TSTF
TECHNICAL SPECIFICATIONS TASK FORCE
A JOINT OWNERS GROUP ACTIVITY

January 9, 2007

TSTF-07-01
PROJ0753

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

SUBJECT: TSTF-476, Revision 1, "Improved BPWS Control Rod Insertion Process (NEDO-33091)"

REFERENCE: Letter from T. J. Kobetz (NRC) to Technical Specification Task Force regarding TSTF-476, dated October 27, 2006.

Dear Sir or Madam:

Enclosed for NRC review is Revision 1 of TSTF-476, "Improved BPWS Control Rod Insertion Process (NEDO-33091)." TSTF-476 is revised to reflect changes requested by the NRC in the referenced letter.

Any NRC review fees associated with the review of TSTF-476 should be billed to the Boiling Water Reactor Owners' Group.

The TSTF requests that the Traveler be made available under the Consolidated Line Item Improvement Process.

Should you have any questions, please do not hesitate to contact us.

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Enclosure

cc: Tim Kobetz, Technical Specifications Branch, NRC
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PWROG
PWR Owners Group
BWR OWNERS' GROUP

Technical Specification Task Force
Improved Standard Technical Specifications Change Traveler

Improved BPWS Control Rod Insertion Process (NEDO-33091)

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

Classification: 1) Technical Change | Recommended for CLIIP?: Yes

Correction or Improvement: Improvement | NRC Fee Status: Not Exempt

Benefit: Shortens Outages

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1.0 Description

The provisions described in Topical Report NEDO-33091, Revision 2, "Improved BPWS Control Rod Insertion Process," are incorporated into the ISTS BWR/4 and BWR/6 (NUREG-1433 and 1434) Specifications 3.1.6, Rod Pattern Control, and 3.3.2.1, Control Rod Block Instrumentation, and bracketed changes are provided for Technical Specification Table 3.3.2.1-1, Control Rod Block Instrumentation. Topical Report NEDO-33091, Revision 2, was approved by the NRC on June 16, 2004.

The changes to the Bases to reference this new Banked Position Withdrawal Sequence (BPWS) shutdown sequence will be necessary for all plants whose Bases currently reference only the standard BPWS analyses, and who desire to utilize the improved BPWS shutdown sequence.

Inclusion of the bracketed change to the Applicability Note in Table 3.3.2.1-1 (and the bracketed information in the Bases) would only be necessary for those plants that cannot reprogram the Rod Worth Minimizer (BWR/4 plants) or Rod Pattern Controller (BWR/6 plants).

2.0 Proposed Changes

The Bases of NUREG-1433 and 1434 Specifications 3.1.6, Rod Pattern Control, and 3.3.2.1, Control Rod Block Instrumentation, are revised to reference the improved BPWS shutdown sequence. The Bases changes also include a brief description of the most important aspects of the approved Topical. In addition to the Bases changes, bracketed Specification changes are provided in Table 3.3.2.1-1, Control Rod Block Instrumentation, for the Applicability of the Rod Worth Minimizer (BWR/4 plants) and Rod Pattern Controller (BWR/6 plants), which can be incorporated if needed on a plant-specific basis. The Applicability for this system is listed in a footnote to Table 3.3.2.1-1. The wording of this footnote in the NUREG is revised from “with Thermal Power $\leq$ [10]% RTP” to "with Thermal Power $\leq$ [10]% RTP [, except during the reactor shutdown process if the coupling of each withdrawn control rod has been confirmed]." Bracketed Bases changes are also included for plants which incorporate the bracketed change to Table 3.3.2.1-1.

3.0 Background

The BPWS, as currently implemented, limits the potential reactivity increase from a postulated Control Rod Drop Accident (CRDA) during reactor startups and shutdowns below the Low Power Setpoint (LPSP) (generically based on 10% of original licensed thermal power). The BPWS is required by the ISTS to be applied to both reactor startup and shutdown processes. Because of the delay caused by the use of the standard BPWS in achieving shutdown, some plants perform manual scrams instead of going through the multiple-step BPWS shutdown process (approximately 400 steps for a medium sized reactor).

An improved BPWS process which can be used for performing reactor shutdowns is described in Topical Report NEDO-33091. During the reactor shutdown process, confirming that control rods are coupled prior to decreasing power below the LPSP eliminates the postulated scenario for a CRDA, and thus, the CRDA would no longer be a credible event. Modifying the Technical Specifications, Bases, and/or site procedures to reflect the use of the improved BPWS process would allow control rods to be fully inserted with continuous motion during the reactor shutdown process below the LPSP.

This provides the following benefits:

- Allows the plant to reach the all-rods-in condition prior to significant reactor cool down, which reduces the potential for a re-criticality as the reactor cools down;
- Reduces the potential for an operator reactivity control error by reducing the total number of control rod manipulations;
- Minimizes the need for manual scrams during plant shutdowns, resulting in less wear on Control Rod Drive (CRD) system components and CRD mechanisms; and
- Eliminates unnecessary control rod manipulations at low power, resulting in less wear on Reactor Manual Control and CRD system components.

