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December 23, 2019

L-PI-19-041
10 CFR 50.90

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

Prairie Island Nuclear Generating Plant, Units 1 and 2
Docket Nos. 50-282 and 50-306
Renewed Facility Operating License Nos. DPR-42 and DPR-60

Application to Revise Technical Specifications to Adopt TSTF-547, "Clarification of Rod Position Requirements"

Pursuant to 10 CFR 50.90, Northern States Power Company, a Minnesota corporation, doing business as Xcel Energy (hereafter “NSPM”), hereby requests an amendment to the Technical Specifications (TS) for the Prairie Island Nuclear Generating Plant (PINGP) Units 1 and 2.

The proposed amendment will adopt TSTF-547, “Clarification of Rod Position Requirements”, with site-specific variations. The proposed amendment revises the requirements on control and shutdown rods, and rod and bank position indication. The Enclosure provides a description and assessment of the proposed changes. Attachment 1 to the Enclosure provides the existing TS pages marked up to show the proposed changes. Attachment 2 to the Enclosure provides revised (clean) TS pages. Attachment 3 to the Enclosure provides existing TS Bases pages marked to show the proposed changes for information only.

Approval of the proposed amendment is requested by January 20, 2021. Once approved, the amendment shall be implemented within 90 days.

In accordance with 10 CFR 50.91(b)(1), a copy of this application, with the enclosure, is being provided to the designated Minnesota Official.

Please contact Mr. Jeff Kivi at (612) 330-5788 or Jeffrey.Kivi@xenuclear.com if there are any questions or if additional information is needed.

Summary of Commitments

This letter makes no new commitments and no revisions to existing commitments.

I declare under penalty of perjury, that the foregoing is true and correct.
Executed on December 23, 2019.

Scott Sharp
Site Vice President, Prairie Island Nuclear Generating Plant
Northern States Power Company – Minnesota

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, Prairie Island, USNRC
Resident Inspector, Prairie Island, USNRC
State of Minnesota

ENCLOSURE

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Description and Assessment

License Amendment Request

TSTF-547, "CLARIFICATION OF ROD POSITION REQUIREMENTS"

ATTACHMENTS

1. Proposed Technical Specification Changes (Mark-Up)
2. Revised Technical Specification Pages
3. Proposed Technical Specification Bases Changes (Mark-Up)

License Amendment Request

TSTF-547, "CLARIFICATION OF ROD POSITION REQUIREMENTS"

1.0 DESCRIPTION

The proposed amendment will adopt TSTF-547, “Clarification of Rod Position Requirements”, with site-specific variations. The proposed amendment revises the requirements on control and shutdown rods, and rod and bank position indication in Technical Specification (TS) 3.1.4, "Rod Group Alignment Limits," TS 3.1.5, "Shutdown Bank Insertion Limits," TS 3.1.6, "Control Bank Insertion Limits," and TS 3.1.7, "Rod Position Indication," to provide time to repair rod movement failures that do not affect rod Operability, to provide an alternative to frequent use of the movable incore detector system or power distribution monitoring system (PDMS) when position indication for a rod is inoperable, to provide time for analog position indication instruments to read accurately after rod movement, to correct conflicts between the TS, to eliminate an unnecessary action, and to increase consistency and to improve the presentation.

2.0 ASSESSMENT

2.1 Applicability of Safety Evaluation

NSPM has reviewed the safety evaluation for TSTF-547 provided to the Technical Specifications Task Force in a letter dated March 4, 2016. This review included a review of the NRC staff’s evaluation, as well as the information provided in TSTF-547. As described in the subsequent paragraphs, NSPM has concluded that the justifications presented in the TSTF-547 proposal and the safety evaluation prepared by the NRC staff are applicable to PINGP Unit 1 and Unit 2 and justify this amendment for the incorporation of the changes to the PINGP TS.

2.2 Variations

NSPM is proposing the following variations from the TS changes described in the TSTF-547 or the applicable parts of the NRC staff’s safety evaluation dated March 4, 2016. These variations do not affect the applicability of TSTF-547 or the NRC staff's safety evaluation to the proposed license amendment.

- TSTF-547 deletes TS 3.1.4 Required Action (RA) B.1 to restore rod to within limit. This Required Action is not in PINGP TS.

- TSTF-547 and standard TS 3.1.4 RA B.2 reduces Thermal Power to ≤ 75% RTP. The equivalent RA for the current PINGP TS is to reduce the High Neutron Flux Trip setpoint to ≤ 85%. NSPM proposes to reflect the TSTF and standard by changing RA B.2 to require a reduction of thermal power to ≤ 75%. In addition, the associated Completion Time for RA

B.2 in the standard TS is 2 hours whereas the Completion Time in the PINGP TS is 8 hours. NSPM proposes to keep the existing PINGP RA B.2 Completion Time.

- TSTF-547 and standard TS 3.1.4 RA B.5 is, “Re-evaluate safety analyses and confirm results remain valid for duration of operation under these conditions”. The equivalent RA for the current PINGP TS is, “Re-evaluate safety analyses and determine the THERMAL POWER for which the results remain valid for duration of operation under these conditions”. NSPM proposes to keep the existing RA (renumbered). In addition, the associated RA B.5 Completion Time in the standard TS is 5 days whereas the RA B.5 Completion Time in the PINGP TS is 30 days. NSPM proposes to keep the existing PINGP RA B.5 Completion Time.

- For TS 3.1.5 and TS 3.1.6, TSTF-547 moves a note from the Applicability section to the LCO section. The equivalent of this note in the PINGP TS 3.1.5 and TS 3.1.6 is already associated with the LCO in the PINGP TS. PINGP proposes to adopt the wording from TSTF-547 in the note.

- TS 3.1.7 for PINGP uses the term, “core power distribution measurement information” instead of referring to “movable incore detectors” as is done in the standard and in TSTF-547. PINGP Unit 1 license amendment number 201 and Unit 2 license amendment number 188 permit the use of BEACON™ power distribution monitoring system or movable incore detectors for the purpose of rod position verification in the associated TS 3.1.7 RAs.

- TS 3.1.7, Condition A: PINGP TS and TS Bases 3.1.7 will not include RA A.2.2 and will renumber RA A.2.1 to RA A.2. The Pressurized Water Reactor Owner's Group (PWROG) notified Tennessee Valley Authority (TVA) of a generic error in TSTF-547, Revision 1. The TSTF includes a new RA A2.2 that requires the inoperable RPI to be returned to OPERABLE status prior to entering MODE 2 from MODE 3. This new RA A.2.2 is made irrelevant, as the logical "OR" connector would allow the licensee to transition from RA A.2.1 and RA A.2.2 into either RA A.1 or RA A.3 (which do not have that requirement), and thereby not have to restore the inoperable RPI to OPERABLE status.

  Reference TVA Supplemental Letter to NRC dated May 11, 2018, ML 18135A340 and Ginna LAR to TS to adopt TSTF-547, Revision 1, dated June 25, 2018, ML 18176A327.

