Industry/TSTF Standard Technical Specification Change Traveler

Separate control rods that are untrippable versus inoperable

Classification: 3) Improve Specifications

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

Description:

This change corrects an ambiguity regarding control rods that are inoperable vs. out of alignment.

A rod is operable if the rod can be tripped into the core. This is consistent with the Bases, of which the first statement of the Background equates operability with trippability.

The LCO statement is revised to clarify that the alignment limit is separate from the operability of the rod; a rod can remain operable even though it may be beyond the 12-step alignment limit.

Condition A wording is broadened, from "untrippable" to "inoperable" such that the Condition encompasses all inoperabilities. Previous wording was ambiguous for rods that, for instance, had slow drop times but were still trippable. These slow rods are inoperable (i.e., cannot provide the required SDM in the required time), and the revised Action properly addresses this condition.

Bases clarifications, consistent with the clarity proposed in the Specification, are also provided. Specifically, the change adds clarification regarding a rod that is immovable by normal means, but remains trippable. This clarifies that the rod remains operable (i.e., trippable) even though it cannot be moved without a reactor trip.

Justification:

The requirements of LCO 3.1.5, "Rod Alignment Limits," consist of two separate requirements: 1) a requirement for rod OPERABILITY (defined in the Bases as the ability to insert on an RTS trip), and 2) a requirement for the indicated position of each rod to be within 12 steps of its group demand position (i.e., correctly positioned). These requirements have been separated in the LCO and Actions to ensure that the appropriate actions are taken for each condition.

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Revision History

OG Revision 0 **Revision Status: Closed**

Revision Proposed by:

Revision Description:
Original Issue

Owners Group Review Information

Date Originated by OG: 18-Jan-96

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 18-Jan-96

TSTF Review Information

TSTF Received Date: 20-Feb-96 Date Distributed for Review 12-Apr-96

OG Revision 0 **Revision Status: Closed**

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

TSTF Comments.

NA CEOG, BWOG, BWROG.
BWOG - Justification only applies to the administrative portion of the change. Justification should be supplied on trippable vs. operable. (NOTE: Description and justification were revised to address this comment.)

TSTF Resolution: Approved Date: 28-May-96

NRC Review Information

NRC Received Date: 17-Jul-96

NRC Comments:

9/18/96 - NRC would like to arrange a technical discussion on this change.
9/18/96 - TSTF to arrange meeting or conference call.
10/30/96 - TSTF to take the issue back and revise to provide consistency in presentation and to ensure all the aspects of operability are addressed in the Bases.

Final Resolution: Superceded by Revision Final Resolution Date: 30-Oct-96

TSTF Revision 1 **Revision Status: Closed**

Revision Proposed by: WOG

Revision Description:
Develop to address NRC (B. Tjader) requested changes to the Bases B3.1.5 LCO Section and to modify the insert.

Owners Group Review Information

Date Originated by OG: 23-Jun-98

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 01-Sep-98

TSTF Review Information

TSTF Received Date: 02-Sep-98 Date Distributed for Review 23-Sep-98

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

TSTF Comments:

(No Comments)

TSTF Resolution: Approved Date: 23-Sep-98

NRC Review Information

NRC Received Date: 25-Sep-98

NRC Comments:

(No Comments)

Final Resolution: NRC Approves Final Resolution Date: 11-Jan-99

TSTF Revision 1 **Revision Status: Closed**

TSTF Revision 2 **Revision Status: Closed**

Revision Proposed by: NRC

Revision Description:
Applied TSTF-107 change to CEOG and BWOG NUREGs per NRC request.

Owners Group Review Information

Date Originated by OG: 01-Sep-98

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 01-Sep-98

TSTF Review Information

TSTF Received Date: 25-Sep-98 Date Distributed for Review 12-Oct-98

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

TSTF Comments:

T. Weber to provide revision to D. Hoffman.
Change Insert for CE/BW from i.e. to e.g.

TSTF Resolution: Superceeded Date: 03-Feb-99

TSTF Revision 3 **Revision Status: Closed**

Revision Proposed by: TSTF

Revision Description:
Revised CE Actions to reflect the philosophy behind the SDM changes made and approved in TSTF-67.

TSTF Review Information

TSTF Received Date: 03-Feb-99 Date Distributed for Review 03-Feb-99

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

TSTF Comments:

Rev. 2 approved by TSTF. Rev. 3 revised TSTF-107, Rev. 2 to incorporate TSTF comments.

TSTF Resolution: Approved Date: 03-Feb-99

NRC Review Information

NRC Received Date: 16-Mar-99

NRC Comments:

4/22/98 - NRC to complete review by 4/30/99.

Final Resolution: Superceded by Revision Final Resolution Date:

TSTF Revision 4 **Revision Status: Active** **Next Action: NRC**

Revision Proposed by: NRC

Revision Description:
Made several editorial corrections to Rev. 3.
> BWOG Pg. 3.1-6, Added "shall be" after "Each Control Rod".
> CEOG Pg. 3.1-8, Added "shall be"' after "All CEAs"
> CEOG LCO 3.1.5, Placed bracketed portion on a separate line connected by AND.
> CEOG Pg 3.1-11.Condition F. The added portion is changed to "inoperable" eliminating "for reasons other than Condition C or D." Conditions C and D do not address the same condition as Condition F.
> Removed additional copy of WOG Insert 2.

TSTF Review Information

TSTF Received Date: 30-Apr-99 Date Distributed for Review 30-Apr-99

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

TSTF Comments:

(No Comments)

TSTF Resolution: Approved Date: 09-May-99

NRC Review Information

NRC Received Date: 09-Jun-99

NRC Comments:

(No Comments)

Final Resolution: NRC Action Pending Final Resolution Date:

Incorporation Into the NUREGs

File to BBS/LAN Date: TSTF Informed Date: TSTF Approved Date:

NUREG Rev Incorporated:

Affected Technical Specifications

Bkgnd 3.1.4 Bases	CONTROL ROD Group Alignment Limits	NUREG(s)- 1430 Only
LCO 3.1.4	CONTROL ROD Group Alignment Limits	NUREG(s)- 1430 Only
S/A 3.1.4.A Bases	CONTROL ROD Group Alignment Limits	NUREG(s)- 1430 Only
Action 3.1.4.A	CONTROL ROD Group Alignment Limits	NUREG(s)- 1430 Only
Action 3.1.4.A Bases	CONTROL ROD Group Alignment Limits	NUREG(s)- 1430 Only
Action 3.1.4.C	CONTROL ROD Group Alignment Limits	NUREG(s)- 1430 Only
Action 3.1.4.C Bases	CONTROL ROD Group Alignment Limits	NUREG(s)- 1430 Only
Action 3.1.4.D	CONTROL ROD Group Alignment Limits	NUREG(s)- 1430 Only

Action 3.1.4.D Bases	CONTROL ROD Group Alignment Limits	NUREG(s)- 1430 Only
SR 3.1.4.2 Bases	CONTROL ROD Group Alignment Limits	NUREG(s)- 1430 Only
Bkgnd 3.1.5 Bases	Rod Group Alignment Limits	NUREG(s)- 1431 Only
LCO 3.1.5	Rod Group Alignment Limits	NUREG(s)- 1431 Only
LCO 3.1.5 Bases	Rod Group Alignment Limits	NUREG(s)- 1431 Only
Action 3.1.5.A	Rod Group Alignment Limits	NUREG(s)- 1431 Only
Action 3.1.5.A Bases	Rod Group Alignment Limits	NUREG(s)- 1431 Only
SR 3.1.5.2 Bases	Rod Group Alignment Limits	NUREG(s)- 1431 Only
Bkgnd 3.1.5 Bases	CEA Alignment (Analog)	NUREG(s)- 1432 Only
Bkgnd 3.1.5 Bases	CEA Alignment (Digital)	NUREG(s)- 1432 Only
S/A 3.1.5 Bases	CEA Alignment (Analog)	NUREG(s)- 1432 Only
S/A 3.1.5 Bases	CEA Alignment (Digital)	NUREG(s)- 1432 Only
LCO 3.1.5	CEA Alignment (Analog)	NUREG(s)- 1432 Only
LCO 3.1.5	CEA Alignment (Digital)	NUREG(s)- 1432 Only
LCO 3.1.5 Bases	CEA Alignment (Analog)	NUREG(s)- 1432 Only
LCO 3.1.5 Bases	CEA Alignment (Digital)	NUREG(s)- 1432 Only
Appl. 3.1.5 Bases	CEA Alignment (Analog)	NUREG(s)- 1432 Only
Appl. 3.1.5 Bases	CEA Alignment (Digital)	NUREG(s)- 1432 Only
Action 3.1.5.A	CEA Alignment (Analog)	NUREG(s)- 1432 Only
Action 3.1.5.A	CEA Alignment (Digital)	NUREG(s)- 1432 Only
Action 3.1.5.A Bases	CEA Alignment (Analog)	NUREG(s)- 1432 Only
Action 3.1.5.A Bases	CEA Alignment (Digital)	NUREG(s)- 1432 Only
Action 3.1.5.B	CEA Alignment (Analog)	NUREG(s)- 1432 Only
Action 3.1.5.B	CEA Alignment (Digital)	NUREG(s)- 1432 Only
Action 3.1.5.B Bases	CEA Alignment (Analog)	NUREG(s)- 1432 Only
Action 3.1.5.B Bases	CEA Alignment (Digital)	NUREG(s)- 1432 Only
Action 3.1.5.D	CEA Alignment (Digital)	NUREG(s)- 1432 Only

