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Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-16-148

November 23, 2016

10 CFR 50.90

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

Watts Bar Nuclear Plant, Unit 1
Facility Operating License No. NPF-90
NRC Docket No. 50-390

Watts Bar Nuclear Plant, Unit 2
Facility Operating License No. NPF-96
NRC Docket No. 50-391

Subject: **Application to Revise Technical Specifications to Adopt TSTF-547, Revision 1, "Clarification of Rod Position Requirements" (WBN-TS-16-025)**

Pursuant to Title 10 of the *Code of Federal Regulations* (CFR), Section 50.90, Tennessee Valley Authority (TVA) is submitting a request for an amendment to the Technical Specifications (TS) for the Watts Bar Nuclear Plant (WBN), Unit 1 and Unit 2.

The proposed amendment revises the requirements on control and shutdown rods, and rod and bank position indication. The proposed amendment adopts the changes contained in Technical Specification Task Force (TSTF) - 547, Revision 1, "Clarification of Rod Position Requirements," with minor variations as described in Attachment 1. Attachment 1 provides a description and assessment of the proposed changes. Attachments 2 and 3 provide the existing respective WBN Unit 1 and Unit 2 TS pages marked up to show the proposed changes. Attachments 4 and 5 provide the revised (clean) respective WBN Unit 1 and Unit 2 TS pages. Attachments 6 and 7 provide the existing respective WBN Unit 1 and Unit 2 TS Bases pages marked to show the proposed changes for information only.

The WBN Plant Operations Review Committee and the TVA Nuclear Safety Review Board have reviewed this proposed change and determined that operation of WBN Unit 1 and Unit 2 in accordance with the proposed change will not endanger the health and safety of the public.

TVA requests approval of the proposed TS change within 12 months of the date of this letter. The requested review period is consistent with NRC guidance and supports plans for implementation. Once approved, the amendment will be fully implemented within 60 days.

TVA has determined that there are no significant hazards consideration associated with the proposed change and that the TS change qualifies for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9). Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and enclosures to the Tennessee State Department of Environment and Conservation.

Please address any questions regarding this request to Edward D. Schrull at (423) 751-3850.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 23rd day of November 2016.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Attachments:

1. Description and Assessment
2. Proposed Technical Specification Changes (Mark-Up) for WBN Unit 1
3. Proposed Technical Specification Changes (Mark-Up) for WBN Unit 2
4. Revised Technical Specification Pages (Final Typed) for WBN Unit 1
5. Revised Technical Specification Pages (Final Typed) for WBN Unit 2
6. Proposed Technical Specification Bases Changes (Mark-Up) for WBN Unit 1 (For Information Only)
7. Proposed Technical Specification Bases Changes (Mark-Up) for WBN Unit 2 (For Information Only)

cc (Attachments):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Watts Bar Nuclear Plant
NRC Project Manager – Watts Bar Nuclear Plant
Director, Division of Radiological Health - Tennessee State Department of Environment and Conservation (w/o attachments)

ATTACHMENT 1 - DESCRIPTION AND ASSESSMENT

1.0 DESCRIPTION

The proposed amendment revises the requirements on control and shutdown rods, and rod and bank position indication in the Watts Bar Nuclear (WBN) Plant, Unit 1 and Unit 2 Technical Specification (TS) 3.1.5, "Rod Group Alignment Limits," TS 3.1.6, "Shutdown Bank Insertion Limits," TS 3.1.7, "Control Bank Insertion Limits," and TS 3.1.8, "Rod Position Indication," to provide time to repair rod movement failures that do not affect rod Operability, to provide time for analog position indication instruments to read accurately after rod movement, to correct conflicts between the TS, to eliminate an unnecessary action, and to increase consistency and to improve the presentation.

2.0 ASSESSMENT

2.1 Applicability of Safety Evaluation

The Tennessee Valley Authority (TVA) has reviewed the safety evaluation for Technical Specifications Task Force 547 (TSTF-547), Revision 1 provided to the TSTF in a letter dated March 4, 2016. This review included a review of the Nuclear Regulatory Commission (NRC) staff's evaluation, as well as the information provided in TSTF-547, Revision 1. As described in the subsequent paragraphs, TVA has concluded that the justifications presented in the TSTF-547, Revision 1 proposal and the safety evaluation prepared by the NRC staff are applicable to WBN Unit 1 and Unit 2, and justify this amendment for the incorporation of the changes to the WBN Unit 1 and Unit 2 TS.

2.2 Variations

TVA is proposing the following minor variations from the TS changes described in TSTF-547, Revision 1. These variations do not affect the applicability of TSTF-547, Revision 1 or the NRC staff's safety evaluation to the proposed license amendment.

1. The WBN Unit 1 and Unit 2 TS utilize different numbering than the Standard Technical Specifications on which TSTF-547, Revision 1 was based. The following table summarizes the differences between the WBN Unit 1 and Unit 2 TS numbering and the TSTF-547, Revision 1 numbering and titles.

TSTF-547, Rev. 1	WBN Unit 1	WBN Unit 2
TS 3.1.4, "Rod Group Alignment Limits"	TS 3.1.5, "Rod Group Alignment Limits"	TS 3.1.5, "Rod Group Alignment Limits"
TS 3.1.5, "Shutdown Bank Insertion Limits"	TS 3.1.6, "Shutdown Bank Insertion Limits"	TS 3.1.6, "Shutdown Bank Insertion Limits"
TS 3.1.6, "Control Bank Insertion Limits"	TS 3.1.7, "Control Bank Insertion Limits"	TS 3.1.7, "Control Bank Insertion Limits"
TS 3.1.7, "Rod Position Indication"	TS 3.1.8, "Rod Position Indication"	TS 3.1.8, "Rod Position Indication"

The use of different numbering does not affect the applicability of TSTF-547, Revision 1 to the WBN Unit 1 and Unit 2 TS.

2. TSTF-547, Revision 1, TS 3.1.7, "Rod Position Indication," Required Actions A.1 and C.1 discuss indirect verification of rod position by using moveable incore detectors when the rod position indication system is inoperable. As described in Section 7.7.1.9 of the WBN Dual Unit Updated Final Safety Analysis Report, WBN Unit 1 and Unit 2 have a power distribution monitoring system (PDMS) that can be utilized to obtain a three-dimensional power distribution measurement to indirectly provide rod position verification.

   WBN Unit 1 has the ability to indirectly verify rod position utilizing either a moveable incore system or the PDMS (References 1 and 2). WBN Unit 2 uses the fixed incore system as input to PDMS to indirectly verify rod position (Reference 3). Accordingly, the proposed WBN Unit 1 and Unit 2 TS 3.1.8, "Rod Positon Indication" and associated TS Bases refer to utilizing the PDMS or moveable incore detectors for WBN Unit 1 and the PDMS for WBN Unit 2 in order to provide indirect verification of rod position for an inoperable rod indicator.

   TVA has determined that the variation from TSTF-547 to continue allowing the use of the PDMS to indirectly verify rod position does not affect the applicability of TSTF-547, Revision 1 to the WBN Unit 1 and Unit 2 TS.

3. TSTF-547, Revision 1, Surveillance Requirement (SR) 3.1.4.3 contains a value for T_{avg} of 500°F, whereas the current WBN value (in SR 3.1.5.3) is 551°F. The temperature of 551°F represents a WBN Unit 1 plant-specific historical artifact of the licensing evolution process as the WBN Unit 1 TS transitioned from NUREG-0452, Revision 4 to NUREG-1431, Revision 0 (the Westinghouse Standard Technical Specifications), which kept the value at 551°F. The SR to demonstrate rod drop time was initially based on performing the test with all reactor coolant pumps operating and the average moderator temperature ≥ 551°F to simulate a reactor trip under actual conditions. WBN Unit 2 also specifies the 551°F temperature.

   TVA has determined that the variation of the temperature specified in SR 3.1.4.3 (TVA proposed SR 3.1.5.3) is consistent with the current licensing basis of the plants and does not affect the applicability of TSTF-547, Revision 1 to the WBN Unit 1 and Unit 2 TS.

4. Incorporation of specific WBN minor format variations:
   - Indentation of "<u>OR</u>" between TS 3.1.5, Required Action B.1.1 and B.1.2.
   - Addition of the word "overlap" in TS 3.1.7, Required Action A.3, which was inadvertently left out of the TSTF-547 template. Note that the word "overlap" is correctly contained in and consistent with Limiting Condition for Operation (LCO) 3.1.7, TS 3.1.7 Conditions A. and C., TS 3.1.7 Required Action C.2, and SR 3.1.7.3.

   These differences are administrative and do not affect the applicability of TSTF-547, Revision 1 to the WBN Unit 1 and Unit 2 TS.

Therefore, TVA is not proposing any significant variations or deviations from the TS changes described in TSTF-547, Revision 1 or the applicable parts of the NRC staff's Safety Evaluation.

The Traveler and safety evaluation discuss the applicable regulatory requirements and guidance, including the 10 CFR 50, Appendix A, General Design Criteria (GDC). WBN Unit 1 and Unit 2 were designed to meet the intent of the “Proposed General Design Criteria for Nuclear Power Plant Construction,” published for comment in the Federal Register on July 11, 1967 (32 FR 10213). The WBN Unit 1 and Unit 2 construction permit was issued in January 1973. UFSAR Section 3.1, “Conformance with NRC General Design Criteria,” addresses the NRC General Design Criteria published as Appendix A to 10 CFR 50 in July 1971, including Criterion 4 as amended October 27, 1987. This difference does not alter the conclusion that the proposed change is applicable to WBN Unit 1 and Unit 2.

3.0 REGULATORY ANALYSIS

3.1 No Significant Hazards Consideration Analysis

TVA requests adoption of TSTF-547, Revision 1, "Clarification of Rod Position Requirements," which is an approved change to the Standard Technical Specifications, into the Watts Bar Nuclear Plant, Unit 1 and Unit 2 Technical Specifications (TS). The proposed change revises the requirements on control and shutdown rods, and rod and bank position indication to provide time to repair rod movement failures that do not affect rod Operability, to provide time for analog position indication instruments to read accurately after rod movement, to correct conflicts between the TS, to eliminate an unnecessary action, and to increase consistency and to improve the presentation.

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

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

   Response: No

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

   Control and shutdown rods are initiators to several accidents previously evaluated, such as rod ejection. The proposed change does change the limiting conditions for operation for the rods and makes technical changes to the Surveillance Requirements (SRs) governing the rods. However, the proposed change has no significant effect on the probability of any accident previously evaluated.

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

incore detector system to verify the position of rods with inoperable rod position indicator does not change the requirement for the rods to be aligned and within the insertion limits.

Therefore, the assumptions used in any accidents previously evaluated are unchanged and there is no significant increase in the consequences.

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

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

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

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

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

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

   Response: No

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

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

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

   Response: No

   The proposed change to allow time for rod position indication to stabilize after rod

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

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

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

3.2 Conclusions

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

4.0 ENVIRONMENTAL EVALUATION

The proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9).

Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

5.0 REFERENCES

1. NRC letter to TVA, “Watts Bar Nuclear Plant Unit 1 - Issuance of Amendment Regarding the Application to Implement BEACON Core Power Distribution and Monitoring System (TAC No. ME1698),” dated October 27, 2009 (ML092710381)
2. NRC letter to TVA, “Watts Bar Nuclear Plant Unit 1 - Issuance of Amendment Regarding Alternate Means for Monitoring Control or Shutdown Rod Positions (TAC No. MC1419) (WBN-TS-03-12),” dated September 20, 2005 (ML052300162)
3. Watts Bar Nuclear Plant Unit 2, Technical Specification 3.1.8, “Rod Positon Indication,” Facility Operating License No. NPF-96, dated October 22, 2015 (ML15251A587)

ATTACHMENT 2 - PROPOSED TECHNICAL SPECIFICATION CHANGES (MARK-UP) FOR WBN UNIT 1

3.1 REACTIVITY CONTROL SYSTEMS

3.1.5 Rod Group Alignment Limits

LCO 3.1.5 All shutdown and control rods shall be OPERABLE.~~, with all individual indicated rod positions within 12 steps of their group step counter demand position.~~

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) ~~untrippable~~inoperable.	A.1.1 Verify SDM ~~is ≥ 1.6% Δk/k~~to be 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
B. One rod not within alignment limits.	~~B.1 Restore rod to within alignment limits.~~	~~1 hour~~
	~~OR~~	
	~~B.2.1.1~~B.1.1 Verify SDM ~~is ≥ 1.6% Δk/k~~to be within the limits specified in the COLR.	1 hour
	OR	
	~~B.2.1.2~~B.1.2 Initiate boration to restore SDM to within limit.	1 hour
	AND	(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. (continued)	B.2.2	Reduce THERMAL POWER to ≤ 75% RTP.	2 hours
	AND		
	B.2.3	Verify SDM is ≥ 1.6% Δk/kwithin the limits specified in the COLR.	Once per 12 hours
	AND		
	B.2.4	Perform SR 3.2.1.1, SR 3.2.1.2, and SR 3.2.2.1.	72 hours
	AND		
	B.2.5	Perform SR 3.2.2.1.	72 hours
	AND		
	B.2.65	Re-evaluate safety analyses and confirm results remain valid for duration of operation under these conditions.	5 days
C. Required Action and associated Completion Time of Condition B not met.	C.1	Be in MODE 3.	6 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. More than one rod not within alignment limit.	D.1.1 Verify SDM is ≥ 1.6% Δk/kwithin the limits specified in the COLR. OR D.1.2 Initiate boration to restore required SDM to within limit. AND D.2 Be in MODE 3.	1 hour 1 hour 6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.5.1	------------------------------ NOTES ------------------------------ 1. Not required to be performed for rods associated with inoperable rod position indicator or demand position indicator 2. Not required to be performed until 1 hour after associated rod motion -- Verify position of individual rods positions within alignment limit.	12 hours AND Once within 4 hours and every 4 hours thereafter when the rod position deviation monitor is inoperable
SR 3.1.5.2	Verify rod freedom of movement (trippability) by moving each rod not fully inserted in the core ≥ 10 steps in either direction.	92 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.1.5.3	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} ≥ 551°F; and b. All reactor coolant pumps operating.	Prior to ~~reactor~~ criticality after~~initial fuel loading and~~ each removal of the reactor head

3.1 REACTIVITY CONTROL SYSTEMS

3.1.6 Shutdown Bank Insertion Limits

LCO 3.1.6 Each shutdown bank shall be within insertion limits specified in the COLR.

-- NOTE --
Not applicable to shutdown banks inserted while performing SR 3.1.5.2.

