Advanced Passive 1000 (AP1000)
Generic Technical Specification Traveler (GTST)

Title: Changes related to Section 3.1.3, Moderator Temperature Coefficient (MTC)

I. Technical Specifications Task Force (TSTF) Travelers, Approved Since Revision 2 of STS NUREG-1431, and Used to Develop this GTST

TSTF Number and Title:

TSTF-425, Rev. 3, Relocate Surveillance Frequencies to Licensee Control - RITSTF Initiative 5b
TSTF-524-T, Rev. 0, Clarify the Application of SR 3.0.2 to SR 3.1.3.2, MTC

STS NUREGs Affected:

TSTF-425: NUREG-1430, -1431, -1432, -1433, -1434
TSTF-524: NUREG-1431

NRC Approval Date:

TSTF-425: 18-Mar-09
TSTF-524: 13-May-10

TSTF Classification:

TSTF-425: Technical change
TSTF-524: Improves Bases; Bases only change

II. Reference Combined License (RCOL) Standard Departures (Std. Dep.), RCOL COL Items, and RCOL Plant-Specific Technical Specifications (PTS) Changes Used to Develop this GTST

RCOL Std. Dep. Number and Title:

None

RCOL COL Item Number and Title:

None

RCOL PTS Change Number and Title:

VEGP LAR DOC A008:	TS 3.1.3, SR 3.1.3.1 Frequency is revised to add “Once” as the lead in and is stated as “Once prior to entering MODE 1 after each refueling.”
VEGP LAR DOC A009:	TS 3.1.3, SR 3.1.3.2 Frequency is revised replacing “once each cycle” with a specific time during the cycle at which the Surveillance must performed.

III. Comments on Relations Among TSTFs, RCOL Std. Dep., RCOL COL Items, and RCOL PTS Changes

This section discusses the considered changes that are: (1) applicable to operating reactor designs, but not to the AP1000 design; (2) already incorporated in the GTS; or (3) superseded by another change.

TSTF-425 is deferred for future consideration.

TSTF-524-T revised the Bases for the Moderator Temperature Coefficient (MTC) lower-limit Surveillance to clarify the application of SR 3.0.2. This involved adding the phrase “plus the extensions allowed by SR 3.0.2” to clarify that the provisions in SR 3.0.2 are applicable to the intervals specified in Surveillance Notes 1 and 2. VEGP LAR DOC A009 revised SR 3.1.3.2 to replace the Surveillance Frequency of “Once each cycle” with Surveillance Notes 1 and 2, which are moved to the Frequency column and are connected with the logical connector “AND.” The Bases discussion is revised to clearly describe the condition as to when the Surveillance must be performed. VEGP LAR DOC A009 essentially supersedes the changes proposed by TSTF-524-T.

IV. Additional Changes Proposed as Part of this GTST (modifications proposed by NRC staff and/or clear editorial changes or deviations identified by preparer of GTST)

In the “References” section of the Bases, “Accident Analysis” was changed to “Accident Analyses” in Reference 2.

APOG Recommended Changes to Improve the Bases

Throughout the Bases, references to Sections and Chapters of the FSAR do not include the “FSAR” clarifier. Since these Section and Chapter references are to an external document, it is appropriate to include the “FSAR” modifier. (DOC A003)

The following editorial changes were recommended:

1. The last sentence in the “Background” section of the Bases was modified.

2. The second paragraph in the “Applicability” section in the Bases was revised.

3. Discussion in the 'Surveillance Requirements” section in the Bases for SR 3.1.3.1 was modified to add “once” for consistency with the requirements.

4. Discussion in the 'Surveillance Requirements” section in the Bases for SR 3.1.3.2 was modified adding “second” before “Frequency of 14 EFPD..”

V. Applicability

Affected Generic Technical Specifications and Bases:

Section 3.1.3, Moderator Temperature Coefficient (MTC)

Changes to the Generic Technical Specifications and Bases:

SR 3.1.3.1 Frequency is revised to add “Once” as lead in. (DOC A008)

SR 3.1.3.2 Frequency and Notes are revised. The Frequency “once each cycle” is replaced with specific timing of Surveillance replacing Notes 1 and 2. Note 3 remains as a Note with modifications. (DOC A009)

The Bases are revised to reflect the above changes. The second paragraph of the Bases for SR 3.1.3.2 is revised and reflects that Notes 1and 2 have been removed and are included as part of the Frequency. (DOC A009)

The revised new second paragraph is as follows:

> The SR is ~~not~~ required to be performed ~~until~~**once within** 7 effective full power days (EFPD~~s~~) after reaching **an RCS boron concentration that is** ~~the~~ equivalent ~~of~~ **to** an equilibrium RTP all rod out (ARO) boron concentration of 300 ppm.

