Industry/TSTF Standard Technical Specification Change Traveler

LCO 3.2.5, "Power Peaking Factors" Applicability Change to MODE 1 with THERMAL POWER > 20% RTP

Priority/Classification 1) Correct Specifications

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

Description:

Change LCO 3.2.5 Applicability to MODE 1 with THERMAL POWER > 20% RTP. Add Notes to LCO 3.1.4 Required Action A.2.5, LCO 3.1.8.c, LCO 3.1.8 Condition B, SR 3.1.8.2, LCO 3.2.1 Required Action A.1, and LCO 3.2.2 Required Action A.1 to state that these requirements are not applicable when thermal power is < = 20% RTP. The associated Bases have also been revised to discuss the Notes and Applicability changes. The requirements as written are not technically accurate and do not reflect the design of a B&W plant.

Justification:

The power peaking factors referred to in Sections 3.1 and 3.2 are calculated from data received from the incore detector system. However, it is not possible to obtain meaningful power distribution data from the incore detector system at thermal power levels much below 20% RTP. Therefore, at very low power levels the calculation of power peaking factors may be erroneous. All requirements associated with the power peaking factors (LCOs, SRs, Conditions, and Required Actions) have been modified by a Note stating that these requirements are only required when > 20% RTP. This results in requirements that are consistent with the instrumentation capability available to satisfy the LCO.

Revision History

OG Revision 0 Revision Status: Closed

Revision Proposed by: ANO-1

Revision Description:
Original Issue

Owners Group Review Information

Date Originated by OG: 01-Oct-96

Owners Group Comments
Designated ANO-1-13

Owners Group Resolution: Approved Date: 17-Sep-96

TSTF Review Information

TSTF Received Date: 01-Nov-96 Date Distributed for Review 05-Dec-96

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

TSTF Comments:

CEOG - Not applicable, accepts. Similar allowances already in NUREG-1432.
WOG - Not applicable, accepts
BWROG - Not applicable, accepts

Additional comments received from the BWOG on 1/13/97. On hold for resolution.

TSTF Resolution: Approved Date: 07-Jan-97

NRC Review Information

NRC Received Date: 24-Jan-97 NRC Reviewer:

NRC Comments:

NOTE: TSTF-155 through 160 were inadvertently submitted to the NRC without BWOG approval. The NRC was informed in February to ignore the travelers until BWOG review and approval could be obtained.

Final Resolution: TSTF Withdraws Final Resolution Date: 27-Mar-97

TSTF Revision 1 Revision Status: Active Next Action: EXCEL

Revision Proposed by: BWOG

Revision Description:
After further review, BWOG-32 (TSTF-160), was approved by the BWOG without changes. Revision 1 was issued to facilitate tracking.

Owners Group Review Information

Date Originated by OG: 06-Nov-97

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 06-Nov-97

TSTF Review Information

TSTF Received Date: 06-Nov-97 Date Distributed for Review 06-Nov-97

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

TSTF Comments:
(No Comments)

TSTF Resolution: Approved Date: 05-Feb-98

Incorporation Into the NUREGs

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

NUREG Rev Incorporated:

Affected Technical Specifications

Action 3.1.4.A	Control Rod Group Alignment Limits
Action 3.1.4.A Bases	Control Rod Group Alignment Limits
S/A 3.1.8 Bases	Physics Tests Exceptions - Mode 1
LCO 3.1.8	Physics Tests Exceptions - Mode 1
LCO 3.1.8 Bases	Physics Tests Exceptions - Mode 1
Action 3.1.8.B	Physics Tests Exceptions - Mode 1

Action 3.1.8.B Bases	Physics Tests Exceptions - Mode 1
SR 3.1.8.2	Physics Tests Exceptions - Mode 1
SR 3.1.8.2 Bases	Physics Tests Exceptions - Mode 1
Action 3.2.1.A	Regulating Rod Insertion Limits
Action 3.2.1.A Bases	Regulating Rod Insertion Limits
Action 3.2.2.A	APSR Insertion Limits
Action 3.2.2.A Bases	APSR Insertion Limits
Bkgnd 3.2.5 Bases	Power Peaking Factors
S/A 3.2.5 Bases	Power Peaking Factors
Appl. 3.2.5	Power Peaking Factors
Appl. 3.2.5 Bases	Power Peaking Factors
Action 3.2.5.C	Power Peaking Factors
Action 3.2.5.C Bases	Power Peaking Factors

