TSTF
TECHNICAL SPECIFICATIONS TASK FORCE
A JOINT OWNERS GROUP ACTIVITY

February 20, 2007

TSTF-07-06
PROJ0753

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

SUBJECT: Response to NRC Request for Additional Information Regarding TSTF-486, Revision 0, "Revise MTC Surveillance for Startup Test Activity Reduction (STAR) Program (WCAP-16011)," dated November 20, 2006 and Submittal of Revision 1

REFERENCE: Letter from T. J. Kobetz (NRC) to the Technical Specifications Task Force, requesting additional information regarding TSTF-486, Revision 0, "Revise MTC Surveillance for Startup Test Activity Reduction (STAR) Program (WCAP-16011)," dated November 20, 2006.

Dear Sir or Madam:

In the referenced letter, the NRC provided a Request for Additional Information (RAI) regarding TSTF-486, Revision 0, "Revise MTC Surveillance for Startup Test Activity Reduction (STAR) Program (WCAP-16011)." TSTF-486, Revision 0, was submitted to the NRC by the TSTF on June 3, 2005. This letter responds to the NRC's referenced request.

Revision 1 to TSTF-486 is enclosed. Revision 1 reflects the changes to TSTF-486 discussed in the RAI responses.

Any NRC review fees associated with the review of TSTF-486 should continue to be billed to the Pressurized Water Reactor Owners Group.

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

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PWROG
PWR Owners Group

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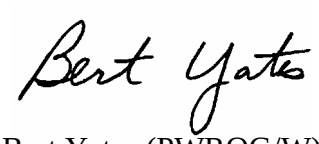
Should you have any questions, please do not hesitate to contact us.



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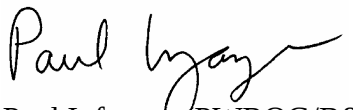

Paul Infanger (PWROG/B&W)

Enclosure

cc: Tim Kobetz, Technical Specifications Branch, NRC
Ross Telson, Technical Specifications Branch, NRC

**Response to NRC Request for Additional Information Regarding TSTF-486, Revision 0, "Revise MTC Surveillance for Startup Test Activity Reduction (STAR) Program (WCAP-16011)," dated November 20, 2006**

RAI #1 The proposed change revises STS 3.1.3, "Moderator Temperature Coefficient (MTC) (Analog)," surveillance requirement (SR) 3.1.3.1 to indicate the MTC upper limit is specified in the Core Operating Limits Report (COLR). However, the proposed change conflicts with STS 3.1.3 MTC (Analog) Limiting Condition for Operation (LCO) 3.1.3 second sentence which states, "The maximum positive limit shall be that specified in Figure 3.1.3-1." As Figure 3.1.3-1 is in the STS and not the COLR, it is inappropriate to direct the operator to the COLR for the upper limit to the MTC. Note, the first sentence in the STS 3.1.3 MTC (Analog) LCO states, "The MTC shall be maintained within the limits specified in the COLR," which also appears to be in conflict with the second sentence of the LCO. Please revise TSTF-486 to make the wording consistent with where the actual requirements are located.

Response: The two LCO requirements are not in conflict. The NRC has historically required a high level of justification from licensees to operate with a positive MTC value, and typically requires licensees to demonstrate that MTC will be zero or negative at 100% power. As described in the Background section of the Bases, "The reactor is designed to operate with a negative MTC over the largest possible range of fuel cycle operation." Therefore, the maximum positive MTC value is specified in the Technical Specifications and changing that limit requires NRC prior review and approval. Cycle-specific MTC limits are determined by the licensee using the approved methodology specified in Specification 5.6.3, "Core Operating Limits Report." The maximum positive cycle specific MTC limit in the COLR must be less than or equal to the maximum positive MTC value given in Figure 3.1.3-1 (analog) or LCO 3.1.3 (digital). As stated in the Background section of the Bases, "Both initial and reload cores are designed so that the beginning of cycle (BOC) MTC is less positive than that allowed by the LCO. The actual value of the MTC is dependent on core characteristics such as fuel loading and reactor coolant soluble boron concentration." Without specifying the maximum positive limit in the LCO, the methodologies specified in Specification 5.6.3 could be used to set a cycle-specific MTC value more positive than the value specified in Figure 3.1.3-1 (analog) or the LCO (digital).

Note that the MTC LCO presentation in TSTF-486 is consistent with the MTC LCO in NUREG-1430 (Babcock and Wilcox STS) and NUREG-1431 (Westinghouse STS) and the SR 3.1.3.1 presentation in TSTF-486 is consistent with NUREG-1430.

Because the cycle-specific positive MTC limit specified in the COLR must be equal to or less than the maximum positive MTC limit specified in Figure 3.1.3-1, SR 3.1.3.1 must verify that MTC is within the COLR limit, not the limit in Figure 3.1.3-1 (analog) or the LCO (digital). The proposed change to SR 3.1.3.1 is an editorial clarification to make the intent clear.