The new third paragraph is as follows:

> If the 300 ppm Surveillance limit is exceeded, it is possible that the EOC limit on MTC could be reached before the planned EOC. Because the MTC changes slowly with core depletion, the **second** Frequency of 14 **EFPD thereafter** ~~effective full power days~~ is sufficient to avoid exceeding the EOC limit.

The new fourth paragraph is as follows:

> **SR 3.1.3.2 is modified by a Note.** The Surveillance limit for RTP boron concentration of 60 ppm is conservative. If the measured MTC at 60 ppm is more positive than the 60 ppm surveillance limit, the EOC limit will not be exceeded because of the gradual manner in which MTC changes with core burnup**, and the continued performance of SR 3.1.3.2 is no longer required**.

The acronym “FSAR” is added to modify “Section” and “Chapter” in references to the FSAR throughout the Bases. (DOC A003)

Editorial changes are made in “Background”, “Applicability”, “Surveillance Requirements, SR 3.1.3.2”, and “Surveillance Requirements, SR 3.1.3.2” sections of the Bases, as discussed in Section IV. (APOG Comment)

VI. Traveler Information

Description of TSTF changes:

TSTF-524-T

The proposed change modifies the Bases for SR 3.1.3.2 in the Westinghouse plant Improved Standard Technical Specifications (ISTS), NUREG-1431, to clarify that the provisions in SR 3.0.2 are applicable to the intervals specified in Notes 1 and 2.

The proposed changes in TSTF-524-T are not needed for AP1000 GTS after incorporating changes proposed by VEGP LAR DOC A009. The DOC A009 changes moved the Surveillance Notes to the Frequency column which to remove any confusion regarding the applicability of SR 3.0.2. TSTF-524-T was intended to clarify the Surveillance Notes and is therefore no longer applicable.

Rationale for TSTF changes:

Since the rationale for TSTF-524-T is no longer relevant, it is not presented.

Description of changes in RCOL Std. Dep., RCOL COL Item(s), and RCOL PTS Changes:

VEGP LAR DOC A008:

TS 3.1.3, SR 3.1.3.1 Frequency is revised to add “Once” as the lead in and is stated as “Once prior to entering MODE 1 after each refueling.”

VEGP LAR DOC A009:

TS 3.1.3, SR 3.1.3.2 Frequency is revised replacing “once each cycle” with a specific time during the cycle at which the Surveillance must performed. Previously defined Notes are modified and are used to define the Frequency.

The Surveillance Frequency is revised to state:

> “Once within 7 effective full power days (EFPD) after reaching the equivalent of an equilibrium RTP ARO boron concentration of 300 ppm
>
> AND
>
> 14 EFPD thereafter when MTC is more negative than the 300 ppm Surveillance limit (not LCO limit) specified in the COLR”

Note 3 becomes the sole note and is stated as:

> “Not required to be performed if the MTC measured at the equivalent of equilibrium RTP all rods out (ARO) boron concentration of ≤ 60 ppm is less negative than the 60 ppm Surveillance limit specified in the COLR.”

The discussion in the Bases is revised to explain the revisions in Surveillance Frequency. The second paragraph of the Bases for SR 3.1.3.2 is revised to state:

> "The SR is required to be performed once within 7 effective full power days (EFPD) after reaching an RCS boron concentration that is equivalent to an equilibrium RTP all rods out (ARO) boron concentration of 300 ppm."

Rationale for changes in RCOL Std. Dep., RCOL COL Item(s), and RCOL PTS Changes:

VEGP LAR DOC A008:

As described in the STS Writer's Guide (Ref. 6), the frequency of performance is always implied as "once per" unless otherwise stated. The above frequencies are vague by not explicitly stating "once." TS Section 1.4, Frequency, Example 1.4-2 describes that "The use of 'Once' indicates a single performance will satisfy the specified Frequency."

Since the described SR does not include the clarifier "once," a potential misreading of the frequency could lead to performance prior to establishing the stated condition (i.e., each entry into Mode 1).

VEGP LAR DOC A009:

The current stated Frequency for SR 3.1.3.2 of "once each cycle" does not clearly express a specific time during the cycle at which the Surveillance must be performed. Note 1 provides an exception to having to perform the Surveillance within the first 7 effective full power days (EFPD) after reaching the equivalent of an equilibrium rated thermal power (RTP) all rods out (ARO) boron concentration of 300 ppm, and is intended to be the initial required performance. This format is generally reserved for providing conditional period of exception to performance, and not to impose a time limit on performance. Replacing the "once each cycle" Frequency with the required performance intended by existing Note 1 provides clarity which will avoid the appearance of allowing performance anytime during the cycle. The change to the wording of Note 1 as revised and presented in the Frequency, more clearly states the condition as a limitation on when the Surveillance must be performed.

Existing Note 2 specifies a repetitive performance of the SR and is intended to be tied to the Note 1 performance condition. As a separate Note in the current format, it is not clearly tied to the Note 1 condition. Furthermore, the intended repetitive performance is potentially confusing with the current stated Frequency of "once each cycle." By moving Note 2 to the Frequency column, combining it with "AND" to the moved Note 1, editorially rewording it to more clearly convey the intent of its association with Note 1, and eliminating the "once each cycle" current Frequency, the overall requirement is presented in a more human factored fashion that is intended to reduce potential misapplication.