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ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.2.2 Reduce THERMAL POWER to ≤ 60% of the ALLOWABLE THERMAL POWER. AND A.2.3 Reduce the nuclear overpower trip setpoint to ≤ 70% of the ALLOWABLE THERMAL POWER. AND A.2.4 Verify the potential ejected rod worth is within the assumptions of the rod ejection analysis. AND A.2.5 Perform SR 3.2.5.1.	2 hours 10 hours 72 hours 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]% Δk/k. OR	1 hour (continued)

<INSERT 3.1-7A>

<Insert 3.1-7A>

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A.2.5	----------NOTE---------- Only required when THERMAL POWER is > 20% RTP. ----------	

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3.1 REACTIVITY CONTROL SYSTEMS

3.1.8 PHYSICS TESTS Exceptions—MODE 1

LCO 3.1.8 During the performance of PHYSICS TESTS, the requirements of

LCO 3.1.4, "CONTROL ROD Alignment Limits";
LCO 3.1.5, "Safety Rod Insertion Limits";
LCO 3.1.6, "AXIAL POWER SHAPING ROD (APSR) Alignment Limits";
LCO 3.2.1, "Regulating Rod Insertion Limits," for the restricted operation region only;
LCO 3.2.3, "AXIAL POWER IMBALANCE Operating Limits"; and
LCO 3.2.4, "QUADRANT POWER TILT (QPT)"

may be suspended, provided:

a. THERMAL POWER is maintained ≤ 85% RTP;

b. Nuclear overpower trip setpoint is ≤ 10% RTP higher than the THERMAL POWER at which the test is performed, with a maximum setting of 90% RTP;

<INSERT 3.1-18A>

c. $F_Q(Z)$ and $F^N_{\Delta H}$ are maintained within the limits specified in the COLR; and

d. SDM is ≥ [1.0]% Δk/k.

APPLICABILITY: MODE 1 during PHYSICS TESTS.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. SDM not within limit.	A.1	Initiate boration to restore SDM to within limit.	15 minutes
	AND		
	A.2	Suspend PHYSICS TESTS exceptions.	1 hour

(continued)

<Insert 3.1-18A>

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c. ----------NOTE----------
Only required when THERMAL POWER is > 20% RTP.

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ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. THERMAL POWER > 85% RTP. OR Nuclear overpower trip setpoint > 10% higher than PHYSICS TESTS power level. OR Nuclear overpower trip setpoint > 90% RTP. OR <INSERT 3.1-19A> $F_Q(Z)$ or $F^N_{\Delta H}$ not within limits.	B.1 Suspend PHYSICS TESTS exceptions.	1 hour

SURVEILLANCE REQUIREMENTS

SURVEILLANCE			FREQUENCY
SR	3.1.8.1	Verify THERMAL POWER is ≤ 85% RTP.	1 hour
<INSERT 3.1-19B> SR	3.1.8.2	Perform SR 3.2.5.1.	2 hours
SR	3.1.8.3	Verify nuclear overpower trip setpoint is ≤ 10% RTP higher than the THERMAL POWER at which the test is performed, with a maximum setting of 90% RTP.	8 hours

(continued)

<Insert 3.1-19A>

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---------NOTE----------
Only required when
THERMAL POWER
is > 20% RTP.

<Insert 3.1-19B>

----------NOTE----------
Only required when THERMAL
POWER is > 20% RTP.

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3.2 POWER DISTRIBUTION LIMITS

3.2.1 Regulating Rod Insertion Limits

LCO 3.2.1 Regulating rod groups shall be within the physical insertion, sequence, and overlap limits specified in the COLR.

APPLICABILITY: MODES 1 and 2.