- The standard TS includes Required Action B.1 to place control rods under manual control that is not part of PINGP TS. NSPM has determined that incorporating the RA to place control rods in manual is a prudent action and proposes to add this RA to the PINGP TS.

- Current TS 3.1.7 Condition B, RA B.3, verifies the position of the rods and is deleted in TSTF-547. The equivalent proposed PINGP RA B.2 will not be deleted. The proposed PINGP RA B.2 includes the position verification from Condition C of the standard, which was incorporated in PINGP RA B.2.

The Traveler and safety evaluation discuss the applicable regulatory requirements and guidance, including the 10 CFR 50, Appendix A, General Design Criteria (GDC). PINGP was not licensed to the 10 CFR 50, Appendix A, GDC. The PINGP was designed and constructed

to comply with NSP's understanding of the intent of the AEC General Design Criteria for Nuclear Power Plant Construction Permits, as proposed on July 10, 1967. Since the construction of the plant was significantly completed prior to the issuance of the February 20, 1971, 10CFR50, Appendix A GDC, the plant was not reanalyzed and the Final Safety Analysis Report (FSAR) was not revised to reflect these later criteria. However, the AEC Safety Evaluation Report acknowledged that the AEC staff assessed the plant, as described in the FSAR, against the Appendix A design criteria and "... are satisfied that the plant design generally conforms to the intent of these criteria." This difference does not alter the conclusion that the proposed change is applicable to PINGP.

3.0 REGULATORY ANALYSIS

3.1 No Significant Hazard Consideration Analysis

NSPM requests adoption of TSTF-547, "Clarification of Rod Position Requirements," which is an approved change to the Standard Technical Specifications, into the PINGP Units 1 and 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 an alternative to frequent use of the movable incore detector system when position indication for a rod is inoperable, to provide time for analog position indication instruments to read accurately after rod movement, to correct conflicts between the TS, to eliminate an unnecessary action, and to increase consistency and to improve the presentation.

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

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

   Response: No

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

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

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

Revising the TS Actions to provide an alternative to frequent use of the moveable incore detector system or PDMS to verify the position of rods with inoperable rod position indicator does not change the requirement for the rods to be aligned and within the insertion limits.

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

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

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

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

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

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

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

Response: No

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

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

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

Response: No

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

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

Based on the above, NSPM 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.

ENCLOSURE, ATTACHMENT 1

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2

License Amendment Request

TSTF-547, "CLARIFICATION OF ROD POSITION REQUIREMENTS"

TECHNICAL SPECIFICATION PAGES (Markup)

(16 Pages Follow)

3.1 REACTIVITY CONTROL SYSTEMS

3.1.4 Rod Group Alignment Limits.

LCO 3.1.4 All shutdown and control rods shall be OPERABLE.

AND

Individual actual rod positions shall be within 24 steps of their group step counter demand position when the demand position is between 30 and 215 steps, or within 36 steps of their group step counter demand position when the demand position ≤ 30 steps, or ≥ 215 steps.

----------NOTE----------
Individual RPIs may be outside their limits for ~~≤~~ 1 hour following ~~substantial rod movement.~~ movement of the associated rods.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more rod(s) inoperable.	A.1.1 Verify SDM is within the limits provided 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

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One rod not within alignment limits.	B.1.1 Verify SDM is within the limits provided in the COLR.	1 hour
	OR	
	B.1.2 Initiate boration to restore SDM to within limit.	1 hour
	AND	
	~~B.2.1.1~~ Perform SR 3.2.1.1 ~~and~~ SR 3.2.1.2, and SR 3.2.2.1.	~~8 hours~~ 72 hours
	AND	
	~~B.2.1.2 Perform SR 3.2.2.1.~~	~~8 hours~~
	~~OR~~	
	B.2.~~2~~ Reduce ~~High Neutron Flux Trip Setpoint~~ to ≤ ~~85~~ 75% THERMAL POWER.	8 hours
	AND	
	B.3 Verify SDM is within the limits provided in the COLR.	Once per 12 hours
	AND	

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. (continued) B.5	~~B.4~~ Re-evaluate safety analyses and determine the THERMAL POWER for which the results remain valid for duration of operation under these conditions.	30 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 provided 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 3.1.4.1	Verify individual rod ~~positions~~ within alignment limit.	In accordance with the Surveillance Frequency Control Program
SR 3.1.4.2	Verify rod freedom of movement (trippability) by moving each rod, not fully inserted in the core, $\geq$ 10 steps in either direction.	In accordance with the Surveillance Frequency Control Program
SR 3.1.4.3	Verify rod drop time of each rod, from the fully withdrawn position, is $\leq$ 1.8 seconds from the beginning of decay of stationary gripper coil voltage to dashpot entry, with: a. $T_{avg} \geq 500°F$; and b. Both reactor coolant pumps operating.	Prior to reactor criticality after each removal of the reactor head

Insert A

position of

s

Insert A

----------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.

3.1 REACTIVITY CONTROL SYSTEMS

3.1.5 Shutdown Bank Insertion Limits

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

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

Not applicable to shutdown banks inserted while performing SR 3.1.4.2.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
Insert B		
B. ~~A~~. One or more shutdown banks not within limits for reasons other than Condition A.	B. ~~A~~.1.1 Verify SDM is within the limits provided in the COLR. OR B. ~~A~~.1.2 Initiate boration to restore SDM to within limit. AND B. ~~A~~.2 Restore shutdown banks to within limits.	1 hour 1 hour 2 hours

Insert B

A. One shutdown bank inserted ≤ 10 steps beyond the insertion limits specified in the COLR.	*A.1 Verify all control banks are within the insertion limits specified in the COLR.* *AND*	*1 hour*
	A.2.1 Verify SDM is within the limits specified in the COLR. *OR*	*1 hour*
	A.2.2 Initiate boration to restore SDM to within limit. *AND*	*1 hour*
	A.3 Restore the shutdown bank to within the insertion limits specified in the COLR.	*24 hours*

ACTIONS (continued)

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

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
Inert C SR 3.1.5.1 Verify each shutdown bank is within the limits specified in the COLR.	In accordance with the Surveillance Frequency Control Program

Insert C

----------NOTES----------
Not required to be performed until 1 hour after associated rod motion.