APPLICABILITY: MODES 1 and~~,~~ 2
~~MODE 2 with any control bank not fully inserted.~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One ~~or more~~ shutdown bank~~s~~ ~~not within limits~~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.~~1~~2.1 Verify SDM is ~~≥ 1.6% Δk/k~~within the limits specified in the COLR.	1 hour
	OR	
	A.~~1~~2.2 Initiate boration to restore SDM to within limit.	1 hour
	AND	
	A.~~2~~3 Restore shutdown bank~~s~~ to within ~~limits~~the insertion limits specified in the COLR.	~~2~~ 24 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One or more shutdown banks not within limits for reasons other than Condition A.	B.1.1 Verify SDM is within the limits specified in the COLR. OR B.1.2 Initiate boration to restore SDM to within limit. AND B.2 Restore shutdown banks to within limits.	1 hour 1 hour 2 hours
BC. Required Action and associated Completion Time not met.	BC.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
	---------- NOTE ---------- Not required to be performed until 1 hour after associated rod motion. --------------------	
SR 3.1.6.1	Verify each shutdown bank is within the insertion limits specified in the COLR.	12 hours

3.1 REACTIVITY CONTROL SYSTEMS

3.1.7 Control Bank Insertion Limits

LCO 3.1.7 Control banks shall be within the insertion, sequence, and overlap limits specified in the COLR.

---NOTE---
Not applicable to control banks inserted while performing SR 3.1.5.2.

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

~~---NOTE---~~
~~This LCO is not applicable while performing SR 3.1.5.2.~~
~~---~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Control bank A, B, or C inserted ≤ 16 steps beyond the insertion, sequence, or overlap limits specified in the COLR.	A.1 Verify all shutdown banks are within the insertion limits specified in the COLR.	1 hour
	<u>AND</u>	
	A.2.1 Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>	
	A.2.2 Initiate boration to restore SDM to within limits.	1 hour
	<u>AND</u>	
	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
~~A~~B. Control bank insertion limits not met for reasons other than Condition A.	~~A~~B.1.1	Verify SDM is ~~≥ 1.6% Δk/k~~ within the limits specified in the COLR.	1 hour
	OR		
	~~A~~B.1.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	~~A~~B.2	Restore control bank(s) to within limits.	2 hours
~~B~~C. Control bank sequence or overlap limits not met for reasons other than Condition A.	~~B~~C.1.1	Verify SDM is ~~≥ 1.6% Δk/k~~within the limits specified in the COLR.	1 hour
	OR		
	~~B~~C.1.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	~~B~~C.2	Restore control bank sequence and overlap to within limits.	2 hours
~~C~~D. Required Action and associated Completion Time not met.	~~C~~D.1	Be in MODE ~~3~~2 with k_{eff} < 1.0.	6 hours

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.1.7.1	Verify estimated critical control bank position is within the limits specified in the COLR.	Within 4 hours prior to achieving criticality
SR 3.1.7.2	------------------------------- NOTE ------------------------------- Not required to be performed until 1 hour after associated rod motion. -- Verify each control bank insertion is within the limits specified in the COLR.	12 hours AND Once within 4 hours and every 4 hours thereafter when the rod insertion limit monitor is inoperable
SR 3.1.7.3	------------------------------- NOTE ------------------------------- Not required to be performed until 1 hour after associated rod motion. -- Verify sequence and overlap limits specified in the COLR are met for control banks not fully withdrawn from the core.	12 hours

3.1 REACTIVITY CONTROL SYSTEMS

3.1.8 Rod Position Indication

LCO 3.1.8 The ~~Analog~~ Rod Position Indication (ARPI) System and the Demand Position Indication System shall be OPERABLE.

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

APPLICABILITY: MODES 1 and 2.

ACTIONS

---NOTE---
Separate Condition entry is allowed for each inoperable ~~od position indicator per group~~RPI and each demand position indicator~~ per bank~~.

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~-----------------NOTE-----------------~~ ~~Rod position monitoring by Required Actions A.2.1 and A.2.2 may only be applied to one inoperable ARPI and shall only be allowed: (1) until the end of the current cycle, or (2) until an entry into MODE 5 of sufficient duration, whichever occurs first, when the repair of the inoperable ARPI can safely be performed. Required Actions A.2.1, A.2.2 and A.2.3 shall not be allowed after the plant has been in MODE 5 or other plant condition, for a sufficient period of time, in which the repair of the inoperable ARPI could have safely been performed.~~ ~~--~~ A. One ARPI per group inoperable ~~for~~ in one or more groups.	A.1 Verify the position of the rods with inoperable ~~position indicators~~RPI indirectly by using either the movable incore detectors or the PDMS. OR A.2.1 Verify the position of the rods with the inoperable ~~position indicator~~RPI indirectly by using either the movable incore detectors or the PDMS. ~~AND~~	Once per 8 hours 8 hours AND Once every 31 ~~days~~ EFPD thereafter AND 8 hours ~~, if rod control system parameters indicate~~after discovery of each unintended rod movement AND

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.2.2 Review the parameters of the rod control system for indications of unintended rod movement for the rod with an inoperable position indicator. AND A.2.3 Verify the position of the rod with an inoperable position indicator by using either the movable incore detectors or the PDMS.	16 hours8 hours after each movement of rod with inoperable RPI > 12 steps AND Prior to THERMAL POWER exceeding 50% RTP AND 8 hours after reaching RTP AND Once per 8 hours thereafter 8 hours, if the rod with an inoperable position indicator is moved greater than 12 steps.
	AND A.2.2 Restore inoperable RPI to OPERABLE status.	Prior to entering MODE 2 from MODE 3. AND Prior to increasing THERMAL POWER above 50% RTP and within 8 hours of reaching 100% RTP
	OR A.3 Reduce THERMAL POWER to ≤less than or equal to 50% RTP.	8 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. More than one RPI per group inoperable in one or more groups.	B.1 Place the control rods under manual control.	Immediately
	AND	
	B.2 Restore inoperable RPIs to OPERABLE status such that a maximum of one RPI per group is inoperable.	24 hours
BC. One or more rods withRPI inoperable position indicators havein one or more groups and associated rod has been moved >in excess of 24 steps in one direction since the last determination of the rod's position.	BC.1 Verify the position of the rods with inoperable position indicatorsRPIs indirectly by using either the movable incore detectors or the PDMS.	4 hours
	OR	
	BC.2 Reduce THERMAL POWER to ≤less than or equal to 50% RTP.	8 hours
CD. One or more demand position indicators per bank inoperable for in one or more banks.	CD.1.1 Verify by administrative means all ARPIs for the affected banks are OPERABLE.	Once per 8 hours
	AND	
	CD.1.2 Verify the most withdrawn rod and the least withdrawn rod of the affected banks are ≤ 12 less than or equal to 12 steps apart.	Once per 8 hours
	OR	
	CD.2 Reduce THERMAL POWER to ≤less than or equal to 50% RTP.	8 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~D~~E. Required Action and associated Completion Time not met.	~~D~~E.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.8.1	-------------------------------- NOTE -------------------------- Not required to be met for RPIs associated with rods that do not meet LCO 3.1.5. -- Verify each ~~A~~RPI agrees within 12 steps of the group demand position for the full indicated range of rod travel.	~~18 months~~Once prior to criticality after each removal of the reactor head.

**ATTACHMENT 3 - PROPOSED TECHNICAL SPECIFICATION CHANGES (MARK-UP)
FOR WBN UNIT 2**

3.1 REACTIVITY CONTROL SYSTEMS

3.1.5 Rod Group Alignment Limits

LCO 3.1.5 All shutdown and control rods shall be OPERABLE.~~, with all individual indicated rod positions within 12 steps of their group step counter demand position.~~

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) ~~untrippable~~inoperable.	A.1.1 Verify SDM ~~is ≥ 1.6% Δk/k~~to be within the limits specified in the COLR. OR A.1.2 Initiate boration to restore SDM to within limit. AND A.2 Be in MODE 3.	1 hour 1 hour 6 hours
B. One rod not within alignment limits.	~~B.1 Restore rod to within alignment limits.~~ ~~OR~~ ~~B.2.1.1~~ B.1.1 Verify SDM ~~is ≥ 1.6% Δk/k~~to be within the limits specified in the COLR. OR ~~OR~~ ~~B.2.1.2~~ B.1.2 Initiate boration to restore SDM to within limit. AND	~~1 hour~~ 1 hour 1 hour

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. (continued)	B.2~~.2~~	Reduce THERMAL POWER to ≤ 75% RTP.	2 hours
	<u>AND</u>		
	B.~~2.~~3	Verify SDM is ~~≥ 1.6% Δk/k~~within the limits specified in the COLR.	Once per 12 hours
	<u>AND</u>		
	B.~~2.~~4	Perform SR 3.2.1.1, SR 3.2.1.2, and SR 3.2.2.1.	72 hours
	<u>AND</u>		
	B.~~2.6~~5	Re-evaluate safety analyses and confirm results remain valid for duration of operation under these conditions.	5 days
C. Required Action and associated Completion Time of Condition B not met.	C.1	Be in MODE 3.	6 hours
D. More than one rod not within alignment limit.	D.1.1	Verify SDM is ~~≥ 1.6% Δk/k~~within the limits specified in the COLR.	1 hour
	<u>OR</u>		
	D.1.2	Initiate boration to restore required SDM to within limit.	1 hour
	<u>AND</u>		
	D.2	Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.5.1	---------------------------- NOTES ---------------------------- 1. Not required to be performed for rods associated with inoperable rod position indicator or demand position indicator. 2. Not required to be performed until 1 hour after associated rod motion. --- Verify position of individual rods ~~positions~~ within alignment limit.	12 hours AND Once within 4 hours and every 4 hours thereafter when the rod position deviation monitor is inoperable
SR 3.1.5.2	Verify rod freedom of movement (trippability) by moving each rod not fully inserted in the core ≥ 10 steps in either direction.	92 days
SR 3.1.5.3	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} ≥ 551°F; and b. All reactor coolant pumps operating.	Prior to ~~reactor~~ criticality after ~~initial fuel loading and~~ each removal of the reactor head

3.1 REACTIVITY CONTROL SYSTEMS

3.1.6 Shutdown Bank Insertion Limits

LCO 3.1.6 Each shutdown bank shall be within insertion limits specified in the COLR.

-- NOTE --
Not applicable to shutdown banks inserted while performing SR 3.1.5.2.

APPLICABILITY: MODES 1 and 2~~,~~
~~MODE 2 with any control bank not fully inserted.~~

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One ~~or more~~ shutdown bank~~s not within limits~~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.~~1~~2.1	Verify SDM is ~~≥ 1.6% Δk/k~~within the limits specified in the COLR.	1 hour
	OR		
	A.~~1~~2.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	A.~~2~~3	Restore shutdown bank~~s~~ to within ~~limits~~the insertion limits specified in the COLR.	~~2~~ 24 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One or more shutdown banks not within limits for reasons other than Condition A.	B.1.1 Verify SDM is within the limits specified in the COLR. OR B.1.2 Initiate boration to restore SDM to within limit. AND B.2 Restore shutdown banks to within limits.	1 hour 1 hour 2 hours
~~B.~~C. Required Action and associated Completion Time not met.	~~B~~C.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.6.1	------------------------------- NOTE ---------------------------- Not required to be performed until 1 hour after associated rod motion. --- Verify each shutdown bank is within the insertion limits specified in the COLR	12 hours

3.1 REACTIVITY CONTROL SYSTEMS

3.1.7 Control Bank Insertion Limits

LCO 3.1.7 Control banks shall be within the insertion, sequence, and overlap limits specified in the COLR

-- NOTE --
Not applicable to control banks inserted while performing SR 3.1.5.2.

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

~~-- NOTE --~~
~~This LCO is not applicable while performing SR 3.1.5.2.~~
~~--~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Control bank A, B, or C inserted ≤ 16 steps beyond the insertion, sequence, or overlap limits specified in the COLR.	A.1 Verify all shutdown banks are within the insertion limits specified in the COLR.	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 limits.	1 hour
	AND	

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. (continued)	A.3	Restore the control bank to within the insertion, sequence, and overlap limits specified in the COLR.	24 hours
~~A.~~ B. Control bank insertion limits not met for reasons other than Condition A.	~~A~~B.1.1	Verify SDM is ~~≥ 1.6% Δk/k~~within the limits specified in the COLR.	1 hour
	OR		
	~~A~~B.1.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	~~A~~B.2	Restore control bank(s) to within limits.	2 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
~~B.~~ C. Control bank sequence or-overlap limits not met for reasons other than Condition A.	~~B~~C.1.1	Verify SDM is ~~≥ 1.6% Δk/k~~within the limits specified in the COLR.	1 hour
	<u>OR</u>		
	~~B~~C.1.2	Initiate boration to restore SDM to within limit.	1 hour
	<u>AND</u>		
	~~B~~C.2	Restore control bank sequence and overlap to within limits.	2 hours
~~C.~~ D. Required Action and associated Completion Time not met	~~C~~D.1	Be in MODE ~~3~~2 with k_{eff} < 1.0.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.7.1	Verify estimated critical control bank position is within the limits specified in the COLR.	Within 4 hours prior to achieving criticality

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.1.7.2	------------------------------- NOTE ---------------------------- Not required to be performed until 1 hour after associated rod motion. --- Verify each control bank insertion is within the limits specified in the COLR.	12 hours <u>AND</u> Once within 4 hours and every 4 hours thereafter when the rod insertion limit monitor is inoperable
SR 3.1.7.3	------------------------------- NOTE ---------------------------- Not required to be performed until 1 hour after associated rod motion. --- Verify sequence and overlap limits specified in the COLR are met for control banks not fully withdrawn from the core.	12 hours

3.1 REACTIVITY CONTROL SYSTEMS

3.1.8 Rod Position Indication

LCO 3.1.8 The Rod Position Indication (RPI) System and the Demand Position Indication System shall be OPERABLE.

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

APPLICABILITY: MODES 1 and 2.