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

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
<INSERT 3.2-1A> A. Regulating rod groups inserted in restricted operational region, or sequence or overlap, or any combination, not met.	A.1	Perform SR 3.2.5.1.	Once per 2 hours
	AND		
	A.2	Restore regulating rod groups to within limits.	24 hours from discovery of failure to meet the LCO
B. Required Action and associated Completion Time of Condition A not met.	B.1	Reduce THERMAL POWER to less than or equal to THERMAL POWER allowed by regulating rod group insertion limits.	2 hours

(continued)

<Insert 3.2-1A>

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A.1	----------NOTE---------- Only required when THERMAL POWER is > 20% RTP. ----------	

Insert follows page 3.2-1
3.2-1A

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3.2 POWER DISTRIBUTION LIMITS

3.2.2 AXIAL POWER SHAPING ROD (APSR) Insertion Limits

LCO 3.2.2 *APSRs shall be positioned within the limits specified in the* COLR.

APPLICABILITY: MODES 1 and 2.

ACTIONS

<INSERT 3.2-4A>

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. APSRs not within limits.	A.1	Perform SR 3.2.5.1.	Once per 2 hours
	AND		
	A.2	Restore APSRs to within limits.	24 hours
B. Required Action and associated Completion Time not met.	B.1	Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.2.1	Verify APSRs are within acceptable limits specified in the COLR.	12 hours

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<Insert 3.2-4A>

A.1	----------NOTE---------- Only required when THERMAL POWER is > 20% RTP. ----------	

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3.2 POWER DISTRIBUTION LIMITS

3.2.5 Power Peaking Factors

LCO 3.2.5 $F_Q(Z)$ and $F^N_{\Delta H}$ shall be within the limits specified in the COLR.

APPLICABILITY: MODE 1 with THERMAL POWER > 20% RTP.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. $F_Q(Z)$ not within limit.	A.1	Reduce THERMAL POWER ≥ 1% RTP for each 1% that $F_Q(Z)$ exceeds limit.	15 minutes
	AND		
	A.2	Reduce nuclear overpower trip setpoint and nuclear overpower based on Reactor Coolant System (RCS) flow and AXIAL POWER IMBALANCE trip setpoint ≥ 1% RTP for each 1% that $F_Q(Z)$ exceeds limit.	8 hours
	AND		
	A.3	Restore $F_Q(Z)$ to within limit.	24 hours

(continued)

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ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. $F^N_{\Delta H}$ not within limit.	B.1	Reduce THERMAL POWER ≥ RH(%) RTP (specified in the COLR) for each 1% that $F^N_{\Delta H}$ exceeds limit.	15 minutes
	AND		
	B.2	Reduce nuclear overpower trip setpoint and nuclear overpower based on RCS flow and AXIAL POWER IMBALANCE trip setpoint ≥ RH(%) RTP (specified in the COLR) for each 1% that $F^N_{\Delta H}$ exceeds limit.	8 hours
	AND		
	B.3	Restore $F^N_{\Delta H}$ to within limit.	24 hours
C. Required Action and associated Completion Time not met.	C.1	Be in MODE 2 / 1 with THERMAL POWER ≤ 20% RTP.	2 hours

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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.

<INSERT B3.1-23A> →→

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)

<Insert B3.1-23A>

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Required Action A.2.5 is modified by a Note that requires the performance of SR 3.2.5.1 only when THERMAL POWER is greater than 20% RTP. This establishes a Required Action that is consistent with the Applicability of LCO 3.2.5, "Power Peaking Factors."