Action 3.1.5.D Bases	CEA Alignment (Digital)	NUREG(s)- 1432 Only
Action 3.1.5.E	CEA Alignment (Analog)	NUREG(s)- 1432 Only
Action 3.1.5.E	CEA Alignment (Digital) Change Description: New ACTION	NUREG(s)- 1432 Only
Action 3.1.5.E Bases	CEA Alignment (Analog)	NUREG(s)- 1432 Only
Action 3.1.5.E Bases	CEA Alignment (Digital) *Change Description:* New Action	NUREG(s)- 1432 Only
Action 3.1.5.F	CEA Alignment (Analog)	NUREG(s)- 1432 Only
SR 3.1.5.3 Bases	CEA Alignment (Digital)	NUREG(s)- 1432 Only
SR 3.1.5.5 Bases	CEA Alignment (Analog)	NUREG(s)- 1432 Only

Insert 1 (BWOG)

The requirements on rod OPERABILITY ensure that upon reactor trip, the assumed reactivity will be available and will be inserted. The rod OPERABILITY requirements (i.e., trippability) are separate from the alignment requirements. 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 (~~i.e.~~ e.g., rod lift coil failures), but that do not impact trippability, do not result in rod inoperability.

Insert 2 (WOG)

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 (~~i.e.~~ e.g., rod lift coil failures), but that do not impact trippability, do not result in rod inoperability.

Insert 3 (CEOG)

The CEA OPERABILITY requirement is satisfied provided the CEA will fully insert in the required CEA drop time assumed in the safety analysis. CEA control malfunctions that result in the inability to move a CEA (~~i.e.~~ e.g., CEA lift coil failures), but that do not impact trippability, do not result in CEA inoperability.

Insert 4 (CEOG Analog)

F.~~2~~ 1

If the inoperable CEA(s) cannot be restored to an 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 plant 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.

TSTF-107 Rev 4

Insert 5 (CEOG Digital)

E.~~2~~ 1

If the inoperable full-length CEA(s) cannot be restored to an 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 plant 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.

TSTF-107 Rev 4.

3.1 REACTIVITY CONTROL SYSTEMS

3.1.4 CONTROL ROD Group Alignment Limits

Each CONTROL ROD shall be

LCO 3.1.4 Each CONTROL ROD shall be OPERABLE and aligned to within [6.5]% of its group average height.

AND

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One trippable CONTROL ROD inoperable, or not aligned to within [6.5]% of its group average height, or both.	A.1 Align all CONTROL RODS in the group to within [6.5]% of the group average height, while maintaining the rod insertion, group sequence, and group overlap limits in accordance with LCO 3.2.1, "Regulating Rod Insertion Limits."	1 hour
	OR	
	A.2.1.1 Verify SDM is $\geq$ [1]% $\Delta k/k$.	1 hour AND Once per 12 hours thereafter
	OR	
	A.2.1.2 Initiate boration to restore SDM to within limit.	1 hour
	AND	
		(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. (continued)	A.2.2	Reduce THERMAL POWER to ≤ 60% of the ALLOWABLE THERMAL POWER.	2 hours
		<u>AND</u>	
	A.2.3	Reduce the nuclear overpower trip setpoint to ≤ 70% of the ALLOWABLE THERMAL POWER.	10 hours
		<u>AND</u>	
	A.2.4	Verify the potential ejected rod worth is within the assumptions of the rod ejection analysis.	72 hours
		<u>AND</u>	
	A.2.5	Perform SR 3.2.5.1.	72 hours
B. Required Action and associated Completion Time for Condition A not met.	B.1	Be in MODE 3.	6 hours
C. More than one ~~trippable~~ CONTROL ROD ~~inoperable, or~~ not aligned within [6.5]% of its group average height~~, or both~~.	C.1.1	Verify SDM is ≥ [1]% $\Delta k/k$.	1 hour
		<u>OR</u>	
			(continued)

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. (continued)	C.1.2 Initiate boration to restore SDM to within limit. AND C.2 Be in MODE 3.	1 hour 6 hours
D. One or more rods ~~untrippable~~ inoperable.	D.1.1 Verify SDM is ≥ [1]% Δk/k. OR D.1.2 Initiate boration to restore SDM to within limit. AND D.2 Be in MODE 3.	1 hour 1 hour 6 hours

TSTF-107 Rev 4

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.4 CONTROL ROD Group Alignment Limits

BASES

i.e.,

BACKGROUND

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

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

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 within 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.

CONTROL RODS are moved by their CONTROL ROD drive mechanisms (CRDMs). Each CRDM moves its rod ¾ inch for one revolution of the leadscrew, but at varying rates depending on the signal output from the Control Rod Drive Control System (CRDCS).

The CONTROL RODS are arranged into rod groups that are radially symmetric. Therefore, movement of the CONTROL RODS does not introduce radial asymmetries in the core power distribution. The safety rods and the regulating rods

(continued)

BASES

no changes provided FYI

BACKGROUND (continued)

provide required reactivity worth for immediate reactor shutdown upon a reactor trip. The regulating rods provide reactivity (power level) control during normal operation and transients, and their movement is normally governed by the automatic control system.

The axial position of safety rods and regulating rods is indicated by two separate and independent systems, which are the relative position indicator transducers and the absolute position indicator transducers (see LCO 3.1.7, "Position Indicator Channels").

The relative position indicator transducer is a potentiometer that is driven by electrical pulses from the CRDCS. There is one counter for each CONTROL ROD drive. Individual rods in a group all receive the same signal to move; therefore, the counters for all rods in a group should indicate the same position. The Relative Position Indicator System is considered highly precise (one rotation of the leadscrew is ¾ inch in rod motion). If a rod does not move for each demand pulse, the counter will still count the pulse and incorrectly reflect the position of the rod.

The Absolute Position Indicator System provides a highly accurate indication of actual CONTROL ROD position, but at a lower precision than relative position indicators. This system is based on inductive analog signals from a series of reed switches spaced along a tube with a center to center distance of 3.75 inches.

APPLICABLE SAFETY ANALYSES

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

a. There shall be no violations of:

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

b. The core must remain subcritical after accident transients.

(continued)

TSTF-107, Rev. 4

BASES

no changes provided FYI

APPLICABLE SAFETY ANALYSES (continued)

Three 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. If a CONTROL ROD is stuck in the fully withdrawn position, its worth is accounted for in the calculation of SDM, since the safety analysis does not take two stuck rods into account. The third type of misalignment occurs when one rod drops partially or fully into the reactor core. This event causes an initial power reduction followed by a return towards the original power due to positive reactivity feedback from the negative moderator temperature coefficient. Increased peaking during the power increase may result in excessive local linear heat rates (LHRs).

The accident analysis and reload safety evaluations define regulating rod insertion limits that ensure the required SDM can always be achieved if the maximum worth CONTROL ROD is stuck fully withdrawn (Ref. 4). If a CONTROL ROD is stuck in or dropped in, continued operation is permitted if the increase in local LHR is within the design limits. The Required Action statements in the LCOs provide conservative reductions in THERMAL POWER and verification of SDM to ensure continued operation remains within the bounds of the safety analysis (Ref. 5).

Continued operation of the reactor with a misaligned or dropped CONTROL ROD is allowed if the $F_Q(Z)$ and the $F^N_{\Delta H}$ are verified to be within their limits in the COLR. When a CONTROL ROD is misaligned, the assumptions that are used to determine the regulating rod insertion limits, APSR insertion limits, AXIAL POWER IMBALANCE limits, and QPT limits are not preserved. Therefore, the limits may not preserve the design peaking factors, and $F_Q(Z)$ and $F^N_{\Delta H}$ must be verified directly by incore mapping. Bases Section 3.2, Power Distribution Limits, contains a more complete discussion of the relation of $F_Q(Z)$ and $F^N_{\Delta H}$ to the operating limits.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

The CONTROL ROD group alignment limits and OPERABILITY requirements satisfy Criterion 2 of the NRC Policy Statement.