ACTIONS

--NOTE--
Separate Condition entry is allowed for each inoperable rod position indicatorRPI per group and each demand position indicator per bank.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One RPI per group inoperable in one or more groups.---------------NOTE--- ------------- Rod position monitoring by Required Actions A.2.1 and A.2.2 may only be applied to one inoperable RPI and shall only be allowed: (1) until the end of the current cycle, or (2) until an entry into MODE 5 of sufficient duration, whichever occurs first, when the repair of the inoperable RPI can safely be performed. Required Actions A.2.1, A.2.2 and A.2.3 shall not be allowed after the plant has been in MODE 5 or other plant condition, for a sufficient period of time, in which the repair of the inoperable RPI could have safely been performed. -------------------------------------	A.1	Verify the position of the rods with inoperable position indicatorsRPI indirectly by using the PDMS.	Once per 8 hours
	OR		
	A.2.1	Verify the position of the rods with the inoperable position indicatorRPI indirectly by using the PDMS.	8 hours AND Once every 31 days EFPD thereafter AND 8 hours, if rod control system parameters indicate after discovery of each unintended rod movement AND

(continued)

ACTIONS (continued)

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

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~A.~~ C. One or more ~~rods with~~RPI inoperable ~~position indicators have~~in one or more groups and associated rod has been moved >~~in excess of~~ 24 steps in one direction since the last determination of the rod's position.	~~B~~C.1 Verify the position of the rods with inoperable ~~position indicators~~RPIs indirectly by using the PDMS.	4 hours
	<u>OR</u>	
	~~B~~C.2 Reduce THERMAL POWER to ≤~~less than or equal to~~ 50% RTP.	8 hours
~~B.~~ D. One or more demand position indicators per bank inoperable ~~for~~ in one or more banks.	~~C~~D.1.1 Verify by administrative means all RPIs for the affected banks are OPERABLE.	Once per 8 hours
	<u>AND</u>	
	~~C~~D.1.2 Verify the most withdrawn rod and the least withdrawn rod of the affected banks are ≤ 12 ~~less than or equal to 12~~ steps apart.	Once per 8 hours
	<u>OR</u>	
	~~C~~D.2 Reduce THERMAL POWER to ≤~~less than or equal to~~ 50% RTP.	8 hours
~~C.~~ E. Required Action and associated Completion Time not met.	~~D~~E.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.8.1	-------------------------------- NOTE ----------------------------- Not required to be met for RPIs associated with rods that do not meet LCO 3.1.5. -- Verify each RPI agrees within 12 steps of the group demand position for the full indicated range of rod travel.	~~18 months~~Once prior to criticality after each removal of the reactor head

ATTACHMENT 4 - REVISED TECHNICAL SPECIFICATION PAGES (FINAL TYPED) FOR WBN UNIT 1

3.1 REACTIVITY CONTROL SYSTEMS

3.1.5 Rod Group Alignment Limits

LCO 3.1.5 All shutdown and control rods shall be OPERABLE.

AND

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

APPLICABILITY: MODES 1 and 2.

ACTIONS

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

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. (continued)	B.2	Reduce THERMAL POWER to ≤ 75% RTP.	2 hours
	AND		
	B.3	Verify SDM is within the limits specified in the COLR.	Once per 12 hours
	AND		
	B.4	Perform SR 3.2.1.1, SR 3.2.1.2, and SR 3.2.2.1.	72 hours
	AND		
	B.5	Re-evaluate safety analyses and confirm results remain valid for duration of operation under these conditions.	5 days
C. Required Action and associated Completion Time of Condition B not met.	C.1	Be in MODE 3.	6 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. More than one rod not within alignment limit.	D.1.1 Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>	
	D.1.2 Initiate boration to restore required SDM to within limit.	1 hour
	<u>AND</u>	
	D.2 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.5.1	-------------------------------- NOTES -------------------------------- 1. Not required to be performed for rods associated with inoperable rod position indicator or demand position indicator 2. Not required to be performed until 1 hour after associated rod motion -- Verify position of individual rods within alignment limit.	12 hours <u>AND</u> Once within 4 hours and every 4 hours thereafter when the rod position deviation monitor is inoperable
SR 3.1.5.2	Verify rod freedom of movement (trippability) by moving each rod not fully inserted in the core ≥ 10 steps in either direction.	92 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.1.5.3	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} ≥ 551°F; and b. All reactor coolant pumps operating.	Prior to criticality after each removal of the reactor head

3.1 REACTIVITY CONTROL SYSTEMS

3.1.6 Shutdown Bank Insertion Limits

LCO 3.1.6 Each shutdown bank shall be within insertion limits specified in the COLR.

--- NOTE ---
Not applicable to shutdown banks inserted while performing SR 3.1.5.2.

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
	<u>AND</u>	
	A.2.1 Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>	
	A.2.2 Initiate boration to restore SDM to within limit.	1 hour
	<u>AND</u>	
	A.3 Restore shutdown bank to within the insertion limits specified in the COLR.	24 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One or more shutdown banks not within limits for reasons other than Condition A.	B.1.1 Verify SDM is within the limits specified in the COLR. OR B.1.2 Initiate boration to restore SDM to within limit. AND B.2 Restore shutdown banks to within limits.	1 hour 1 hour 2 hours
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
	---------- NOTE ---------- Not required to be performed until 1 hour after associated rod motion. --------------------	
SR 3.1.6.1	Verify each shutdown bank is within the insertion limits specified in the COLR.	12 hours

3.1 REACTIVITY CONTROL SYSTEMS

3.1.7 Control Bank Insertion Limits

LCO 3.1.7 Control banks shall be within the insertion, sequence, and overlap limits specified in the COLR.

---NOTE---
Not applicable to control banks inserted while performing SR 3.1.5.2.

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 limits.	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. Control bank insertion limits not met for reasons other than Condition A.	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	Restore control bank(s) to within limits.	2 hours
C. Control bank sequence or overlap limits not met for reasons other than Condition A.	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 SDM to within limit.	1 hour
	<u>AND</u>		
	C.2	Restore control bank sequence and overlap to within limits.	2 hours
D. Required Action and associated Completion Time not met.	D.1	Be in MODE 2 with k_{eff} < 1.0.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.7.1	Verify estimated critical control bank position is within the limits specified in the COLR.	Within 4 hours prior to achieving criticality
SR 3.1.7.2	-------------------------------- NOTE ------------------------------ Not required to be performed until 1 hour after associated rod motion. --- Verify each control bank insertion is within the limits specified in the COLR.	12 hours AND Once within 4 hours and every 4 hours thereafter when the rod insertion limit monitor is inoperable
SR 3.1.7.3	--------------------------------- NOTE ----------------------------- Not required to be performed until 1 hour after associated rod motion. --- Verify sequence and overlap limits specified in the COLR are met for control banks not fully withdrawn from the core.	12 hours

3.1 REACTIVITY CONTROL SYSTEMS

3.1.8 Rod Position Indication

LCO 3.1.8 The Rod Position Indication (RPI) System and the Demand Position Indication System shall be OPERABLE.

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

APPLICABILITY: MODES 1 and 2.

ACTIONS

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

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One RPI per group inoperable in one or more groups.	A.1 Verify the position of the rods with inoperable RPI indirectly by using either the movable incore detectors or the PDMS.	Once per 8 hours
	<u>OR</u>	
	A.2.1 Verify the position of the rods with the inoperable RPI indirectly by using either the movable incore detectors or the PDMS.	8 hours <u>AND</u> Once every 31 EFPD thereafter <u>AND</u> 8 hours after discovery of each unintended rod movement <u>AND</u>
		(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)		8 hours after each movement of rod with inoperable RPI > 12 steps <u>AND</u> Prior to THERMAL POWER exceeding 50% RTP <u>AND</u> 8 hours after reaching RTP
	<u>AND</u>	
	A.2.2 Restore inoperable RPI to OPERABLE status.	Prior to entering MODE 2 from MODE 3.
	<u>OR</u>	
	A.3 Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
		(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. More than one RPI per group inoperable in one or more groups.	B.1 Place the control rods under manual control.	Immediately
	<u>AND</u>	
	B.2 Restore inoperable RPIs to OPERABLE status such that a maximum of one RPI per group is inoperable.	24 hours
C. One or more RPI 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.	C.1 Verify the position of the rods with inoperable RPIs indirectly by using either the movable incore detectors or the PDMS.	4 hours
	<u>OR</u>	
	C.2 Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
D. One or more demand position indicators per bank inoperable in one or more banks.	D.1.1 Verify by administrative means all RPIs for the affected banks are OPERABLE.	Once per 8 hours
	<u>AND</u>	
	D.1.2 Verify the most withdrawn rod and the least withdrawn rod of the affected banks are ≤ 12 steps apart.	Once per 8 hours
	<u>OR</u>	
	D.2 Reduce THERMAL POWER to ≤ 50% RTP.	8 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. Required Action and associated Completion Time not met.	E.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.8.1	-------------------------------- NOTE -------------------------- Not required to be met for RPIs associated with rods that do not meet LCO 3.1.5. -- Verify each RPI agrees within 12 steps of the group demand position for the full indicated range of rod travel.	Once prior to criticality after each removal of the reactor head.

ATTACHMENT 5 - REVISED TECHNICAL SPECIFICATION PAGES (FINAL TYPED)
FOR WBN UNIT 2

3.1 REACTIVITY CONTROL SYSTEMS

3.1.5 Rod Group Alignment Limits

LCO 3.1.5 All shutdown and control rods shall be OPERABLE.

AND

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

APPLICABILITY: MODES 1 and 2.

ACTIONS

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

(continued)

ACTIONS (continued)

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

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.5.1	----------------------------- NOTES ----------------------------- 1. Not required to be performed for rods associated with inoperable rod position indicator or demand position indicator. 2. Not required to be performed until 1 hour after associated rod motion. --- Verify position of individual rods within alignment limit.	12 hours <u>AND</u> Once within 4 hours and every 4 hours thereafter when the rod position deviation monitor is inoperable
SR 3.1.5.2	Verify rod freedom of movement (trippability) by moving each rod not fully inserted in the core ≥ 10 steps in either direction.	92 days
SR 3.1.5.3	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. $T_{avg} \geq 551°F$; and b. All reactor coolant pumps operating.	Prior to criticality after each removal of the reactor head

3.1 REACTIVITY CONTROL SYSTEMS

3.1.6 Shutdown Bank Insertion Limits

LCO 3.1.6 Each shutdown bank shall be within insertion limits specified in the COLR.

--- NOTE ---
Not applicable to shutdown banks inserted while performing SR 3.1.5.2.

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
	<u>AND</u>		
	A.2.1	Verify SDM is within the limits specified in the COLR.	1 hour
	<u>OR</u>		
	A.2.2	Initiate boration to restore SDM to within limit.	1 hour
	<u>AND</u>		
	A.3	Restore shutdown bank to within the insertion limits specified in the COLR.	24 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. One or more shutdown banks not within limits for reasons other than Condition A.	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	Restore shutdown banks to within limits.	2 hours
C. Required Action and associated Completion Time not met.	C.1	Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.6.1	------------------------------- NOTE ---------------------------- Not required to be performed until 1 hour after associated rod motion. -- Verify each shutdown bank is within the insertion limits specified in the COLR	12 hours

3.1 REACTIVITY CONTROL SYSTEMS

3.1.7 Control Bank Insertion Limits

LCO 3.1.7 Control banks shall be within the insertion, sequence, and overlap limits specified in the COLR

-- NOTE --
Not applicable to control banks inserted while performing SR 3.1.5.2.

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 limits.	1 hour
	AND	

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. (continued)	A.3	Restore the control bank to within the insertion, sequence, and overlap limits specified in the COLR.	24 hours
B. Control bank insertion limits not met for reasons other than Condition A.	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	Restore control bank(s) to within limits.	2 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Control bank sequence or overlap limits not met for reasons other than Condition A.	C.1.1 Verify SDM is within the limits specified in the COLR. OR C.1.2 Initiate boration to restore SDM to within limit. AND C.2 Restore control bank sequence and overlap to within limits.	1 hour 1 hour 2 hours
D. Required Action and associated Completion Time not met.	D.1 Be in MODE 2 with $k_{eff} < 1.0$.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.7.1	Verify estimated critical control bank position is within the limits specified in the COLR.	Within 4 hours prior to achieving criticality

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.1.7.2	------------------------------- NOTE ----------------------------- Not required to be performed until 1 hour after associated rod motion. --- Verify each control bank insertion is within the limits specified in the COLR.	12 hours AND Once within 4 hours and every 4 hours thereafter when the rod insertion limit monitor is inoperable
SR 3.1.7.3	------------------------------- NOTE ----------------------------- Not required to be performed until 1 hour after associated rod motion. --- Verify sequence and overlap limits specified in the COLR are met for control banks not fully withdrawn from the core.	12 hours

3.1 REACTIVITY CONTROL SYSTEMS

3.1.8 Rod Position Indication

LCO 3.1.8 The Rod Position Indication (RPI) System and the Demand Position Indication System shall be OPERABLE.

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

APPLICABILITY: MODES 1 and 2.

ACTIONS

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

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One RPI per group inoperable in one or more groups.	A.1 Verify the position of the rods with inoperable RPI indirectly by using the PDMS.	Once per 8 hours
	OR	
	A.2.1 Verify the position of the rods with the inoperable RPI indirectly by using the PDMS.	8 hours AND Once every 31 EFPD thereafter AND 8 hours after discovery of each unintended rod movement AND

(continued)

ACTIONS (continued)

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

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
C. One or more RPI 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.	C.1	Verify the position of the rods with inoperable RPIs indirectly by using the PDMS.	4 hours
	<u>OR</u>		
	C.2	Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
D. One or more demand position indicators per bank inoperable in one or more banks.	D.1.1	Verify by administrative means all RPIs for the affected banks are OPERABLE.	Once per 8 hours
	<u>AND</u>		
	D.1.2	Verify the most withdrawn rod and the least withdrawn rod of the affected banks are ≤ 12 steps apart.	Once per 8 hours
	<u>OR</u>		
	D.2	Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
E. Required Action and associated Completion Time not met.	E.1	Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.8.1	------------------------------- NOTE ---------------------------- Not required to be met for RPIs associated with rods that do not meet LCO 3.1.5. -- Verify each RPI agrees within 12 steps of the group demand position for the full indicated range of rod travel.	Once prior to criticality after each removal of the reactor head

ATTACHMENT 6 - PROPOSED TECHNICAL SPECIFICATION BASES CHANGES (MARK-UP) FOR WBN UNIT 1 (FOR INFORMATION ONLY)

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.5 Rod Group Alignment Limits

BASES

BACKGROUND

The OPERABILITY (~~e~~i.~~g~~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," and GDC 26, "Reactivity Control System Redundancy and Capability," (Ref. 1), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors" (Ref. 2).

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

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

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

The RCCAs are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control (Shutdown Banks C and D have only one group each). A group consists

(continued)

BACKGROUND (continued)

of two or more RCCAs that are electrically paralleled to step simultaneously. Except for Shutdown Banks C and D, a bank of RCCAs consists of two groups that are moved in a staggered fashion, but always within one step of each other. There are four control banks and four shutdown banks.

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

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

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

The ~~A~~RPI System provides an accurate indication of actual control rod position, but at a lower precision than the step counters. This system is based on inductive analog signals from a series of coils spaced along a hollow tube with a center to center distance of 3.75 inches, which is six steps. The normal

(continued)

BASES

BACKGROUND (continued)

indication accuracy of the ARPI 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 ARPI, the maximum deviation between actual rod position and the demand position could be 24 steps, or 15 inches.

APPLICABLE SAFETY ANALYSES

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

a. There be no violations of:

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

b. The core remains subcritical after accident transients other than a main steam line break (MSLB).

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

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

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

Another type of misalignment occurs if one RCCA fails to insert upon a reactor trip in response to a main steam pipe rupture and remains stuck fully withdrawn. This condition is assumed in the evaluation to determine that the required SDM is met with the maximum worth RCCA also fully withdrawn (Ref. 5). The reactor is shutdown by the boric acid injection delivered by the ECCS.