4.0 Technical Analysis

The complete technical analysis of the improved BPWS process is described in NEDO-33091, "Improved BPWS Control Rod Insertion Process." The Topical Report was approved by the NRC on June 16, 2004 (Reference 2). The technical analysis is summarized below.

The BPWS was originally focused on application to reactor startups; however, it was also applied to reactor shutdowns, because of the potential for high worth rod patterns during the shutdown process. However, confirming that control rods are coupled prior to decreasing power below the LPSP eliminates the potential for a CRDA during the reactor shutdown process, and thus, the need for banking. The following discusses how control rod coupling is confirmed prior to reducing power to the STS BPWS Applicability limit during the reactor shutdown process, thereby eliminating the need for the control rod banking steps.

NUREG-1433 and NUREG-1434 require coupling checks be performed any time a control rod is fully withdrawn. Coupling is confirmed by a continuous indication of position "48" on the control rod position indication display while the operator attempts to withdraw the control rod past position 48. If the control rod is not coupled, the position 48 indication will extinguish, the over travel light will light, and an alarm sounds. Therefore, it can be deduced:

- If a rod has been fully withdrawn during the cycle and then determined to be coupled, and the rod has not been moved from position 48, then coupling integrity is assured, because of the improbability of a control rod becoming decoupled when it has not been moved.

- If after a coupling check is performed for a control rod, the rod is inserted and then withdrawn to the full out position, it again requires a coupling check. However, if the rod is withdrawn to an intermediate position, coupling integrity is not assured for this rod.

- If a rod has been checked for coupling at notch position 48 and the rod has since only been moved inward, no subsequent coupling check is required, because control rod insertion maintains contact between the control rod and the drive.

Therefore, to eliminate the possibility of a CRDA, the proposed controls require that any partially inserted control rods, which have not been confirmed to be coupled since their last withdrawal, be fully inserted prior to reducing power to the LPSP.

However, if a rod has been checked for coupling at notch position 48 and the rod has since only been moved inward, this rod is in contact with its drive and thus is not required to be fully inserted prior to reaching the LPSP. However, if only inward movement cannot be confirmed for a partially inserted control rod, the control rod shall be fully inserted prior to reducing power to the LPSP.

If a plant is shutting down and all rods not confirmed of coupling cannot be fully inserted prior to the power being reduced to the LPSP (e.g., shortly after a startup), then compliance with the improved BPWS shutdown process is not maintained and the process may not be implemented until all rods that are not confirmed of coupling have been fully inserted. Once all the "non-confirmed" rods are inserted, the improved BPWS shutdown process is allowed.

Additionally, if a plant is in the process of shutting down while using the improved BPWS control rod insertion process below the LPSP, no control rod shall be withdrawn unless the control rod pattern is in compliance with the standard BPWS requirements (e.g., at about 75% or higher control rod density). This assures that rod withdrawals comply with standard BPWS withdrawal requirements.

To be allowed to utilize this BPWS shutdown process with a stuck control rod which is not fully inserted, the CRD must have been inserted as much as possible and then disarmed, an evaluation of adequate (per TS requirements) cold shutdown margin (SDM) must have been completed, and an evaluation that justified (consistent with STS 3.1.3) operating with a stuck rod must have been approved.

Note that for use of this BPWS shutdown process, special requirements are imposed in order to consider a rod to be "confirmed" to be coupled. These requirements are implemented to ensure that no single operator error can result in an incorrect coupling check. Therefore, just for this BPWS shutdown process, the coupling of each withdrawn control rod is only "confirmed" if the guidance in Section 5.0 of NEDO-33091 is met. The guidance is summarized as follows:

The method for "confirming" that control rods are coupled varies depending on the control rod position:

1) No action is required to confirm coupling of fully inserted control rods.

2) For fully withdrawn control rods, control rod coupling must be "confirmed" before reducing power below the LPSP. If control rod coupling has been checked twice or if a single check has been verified, and the rod has not been subsequently inserted and withdrawn, the coupling check need not be repeated prior to reducing power below the LPSP. As noted above, this step ensures that no single operator error can result in an incorrect coupling check.

3) Control rods in intermediate positions that have not been "confirmed" coupled (at notch position 48 since they were last withdrawn) must be fully inserted prior to power reduction to the LPSP. However, if a rod has been "confirmed" to be coupled at position 48 and the rod has since only been moved inward, this rod does not need to be inserted prior to reaching the LPSP.

4) If there is one stuck control rod, its drive must be inserted as much as possible and disarmed, and continued operation must have been justified per STS 3.1.3, then the improved BPWS shutdown process is allowed. In all other cases with stuck control rods, the improved BPWS shutdown process may not be used.