LCO

The limits on CONTROL ROD group alignment, safety rod insertion, and APSR alignment, together with the limits on regulating rod insertion, APSR insertion, AXIAL POWER IMBALANCE, and QPT, ensure the reactor will operate within the fuel design criteria. The Required Actions in these LCOs ensure that deviations from the alignment limits will either be corrected or that THERMAL POWER will be adjusted, so that excessive local LHRs will not occur and the requirements on SDM and ejected rod worth are preserved.

INSERT 1

The limit for individual CONTROL ROD misalignment is [6.5]% (9 inches) deviation from the group average position. This value is established, based on the distance between reed switches, with additional allowances for uncertainty in the absolute position indicator amplifiers, group maximum or minimum synthesizer, and asymmetric alarm or fault detector outputs. The position of an inoperable rod is not included in the calculation of the rod group average position.

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

APPLICABILITY

The requirements on CONTROL ROD OPERABILITY and alignment are applicable in MODES 1 and 2 because these are the only MODES in which neutron (or fission) power is generated, and the OPERABILITY (i.e., trippability) and alignment of rods have the potential to affect the safety of the plant. In MODES 3, 4, 5, and 6, the alignment limits do not apply because the CONTROL RODS are typically bottomed, and the reactor is shut down and not producing fission power. In the shutdown MODES, the OPERABILITY of the safety and regulating 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

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APPLICABILITY (continued)

LCO 3.9.1, "Boron Concentration," for boron concentration requirements during refueling.

ACTIONS

A.1

Alignment of the ~~inoperable or~~ misaligned CONTROL ROD may be accomplished by either moving the single CONTROL ROD to the group average position, or by moving the remainder of the group to the position of the single ~~inoperable or~~ misaligned CONTROL ROD. Either action can be used to restore the CONTROL RODS to a radially symmetric pattern. However, this must be done without violating the CONTROL ROD group sequence, overlap, and insertion limits of LCO 3.2.1, "Regulating Rod Insertion Limits," given in the COLR. THERMAL POWER must also be restricted, as necessary, to the value allowed by the insertion limits of LCO 3.2.1. The required Completion Time of 1 hour is acceptable because local xenon redistribution during this short interval will not cause a significant increase in LHR. This option is not available if a safety rod is misaligned, since the limits of LCO 3.1.5, "Safety Rod Insertion Limits," would be violated.

A.2.1.1

Compliance with Required Actions A.2.1.1 through A.2.5 allows for continued power operation with one CONTROL ROD ~~inoperable but trippable, or~~ misaligned from its group average position. These Required Actions comprise the final alternate for Condition A.

~~If realignment of the CONTROL ROD to the group average or alignment of the group to the misaligned CONTROL ROD is not completed within 1 hour (Required Action A.1 not met), the rod should be considered inoperable.~~ Since the rod may be inserted farther than the group average insertion for a long time, SDM must be evaluated. Ensuring the SDM meets the minimum requirement within 1 hour is adequate to determine that further degradation of the SDM is not occurring.

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TSTF-107, Rev. 3 -
Proposed Revision

BASES

No Changes Provided FYI

ACTIONS (continued)

A.2.1.2

Restoration of the required SDM requires increasing the RCS boron concentration, since the CONTROL ROD may remain misaligned and not be providing its normal negative reactivity on tripping. RCS boration must occur as described in Bases Section 3.1.1. The required Completion Time of 1 hour to initiate 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 for aligning the required valves and starting the boric acid pumps. Boration will continue until the required SDM is restored.

A.2.2

Reduction of THERMAL POWER to ≤ 60% ALLOWABLE THERMAL POWER ensures that local LHR increases, due to a misaligned rod, will not cause the core design criteria to be exceeded. The required Completion Time of 2 hours allows the operator sufficient time for reducing THERMAL POWER.

A.2.3

Reduction of the nuclear overpower trip setpoint to ≤ 70% ALLOWABLE THERMAL POWER, after THERMAL POWER has been reduced to 60% ALLOWABLE THERMAL POWER, maintains both core protection and an operating margin at reduced power similar to that at RTP. The required Completion Time of 10 hours allows the operator 8 additional hours after completion of the THERMAL POWER reduction in Required Action A.2.2 to adjust the trip setpoint.

A.2.4

The existing CONTROL ROD configuration must not cause an ejected rod to exceed the limit of 0.65% $\Delta k/k$ at RTP or 1.00% $\Delta k/k$ at zero power (Ref. 6). This evaluation may require a computer calculation of the maximum ejected rod worth based on nonstandard configurations of the CONTROL ROD groups. The evaluation must determine the ejected rod worth for the remainder of the fuel cycle to ensure a valid

(continued)

BASES

ACTIONS

A.2.4 (continued)

evaluation, should fuel cycle conditions at some later time become more bounding than those at the time of the rod misalignment. The required Completion Time of 72 hours is acceptable because LHRs are limited by the THERMAL POWER reduction and sufficient time is provided to perform the required evaluation.

A.2.5

Performance of SR 3.2.5.1 provides a determination of the power peaking factors using the Incore Detector System. Verification of the $F_Q(Z)$ and $F^N_{\Delta H}$ from an incore power distribution map is necessary to ensure that excessive local LHRs will not occur due to CONTROL ROD misalignment. This is necessary because the assumption that all CONTROL RODS are aligned (used to determine the regulating rod insertion, AXIAL POWER IMBALANCE, and QPT limits) is not valid when the CONTROL RODS are not aligned. The required Completion Time of 72 hours is acceptable because LHRs are limited by the THERMAL POWER reduction and adequate time is allowed to obtain an incore power distribution map.

B.1

If the Required Actions and associated Completion Times for Condition A cannot be met, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours. 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 plant systems.

C.1.1

More than one ~~trippable~~ CONTROL ROD becoming ~~inoperable or misaligned, or both inoperable but trippable and misaligned from their group average position,~~ is not expected and may violate the minimum SDM requirement. Therefore, SDM must be evaluated. Ensuring the SDM meets the minimum requirement

(continued)

ACTIONS

C.1.1 (continued)

within 1 hour allows the operator adequate time to determine the SDM.

C.1.2

Restoration of the required SDM requires increasing the RCS boron concentration to provide negative reactivity. RCS boration must occur as described in Bases Section 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 for aligning the required valves and starting the boric acid pumps. Boration will continue until the required SDM is restored.

C.2

If more than one ~~trippable~~ CONTROL ROD is ~~inoperable or~~ misaligned, continued operation of the reactor may cause the misalignment to increase, as the regulating rods insert or withdraw to control reactivity. If the CONTROL ROD misalignment increases, local power peaking may also increase, and local LHRs will also increase if the reactor continues operation at THERMAL POWER. The SDM is decreased when ~~one or more CONTROL RODS become inoperable at a given THERMAL POWER level, or if~~ one or more CONTROL RODS become misaligned by insertion from the group average position.

Therefore, it is prudent to place the reactor in MODE 3. LCO 3.1.4 does not apply in MODE 3 since excessive power peaking cannot occur and the minimum required SDM is ensured. 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 plant systems.

(continued)

ACTIONS (continued)

D.1.1 and D.1.2

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

In this situation, SDM verification must include the worth of the ~~untrippable~~ inoperable rod(s) as well as a rod of maximum worth.

D.2

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

Verification that individual rods are aligned within [6.5]% of their group average height limits at a 12 hour Frequency allows the operator to detect a rod that is beginning to deviate from its expected position. If the asymmetric CONTROL ROD alarm is inoperable, a Frequency of 4 hours is reasonable to prevent large deviations in CONTROL ROD alignment from occurring without detection. The specified Frequency takes into account other rod position information that is continuously available to the operator in the control room, so that during actual rod motion, deviations can immediately be detected.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.1.4.2

Verifying each CONTROL ROD is OPERABLE would require that each rod be tripped. However, in MODES 1 and 2, tripping each CONTROL ROD could result in radial tilts. Exercising each individual CONTROL ROD every 92 days provides increased confidence that all rods continue to be OPERABLE without exceeding the alignment limit, even if they are not regularly tripped. Moving each CONTROL ROD by 3% will not cause radial or axial power tilts, or oscillations, to occur. The 92 day Frequency takes into consideration other information available to the operator in the control room and SR 3.1.4.1, which is performed more frequently and adds to the determination of OPERABILITY of the rods. 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 is determined to be trippable and aligned, the CONTROL ROD(S) is considered to be OPERABLE. At any time, if a CONTROL ROD(S) is immovable, a determination of the trippability (OPERABILITY) of the CONTROL ROD(S) must be made, and appropriate action taken.