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

Continued operation of the reactor with a misaligned control rod is allowed if the heat flux hot channel factor ($F_Q(Z)$) and the nuclear enthalpy hot channel factor($F^N_{\Delta H}$) are verified to be within their limits in the COLR and the safety analysis is verified to remain valid. When a control rod is misaligned, the assumptions that are used to determine the rod insertion limits, AFD limits, and quadrant power tilt limits are not preserved. Therefore, the limits may not preserve the design peaking factors, and $F_Q(Z)$ and $F^N_{\Delta H}$ must be verified directly using incore power distribution measurements. 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)~~the NRC Policy Statement~~.

LCO

The limits on shutdown or control rod alignments ensure that the assumptions in the safety analysis will remain valid. The requirements on OPERABILITY ensure that upon reactor trip, the assumed reactivity will be available and will be inserted. The control rod OPERABILITY requirements (i.e., trippability) ~~also~~ are acceptable 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 do not result in the inability to move a rod (e.g., rod lift coil failures), but that do not impact trippability, do not result in rod inoperability.

The requirement to maintain the rod alignment to within plus or minus 12 steps is conservative. The minimum misalignment assumed in safety analysis is 24 steps (15 inches), and in some cases a total misalignment from fully withdrawn to fully inserted is assumed.

(continued)

BASES

LCO (continued)

Failure to meet the requirements of this LCO may produce unacceptable power peaking factors and LHRs, or unacceptable SDMs, all of which may constitute initial conditions inconsistent with the safety analysis.

APPLICABILITY

The requirements on RCCA OPERABILITY and alignment are applicable in MODES 1 and 2 because these are the only MODES in which neutron (or fission) power is generated, and the OPERABILITY (i.e., trippability) and alignment of rods have the potential to affect the safety of the plant. In MODES 3, 4, 5, and 6, the alignment limits do not apply because the control rods are bottomed and the reactor is shut down and not producing fission power. In the shutdown MODES, the OPERABILITY of the shutdown and control rods has the potential to affect the required SDM, but this effect can be compensated for by an increase in the boron concentration of the RCS. See LCO 3.1.1, "SHUTDOWN MARGIN (SDM) - T_{avg} > 200°F," for SDM in MODES 3 and 4, LCO 3.1.2, "Shutdown Margin (SDM)-T_{avg} ≤≤ 200°F" for SDM in MODE 5, and LCO 3.9.1, "Boron Concentration," for boron concentration requirements during refueling.

ACTIONS

A.1.1 and A.1.2

When one or more rods are ~~untrippable~~inoperable (i.e., untrippable), there is a possibility that the required SDM may be adversely affected. Under these conditions, it is important to determine the SDM, and if it is less than the required value, initiate boration until the required SDM is recovered. The Completion Time of 1 hour is adequate for determining SDM and, if necessary, for initiating boration to restore SDM.

In this situation, SDM verification must include the worth of the untrippable rod, as well as a rod of maximum worth.

(continued)

ACTIONS (continued)

A.2

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

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

B.1.1 and B.1.2

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

An alternative to realigning a single misaligned RCCA to the group average position is to align the remainder of the group to the position of the misaligned RCCA. However, this must be done without violating the bank sequence, overlap, and insertion limits specified in LCO 3.1.6, "Shutdown Bank Insertion Limits," and LCO 3.1.7, "Control Bank Insertion Limits." ~~The Completion Time of 1 hour gives the operator sufficient time to adjust the rod positions in an orderly manner.~~

~~B.2.1.1 and B.2.1.2~~

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

In many cases, realigning the remainder of the group to the misaligned rod may not be desirable. For example, realigning control bank B to a rod that is misaligned 15 steps from the top of the core would require a significant power reduction, since control bank D must be moved fully in and control bank C must be moved in to approximately 100 to 115 steps.

(continued)

ACTIONS

B.2.1.1 and B.2.1.2B1.1 and B.1.2 (continued)

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.

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

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

Reduction of power to 75% RTP ensures that local LHR increases due to a misaligned RCCA will not cause the core design criteria to be exceeded (Ref. 6). The Completion Time of 2 hours gives the operator sufficient time to accomplish an orderly power reduction without challenging the Reactor Protection System.

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

Verifying that $F_Q(Z)$, as approximated by $F^C_Q(Z)$ and $F^W_Q(Z)$, and $F^N_{\Delta H}$ are within the required limits ensures that current operation at 75% RTP with a rod misaligned is not resulting in power distributions that may invalidate safety analysis assumptions at full power. The Completion Time of 72 hours allows sufficient time to obtain an incore power distribution measurement and to calculate $F_Q(Z)$ and $F^N_{\Delta H}$.

Once current conditions have been verified acceptable, time is available to perform evaluations of accident analysis to determine that core limits will not be exceeded during a Design Basis Event for the duration of operation under these conditions. The accident analyses presented in UFSAR Chapter 15 (Ref. 3) that may be evaluated to ensure that the analyses remain valid for the duration of continued operation under these conditions. A Completion Time of 5 days is sufficient time to obtain the required input data and to perform the analysis.

(continued)

BASES

ACTIONS (continued)

C.1

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

D.1.1 and D.1.2

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

D.2

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

To achieve this status, the unit must be brought to at least MODE 3 within 6 hours. The allowed Completion Time is reasonable, based on operating experience, for reaching MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.1.5.1

Verification that the position of individual rod 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. If the rod position deviation monitor is inoperable, a Frequency of 4 hours accomplishes the same goal. 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.

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 3.1.8, "Rod Position Indication," provides Actions to verify the rods are in alignment when one or more rod positon indicators are inoperable.

The Surveillance is modified by a Note which states that the SR is not required to be performed until 1 hour after associated rod motion. Control rod temperature affects the accuracy of the rod position indication system. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated positon is expected to change with time as the drive shaft temperature changes. The one hour period allows control rod temperature to stabilize following rod movement in order to ensure the indicated rod positon is accurate.

SR 3.1.5.2

Verifying each control rod is OPERABLE would require that each rod be tripped. However, in MODES 1 and 2, tripping each control rod would result in radial or axial power tilts, or oscillations. Exercising each individual control rod every 92 days provides increased confidence that all rods continue to be OPERABLE without exceeding the alignment limit, even if they are not regularly tripped. Moving each control rod by 10 steps will not cause radial or axial power tilts, or oscillations, to occur. The 92 day Frequency takes into consideration other information available to the operator in the control room and SR 3.1.5.1, which is performed more frequently and adds to the determination of OPERABILITY of the rods. Between required performances of SR 3.1.5.2 (determination of control rod OPERABILITY by movement), if a control rod(s) is discovered to be immovable, but remains trippable and aligned, the control rod(s) is considered to be OPERABLE. At any time, if a control rod(s) is immovable, a determination of the trippability (OPERABILITY) of the control rod(s) must be made, and appropriate action taken.

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SR 3.1.5.3

Verification of rod drop times allows the operator to determine that the maximum rod drop time permitted is consistent with the assumed rod drop time used in the safety analysis. Measuring rod drop times prior to reactor criticality, ~~after initial fuel loading and~~ after each reactor vessel head removal, ensures that the reactor internals and rod drive mechanism will not interfere with rod motion or rod drop time, and that no degradation in these systems has occurred that would adversely affect control rod motion or drop time. This testing is performed with all RCPs operating and the average moderator temperature ≥≥ 551°F to simulate a reactor trip under actual conditions.

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

BASES

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 10, "Reactor Design," and General Design Criterion 26, "Reactivity Control System Redundancy and Capability."

2. Title 10, Code of Federal Regulations, Part 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors."

3. Watts Bar FSAR, Section 15.0, "Accident Analyses."

4. Watts Bar FSAR, Section 15.2.3, "Rod Cluster Control Assembly Misalignment."

5. Watts Bar FSAR, Section 15.4.2, "Major Secondary System Pipe Rupture."

6. Watts Bar FSAR, Section 15.3.6, "Single Rod Cluster Control Assembly Withdrawal at Full Power."

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.6 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 Capability," and GDC 28, "Reactivity Limits" (Ref. 1), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors" (Ref. 2). Limits on control rod insertion have been established, and all rod positions are monitored and controlled during power operation to ensure that the power distribution and reactivity limits defined by the design power peaking and SDM limits are preserved.

The rod cluster control assemblies (RCCAs) are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control (Shutdown Banks C and D have only one group each). A group consists of two or more RCCAs that are electrically paralleled to step simultaneously. Except for Shutdown Banks C and D, a bank of RCCAs consists of two groups that are moved in a staggered fashion, but always within one step of each other. There are four control banks and four shutdown banks. See LCO 3.1.5, "Rod Group Alignment Limits," for control and shutdown rod OPERABILITY and alignment requirements, and LCO 3.1.8, "Rod Position Indication," for position indication requirements.

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

(continued)

BASES

BACKGROUND (continued)

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 are controlled manually by the control room operator. During normal unit operation, the shutdown banks are either fully withdrawn or fully inserted. The shutdown banks must be completely withdrawn from the core, prior to withdrawing any control banks during an approach to criticality. The shutdown banks can be fully withdrawn without the core going critical. This provides available negative reactivity in the event of boration errors. The shutdown banks are then left in this position until the reactor is shut down. They add negative reactivity to shut down the reactor upon receipt of a reactor trip signal.

APPLICABLE SAFETY ANALYSES

On a reactor trip, all RCCAs (shutdown banks and control banks), except the most reactive RCCA, are assumed to insert into the core. The shutdown banks shall be at or above their insertion limits and available to insert the maximum amount of negative reactivity on a reactor trip signal. The control banks may be partially inserted in the core, as allowed by LCO 3.1.7, "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) - T_{avg} > 200°F," and LCO 3.1.2, "SHUTDOWN MARGIN (SDM) - T_{avg} ≤≤ 200°F") following a reactor trip from full power. The combination of control banks and shutdown banks (less the most reactive RCCA, which is assumed to be fully withdrawn) is sufficient to take the reactor from full power conditions at rated temperature to zero power, and to maintain the required SDM at rated no load temperature (Ref. 3). The shutdown bank insertion limit also limits the reactivity worth of an ejected shutdown rod.

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

a. There be no violations of:

   1. ~~specified~~ Specified acceptable fuel design limits, or

   2. RCS pressure boundary integrity; and

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

b. The core remains subcritical after accident transients other than a main steam line break (MSLB).

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 ~~the NRC Policy Statement~~10 CFR 50.36(c)(2)(ii).

LCO

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

The shutdown bank insertion limits are defined in the COLR.

The LCO is modified by a Note indicating the LCO requirement is not applicable to shutdown banks being inserted while performing SR 3.1.3.2. This SR verifies the freedom of the rods to move, and may require the shutdown bank to move below the LCO limits, which would normally violate the LCO. This Note applies to each shutdown bank as it is moved below the insertion limit to perform the SR. This Note is not applicable should a malfunction stop performance of the SR.

APPLICABILITY

The shutdown banks must be within their insertion limits, with the reactor in MODES 1 and 2. ~~The applicability in MODE 2 begins prior to initial control bank withdrawal, during an approach to criticality, and continues throughout MODE 2, until all control bank rods are again fully inserted by reactor trip or by shutdown.~~ This ensures that a sufficient amount of negative reactivity is available to shut down the reactor and maintain the required SDM following a reactor trip. The shutdown banks do not have to be within their insertion limits in MODE 3, unless an approach to criticality is being made. Refer to LCO 3.1.1 and LCO 3.1.2 for SDM requirements in MODES 3, 4, and 5. LCO 3.9.1, "Boron Concentration," ensures adequate SDM in MODE 6.

~~The Applicability requirements have been modified by a Note indicating the LCO requirement is suspended during SR 3.1.5.2. This SR verifies the freedom of the rods to move, and requires the shutdown bank to move below the LCO limits, which would normally violate the LCO.~~

(continued)

BASES

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 within its insertion limit. Also, verification of SDM or initiation of boration within 1 hour is required, since the SDM in MODES 1 and 2 is ensured by adhering to the control and shutdown bank insertion limits (see LCO 3.1.1). If a shutdown bank is not within its insertion limit, SDM will be verified by performing a reactivity balance calculation, considering the effects listed in the BASES for SR 3.1.1.1.

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

AB.1.1, AB.1.2 and AB.2

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

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

BC.1

If the shutdown banks cannot be restored to within their insertion limits within 2 hoursRequired Actions and 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.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.6.1

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

The Surveillance is modified by a Note which states that the SR is not required to be performed for shutdown banks until 1 hour after motion of rods in those banks. Rod temperature affects the accuracy of the rod position indication system. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated position is expected to change with time as the drive shaft temperature changes. The one hour period allows rod temperature to stabilize following rod movement in order to ensure the indicated position is accurate.

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

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 10, "Reactor Design," General Design Criterion 26, "Reactivity Control System Redundancy and Capability," and General Design Criterion 28, "Reactivity Limits."

2. Title 10, Code of Federal Regulations, Part 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors."

3. Watts Bar FSAR, Section 15.0, "Accident Analyses."

BASES

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.7 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 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 Capability," and GDC 28, "Reactivity Limits" (Ref. 1), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors" (Ref. 2). Limits on control rod insertion have been established, and all rod positions are monitored and controlled during power operation to ensure that the power distribution and reactivity limits defined by the design power peaking and SDM limits are preserved.

The rod cluster control assemblies (RCCAs) are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control (Shutdown Banks C and D have only one group each). A group consists of two or more RCCAs that are electrically paralleled to step simultaneously. Except for Shutdown Banks C and D, a bank of RCCAs consists of two groups that are moved in a staggered fashion, but always within one step of each other. There are four control banks and four shutdown banks. See LCO 3.1.5, "Rod Group Alignment Limits," for control and shutdown rod OPERABILITY and alignment requirements, and LCO 3.1.8, "Rod Position Indication," for position indication requirements.

The control bank insertion limits are specified in the COLR. An example is provided for information only in Figure B 3.1.7-1. The control banks are required to be at or above the insertion limit lines.

Figure B 3.1.7-1 also indicates how the control banks are moved in an overlap pattern. Overlap is the distance traveled together by two control banks. The predetermined position of control bank C, at which control bank D will begin

(continued)

BACKGROUND (continued).

to move with bank C on a withdrawal, as an example may be at 128 steps Therefore, in this example, control bank C overlaps control bank D from 128 steps to the fully withdrawn position for control bank C. The fully withdrawn position and predetermined overlap positions are 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 3.1.5, “Rod Group Alignment Limits,” LCO 3.1.6, "Shutdown Bank Insertion Limits," LCO 3.1.7, “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 subject LCO limits will prevent fuel cladding failures that would breach the primary fission product barrier and release fission products to the reactor coolant in the event of a loss of coolant accident (LOCA), loss of flow, ejected rod, or other accident requiring termination by a Reactor Trip System (RTS) trip function.