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APPLICABLE SAFETY ANALYSES (continued)

surveillance of the $F_Q(Z)$, the $F^N_{\Delta H}$, and SDM is required to verify that their limits are not exceeded. The limits for the nuclear hot channel factors are specified in the COLR. Refer to the Bases for LCO 3.2.5 for a complete discussion of $F_Q(Z)$ and $F^N_{\Delta H}$. During PHYSICS TESTS, one or more of the LCOs that normally preserve the $F_Q(Z)$ and $F^N_{\Delta H}$ limits may be suspended. However, the results of the safety analysis are not adversely impacted if verification that $F_Q(Z)$ and $F^N_{\Delta H}$ are within their limits is obtained, while one or more of the LCOs is suspended. Therefore, SRs are placed on $F_Q(Z)$ and $F^N_{\Delta H}$ during MODE 1 PHYSICS TESTS to verify that these factors remain within their limits. Periodic verification of these factors allows PHYSICS TESTS to be conducted while continuing to maintain the design criteria.

when THERMAL POWER exceeds 20% RTP

PHYSICS TESTS include measurement of core nuclear parameters or exercise of control components that affect process variables. Among the process variables involved are AXIAL POWER IMBALANCE and QPT, which represent initial condition input (power peaking) for the accident analysis. Also involved are the movable control components, i.e., the regulating rods and the APSRs, which affect power peaking and are required for shutdown of the reactor. The limits for these variables are specified for each fuel cycle in the COLR.

PHYSICS TESTS satisfy Criteria 1, 2, and 3 of the NRC Policy Statement.

LCO

This LCO permits individual CONTROL RODS to be positioned outside of their specified group alignment and withdrawal limits and to be assigned to other than specified CONTROL ROD groups, and permits AXIAL POWER IMBALANCE and QPT limits to be exceeded during the performance of PHYSICS TESTS. In addition, this LCO permits verification of the fundamental core characteristics and nuclear instrumentation operation.

The requirements of LCO 3.1.4, LCO 3.1.5, LCO 3.1.6, LCO 3.2.1 (for the restricted operation region only), LCO 3.2.3, and LCO 3.2.4 may be suspended during the performance of PHYSICS TESTS provided:

a. THERMAL POWER is maintained ≤ 85% RTP;

(continued)

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BASES

LCO (continued)

b. Nuclear overpower trip setpoint is ≤ 10% RTP higher than the THERMAL POWER at which the test is performed, with a maximum setting of 90% RTP;

c. $F_Q(Z)$ and $F^N_{\Delta H}$ are maintained within limits specified in the COLR; and

While operating at greater than 20% RTP

d. SDM is maintained ≥ 1.0% Δk/k.

Operation with THERMAL POWER ≤ 85% RTP during PHYSICS TESTS provides an acceptable thermal margin when one or more of the applicable LCOs is out of specification. Eighty-five percent RTP is consistent with the maximum power level for conducting the intermediate core power distribution test specified in Reference 4. The nuclear overpower trip setpoint is reduced so that a similar margin exists between the steady state condition and trip setpoint as exists during normal operation at RTP.

<INSERT B 3.1-48A>

APPLICABILITY

This LCO is applicable in MODE 1, when the reactor has completed low power testing and is in power ascension, or during power operation with THERMAL POWER > 5% RTP but ≤ 85% RTP. This LCO is applicable for power ascension testing, as defined by Regulatory Guide 1.68 (Ref. 3). In MODE 2, Applicability of this LCO is not required because LCO 3.1.9, "PHYSICS TESTS Exceptions—MODE 2," addresses PHYSICS TESTS exceptions in MODE 2. In MODES 3, 4, 5, and 6, Applicability is not required because PHYSICS TESTS are not performed in these MODES.

ACTIONS

A.1 and A.2

If the SDM requirements are not met, boration must be initiated promptly. A Completion Time of 15 minutes is adequate for an operator to correctly align and start the required systems and components. The operator should begin boration with the best source available for the plant conditions. Boration will be continued until SDM is within limit. In the determination of the required combination of boration flow rate and boron concentration, there is no unique requirement that must be satisfied.

(continued)

<Insert B3.1-48A>

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LCO provision c is modified by a Note that requires the adherence to power peaking factor requirements only when THERMAL POWER is greater than 20% RTP. This establishes an LCO provision that is consistent with the Applicability of LCO 3.2.5, "Power Peaking Factors."

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BASES

ACTIONS

A.1 and A.2 (continued)

Suspension of PHYSICS TESTS exceptions requires restoration of each of the applicable LCOs to within specification.