SR 3.1.4.3

Verification of rod drop time 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. The rod drop time given in the safety analysis is 1.4 seconds to ⅔ insertion. Using the identical rod drop curve gives a value of [1.66] seconds to ¾ insertion. The latter value is used in the Surveillance because the zone reference lights are located at 25% insertion intervals. The zone reference lights will activate at ¾ insertion to give an indication of the rod drop time and rod location. Measuring rod drop times, prior to reactor criticality after reactor vessel head removal and after CONTROL ROD drive system maintenance or modification, ensures that the reactor internals and CRDM will not interfere with CONTROL ROD motion or rod drop time. 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.

(continued)

TSTF-107, Rev. 4
Proposed Revision

BASES

No changes provided FYI

SURVEILLANCE REQUIREMENTS

SR 3.1.4.3 (continued)

This testing is normally performed with all reactor coolant pumps operating and average moderator temperature ≥ 525°F to simulate a reactor trip under actual conditions. However, if the rod drop times are determined with less than four reactor coolant pumps operating, a Note allows power operation to continue, provided operation is restricted to the pump combination utilized during the rod drop time determination.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10 and GDC 26.
2. 10 CFR 50.46.
3. FSAR, Chapter [14].
4. FSAR, Section [ ].
5. FSAR, Section [ ].
6. FSAR, Section [ ].

3.1 REACTIVITY CONTROL SYSTEMS

3.1.5 Control Element Assembly (CEA) Alignment (Analog)

LCO 3.1.5 All CEAs shall be OPERABLE. ~~and~~ all CEAs shall be aligned to within [7] inches (indicated position) of their respective group [, and the CEA motion inhibit and the CEA deviation circuit shall be OPERABLE].

AND

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more regulating CEAs ~~trippable and~~ misaligned from its group by > [7 inches] and ≤ [15 inches]. OR One regulating CEA ~~trippable and~~ misaligned from its group by > [15 inches].	A.1 Reduce THERMAL POWER to ≤ 70% RTP.	1 hour
	AND	
	A.2.1 Verify SDM is ≥ [4.5]% Δk/k.	1 hour
	OR	
	A.2.2 Initiate boration to restore SDM to within limit.	1 hour
	AND	
	A.3.1 Restore the misaligned CEA(s) to within [7 inches] (indicated position) of its group.	2 hours
	OR	
		(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. (continued)	A.3.2	Align the remainder of the CEAs in the group to within [7 inches] (indicated position) of the misaligned CEA(s) while maintaining the insertion limit of LCO 3.1.7, "Regulating Control Element Assembly (CEA) Insertion Limits."	2 hours
B. One or more shutdown CEAs ~~trippable and~~ misaligned from its group by > [7 inches] and ≤ [15 inches]. OR One shutdown CEA ~~trippable and~~ misaligned from its group by > [15 inches].	B.1	Reduce THERMAL POWER to ≤ 70% RTP.	1 hour
	AND		
	B.2.1	Verify SDM is ≥ [4.5]% Δk/k.	1 hour
	OR		
	B.2.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	B.3	Restore the misaligned CEA(s) to within [7 inches] (indicated position) of its group.	2 hours

(continued)

FYI: NO CHANGES

TSTF-107, Rev. 4
Proposed revision

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
C. CEA motion inhibit inoperable.	C.1	Perform SR 3.1.5.1.	1 hour AND Every 4 hours thereafter
	AND		
	C.2.1	Restore CEA motion inhibit to OPERABLE status.	6 hours
	OR		
	C.2.2	--------NOTE--------- Performance of Required Action C.2.2 is allowed only when not in conflict with Required Action A.1, A.3.1, A.3.2, B.1, B.3, or D.1. --------------------- Place and maintain the CEA drive switch in either the "off" or "manual" position [, and fully withdraw all CEAs in groups 3 and 4 and withdraw all CEAs in group 5 to < 5% insertion].	6 hours
D. CEA deviation circuit inoperable.	D.1	Perform SR 3.1.5.1.	1 hour AND Every 4 hours thereafter

(continued)

TSTF-107 Rev 4

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. Required Action and associated Completion Time not met. of Condition A, B, C, or D OR	E.1 Be in MODE 3.	6 hours
F. One or more CEAs untrippable. inoperable OR Two or more CEAs misaligned by > [15 inches].	F.1: Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.5.1	Verify the indicated position of each CEA to be within [7 inches] of all other CEAs in its group.	12 hours
SR 3.1.5.2	Verify that, for each CEA, the OPERABLE CEA position indicator channels, reed switch, and plant computer CEA position indication indicate within [5 inches] of each other.	12 hours
SR 3.1.5.3	Verify the CEA motion inhibit is OPERABLE.	31 days

(continued)

TSTF-107 Rev 7

3.1 REACTIVITY CONTROL SYSTEMS

3.1.5 Control Element Assembly (CEA) Alignment (Digital)

LCO 3.1.5 All full length CEAs shall be OPERABLE, and all full and part length CEAs shall be aligned to within [7 inches] (indicated position) of their respective groups.

AND

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One or more regulating CEAs trippable and misaligned from its group by > [7 inches] and ≤ [19 inches].	A.1	Reduce THERMAL POWER in accordance with Figure 3.1.5-1.	1 hour
OR	AND		
One regulating CEA trippable and misaligned from its group by > [19 inches].	A.2.1	Verify SDM is ≥ [5.0]% Δk/k.	1 hour
	OR		
	A.2.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	A.3.1	Restore the misaligned CEA(s) to within [7 inches] (indicated position) of its group.	2 hours
	OR		
			(continued)

TSTF-107 Rev 4

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. (continued)	A.3.2	Align the remainder of the CEAs in the group to within [7 inches] (indicated position) of the misaligned CEA(s) while maintaining the insertion limit of LCO 3.1.7, "Regulating Control Element Assembly (CEA) Insertion Limits."	2 hours
B. One or more shutdown CEAs ~~trippable and~~ misaligned from its group by > [7 inches] and ≤ [19 inches]. OR One shutdown CEA ~~trippable and~~ misaligned from its group by > [19 inches].	B.1	Reduce THERMAL POWER in accordance with Figure 3.1.5-1.	1 hour
	AND		
	B.2.1	Verify SDM is ≥ [5.0]% Δk/k.	1 hour
	OR		
	B.2.2	Initiate boration to restore SDM to within limit.	1 hour
	AND		
	B.3	Restore the misaligned CEA(s) to within [7 inches] (indicated position) of its group.	2 hours

(continued)

TSTF-K9 Rev 4

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
C. One or more part length CEAs misaligned from its group by > [7 inches] and ≤ [19 inches].	C.1	Reduce THERMAL POWER in accordance with Figure 3.1.5-1.	1 hour
	AND		
OR	C.2.1	Restore the misaligned CEA(s) to within [7 inches] (indicated position) of its group.	2 hours
One part length CEA misaligned from its group by > [19 inches].			
	OR		
	C.2.2	Align the remainder of the CEAs in the group to within [7 inches] (indicated position) of the misaligned CEA(s).	2 hours
D. Required Action and associated Completion Time of Condition A, B, or C not met.	D.1	Be in MODE 3.	6 hours
OR			
E. One or more full length CEAs ~~untrippable~~ inoperable.	E.1	Be in MODE 3.	6 hours
OR			
Two or more CEAs misaligned by > [19 inches].			

TSTF-107 Rev 4

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.5 Control Element Assembly (CEA) Alignment (Analog)

BASES

i.e.

BACKGROUND

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

The applicable criteria for these reactivity and power distribution design requirements are 10 CFR 50, Appendix A, GDC 10 and GDC 26 (Ref. 1), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Plants" (Ref. 2).

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

Limits on CEA alignment and OPERABILITY have been established, and all CEA 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.

CEAs are moved by their control element drive mechanisms (CEDMs). Each CEDM moves its CEA one step (approximately ¾ inch) at a time, but at varying rates (steps per minute) depending on the signal output from the Control Element Drive Mechanism Control System (CEDMCS).

The CEAs are arranged into groups that are radially symmetric. Therefore, movement of the CEAs does not introduce radial asymmetries in the core power distribution. The shutdown and regulating CEAs provide the required reactivity worth for immediate reactor shutdown upon a reactor trip. The regulating CEAs also provide reactivity (power level) control during normal operation and

(continued)

BACKGROUND (continued)

transients. Their movement may be automatically controlled by the Reactor Regulating System.