(continued)

BASES

APPLICABLE SAFETY ANALYSES

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

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

a. There be no violations of:

   1. ~~specified~~ Specified acceptable fuel design limits, or
   2. Reactor Coolant System pressure boundary integrity; and

b. The core remains subcritical after accident transients other than a main steam line break (MSLB).

As such, the shutdown and control bank insertion limits affect safety analysis involving core reactivity and power distributions (Ref. 3 through 13).

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. 5, 6, 8 and 11).

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

The control and shutdown bank insertion limits ensure that safety analyses assumptions for SDM, ejected rod worth, and power distribution peaking factors are preserved (Ref. 3 through 13).

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

(continued)

BASES

LCO

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

The LCO is modified by a Note indicating the LCO requirement is not applicable to control banks being inserted while performing SR 3.1.5.2. This SR verifies the freedom of the rods to move, and may require the control bank to move below the LCO limits, which would normally violate the LCO. This Note applies to each control bank as it is moved below the insertion limit to perform the SR. This Note is not applicable should a malfunction stop performance of the SR.

APPLICABILITY

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

~~The applicability requirements have been modified by a Note indicating the LCO requirements are suspended during the performance of SR 3.1.5.2. This SR verifies the freedom of the rods to move, and requires the control bank to move below the LCO limits, which would violate the LCO.~~

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 shutdown bank.

Condition A is limited to Control Banks A, B, or C. The allowance is not required for Control Bank D because the full power bank insertion limit can be met during performance of the SR 3.1.5.2 control rod freedom of movement (trippability) testing.

(continued)

BASES

ACTIONS

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

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

a. Reducing power to be consistent with rod position; or

b. Moving rods to be consistent with power.

Also, verification of SDM or initiation of boration to regain SDM is required within 1 hour, since the SDM in MODES 1 and 2 normally ensured by adhering to the control and shutdown bank insertion limits (see LCO 3.1.1, "SHUTDOWN MARGIN (SDM) - T_{avg} > 200°F") has been upset. If control banks are not within their insertion limits, then SDM will be verified by performing a reactivity balance calculation, considering the effects listed in the Bases for SR 3.1.1.1.

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

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

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

~~C~~D.1

If the Required Actions ~~A.1 and A.2, or B.1 and B.2~~ cannot be completed within the associated Completion Times, the plant must be brought to MODE ~~3~~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.

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.1.7.1

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 3.1.7.2

With an OPERABLE bank insertion limit monitor, verification of the control bank insertion limits at a Frequency of 12 hours is sufficient to ensure OPERABILITY of the bank insertion limit monitor and to detect control banks that may be approaching the insertion limits since, normally, very little rod motion occurs in 12 hours. If the insertion limit monitor becomes inoperable, verification of the control bank position at a Frequency of 4 hours is sufficient to detect control banks that may be approaching the insertion limits.

The Surveillance is modified by a Note stating that the SR is not required to be performed for control banks until 1 hour after motion of rods in those banks. Control rod temperature affects the accuracy of the rod position indication system. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated position is expected to change with time as the drive shaft temperature changes. The one hour period allows control rod temperature to stabilize following rod movement in order to ensure the indicated rod position is accurate.

SR 3.1.7.3

When control banks are maintained within their insertion limits as checked by SR 3.1.7.2 above, it is unlikely that their sequence and overlap will not be in accordance with requirements provided in the COLR. ~~A Frequency of 12 hours is consistent with the insertion limit check above in SR 3.1.7.2.~~

The Surveillance is modified by a Note stating that the SR is not required to be performed for control banks until 1 hour after motion of rods in those banks. Control rod temperature affects the accuracy of the rod position indication system. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated position is expected to change with time as the drive shaft temperature changes. The one hour period allows control rod temperature to stabilize following rod movement in order to ensure the indicated rod position is accurate.

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.1.7.3 (continued)

A Frequency of 12 hours is consistent with the insertion limit check above in SR 3.1.7.2.

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 10, "Reactor Design," General Design Criterion 26, "Reactivity Control System Redundancy and Capability," and General Design Criterion 28, "Reactivity Limits."

2. Title 10, Code of Federal Regulations, Part 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors."

3. Watts Bar FSAR, Section 15.2.1, "Uncontrolled Rod Cluster Control Assembly Bank Withdrawal From a Subcritical Condition."

4. Watts Bar FSAR, Section 15.2.2, "Uncontrolled Rod Cluster Control Assembly Bank Withdrawal At Power."

5. Watts Bar FSAR, Section 15.2.3, "Rod Cluster Control Assembly Misalignment."

6. Watts Bar FSAR, Section 15.2.4, "Uncontrolled Boron Dilution."

7. Watts Bar FSAR, Section 15.2.5, "Partial Loss of Forced Reactor Coolant Flow."

8. Watts Bar FSAR, Section 15.2.13, "Accidental Depressurization of the Main Steam System."

9. Watts Bar FSAR, Section 15.3.4, "Complete Loss of Forced Reactor Coolant Flow."

10. Watts Bar FSAR, Section 15.3.6, "Single Rod Cluster Control Assembly Withdrawal At Full Power."

11. Watts Bar FSAR, Section 15.4.2.1, "Major Rupture of Main Steam Line."

12. Watts Bar FSAR, Section 15.4.4, "Single Reactor Coolant Pump Locked Rotor."

13. Watts Bar FSAR, Section 15.4.6, "Rupture of a Control Rod Drive Mechanism Housing (Rod Cluster Control Assembly Ejection)."

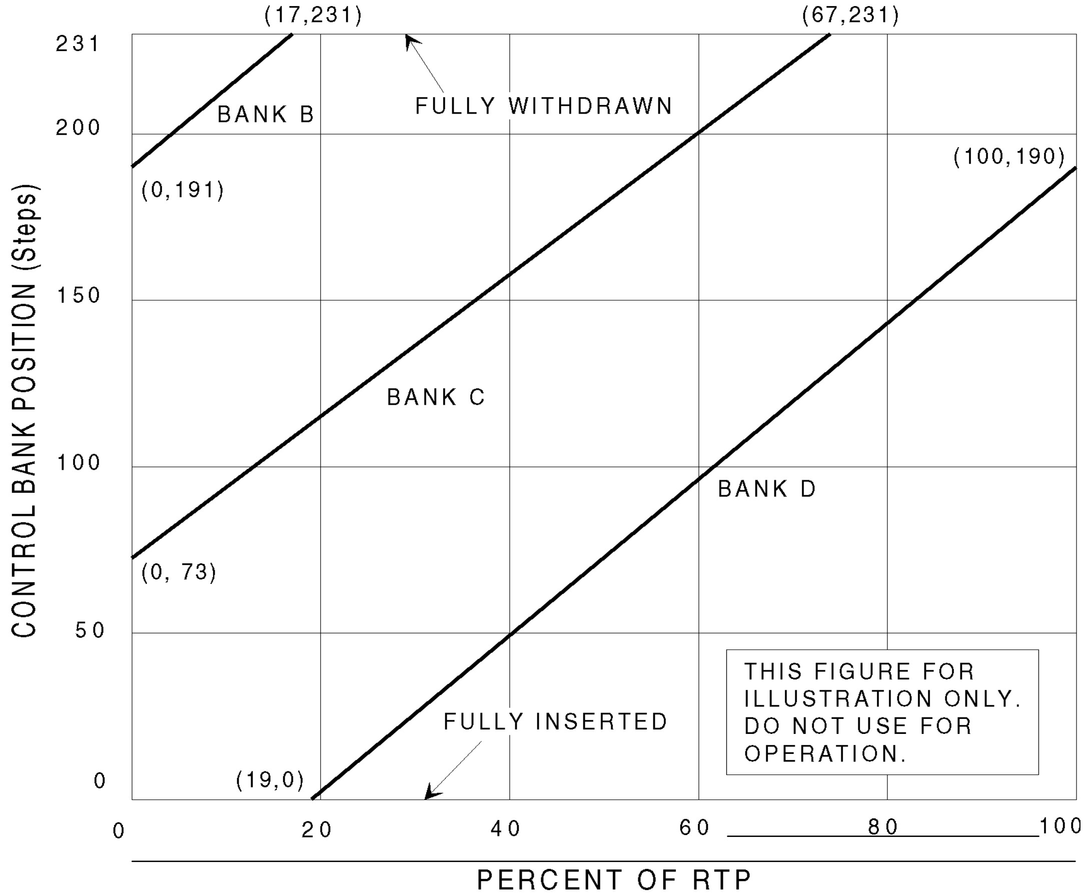

Figure B 3.1.7-1 (page 1 of 1)
Control Bank Insertion vs. Percent RTP

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.8 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 3.1.8 is required to ensure OPERABILITY of the control rod position indicators to determine control rod positions and thereby ensure compliance with the control rod alignment and insertion limits.

The OPERABILITY, including position indication, of the shutdown and control rods is an initial assumption in all safety analyses that assume rod insertion upon reactor trip. Maximum rod misalignment is an initial assumption in the safety analysis that directly affects core power distributions and assumptions of available SDM. Rod position indication is required to assess OPERABILITY and misalignment.

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

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

Rod cluster control assemblies (RCCAs), or rods, are moved out of the core (up or withdrawn) or into the core (down or inserted) by their control rod drive mechanisms. The RCCAs are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control (Shutdown Banks C and D have only one group each).

The axial position of shutdown rods and control rods are determined by two separate and independent systems: the Bank Demand Position Indication System (commonly called group step counters) and the analog ~~Analog~~ Rod Position Indication (ARPI) System.

(continued)

BACKGROUND (continued)

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

The ARPI System provides an accurate indication of actual control rod position, but at a lower precision than the step counters. This system is based on inductive analog signals from a series of coils spaced along a hollow tube with a center to center distance of 3.75 inches, which is 6 steps. The normal indication accuracy of the ARPI 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 ARPI, the maximum deviation between actual rod position and the demand position could be 24 steps, or 15 inches.

APPLICABLE SAFETY ANALYSES

Control and shutdown rod position accuracy is essential during power operation. Power peaking, ejected rod worth, or SDM limits may be violated in the event of a Design Basis Accident (Ref. 2 through 12), with control or shutdown rods operating outside their limits undetected. Therefore, the acceptance criteria for rod position indication is that rod positions must be known with sufficient accuracy in order to verify the core is operating within the group sequence, overlap, design peaking limits, ejected rod worth, and with minimum SDM (LCO 3.1.6, "Shutdown Bank Insertion Limits," and LCO 3.1.7, "Control Bank Insertion Limits"). The rod positions must also be known in order to verify the alignment limits are preserved (LCO 3.1.5, "Rod Group Alignment Limits"). Control rod positions are continuously monitored to provide operators with information that ensures the plant is operating within the bounds of the accident analysis assumptions.

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

LCO

LCO 3.1.8 specifies that the ARPI System and the Bank Demand Position Indication System be OPERABLE for all control rods. For the control rod position indicators to be OPERABLE requires meeting the SR of the LCO (when required) and the following:

(continued)

BASES

LCO (continued)

a. The ARPI System indicates within 12 steps of the group step counter demand position as required by LCO 3.1.5, "Rod Group Alignment Limits;"

b. For the ARPI System there are no failed coils; and

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

The SR of the LCO is modified by a Note which states it is not required to be met for RPIs associated with rods that do not meet LCO 3.1.5. If a rod is known to not be within 12 steps of the group demand position, the Actions of LCO 3.1.5 provide appropriate Actions. Otherwise, The the 12 step agreement limit between the Bank Demand Position Indication System and the ARPI System indicates that the Bank Demand Position Indication System is adequately calibrated, and can be used for indication of the measurement of control rod bank position.

A deviation of less than the allowable limit, given in LCO 3.1.5, in position indication for a single control rod, ensures high confidence that the position uncertainty of the corresponding control rod group is within the assumed values used in the analysis (that specified control rod group insertion limits).

These requirements ensure that control rod position indication during power operation and PHYSICS TESTS is accurate, and that design assumptions are not challenged. OPERABILITY of the position indicator channels ensures that inoperable, misaligned, or mispositioned control rods can be detected. Therefore, power peaking, ejected rod worth, and SDM can be controlled within acceptable limits.

The LCO is modified by a Note stating that the RPI system is not required to be OPERABLE for 1 hour following movement of the associated rods. Control and shutdown rod temperature affects the accuracy of the RPI System. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated position is expected to change with time as the drive shaft temperature changes. The one hour period allows temperature to stabilize following rod movement in order to ensure the indicated positon is accurate.

APPLICABILITY

The requirements on the ARPI and step counters are only applicable in MODES 1 and 2 (consistent with LCO 3.1.5, LCO 3.1.6, and LCO 3.1.7), 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.

(continued)

BASES

ACTIONS

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

<u>A.1, A.2.1, and A.2.2</u>

When one ~~A~~RPI channel per group in one or more groups fails, the position of the rod can still be determined indirectly by use of incore power distribution measurement information. Incore power distribution measurement information can be obtained from flux traces using the Movable Incore Detector System or from an OPERABLE Power Distribution Monitoring System (PDMS) (ref. 15). The Required Action may also be satisfied by ensuring at least once per 8 hours that F_Q satisfies LCO 3.2.1, $F^N_{\Delta H}$ satisfies LCO 3.2.2, and SHUTDOWN MARGIN is within the limits provided in the COLR, provided the non-indicating rods have not been moved. Based on experience, normal power operation does not require excessive movement of banks. If a bank has been significantly moved, the Required Action of ~~B~~C.1 or ~~B~~C.2 below is required. Therefore, verification of RCCA position within the Completion Time of 8 hours is adequate for allowing continued full power operation, since the probability of simultaneously having a rod significantly out of position and an event sensitive to that rod position is small.