3.1 REACTIVITY CONTROL SYSTEMS

3.1.6 Control Bank Insertion Limits

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

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

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
Insert D		
B. ~~A.~~ Control bank insertion limits not met ~~-~~ for reasons other than Condition A.	B. ~~A~~.1.1 Verify SDM is within the limits provided in the COLR. OR	1 hour
	B. ~~A~~.1.2 Initiate boration to restore SDM to within limit. AND	1 hour
	B. ~~A~~.2 Restore control bank(s) to within limits.	2 hours

Insert D

A. Control bank A, B, or C inserted ≤ 10 steps beyond the insertion, sequence, or overlap limits specified in the COLR.	*A.1*	*Verify all shutdown banks are within the insertion limits specified in the COLR.*	*1 hour*
	AND		
	A.2.1	*Verify SDM is within the limits specified in the COLR.*	*1 hour*
	OR		
	A.2.2	*Initiate boration to restore SDM to within limit.*	*1 hour*
	AND		
	A.3	*Restore the control bank to within the insertion sequence, and overlap limits specified in the COLR.*	*24 hours*

ACTIONS (continued)

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

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.6.1	Verify estimated critical control bank position is within the limits specified in the COLR.	Prior to achieving criticality
	Insert E	
SR 3.1.6.2	Verify each control bank insertion is within the limits specified in the COLR.	In accordance with the Surveillance Frequency Control Program
	Insert E	
SR 3.1.6.3	Verify sequence and overlap limits specified in the COLR are met for control banks not fully withdrawn from the core.	In accordance with the Surveillance Frequency Control Program

Insert E

----------NOTE----------
Not required to be performed until 1 hour after associated rod motion.

3.1 REACTIVITY CONTROL SYSTEMS

3.1.7 Rod Position Indication

LCO 3.1.7 The Rod Position Indication (RPI) System and demand position indication shall be OPERABLE.

----------NOTE----------
Individual RPIs may be outside their limits for ~~<~~ 1 hour following ~~substantial rod movement.~~ movement of the associated rods.

APPLICABILITY: MODES 1 and 2.

ACTIONS

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

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One RPI per group inoperable ~~for~~ in one or more groups.	A.1 Verify the position of the rod~~(s)~~ with inoperable RPI indirectly ~~position indicators~~ by using core power distribution measurement information. Insert F OR	Once per 8 hours
	A.~~2~~ 3 Reduce THERMAL POWER to ≤ 50% RTP.	8 hours

Insert F

	OR		
	A.2	Verify the position of the rods with inoperable RPI indirectly by using core power distribution measurement information.	8 hours AND Once per 31 EFPD thereafter AND 8 hours after discovery of each unintended rod movement AND 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

B.1 Place the control rods under manual control.

AND

Immediately

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. More than one RPI per group inoperable ~~for~~ in one or more groups.	B.~~1~~ 2 Monitor and record demand position indication for rods with inoperable RPI**s**.	Once per hour
	AND	
	~~B.2 Monitor and record reactor coolant system average temperature.~~	~~Once per hour~~
	~~AND~~	
	B.3 Verify, using core power distribution measurement information, position of rods with inoperable RPIs which have been moved in excess of 24 steps in one direction since last determination of their position.	Once per 4 hours
	AND	
	B.~~4~~ Restore inoperable RPIs to OPERABLE status such that a maximum of one RPI per group is inoperable.	24 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. ~~Indication for one demand position per bank inoperable for one or more banks.~~	C.1.1 Verify by administrative means all RPIs for the affected bank(s) are OPERABLE. AND	Once per 8 hours
	C.1.2 ~~Verify the rod position indication of the most withdrawn rod and the least withdrawn rod of the affected bank(s) are ≤ 12 steps apart.~~ OR	Once per 8 hours
	C.2 Reduce THERMAL POWER to ≤ 50% RTP.	8 hours
D. Required Action and associated Completion Time not met.	D.1 Be in MODE 3.	6 hours

One or more demand position indicators per bank inoperable in one or more banks.

Verify the most withdrawn rod and the least withdrawn rod of the affected banks are ≤ 12 steps apart.

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
	Insert G	
SR 3.1.7.1	Verify each RPI agrees within 12 steps of the group demand position between 30 and 215 steps, or within 24 steps of the group demand position when the demand position is $\geq$ 215 steps or $\leq$ 30 steps.	Once prior to criticality after each removal of the reactor head

Insert G

----------NOTE----------
Not required to be met for RPIs associated with rods that do not meet LCO 3.1.4.

ENCLOSURE, ATTACHMENT 2

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2

License Amendment Request

TSTF-547, "CLARIFICATION OF ROD POSITION REQUIREMENTS"

TECHNICAL SPECIFICATION PAGES (Re-typed)

(16 Pages Follow)

3.1 REACTIVITY CONTROL SYSTEMS

3.1.4 Rod Group Alignment Limits.

LCO 3.1.4 All shutdown and control rods shall be OPERABLE.

AND

Individual actual rod positions shall be within 24 steps of their group step counter demand position when the demand position is between 30 and 215 steps, or within 36 steps of their group step counter demand position when the demand position $\leq$ 30 steps, or $\geq$ 215 steps.

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

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One or more rod(s) inoperable.	A.1.1	Verify SDM is within the limits provided 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

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One rod not within alignment limits.	B.1.1 Verify SDM is within the limits provided in the COLR. OR	1 hour
	B.1.2 Initiate boration to restore SDM to within limit. AND	1 hour
	B.2 Reduce THERMAL POWER to ≤ 75% RTP. AND	8 hours
	B.3 Verify SDM is within the limits provided in the COLR. AND	Once per 12 hours
	B.4 Perform SR 3.2.1.1, SR 3.2.1.2, and SR 3.2.2.1. AND	72 hours
	B.5 Re-evaluate safety analyses and determine the THERMAL POWER for which the results remain valid for duration of operation under these conditions.	30 days

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
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 provided 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 3.1.4.1	---------- NOTES---------- 1. Not required to be performed for rods associated with inoperable rod position indicator or demand position indicator. 2. Not required to be performed until 1 hour after associated rod motion. --- Verify position of individual rods within alignment limit.	In accordance with the Surveillance Frequency Control Program
SR 3.1.4.2	Verify rod freedom of movement (trippability) by moving each rod, not fully inserted in the core, $\geq$ 10 steps in either direction.	In accordance with the Surveillance Frequency Control Program
SR 3.1.4.3	Verify rod drop time of each rod, from the fully withdrawn position, is $\leq$ 1.8 seconds from the beginning of decay of stationary gripper coil voltage to dashpot entry, with: a. $T_{avg} \geq 500°F$; and b. Both reactor coolant pumps operating.	Prior to reactor criticality after each removal of the reactor head

3.1 REACTIVITY CONTROL SYSTEMS

3.1.5 Shutdown Bank Insertion Limits

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

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

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One shutdown bank inserted ≤ 10 steps beyond the insertion limits specified in the COLR.	A.1 Verify all control banks are within the insertion limits specified in the COLR. AND	1 hour

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.2.1 Verify SDM is within the limits specified in the COLR. OR A.2.2 Initiate boration to restore SDM to within limit. AND A.3 Restore the shutdown bank to within the insertion limits specified in the COLR.	1 hour 1 hour 24 hours
B. One or more shutdown banks not within limits for reasons other than Condition A.	B.1.1 Verify SDM is within the limits provided 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

ACTIONS (continued)