After power is reduced to the LPSP and all rods that were not confirmed coupled have been fully inserted, the RWM/RPC may be bypassed if it is not programmed to the improved BPWS shutdown sequence. The new bracketed phrase in the Table 3.3.2.1-1 Applicability footnote is added to permit the bypassing of the RWM/RPC and use of the improved shutdown process.

If the plant is in the process of shutting down and fully inserting control rods in a continous motion with THERMAL POWER below the LPSP, no control rod shall be withdrawn unless the control rod pattern is in compliance with standard BPWS requirements.

Additional details are provided in NEDO-33091, which is added as a reference to the STS Bases, similar to how the original BPWS Topical Report is referenced in the ISTS.

5.0 Regulatory Analysis

5.1 No Significant Hazards Consideration

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

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

   Response: No.

   The proposed change revises the banked position withdrawal sequence (BPWS) for a plant shutdown. The BPWS is used to minimize the consequences of an accident previously evaluated, i.e., the control rod drop accident (CRDA). As described in Topical Report NEDO-33091, "Improved BPWS Control Rod Insertion Process," the revised BPWS process for reactor shutdown eliminates the possibility of a CRDA by confirming that all control rods are coupled or incapable of being dropped. As a result, the probability of any accident previously evaluated is not significantly increased. The consequences of any accident previously evaluated while using the improved BPWS process are not significantly increased because the revised BPWS process for plant shutdowns provides a level of protection equivalent to or better than the current BPWS process.

   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.

   No new or different accidents result from utilizing the proposed change. The changes do not involve a physical alteration of the plant (i.e., no new or different type of equipment will be installed) or a significant change in the methods governing normal plant operation. In addition, the changes do not significantly alter any existing requirements except to implement controls to ensure the CRDA cannot occur during a plant shutdown which do not introduce the possibility of a new or different kind of accident. The changes do not alter assumptions made in the safety analysis. The proposed changes are consistent with the safety analysis assumptions and current plant operating practice.

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

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

   Response: No.

   The existing BPWS process protects the plant from the consequences of a CRDA by minimizing the reactivity worth of control rods that could be potentially dropped. The improved BPWS process protects the plant from the consequences of a CRDA during shutdown by ensuring that all control rods are coupled or otherwise incapable of being dropped. This eliminates the probability of a CRDA

instead of minimizing the consequences of a CRDA. This increases the margin of safety.

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

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

5.2 Applicable Regulatory Requirements/Criteria

Prevention or mitigation of positive reactivity insertion events is necessary to limit the energy deposition in the fuel, thereby preventing significant fuel damage, which could result in undue release of radioactivity. Since the failure consequences for UO_2 have been shown to be insignificant below fuel energy depositions of 300 cal/gm, the fuel damage limit of 280 cal/gm provides a margin of safety from significant core damage, which would result in release of radioactivity. Generic evaluations of a design basis CRDA (i.e., a CRDA resulting in a peak fuel energy deposition of 280 cal/gm) using the existing or improved BPWS process have shown that the peak fuel enthalpy remains below 280 cal/gm and the maximum reactor pressure will be less than the required ASME Code limits and the calculated offsite doses will be well within the required limits of 10 CFR 100.

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 approval of the proposed change will not be inimical to the common defense and security or to the health and safety of the public.

6.0 Environmental Consideration

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

7.0 References

1. NEDO-33091, Revision 2, "Improved BPWS Control Rod Insertion Process," April 2003.

2. Letter from Herbert N. Berkow (NRC) to Kenneth Putnam (BWROG) dated June 16, 2004, "Safety Evaluation for Licensing Topical Report (LTR) NEDO-33091, "Improved BPWS Control Rod Insertion Process" (TAC No. MB9642)."

3. NEDO-33091-A, Revision 2, "Improved BPWS Control Rod Insertion Process," July 2004.

Revision History

OG Revision 0 Revision Status: Closed

Revision Proposed by: BWROG

Revision Description:
Original Issue

OG Revision 0 Revision Status: Closed

Owners Group Review Information

Date Originated by OG: 10-May-04

Owners Group Comments
(No Comments)

Owners Group Resolution: Superceeded Date: 18-May-04

OG Revision 1 Revision Status: Closed

Revision Proposed by: BWROG

Revision Description:
Revised the markup and the justification to incorporate BWROG TSICC comments.

Owners Group Review Information

Date Originated by OG: 21-Jun-04

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 13-Jul-04

TSTF Review Information

TSTF Received Date: 13-Jul-04 Date Distributed for Review 13-Jul-04

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

TSTF Comments:

(No Comments)

TSTF Resolution: Approved Date: 17-Aug-04

NRC Review Information

NRC Received Date: 30-Aug-04

NRC Comments:

FRN for comment published 5/3/06. TSTF provided comments on 5/31/06.
Request to provide TS changes for BWR/4 NUREG received 10/27/06.

