10 CFR 50.90

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102-06784-DCM/RKR
November 20, 2013

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, Maryland 20852

Dear Sirs:

Reference:

APS to NRC letter number 102-06785, *Palo Verde Nuclear Generating Station, Units 1, 2, and 3, Docket Nos. STN 50-528/529/530, Transmittal of Proprietary Documents for Startup Test Activity Reduction (STAR) Program License Amendment Request (LAR)*, dated November 20, 2013

Subject: Palo Verde Nuclear Generating Station
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
Application for Technical Specification Change Regarding Moderator Temperature Coefficient (MTC) Surveillance for Startup Test Activity Reduction (STAR) Program Using the Consolidated Line Item Improvement Process (CLIIP)

In accordance with the provisions of 10 CFR 50.90 Arizona Public Service Company (APS) is submitting a request for an amendment to the technical specifications (TS) for Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3. The proposed amendment would modify moderator temperature coefficient (MTC) TS surveillance requirements (SR) associated with implementation of WCAP-16011-P-A, *Startup Test Activity Reduction (STAR) Program.* The availability of this TS improvement was announced in the Federal Register (FR) on September 6, 2007 (72 FR 51259), as part of the Consolidated Line Item Improvement Process (CLIIP). In addition, related TSTF-406, Revision 2, *Predicting End-Of-Cycle MTC and Deleting Need for End-Of-Cycle MTC Verification (CE-NPSD-911-A)*, is also included in this submittal.

Attachment 1 provides a description of the proposed change, the requested confirmation of applicability and plant-specific verifications. Attachment 2 provides the existing TS pages marked up to show the proposed change. Attachment 3 provides revised (clean) TS pages. Attachment 4 provides a summary of the regulatory commitments made in this submittal. Attachment 5 provides the

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NRR

proposed changes to Technical Specification Bases pages.

The changes are consistent with NRC approved Industry Technical Specification Task Force (TSTF) Standard Technical Specification Change Traveler, TSTF-486, Revision 2, *Revise MTC Surveillance for Startup Test Activity Reduction (STAR) Program (WCAP-16011).* The non-proprietary version of WCAP-16011, *Startup Test Reduction Activity Program* is available to the NRC staff [Agencywide Documents Access and Management System (ADAMS) Accession number ML050660118]. APS did not initially participate in the industry effort that developed WCAP-16011. APS has subsequently become a participant and specific evaluations have been performed to support implementation of TSTF-486 for PVNGS. The evaluations included relevant industry operating experience since NRC approval of TSTF-486. The non-proprietary version of the evaluation document (WCAP-17787, *Palo Verde Nuclear Generating Station STAR Program Implementation Report*) is provided as Attachment 6 to this submittal. The proprietary versions of WCAP-16011 and WCAP-17787 were provided by the reference letter.

Related TSTF-406, Revision 2, *Predicting End-Of-Cycle MTC and Deleting Need for End-Of-Cycle MTC Verification (CE-NPSD-911-A)*, is included in this submittal. The supporting document for TSTF-406, CE-NPSD-911-A and Amendment 1-A, *Analysis of Moderator Temperature Coefficients in Support of a Change in the Technical Specification End of Cycle Negative MTC Limit,* September 15, 2000, is available to the NRC staff (ADAMS Accession number ML003752592). Attachment 7 is *Near End of Cycle (EOC) MTC Elimination Informational Benchmark*, that documents that computer codes CASMO/SIMULATE and DIT/ROCS provide similar results. This attachment, in conjunction with Appendix D of WCAP-17787, supports the application of CE-NPSD-911-A and Amendment 1-A for PVNGS.

APS requests approval of the proposed license amendment within one year of the date of this letter. APS requests an implementation period of 90-days after issuance of the license amendment.

A pre-submittal public meeting was held, regarding this submittal, between APS and the NRC staff on July 11, 2013, and is summarized in NRC letter dated August 5, 2013 (ADAMS Accession number ML13197A095).

In accordance with the PVNGS Quality Assurance Program, the Plant Review Board and the Offsite Safety Review Committee have reviewed and concurred with the amendment proposed herein. By copy of this letter, this submittal is being forwarded to the Arizona Radiation Regulatory Agency (ARRA) pursuant to 10 CFR 50.91(b)(1).