In addition, the proposed change makes SR 3.1.3.1 consistent with the other SRs in the ISTS that verify values specified in the COLR. It is consistent with TSTF-

GG-05-01, "Writer's Guide for Plant-Specific Improved Technical Specifications," Section 4.1.7, "Chapter 3 Surveillance Requirements (SRs) Content," paragraph b. Paragraph b states, "Surveillances on parameter limits will specify, to the extent practical, the limit. This applies whether or not the LCO also requires the precise limit. Reference to where the limit(s) may be located is an acceptable alternative (i.e., '...within limits specified in the COLR')."

TSTF-486, Revision 1, revises the LCO Bases to clearly state this intent. This does not represent a change from the current requirements.

RAI #2 The proposed change revises STS 3.1.3, "Moderator Temperature Coefficient (MTC) (Digital)," surveillance requirement (SR) 3.1.3.1 to indicate the MTC upper limit is specified in the COLR. However, the proposed change conflicts with STS 3.1.3 MTC (Digital) LCO 3.1.3 which states, ". . . a maximum positive limit as specified below . . . " The maximum MTC is given by two criteria that follow. Since the maximum MTC is specified in the STS and not the COLR, it is inappropriate to direct the operator to the COLR for the upper limit to the MTC. Note, the first part of the sentence in the STS 3.1.3 MTC (Digital) LCO states, "The MTC shall be maintained within the limits specified in the COLR . . . ," which also appears to be in conflict with the second part of the sentence of the LCO. Please revise TSTF-486 to make the wording consistent with where the actual requirements are located.

Response: See the response to RAI #1.

RAI #3 The staff has approved two license amendment requests for plants to implement the WCAP-16011-P-A alternate startup MTC verification, references 4, 5, 6, and 7. Each contained a Note that specified when the WCAP-16011-P-A alternate startup MTC verification could be used. Those Notes read as follows, "For fuel cycles that meet the applicability requirements given in WCAP-16011-P-A, the verification prior to entering MODE 1 may be made using the predicted MTC as adjusted for the measured boron concentration." Please explain why a similar note is not included in TSTF-486, as when the applicability requirements given in WCAP-16011-P-A are not met the WCAP-16011-P-A alternate startup MTC verification cannot be used, and the licensee must revert back to its original MTC startup verification.

Response: The two license amendments referenced are proposing changes to plant-specific Technical Specifications that are not based on the STS (NUREG-1432). TSTF-486 was reviewed by the industry to ensure that the proposed changes are consistent with the STS format and usage rules and the Writer's Guide (TSTF-GG-05-01). We do not consider these non-STS, plant-specific license amendment requests to set a precedent for a generic, industry-reviewed proposed Traveler.

The referenced license amendment requests use in the proposed Technical Specifications the phrase, "For fuel cycles that meet the applicability requirements given in WCAP-16011-P-A,…" TSTF-486 uses in the Technical Specifications the phrase, "when MTC is determined .. using adjusted predicted MTC." The TSTF-486 proposed Bases state that only the fuel cycles that meet the requirements of WCAP-16011-P-A can determine MTC using the adjusted predicted MTC. The only significant difference in these presentations is whether the Topical Report number, WCAP-16011-P-A, is included in the STS. Including the Topical Report number in the Technical Specifications is not consistent with the STS format and content rules. There are no instances in NUREG-1432 (or any of the STS NUREGs) of a Topical Report being referenced in Chapter 3 of the Technical Specifications proper. Topical Reports are referenced in the Bases to explain the purpose or justification for a requirement.

One of the improvements in the STS over the previous standard Technical Specifications is the philosophy that the Surveillance Requirements should specify what is being verified, but should not specify how that verification is performed. The description of how the Surveillance is performed is removed from the Technical Specifications and placed in the Bases or plant-specific documentation. Under both the STS and the changes proposed by TSTF-486, SR 3.1.3.1 verifies that MTC is within the upper limit. It is how that verification is performed that is modified by TSTF-486. Therefore, the discussion of how the SR is performed should reside, to the extent possible, in the Bases and not in the Technical Specifications.

RAI #4 TSTF-486 proposes changes to the STS Bases B 3.1.3 MTC LCO description, both Analog and Digital variations, that adds one means by which the MTC may be controlled once a core design is fixed. The means described is adjusting the CEA position. While CEA position adjustment may be the most expedient, it is not the only means by which MTC may be controlled once a core design is fixed. Please provide a justification for adding a description of how MTC may be controlled, once a core design is fixed, to the STS Bases. Please provide a justification for limiting that description on only one means of controlling MTC.