The reamining Note 3 becomes the sole note and the wording is revised to state that the surveillance is not required to be performed if the MTC measured at the equivalent of equilibrium RTP all rods out (ARO) boron concentratuion of ≤ 60 ppm is less negative than the 60 ppm Surveillance limit specified in the COLR. This Note ensures that Surveillance is performed if specific conditions are satisfied and the continuous performace of SR 3.1.3.2 is not required.

Since the overall intent of the current SR is consistent with the proposed revision, this change does not result in technical changes to the TS, and is acceptable.

Description of additional changes proposed by NRC staff/preparer of GTST:

The acronym “FSAR” is added to modify “Section” and “Chapter” in references to the FSAR throughout the Bases. (DOC A003)

The following editorial changes are made:

1. The last sentence in the “Background” section in the Bases was revised as follows:

   ... since this coefficient changes slowly due principally to the RCS boron concentration **changes** associated with fuel burnup and burnable absorbers **depletion**.

2. The second paragraph in the “Applicability” section in the Bases was revised as follows:

   In MODE 2, with the reactor critical, the upper limit must also be maintained to ensure that startup and subcritical accidents (such as the uncontrolled ~~CONTROL ROD assembly~~ **control rod** or **control rod** group withdrawal) will not violate the assumptions of...

3. SR 3.1.3.1 Bases was revised as follows:

   This SR requires measurement of MTC **once** at BOC prior to entering MODE 1...

4. SR 3.1.3.2 Bases was revised as follows:

   Because the MTC changes slowly with core depletion, the **second** Frequency of 14 **EFPD thereafter** ~~effective full power days~~ is sufficient to avoid exceeding the EOC limit.

Rationale for additional changes proposed by NRC staff/preparer of GTST:

Since Bases references to FSAR Sections and Chapters are to an external document, it is appropriate to include the “FSAR” modifier.

The editorial changes make the Bases consistent with the TS requirement(s) and provide improved clarity, consistency, and operator usability.

VII. GTST Safety Evaluation

Technical Analysis:

Revision to SR 3.1.3.1 Frequency

Adding “once” as the lead in to define the surveillance frequency, i.e. revising the Frequency to state: “Once prior to entering MODE 1 after each refueling”, clarifies the intent of this Surveillance. In this case, a single performance will satisfy the specified frequency. Without the clarifier “once”, a misinterpretation is possible where the surveillance is performed for each entry into MODE 1. Accordingly, this change will provide a better understood surveillance frequency for AP1000, will avoid misinterpretation, and is acceptable.

Revision to SR 3.1.3.2 Frequency and Bases

The revised Frequency which states “Once within the 7 effective full power days (EFPD) after reaching the equivalent of an equilibrium RTP ARO boron concentration of 300 ppm AND 14 EFPD thereafter when MTC is more negative than the 300 ppm Surveillance limit (not LCO limit) specified in the COLR” provides clear timing for performing the surveillance. This wording of the Frequency clearly defines the requirement and will avoid any misinterpretation. Use of Notes, as was done previously, did not clearly present the intent and the use of “once each cycle” as the Frequency gave an impression that the surveillance can be carried at any time during the cycle. This change is an improvement because it clarifies the current intent of the surveillance performance requirement and is therefore acceptable. The remaining Note clarifies the condition under which surveillance is not required to be performed and is therefore acceptable. The associated changes in the Bases are consistent with the changes made to the Surveillance Frequency and the Notes. In response to NRC's request for additional information (RAI), the second paragraph of the Bases for SR 3.1.3.2 is revised with the following: “The SR is required to be performed once within 7 effective full power days (EFPD) after reaching an RCS boron concentration that is equivalent to an equilibrium RTP all rods out (ARO) boron concentration of 300 ppm.” Since this change clarifies the meaning and the intent of the SR, it is acceptable. The new third paragraph is the modified previous discussion of Note 2 which is now included as the second Frequency. This paragraph discusses the second Frequency and is acceptable. The fourth and final paragraph discusses the remaining Note, which was the previous Note 3. This discussion presents the Note, i.e, states the condition for which the Surveillance is not required to be performed. This clarifies that continuous performance of SR 3.1.3.2 is not required. This discussion is consistent with Note 3 and is acceptable.

The changes made to the Frequency clearly state the performance timing as part of the Frequency and the provisions for SR 3.0.2 are clearly applicable in such cases. For the first part where the surveillance needs to be carried out within 7 EFPD, the surveillance test interval 25 percent extension provision of SR 3.0.2 is not necessary. For the second part where the surveillance is carried out 14 EFPD thereafter, this provision is applicable; therefore no separate statement is needed. Accordingly, changes in TSTF-524-T are not applicable and are not applied.