B.1

If THERMAL POWER exceeds 85% RTP, then 1 hour is allowed for the operator to reduce THERMAL POWER to within limits or to complete an orderly suspension of PHYSICS TESTS exceptions. Suspension of PHYSICS TESTS exceptions requires restoration of each of the applicable individual LCOs to within specification. This required Completion Time is consistent with, or more conservative than, those specified for the individual LCO, addressed by PHYSICS TESTS exceptions.

If the nuclear overpower trip setpoint is not within the specified limits, then 1 hour is allowed for the operator to restore the nuclear overpower trip setpoint within limits or to complete an orderly suspension of PHYSICS TESTS exceptions. Suspension of PHYSICS TESTS exceptions requires restoration of each of the applicable individual LCOs to within specification. This required Completion Time is consistent with, or more conservative than, those specified for the individual LCO, addressed by these PHYSICS TESTS exceptions.

If the results of the incore flux map indicate that either $F_Q(Z)$ or $F^M_{\Delta H}$ has exceeded its limit, then PHYSICS TESTS are suspended. This action is required because of direct indication that the core peaking factors, which are fundamental initial conditions for the safety analysis, are excessive. Suspension of PHYSICS TESTS exceptions requires restoration of each of the applicable LCOs to within specification.

<INSERT B3.1-49A> —>>

SURVEILLANCE REQUIREMENTS

SR 3.1.8.1

Verification that THERMAL POWER is ≤ 85% RTP ensures that the required additional thermal margin has been established prior to and during PHYSICS TESTS. The required Frequency of once per hour allows the operator adequate time to

(continued)

<Insert B3.1-49A>

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This Condition is modified by a Note that requires performance of the Required Action only when THERMAL POWER is greater than 20% RTP. This establishes an ACTIONS entry Condition that is consistent with LCO provision c and the Applicability of LCO 3.2.5, "Power Peaking Factors."

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BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.8.1 (continued)

determine any degradation of the established thermal margin during PHYSICS TESTS.

SR 3.1.8.2

Verification that $F_Q(Z)$ and $F^N_{\Delta H}$ are within their limits ensures that core local linear heat rate and departure from nucleate boiling ratio will remain within their limits, while one or more of the LCOs that normally control these design limits are out of specification. The required Frequency of 2 hours allows the operator adequate time for collecting a flux map and for performing the hot channel factor verifications, based on operating experience. If SR 3.2.5.1 is not met, PHYSICS TESTS are suspended and LCO 3.2.5 applies. This Frequency is more conservative than the Completion Time for restoration of the individual LCOs that preserve the $F_Q(Z)$ and $F^N_{\Delta H}$ limits.

<INSERT B3.1-50A> →→

SR 3.1.8.3

Verification that the nuclear overpower trip setpoint is within the limit specified for each PHYSICS TEST ensures that core protection at the reduced power level is established and will remain in place during the PHYSICS TESTS. Performing the verification once every 8 hours allows the operator adequate time for determining any degradation of the established trip setpoint margin before and during PHYSICS TESTS and for adjusting the nuclear overpower trip setpoint.

SR 3.1.8.4

The SDM is verified by performing a reactivity balance calculation, considering the following reactivity effects:

a. Reactor Coolant System (RCS) boron concentration;

b. CONTROL ROD position;

c. RCS average temperature;

(continued)

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<Insert B3.1-50A>

This SR is modified by a Note that requires performance only when THERMAL POWER is greater than 20% RTP. This establishes a performance requirement that is consistent with the Applicability of LCO 3.2.5, "Power Peaking Factors."

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BASES

ACTIONS

A.1 (continued)

that a rod insertion limit is ejected rod worth limited, then the ejected rod worth is no more limiting than the SDM based rod insertion limit in the core design (Ref. 8). Ejected rod worth limits are independently maintained by the Required Actions of Conditions A and C.

