TSTF
TECHNICAL SPECIFICATIONS TASK FORCE
A JOINT OWNERS GROUP ACTIVITY

May 10, 2007

TSTF-07-18
PROJ0753

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

SUBJECT: TSTF-486, Revision 2, "Revise MTC Surveillance for Startup Test Activity Reduction (STAR) Program (WCAP-16011)"

Dear Sir or Madam:

Enclosed for NRC review is Revision 2 of TSTF-486, "Revise MTC Surveillance for Startup Test Activity Reduction (STAR) Program (WCAP-16011)."

Revision 2 addresses NRC comments on Revision 1.

Any NRC review fees associated with the review of TSTF-486, Revision 2, should continue to be billed to the Pressurized Water Reactors Owners Group.

We request that the Traveler be made available under the Consolidated Line Item Improvement Process.

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

Bert Yates (PWROG/W)

John Messina (BWROG)

Dana Millar (PWROG/CE)

Reene' Gambrell (PWROG/B&W)

Enclosure

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

11921 Rockville Pike, Suite 100, Rockville, MD 20852
Phone: 301-984-4400, Fax: 301-984-7600
Email: tstf@excelservices.com
Administered by EXCEL Services Corporation

PWROG
PWR Owners Group

BWR
OWNERS' GROUP

# 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: Dana Millar, (601) 368-5445, DMILLAR@entergy.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 each fuel cycle within 7 effective full power days (EFPD) of reaching 40 EFPD 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, 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: Closed

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: Closed

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

## TSTF Revision 2 Revision Status: Active

Revision Proposed by: NRC

Revision Description:
This revision was created to address NRC comments.

The SR 3.1.3.1 and SR 3.1.3.2 Bases are revised to mention the acceptance criteria for determining MTC using the adjusted predicted MTC method.

The brackets are removed around the existing SR 3.1.3.1 and SR 3.1.3.2 Bases statement, "The requirement for measurement prior to operation > 5% RTP satisfies the confirmatory check on the most positive (least negative) MTC value." as the statement is true regardless of the method of verifying MTC.

### TSTF Review Information

TSTF Received Date: 04-May-07 Date Distributed for Review 04-May-07

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

TSTF Comments:
(No Comments)

TSTF Resolution: Approved Date: 10-May-07

**TSTF Revision 2** **Revision Status: Active**

## NRC Review Information

NRC Received Date: 10-May-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).
---

[ For fuel cycles that meet the applicability requirements in Reference 5, and specifically the acceptance criteria that must be met in order to substitute the measured value of MTC at hot zero power (HZP) with an alternate MTC value, 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).
---

[ For fuel cycles that meet the applicability requirements in Reference 5, and specifically the acceptance criteria that must be met in order to substitute the measured value of MTC at hot zero power (HZP) with an alternate MTC value, 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.]