The change in the Bases of SR 3.1.3.2 is acceptable because it clarifies the intended meaning of the Frequency that states when the Surveillance is required to be performed, and therefore does not result in a technical change to SR 3.1.3.2.

Remaining Changes

The remaining changes are editorial, clarifying, grammatical, or otherwise considered administrative. These changes do not affect the technical content, but improve the readability, implementation, and understanding of the requirements, and are therefore acceptable.

Having found that this GTST's proposed changes to the GTS and Bases are acceptable, the NRC staff concludes that AP1000 STS Subsection 3.1.3 is an acceptable model Specification for the AP1000 standard reactor design.

References to Previous NRC Safety Evaluation Reports (SERs):

None

VIII. Review Information

Evaluator Comments:

None

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Review Information:

Availability for public review and comment on Revision 0 of this traveler approved by NRC staff on 5/20/2014.

APOG Comments (Ref. 7) and Resolutions

1. (Internal #3) Throughout the Bases, references to Sections and Chapters of the FSAR do not include the “FSAR” modifier. Since these Section and Chapter references are to an external document, it is appropriate to include the “FSAR” modifier. This is resolved by adding the “FSAR” modifier as appropriate.

2. (Internal #71) 3.1.03, Pg. 26, the last sentence in the “Background” section in the Bases was revised.

3. (Internal #72) 3.1.03, Pg. 27, the second paragraph in the “Applicability” section in the Bases was revised.

4. (Internal #73) 3.1.03, Pg. 29, SR 3.1.3.1 Bases was revised.

5. (Internal #74) 3.1.03, pg. 30, SR 3.1.3.2 Bases was revised.

NRC Final Approval Date: 12/4/2015

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IX. Evaluator Comments for Consideration in Finalizing Technical Specifications and Bases

None

X. References Used in GTST

1. AP1000 DCD, Revision 19, Section 16, “Technical Specifications,” June 2011 (ML11171A500).

2. Southern Nuclear Operating Company, Vogtle Electric Generating Plant, Unit 3 and 4, Technical Specifications Upgrade License Amendment Request, February 24, 2011 (ML12065A057).

3. RAI Letter No. 01 Related to License Amendment Request (LAR) 12-002 for the Vogtle Electric Generating Plant Units 3 and 4 Combined Licenses, September 7, 2012 (ML12251A355).

4. Southern Nuclear Operating Company, Vogtle Electric Generating Plant, Units 3 and 4, Response to Request for Additional Information Letter No. 01 Related to License Amendment Request LAR-12-002, ND-12-2015, October 04, 2012 (ML12286A363 and ML12286A360).

5. NRC Safety Evaluation (SE) for Amendment No. 13 to Combined License (COL) No. NPF-91 for Vogtle Electric Generating Plant (VEGP) Unit 3, and Amendment No. 13 to COL No. NPF-92 for VEGP Unit 4, September 9, 2013 (ADAMS Package Accession No. ML13238A337), which contains:

ML13238A355,	Cover Letter - Issuance of License Amendment No. 13 for Vogtle Units 3 and 4 (LAR 12-002).
ML13238A359,	Enclosure 1 - Amendment No. 13 to COL No. NPF-91
ML13239A256,	Enclosure 2 - Amendment No. 13 to COL No. NPF-92
ML13239A284,	Enclosure 3 - Revised plant-specific TS pages (Attachment to Amendment No. 13)
ML13239A287,	Enclosure 4 - Safety Evaluation (SE), and Attachment 1 - Acronyms
ML13239A288,	SE Attachment 2 - Table A - Administrative Changes
ML13239A319,	SE Attachment 3 - Table M - More Restrictive Changes
ML13239A333,	SE Attachment 4 - Table R - Relocated Specifications
ML13239A331,	SE Attachment 5 - Table D - Detail Removed Changes
ML13239A316,	SE Attachment 6 - Table L - Less Restrictive Changes

   The following documents were subsequently issued to correct an administrative error in Enclosure 3:

ML13277A616,	Letter - Correction To The Attachment (Replacement Pages) - Vogtle Electric Generating Plant Units 3 and 4- Issuance of Amendment Re: Technical Specifications Upgrade (LAR 12-002) (TAC No. RP9402)
ML13277A637,	Enclosure 3 - Revised plant-specific TS pages (Attachment to Amendment No. 13) (corrected)

6. TSTF-GG-05-01, “Writer's Guide for Plant-Specific Improved Technical Specifications,” June 2005.

7. APOG-2014-008, APOG (AP1000 Utilities) Comments on AP1000 Standardized Technical Specifications (STS) Generic Technical Specification Travelers (GTSTs), Docket ID NRC-2014-0147, September 22, 2014 (ML 14265A493).

XI. MARKUP of the Applicable GTS Subsection for Preparation of the STS NUREG

The entire section of the Specifications and the Bases associated with this GTST is presented next.