<INSERT B3.2-6A>

A.2

Indefinite operation with the regulating rods inserted in the restricted region, or in violation of the group sequence or overlap limits, is not prudent. Even if power peaking monitoring per Required Action A.1 is continued, reactivity limits may not be met and the abnormal regulating rod insertion or group configuration may cause an adverse xenon redistribution, may cause the limits on AXIAL POWER IMBALANCE to be exceeded, or may adversely affect the long term fuel depletion pattern. Therefore, power peaking monitoring is allowed for up to 24 hours after discovery of failure to meet the requirements of this LCO. This required Completion Time is reasonable based on the low probability of an event occurring simultaneously with the limit out of specification in this relatively short time period. In addition, it precludes long term depletion with abnormal group insertions or configurations, thereby limiting the potential for an adverse xenon redistribution.

B.1

If the regulating rods cannot be restored within the acceptable operating limits shown on the figures in the COLR within the required Completion Time (i.e., Required Action A.2 not met), then the limits can be restored by reducing the THERMAL POWER to a value allowed by the regulating rod insertion limits in the COLR. The required Completion Time of 2 hours is sufficient to allow the operator to complete the power reduction in an orderly manner and without challenging the plant systems. Operation for up to 2 hours more in the restricted region shown in the COLR is acceptable, based on the low probability of an event occurring simultaneously with the limit out of specification in this relatively short time period. In addition, it precludes long term depletion with abnormal group insertions

(continued)

<Insert B3.2-6A>

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Required Action A.1 is modified by a Note that requires the performance of SR 3.2.5.1 only when THERMAL POWER is greater than 20% RTP. This establishes a Required Action that is consistent with the Applicability of LCO 3.2.5, "Power Peaking Factors."

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BASES

ACTIONS (continued)

the APSR withdrawal. If this occurs, the APSRs must be restored to their normal inserted position. Conversely, after the fuel cycle burnup for the APSR withdrawal occurs, the APSRs may not be reinserted for the remainder of the fuel cycle. These restrictions apply to ensure the axial burnup distribution that accumulates in the fuel will be consistent with the expected (as designed) distribution.

A.1

For verification that the core parameters $F_Q(Z)$ and $F^N_{\Delta H}$ are within their limits, SR 3.2.5.1 is performed using the Incore Detector System to obtain a three dimensional power distribution map. Successful verification that $F_Q(Z)$ and $F^N_{\Delta H}$ are within their limits ensures that operation with the APSRs inserted or withdrawn in violation of the times specified in the COLR do not violate either the ECCS or DNB criteria (Ref. 4). The required Completion Time of 2 hours is reasonable to allow the operator to obtain a power distribution map and to verify the power peaking factors. Repeating SR 3.2.5.1 every 2 hours is reasonable to ensure that continued verification of the power peaking factors is obtained as core conditions (primarily the regulating rod insertion and induced xenon redistribution) change.

<INSERT B3.2-14A>

A.2

Indefinite operation with the APSRs inserted or withdrawn in violation of the times specified in the COLR is not prudent. Even if power peaking monitoring per Required Action A.1 is continued, the abnormal APSR insertion or withdrawal may cause an adverse xenon redistribution, may cause the limits on AXIAL POWER IMBALANCE to be exceeded, or may affect the long term fuel depletion pattern. Therefore, power peaking monitoring is allowed for up to 24 hours. This required Completion Time is reasonable based on the low probability of an event occurring simultaneously with the APSR limit out of specification. In addition, it precludes long term depletion with the APSRs in positions that have not been analyzed, thereby limiting the potential for an adverse xenon redistribution. This time limit also ensures that the intended burnup distribution is maintained, and allows the operator sufficient time to reposition the APSRs to correct their positions.

(continued)

<Insert B3.2-14A>

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Required Action A.1 is modified by a Note that requires the performance of SR 3.2.5.1 only when THERMAL POWER is greater than 20% RTP. This establishes a Required Action that is consistent with the Applicability of LCO 3.2.5, "Power Peaking Factors."

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B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.5 Power Peaking Factors

BASES

BACKGROUND

The purpose of this MODE 1 LCO is to establish limits that constrain the core power distribution within design limits during normal operation (Condition 1) and during anticipated operational occurrences (Condition 2) such that accident initial condition protection criteria are preserved. The accident initial condition criteria are preserved by bounding operation at THERMAL POWER within specified acceptable fuel design limits.