Response: The STS 3.1.3 Bases, as modified by TSTF-486, state, "MTC is a core physics parameter determined by the fuel and fuel cycle design and cannot be easily controlled once the core design is fixed. Limited control of MTC can be achieved by adjusting CEA position and boron concentration. During operation, the LCO can be ensured through measurement and adjustments to CEA position and boron concentration." The sentence, "Limited control of MTC can be achieved by adjusting CEA position and boron concentration," was added to clarify the existing Bases statement that MTC cannot be easily controlled once the core design is fixed. There are only three operational mechanisms to alter the reactivity of a reactor core during operation: control rods, boron concentration, and temperature. During operation, temperature is kept within a programmed band and, in any case, does not significantly affect MTC. Boron concentration

has a strong influence on MTC, but changes in boron concentration must be offset using CEAs to maintain the reactivity balance. In fact, NUREG-1431 contains a Required Action for MTC not within the upper limit that requires the establishment of administrative rod withdrawal limits for the control banks. The NUREG-1431 Bases discusses how rod insertion causes MTC to become more negative. As core burnup increase, RCS boron concentration is programmatically reduced which also causes MTC to become more negative and Condition A of NUREG-1431, LCO 3.0.3 is typically exited. Therefore, the proposed statement is technically correct and provides a needed clarification to the statement that MTC cannot be easily controlled after a core design is fixed (i.e., during operation).

RAI #5 TSTF-486 proposes changes to the STS Bases B 3.1.3 MTC SR description, both Analog and Digital variations, that adds a Reviewer's Note for plants that have implemented WCAP-16011-P-A. The Reviewer's Note says that for fuel cycles that do not meet the applicability requirements of WCAP-16011-P-A the plant must verify the MTC prior to entering Mode 1 by measuring the isothermal temperature coefficient (ITC). While the staff recognizes that the actual measurement taking place when the MTC is verified is the ITC, all of the current terminology only refers to the MTC. Changing the terminology in only one instance may confuse the overall topic. Please justify the change in terminology. Please show how changing the terminology in this one instance will not result in confusion with respect to MTC verification.

Response: We believe the statement, as proposed, is necessary to be technically correct. Moderator temperature coefficient is not a directly measurable parameter. The statement in the Reviewer's Note makes the important parallel that under the WCAP-16011 methodology, MTC is determined from the measured RCS boron concentration and under the existing methodology, MTC is determined from measuring ITC. In both cases, MTC is not measured directly.

Introducing the concept of isothermal temperature coefficient will not be confusing. The NUREG-1432 Bases already refer to measuring ITC in the Bases for Special Test Exception (STE) 3.1.8, "STE - Modes 1 and 2 (Analog)," and STE 3.1.9 "STE - Modes 1 and 2 (Digital)," which state, "[i]t permits the center CEA to be misaligned during PHYSICS TESTS required to determine the isothermal temperature coefficient (ITC), MTC, and power coefficient." In addition, the relationship between MTC and ITC is well understood by reactor operators and reactor engineers performing the Surveillance Test.

TSTF-486, Revision 1, revises the proposed SR 3.1.3.1 and SR 3.1.3.2 Bases to avoid any possible confusion that measurement of ITC alone, without calculating MTC based on the measured ITC, would satisfy the SR.

RAI #6 TSTF-486 proposes changes to the STS Bases B 3.1.3 MTC SR description, Analog only, such that the description of the requirement to verify the MTC at

2/3rds of the fuel cycle is removed. Please justify removing the description of the requirement to verify the MTC at 2/3rds of the fuel cycle.

Response The removal of the phrase "and a 2/3" core burnup was an administrative error. The phrase has been restored to the TSTF-486, Revision 1, markup.

RAI #7 The second paragraph of the STS Bases B 3.1.3 MTC Background description, both Analog and Digital variations, states, "The MTC relates a change in core reactivity to a change in reactor coolant temperature. A positive MTC means that reactivity increases with increasing moderator temperature; conversely, a negative MTC means that reactivity decreases with increasing moderator temperature. The reactor is designed to operate with a negative MTC over the largest possible range of fuel cycle operation. Therefore, a coolant temperature increase will cause a reactivity decrease, so that the coolant temperature tends to return toward its initial value. Reactivity increases that cause a coolant temperature increase will thus be self limiting, and stable power operation will result. The same characteristic is true when the MTC is positive and coolant temperature decreases occur." The last sentence is incorrect. Please investigate removing it along with the other changes proposed by TSTF-486.

Response: We agree to remove the sentence in TSTF-486, Revision 1.

# Technical Specification Task Force
# Improved Standard Technical Specifications Change Traveler

**Revise MTC Surveillance for Startup Test Activity Reduction (STAR) Program (WCAP-16011)**

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

Classification: 1) Technical Change

Recommended for CLIIP?: Yes

Correction or Improvement: Improvement

NRC Fee Status: Not Exempt

Benefit: Shortens Outages

Industry Contact: Brian Woods, (949) 368-7621, woodsbl@songs.sce.com

## 1.0 Description

WCAP-16011-P, Rev. 0, "Startup Test Activity Reduction Program," proposed changes to pressurized water reactor reload startup testing to reduce testing operations and testing time while achieving the following objectives: (1) ensure that the core can be operated as designed, and (2) employ normal operating procedures in the startup evolution. The Topical Report was approved on January 14, 2005. One of the proposed changes relates to the verification of Moderator Temperature Coefficient (MTC) and requires a change to the Technical Specifications. The beginning of cycle verification of MTC is required prior to entering MODE 1. For fuel cycles that meet the applicability requirements given in WCAP-16011, the verification prior to entering MODE 1 may be made using the predicted MTC as adjusted for the actual boron concentration. When this approach is used, an additional measurement of MTC is required within 7 EFPD after reaching 40 EFPD. Implementation of the Startup Test Activity Reduction Program shortens the time required to perform startup testing, allowing a quicker return to power generation.