Changes to the Specifications and Bases are denoted as follows: Deleted portions are marked in strikethrough red font, and inserted portions in bold blue font.

3.1 REACTIVITY CONTROL SYSTEMS

3.1.3 Moderator Temperature Coefficient (MTC)

LCO 3.1.3 The MTC shall be maintained within the limits specified in the COLR.

APPLICABILITY: MODE 1 for the upper MTC limit,
MODE 2 with $k_{eff} \geq 1.0$ for the upper MTC limit,
MODES 1, 2, and 3 for the lower MTC limit.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. MTC not within upper limit.	A.1 Establish administrative withdrawal limits for control banks to maintain MTC within limit.	24 hour
B. Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 2 with $k_{eff} < 1.0$.	6 hours
C. MTC not within lower limit.	C.1 Be in MODE 4.	12 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.3.1	Verify MTC within upper limit.	**Once prior**~~Prior~~ to entering MODE 1 after each refueling

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.1.3.2	----------NOTES---------- 1. ~~Not required to be performed until 7 effective full power days (EFPD) after reaching the equivalent of an equilibrium RTP all rods out (ARO) boron concentration of 300 ppm.2. If the MTC is more negative than the 300 ppm Surveillance limit (not LCO limit) specified in the COLR, SR 3.1.3.2 shall be repeated once per 14 EFPD during the remainder of the fuel cycle.3. SR 3.1.3.2 need not be repeated~~**Not required to be performed** if the MTC measured at the equivalent of equilibrium RTP **all rods out** (ARO**)** boron concentration of ≤ 60 ppm is less negative than the 60 ppm Surveillance limit specified in the COLR. ---------- Verify MTC is within lower limit.	~~Once each cycle~~ **Once within 7 effective full power days (EFPD) after reaching the equivalent of an equilibrium RTP ARO boron concentration of 300 ppm** **AND** **14 EFPD thereafter when MTC is more negative than the 300 ppm Surveillance limit (not LCO limit) specified in the COLR**

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.3 Moderator Temperature Coefficient (MTC)

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 non-positive MTC over the 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.

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 MTC is less than zero when THERMAL POWER is at RTP. 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 (burnable absorbers) to yield an MTC 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 designed to achieve high burnups that have changes to other characteristics are evaluated to ensure that the MTC does not exceed the EOC limit.

The limitations on MTC are provided to ensure that the value of this coefficient remains within the limiting conditions assumed in the **FSAR** Chapter 15 accident and transient analyses (Ref. 2).

If the LCO limits are not met, the plant response during transients may not be as predicted. The core could violate criteria that prohibit a return to criticality, or the departure from nucleate boiling ratio criteria of the approved correlation may be violated, which could lead to a loss of the fuel cladding integrity.

BASES

BACKGROUND (continued)

The SRs for measurement of the MTC at the beginning and near the end of the fuel cycle are adequate to confirm that the MTC remains within its limits since this coefficient changes slowly due principally to the RCS boron concentration **changes** associated with fuel burnup and burnable absorbers **depletion**.

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 accidents, such as overheating and overcooling events.

FSAR Chapter 15 (Ref. 2) contains analyses of accidents that result in both overheating and overcooling of the reactor core. MTC is one of the controlling parameters for core reactivity in these accidents. Both the least negative value and most negative value of the MTC are important to safety, and both values must be bounded. Values used in the analyses consider worst case conditions to ensure that the accident results are bounding (Ref. 3).

The consequences of accidents that cause core heat-up must be evaluated when the MTC is least negative. Such accidents include the rod withdrawal transient from either zero (Ref. 2) or RTP, loss of main feedwater flow, and loss of forced reactor coolant flow. The consequences of accidents that cause core overcooling must be evaluated when the MTC is negative. Such accidents include sudden feedwater flow increase and sudden decrease in feedwater temperature.

In order to ensure a bounding accident analysis, the MTC is assumed to be its most limiting value for the analysis conditions appropriate to each accident. The bounding value is determined by considering rodded and unrodded conditions, whether the reactor is at full or zero power, and whether it is BOC or EOC. The most conservative combination appropriate to the accident is then used for the analysis (Ref. 2).

BASES

APPLICABLE SAFETY ANALYSES (continued)

MTC values are bounded in reload safety evaluations assuming steady state conditions at the limiting time in cycle life. An EOC measurement is conducted at conditions when the RCS boron concentration reaches approximately 300 ppm. The measured value may be extrapolated to project the EOC value, in order to confirm reload design predictions.

MTC satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii). Even though it is not directly observed and controlled from the control room, MTC is considered an initial condition process variable because of its dependence on boron concentration.

LCO

LCO 3.1.3 requires the MTC to be within specified limits of the COLR to ensure that 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 accident analysis during operation.