Final Resolution: Superceded by Revision Final Resolution Date: 03-May-06

TSTF Revision 1 Revision Status: Active

Revision Proposed by: BWROG

Revision Description:
On 10/27/06, the NRC requested that TSTF-476 be revised to include changes to the BWR/4 Rod Worth Minimizer Technical Specifications similar to the proposed BWR/6 Rod Pattern Controller Technical Specifications.

TSTF Revision 1 **Revision Status: Active**

Owners Group Review Information

Date Originated by OG: 21-Dec-06

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 04-Jan-07

TSTF Review Information

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

TSTF Comments:
(No Comments)

TSTF Resolution: Approved Date: 08-Jan-07

NRC Review Information

NRC Received Date: 09-Jan-07

Affected Technical Specifications

S/A 3.1.6 Bases	Rod Pattern Control	
Ref. 3.1.6 Bases	Rod Pattern Control	
S/A 3.3.2.1 Bases	Control Rod Block Instrumentation	
LCO 3.3.2.1	Control Rod Block Instrumentation Change Description: Table 3.3.2.1-1	
SR 3.3.2.1 Bases	Control Rod Block Instrumentation	
Ref. 3.3.2.1 Bases	Control Rod Block Instrumentation	
SR 3.3.2.1.1 Bases	Control Rod Block Instrumentation	
SR 3.3.2.1.2 Bases	Control Rod Block Instrumentation	NUREG(s)- 1433 Only

Table 3.3.2.1-1 (page 1 of 1)
Control Rod Block Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Rod Block Monitor				
a. Low Power Range - Upscale	(a)	[2]	SR 3.3.2.1.1 SR 3.3.2.1.4 SR 3.3.2.1.7	≤ [115.5/125] divisions of full scale
b. Intermediate Power Range - Upscale	(b)	[2]	SR 3.3.2.1.1 SR 3.3.2.1.4 SR 3.3.2.1.7	≤ [109.7/125] divisions of full scale
c. High Power Range - Upscale	(c),(d)	[2]	SR 3.3.2.1.1 SR 3.3.2.1.4 SR 3.3.2.1.7	≤ [105.9/125] divisions of full scale
d. Inop	(d),(e)	[2]	SR 3.3.2.1.1	NA
e. Downscale	(d),(e)	[2]	SR 3.3.2.1.1 SR 3.3.2.1.7	≥ [93/125] divisions of full scale
f. Bypass Time Delay	(d),(e)	[2]	SR 3.3.2.1.1 SR 3.3.2.1.7	≤ [2.0] seconds
2. Rod Worth Minimizer	1[(f)], 2[(f)]	[1]	SR 3.3.2.1.2 SR 3.3.2.1.3 SR 3.3.2.1.5 SR 3.3.2.1.8	NA
3. Reactor Mode Switch - Shutdown Position	(g)	[2]	SR 3.3.2.1.6	NA

(a) THERMAL POWER ≥ [29]% and ≤ [64]% RTP and MCPR < 1.70.

(b) THERMAL POWER > [64]% and ≤ [84]% RTP and MCPR < 1.70.

(c) THERMAL POWER > [84]% and < 90% RTP and MCPR < 1.70.

(d) THERMAL POWER ≥ 90% RTP and MCPR < 1.40.

(e) THERMAL POWER ≥ [64]% and < 90% RTP and MCPR < 1.70.

(f) With THERMAL POWER ≤ [10]% RTP [, except during the reactor shutdown process if the coupling of each withdrawn control rod has been confirmed].

(g) Reactor mode switch in the shutdown position.

BASES

APPLICABLE SAFETY ANALYSES (continued)

Generic analysis of the BPWS (Ref. 1) has demonstrated that the 280 cal/gm fuel damage limit will not be violated during a CRDA while following the BPWS ~~MODE~~ mode of operation. The generic BPWS analysis (Ref. 8) also evaluates the effect of fully inserted, inoperable control rods not in compliance with the sequence, to allow a limited number (i.e., eight) and distribution of fully inserted, inoperable control rods.

When performing a shutdown of the plant, an optional BPWS control rod sequence (Ref. 9) may be used provided that all withdrawn control rods have been confirmed to be coupled. The rods may be inserted without the need to stop at intermediate positions since the possibility of a CRDA is eliminated by the confirmation that withdrawn control rods are coupled. When using the Reference 9 control rod sequence for shutdown, the rod worth minimizer may be reprogrammed to enforce the requirements of the improved BPWS control rod insertion process, [or bypassed in accordance with the allowance provided in the Applicability Note for the Rod Worth Minimizer in Table 3.3.2.1-1.]