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

SURVEILLANCE REQUIREMENTS

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

3.1 REACTIVITY CONTROL SYSTEMS

3.1.6 Control Bank Insertion Limits

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

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

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Control bank A, B, or C inserted ≤ 10 steps beyond the insertion, sequence, or overlap limits specified in the COLR.	A.1 Verify all shutdown banks are within the insertion limits specified in the COLR. AND A.2.1 Verify SDM is within the limits specified in the COLR. OR	1 hour 1 hour

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.2.2 Initiate boration to restore SDM to within limit. AND	1 hour
	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 provided in the COLR. OR	1 hour
	B.1.2 Initiate boration to restore SDM to within limit. AND	1 hour
	B.2 Restore control bank(s) to within limits.	2 hours

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

3.1 REACTIVITY CONTROL SYSTEMS

3.1.7 Rod Position Indication

LCO 3.1.7 The Rod Position Indication (RPI) System and demand position indication 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 rod with inoperable RPI indirectly by using core power distribution measurement information. OR	Once per 8 hours

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.2 Verify the position of the rods with inoperable RPI indirectly by using core power distribution measurement information. OR	8 hours AND Once per 31 EFPD thereafter AND 8 hours after discovery of each unintended rod movement AND 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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.3 Reduce THERMAL POWER to $\leq$ 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. AND	Immediately
	B.2 Monitor and record demand position indication for rods with inoperable RPIs. AND	Once per hour
	B.3 Verify, using core power distribution measurement information, position of rods with inoperable RPIs which have been moved in excess of 24 steps in one direction since last determination of their position. AND	Once per 4 hours
	B.4 Restore inoperable RPIs to OPERABLE status such that a maximum of one RPI per group is inoperable.	24 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One or more demand position indicators per bank inoperable in one or more banks.	C.1.1 Verify by administrative means all RPIs for the affected bank(s) are OPERABLE. AND	Once per 8 hours
	C.1.2 Verify the most withdrawn rod and the least withdrawn rod of the affected bank(s) are $\leq$ 12 steps apart. OR	Once per 8 hours
	C.2 Reduce THERMAL POWER to $\leq$ 50% RTP.	8 hours
D. Required Action and associated Completion Time not met.	D.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.7.1	---------- NOTE---------- Not required to be met for RPIs associated with rods that do not meet LCO 3.1.4. ----------	
	Verify each RPI agrees within 12 steps of the group demand position between 30 and 215 steps, or within 24 steps of the group demand position when the demand position is $\geq$ 215 steps or $\leq$ 30 steps.	Once prior to criticality after each removal of the reactor head

ENCLOSURE, ATTACHMENT 3

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2

License Amendment Request

TSTF-547, "CLARIFICATION OF ROD POSITION REQUIREMENTS"

TECHNICAL SPECIFICATION BASES PAGES (MARKUP)

FOR INFORMATION ONLY

(48 Pages Follow)

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.4 Rod Group Alignment Limits

BASES

BACKGROUND

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

The applicable criteria for these reactivity and power distribution design requirements are AEC GDC Criteria 6, 14, 27, and 28 (Ref. 1), and 10 CFR 50.46 (Ref. 2).

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

Limits on rod alignment 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 by their control rod drive mechanisms (CRDMs). Each CRDM moves its RCCA one step (approximately ⅝ inch) at a time, but at varying rates (steps per minute) depending on the signal output from the Rod Control System.

The RCCAs are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control. A group consists of two or more RCCAs

BASES

BACKGROUND (continued)

that are electrically paralleled to step simultaneously. A bank of RCCAs consists of two groups that are moved in a staggered fashion, but always within one step of each other. Both units have four control banks and two shutdown banks.

The shutdown banks are maintained either in the fully inserted or fully withdrawn position. The control banks are moved in an overlap pattern, using the following withdrawal sequence: When control bank A reaches a predetermined height in the core, control bank B begins to move out with 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 indications, which are the bank demand position indication (usually the group step counters) and the individual Rod Position Indication (RPI) System.

The bank demand position indication 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 is considered highly precise ($\pm$ 1 step or $\pm$ 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.

BASES

BACKGROUND (continued)

Demand position indication may be provided by various means such as step counters, Emergency Response Computer System (ERCS), calculations using rod drive cabinet counters or Pulse to Analog counters.

The RPI System provides a highly reliable indication of rod position, but at a lower accuracy than the step counters. This system is based on inductive analog signals from a series of coils spaced along a hollow tube. The RPI System is designed with an accuracy of $\pm$ 5% (approximately 12 steps) of full rod travel. There are inaccuracies arising from the normal range of coolant temperature variation from hot shutdown to full power which are compensated for by allowing $\pm$ 24 steps at the lower and upper ends of rod travel.

With an indicated deviation of 12 steps between the group demand position and RPI, the maximum deviation between actual rod position and the demand position could be 24 steps, or 15 inches. At the lower and upper ends of rod travel with an indicated deviation of 24 steps between the group demand position and RPI, the deviation between actual rod position and the demand position could be 36 steps, or 22.5 inches.

Individual rod position indication may be provided by either the Individual Rod Position Indication (IRPI) control board meters or ERCS.

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 assure that:

a. There are no violations of:

1. specified acceptable fuel design limits, or

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

BASES

APPLICABLE SAFETY ANALYSES (continued)

b. The core remains subcritical after accident transients

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

Two types of analysis are performed in regard to static rod misalignment. With control banks at their insertion limits or all rods out, one type of analysis considers the case when any one rod is completely inserted into the core. The second type of analysis considers the case of a completely withdrawn single rod from a bank inserted to its insertion limit. Satisfying limits on DNBR in both these cases bounds the situation when a rod is misaligned from its group by 24 steps.

Another type of misalignment occurs if one RCCA fails to insert upon a reactor trip and remains stuck fully withdrawn. This condition is assumed in the evaluation to determine that the required SDM is met with the maximum worth RCCA fully withdrawn (Ref. 3).

The Required Actions in this LCO ensure that either deviations from the alignment limits will be corrected, that the linear heat rates (LHRs) are not significantly affected, or that THERMAL POWER will be adjusted so that excessive local 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

BASES

APPLICABLE SAFETY ANALYSES (continued)

valid. When a control rod is misaligned the assumed power distribution used in the safety analysis may not be preserved.

Therefore, the limits may not preserve the design peaking factors, and $F_Q(Z)$ and $F^N_{\Delta H}$ must be verified directly by core 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 control rod OPERABILITY ensure that upon reactor trip, the assumed reactivity will be available and will be inserted. The control rod OPERABILITY requirements (i.e., trippability) are separate from the alignment requirements which ensure that the RCCAs and banks maintain the correct power distribution and rod alignment. The rod OPERABILITY requirement is satisfied provided the rod will fully insert in the required rod drop time assumed in the safety analysis. Rod control malfunctions that result in the inability to move a rod (e.g., rod lift coil failures), but that do not impact trippability, do not result in rod inoperability.

The rod alignment requirements are satisfied when individual actual rod positions are within 24 steps of their group demand position, when the demand position is between 30 and 215 steps, or within 36 steps of their group demand position when the demand position is $\leq$ 30 steps, or $\geq$ 215 steps.