## 2.0 Proposed Change

The proposed change revises SR 3.1.3.1 in the digital and analog Combustion Engineering ISTS (NUREG-1432) by adding a second Frequency. This second Frequency requires verifying that MTC is within the upper limit each fuel cycle within 7 EFPD after reaching 40 EFPD of core burnup, but only when the MTC determined prior to entering MODE 1 is verified using predicted MTC as adjusted for actual RCS boron concentration. The Frequency is consistent with the existing MODE 1 MTC Surveillance Frequency. The Bases are revised to describe the new requirements and to clarify the analytical basis of the MTC utilizing the suggested changes in WCAP-16011-P.

Minor editorial changes are made to the Surveillances to properly reference the limit specified in the COLR.

Enhancements are made to the Bases to clarify the relationship between the MTC limits specified in the COLR and the maximum positive MTC value specified in the LCO.

## 3.0 Background

WCAP-16011-P, Rev. 0, "Startup Test Activity Reduction Program," proposed changes to pressurized water reactor reload startup testing. The Topical Report was approved on January 14, 2005. One of the changes proposed in the Topical Report and approved by the NRC requires a change to Specification 3.1.3, Moderator Temperature Coefficient.

## 4.0 Technical Analysis

WCAP-16011-P describes a method to reduce the time required for startup testing. To this end, the Topical Report (TR) justifies the elimination of certain startup testing requirements, including the control element assembly (CEA) worth and isothermal temperature coefficient (ITC) measurements at hot zero power (HZP). The TR also proposed to substitute the measured value of the moderator temperature coefficient (MTC) at HZP with an alternate MTC value consisting of the predicted (calculated) MTC as adjusted for the measured critical boron concentration (CBC) at HZP. An ITC measurement at intermediate to hot full power (HFP) is also added.

This method may be applied to cores that are well characterized by an existing database, using applicability requirements described in WCAP-16011.

## 5.0 Regulatory Analysis
## 5.1 No Significant Hazards Consideration

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

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

   Response: No.

   The proposed change allows the Moderator Temperature Coefficient (MTC) verification performed prior to entering MODE 1 after each refueling to consist of adjusting the predicted MTC for the measured reactor coolant system (RCS) boron concentration for those fuel cycles that fall within the applicability requirements described in WCAP-16011. When this modified verification is used, an additional measurement of MTC must be performed prior to exceeding 40 Effective Full Power Days (EFPDs) of core burnup. The MTC is not an initiator to any accident previously evaluated. Therefore, there is no significant increase in the probability of any accident previously evaluated. The MTC is an input to the accident analyses used to predict plant behavior in the event of an accident. However, WCAP-16011 demonstrated, and the NRC concurred, that the modified MTC verification is adequate to ensure that MTC stays within the limits. Therefore, there is not a significant increase in the consequences of any accident previously evaluated. Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

   Response: No.

   No new or different accidents result from utilizing the proposed change. The changes do not involve a physical alteration of the plant (i.e., no new or different type of equipment will be installed) or a change in the methods governing normal plant operation. In addition, the changes do not impose any new or different requirements or eliminate any existing requirements. The changes do not alter assumptions made in the safety analysis. The proposed changes are consistent with the safety analysis assumptions and current plant operating practice. Therefore, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

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

   Response: No.

   This change will have no effect on the margin of safety. The MTC limits are unaffected and an acceptable method will be used to demonstrate that MTC is within its limit. Therefore, the proposed change does not involve a significant reduction in a margin of safety.

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

## 5.2 Applicable Regulatory Requirements/Criteria

The regulations (10 CFR Part 50) do not deal explicitly with startup testing. In the past, the NRC staff exercised oversight based on the provisions of the applicable American National Standard Institute (ANSI), in this case ANSI/ANS 19.6.1. However, except for the NRC staff's general interest in preventing core abnormalities through startup testing, the value of the MTC (a quantity measured and validated in the startup tests) is in the technical specifications, and therefore, is subject to regulatory oversight.

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

## 6.0 Environmental Consideration

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

## 7.0 References

1. WCAP-16011-P-A, Rev. 0, "Startup Test Activity Reduction Program," dated February 2005.

2. Herbert N. Berkow (NRC) to Gordon Bischoff, dated January 14, 2005, "Final Safety Evaluation for Topical Report WCAP-16011-P, 'Startup Test Activity Reduction Program'."