The axial position of shutdown and regulating CEAs is indicated by two separate and independent systems, which are the Plant Computer CEA Position Indication System and the Reed Switch Position Indication System.

The Plant Computer CEA Position Indication System counts the commands sent to the CEA gripper coils from the CEDM Control System that moves the CEAs. There is a one step counter for each group of CEAs. Individual CEAs 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. Plant Computer CEA Position Indication System is considered highly precise (± 1 step or ± ¾ inch). If a CEA does not move one step for each command signal, the step counter will still count the command and incorrectly reflect the position of the CEA.

The Reed Switch Position Indication System provides a highly accurate indication of actual CEA position, but at a lower precision than the step counters. This system is based on inductive analog signals from a series of reed switches spaced along a tube with a center to center distance of 1.5 inches, which is two steps. To increase the reliability of the system, there are redundant reed switches at each position.

APPLICABLE SAFETY ANALYSES

CEA misalignment accidents are analyzed in the safety analysis (Ref. 3). The accident analysis defines CEA misoperation as any event, with the exception of sequential group withdraws, which could result from a single malfunction in the reactivity control systems. For example, CEA misalignment may be caused by a malfunction of the CEDM, CEDMCS, or by operator error. A stuck CEA may be caused by mechanical jamming of the CEA fingers or of the gripper. Inadvertent withdrawal of a single CEA may be caused by the opening of the electrical circuit of the CEDM holding coil for a full length or part length CEA. A dropped CEA could be caused by an electrical failure in the CEA coil power programmers.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

The acceptance criteria for addressing CEA inoperability ~~and~~ or misalignment are that:

a. There shall be no violations of:

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

b. The core must remain subcritical after accident transients.

Three types of misalignment are distinguished in the safety analysis (Ref. 1). During movement of a group, one CEA may stop moving while the other CEAs in the group continue. This condition may cause excessive power peaking. The second type of misalignment occurs if one CEA 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 remaining CEAs to meet the SDM requirement with the maximum worth CEA stuck fully withdrawn. If a CEA is stuck in the fully withdrawn position, its worth is added to the SDM requirement, since the safety analysis does not take two stuck CEAs into account. The third type of misalignment occurs when one CEA drops partially or fully into the reactor core. This event causes an initial power reduction followed by a return towards the original power, due to positive reactivity feedback from the negative moderator temperature coefficient. Increased peaking during the power increase may result in excessive local linear heat rates (LHRs).

Two types of analyses are performed in regard to static CEA misalignment (Ref. 4). With CEA banks at their insertion limits, one type of analysis considers the case when any one CEA is inserted [ ] inches into the core. The second type of analysis considers the case of a single CEA withdrawn [ ] inches from a bank inserted into its insertion limit. Satisfying limits on departure from nucleate boiling ratio (DNBR) in both of these cases bounds the situation when a CEA is misaligned from its group by [7 inches].

Another type of misalignment occurs if one CEA fails to insert upon a reactor trip and remains stuck fully withdrawn. This condition is assumed in the evaluation to

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

determine that the required SDM is met with the maximum worth CEA also fully withdrawn (Ref. 5).

Since the CEA drop incidents result in the most rapid approach to specified acceptable fuel design limits (SAFDLs) caused by a CEA misoperation, the accident analysis analyzed a single full length CEA drop. The most rapid approach to the DNBR SAFDL may be caused by a single full length CEA drop or a CEA subgroup drop, depending upon initial conditions.

All of the above CEA misoperations will result in an automatic reactor trip. In the case of the full length CEA drop, a prompt decrease in core average power and a distortion in radial power are initially produced, which, when conservatively coupled, result in a local power and heat flux increase, and a decrease in DNBR parameters.

The results of the CEA misoperation analysis show that during the most limiting misoperation events, no violations of the SAFDLs, fuel centerline temperature, or RCS pressure occur.

limits and OPERABILITY requirements

CEA alignment satisf~~ies~~ Criteria 2 and 3 of the NRC Policy Statement.

y

LCO

CEA

The limits on shutdown and regulating CEA alignments ensure that the assumptions in the safety analysis will remain valid. The requirements on OPERABILITY ensure that upon reactor trip, the CEAs will be available and will be inserted to provide enough negative reactivity to shut down the reactor. The OPERABILITY requirements ~~also~~ ensure that the CEA banks maintain the correct power distribution and CEA alignment.

CEA

(i.e., trippability) are separate from the alignment requirements which

INSERT 3

The requirement is to maintain the CEA alignment to within [7 inches] between any CEA and its group. The minimum misalignment assumed in safety analysis is [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

(continued)

BASES

LCO (continued)

SDMS, all of which may constitute initial conditions inconsistent with the safety analysis.

APPLICABILITY

The requirements on CEA OPERABILITY and alignment are applicable in MODES 1 and 2 because these are the only MODES in which neutron (or fission) power is generated, and the OPERABILITY (~~e.g.~~ i.e., trippability) and alignment of CEAs 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 CEAs are bottomed, and the reactor is shut down and not producing fission power. In the shutdown Modes, the OPERABILITY of the shutdown and regulating CEAs has the potential to affect the required SDM, but this effect can be compensated for by an increase in the boron concentration of the RCS. See LCO 3.1.1, "SHUTDOWN MARGIN (SDM)—T_{avg} > 200°F," for SDM in MODES 3, 4, and 5, and LCO 3.9.1, "Boron Concentration," for boron concentration requirements during refueling.

ACTIONS

A.1, A.2.1, A.2.2, A.3.1, and A.3.2

~~A CEA may become misaligned, yet remain trippable. In this condition, the CEA can still perform its required function of adding negative reactivity should a reactor trip be necessary.~~

If one or more regulating CEAs are misaligned by > [7 inches] and ≤ [15 inches] ~~but trippable~~, or one regulating CEA is misaligned by > [15 inches] ~~but trippable~~, continued operation in MODES 1 and 2 may continue, provided, within 1 hour, the power is reduced to ≤ 70% RTP and SDM is ≥ [5.0]% $\Delta k/k$, and within 2 hours the misaligned CEA(s) is aligned within [7 inches] of its group, or the misaligned CEA's group is aligned within [7 inches] of the misaligned CEA(s).

Xenon redistribution in the core starts to occur as soon as a CEA becomes misaligned. Reducing THERMAL POWER in accordance with Figure 3.1.5-1 (in the associated LCO) ensures acceptable power distributions are maintained (Ref. 6). For small misalignments (< [15 inches]) of the CEAs, there is:

(continued)

ACTIONS

A.1, A.2.1, A.2.2, A.3.1, and A.3.2 (continued)

a. A small effect on the time dependent long term power distributions relative to those used in generating LCOs and limiting safety system settings (LSSS) setpoints;

b. A small effect on the available SDM; and

c. A small effect on the ejected CEA worth used in the accident analysis.

With a large CEA misalignment (≥ [15 inches]), however, this misalignment would cause distortion of the core power distribution. This distortion may, in turn, have a significant effect on:

a. The available SDM;

b. The time dependent, long term power distributions relative to those used in generating LCOs and LSSS setpoints; and

c. The ejected CEA worth used in the accident analysis.

Therefore, this condition is limited to a single CEA misalignment, while still allowing 2 hours for recovery.

In both cases, a 2 hour time period is sufficient to:

a. Identify cause of a misaligned CEA;

b. Take appropriate corrective action to realign the CEAs; and

c. Minimize the effects of xenon redistribution.

If a CEA is untrippable, it is not available for reactivity insertion during a reactor trip. With an untrippable CEA, meeting the insertion limits of LCO 3.1.6 and LCO 3.1.7 does not ensure that adequate SDM exists. In this condition, an additional allowance must be made for the worth of the affected CEA when calculating the available SDM. This is necessary, since the OPERABLE CEAs must still meet the single failure criterion. If additional negative reactivity is required to provide the necessary SDM, it must be

(continued)

BASES

ACTIONS

A.1, A.2.1, A.2.2, A.3.1, and A.3.2 (continued)

provided by increasing the RCS boron concentration. One hour allows sufficient time to perform the SDM calculation and initiate any required boron adjustment to the RCS.

B.1, B.2.1, B.2.2., and B.3

If one or more shutdown CEAs are misaligned by > [7 inches] and ≤ [15 inches] ~~but trippable~~, or one shutdown CEA is misaligned by > [15 inches] ~~but trippable~~, continued operation in MODES 1 and 2 may continue, provided, within 1 hour, the power is reduced to ≤ 70% RTP and SDM is ≥ [5.0]% Δk/k, and within 2 hours the misaligned CEA(s) is aligned within [7 inches] of its group.