$F_Q(Z)$ is a specified acceptable fuel design limit that preserves the initial conditions for the Emergency Core Cooling Systems (ECCS) analysis. $F_Q(Z)$ is defined as the maximum local fuel rod linear power density divided by the average fuel rod linear power density, assuming nominal fuel pellet and rod dimensions. Because $F_Q(Z)$ is a ratio of local power densities, it is related to the maximum local (pellet) power density in a fuel rod. Operation within the $F_Q(Z)$ limits given in the COLR prevents power peaking that would exceed the loss of coolant accident (LOCA) linear heat rate (LHR) limits derived from the analysis of the ECCS.

The $F^N_{\Delta H}$ limit is a specified acceptable fuel design limit that preserves the initial conditions for the limiting loss of flow transient. $F^N_{\Delta H}$ is defined as the ratio of the integral of linear power along the fuel rod on which the minimum departure from nucleate boiling ratio (DNBR) occurs to the average integrated rod power. Because $F^N_{\Delta H}$ is a ratio of integrated powers, it is related to the maximum total power produced in a fuel rod. Operation within the $F^N_{\Delta H}$ limits given in the COLR prevents departure from nucleate boiling (DNB) during a postulated loss of forced reactor coolant flow accident.

Measurement of the core power peaking factors using the Incore Detector System to obtain a three dimensional power distribution map provides direct confirmation that $F_Q(Z)$ and $F^N_{\Delta H}$ are within their limits, and may be used to verify that the power peaking factors remain bounded when one or more normal operating parameters exceed their limits.

(continued)

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BASES (continued)

APPLICABLE SAFETY ANALYSES

The limits on $F_Q(Z)$ are determined by the ECCS analysis in order to limit peak cladding temperatures to 2200°F during a LOCA. The maximum acceptable cladding temperature is specified by 10 CFR 50.46 (Ref. 1). Higher cladding temperatures could cause severe cladding failure by oxidation due to a Zircaloy water reaction. Other criteria must also be met (e.g., maximum cladding oxidation, maximum hydrogen generation, coolable geometry, and long term cooling). However, peak cladding temperature is usually most limiting.

The limits on $F^N_{\Delta H}$ provide protection from DNB during a limiting loss of flow transient. Proximity to the DNB condition is expressed by the DNBR, defined as the ratio of the cladding surface heat flux required to cause DNB to the actual cladding surface heat flux. The minimum DNBR value during both normal operation and anticipated transients is limited to the DNBR correlation limit for the particular fuel design in use, and is accepted as an appropriate margin to DNB. The DNBR correlation limit ensures that there is at least 95% probability at the 95% confidence level (the 95/95 DNB criterion) that the hot fuel rod in the core does not experience DNB.

This LCO precludes core power distributions that violate the following fuel design criteria:

a. During a large break LOCA, peak cladding temperature must not exceed 2200°F (Ref. 1).

b. During a loss of forced reactor coolant flow accident, there must be at least 95% probability at the 95% confidence level (the 95/95 DNB criterion) that the hot fuel rod in the core does not experience a DNB condition.

The reload safety evaluation analysis determines limits on global core parameters that characterize the core power distribution. The primary parameters used to monitor and control the core power distribution are the regulating rod position, the APSR position, the AXIAL POWER IMBALANCE, and the QPT. These parameters are normally used to monitor and control the core power distribution because their measurements are continuously observable. Limits are placed on these parameters to ensure that the core power peaking factors remain bounded during operation in MODE 1 with THERMAL POWER greater than 20% RTP. Nuclear

(continued)

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BASES

APPLICABLE SAFETY ANALYSES (continued)

design model calculational uncertainty, manufacturing tolerances (e.g., the engineering hot channel factor), effects of fuel densification and rod bow, and modeling simplifications (such as treatment of the spacer grid effects) are accommodated through use of peaking augmentation factors in the reload safety evaluation analysis.

$F_Q(Z)$ and $F^N_{\Delta H}$ satisfy Criterion 2 of the NRC Policy Statement.