## Revision History

**OG Revision 0 Revision Status: Closed**

Revision Proposed by: WOG

Revision Description:
Original Issue

## OG Revision 0 Revision Status: Closed

### Owners Group Review Information

Date Originated by OG: 02-Mar-05

Owners Group Comments
Revised to address comments.

Owners Group Resolution: Superceeded Date: 28-Mar-05

## OG Revision 1 Revision Status: Closed

Revision Proposed by: CEOG

Revision Description:
Revised to reference WCAP-16011-P-A and to make various editorial improvements.

### Owners Group Review Information

Date Originated by OG: 28-Mar-05

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 06-Apr-05

### TSTF Review Information

TSTF Received Date: 05-May-05 Date Distributed for Review 05-May-05

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

TSTF Comments:
(No Comments)

TSTF Resolution: Approved Date: 23-May-05

### NRC Review Information

NRC Received Date: 03-Jun-05

NRC Comments:
NRC provided an RAI on 11/20/06. TSTF responded with a revision to the Traveler and RAI responses.

Final Resolution: Superceded by Revision Final Resolution Date: 20-Nov-06

## TSTF Revision 1 Revision Status: Active

Revision Proposed by: NRC

Revision Description:
Revised TSTF-486 to address NRC comments.

1) The last sentence in the second paragraph of the Background Bases section is deleted as it is not accurate. This correction is not related to the changes proposed in TSTF-486.

**TSTF Revision 1** **Revision Status: Active**

2) A Bases description of the 2/3 core burnup MTC verification that was inadvertently deleted was restored.

3) The LCO Bases are revised to clearly explain the relationship between the cycle-specific positive and negative MTC values specified in the COLR and the maximum positive MTC limit specified in the LCO.

4) The SR 3.1.3.1 and SR 3.1.3.2 Bases are revised to clarify that MTC is determined by calculation based on measured Isothermal Temperature Coefficient.

## TSTF Review Information

TSTF Received Date: 23-Jan-07 Date Distributed for Review 23-Jan-07

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

TSTF Comments:

(No Comments)

TSTF Resolution: Approved Date: 20-Feb-07

## NRC Review Information

NRC Received Date: 20-Feb-07

## Affected Technical Specifications

| | |
|---|---|
| Bkgnd 3.1.3 Bases | MTC (Analog) |
| Bkgnd 3.1.3 Bases | MTC (Digital) |
| LCO 3.1.3 Bases | MTC (Analog) |
| LCO 3.1.3 Bases | MTC (Digital) |
| Ref. 3.1.3 Bases | MTC (Analog) |
| Ref. 3.1.3 Bases | MTC (Digital) |
| SR 3.1.3.1 | MTC (Analog) |
| SR 3.1.3.1 | MTC (Digital) |
| SR 3.1.3.1 Bases | MTC (Analog) |
| SR 3.1.3.1 Bases | MTC (Digital) |
| SR 3.1.3.2 | MTC (Analog) |

| | |
|---|---|
| SR 3.1.3.2 | MTC (Digital) |
| SR 3.1.3.2 Bases | MTC (Analog) |
| SR 3.1.3.2 Bases | MTC (Digital) |

SURVEILLANCE REQUIREMENTS

| | SURVEILLANCE | FREQUENCY |
|---|---|---|
| SR 3.1.3.1 | Verify MTC is within the upper limit specified in the COLR. | Prior to entering MODE 1 after each fuel loading<br><br>[ AND<br><br>------- NOTE -------<br>Only required to be performed when MTC determined prior to entering MODE 1 is verified using adjusted predicted MTC.<br>----------<br><br>Each fuel cycle within 7 effective full power days (EFPD) of reaching 40 EFPD core burnup ] |
| SR 3.1.3.2 | ----------NOTE----------<br>If the MTC is more negative than the ~~COLR~~ limit specified in the COLR when extrapolated to the end of cycle, SR 3.1.3.2 may be repeated. Shutdown must occur prior to exceeding the minimum allowable boron concentration at which MTC is projected to exceed the lower limit.<br>----------<br><br>Verify MTC is within the lower limit specified in the COLR. | Each fuel cycle within 7 ~~effective full power days (~~EFPD~~)~~ of reaching 40 EFPD core burnup<br><br>AND<br><br>Each fuel cycle within 7 EFPD of reaching 2/3 of expected core burnup |

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.3 Moderator Temperature Coefficient (MTC) (Analog)

BASES

BACKGROUND

According to GDC 11 (Ref. 1), the reactor core and its interaction with the Reactor Coolant System (RCS) must be designed for inherently stable power operation, even in the possible event of an accident. In particular, the net reactivity feedback in the system must compensate for any unintended or rapid reactivity increases.

