel B. Thus, if one data channel fails, the DRPI System can be placed in "half accuracy" mode. The DRPI System is capable of monitoring rod position within the required band of ± 12 steps in either full accuracy mode or "half accuracy mode.

Normal system accuracy is ± 4 steps (± 3 steps with an additional step added for coil placement and thermal expansion). If a data error occurs, the system is shifted to the "half accuracy" mode. As a rod is moved under "half accuracy" conditions, only every other LED will light (i.e., the LEDs associated with the operable data system) since the effective coil spacing is 7.5 inches (12 steps). Under "half accuracy" conditions with data A bad, the system accuracy is + 10 steps, - 4 steps. Under "half accuracy" conditions with data B bad, the system accuracy is + 4 steps, - 10 steps. Therefore, the normal indication accuracy of the DRPI System is ± 4 steps, and the maximum uncertainty is 10 steps. With an indicated deviation of 12 steps between the group step counter and DRPI, the maximum deviation between actual rod position and the demand position could be 22 steps.

BASES

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, ejected rod worth, and with minimum SDM limits (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"). 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 rod position indicator channels satisfy Criterion 2 of 10 CFR 50.36(c)(2)(ii). The rod position indicators monitor rod position, which is an initial condition of the accident.

LCO

LCO 3.1.7 specifies that the DRPI System for each rod and the Bank Demand Position Indication System for each group be OPERABLE. For the rod position indicators to be OPERABLE the following requirements must be met:

a. The DRPI System consisting of either Data Channel A, Data Channel B, or both data channels indicates within 12 steps of the group step counter demand position as required by LCO 3.1.4, "Rod Group Alignment Limits;" and

b. The Bank Demand Indication System has been calibrated either in the fully inserted position or to the DRPI System.

BASES

LCO (continued)

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

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

These requirements ensure that 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 rods can be detected. Therefore, power peaking, ejected rod worth, and SDM can be controlled within acceptable limits.

APPLICABILITY

The requirements on the DRPI 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.

ACTIONS

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

BASES

ACTIONS (continued)

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

When one DRPI per group in one or more groups fails, (i.e., one rod position per group can not be determined by the DRPI System) the position of the rod can still be determined by use of the movable incore detectors or Power Distribution Monitoring System (PDMS). When PDMS is OPERABLE, the position of the rod may be determined from the difference between the measured core power distribution and the core power distribution expected to exist based on the position of the rod indicated by the group step counter demand position. Based on experience, normal power operation does not require excessive movement of banks. If a bank has been significantly moved, the Required Action of B.1 or B.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 DRPI once per 8 hours which may put excessive wear and tear on the moveable incore detector system when PDMS is inoperable; Required Action A.2.1 provides an alternative. Required Action A.2.1 requires verification of rod position every 31 EFPD, which coincides with the normal surveillance frequency for verification of core power distribution.

Required Action A.2.1 includes six distinct requirements for verification of the position of rods associated with an inoperable DRPI:

a. Initial verification within 8 hours of the inoperability of the DRPI;

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

BASES

ACTIONS (continued)

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 DRPI 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 DRPI be moved more than 12 steps, or if reactor power is changed, the position of the rod with the inoperable DRPI must be verified.

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

A.3~~2~~

Reduction of THERMAL POWER to ≤ 50% RTP puts the core into a condition where rod position will not cause core peaking factors to approach the core peaking factor limits.

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.

BASES

ACTIONS (continued)

B.1 and B.2

When more than one DRPI per group in one or more groups fail, additional actions are necessary. Placing the Rod Control System in manual assures unplanned rod motion will not occur. 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.

The inoperable DRPIs must be restored, such that a maximum of one DRPI per group is inoperable, within 24 hours. The 24 hour Completion Time provides sufficient time to troubleshoot and restore the DRPI 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~~B~~.1 and C~~B~~.2

~~These Required Actions clarify that when one or more rods with inoperable DRPIs 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 are still appropriate but must be initiated promptly under Required Action B.1 to begin verifying that~~ With one DRPI 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 with an inoperable DRPI. Action must be initiated immediately to verify these rods are still properly positioned, relative to their group positions.

If immediate actions have not been initiated to verify the rod's position, 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.

BASES

ACTIONS (continued)

D~~C~~.1.1 and D~~C~~.1.2

With one or more demand position indicator per bank inoperable in one or more banks, the rod positions can be determined by the DRPI System. Since normal power operation does not require excessive movement of rods, verification by administrative means that the DRPIs for the affected banks are OPERABLE and the most withdrawn rod and the least withdrawn rod of the affected banks are ≤ 12 steps apart within the allowed Completion Time of once every 8 hours is adequate. This verification can be an examination of logs, administrative controls, or other information that shows that all DRPIs in the affected bank are OPERABLE.

D~~C~~.2

Reduction of THERMAL POWER to ≤ 50% RTP puts the core into a condition where rod position will not cause core peaking to approach the core peaking factor limits. The allowed Completion Time of 8 hours provides an acceptable period of time to verify the rod positions per Required Actions D~~C~~.1.1 and D~~C~~.1.2 or reduce power to ≤ 50% RTP.

E~~D~~.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.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.7.1

Verification that the DRPI agrees with the demand position within 12 steps ensures that the DRPI is operating correctly. Since the DRPI 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, since there is 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 DRPIs 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.

REFERENCES

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

2. UFSAR, Chapter 15.