Assumptions made in safety analyses require that the MTC be more negative than a given upper limit and less negative than a given lower limit. The MTC is least negative near BOC; this upper bound must not be exceeded. This maximum upper limit occurs at all rods out (ARO), hot zero power conditions. At EOC the MTC takes on its most negative value, when the lower bound becomes important. This LCO exists to ensure that both the upper and lower bounds are not exceeded.

During operation, therefore, the conditions of the LCO can only be ensured through measurement. The surveillance checks at BOC and EOC on MTC provide confirmation that the MTC is behaving as anticipated so that the acceptance criteria are met.

The BOC limit and the EOC limit are established in the COLR to allow specifying limits for each particular cycle. This permits the unit to take advantage of improved fuel management and changes in unit operating schedule.

APPLICABILITY

Technical Specifications place both LCO and SR values on MTC, based on the safety analysis assumptions described above.

BASES

APPLICABILITY (continued)

In MODE 1, the limits on MTC must be maintained to assure that any accident initiated from THERMAL POWER operation will not violate the design assumptions of the accident analysis. In MODE 2, with the reactor critical, the upper limit must also be maintained to ensure that startup and subcritical accidents (such as the uncontrolled ~~CONTROL ROD assembly~~ **control rod** or **control rod** group withdrawal) will not violate the assumptions of the accident analysis. The lower MTC limit must be maintained in MODES 2 and 3, in addition to MODE 1, to ensure that cooldown accidents will not violate the assumptions of the accident analysis. In MODES 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.

ACTIONS

A.1

If the upper MTC limit is violated, administrative withdrawal limits for control banks must be established to maintain the MTC within its limits. The MTC becomes more negative with control bank insertion and decreased boron concentration. A Completion Time of 24 hours provides enough time for evaluating the MTC measurement and computing the required bank withdrawal limits.

As cycle burnup is increased, the RCS boron concentration will be reduced. The reduced boron concentration causes the MTC to become more negative. Using physics calculations, the time in cycle life at which the calculated MTC will meet the LCO requirement can be determined. At this point in core life, Condition A no longer exists. The unit is no longer in the Required Action, so the administrative withdrawal limits are no longer in effect.

B.1

If the required administrative withdrawal limits at BOC are not established within 24 hours, the unit must be placed in MODE 2 with $k_{eff} < 1.0$ to prevent operation with an MTC which is less negative than that assumed in safety analyses.

The allowed Completion Time of 6 hours is reasonable, based on operating experience, for reaching the required MODE from full power conditions in an orderly manner and without challenging plant systems.

BASES

ACTIONS (continued)

C.1

Exceeding the EOC MTC limit means that the safety analysis assumptions for the EOC accidents that use a bounding negative MTC value may be invalid. If the EOC MTC limit is exceeded, the plant must be placed in a MODE or Condition in which the LCO requirements are not applicable. This is done by placing the plant in at least MODE 4 within 12 hours.

The allowed Completion Time is a reasonable time based on operating experience to reach the required MODE from full power operation in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.1.3.1

This SR requires measurement of the MTC **once** at BOC prior to entering MODE 1 in order to demonstrate compliance with the most limiting MTC LCO. Meeting the limit prior to entering MODE 1 assures that the limit will also be met at higher power levels.

The BOC MTC value for ARO will be inferred from isothermal temperature coefficient measurements obtained during the physics tests after refueling. The ARO value can be directly compared to the MTC limit of the LCO. If required, measurement results and predicted design values can be used to establish administrative withdrawal limits for control banks.

SR 3.1.3.2

In similar fashion, the LCO demands that the MTC be less negative than the specified value for EOC full power conditions. This measurement may be performed at any THERMAL POWER, but its results must be extrapolated to the conditions of RTP and all banks withdrawn in order to make a proper comparison with the LCO value. Because the RTP MTC value will gradually become more negative with further core depletion and boron concentration reduction, a 300 ppm SR value of MTC should necessarily be less negative than the EOC LCO limit. The 300 ppm SR value is sufficiently less negative than the EOC LCO limit value to provide assurance that the LCO limit will be met at EOC when the 300 ppm Surveillance criterion is met.

BASES

SURVEILLANCE REQUIREMENTS (continued)

~~SR 3.1.3.2 is modified by three Notes that include the following requirements:~~

~~a.~~ The SR is ~~not~~ required to be performed ~~until~~**once within** 7 effective full power days (EFPD~~s~~) after reaching **an RCS boron concentration that is** ~~the~~ equivalent ~~of~~ **to** an equilibrium RTP all rods out (ARO) boron concentration of 300 ppm.

~~b.~~ If the 300 ppm Surveillance limit is exceeded, it is possible that the EOC limit on MTC could be reached before the planned EOC. Because the MTC changes slowly with core depletion, the **second** Frequency of 14 **EFPD thereafter** ~~effective full power days~~ is sufficient to avoid exceeding the EOC limit.