The MTC relates a change in core reactivity to a change in reactor coolant temperature. A positive MTC means that reactivity increases with increasing moderator temperature; conversely, a negative MTC means that reactivity decreases with increasing moderator temperature. The reactor is designed to operate with a negative MTC over the largest possible range of fuel cycle operation. Therefore, a coolant temperature increase will cause a reactivity decrease, so that the coolant temperature tends to return toward its initial value. Reactivity increases that cause a coolant temperature increase will thus be self limiting, and stable power operation will result. ~~The same characteristic is true when the MTC is positive and coolant temperature decreases occur.~~

MTC values are predicted at selected burnups during the safety evaluation analysis and are confirmed to be acceptable by measurements. Both initial and reload cores are designed so that the beginning of cycle (BOC) MTC is less positive than that allowed by the LCO. The actual value of the MTC is dependent on core characteristics, such as fuel loading and reactor coolant soluble boron concentration. The core design may require additional fixed distributed poisons (lumped burnable poison assemblies) to yield an MTC at the BOC within the range analyzed in the plant accident analysis. The end of cycle (EOC) MTC is also limited by the requirements of the accident analysis. Fuel cycles that are designed to achieve high burnups or that have changes to other characteristics are evaluated to ensure that the MTC does not exceed the EOC limit.

APPLICABLE SAFETY ANALYSES

The acceptance criteria for the specified MTC are:

a. The MTC values must remain within the bounds of those used in the accident analysis (Ref. 2) and

b. The MTC must be such that inherently stable power operations result during normal operation and during accidents, such as overheating and overcooling events.

BASES

LCO

LCO 3.1.3 requires the MTC to be within the positive and negative limits specified ~~limits of~~ in the COLR to ensure the core operates within the assumptions of the accident analysis. During the reload core safety evaluation, the MTC is analyzed to determine that its values remain within the bounds of the original accident analysis during operation. ~~The limit on a positive MTC~~The positive MTC limit in the COLR ensures that core overheating accidents will not violate the accident analysis assumptions. The negative MTC limit for EOC specified in the COLR ensures that core overcooling accidents will not violate the accident analysis assumptions.

The MTC limit in Figure 3.1.3-1 is the maximum positive MTC value approved in the plant's licensing basis and ensures that the reactor operates with a negative MTC over the largest possible range of fuel cycle operation. The cycle-specific MTC limit specified in the COLR must be equal to or less positive than the MTC limit specified in Figure 3.1.3-1.

MTC is a core physics parameter determined by the fuel and fuel cycle design and cannot be easily controlled once the core design is fixed. Limited control of MTC can be achieved by adjusting CEA position and boron concentration. During operation~~, therefore,~~ the LCO can ~~only~~ be ensured through measurement and adjustments to CEA position and boron concentration. The surveillance checks at BOC and MOC on an MTC provide confirmation that the MTC is behaving as anticipated, so that the acceptance criteria are met.

APPLICABILITY

In MODE 1, the limits on the MTC must be maintained to ensure that any accident initiated from THERMAL POWER operation will not violate the design assumptions of the accident analysis. In MODE 2, the limits must also be maintained to ensure startup and subcritical accidents, such as the uncontrolled CEA or group withdrawal, will not violate the assumptions of the accident analysis. In MODES 3, 4, 5, and 6, this LCO is not applicable, since no Design Basis Accidents (DBAs) using the MTC as an analysis assumption are initiated from these MODES. However, the variation of the MTC, with temperature in MODES 3, 4, and 5, for DBAs initiated in MODES 1 and 2, is accounted for in the subject accident analysis. The variation of the MTC, with temperature assumed in the safety analysis, is accepted as valid once the BOC and MOC measurements are used for normalization.

ACTIONS

A.1

MTC is a function of the fuel and fuel cycle designs, and cannot be controlled directly once the designs have been implemented in the core. If MTC exceeds its limits, the reactor must be placed in MODE 3. This eliminates the potential for violation of the accident analysis bounds. The associated Completion Time of 6 hours is reasonable, considering the probability of an accident occurring during the time period that would require an MTC value within the LCO limits, and the time for reaching

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.3.1 and SR 3.1.3.2

The SRs for measurement of the MTC at the beginning and middle of each fuel cycle provide for confirmation of the limiting MTC values. The MTC changes smoothly from most positive (least negative) to most negative value during fuel cycle operation, as the RCS boron concentration is reduced to compensate for fuel depletion.

---------- REVIEWER'S NOTE ----------
The following Bases and the second Frequency of SR 3.1.3.1 are only applicable to plants that adopt WCAP-16011 (Reference 5).
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[ For fuel cycles that meet the applicability requirements in Reference 5, SR 3.1.3.1 may be met prior to entering MODE 1 after each fuel loading by confirmation that the predicted MTC, when adjusted for the measured RCS boron concentration, is within the most positive (least negative) MTC limit specified in the COLR. If this adjusted predicted MTC value is used to meet the SR prior to entering MODE 1, a confirmation by measurement that MTC is within the upper MTC limit must be performed in MODE 1 within 7 Effective Full Power Days (EFPD) after reaching 40 EFPD of core burnup. The applicability requirements in Reference 5 ensure core designs are not significantly different from those used to benchmark predictions and require that the measured RCS boron concentration meets specific test criteria. This provides assurance that the MTC obtained from the adjusted predicted MTC is accurate.