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

Required Action A.2.1 includes six distinct requirements for verification of the position of rods associated with an inoperable RPI using incore power distribution measurements information:

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

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

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

(continued)

ACTIONS (continued)

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

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

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

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

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

~~A.2.1, A.2.2~~

~~The control rod drive mechanism (a portion of the rod control system) consists of four separate subassemblies; 1) the pressure vessel, 2) the coil stack assembly, 3) the latch assembly, and 4) the drive rod assembly. The coil stack assembly contains three operating coils; 1) the stationary gripper coil, 2) the moveable gripper coil, and 3) the lift coil. In support of Actions A.2.1 and A.2.2, a Temporary Alteration (TA) to the configuration of the plant is implemented to provide instrumentation for the monitoring of the rod control system parameters in the Main Control Room. The TA creates a circuit that monitors the operation and timing of the lift coil and the stationary gripper coil. Additional details regarding the TA are provided in the FSAR (Ref. 14).~~

~~Required Actions A.2.1 and A.1 are essentially the same. Therefore, the discussion provided above for Required Action A.1 applies to Required Action A.2.1. The options provided by Required Actions A.2.1 and A.2.2 allow for continued operation in a situation where the component causing the ARPI to be inoperable is inaccessible due to operating conditions (adverse radiological or temperature environment). In this situation, repair of the ARPI cannot occur until the unit is in an operating MODE that allows access to the failed components.~~

~~In addition to the initial 8 hour verification, Required Action A.2.1 also requires the following for the rod with the failed ARPI:~~

~~1. Verification of the position of the rod every 31 days using either the incore movable detectors or the PDMS.~~

~~2. Verification of the position of the rod using either the incore movable detectors or the PDMS within 8 hours of the performance of Required Action A.2.2 whenever there is an indication of unintended rod movement based on the parameters of the rod~~

(continued)

~~control system.~~

~~ACTIONS~~ ~~A.2.1, A.2.2 (continued)~~

~~Required Action A.2.2 is in lieu of the verification of the position of the rod using either the incore movable detectors or PDMS every 8 hours as required by Required Action A.1. This action alleviates the potential for excessive wear on the incore system due to the repeated use of the incore detectors. Once the position of the rod with the failed ARPI is confirmed through the use of either the moveable incore detectors or PDMS in accordance with Required Action A.2.1, the parameters of the rod control system must be monitored until the failed ARPI is repaired. Should the review of the rod control system parameters indicate unintended movement of the rod, the position of the rod must be verified within 8 hours in accordance with Required Action A.2.1. Should there be unintended movement of the rod with the failed ARPI, an alarm will be received. Alarms will also be received if the rod steps in a direction other than what was demanded, and if the circuitry of the TA fails. Receipt of any alarm requires the verification of the position of the rod in accordance with Required Action A.2.1.~~

~~Required Actions A.2.1, A.2.2 and A.2.3 are modified by a note. The note clarifies that rod position monitoring by Required Actions A.2.1 and A.2.2 shall only be applied to one rod with an inoperable ARPI and shall only be allowed until the end of the current cycle. Further, Required Actions A.2.1, A.2.2 and A.2.3 shall not be allowed after the plant has been in MODE 5 or other plant condition, for a sufficient period of time, in which the repair of the inoperable ARPI(s) could have safely been performed.~~

~~As indicated previously, the modifications required for the monitoring of the rod control system will be implemented as a TA. Implementation of the TA includes a review for the impact on plant procedures and training. This ensures that changes are initiated for key issues like the monitoring requirements in the control room, and operator training on the temporary equipment.~~

~~A.2.3~~

~~Required Action A.2.3 addresses two contingency measures when the TA is utilized:~~

1. ~~Verification of the position of the rod with the inoperable ARPI by use of either the moveable incore detectors or PDMS, whenever the rod is moved greater than 12 steps in one direction.~~
2. ~~Operation of the unit when THERMAL POWER is less than or equal to 50% RTP.~~

~~For the first contingency, the rod group alignment limits of LCO 3.1.5 require that all shutdown and control rods be within 12 steps of their group step counter demand position. The limits on shutdown or control rod~~

BASES

ACTIONS (continued)

~~A.2.3 (continued)~~

~~alignments ensure that the assumptions in the safety analysis will remain valid and that the assumed reactivity will be available to be inserted for a unit shutdown. Therefore, this conservative measure ensures LCO 3.1.5 is met whenever the rod with the inoperable ARPI is moved greater than 12 steps. For the second contingency, the reduction of THERMAL POWER to less than or equal to 50% RTP puts the core into a condition where rod position is not significantly affecting core peaking factors (Ref. 13). Consistent with LCO 3.0.4 and this action, unit startup and operation to less than or equal to 50% RTP may occur with one ARPI per group inoperable. However, prior to escalating THERMAL POWER above 50% RTP, the position of the rod with an inoperable ARPI must be verified by use of either the moveable incore detectors or PDMS. Once 100% RTP is achieved, the position of the rod must be reverified within 8 hours by use of either the moveable incore detectors or PDMS. Monitoring of the rod control system parameters in accordance with Required Action A.2.2 for the rod with an inoperable ARPI may resume upon completion of the verification at 100% RTP.~~

A.3

Reduction of THERMAL POWER to ≤ 50% RTP puts core into a condition where rod position is not significantly affecting core peaking factors (Ref. 4). 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 positon determination by Required Action A.1 above.

~~Required Action A.3 applies whenever the TA is not utilized. The discussion for Required Action A.2.3 (above) clarified that a reduction of THERMAL POWER to less than or equal to 50% RTP puts the core into a condition where rod position is not significantly affecting core peaking factors (Ref. 13). The allowed Completion Time of 8 hours is reasonable, based on operating experience, for reducing power to less than or equal to 50% RTP from full power conditions without challenging plant systems and allowing for rod position determination by Required Action A.1 above. Consistent with LCO 3.0.4 and this action, unit startup and operation to less than or equal to 50% RTP may occur with one ARPI per group inoperable. Thermal Power may be escalated to 100% RTP as long as Required Action A.1 is satisfied.~~

B.1 and B.2

When more than one RPI 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.

(continued)

BASES

ACTIONS (continued)

The inoperable RPIs must be restored, such that a maximum of one RPI per group is inoperable, within 24 hours. The 24 hour Completion Time provides sufficient time to troubleshoot and restore the RPI system to operation while avoiding the plant challenges associated with the shutdown without full rod position indication.

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

~~B~~C.1 and ~~B~~C.2

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

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

~~C~~D.1.1 and ~~C~~D.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 ~~A~~RPI System. Since normal power operation does not require excessive movement of rods, verification by administrative means that the rod position indicators are OPERABLE and the most withdrawn rod and the least withdrawn rod are ≤~~less than or equal to~~ 12 steps apart within the allowed Completion Time of once every 8 hours is adequate.

~~C~~D.2

Reduction of THERMAL POWER to ≤~~less than or equal to~~ 50% RTP puts the core into a condition where rod position is not significantly affecting core peaking factor limits (Ref. 13). The allowed Completion Time of 8 hours provides an acceptable period of time to verify the rod positions per Required Actions ~~C~~D.1.1 and ~~C~~D.1.2 or reduce power to ≤~~less than or equal to~~ 50% RTP.

(continued)

DE.1

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

SURVEILLANCE REQUIREMENTS

SR 3.1.8.1

Verification that the ARPI agrees with the demand position within 12 steps ensures that the ARPI is operating correctly.

This Surveillance is performed prior to reactor criticality after each removal of the reactor head, as there is ~~The 18 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and~~ the potential for unnecessary plant transients if the SR were performed with the reactor at power. ~~Operating experience has shown these components usually pass the SR when performed at a Frequency of once every 18 months. Therefore, the Frequency was concluded to be acceptable from a reliability standpoint.~~

The Surveillance is modified by a Note which states it is not required to be met for RPIs associated with rods that do not meet LCO 3.1.5. If a rod is known to not be within 12 steps of the group demand position, the ACTIONS of LCO 3.1.5 provide the appropriate Actions.

(continued)

BASES (continued)

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 13, "Instrumentation and Control."

2. Watts Bar FSAR, Section 15.2.1, “Uncontrolled Rod Cluster Control Assembly Bank Withdrawal From a Subcritical Condition."

3. Watts Bar FSAR, Section 15.2.2, “Uncontrolled Rod Cluster Control Assembly Bank Withdrawal At Power."

4. Watts Bar FSAR, Section 15.2.3, “Rod Cluster Control Assembly Misalignment."

5. Watts Bar FSAR, Section 15.2.4, “Uncontrolled Boron Dilution."

6. Watts Bar FSAR, Section 15.2.5, “Partial Loss of Forced Reactor Coolant Flow."

7. Watts Bar FSAR, Section 15.2.13, “Accidental Depressurization of the Main Steam System."

8. Watts Bar FSAR, Section 15.3.4, “Complete Loss of Forced Reactor Coolant Flow."

9. Watts Bar FSAR, Section 15.3.6, “Single Rod Cluster Control Assembly Withdrawal At Full Power."

10. Watts Bar FSAR, Section 15.4.2.1, “Major Rupture of Main Steam Line."

11. Watts Bar FSAR, Section 15.4.4, “Single Reactor Coolant Pump Locked Rotor."

12. Watts Bar FSAR, Section 15.4.6, “Rupture of a Control Rod Drive Mechanism Housing (Rod Cluster Control Assembly Ejection)."

13. Watts Bar FSAR, Section 4.3, “Nuclear Design."

14. Watts Bar FSAR, Section 7.7.1.3.2, “Main Control Room Rod Position Indication.”

15. WCAP-12472-P-A,“BEACON Core Monitoring and Operations Support System,” August 1994.

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ATTACHMENT 7 - PROPOSED TECHNICAL SPECIFICATION BASES CHANGES (MARK-UP) FOR WBN UNIT 2 (FOR INFORMATION ONLY)

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.5 Rod Group Alignment Limits

BASES

BACKGROUND

The OPERABILITY (e.g., 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," and GDC 26, "Reactivity Control System Redundancy and Capability," (Ref. 1), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors" (Ref. 2).

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

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

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

The RCCAs are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control (Shutdown Banks C and D have only one group each). A group consists of two or more RCCAs that are electrically paralleled to step simultaneously. Except for Shutdown Banks C and D,

(continued)

BASES

BACKGROUND (continued)

a bank of RCCAs consists of two groups that are moved in a staggered fashion, but always within one step of each other. There are four control banks and four shutdown banks.

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

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

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

The RPI System provides an accurate indication of actual control rod position, but at a lower precision than the step counters. This system is based on inductive analog signals from a series of coils spaced along a hollow tube with a center to center distance of 3.75 inches, which is six steps. The normal indication accuracy of the RPI System is ± 6 steps (± 3.75 inches), and the maximum uncertainty is ± 12 steps (± 7.5 inches). With an indicated deviation of 12 steps between the group step counter and RPI, the maximum deviation between actual rod position and the demand position could be 24 steps, or 15 inches.

APPLICABLE SAFETY ANALYSES

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

a. There be no violations of:

   1. ~~specified~~ Specified acceptable fuel design limits, or

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

b. The core remains subcritical after accident transients other than a main steam line break (MSLB).

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

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

Another type of misalignment occurs if one RCCA fails to insert upon a reactor trip in response to a main steam pipe rupture and remains stuck fully withdrawn. This condition is assumed in the evaluation to determine that the required SDM is met with the maximum worth RCCA also fully withdrawn (Ref. 5). The reactor is shutdown by the boric acid injection delivered by the ECCS.

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)

BASES

APPLICABLE SAFETY ANALYSES (continued)

Continued operation of the reactor with a misaligned control rod is allowed if the heat flux hot channel factor ($F_Q(Z)$) and the nuclear enthalpy hot channel factor ($F^N_{\Delta H}$) are verified to be within their limits in the COLR and the safety analysis is verified to remain valid. When a control rod is misaligned, the assumptions that are used to determine the rod insertion limits, AFD limits, and quadrant power tilt limits are not preserved. Therefore, the limits may not preserve the design peaking factors, and $F_Q(Z)$ and $F^N_{\Delta H}$ must be verified directly using incore power distribution measurements. 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 control rod OPERABILITY requirements (i.e., trippability) ~~also~~ are separate from the alignment requirements, which ensure that the RCCAs and banks maintain the correct power distribution and rod alignment. The rod OPERABILITY requirement is satisfied provided the rod will fully insert in the required rod drop time assumed in the safety analysis. Rod control malfunctions that result in the inability to move a rod (e.g., rod lift coil failures), but that do not impact trippability, do not result in rod inoperability.

The requirement to maintain the rod alignment to within plus or minus 12 steps is conservative. The minimum misalignment assumed in safety analysis is 24 steps (15 inches), and in some cases a total misalignment from fully withdrawn to fully inserted is assumed.

Failure to meet the requirements of this LCO may produce unacceptable power peaking factors and LHRs, or unacceptable SDMs, all of which may constitute initial conditions inconsistent with the safety analysis.

BASES (continued)

APPLICABILITY

The requirements on RCCA OPERABILITY and alignment are applicable in MODES 1 and 2 because these are the only MODES in which neutron (or fission) power is generated, and the OPERABILITY (i.e., trippability) and alignment of rods have the potential to affect the safety of the plant. In MODES 3, 4, 5, and 6, the alignment limits do not apply because the control rods are bottomed and the reactor is shut down and not producing fission power. In the shutdown MODES, the OPERABILITY of the shutdown and control rods has the potential to affect the required SDM, but this effect can be compensated for by an increase in the boron concentration of the RCS. See LCO 3.1.1, "SHUTDOWN MARGIN (SDM) - T_{avg} > 200°F," for SDM in MODES 3 and 4, LCO 3.1.2, "Shutdown Margin (SDM) - $T_{avg} \leq$ 200°F" for SDM in MODE 5, and LCO 3.9.1, "Boron Concentration," for boron concentration requirements during refueling.

ACTIONS

A.1.1 and A.1.2

When one or more rods are ~~untrippable~~inoperable (i.e., untrippable), there is a possibility that the required SDM may be adversely affected. Under these conditions, it is important to determine the SDM, and if it is less than the required value, initiate boration until the required SDM is recovered. The Completion Time of 1 hour is adequate for determining SDM and, if necessary, for initiating boration to restore SDM.

In this situation, SDM verification must include the worth of the untrippable rod, as well as a rod of maximum worth.

A.2

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

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

(continued)

ACTIONS (continued)

B.1.1 and B.1.2

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

An alternative to realigning a single misaligned RCCA to the group average position is to align the remainder of the group to the position of the misaligned RCCA. However, this must be done without violating the bank sequence, overlap, and insertion limits specified in LCO 3.1.6, "Shutdown Bank Insertion Limits," and LCO 3.1.7, "Control Bank Insertion Limits." ~~The Completion Time of 1 hour gives the operator sufficient time to adjust the rod positions in an orderly manner.~~

~~B.2.1.1 and B.2.1.2~~

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

In many cases, realigning the remainder of the group to the misaligned rod may not be desirable. For example, realigning control bank B to a rod that is misaligned 15 steps from the top of the core would require a significant power reduction, since control bank D must be moved fully in and control bank C must be moved in to approximately 100 to 115 steps.

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

(continued)

ACTIONS (continued)

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

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

Reduction of power to 75% RTP ensures that local LHR increases due to a misaligned RCCA will not cause the core design criteria to be exceeded (Ref. 6). The Completion Time of 2 hours gives the operator sufficient time to accomplish an orderly power reduction without challenging the Reactor Protection System.

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

Verifying that $F_Q(Z)$, as approximated by $F^C_Q(Z)$ and $F^W_Q(Z)$, and $F^N_{\Delta H}$ are within the required limits ensures that current operation at 75% RTP with a rod misaligned is not resulting in power distributions that may invalidate safety analysis assumptions at full power. The Completion Time of 72 hours allows sufficient time to obtain an incore power distribution measurement and to calculate $F_Q(Z)$ and $F^N_{\Delta H}$.