~~c.~~ **SR 3.1.3.2 is modified by a Note.** The Surveillance limit for RTP boron concentration of 60 ppm is conservative. If the measured MTC at 60 ppm is more positive than the 60 ppm surveillance limit, the EOC limit will not be exceeded because of the gradual manner in which MTC changes with core burnup**, and the continued performance of SR 3.1.3.2 is no longer required**.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 11.

2. **FSAR** Chapter 15, “Accident Analys~~e~~**e**~~i~~s.”

3. WCAP 9273-NP-A, “Westinghouse Reload Safety Evaluation Methodology,” July 1985.

XII. Applicable STS Subsection After Incorporation of this GTST's Modifications

The entire subsection of the Specifications and the Bases associated with this GTST, following incorporation of the modifications, is presented next.

3.1 REACTIVITY CONTROL SYSTEMS

3.1.3 Moderator Temperature Coefficient (MTC)

LCO 3.1.3 The MTC shall be maintained within the limits specified in the COLR.

APPLICABILITY: MODE 1 for the upper MTC limit,
MODE 2 with $k_{eff} \geq 1.0$ for the upper MTC limit,
MODES 1, 2, and 3 for the lower MTC limit.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. MTC not within upper limit.	A.1 Establish administrative withdrawal limits for control banks to maintain MTC within limit.	24 hour
B. Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 2 with $k_{eff} < 1.0$.	6 hours
C. MTC not within lower limit.	C.1 Be in MODE 4.	12 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.3.1	Verify MTC within upper limit.	Once prior to entering MODE 1 after each refueling

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.1.3.2	----------NOTE---------- Not required to be performed if the MTC measured at the equivalent of equilibrium RTP all rods out (ARO) boron concentration of ≤ 60 ppm is less negative than the 60 ppm Surveillance limit specified in the COLR. ----------	
	Verify MTC is within lower limit.	Once within 7 effective full power days (EFPD) after reaching the equivalent of an equilibrium RTP ARO boron concentration of 300 ppm AND 14 EFPD thereafter when MTC is more negative than the 300 ppm Surveillance limit (not LCO limit) specified in the COLR

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.3 Moderator Temperature Coefficient (MTC)

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 non-positive MTC over the 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.

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 MTC is less than zero when THERMAL POWER is at RTP. 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 (burnable absorbers) to yield an MTC 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 designed to achieve high burnups that have changes to other characteristics are evaluated to ensure that the MTC does not exceed the EOC limit.

The limitations on MTC are provided to ensure that the value of this coefficient remains within the limiting conditions assumed in the FSAR Chapter 15 accident and transient analyses (Ref. 2).

If the LCO limits are not met, the plant response during transients may not be as predicted. The core could violate criteria that prohibit a return to criticality, or the departure from nucleate boiling ratio criteria of the approved correlation may be violated, which could lead to a loss of the fuel cladding integrity.

BASES

BACKGROUND (continued)

The SRs for measurement of the MTC at the beginning and near the end of the fuel cycle are adequate to confirm that the MTC remains within its limits since this coefficient changes slowly due principally to the RCS boron concentration changes associated with fuel burnup and burnable absorbers depletion.

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 accidents, such as overheating and overcooling events.

FSAR Chapter 15 (Ref. 2) contains analyses of accidents that result in both overheating and overcooling of the reactor core. MTC is one of the controlling parameters for core reactivity in these accidents. Both the least negative value and most negative value of the MTC are important to safety, and both values must be bounded. Values used in the analyses consider worst case conditions to ensure that the accident results are bounding (Ref. 3).

The consequences of accidents that cause core heat-up must be evaluated when the MTC is least negative. Such accidents include the rod withdrawal transient from either zero (Ref. 2) or RTP, loss of main feedwater flow, and loss of forced reactor coolant flow. The consequences of accidents that cause core overcooling must be evaluated when the MTC is negative. Such accidents include sudden feedwater flow increase and sudden decrease in feedwater temperature.

In order to ensure a bounding accident analysis, the MTC is assumed to be its most limiting value for the analysis conditions appropriate to each accident. The bounding value is determined by considering rodded and unrodded conditions, whether the reactor is at full or zero power, and whether it is BOC or EOC. The most conservative combination appropriate to the accident is then used for the analysis (Ref. 2).

BASES

APPLICABLE SAFETY ANALYSES (continued)

MTC values are bounded in reload safety evaluations assuming steady state conditions at the limiting time in cycle life. An EOC measurement is conducted at conditions when the RCS boron concentration reaches approximately 300 ppm. The measured value may be extrapolated to project the EOC value, in order to confirm reload design predictions.

MTC satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii). Even though it is not directly observed and controlled from the control room, MTC is considered an initial condition process variable because of its dependence on boron concentration.

LCO

LCO 3.1.3 requires the MTC to be within specified limits of the COLR to ensure that 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 accident analysis during operation.