In order to use the Reference 9 BPWS shutdown process, an extra check is required in order to consider a control rod to be "confirmed" to be coupled. This extra check ensures that no Single Operator Error can result in an incorrect coupling check. For purposes of this shutdown process, the method for confirming that control rods are coupled varies depending on the position of the control rod in the core. Details on this coupling confirmation requirement are provided in Reference 9. If the requirements for use of the BPWS control rod insertion process contained in Reference 9 are followed, the plant is considered to be in compliance with BPWS requirements, as required by LCO 3.1.6.

Rod pattern control satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

Compliance with the prescribed control rod sequences minimizes the potential consequences of a CRDA by limiting the initial conditions to those consistent with the BPWS. This LCO only applies to OPERABLE control rods. For inoperable control rods required to be inserted, separate requirements are specified in LCO 3.1.3, "Control Rod OPERABILITY," consistent with the allowances for inoperable control rods in the BPWS.

BASES

REFERENCES (continued)

6. NEDO-21778-A, "Transient Pressure Rises Affected Fracture Toughness Requirements for Boiling Water Reactors," December 1978.

7. ASME, Boiler and Pressure Vessel Code.

8. NEDO-21231, "Banked Position Withdrawal Sequence," January 1977.

9. NEDO 33091-A, Revision 2, "Improved BPWS Control Rod Insertion Process," July 2004.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

Nominal trip setpoints are specified in the setpoint calculations. The nominal setpoints are selected to ensure that the setpoints do not exceed the Allowable Values between successive CHANNEL CALIBRATIONS. Operation with a trip setpoint less conservative than the nominal trip setpoint, but within its Allowable Value, is acceptable. Trip setpoints are those predetermined values of output at which an action should take place. The setpoints are compared to the actual process parameter (e.g., reactor power), and when the measured output value of the process parameter exceeds the setpoint, the associated device (e.g., trip unit) changes state. The analytic limits are derived from the limiting values of the process parameters obtained from the safety analysis. The Allowable Values are derived from the analytic limits, corrected for calibration, process, and some of the instrument errors. The trip setpoints are then determined accounting for the remaining instrument errors (e.g., drift). The trip setpoints derived in this manner provide adequate protection because instrumentation uncertainties, process effects, calibration tolerances, instrument drift, and severe environment errors (for channels that must function in harsh environments as defined by 10 CFR 50.49) are accounted for.

The RBM is assumed to mitigate the consequences of an RWE event when operating ≥ 29% RTP. Below this power level, the consequences of an RWE event will not exceed the MCPR SL and, therefore, the RBM is not required to be OPERABLE (Ref. 3). When operating < 90% RTP, analyses (Ref. 3) have shown that with an initial MCPR ≥ 1.70, no RWE event will result in exceeding the MCPR SL. Also, the analyses demonstrate that when operating at ≥ 90% RTP with MCPR ≥ 1.40, no RWE event will result in exceeding the MCPR SL (Ref. 3). Therefore, under these conditions, the RBM is also not required to be OPERABLE.

2. Rod Worth Minimizer

The RWM enforces the banked position withdrawal sequence (BPWS) to ensure that the initial conditions of the CRDA analysis are not violated. The analytical methods and assumptions used in evaluating the CRDA are summarized in References 4, 5, 6, 7, and ~~7~~8. The standard BPWS requires that control rods be moved in groups, with all control rods assigned to a specific group required to be within specified banked positions. Requirements that the control rod sequence is in compliance with the BPWS are specified in LCO 3.1.6, "Rod Pattern Control."

When performing a shutdown of the plant, an optional BPWS control rod sequence (Ref. 7) may be used if the coupling of each withdrawn control rod has been confirmed. The rods may be inserted without the need to stop at intermediate positions. When using the Reference 7 control rod insertion sequence for shutdown, the rod worth minimizer may be

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

reprogrammed to enforce the requirements of the improved BPWS control rod insertion process[, or it can be bypassed if it is not programmed to reflect the optional BPWS shutdown sequence, as permitted by the Applicability Note for the RWM in Table 3.3.2.1-1].

The RWM Function satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

Since the RWM is a hardwired system designed to act as a backup to operator control of the rod sequences, only one channel of the RWM is available and required to be OPERABLE (Ref. ~~7~~8). Special circumstances provided for in the Required Action of LCO 3.1.3, "Control Rod OPERABILITY," and LCO 3.1.6 may necessitate bypassing the RWM to allow continued operation with inoperable control rods, or to allow correction of a control rod pattern not in compliance with the BPWS. The RWM may be bypassed as required by these conditions, but then it must be considered inoperable and the Required Actions of this LCO followed.