Demand position indication may be provided by various means such as step counters, Emergency Response Computer System (ERCS),

BASES

LCO (continued)

calculations using rod drive cabinet counters or Pulse to Analog counters. Individual rod indication may be provided by either the IRPI control board meters or ERCS.

The requirement to maintain the indicated rod alignment to within plus or minus 12 steps of group demand when the group demand position is between 30 and 215 steps accounts for RPI system inaccuracy of ±5% (approximately 12 steps) of full rod travel. The minimum actual 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.

This LCO is modified by a Note indicating individual control rod position indications may be outside their limits for up to and including one hour following substantial control rod movement. This allows up to one hour of thermal soak time to allow the control rod drive shaft to reach thermal equilibrium and thus present a consistent position indication. Substantial rod movement is considered to be 10 or more steps in one direction in less than or equal to one hour.

In accordance with this Note, the comparison of group demand position and RPI may take place at any time up to one hour after rod motion, at any power level. Based on this allowance, rod position may be considered within limits during the thermal soak time to allow position indication to stabilize.

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

BASES

APPLICABILITY (continued)

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 normally bottomed and the reactor is shutdown and not producing fission power. In the shutdown MODES, the OPERABILITY of the shutdown and control rods has the potential to affect the required SDM, but this effect can be compensated for by an increase in the boron concentration of the RCS. See LCO 3.1.1, "SHUTDOWN MARGIN (SDM)," for SDM in MODES 3, 4, and 5 and LCO 3.9.1, "Boron Concentration," for boron concentration requirements during refueling.

ACTIONS

A.1.1 and A.1.2

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

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

A.2

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

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

BASES

ACTIONS (continued)

B.1.1 and B.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 unit SDM and, if necessary, aligning and starting the necessary systems and components to initiate boration.

~~B.2.1.1, B.2.1.2, B.2.2, B.3, and B.4~~ B.2, B.3, B.4, and B.5

~~For continued operation with a misaligned rod, hot channel factors ($F_Q(Z)$ and $F^N_{\Delta H}$ must be verified within limits or the high neutron flux trip setpoint must be reduced, SDM must periodically be verified within limits, the safety analyses must be re-evaluated to confirm continued operation is permissible, and, if necessary, the power level must be reduced to a level consistent with the safety analysis. Considerations in these analyses include the potential ejected rod worth and associated transient power distribution peaking factors. The analysis shall include due allowance for nonuniform fuel depletion in the neighborhood of the inoperable rod.~~

Insert E

Insert E

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. 3). The Completion Time of 8 hours gives the operator sufficient time to accomplish an orderly power reduction without challenging the Reactor Protection System.

BASES

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

ACTIONS ~~B.2.1.1, B.2.1.2, B.2.2, B.3, and B4~~ (continued)

Verifying that $F_Q(Z)$, as approximated by $F_Q^C(Z)$ and $F_Q^W(Z)$, and $F_{\Delta H}^N$ are within the required limits (i.e., SR 3.2.1.1, SR 3.2.1.2 and SR 3.2.2.1) ensures that current operation at RTP with a rod misaligned is not resulting in power distributions that may invalidate safety analysis assumptions at full power. The Completion Time of ~~8~~ 72 hours allows sufficient time to obtain core power distribution measurements using either the incore flux mapping system or the Power Distribution Monitoring System and to calculate $F_Q(Z)$ and $F_{\Delta H}^N$.

≤ 75%

~~In lieu of determining hot channel factors ($F_Q(Z)$ and $F_{\Delta H}^N$) within the Completion Time of 8 hours, reducing the high neutron flux trip setpoint to 85% RTP ensures that local LHR increases due to a misaligned RCCA will not cause the core design criteria to be exceeded. The Completion Time of 8 hours gives the operator sufficient time to accomplish an orderly power reduction and setpoint change 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.

Once current conditions have been verified acceptable, time is available to perform evaluations of accident analyses 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 Ref. 3 that may be adversely affected will be evaluated to ensure that the analysis results remain valid for the duration of continued operation under these conditions.

If the analyses do not support continued operation at RTP, then the power must be reduced to a level consistent with the safety analyses.

BASES

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

ACTIONS ~~B.2.1.1, B.2.1.2, B.2.2, B.3, and B4~~ (continued)

A Completion Time of 30 days is sufficient time to obtain the required input data and to perform the analysis and adjust power level.

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 eliminates 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 for 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 initiate boration. Boration will continue until the required SDM is restored.

BASES

ACTIONS (continued)

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. 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 3.1.4.1

Insert H

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

SR 3.1.4.2

Verifying each control rod is OPERABLE would require that each rod be tripped. However, in MODES 1 and 2, tripping each control rod would result in radial or axial power tilts, or oscillations. Exercising each individual control rod provides increased confidence that all rods continue to be OPERABLE without exceeding the alignment limit, even if they are not regularly tripped. Moving each control rod by $\geq$ 10 steps will not cause radial or axial power tilts, or oscillations, to occur providing rod alignment limits are not exceeded.

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

Insert H

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

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

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.4.2 (continued)

Between required performances of SR 3.1.4.2 (determination of control rod OPERABILITY by movement), if a control rod(s) is discovered to be immovable, but remains trippable, the control rod(s) is considered to be OPERABLE. At any time, if a control rod(s) is immovable, a determination of the trippability (OPERABILITY) of the control rod(s) must be made, and appropriate action taken.

SR 3.1.4.3

Verification of rod drop times allows the operator to determine that the maximum rod drop time permitted is consistent with the assumed rod drop time used in the safety analysis. Measuring rod drop times prior to reactor criticality, after reactor vessel head removal, ensures that the reactor internals and rod drive mechanism will not interfere with rod motion or rod drop time, and that no degradation in these systems has occurred that would adversely affect control rod motion or drop time. This testing is performed with all RCPs operating and the average moderator temperature $\geq$ 500°F to simulate a reactor trip under actual conditions. Actual rod drop time is measured from opening of the reactor trip breaker (RTB) which is conservative with respect to beginning of decay of stationary gripper coil voltage.

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

BASES (continued)

REFERENCES

1. Criteria 6, 14, 27, and 28 of:
Atomic Energy Commission Proposed Rule Making, Part 50 - Licensing of Production and Utilization Facilities; General Design Criteria for Nuclear Power Plant Construction Permits, Federal Register 32, No. 132 (July 11, 1967): 10213. [NRC Accession Number: ML043310029]

2. 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Plants".

3. USAR, Section 14.4.

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.5 Shutdown Bank Insertion Limits

BASES

BACKGROUND

The insertion limits of the shutdown and control rods define the deepest insertion into the core with respect to core power which is allowed and 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, SHUTDOWN MARGIN (SDM) and initial reactivity insertion rate.

The applicable criteria for these reactivity and power distribution design requirements are AEC GDC Criteria 27, 28, 29, and 32 (Ref. 1), and 10 CFR 50.46 (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, reactivity limits, and SDM limits are preserved.