C.1, C.2.1, and C.2.2

The CEA motion inhibit permits CEA motion within the requirements of LCO 3.1.7, "Regulating Control Element Assembly (CEA) Insertion Limits," and prevents regulating CEAs from being misaligned from other CEAs in the group.

Performing SR 3.1.5.1 within 1 hour and every 4 hours thereafter, is considered acceptable in view of other information continuously available to the operator in the control room.

With the CEA motion inhibit inoperable, a Completion Time of 6 hours is allowed for restoring the CEA motion inhibit to OPERABLE status, or placing and maintaining the CEA drive switch in either the "off" or "manual" position, fully withdrawing the CEAs in groups 3 and 4, and withdrawing all CEAs in group 5 to < 5% insertion.

Placing the CEA drive switch in the "off" or "manual" position ensures the CEAs will not move in response to Reactor Regulating System automatic motion commands. Withdrawal of the CEAs to the positions required in the Required Action C.2.2 ensures that core perturbations in local burnup, perking factors, and SDM will not be more adverse than the Conditions assumed in the safety analyses and LCO setpoint determination (Ref. 6).

(continued)

BASES

ACTIONS

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

The 6 hour Completion Time takes into account Required Action C.1, the protection afforded by the CEA deviation circuits, and other information continuously available to the operator in the control room, so that during actual CEA motion, deviations can be detected.

Required Action C.2.2 is modified by a Note indicating that performing this Required Action is not required when in conflict with Required Actions A.1, A.3.1, A.3.2, B.1, B.3, or D.1.

D.1

When the CEA deviation circuit is inoperable, performing SR 3.1.5.1, within 1 hour and every 4 hours thereafter, ensures improper CEA alignments are identified before unacceptable flux distributions occur. The specified Completion Times take into account other information continuously available to the operator in the control room, so that during CEA movement, deviations can be detected, and the protection provided by the CEA inhibit and deviation circuit is not required.

E.1

If the Required Action or associated Completion Time of Condition A, Condition B, Condition C, or Condition D is not met~~; one or more regulating or shutdown CEAs are untrippable,~~ or two or more CEAs are misaligned by > [15 inches], the unit is required to be brought to MODE 3. By being brought to MODE 3, the unit is brought outside its MODE of applicability. Continued operation is not allowed in the case of more than one CEA misaligned from any other CEA in its group by > [15 inches]~~, or one or more CEAs untrippable~~. This is because ~~these cases are~~ It is indicative of a loss of SDM and power distribution~~, and a loss of safety function, respectively~~.

When a Required Action cannot be completed within the required Completion Time, a controlled shutdown should be commenced. The allowed Completion Time of 6 hours is reasonable, based on operating experience, for reaching

(continued)

TSTF-107 Rev 4

INSERT 4

BASES

ACTIONS

E.1 (continued)

MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.1.5.1

Verification that individual CEA positions are within [7 inches] (indicated reed switch positions) of all other CEAs in the group at a 12 hour Frequency allows the operator to detect a CEA that is beginning to deviate from its expected position. The specified Frequency takes into account other CEA position information that is continuously available to the operator in the control room, so that during CEA movement, deviations can be detected, and protection can be provided by the CEA motion inhibit and deviation circuits.

SR 3.1.5.2

OPERABILITY of at least two CEA position indicator channels is required to determine CEA positions, and thereby ensure compliance with the CEA alignment and insertion limits. The CEA "full in" and "full out" limits provide an additional independent means for determining the CEA positions when the CEAs are at either their fully inserted or fully withdrawn positions.

The 12 hour Frequency takes into consideration other information continuously available to the operator in the control room, so that during CEA movement, deviations can be detected, and protection can be provided by the CEA motion inhibit and deviation circuits.

SR 3.1.5.3

Demonstrating the CEA motion inhibit OPERABLE verifies that the CEA motion inhibit is functional, even if it is not regularly operated. The 31 day Frequency takes into account other information continuously available to the operator in the control room, so that during CEA movement, deviations

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.5.3 (continued)

can be detected, and protection can be provided by the CEA deviation circuits.

SR 3.1.5.4

Demonstrating the CEA deviation circuit is OPERABLE verifies the circuit is functional. The 31 day Frequency takes into account other information continuously available to the operator in the control room, so that during CEA movement, deviations can be detected, and protection can be provided by the CEA motion inhibit.

SR 3.1.5.5

Verifying each CEA is trippable would require that each CEA be tripped. In MODES 1 and 2, tripping each CEA would result in radial or axial power tilts, or oscillations. Therefore, individual CEAs are exercised every 92 days to provide increased confidence that all CEAs continue to be trippable, even if they are not regularly tripped. A movement of [5 inches] is adequate to demonstrate motion without exceeding the alignment limit when only one CEA is being moved. The 92 day Frequency takes into consideration other information available to the operator in the control room and other surveillances being performed more frequently, which add to the determination of OPERABILITY of the CEAs. Between required performances of SR 3.1.5.5, if a CEA(s) is discovered to be immovable, but remains trippable and aligned, the CEA is considered to be OPERABLE. At any time, if a CEA(s) is immovable, a determination of the trippability (OPERABILITY) of the CEA(s) must be made, and appropriate action taken.

SR 3.1.5.6

Performance of a CHANNEL FUNCTIONAL TEST of each reed switch position transmitter channel ensures the channel is OPERABLE and capable of indicating CEA position over the entire length of the CEA's travel. Since this Surveillance must be performed when the reactor is shut down, an 18 month Frequency to be coincident with refueling outage was

(continued)

TSTF-107, Rev. 4
Proposed Revision
No changes provided FYC

SURVEILLANCE REQUIREMENTS

SR 3.1.5.6 (continued)

selected. Operating experience has shown that these components usually pass this Surveillance when performed at a Frequency of once every 18 months. Furthermore, the Frequency takes into account other surveillances being performed at shorter Frequencies, which determine the OPERABILITY of the CEA Reed Switch Indication System.

SR 3.1.5.7

Verification of CEA drop times determined that the maximum CEA drop time permitted is consistent with the assumed drop time used in that safety analysis (Ref. 7). Measuring drop times prior to reactor criticality, after reactor vessel head removal, ensures that reactor internals and CEDM will not interfere with CEA motion or drop time and that no degradation in these systems has occurred that would adversely affect CEA motion or drop time. Individual CEAs whose drop times are greater than safety analysis assumptions are not OPERABLE. This SR is performed prior to criticality, based on the need to perform this Surveillance under the conditions that apply during a unit outage and because of the potential for an unplanned unit transient if the Surveillance were performed with the reactor at power.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10 and GDC 26.
2. 10 CFR 50.46.
3. FSAR, Section [ ].
4. FSAR, Section [ ].
5. FSAR, Section [ ].
6. FSAR, Section [ ].
7. FSAR, Section [ ].

TSTF-107 Rev 4

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.5 Control Element Assembly (CEA) Alignment (Digital)

BASES

i.e.

BACKGROUND

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

The applicable criteria for these reactivity and power distribution design requirements are 10 CFR 50, Appendix A, GDC 10 and GDC 26 (Ref. 1) and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Cooled Nuclear Power Plants" (Ref. 2).

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

OPERABILITY

Limits on CEA alignment and ~~operability~~ have been established, and all CEA 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.

CEAs are moved by their control element drive mechanisms (CEDMs). Each CEDM moves its CEA one step (approximately ¾ inch) at a time, but at varying rates (steps per minute) depending on the signal output from the Control Element Drive Mechanism Control System (CEDMCS).

The CEAs are arranged into groups that are radially symmetric. Therefore, movement of the CEAs does not introduce radial asymmetries in the core power distribution. The shutdown and regulating CEAs provide the required reactivity worth for immediate reactor shutdown upon a reactor trip. The regulating CEAs also provide reactivity (power level) control during normal operation and

(continued)

BACKGROUND (continued)

transients. Their movement may be automatically controlled by the Reactor Regulating System. Part length CEAs are not credited in the safety analyses for shutting down the reactor, as are the regulating and shutdown groups. The part length CEAs are used solely for ASI control.

The axial position of shutdown and regulating CEAs is indicated by two separate and independent systems, which are the Plant Computer CEA Position Indication System and the Reed Switch Position Indication System.

The Plant Computer CEA Position Indication System counts the commands sent to the CEA gripper coils from the CEDMCS that moves the CEAs. There is one step counter for each group of CEAs. Individual CEAs 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 Plant Computer CEA Position Indication System is considered highly precise (± one step or ± ¾ inch). If a CEA does not move one step for each command signal, the step counter will still count the command and incorrectly reflect the position of the CEA.