Compliance with the BPWS, and therefore OPERABILITY of the RWM, is required in MODES 1 and 2 when THERMAL POWER is ≤ 10% RTP. When THERMAL POWER is > 10% RTP, there is no possible control rod configuration that results in a control rod worth that could exceed the 280 cal/gm fuel damage limit during a CRDA (Refs. 5 and ~~7~~8). In MODES 3 and 4, all control rods are required to be inserted into the core; therefore, a CRDA cannot occur. In MODE 5, since only a single control rod can be withdrawn from a core cell containing fuel assemblies, adequate SDM ensures that the consequences of a CRDA are acceptable, since the reactor will be subcritical.

3. Reactor Mode Switch - Shutdown Position

During MODES 3 and 4, and during MODE 5 when the reactor mode switch is required to be in the shutdown position, the core is assumed to be subcritical; therefore, no positive reactivity insertion events are analyzed. The Reactor Mode Switch - Shutdown Position control rod withdrawal block ensures that the reactor remains subcritical by blocking control rod withdrawal, thereby preserving the assumptions of the safety analysis.

The Reactor Mode Switch - Shutdown Position Function satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

BASES

ACTIONS (continued)

E.1 and E.2

With one Reactor Mode Switch - Shutdown Position control rod withdrawal block channel inoperable, the remaining OPERABLE channel is adequate to perform the control rod withdrawal block function. However, since the Required Actions are consistent with the normal action of an OPERABLE Reactor Mode Switch - Shutdown Position Function (i.e., maintaining all control rods inserted), there is no distinction between having one or two channels inoperable.

In both cases (one or both channels inoperable), suspending all control rod withdrawal and initiating action to fully insert all insertable control rods in core cells containing one or more fuel assemblies will ensure that the core is subcritical with adequate SDM ensured by LCO 3.1.1. Control rods in core cells containing no fuel assemblies do not affect the reactivity of the core and are therefore not required to be inserted. Action must continue until all insertable control rods in core cells containing one or more fuel assemblies are fully inserted.

SURVEILLANCE REQUIREMENTS

----------REVIEWER'S NOTE----------
Certain Frequencies are based on approved topical reports. In order for a licensee to use these Frequencies, the licensee must justify the Frequencies as required by the staff SER for the topical report.

As noted at the beginning of the SRs, the SRs for each Control Rod Block instrumentation Function are found in the SRs column of Table 3.3.2.1-1.

The Surveillances are modified by a Note to indicate that when an RBM channel is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours provided the associated Function maintains control rod block capability. Upon completion of the Surveillance, or expiration of the 6 hour allowance, the channel must be returned to OPERABLE status or the applicable Condition entered and Required Actions taken. This Note is based on the reliability analysis (Ref. ~~9~~10) assumption of the average time required to perform channel Surveillance. That analysis demonstrated that the 6 hour testing allowance does not significantly reduce the probability that a control rod block will be initiated when necessary.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.1.1

A CHANNEL FUNCTIONAL TEST is performed for each RBM channel to ensure that the entire channel will perform the intended function. It includes the Reactor Manual Control Multiplexing System input. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable CHANNEL FUNCTIONAL TEST of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications and non-Technical Specifications tests at least once per refueling interval with applicable extensions.

Any setpoint adjustment shall be consistent with the assumptions of the current plant specific setpoint methodology. The Frequency of 92 days is based on reliability analyses (Ref. ~~8~~9).

SR 3.3.2.1.2 and SR 3.3.2.1.3

A CHANNEL FUNCTIONAL TEST is performed for the RWM to ensure that the entire system will perform the intended function. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable CHANNEL FUNCTIONAL TEST of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications and non-Technical Specifications tests at least once per refueling interval with applicable extensions. The CHANNEL FUNCTIONAL TEST for the RWM is performed by attempting to withdraw a control rod not in compliance with the prescribed sequence and verifying a control rod block occurs. As noted in the SRs, SR 3.3.2.1.2 is not required to be performed until 1 hour after any control rod is withdrawn in MODE 2. As noted, SR 3.3.2.1.3 is not required to be performed until 1 hour after THERMAL POWER is ≤ 10% RTP in MODE 1. This allows entry into MODE 2 for SR 3.3.2.1.2, and entry into MODE 1 when THERMAL POWER is ≤ 10% RTP for SR 3.3.2.1.3, to perform the required Surveillance if the 92 day Frequency is not met per SR 3.0.2. The 1 hour allowance is based on operating experience and in consideration of providing a reasonable time in which to complete the SRs. The Frequencies are based on reliability analysis (Ref. ~~8~~9).

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.1.8

The RWM will only enforce the proper control rod sequence if the rod sequence is properly input into the RWM computer. This SR ensures that the proper sequence is loaded into the RWM so that it can perform its intended function. The Surveillance is performed once prior to declaring RWM OPERABLE following loading of sequence into RWM, since this is when rod sequence input errors are possible.

REFERENCES

1. FSAR, Section [7.6.2.2.5].

2. FSAR, Section [7.6.8.2.6].

3. NEDC-30474-P, "Average Power Range Monitor, Rod Block Monitor, and Technical Specification Improvements (ARTS) Program for Edwin I. Hatch Nuclear Plants," December 1983.