Once current conditions have been verified acceptable, time is available to perform evaluations of accident analysis to determine that core limits will not be exceeded during a Design Basis Event for the duration of operation under these conditions. The accident analyses presented in UFSAR Chapter 15 (Ref. 3) that may be adversely affected will be evaluated to ensure that the analyses remain valid for the duration of continued operation under these conditions. A Completion Time of 5 days is sufficient time to obtain the required input data and to perform the analysis.

C.1

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

BASES

ACTIONS (continued)

D.1.1 and D.1.2

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

D.2

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

To achieve this status, the unit must be brought to at least MODE 3 within 6 hours. The allowed Completion Time is reasonable, based on operating experience, for reaching MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.1.5.1

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. If the rod position deviation monitor is inoperable, a Frequency of 4 hours accomplishes the same goal. 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.

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 3.1.8, “Rod Position Indication,” provides Actions to verify the rods are in alignment when one or more rod positon indicators are inoperable.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.1.5.1 (continued)

The Surveillance is modified by a Note which states that the SR is not required to be performed until 1 hour after associated rod motion. Control rod temperature affects the accuracy of the rod position indication system. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated position is expected to change with time as the drive shaft temperature changes. The one hour period allows control rod temperature to stabilize following rod movement in order to ensure the indicated rod positon is accurate.

SR 3.1.5.2

Verifying each control rod is OPERABLE would require that each rod be tripped. However, in MODES 1 and 2, tripping each control rod would result in radial or axial power tilts, or oscillations. Exercising each individual control rod every 92 days provides increased confidence that all rods continue to be OPERABLE without exceeding the alignment limit, even if they are not regularly tripped. Moving each control rod by 10 steps will not cause radial or axial power tilts, or oscillations, to occur. The 92 day Frequency takes into consideration other information available to the operator in the control room and SR 3.1.5.1, which is performed more frequently and adds to the determination of OPERABILITY of the rods. Between required performances of SR 3.1.5.2 (determination of control rod OPERABILITY by movement), if a control rod(s) is discovered to be immovable, but remains trippable and aligned, the control rod(s) is considered to be OPERABLE. At any time, if a control rod(s) is immovable, a determination of the trippability (OPERABILITY) of the control rod(s) must be made, and appropriate action taken.

SR 3.1.5.3

Verification of rod drop times allows the operator to determine that the maximum rod drop time permitted is consistent with the assumed rod drop time used in the safety analysis. Measuring rod drop times prior to reactor criticality after each~~,~~ ~~after initial fuel loading and~~ reactor vessel head removal~~,~~ ensures that the reactor internals and rod drive mechanism will not interfere with rod motion or rod drop time, and that no degradation in these systems has occurred that would adversely affect control rod motion or drop time. This testing is performed with all RCPs operating and the average moderator temperature ≥ 551°F to simulate a reactor trip under actual conditions.

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

BASES (continued)

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 10, "Reactor Design," and General Design Criterion 26, "Reactivity Control System Redundancy and Capability."

2. Title 10, Code of Federal Regulations, Part 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors."

3. Watts Bar FSAR, Section 15.0, "Accident Analyses."

4. Watts Bar FSAR, Section 15.2.3, "Rod Cluster Control Assembly Misalignment."

5. Watts Bar FSAR, Section 15.4.2, "Major Secondary System Pipe Rupture."

6. Watts Bar FSAR, Section 15.3.6, "Single Rod Cluster Control Assembly Withdrawal at Full Power."

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.6 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 Capability," and GDC 28, "Reactivity Limits" (Ref. 1), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors" (Ref. 2). Limits on control rod insertion have been established, and all rod positions are monitored and controlled during power operation to ensure that the power distribution and reactivity limits defined by the design power peaking and SDM limits are preserved.

The rod cluster control assemblies (RCCAs) are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control (Shutdown Banks C and D have only one group each). A group consists of two or more RCCAs that are electrically paralleled to step simultaneously. Except for Shutdown Banks C and D, a bank of RCCAs consists of two groups that are moved in a staggered fashion, but always within one step of each other. There are four control banks and four shutdown banks. See LCO 3.1.5, "Rod Group Alignment Limits," for control and shutdown rod OPERABILITY and alignment requirements, and LCO 3.1.8, "Rod Position Indication," for position indication requirements.

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

(continued)

BASES

BACKGROUND (continued)

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 are controlled manually by the control room operator. During normal unit operation, the shutdown banks are either fully withdrawn or fully inserted. The shutdown banks must be completely withdrawn from the core, prior to withdrawing any control banks during an approach to criticality. The shutdown banks can be fully withdrawn without the core going critical. This provides available negative reactivity in the event of boration errors. The shutdown banks are then left in this position until the reactor is shut down. They add negative reactivity to shut down the reactor upon receipt of a reactor trip signal.

APPLICABLE SAFETY ANALYSES

On a reactor trip, all RCCAs (shutdown banks and control banks), except the most reactive RCCA, are assumed to insert into the core. The shutdown banks shall be at or above their insertion limits and available to insert the maximum amount of negative reactivity on a reactor trip signal. The control banks may be partially inserted in the core, as allowed by LCO 3.1.7, "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) - T_{avg} > 200°F," and LCO 3.1.2, "SHUTDOWN MARGIN (SDM) - T_{avg} ≤ 200°F") following a reactor trip from full power. The combination of control banks and shutdown banks (less the most reactive RCCA, which is assumed to be fully withdrawn) is sufficient to take the reactor from full power conditions at rated temperature to zero power, and to maintain the required SDM at rated no load temperature (Ref. 3). The shutdown bank insertion limit also limits the reactivity worth of an ejected shutdown rod.

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

a. There be no violations of:

    1. ~~specified~~ Specified acceptable fuel design limits, or

    2. RCS pressure boundary integrity; and

b. The core remains subcritical after accident transients other than a main steam line break (MSLB).

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

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).

LCO

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

The shutdown bank insertion limits are defined in the COLR.

The LCO is modified by a Note indicating the LCO requirement is not applicable to shutdown banks being inserted while performing SR 3.1.5.2. This SR verifies the freedom of the rods to move, and may require the shutdown bank to move below the LCO limits, which would normally violate the LCO. This Note applies to each shutdown bank as it is moved below the insertion limit to perform the SR. This Note is not applicable should a malfunction stop performance of the SR.

APPLICABILITY

The shutdown banks must be within their insertion limits, with the reactor in MODES 1 and 2. ~~The applicability in MODE 2 begins prior to initial control bank withdrawal, during an approach to criticality, and continues throughout MODE 2, until all control bank rods are again fully inserted by reactor trip or by shutdown.~~ This ensures that a sufficient amount of negative reactivity is available to shut down the reactor and maintain the required SDM following a reactor trip. The shutdown banks do not have to be within their insertion limits in MODE 3, unless an approach to criticality is being made. Refer to LCO 3.1.1 and LCO 3.1.2 for SDM requirements in MODES 3, 4, and 5. LCO 3.9.1, "Boron Concentration," ensures adequate SDM in MODE 6.

~~The Applicability requirements have been modified by a Note indicating the LCO requirement is suspended during SR 3.1.5.2. This SR verifies the freedom of the rods to move, and requires the shutdown bank to move below the LCO limits, which would normally violate the LCO.~~

(continued)

BASES

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 failures that would prevent movement of a shutdown bank.

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

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

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

~~B~~C.1

If the ~~shutdown banks cannot be restored to within their insertion limits within 2 hours~~Required Actions and 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.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.6.1

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

The Surveillance is modified by a Note which states that the SR is not required to be performed for shutdown banks until 1 hour after motion of rods in those banks. Rod temperature affects the accuracy of the rod position indication system. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated position is expected to change with time as the drive shaft temperature changes. The one hour period allows rod temperature to stabilize following rod movement in order to ensure the indicated position is accurate.

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

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 10, "Reactor Design," General Design Criterion 26, "Reactivity Control System Redundancy and Capability," and General Design Criterion 28, "Reactivity Limits."
2. Title 10, Code of Federal Regulations, Part 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors."
3. Watts Bar FSAR, Section 15.0, "Accident Analyses."

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.7 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 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 Capability," and GDC 28, "Reactivity Limits" (Ref. 1), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors" (Ref. 2). Limits on control rod insertion have been established, and all rod positions are monitored and controlled during power operation to ensure that the power distribution and reactivity limits defined by the design power peaking and SDM limits are preserved.

The rod cluster control assemblies (RCCAs) are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control (Shutdown Banks C and D have only one group each). A group consists of two or more RCCAs that are electrically paralleled to step simultaneously. Except for Shutdown Banks C and D, a bank of RCCAs consists of two groups that are moved in a staggered fashion, but always within one step of each other. There are four control banks and four shutdown banks. See LCO 3.1.5, "Rod Group Alignment Limits," for control and shutdown rod OPERABILITY and alignment requirements, and LCO 3.1.8, "Rod Position Indication," for position indication requirements.

The control bank insertion limits are specified in the COLR. An example is provided for information only in Figure B 3.1.7-1. The control banks are required to be at or above the insertion limit lines.

Figure B 3.1.7-1 also indicates how the control banks are moved in an overlap pattern. Overlap is the distance traveled together by two control banks. The predetermined position of control bank C, at which control bank D will begin to move with bank C on a withdrawal, as an example may be at 128 steps. Therefore, in this example, control bank C overlaps control bank D from 128 steps to the fully withdrawn position for control bank C. The fully withdrawn position and predetermined overlap positions are defined in the COLR.

(continued)

BASES

BACKGROUND (continued)

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

The power density at any point in the core must be limited, so that the fuel design criteria are maintained. Together, LCO 3.1.5, “Rod Group Alignment Limits,” LCO 3.1.6, "Shutdown Bank Insertion Limits," LCO 3.1.7, “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 subject LCO limits will prevent fuel cladding failures that would breach the primary fission product barrier and release fission products to the reactor coolant in the event of a loss of coolant accident (LOCA), loss of flow, ejected rod, or other accident requiring termination by a Reactor Trip System (RTS) trip function.

BASES (continued)

APPLICABLE SAFETY ANALYSES

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

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

a. There be no violations of:

   1. ~~specified~~ Specified acceptable fuel design limits, or

   2. Reactor Coolant System pressure boundary integrity; and

b. The core remains subcritical after accident transients other than a main steam line break (MSLB).

As such, the shutdown and control bank insertion limits affect safety analysis involving core reactivity and power distributions (Ref. 3 through 13).

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. 5, 6, 8 and 11).

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

The control and shutdown bank insertion limits ensure that safety analyses assumptions for SDM, ejected rod worth, and power distribution peaking factors are preserved (Ref. 3 through 13).

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

BASES (continued)

LCO

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

The LCO is modified by a Note indicating the LCO requirement is not applicable to control banks being inserted while performing SR 3.1.5.2. This SR verifies the freedom of the rods to move, and may require the control bank to move below the LCO limits, which would normally violate the LCO. This Note applies to each control bank as it is moved below the insertion limit to perform the SR. This Note is not applicable should a malfunction stop performance of the SR.

APPLICABILITY

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

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 shutdown bank.

Condition A is limited to Control Banks A, B, or C. The allowance is not required for Control Bank D because the full power bank insertion limit can be met during performance of the SR 3.1.5.2 control rod freedom of movement (trippability) testing.

BASES (continued)

ACTIONS (continued)

AB.1.1, AB.1.2, AB.2, BC.1.1, BC.1.2, and BC.2

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

a. Reducing power to be consistent with rod position; or

b. Moving rods to be consistent with power.

Also, verification of SDM or initiation of boration to regain SDM is required within 1 hour, since the SDM in MODES 1 and 2 normally ensured by adhering to the control and shutdown bank insertion limits (see LCO 3.1.1, "SHUTDOWN MARGIN (SDM) - T_{avg} > 200°F") has been upset. If control banks are not within their insertion limits, then SDM will be verified by performing a reactivity balance calculation, considering the effects listed in the Bases for SR 3.1.1.1.

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

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

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

CD.1

If the Required Actions A.1 and A.2, or B.1 and B.2 cannot be completed within the associated Completion Times, the plant must be brought to MODE 32 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 (continued)

SURVEILLANCE REQUIREMENTS

SR 3.1.7.1

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 3.1.7.2

With an OPERABLE bank insertion limit monitor, verification of the control bank insertion limits at a Frequency of 12 hours is sufficient to ensure OPERABILITY of the bank insertion limit monitor and to detect control banks that may be approaching the insertion limits since, normally, very little rod motion occurs in 12 hours. If the insertion limit monitor becomes inoperable, verification of the control bank position at a Frequency of 4 hours is sufficient to detect control banks that may be approaching the insertion limits.

The Surveillance is modified by a Note stating that the SR is not required to be performed for control banks until 1 hour after motion of rods in those banks. Control rod temperature affects the accuracy of the rod position indication system. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated position is expected to change with time as the drive shaft temperature changes. The one hour period allows control rod temperature to stabilize following rod movement in order to ensure the indicated rod position is accurate.

SR 3.1.7.3

When control banks are maintained within their insertion limits as checked by SR 3.1.7.2 above, it is unlikely that their sequence and overlap will not be in accordance with requirements provided in the COLR.

~~A Frequency of 12 hours is consistent with the insertion limit check above in SR 3.1.7.2.~~The Surveillance is modified by a Note stating that the SR is not required to be performed for control banks until 1 hour after motion of rods in those banks. Control rod temperature affects the accuracy of the rod position indication system. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated position is expected to change with time as the drive shaft temperature

BASES (continued)

SURVEILLANCE REQUIREMENTS (continued)

SR 3.1.7.3 (continued0

following rod movement in order to ensure the indicated rod position is accurate.

A Frequency of 12 hours is consistent with the insertion limit check above in SR 3.1.7.2.

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 10, "Reactor Design," General Design Criterion 26, "Reactivity Control System Redundancy and Capability," and General Design Criterion 28, "Reactivity Limits."

2. Title 10, Code of Federal Regulations, Part 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors."

3. Watts Bar FSAR, Section 15.2.1, "Uncontrolled Rod Cluster Control Assembly Bank Withdrawal From a Subcritical Condition."

4. Watts Bar FSAR, Section 15.2.2, "Uncontrolled Rod Cluster Control Assembly Bank Withdrawal At Power."

5. Watts Bar FSAR, Section 15.2.3, "Rod Cluster Control Assembly Misalignment."

6. Watts Bar FSAR, Section 15.2.4, "Uncontrolled Boron Dilution."

7. Watts Bar FSAR, Section 15.2.5, "Partial Loss of Forced Reactor Coolant Flow."

8. Watts Bar FSAR, Section 15.2.13, "Accidental Depressurization of the Main Steam System."

9. Watts Bar FSAR, Section 15.3.4, "Complete Loss of Forced Reactor Coolant Flow."

10. Watts Bar FSAR, Section 15.3.6, "Single Rod Cluster Control Assembly Withdrawal At Full Power."

11. Watts Bar FSAR, Section 15.4.2.1, "Major Rupture of Main Steam Line."

12. Watts Bar FSAR, Section 15.4.4, "Single Reactor Coolant Pump Locked Rotor."

13. Watts Bar FSAR, Section 15.4.6, "Rupture of a Control Rod Drive Mechanism Housing (Rod Cluster Control Assembly Ejection)."