The Reed Switch Position Indication System provides a highly accurate indication of actual CEA position, but at a lower precision than the step counters. This system is based on inductive analog signals from a series of reed switches spaced along a tube with a center to center distance of 1.5 inches, which is two steps. To increase the reliability of the system, there are redundant reed switches at each position.

APPLICABLE SAFETY ANALYSES

CEA misalignment accidents are analyzed in the safety analysis (Ref. 3). The accident analysis defines CEA misoperation as any event, with the exception of sequential group withdrawals, which could result from a single malfunction in the reactivity control systems. For example, CEA misalignment may be caused by a malfunction of the CEDM, CEDMCS, or by operator error. A stuck CEA may be caused by mechanical jamming of the CEA fingers or of the gripper. Inadvertent withdrawal of a single CEA may be caused by opening of the electrical circuit of the CEDM holding coil for a full length or part length CEA. A dropped CEA

(continued)

APPLICABLE SAFETY ANALYSES (continued)

subgroup could be caused by an electrical failure in the CEA coil power programmers.

The acceptance criteria for addressing CEA inoperability or misalignment are that:

a. There shall be no violations of:

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

b. The core must remain subcritical after accident transients.

Three types of misalignment are distinguished. During movement of a group, one CEA may stop moving while the other CEAs in the group continue. This condition may cause excessive power peaking. The second type of misalignment occurs if one CEA 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 remaining CEAs to meet the SDM requirement with the maximum worth CEA stuck fully withdrawn. If a CEA is stuck in the fully withdrawn position, its worth is added to the SDM requirement, since the safety analysis does not take two stuck CEAs into account. The third type of misalignment occurs when one CEA drops partially or fully into the reactor core. This event causes an initial power reduction followed by a return towards the original power due to positive reactivity feedback from the negative moderator temperature coefficient. Increased peaking during the power increase may result in excessive local linear heat rates (LHRs).

Two types of analyses are performed in regard to static CEA misalignment (Ref. 4). With CEA banks at their insertion limits, one type of analysis considers the case when any one CEA is inserted [ ] inches into the core. The second type of analysis considers the case of a single CEA withdrawn [ ] inches from a bank inserted to its insertion limit. Satisfying limits on departure from nucleate boiling ratio (DNBR) in both of these cases bounds the situation when a CEA is misaligned from its group by [7 inches].

(continued)

APPLICABLE SAFETY ANALYSES (continued)

Another type of misalignment occurs if one CEA 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 CEA also fully withdrawn (Ref. 5).

The effect of any misoperated CEA on the core power distribution will be assessed by the CEA calculators, and an appropriately augmented power distribution penalty factor will be supplied as input to the core protection calculators (CPCs). As the reactor core responds to the reactivity changes caused by the misoperated CEA and the ensuing reactor coolant and Doppler feedback effects, the CPCs will initiate a low DNBR or high local power density trip signal if specified acceptable fuel design limits (SAFDLs) are approached.

Since the CEA drop incidents result in the most rapid approach to SAFDLs caused by a CEA misoperation, the accident analysis analyzed a single full length CEA drop, a single part length CEA drop, and a part length CEA subgroup drop. The most rapid approach to the DNBR SAFDL may be caused by either a single full length drop or a part length CEA subgroup drop depending upon initial conditions. The most rapid approach to the fuel centerline melt SAFDL is caused by a single part length CEA drop.

In the case of the full length CEA drop, a prompt decrease in core average power and a distortion in radial power are initially produced, which when conservatively coupled result in local power and heat flux increases, and a decrease in DNBR. For plant operation within the DNBR and local power density (LPD) LCOs, DNBR and LPD trips can normally be avoided on a dropped CEA.

For a part length CEA subgroup drop, a distortion in power distribution, and a decrease in core power are produced. As the dropped part length CEA subgroup is detected, an appropriate power distribution penalty factor is supplied to the CPCs, and a reactor trip signal on low DNBR is generated. For the part length CEA drop, both core average power and three dimensional peak to average power density increase promptly. As the dropped part length CEA is detected, core power and an appropriately augmented power distribution penalty factor are supplied to the CPCs.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

CEA alignment limits and OPERABILITY requirements satisfy Criteria 2 and 3 of the NRC Policy Statement.

LCO

The limits on shutdown and regulating CEA alignments ensure that the assumptions in the safety analysis will remain valid. ~~The requirements on~~ CEA OPERABILITY (i.e., trippability) are separate from the alignment requirements which ensure that upon reactor trip, the CEAs will be available and will be inserted to provide enough negative reactivity to shut down the reactor. The OPERABILITY requirements also ensure that the CEA banks maintain the correct power distribution and CEA alignment. INSERT 3

The requirement is to maintain the CEA alignment to within [7 inches] between any CEA and its group. The minimum misalignment assumed in safety analysis is [19 inches], and in some cases, a total misalignment from fully withdrawn to fully inserted is assumed.

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

APPLICABILITY

The requirements on CEA OPERABILITY and alignment are applicable in MODES 1 and 2 because these are the only MODES in which neutron (or fission) power is generated, and the OPERABILITY (e.g., i.e., trippability) and alignment of CEAs 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 CEAs are bottomed, and the reactor is shut down and not producing fission power. In the shutdown modes, the OPERABILITY of the shutdown and regulating CEAs has the potential to affect the required SDM, but this effect can be compensated for by an increase in the boron concentration of the RCS. See LCO 3.1.1, "SHUTDOWN MARGIN (SDM)—T_{avg} > 200°F," for SDM in MODES 3, 4, and 5, and LCO 3.9.1, "Boron Concentration," for boron concentration requirements during refueling.

(continued)

BASES (continued)

ACTIONS

<u>A.1, A.2.1, A.2.2, A.3.1, and A.3.2</u>

~~A CEA may become misaligned, yet remain trippable. In this condition, the CEA can still perform its required function of adding negative reactivity should a reactor trip be necessary.~~

If one or more regulating CEAs are misaligned by [7 inches] and ≤ [19 inches] ~~but trippable~~ or one regulating CEA misaligned by > [19 inches] ~~but trippable~~, continued operation in MODES 1 and 2 may continue, provided, within 1 hour, the power is reduced in accordance with Figure 3.1.5-1, and SDM is ≥ [5.0]% Δk/k, and within 2 hours the misaligned CEA(s) is aligned within [7 inches] of its group or the misaligned CEA's group is aligned within [7 inches] of the misaligned CEA(s).

Xenon redistribution in the core starts to occur as soon as a CEA becomes misaligned. Reducing THERMAL POWER in accordance with Figure 3.1.5-1 (in the accompanying LCO) ensures acceptable power distributions are maintained (Ref. 6). For small misalignments (< [19 inches]) of the CEAs, there is:

a. A small effect on the time dependent long term power distributions relative to those used in generating LCOs and limiting safety system settings (LSSS) setpoints;

b. A small effect on the available SDM; and

c. A small effect on the ejected CEA worth used in the accident analysis.

With a large CEA misalignment (≥ [19 inches]), however, this misalignment would cause distortion of the core power distribution. This distortion may, in turn, have a significant effect on:

a. The available SDM;

b. The time dependent, long term power distributions relative to those used in generating LCOs and LSSS setpoints; and

c. The ejected CEA worth used in the accident analysis.

(continued)

BASES

ACTIONS

A.1, A.2.1, A.2.2, A.3.1, and A.3.2 (continued)

Therefore, this condition is limited to the single CEA misalignment, while still allowing 2 hours for recovery.

In both cases, a 2 hour time period is sufficient to:

a. Identify cause of a misaligned CEA;

b. Take appropriate corrective action to realign the CEAs; and

c. Minimize the effects of xenon redistribution.

In this condition, an additional allowance must be made for the worth of the affected CEA when calculating the available SDM. With one or more misaligned CEAs, SDM must be verified for CEAs at the existing nonaligned positions. SDM is calculated by performing a reactivity balance calculation according to procedure, considering the listed effects in SR 3.1.1.1. This is necessary since the OPERABLE CEAs must still meet the single failure criterion. If additional negative reactivity is required to provide the necessary SDM, it must be provided by increasing the RCS boron concentration. One hour allows sufficient time to perform the SDM calculation and make any required boron adjustment to the RCS.