4. NEDE-24011-P-A-9-US, "General Electrical Standard Application for Reload Fuel," Supplement for United States, Section S 2.2.3.1, September 1988.

5. "Modifications to the Requirements for Control Rod Drop Accident Mitigating Systems," BWR Owners' Group, July 1986.

6. NEDO-21231, "Banked Position Withdrawal Sequence," January 1977.

7. NEDO 33091-A, Revision 2, "Improved BPWS Control Rod Insertion Process," July 2004.

~~7~~8. NRC SER, "Acceptance of Referencing of Licensing Topical Report NEDE-24011-P-A," "General Electric Standard Application for Reactor Fuel, Revision 8, Amendment 17," December 27, 1987.

~~8~~9. NEDC-30851-P-A, "Technical Specification Improvement Analysis for BWR Control Rod Block Instrumentation," October 1988.

~~9~~10. GENE-770-06-1, "Addendum to Bases for Changes to Surveillance Test Intervals and Allowed Out-of-Service Times for Selected Instrumentation Technical Specifications," February 1991.

Table 3.3.2.1-1 (page 1 of 1)
Control Rod Block Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	SURVEILLANCE REQUIREMENTS
1. Rod Pattern Control System			
a. Rod withdrawal limiter	[(a)]	2	SR 3.3.2.1.1 SR 3.3.2.1.6 SR 3.3.2.1.7
	[(b)]	2	SR 3.3.2.1.2 SR 3.3.2.1.5 SR 3.3.2.1.7
b. Rod pattern controller	1[(c)], 2[(c)]	2	SR 3.3.2.1.3 SR 3.3.2.1.4 SR 3.3.2.1.5 SR 3.3.2.1.7 SR 3.3.2.1.9
2. Reactor Mode Switch - Shutdown Position	(d)	2	SR 3.3.2.1.8

(a) THERMAL POWER > [70]% RTP.

(b) THERMAL POWER > [35]% RTP and ≤ [70]% RTP.

(c) With THERMAL POWER ≤ [10]% RTP [, except during the reactor shutdown process if the coupling of each withdrawn control rod has been confirmed].

(d) Reactor mode switch in the shutdown position.

BASES

APPLICABLE SAFETY ANALYSES (continued)

The generic BPWS analysis (Ref. 9) also evaluated the effect of fully inserted, inoperable control rods not in compliance with the sequence, to allow a limited number (i.e., eight) and distribution of fully inserted, inoperable control rods.

When performing a shutdown of the plant, an optional BPWS control rod sequence (Ref. 10) may be used provided that all withdrawn control rods have been confirmed to be coupled. The rods may be inserted without the need to stop at intermediate positions since the possibility of a CRDA is eliminated by the confirmation that withdrawn control rods are coupled. When using the Reference 10 control rod sequence for shutdown, the rod pattern controller may be reprogrammed to enforce the requirements of the improved BPWS control rod insertion process [or bypassed in accordance with the allowance provided in the Applicability Note for the Rod Pattern Controller in Table 3.3.2.1-1.]

In order to use the Reference 10 BPWS shutdown process, an extra check is required in order to consider a control rod to be "confirmed" to be coupled. This extra check ensures that no Single Operator Error can result in an incorrect coupling check. For purposes of this shutdown process, the method for confirming that control rods are coupled varies depending on the position of the control rod in the core. Details on this coupling confirmation requirement are provided in Reference 10. If the requirements for use of the BPWS control rod insertion process contained in Reference 10 are followed, the plant is considered to be in compliance with BPWS requirements, as required by LCO 3.1.6.

Rod pattern control satisfies the requirements of Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

Compliance with the prescribed control rod sequences minimizes the potential consequences of a CRDA by limiting the initial conditions to those consistent with the BPWS. This LCO only applies to OPERABLE control rods. For inoperable control rods required to be inserted, separate requirements are specified in LCO 3.1.3, "Control Rod OPERABILITY," consistent with the allowances for inoperable control rods in the BPWS.

BASES

REFERENCES (continued)

7. NEDO-21778-A, "Transient Pressure Rises Affected Fracture Toughness Requirements for Boiling Water Reactors," December 1978.

8. ASME, Boiler and Pressure Vessel Code.

9. NEDO-21231, "Banked Position Withdrawal Sequence," January 1977.

10. NEDO 33091-A, Revision 2, "Improved BPWS Control Rod Insertion Process," July 2004.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

changes state. The analytic limits are derived from the limiting values of the process parameters obtained from the safety analysis. The Allowable Values are derived from the analytic limits, corrected for calibration, process, and some of the instrument errors. The trip setpoints are then determined accounting for the remaining instrument errors (e.g., drift). The trip setpoints derived in this manner provide adequate protection because instrumentation uncertainties, process effects, calibration tolerances, instrument drive, and severe environment errors (for channels that must function in harsh environments as defined by 10 CFR 50.49) are accounted for.