For fuel cycles that do not meet the applicability requirements in Reference 5, the verification of MTC required prior to entering MODE 1 after each fuel loading is performed by calculation of the MTC based on measurement of the isothermal temperature coefficient. In this case, measurement of MTC within 7 EFPD after reaching 40 EFPD of core burnup is not required.]

[ The requirement for measurement prior to operation > 5% RTP satisfies the confirmatory check on the most positive (least negative) MTC value. ]

The requirement for measurement, within 7 ~~days~~ EFPD after reaching 40 ~~effective full power days~~EFPD and at 2/3 core burnup, satisfies the confirmatory check of the most negative MTC value. The measurement is performed at any THERMAL POWER, so that the projected EOC MTC may be evaluated before the reactor actually reaches the EOC condition. MTC values may be extrapolated and compensated to permit direct comparison to the ~~specified~~ MTC limits specified in the COLR.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.3.1 and SR 3.1.3.2 (continued)

SR 3.1.3.2 is modified by a Note, which indicates that if the extrapolated MTC is more negative than the EOC ~~COLR~~ limit specified in the COLR, the Surveillance may be repeated, and that shutdown must occur prior to exceeding the minimum allowable boron concentration at which MTC is projected to exceed the lower limit. An engineering evaluation is performed if the extrapolated value of MTC exceeds the Specification limits.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 11.
2. FSAR, Section [ ].
3. FSAR, Section [ ].
4. FSAR, Section [ ].
5. [WCAP-16011-P-A, Rev. 0, "Startup Test Activity Reduction Program," dated February 2005.]

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.1.3.1 | Verify MTC is within the upper limit specified in the COLR. | Prior to entering MODE 1 after each fuel loading<br><br>[ AND<br><br>------- NOTE -------<br>Only required to be performed when MTC determined prior to entering MODE 1 is verified using adjusted predicted MTC.<br>----------<br><br>Each fuel cycle within 7 effective full power days (EFPD) of reaching 40 EFPD core burnup ] |
| SR 3.1.3.2 | ----------NOTE----------<br>If the MTC is more negative than the ~~COLR~~ limit specified in the COLR when extrapolated to the end of cycle, SR 3.1.3.2 may be repeated. Shutdown must occur prior to exceeding the minimum allowable boron concentration at which MTC is projected to exceed the lower limit.<br>---<br><br>Verify MTC is within the lower limit specified in the COLR. | Each fuel cycle within 7 ~~effective full power days (~~EFPD~~)~~ of reaching 40 EFPD core burnup<br><br>AND<br><br>Each fuel cycle within 7 EFPD of reaching 2/3 of expected core burnup |

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.3 Moderator Temperature Coefficient (MTC) (Digital)

BASES

BACKGROUND

According to GDC 11 (Ref. 1), the reactor core and its interaction with the Reactor Coolant System (RCS) must be designed for inherently stable power operation, even in the possible event of an accident. In particular, the net reactivity feedback in the system must compensate for any unintended reactivity increases.

The MTC relates a change in core reactivity to a change in reactor coolant temperature. A positive MTC means that reactivity increases with increasing moderator temperature; conversely, a negative MTC means that reactivity decreases with increasing moderator temperature. The reactor is designed to operate with a negative MTC over the largest possible range of fuel cycle operation. Therefore, a coolant temperature increase will cause a reactivity decrease, so that the coolant temperature tends to return toward its initial value. Reactivity increases that cause a coolant temperature increase will thus be self limiting, and stable power operation will result. ~~The same characteristic is true when the MTC is positive and coolant temperature decreases occur.~~

MTC values are predicted at selected burnups during the safety evaluation analysis and are confirmed to be acceptable by measurements. Both initial and reload cores are designed so that the beginning of cycle (BOC) MTC is less positive than that allowed by the LCO. The actual value of the MTC is dependent on core characteristics such as fuel loading and reactor coolant soluble boron concentration. The core design may require additional fixed distributed poisons (lumped burnable poison assemblies) to yield an MTC at the BOC within the range analyzed in the plant accident analysis. The end of cycle (EOC) MTC is also limited by the requirements of the accident analysis. Fuel cycles that are designed to achieve high burnups or that have changes to other characteristics are evaluated to ensure that the MTC does not exceed the EOC limit.

APPLICABLE SAFETY ANALYSES

The acceptance criteria for the specified MTC are:

a. The MTC values must remain within the bounds of those used in the accident analysis (Ref. 2) and

b. The MTC must be such that inherently stable power operations result during normal operation and during accidents, such as overheating and overcooling events.

BASES

LCO

LCO 3.1.3 requires the MTC to be within the the positive and negative limits specified ~~limits of~~ in the COLR to ensure the core operates within the assumptions of the accident analysis. During the reload core safety evaluation, the MTC is analyzed to determine that its values remain within the bounds of the original accident analysis during operation. The positive MTC limit in the COLR ~~The limit on a positive MTC~~ ensures that core overheating accidents will not violate the accident analysis assumptions. The negative MTC limit for EOC specified in the COLR ensures that core overcooling accidents will not violate the accident analysis assumptions.