Assumptions made in safety analyses require that the MTC be more negative than a given upper limit and less negative than a given lower limit. The MTC is least negative near BOC; this upper bound must not be exceeded. This maximum upper limit occurs at all rods out (ARO), hot zero power conditions. At EOC the MTC takes on its most negative value, when the lower bound becomes important. This LCO exists to ensure that both the upper and lower bounds are not exceeded.

During operation, therefore, the conditions of the LCO can only be ensured through measurement. The surveillance checks at BOC and EOC on MTC provide confirmation that the MTC is behaving as anticipated so that the acceptance criteria are met.

The BOC limit and the EOC limit are established in the COLR to allow specifying limits for each particular cycle. This permits the unit to take advantage of improved fuel management and changes in unit operating schedule.

APPLICABILITY

Technical Specifications place both LCO and SR values on MTC, based on the safety analysis assumptions described above.

BASES

APPLICABILITY (continued)

In MODE 1, the limits on MTC must be maintained to assure that any accident initiated from THERMAL POWER operation will not violate the design assumptions of the accident analysis. In MODE 2, with the reactor critical, the upper limit must also be maintained to ensure that startup and subcritical accidents (such as the uncontrolled control rod or control rod group withdrawal) will not violate the assumptions of the accident analysis. The lower MTC limit must be maintained in MODES 2 and 3, in addition to MODE 1, to ensure that cooldown accidents will not violate the assumptions of the accident analysis. In MODES 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.

ACTIONS

A.1

If the upper MTC limit is violated, administrative withdrawal limits for control banks must be established to maintain the MTC within its limits. The MTC becomes more negative with control bank insertion and decreased boron concentration. A Completion Time of 24 hours provides enough time for evaluating the MTC measurement and computing the required bank withdrawal limits.

As cycle burnup is increased, the RCS boron concentration will be reduced. The reduced boron concentration causes the MTC to become more negative. Using physics calculations, the time in cycle life at which the calculated MTC will meet the LCO requirement can be determined. At this point in core life, Condition A no longer exists. The unit is no longer in the Required Action, so the administrative withdrawal limits are no longer in effect.

B.1

If the required administrative withdrawal limits at BOC are not established within 24 hours, the unit must be placed in MODE 2 with $k_{eff} < 1.0$ to prevent operation with an MTC which is less negative than that assumed in safety analyses.

The allowed Completion Time of 6 hours is reasonable, based on operating experience, for reaching the required MODE from full power conditions in an orderly manner and without challenging plant systems.

BASES

ACTIONS (continued)

C.1

Exceeding the EOC MTC limit means that the safety analysis assumptions for the EOC accidents that use a bounding negative MTC value may be invalid. If the EOC MTC limit is exceeded, the plant must be placed in a MODE or Condition in which the LCO requirements are not applicable. This is done by placing the plant in at least MODE 4 within 12 hours.

The allowed Completion Time is a reasonable time based on operating experience to reach the required MODE from full power operation in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.1.3.1

This SR requires measurement of the MTC once at BOC prior to entering MODE 1 in order to demonstrate compliance with the most limiting MTC LCO. Meeting the limit prior to entering MODE 1 assures that the limit will also be met at higher power levels.

The BOC MTC value for ARO will be inferred from isothermal temperature coefficient measurements obtained during the physics tests after refueling. The ARO value can be directly compared to the MTC limit of the LCO. If required, measurement results and predicted design values can be used to establish administrative withdrawal limits for control banks.

SR 3.1.3.2

In similar fashion, the LCO demands that the MTC be less negative than the specified value for EOC full power conditions. This measurement may be performed at any THERMAL POWER, but its results must be extrapolated to the conditions of RTP and all banks withdrawn in order to make a proper comparison with the LCO value. Because the RTP MTC value will gradually become more negative with further core depletion and boron concentration reduction, a 300 ppm SR value of MTC should necessarily be less negative than the EOC LCO limit. The 300 ppm SR value is sufficiently less negative than the EOC LCO limit value to provide assurance that the LCO limit will be met at EOC when the 300 ppm Surveillance criterion is met.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The SR is required to be performed once within 7 effective full power days (EFPD) after reaching an RCS boron concentration that is equivalent to an equilibrium RTP all rods out (ARO) boron concentration of 300 ppm.

If the 300 ppm Surveillance limit is exceeded, it is possible that the EOC limit on MTC could be reached before the planned EOC. Because the MTC changes slowly with core depletion, the second Frequency of 14 EFPD thereafter is sufficient to avoid exceeding the EOC limit.

SR 3.1.3.2 is modified by a Note. The Surveillance limit for RTP boron concentration of 60 ppm is conservative. If the measured MTC at 60 ppm is more positive than the 60 ppm surveillance limit, the EOC limit will not be exceeded because of the gradual manner in which MTC changes with core burnup, and the continued performance of SR 3.1.3.2 is no longer required.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 11.

2. FSAR Chapter 15, “Accident Analyses.”

3. WCAP 9273-NP-A, “Westinghouse Reload Safety Evaluation Methodology,” July 1985.