The RWL is assumed to mitigate the consequences of an RWE event when operating > 35% RTP. Below this power level, the consequences of an RWE event will not exceed the MCPR, and therefore the RWL is not required to be OPERABLE (Ref. 3).

1.b. Rod Pattern Controller

The RPC enforces the banked position withdrawal sequence (BPWS) to ensure that the initial conditions of the CRDA analysis are not violated. The analytical methods and assumptions used in evaluating the CRDA are summarized in References 4, 5, 6, and 7~~6~~. The standard BPWS requires that control rods be moved in groups, with all control rods assigned to a specific group required to be within specified banked positions. Requirements that the control rod sequence is in compliance with BPWS are specified in LCO 3.1.6, "Rod Pattern Control."

When performing a shutdown of the plant, an optional BPWS control rod sequence (Ref. 6) may be used if the coupling of each withdrawn control rod has been confirmed. The rods may be inserted without the need to stop at intermediate positions. When using the Reference 6 control rod insertion sequence for shutdown, the rod pattern controller may be reprogrammed to enforce the requirements of the improved BPWS control rod insertion process [, or it can be bypassed if it is not programmed to reflect the optional BPWS shutdown sequence, as permitted by the Applicability Note for the RPC in Table 3.3.2.1-1].

The Rod Pattern Controller Function satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

Since the RPC is a backup to operator control of control rod sequences, only a single channel would be required OPERABLE to satisfy Criterion 3 (Ref. ~~6~~7). However, the RPC is designed as a dual channel system and will not function without two OPERABLE channels. Required Actions of LCO 3.1.3, "Control Rod OPERABILITY," and LCO 3.1.6 may necessitate bypassing individual control rods in the Rod Action Control System

BASES

ACTIONS (continued)

until all insertable control rods in core cells containing one or more fuel assemblies are fully inserted.

SURVEILLANCE REQUIREMENTS

----------REVIEWER'S NOTE----------
Certain Frequencies are based on approved topical reports. In order for a licensee to use these Frequencies, the licensee must justify the Frequencies as required by the staff SER for the topical report.

As noted at the beginning of the SR, the SRs for each Control Rod Block instrumentation Function are found in the SRs column of Table 3.3.2.1-1.

The Surveillances are also modified by a Note to indicate that when an RWL channel is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours, provided the associated Function maintains control rod block capability. Upon completion of the Surveillance, or expiration of the 6 hour allowance, the channel must be returned to OPERABLE status or the applicable Condition entered and Required Actions taken. This Note is based on the reliability analysis (Ref. ~~8~~9) assumption of the average time required to perform channel Surveillance. That analysis demonstrated that the 6 hour testing allowance does not significantly reduce the probability that a control rod block will be initiated when necessary.

SR 3.3.2.1.1, SR 3.3.2.1.2, SR 3.3.2.1.3, and SR 3.3.2.1.4

The CHANNEL FUNCTIONAL TESTS for the RPC and RWL are performed by attempting to withdraw a control rod not in compliance with the prescribed sequence and verifying that a control rod block occurs. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable CHANNEL FUNCTIONAL TEST of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications and non-Technical Specifications tests at least once per refueling interval with applicable extensions. Any setpoint adjustment shall be consistent with the assumptions of the current plant specific setpoint methodology. As noted, the SRs are not required to be performed until 1 hour after specified conditions are met (e.g., after any control rod is withdrawn in MODE 2). This allows entry into the appropriate conditions needed to perform the required SRs. The Frequencies are based on reliability analysis (Ref. ~~7~~8).

BASES

REFERENCES

1. FSAR, Section [7.6.1.7.3].

2. FSAR, Section [15.4.2].

3. NEDE-24011-P-A-9-US, "General Electrical Standard Application for Reload Fuel," Supplement for United States, Section S 2.2.3.1, September 1988.

4. "Modifications to the Requirements for Control Rod Drop Accident Mitigating Systems," BWR Owners Group, July 1986.

5. NEDO-21231, "Banked Position Withdrawal Sequence," January 1977.

6. NEDO 33091-A, Revision 2, "Improved BPWS Control Rod Insertion Process," July 2004.

~~6~~7. NRC SER, Acceptance of Referencing of Licensing Topical Report NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel, Revision 8, Amendment 17," December 27, 1987.

~~7~~8. NEDC-30851-P-A, "Technical Specification Improvement Analysis for BWR Control Rod Block Instrumentation," October 1988.

~~8~~9. GENE-770-06-1, "Addendum to Bases for Changes to Surveillance Test Intervals and Allowed Out-of-Service Times for Selected Instrumentation Technical Specifications," February 1991.