The MTC limit specified in the LCO is the maximum positive MTC value approved in the plant's licensing basis and ensures that the reactor operates with a negative MTC over the largest possible range of fuel cycle operation. The cycle-specific MTC limit specified in the COLR must be equal to or less positive than the MTC limit specified in the LCO.

MTC is a core physics parameter determined by the fuel and fuel cycle design and cannot be easily controlled once the core design is fixed. Limited control of MTC can be achieved by adjusting CEA position and boron concentration. During operation~~, therefore,~~ the LCO can ~~only~~ be ensured through measurement and adjustments to CEA position and boron concentration. The surveillance checks at BOC and MOC on an MTC provide confirmation that the MTC is behaving as anticipated, so that the acceptance criteria are met.

APPLICABILITY

In MODE 1, the limits on the MTC must be maintained to ensure that any accident initiated from THERMAL POWER operation will not violate the design assumptions of the accident analysis. In MODE 2, the limits must also be maintained to ensure startup and subcritical accidents, such as the uncontrolled CEA assembly or group withdrawal, will not violate the assumptions of the accident analysis. In MODES 3, 4, 5, and 6, this LCO is not applicable, since no Design Basis Accidents (DBAs) using the MTC as an analysis assumption are initiated from these MODES. However, the variation of the MTC, with temperature in MODES 3, 4, and 5, for DBAs initiated in MODES 1 and 2, is accounted for in the subject accident analysis. The variation of the MTC, with temperature assumed in the safety analysis, is accepted as valid once the BOC and MOC measurements are used for normalization.

ACTIONS

A.1

MTC is a function of the fuel and fuel cycle designs, and cannot be controlled directly once the designs have been implemented in the core. If MTC exceeds its limits, the reactor must be placed in MODE 3. This eliminates the potential for violation of the accident analysis bounds. The associated Completion Time of 6 hours is reasonable, considering the probability of an accident occurring during the time period that would

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.3.1 and SR 3.1.3.2

The SRs for measurement of the MTC at the beginning and middle of each fuel cycle provide for confirmation of the limiting MTC values. The MTC changes smoothly from most positive (least negative) to most negative value during fuel cycle operation, as the RCS boron concentration is reduced to compensate for fuel depletion.

---------- REVIEWER'S NOTE ----------
The following Bases and the second Frequency of SR 3.1.3.1 are only applicable to plants that adopt WCAP-16011 (Reference 5).
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[ For fuel cycles that meet the applicability requirements in Reference 5, SR 3.1.3.1 may be met prior to entering MODE 1 after each fuel loading by confirmation that the predicted MTC, when adjusted for the measured RCS boron concentration, is within the most positive (least negative) MTC limit specified in the COLR. If this adjusted predicted MTC value is used to meet the SR prior to entering MODE 1, a confirmation by measurement that MTC is within the upper MTC limit must be performed in MODE 1 within 7 Effective Full Power Days (EFPD) after reaching 40 EFPD of core burnup. The applicability requirements in Reference 5 ensure core designs are not significantly different from those used to benchmark predictions and require that the measured RCS boron concentration meets specific test criteria. This provides assurance that the MTC obtained from the adjusted predicted MTC is accurate.

For fuel cycles that do not meet the applicability requirements in Reference 5, the verification of MTC required prior to entering MODE 1 after each fuel loading is performed by calculation of the MTC based on measurement of the isothermal temperature coefficient. In this case, measurement of MTC within 7 EFPD after reaching 40 EFPD of core burnup is not required.]

[ The requirement for measurement prior to operation > 5% RTP satisfies the confirmatory check on the most positive (least negative) MTC value.]

The requirement for measurement, within 7 EFPD ~~days~~ after reaching 40 EFPD ~~effective full power days~~ and at 2/3 core burnup, satisfies the confirmatory check of the most negative MTC value. The measurement is performed at any THERMAL POWER so that the projected EOC MTC may be evaluated before the reactor actually reaches the EOC condition. MTC values may be extrapolated and compensated to permit direct comparison to the ~~specified~~ MTC limits specified in the COLR.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.1.3.1 and SR 3.1.3.2 (continued)

SR 3.1.3.2 is modified by a Note, which indicates that if extrapolated MTC is more negative than the EOC ~~COLR~~ limit specified in the COLR, the Surveillance may be repeated, and that shutdown must occur prior to exceeding the minimum allowable boron concentration at which MTC is projected to exceed the lower limit. An engineering evaluation is performed if the extrapolated value of MTC exceeds the Specification limits.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 11.
2. FSAR, Section [ ].
3. FSAR, Section [ ].
4. FSAR, Section [ ].
5. [WCAP-16011-P-A, Rev. 0, "Startup Test Activity Reduction Program," dated February 2005.]