BASES

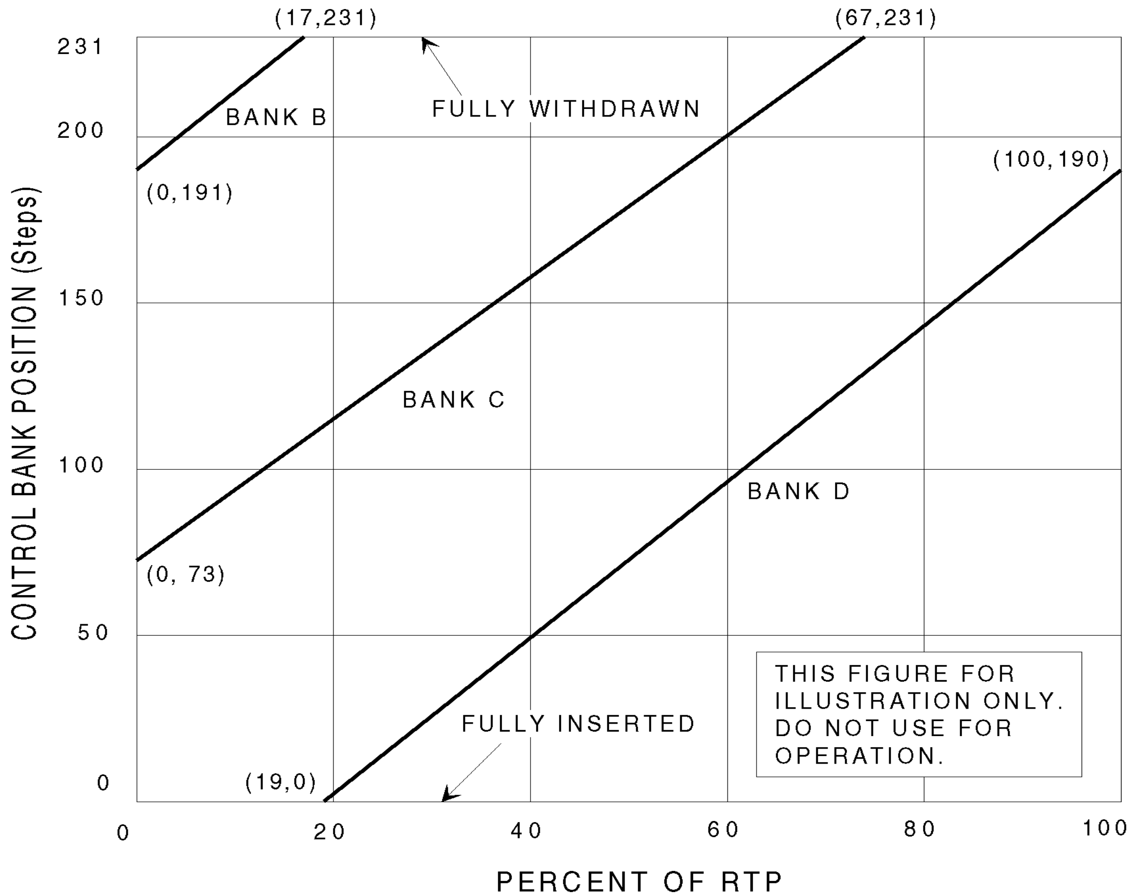

Figure B 3.1.7-1 (page 1 of 1)
Control Bank Insertion vs. Percent RTP

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.8 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 3.1.8 is required to ensure OPERABILITY of the control rod position indicators to determine control rod positions and thereby ensure compliance with the control rod alignment and insertion limits.

The OPERABILITY, including position indication, of the shutdown and control rods is an initial assumption in all safety analyses that assume rod insertion upon reactor trip. Maximum rod misalignment is an initial assumption in the safety analysis that directly affects core power distributions and assumptions of available SDM. Rod position indication is required to assess OPERABILITY and misalignment.

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

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

Rod cluster control assemblies (RCCAs), or rods, are moved out of the core (up or withdrawn) or into the core (down or inserted) by their control rod drive mechanisms. The RCCAs are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control (Shutdown Banks C and D have only one group each).

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

(continued)

BASES

BACKGROUND (continued)

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

The RPI System provides an accurate indication of actual control rod position, but at a lower precision than the step counters. This system is based on inductive analog signals from a series of coils spaced along a hollow tube with a center-to-center distance of 3.75 inches, which is 6 steps. The normal indication accuracy of the RPI System is ± 6 steps (± 3.75 inches), and the maximum uncertainty is ± 12 steps (± 7.5 inches). With an indicated deviation of 12 steps between the group step counter and RPI, the maximum deviation between actual rod position and the demand position could be 24 steps, or 15 inches.

The Power Distribution Monitoring System (PDMS) as controlled by Technical Requirements Manual Section 3.3.~~3~~ 9 develops a detailed three dimensional power distribution via its nodal code coupled with updates from plant instrumentation, including the fixed incore detectors. The monitored power distribution is compared to the reference power distribution corresponding to all control rods properly aligned. Agreement between the two power distributions can be used to indirectly verify the control rod is aligned.

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 through 12), with control or shutdown rods operating outside their limits undetected. Therefore, the acceptance criteria for rod position indication is that rod positions must be known with sufficient accuracy in order to verify the core is operating within the group sequence, overlap, design peaking limits, ejected rod worth, and with minimum SDM (LCO 3.1.6, "Shutdown Bank Insertion Limits," and LCO 3.1.7, "Control Bank Insertion Limits"). The rod positions must also be known in order to verify the alignment limits are preserved (LCO 3.1.5, "Rod Group Alignment Limits"). Control rod positions are continuously monitored to provide operators with information that ensures the plant is operating within the bounds of the accident analysis assumptions.

(continued)

BASES (continued)

APPLICABLE SAFETY ANALYSES (continued)

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

LCO

LCO 3.1.8 specifies that the RPI System and the Bank Demand Position Indication System be OPERABLE for all control rods. For the control rod position indicators to be OPERABLE requires meeting the SR of the LCO (when required) and the following:

a. The RPI System indicates within 12 steps of the group step counter demand position as required by LCO 3.1.5, "Rod Group Alignment Limits;"

b. For the RPI System there are no failed coils; and

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

The SR of the LCO is modified by a Note which states it is not required to be met for RPIs associated with rods that do not meet LCO 3.1.5. If a rod is known to not be within 12 steps of the group demand position, the Actions of LCO 3.1.5 provide appropriate Actions. Otherwise, ~~The~~ the 12 step agreement limit between the Bank Demand Position Indication System and the RPI System indicates that the Bank Demand Position Indication System is adequately calibrated, and can be used for indication of the measurement of control rod bank position.

A deviation of less than the allowable limit, given in LCO 3.1.5, in position indication for a single control rod, ensures high confidence that the position uncertainty of the corresponding control rod group is within the assumed values used in the analysis (that specified control rod group insertion limits).

These requirements ensure that control rod position indication during power operation and PHYSICS TESTS is accurate, and that design assumptions are not challenged. OPERABILITY of the position indicator channels ensures that inoperable, misaligned, or mispositioned control rods can be detected. Therefore, power peaking, ejected rod worth, and SDM can be controlled within acceptable limits.

(continued)

BASES (continued)

LCO (continued)

The LCO is modified by a Note stating that the RPI system is not required to be OPERABLE for 1 hour following movement of the associated rods. Control and shutdown rod temperature affects the accuracy of the RPI System. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated position is expected to change with time as the drive shaft temperature changes. The one hour period allows temperature to stabilize following rod movement in order to ensure the indicated positon is accurate.

APPLICABILITY

The requirements on the RPI and step counters are only applicable in MODES 1 and 2 (consistent with LCO 3.1.5, LCO 3.1.6, and LCO 3.1.7), 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.

(continued)

ACTIONS

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

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

When one RPI channel per group in one or more group fails, the position of the rod can still be determined indirectly by use of incore power distribution measurement information. Incore power distribution measurement information is obtained from an OPERABLE Power Distribution Monitoring System (PDMS) (Ref. 15). The Required Action may also be satisfied by ensuring at least once per 8 hours that F_Q satisfies LCO 3.2.1, $F^N_{\Delta H}$ satisfies LCO 3.2.2, and SHUTDOWN MARGIN is within the limits provided in the COLR, provided the non-indicating rods have not been moved. Based on experience, normal power operation does not require excessive movement of banks. If a bank has been significantly moved, the Required Action of ~~B~~C.1 or ~~B~~C.2 below is required. Therefore, verification of rod 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 a rod with an inoperable RPI once per 8 hours. Required Action A.2.1 provides an alternative. Required Action A.2.1 requires verification of rod position using power distribution measurement information every 31 EFPD, which coincides with the normal measurements to verify core power distribution.

Required Action A.2.1 includes six distinct requirements for verification of the position of rods associated with an inoperable RPI using incore power distribution measurement information:

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

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

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

(continued)

BASES (continued)

ACTIONS

A.1, A.2.1, and A.2.2 (continued)

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

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

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

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

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

~~A.2.1, A.2.2~~

~~The control rod drive mechanism (a portion of the rod control system) consists of four separate subassemblies; 1) the pressure vessel, 2) the coil stack assembly, 3) the latch assembly, and 4) the drive rod assembly. The coil stack assembly contains three operating coils; 1) the stationary gripper coil, 2) the moveable gripper coil, and 3) the lift coil. In support of Actions A.2.1 and A.2.2, a Temporary Alteration (TA) to the configuration of the plant is implemented to provide instrumentation for the monitoring of the rod control system parameters in the Main Control Room. The TA creates a circuit that monitors the operation and timing of the lift coil and the stationary gripper coil. Additional details regarding the TA are provided in the FSAR (Ref. 14).~~

(continued)

BASES

ACTIONS (continued)

A.3

Reduction of THERMAL POWER to ≤ 50% RTP puts core into a condition where rod position is not significantly affecting core peaking factors (Ref. 4). ~~Required Action A.3 applies whenever the TA is not utilized or the position of the rod with an inoperable RPI cannot be verified indirectly. The discussion for Required Action A.2.3 (above) clarified that a reduction of THERMAL POWER to less than or equal to 50% RTP puts the core into a condition where rod position is not significantly affecting core peaking factors (Ref. 13).~~ The allowed Completion Time of 8 hours is reasonable, based on operating experience, for reducing power to ≤~~less than or equal to~~ 50% RTP from full power conditions without challenging plant systems and allowing for rod position determination by Required Action A.1 above. ~~Consistent with LCO 3.0.4 and this action, unit startup and operation to less than or equal to 50% RTP may occur with one RPI per group inoperable. Thermal Power may be escalated to 100% RTP as long as Required Action A.1 is satisfied.~~

B.1 and B.2

When more than one RPI 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 RPIs must be restored, such that a maximum of one RPI per group is inoperable, within 24 hours. The 24 hour Completion Time provides sufficient time to troubleshoot and restore the RPI system to operation while avoiding the plant challenges associated with the shutdown without full rod position indication.

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

(continued)

BASES

ACTIONS (continued)

BC.1 and BC.2

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

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

CD.1.1 and CD.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 RPI System. Since normal power operation does not require excessive movement of rods, verification by administrative means that the rod position indicators are OPERABLE and the most withdrawn rod and the least withdrawn rod are ≤less than or equal to 12 steps apart within the allowed Completion Time of once every 8 hours is adequate.

(continued)

BASES

ACTIONS (continued)

~~C~~D.2

Reduction of THERMAL POWER to ≤~~less than or equal to~~ 50% RTP puts the core into a condition where rod position is not significantly affecting core peaking factor limits (Ref. 13). The allowed Completion Time of 8 hours provides an acceptable period of time to verify the rod positions per Required Actions ~~C~~D.1.1 and ~~C~~D.1.2 or reduce power to ≤~~less than or equal to~~ 50% RTP.

~~D~~E.1

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

SURVEILLANCE REQUIREMENTS

SR 3.1.8.1

Verification that the RPI agrees with the demand position within 12 steps ensures that the RPI is operating correctly.

This Surveillance is performed prior to reactor criticality after each removal of the reactor head, as there is ~~The 18-month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and~~ the potential for unnecessary plant transients if the SR were performed with the reactor at power. ~~Operating experience has shown these components usually pass the SR when performed at a Frequency of once every 18 months. Therefore, the Frequency was concluded to be acceptable from a reliability standpoint.~~

The Surveillance is modified by a Note which states it is not required to be met for RPIs associated with rods that do not meet LCO 3.1.5. If a rod is known to not be within 12 steps of the group demand position, the ACTIONS of LCO 3.1.5 provide the appropriate Actions.

BASES (continued)

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix A, General Design Criterion 13, "Instrumentation and Control."
2. Watts Bar FSAR, Section 15.2.1, "Uncontrolled Rod Cluster Control Assembly Bank Withdrawal From a Subcritical Condition."
3. Watts Bar FSAR, Section 15.2.2, "Uncontrolled Rod Cluster Control Assembly Bank Withdrawal At Power."
4. Watts Bar FSAR, Section 15.2.3, "Rod Cluster Control Assembly Misalignment."
5. Watts Bar FSAR, Section 15.2.4, "Uncontrolled Boron Dilution."
6. Watts Bar FSAR, Section 15.2.5, "Partial Loss of Forced Reactor Coolant Flow."
7. Watts Bar FSAR, Section 15.2.13, "Accidental Depressurization of the Main Steam System."
8. Watts Bar FSAR, Section 15.3.4, "Complete Loss of Forced Reactor Coolant Flow."
9. Watts Bar FSAR, Section 15.3.6, "Single Rod Cluster Control Assembly Withdrawal At Full Power."
10. Watts Bar FSAR, Section 15.4.2.1, "Major Rupture of Main Steam Line."
11. Watts Bar FSAR, Section 15.4.4, "Single Reactor Coolant Pump Locked Rotor."
12. Watts Bar FSAR, Section 15.4.6, "Rupture of a Control Rod Drive Mechanism Housing (Rod Cluster Control Assembly Ejection)."
13. Watts Bar FSAR, Section 4.3, "Nuclear Design."
14. Watts Bar FSAR, Section 7.7.1.3.2, “Main Control Room Rod Position Indication.”
15. WCAP-12472-P-A, “BEACON™ Core Monitoring and Operations Support System,” August 1994 (Addendum 2, April 2002).