The rod cluster control assemblies (RCCAs) are divided among control banks and shutdown banks. Some banks may be further subdivided into two groups to provide for precise reactivity control. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously. A bank of RCCAs that consists of two groups are moved in a staggered fashion, but always within one step of each other. Each reactor has four control banks and two shutdown banks. See LCO 3.1.4, "Rod Group Alignment Limits," for control and shutdown rod OPERABILITY and alignment requirements, and LCO 3.1.7, "Rod Position Indication," for position indication requirements.

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

BASES

BACKGROUND (continued)

must be maintained above designed insertion limits and are typically near the fully withdrawn position during normal full power operations.

Hence, they are not capable of adding a large amount of positive reactivity. Boration or dilution of the Reactor Coolant System (RCS) compensates for the reactivity changes associated with large changes in RCS temperature. The design calculations are performed with the assumption that the shutdown banks are withdrawn first. The shutdown banks can be fully withdrawn without the core going critical. This provides available negative reactivity in the event of boration errors. The shutdown banks are controlled manually by the control room operator. During normal unit operation, the shutdown banks are either fully withdrawn or fully inserted. The shutdown banks must be completely withdrawn from the core, prior to withdrawing any control banks during an approach to criticality. The shutdown banks are then left in this position until the reactor is shut down. They affect core power and burnup distribution, and add negative reactivity to shut down the reactor upon receipt of a reactor trip signal.

APPLICABLE SAFETY ANALYSES

On a reactor trip, all RCCAs (shutdown banks and control banks), except the most reactive RCCA, are assumed to insert into the core. The shutdown banks shall be at or above their insertion limits and available to insert the maximum amount of negative reactivity on a reactor trip signal. The control banks may be partially inserted in the core, as allowed by LCO 3.1.6, "Control Bank Insertion Limits." The shutdown bank and control bank insertion limits are established to ensure that a sufficient amount of negative reactivity is available to shut down the reactor and maintain the required SDM (see LCO 3.1.1, "SHUTDOWN MARGIN (SDM)") following a reactor trip from full power. The combination of control banks and shutdown banks (less the most reactive RCCA, which is assumed to be fully withdrawn) is sufficient to take the reactor from full power conditions at rated temperature to zero

BASES

APPLICABLE SAFETY ANALYSES (continued)

power (547°F), 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 assure that:

a. There are no violations of:

1. specified acceptable fuel design limits, or

2. RCS pressure boundary integrity; and

b. The core remains subcritical after accident transients.

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

The SDM requirement is ensured by limiting the control and shutdown bank insertion limits so that allowable inserted worth of the RCCAs is such that sufficient reactivity is available in the rods to shut down the reactor to hot zero power with a reactivity margin that assumes the maximum worth RCCA remains fully withdrawn upon trip (Ref. 3).

Operation at the insertion limits assures that the maximum linear heat generation rate or peaking factor will be less than that used in the misaligned rod analysis. Operation at the insertion limit also assures that the maximum ejected RCCA worth will be less than the limiting value used in the ejected RCCA analysis.

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

BASES (continued)

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.

Insert I

~~The LCO is modified by a Note indicating that a shutdown bank may be below the insertion limit when required for performance of SR 3.1.4.2. This SR verifies the freedom of the rods to move, and requires the shutdown bank to move below the LCO limits, which would normally violate the LCO.~~

APPLICABILITY

The shutdown banks must be within their insertion limits, with the reactor in MODES 1 and 2. This ensures that a sufficient amount of negative reactivity is available to shut down the reactor and maintain the required SDM following a reactor trip. In MODES 3, 4, 5, or 6, the shutdown bank insertion limit does not apply because the reactor is not producing fission power. In shutdown MODES the OPERABILITY of the shutdown 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. Refer to LCO 3.1.1 for SDM requirements in MODES 3, 4, and 5. LCO 3.9.1, "Boron Concentration," ensures adequate SDM in MODE 6.

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

ACTIONS

Insert J

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

B.1.1, B.1.2, and B.2

With one or more shutdown banks not within insertion 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 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.

for reasons other than Condition A

Insert I

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

Insert J

If one shutdown bank is inserted less than or equal to 10 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.

BASES

ACTIONS ~~A.1.1, A.1.2 and A.2~~ B.1.1, B.1.2, and B.2 (continued)

Operation beyond the LCO limits is allowed for a short time period in order to take appropriate action because the simultaneous occurrence of either an accident or transient 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 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.1~~ C.1 If the Required Actions and associated Completion Times are not met,

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

SURVEILLANCE REQUIREMENTS

SR 3.1.5.1 Insert K

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

Insert K

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.

BASES (continued)

REFERENCES

1. Criteria 27, 28, 29, and 32 of:
Atomic Energy Commission Proposed Rule Making, Part 50 - Licensing of Production and Utilization Facilities; General Design Criteria for Nuclear Power Plant Construction Permits, Federal Register 32, No. 132 (July 11, 1967): 10213. [NRC Accession Number: ML043310029]

2. 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors."

3. USAR, Sections 14.4 and 14.5.

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.6 Control Bank Insertion Limits

BASES

BACKGROUND

The insertion limits of the shutdown and control rods define the deepest insertion into the core with respect to core power which is allowed and 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 SHUTDOWN MARGIN (SDM), and initial reactivity insertion rate. 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.

The applicable criteria for these reactivity and power distribution design requirements are AEC GDC 27, 28, 29, and 32 (Ref. 1), and 10 CFR 50.46 (Ref. 2). Limits on control rod insertion have been established, and all rod positions are monitored and controlled during power operation ($k_{eff} \geq 1.0$) 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. Some banks may be further subdivided into two groups to provide for precise reactivity control. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously. A bank of RCCAs that consists of two groups are moved in a staggered fashion, but always within one step of each other. Each reactor has four control banks and two shutdown banks. See LCO 3.1.4, "Rod Group Alignment Limits," for control and shutdown rod OPERABILITY and alignment requirements, and LCO 3.1.7, "Rod Position Indication," for position indication requirements.

BASES

BACKGROUND (continued)

Insertion Limits

The control bank insertion limits are specified in a figure in the COLR. The control banks are required to be at or above the insertion limit lines.

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 control banks must be maintained above designed insertion limits and are typically near the fully withdrawn position during normal full power operations. The fully withdrawn position is defined in the COLR. Boration or dilution of the Reactor Coolant System (RCS) compensates for the reactivity changes associated with large changes in RCS temperature.

Overlap and Sequence

The insertion limits figure in the COLR also indicates how the control banks are moved in an overlap pattern. Overlap is the distance traveled together by two control banks. By overlapping control bank movements, the small reactivity addition at the beginning and end of control bank travel will be compensated for; that is, the overlapping sequential movement of control banks makes the reactivity addition more uniform.