B.1, B.2.1, B.2.2, and B.3

If one or more shutdown CEAs are misaligned by > [7 inches] and ≤ [19 inches] ~~but trippable~~, or one shutdown CEA misaligned by > [19 inches] ~~but trippable~~, continued operation in MODES 1 and 2 may continue, provided, within 1 hour, the power is reduced in accordance with Figure 3.1.5-1, and SDM is ≥ [5.0]% Δk/k, and within 2 hours the misaligned CEA(s) is aligned within [7 inches] of its group.

C.1, C.2.1, and C.2.2

If one or more part length CEAs are misaligned by > [7 inches] and ≤ [19 inches] or one part length CEA misaligned by > [19 inches], continued operation in MODES 1

(continued)

ACTIONS

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

and 2 may continue, provided power is reduced in accordance with the appropriate figure within 1 hour, and within 2 hours the misaligned CEA(s) is restored to within [7 inches] of its group, or the misaligned CEA's group is aligned within [7 inches] of the misaligned CEA.

Although a part length CEA has less of an effect on core flux than a full length CEA, a misaligned part length CEA will still result in xenon redistribution and affect core power distribution. Requiring realignment within 2 hours minimizes these effects and ensures acceptable power distribution is maintained.

D.1

If a Required Action or associated Completion Time of Condition A, Condition B, or Condition C is not met, ~~one or more regulating or shutdown CEAs are untrippable,~~ or two or more CEAs are misaligned by > [19 inches], the unit is required to be brought to MODE 3. By being brought to MODE 3, the unit is brought outside its MODE of applicability.

When a Required Action cannot be completed within the required Completion Time, a controlled shutdown should be commenced. 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 plant systems.

~~If a CEA is untrippable, it is not available for reactivity insertion during a reactor trip. With an untrippable CEA, meeting the insertion limits of LCO 3.1.6, "Shutdown Control Element Assembly (CEA) Insertion Limits," and LCO 3.1.7, "Regulating Control Element Assembly (CEA) Insertion Limits," does not ensure that adequate SDM exists. Therefore, the plant must be shut down in order to evaluate the SDM required boron concentration and power level for critical operation.~~

Continued operation is not allowed in the case of more than one CEA(s) misaligned from any other CEA in its group by > [19 inches]~~, or with one or more full length CEAs~~

(continued)

BASES

ACTIONS

D.1 (continued)

it is

~~untrippable.~~ This is because ~~these cases are~~ indicative of a loss of SDM and power distribution~~, and a loss of safety function, respectively~~.

Insert 5

SURVEILLANCE REQUIREMENTS

SR 3.1.5.1

Verification that individual CEA positions are within [7 inches] (indicated reed switch positions) of all other CEAs in the group at a 12 hour Frequency allows the operator to detect a CEA that is beginning to deviate from its expected position. The specified Frequency takes into account other CEA position information that is continuously available to the operator in the control room, so that during actual CEA motion, deviations can immediately be detected.

SR 3.1.5.2

OPERABILITY of at least two CEA position indicator channels is required to determine CEA positions, and thereby ensure compliance with the CEA alignment and insertion limits. The CEA full in and full out limits provide an additional independent means for determining the CEA positions when the CEAs are at either their fully inserted or fully withdrawn positions.

SR 3.1.5.3

Verifying each full length CEA is trippable would require that each CEA be tripped. In MODES 1 and 2 tripping each full length CEA would result in radial or axial power tilts, or oscillations. Therefore individual full length CEAs are exercised every 92 days to provide increased confidence that all full length CEAs continue to be trippable, even if they are not regularly tripped. A movement of [5 inches] is adequate to demonstrate motion without exceeding the alignment limit when only one full length CEA is being moved. The 92 day Frequency takes into consideration other information available to the operator in the control room and other surveillances being performed more frequently,

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.5.3 (continued)

which add to the determination of OPERABILITY of the CEAs (Ref. 7). Between required performances of SR 3.1.5.3, if a CEA(s) is discovered to be immovable but remains trippable ~~and aligned~~, the CEA is considered to be OPERABLE. At anytime, if a CEA(s) is immovable, a determination of the trippability (OPERABILITY) of that CEA(s) must be made, and appropriate action taken.

SR 3.1.5.4

Performance of a CHANNEL FUNCTIONAL TEST of each reed switch position transmitter channel ensures the channel is OPERABLE and capable of indicating CEA position over the entire length of the CEA's travel. Since this test must be performed when the reactor is shut down, an 18 month Frequency to be coincident with refueling outage was selected. Operating experience has shown that these components usually pass this Surveillance when performed at a Frequency of once every 18 months. Furthermore, the Frequency takes into account other surveillances being performed at shorter Frequencies, which determine the OPERABILITY of the CEA Reed Switch Indication System.

SR 3.1.5.5

Verification of full length CEA drop times determines that the maximum CEA drop time permitted is consistent with the assumed drop time used in the safety analysis (Ref. 7). Measuring drop times prior to reactor criticality, after reactor vessel head removal, ensures the reactor internals and CEDM will not interfere with CEA motion or drop time, and that no degradation in these systems has occurred that would adversely affect CEA motion or drop time. Individual CEAs whose drop times are greater than safety analysis assumptions are not OPERABLE. This SR is performed prior to criticality 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.

(continued)

BASES (continued) No changes Provided FYI

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10 and GDC 26.
2. 10 CFR 50.46.
3. FSAR, Section [ ].
4. FSAR, Section [ ].
5. FSAR, Section [ ].
6. FSAR, Section [ ].
7. FSAR, Section [ ].

TSTF-107
Rev 4

3.1 REACTIVITY CONTROL SYSTEMS

3.1.5 Rod Group Alignment Limits

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

3

AND

shall be

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more rod(s) ~~untrippable~~. inoperable	A.1.1 Verify SDM is ≥ [1.6]% Δk/k.	1 hour
	OR	
	A.1.2 Initiate boration to restore SDM to within limit.	1 hour
	AND	
	A.2 Be in MODE 3.	6 hours
B. One rod not within alignment limits.	B.1 Restore rod to within alignment limits.	1 hour
	OR	
	B.2.1.1 Verify SDM is ≥ [1.6]% Δk/k.	1 hour
	OR	

(continued)

TSTF-107
REV 4

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.5 Rod Group Alignment Limits

BASES

BACKGROUND

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

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

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

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

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

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

(continued)

TSTF 107
REV 4

BASES

APPLICABLE SAFETY ANALYSES (continued)

Another type of misalignment occurs if one RCCA fails to insert upon a reactor trip and remains stuck fully withdrawn. This condition is assumed in the evaluation to determine that the required SDM is met with the maximum worth RCCA also fully withdrawn (Ref. 5).

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

Continued operation of the reactor with a misaligned control rod is allowed if the heat flux hot channel factor ($F_Q(Z)$) and the nuclear enthalpy hot channel factor ($F^N_{\Delta H}$) are verified to be within their limits in the COLR and the safety analysis is verified to remain valid. When a control rod is misaligned, the assumptions that are used to determine the rod insertion limits, AFD limits, and quadrant power tilt limits are not preserved. Therefore, the limits may not preserve the design peaking factors, and $F_Q(Z)$ and $F^N_{\Delta H}$ must be verified directly by incore mapping. Bases Section 3.2 (Power Distribution Limits) contains more complete discussions of the relation of $F_Q(Z)$ and $F^N_{\Delta H}$ to the operating limits.

Shutdown and control rod OPERABILITY and alignment are directly related to power distributions and SDM, which are initial conditions assumed in safety analyses. Therefore they satisfy Criterion 2 of the NRC Policy Statement.

LCO

control rod

The limits on shutdown or control rod alignments ensure that the assumptions in the safety analysis will remain valid. The requirements on OPERABILITY ensure that upon reactor trip, the assumed reactivity will be available and will be inserted. The OPERABILITY requirements also ensure that the RCCAs and banks maintain the correct power distribution and rod alignment.

(i.e., trippability) are separate from the alignment requirements, which

Insert 2

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

(continued)

TSTF-107
Rev 4-

BASES

LCO (continued)

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

APPLICABILITY

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

ACTIONS

A.1.1 and A.1.2

inoperable (i.e.)

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

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

A.2

inoperable

If the ~~untrippable~~ 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

(continued)

TSTF-107
REV 4-

BASES

ACTIONS

D.1 (continued)

conditions in an orderly manner and without challenging the plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.1.5.1

Verification that individual rod positions are within alignment limits at a Frequency of 12 hours provides a history that allows the operator to detect a rod that is beginning to deviate from its expected position. If the rod position deviation monitor is inoperable, a Frequency of 4 hours accomplishes the same goal. The specified Frequency takes into account other rod position information that is continuously available to the operator in the control room, so that during actual rod motion, deviations can immediately be detected.

SR 3.1.5.2

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

(continued)