LCO

This LCO for the power peaking factors $F_Q(Z)$ and $F^N_{\Delta H}$ ensures that the core operates within the bounds assumed for the ECCS and thermal hydraulic analyses. Verification that $F_Q(Z)$ and $F^N_{\Delta H}$ are within the limits of this LCO as specified in the COLR allows continued operation at THERMAL POWER when the Required Actions of LCO 3.1.4, "CONTROL ROD Group Alignment Limits," LCO 3.2.1, "Regulating Rod Insertion Limits," LCO 3.2.2, "AXIAL POWER SHAPING ROD Insertion Limits," LCO 3.2.3, "AXIAL POWER IMBALANCE Operating Limits," and LCO 3.2.4, "QUADRANT POWER TILT," are entered. Conservative THERMAL POWER reductions are required if the limits on $F_Q(Z)$ and $F^N_{\Delta H}$ are exceeded. Verification that $F_Q(Z)$ and $F^N_{\Delta H}$ are within limits is also required during MODE 1 PHYSICS TESTS per LCO 3.1.8, "PHYSICS TESTS Exceptions—MODE 1."

Measurement uncertainties are applied when $F_Q(Z)$ and $F^N_{\Delta H}$ are determined using the Incore Detector System. The measurement uncertainties applied to the measured values of $F_Q(Z)$ and $F^N_{\Delta H}$ account for uncertainties in observability and instrument string signal processing.

APPLICABILITY

In MODE 1, the limits on $F_Q(Z)$ and $F^N_{\Delta H}$ must be maintained in order to prevent the core power distribution from exceeding the limits assumed in the analyses of the LOCA and loss of flow accidents. In MODES 2, 3, 4, 5, and 6, this LCO is not applicable because the reactor has insufficient stored energy in the fuel or energy being transferred to the coolant to require a limit on the distribution of core power.

with THERMAL POWER greater than 20% RTP

MODE 1 with THERMAL POWER less than or equal to 20% RTP and in

<<INSERT B 3.2-40A>>

(continued)

<Insert B3.2-40A>

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The minimum THERMAL POWER level of 20% RTP was chosen based on the ability of the incore detection system to satisfactorily obtain meaningful power distribution data.

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BASES

ACTIONS

B.2 (continued)

time period and the number of steps required to complete this Action.

B.3

Continued operation with $F^N_{\Delta H}$ exceeding its limit is not permitted, because the initial conditions assumed in the accident analyses are no longer valid. The required Completion Time of 24 hours to restore $F^N_{\Delta H}$ within its limit at the reduced THERMAL POWER level is reasonable based on the low probability of a limiting event occurring simultaneously with $F^N_{\Delta H}$ exceeding its limit. In addition, this Completion Time precludes long term depletion with an unacceptably high local power and limits the potential for inducing an adverse perturbation in the radial xenon distribution.

C.1

If a THERMAL POWER reduction is not sufficient to restore $F_Q(Z)$ or $F^N_{\Delta H}$ within its limit (i.e., the Required Actions and associated Completion Times for Condition A or B are not met), then THERMAL POWER operation should cease. The reactor is placed in MODE 2 in which this LCO does not apply. The required Completion Time of 2 hours is a reasonable amount of time for the operator to reduce THERMAL POWER in an orderly manner and without challenging plant systems.

be significantly reduced.

1 with THERMAL POWER less than or equal to 20% RTP

SURVEILLANCE REQUIREMENTS

SR 3.2.5.1

Core monitoring is performed using the Incore Detector System to obtain a three dimensional power distribution map. Maximum values of $F_Q(Z)$ and $F^N_{\Delta H}$ obtained from this map may then be compared with the $F_Q(Z)$ and limits in the COLR to verify that the limits have not been exceeded. Measurement of the core power peaking factors in this manner may be used to verify that the measured values of $F_Q(Z)$ and $F^N_{\Delta H}$ remain within their specified limits when one or more of the limits specified by LCO 3.1.4, LCO 3.2.1, LCO 3.2.2, LCO 3.2.3, or

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