Control banks are moved in an overlap pattern, using the following withdrawal sequence: When control bank A reaches a predetermined height in the core, control bank B begins to move out with control bank A. Control bank A stops at the fully withdrawn position, and control bank B continues to move out. When control bank B reaches a predetermined height, control bank C begins to move out with control bank B. This sequence continues until control banks A, B,

BASES

BACKGROUND Overlap and Sequence (continued)

and C are at the fully withdrawn position, and control bank D is near the fully withdrawn position at RTP. The insertion sequence is the opposite of the withdrawal sequence (i.e., bank D is inserted first) but follows the same overlap pattern. 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.

General

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

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

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

BASES (continued)

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 shutdown bank and control bank insertion limits are established to ensure that a sufficient amount of negative reactivity is available to shut down the reactor and maintain the required SDM (see LCO 3.1.1, "SHUTDOWN MARGIN (SDM)") following a reactor trip from full power. The combination of control banks and shutdown banks (less the most reactive RCCA, which is assumed to be fully withdrawn) is sufficient to take the reactor from full power conditions at rated temperature to zero power (547°F), and to maintain the required SDM at rated no load temperature (Ref. 3). The control bank insertion limit also limits the reactivity worth of an ejected control rod.

The acceptance criteria for addressing shutdown and control bank insertion limits assure that:

a. There are no violations of:

   1. specified acceptable fuel design limits, or

   2. Reactor Coolant System pressure boundary integrity; and

b. The core remains subcritical after accident transients.

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

The SDM requirement is ensured by limiting the control and shutdown bank insertion limits so that allowable inserted worth of the RCCAs is such that sufficient reactivity is available in the rods to shut down the reactor to hot zero power with a reactivity margin that assumes the maximum worth RCCA remains fully withdrawn upon trip (Ref. 3).

BASES

APPLICABLE SAFETY ANALYSES (continued)

Operation at the insertion limits assures that the maximum linear heat generation rate or peaking factor will be less than that used in the misaligned rod analysis. Operation at the insertion limit also assures that the maximum ejected RCCA worth will be less than the limiting value used in the ejected RCCA analysis.

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

LCO

The limits on control 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 limited, and ensuring adequate negative reactivity insertion is available on a 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.

Insert L

~~The LCO is modified by a Note indicating that a control bank may be below the insertion limit when required for performance of SR 3.1.4.2. This SR verifies the freedom of the rods to move, and requires the control bank to move below the LCO limits, which would normally violate the LCO.~~

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, and SDM. Applicability in MODE 2 with $k_{eff} < 1.0$, and 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.

Insert L

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

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

Insert M

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

BASES (continued)

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

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

for reasons other than Condition A

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 is normally ensured by adhering to the control and shutdown bank insertion limits (see LCO 3.1.1, "SHUTDOWN MARGIN (SDM)"). 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, they must be restored to meet the limits.

for reasons other than Condition A

Operation beyond the LCO limits is allowed for a short time period in order to take conservative action because the simultaneous occurrence of either an accident or transient 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.

Insert M

If Control Bank A, B, or C is inserted less than or equal to 10 steps below the insertion, sequence, or overlap limits, 24 hours is allowed to restore the control bank to within the limits. Verification of SDM or initiation of boration within 1 hour is required, since the SDM in MODES 1 and 2 is ensured by adhering to the control and shutdown bank insertion limits (see LCO 3.1.1). If a control bank is not within its insertion limit, SDM will be verified by performing a reactivity balance calculation, considering the effects listed in the BASES for SR 3.1.1.1.

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

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

BASES

ACTIONS (continued)

D.1

~~C.1~~

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

SURVEILLANCE SURVEILLANCE

SR 3.1.6.1

This Surveillance is required to ensure that the reactor does not achieve criticality with the control banks below their insertion limits. Prior to achieving criticality, the estimated critical position calculation appropriate for the time at which criticality is achieved shall be verified for control bank position.

The estimated critical position (ECP) depends upon a number of factors, one of which is xenon concentration. Typically, a series of ECPs are prepared in time increments applicable for a series of criticality times before and after the estimated time for achieving criticality. These ECPs account for the various factors which affect the ECP, including xenon concentration changes. The operators use the ECP applicable for the time the reactor actually achieves criticality.

SR 3.1.6.2

Insert N

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

Insert N

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.

BASES

SURVEILLANCE (continued)

SR 3.1.6.3

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

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

REFERENCES

1. Criteria 27, 28, 29, and 32 of: Atomic Energy Commission Proposed Rule Making, Part 50 - Licensing of Production and Utilization Facilities; General Design Criteria for Nuclear Power Plant Construction Permits, Federal Register 32, No. 132 (July 11, 1967): 10213. [NRC Accession Number: ML043310029]

2. 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors".

3. USAR, Sections 14.4 and 14.5.

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.

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.7 Rod Position Indication

BASES

BACKGROUND

According to AEC GDC Criteria 12 and 13 (Ref. 1), instrumentation to monitor variables and systems over their operating ranges during normal operation, anticipated operational occurrences, and accident conditions must be OPERABLE. LCO 3.1.7 is required to ensure OPERABILITY of the control rod position indicators to determine control rod positions and thereby ensure compliance with the control rod alignment and insertion limits.

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

BASES

BACKGROUND (continued)

the core (up or withdrawn) or into the core (down or inserted) by their control rod drive mechanisms. The RCCAs are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control.

The axial positions of shutdown rods and control rods are determined by two separate and independent systems: the bank demand position indication (commonly called group step counters) and the individual Rod Position Indication (RPI) System.

The bank demand position indication 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 is considered highly precise ($\pm$ 1 step or $\pm$ 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.

Demand position indication may be provided by various means such as step counters, Emergency Response Computer System (ERCS), calculations using rod drive cabinet counters or Pulse to Analog counters.

The RPI System provides a highly reliable indication of actual control rod position, but at a lower accuracy than the bank demand position indication. This system is based on inductive analog signals from a series of coils spaced along a hollow tube. The RPI System is designed with an accuracy of $\pm$ 5 % (approximately 12 steps) of full rod travel. There are inaccuracies arising from the normal range of coolant temperature variation from hot shutdown to full power which are compensated for by allowing $\pm$ 24 steps at the lower and upper ends of rod travel. With an indicated deviation of 12 steps between the bank demand position and RPI, the maximum deviation between actual rod position and the demand position could be 24 steps, or 15 inches. At the lower and upper ends of rod travel

BASES

BACKGROUND (continued)

with an indicated deviation of 24 steps between the group counter and RPI, the deviation between actual rod position and the demand position could be 36 steps, or 22.5 inches.

Individual rod position indication may be provided by either the IRPI control board meters or ERCS.

APPLICABLE SAFETY ANALYSES

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

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

LCO

LCO 3.1.7 specifies that the RPI System and bank demand position indication be OPERABLE for each control rod. For the control rod position indicators to be OPERABLE requires the following:

a. The RPI System indicates within 12 steps of the group demand position when the demand position is between 30 and 215 steps, or within 24 steps of their group demand position when the demand position is greater than or equal to 215 steps, less than or

BASES

LCO (continued)

equal to 30 steps, or individual rod position indication has been verified to be in agreement with actual rod position through independent means such as movable incore detectors or the Power Distribution Monitoring System in response to Required Actions (individual rod position indication may be provided by either the IRPI control board meters or ERCS); and

b. Bank demand indication has been calibrated either in the fully inserted position or to the RPI System. Demand position indication may be provided by various means such as step counters, Emergency Response Computer System (ERCS), calculations using rod drive cabinet counters or Pulse to Analog counters.

The 12 step agreement limit between bank demand position indication and the RPI System when the demand position is between 30 and 215 steps indicates that the bank demand position indication 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 above, 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.

BASES

LCO (continued)

This LCO is modified by a Note indicating individual control rod position indications may not be within limits for up to and including one hour following substantial control rod movement. This allows up to one hour of thermal soak time to allow the control rod drive shaft to reach thermal equilibrium and thus present a consistent position indication. Substantial rod movement is considered to be 10 or more steps in one direction in less than or equal to one hour.

In accordance with this Note, this comparison of bank demand position and RPI may take place at any time up to one hour after rod motion, at any power level. Based on this allowance, position indication may be considered OPERABLE during the thermal soak time to allow position indication to stabilize.

APPLICABILITY

The requirements on the RPI and step counters are only applicable in MODES 1 and 2 (consistent with LCO 3.1.4, LCO 3.1.5, and LCO 3.1.6), because these are the only MODES in which power is generated, and the OPERABILITY and alignment of rods have the potential to affect the safety of the plant. In the shutdown MODES, the OPERABILITY of the shutdown and control banks has the potential to affect the required SDM, but this effect can be compensated for by an increase in the boron concentration of the Reactor Coolant System. See LCO 3.1.1, "SHUTDOWN MARGIN (SDM)," for SDM requirements in MODE 2 with $k_{eff} < 1.0$ and MODES 3, 4, and 5 and LCO 3.9.1, "Boron Concentration," for boron concentration requirements during MODE 6.

BASES (continued)

ACTIONS

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

A.1 and A.2

in one or more groups

When one RPI channel per group fails, the position of the rod may still be determined indirectly by core power distribution measurement using either the movable incore detectors or the Power Distribution Monitoring System. Based on experience, normal power operation does not require excessive movement of banks. 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. Verification may determine that the RPI is OPERABLE and the rod is misaligned, then the Conditions of LCO 3.1.4, "Rod Group Alignment Limits" must be entered.

Insert O

~~A.2~~ A.3

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

Insert O

Required Action A.2 includes six distinct requirements for verification of the position of rods associated with an inoperable RPI using the movable incore detectors or Power Distribution Monitoring System:

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 movement;

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% 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.

BASES

ACTIONS A.~~2~~ (continued)

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

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

~~When more than one RPI channel per group fails, additional monitoring shall be performed to assure that the reactor remains in a safe condition.~~ The demand position from the group step counters associated with the rods with inoperable position indicators shall be monitored and recorded on an hourly basis. This ensures a periodic assessment of rod position to determine if rod movement in excess of 24 steps has occurred since the last determination of rod position. If rod movement in excess of 24 steps has occurred since the last determination of rod position, the Required Action of B.3 is required.

~~The reactor coolant system average temperature shall be monitored and recorded on an hourly basis. Monitoring and recording of the reactor coolant system average temperature may provide early detection of mispositioned or dropped rods.~~

If THERMAL POWER has not been reduced ≤ 50% RTP in accordance with Required Action A.2 and one or more rods have been moved in excess of 24 steps in one direction, since the position was last determined via Required Action A.1, then action is initiated sooner in accordance with Required Action B.3 to begin verifying that these rods are still properly positioned relative to their group positions. The 4 hour allowance for completion of this action allows adequate time to complete the rod position verification using either the movable incore detectors or the Power Distribution Monitoring System.

Insert P

When more than one RPI channel 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. Monitoring shall be performed to assure that the reactor remains in a safe condition.

BASES

ACTIONS

B.1, B.2, B.3, and B.4 (continued)

~~The position of rods with inoperable RPIs will also continue to be verified indirectly using either the movable incore detectors or the Power Distribution Monitoring System (PDMS) every 8 hours in accordance with Required Action A.1 if THERMAL POWER has not been reduced ≤ 50% RTP in accordance with Required Action A.2. Using the movable incore detectors or the PDMS provides further assurance that the rods have not moved.~~

Based on experience, normal power operation does not require excessive movement of banks. Therefore, the actions specified in this condition are adequate for continued full plant operation for up to 24 hours since the probability of simultaneously having a rod significantly out of position and an event sensitive to that rod position is small. The 24 hour allowed out of service time also provides sufficient time to troubleshoot and restore the RPI System to operation following a component failure in the system, while avoiding the challenges associated with a plant shutdown.

C.1.1 and C.1.2

Demand position indication is provided by any of the following means: step counters; ERCS; calculations using rod drive cabinet counters and Pulse to Analog counters. With all indication for one demand position per bank inoperable, 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 rod position indication of the most withdrawn rod and the rod position indication of the least withdrawn rod are ≤ 12 steps apart within the allowed Completion Time of once every 8 hours is adequate. This ensures that the most withdrawn and least withdrawn rod are no more than 24 steps apart (including instrument

BASES

ACTIONS

C.1.1 and C.1.2 (continued)

uncertainty) which bounds the accident analysis assumptions. This verification can be an examination of logs, administrative controls, or other information that shows that all RPIs in the affected bank are OPERABLE.

Insert Q

C.2

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

D.1

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

SURVEILLANCE REQUIREMENTS

SR 3.1.7.1

Verification that the RPI agrees with the demand position within 12 steps (between 30 and 215 steps) or within 24 steps (when ≤ 30 steps or ≥ 215 steps) ensures that the RPI is operating correctly.

Each RPI includes the coils, signal conditioning device(s) and readout devices (IRPI, meters and ERCS).

Insert Q

The position of rods with inoperable RPIs will also continue to be verified indirectly using either the movable incore detectors or the Power Distribution Monitoring System (PDMS) every 8 hours in accordance with Required Action A.1 if THERMAL POWER has not been reduced < 50% RTP in accordance with Required Action A.2. Using the movable incore detectors or the PDMS provides further assurance that the rods have not moved.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.7.1 (continued)

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

REFERENCES

1. Criteria 12 and 13 of: Atomic Energy Commission Proposed Rule Making, Part 50 - Licensing of Production and Utilization Facilities; General Design Criteria for Nuclear Power Plant Construction Permits, Federal Register 32, No. 132 (July 11, 1967): 10213. [NRC Accession Number: ML043310029]

2. USAR, Sections 14.4 and 14.5.

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 3.1.4. If a rod is known to not to be within 12 steps (between 30 and 215 steps) or within 24 steps (when < 30 steps or > 215 steps) of the group demand position, the ACTIONS of LCO 3.1.4 provide the appropriate Actions.