Should you need further information regarding this amendment request, please contact Robert K. Roehler, Licensing Section Leader, at (623) 393-5241.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on NOVEMBER 20, 2013
(Date)

Sincerely,

FOR D. C. MIMS

DCM/RKR/CJS/hsc

Attachments:

1. Description and Assessment
2. Proposed Technical Specification Changes
3. Revised Technical Specification Pages
4. Regulatory Commitments
5. Proposed Technical Specification Bases Changes
6. WCAP-17787, *Palo Verde Nuclear Generating Station STAR Program Implementation Report* (Non-Proprietary Version)
7. *Near End of Cycle (EOC) MTC Elimination Informational Benchmark,* August 13, 2013

cc:	M. L. Dapas	NRC Region IV Regional Administrator
	J. K. Rankin	NRC NRR Project Manager
	M. A. Brown	NRC Senior Resident Inspector for PVNGS
	A. V. Godwin	Arizona Radiation Regulatory Agency (ARRA)
	T. Morales	Arizona Radiation Regulatory Agency (ARRA)

ATTACHMENT 1

DESCRIPTION AND ASSESSMENT

1.0 DESCRIPTION

The proposed amendment would modify moderator temperature coefficient (MTC) technical specification (TS) surveillance requirements (SR) associated with implementation of WCAP-16011-P-A, *Startup Test Activity Reduction (STAR) Program (WCAP-16011).* The changes are consistent with Nuclear Regulatory Commission (NRC) approved Industry/Technical Specification Task Force (TSTF) Standard Technical Specification change TSTF-486, Revision 2. The *Federal Register* notice published on September 6, 2007, announced the availability of this TS improvement through the consolidated line item improvement process (CLIIP).

The changes are consistent with NRC approved TSTF-486, Revision 2. The non-proprietary version of WCAP-16011, *Startup Test Reduction Activity Program* is available to the NRC staff [Agencywide Documents Access and Management System (ADAMS) Accession number ML050660118] (Reference 1). Arizona Public Service Company (APS) did not initially participate in the industry effort that developed WCAP-16011. APS has subsequently become a participant and specific evaluations have been performed to support implementation of TSTF-486 for the Palo Verde Nuclear Generating Station (PVNGS). The evaluations included relevant industry operating experience since NRC approval of TSTF-486. The non-proprietary version of the evaluation document (WCAP-17787, *Palo Verde Nuclear Generating Station STAR Program Implementation Report*) is provided as Attachment 6 of this submittal. The proprietary versions of the relevant WCAPs were provided by separate correspondence.

In addition, TSTF-406, Revision 2, *Predicting End-Of-Cycle MTC and Deleting Need for End-Of-Cycle MTC Verification (NPSD-911-A)*, is appropriately reflected in this submittal. The supporting document for TSTF-406, CE-NPSD-911-A and Amendment 1-A, *Analysis of Moderator Temperature Coefficients in Support of a Change in the Technical Specification End of Cycle Negative MTC Limit,* September 15, 2000, is available to the NRC staff (ADAMS Accession number ML003752592) and, therefore, is not included in this submittal (Reference 2). Attachment 7 is *Near End of Cycle (EOC) MTC Elimination Informational Benchmark*, that documents that computer codes CASMO/SIMULATE and DIT/ROCS provide similar results. This attachment, in conjunction with Appendix D of WCAP-17787, supports the application of CE-NPSD-911-A for PVNGS.

2.0 ASSESSMENT

2.1 Applicability of Published Safety Evaluation

APS has reviewed the safety evaluation dated August 29, 2007, as part of the CLIIP. This review included a review of the NRC staff's evaluation, as well as the supporting information provided to support TSTF-486, Revision 2. APS has concluded that the justifications presented in the TSTF proposal and the safety

evaluation prepared by the NRC staff are applicable to PVNGS Units 1, 2 and 3 and justify this amendment for the incorporation of the changes to the PVNGS TS for those elements of this license amendment request (LAR) that are derived from TSTF-486.

Related TSTF-406 is also appropriately included in this LAR. The *Regulatory Analysis* section of this LAR addresses the no significant hazards consideration determination (NSHCD) for both TSTF-486 and TSTF-406.

3.2 Optional Changes and Variations

APS is not proposing variations or deviations from the TS changes described in the modified TSTF-486, Revision 2, and the NRC staff's model safety evaluation dated August 29, 2007. The only differences are from the Standard Technical Specification (NUREG-1432) regarding the limiting condition for operation (LCO) number and an existing note in SR 3.1.4.2, which remain consistent with the PVNGS TS.

The changes to TS that implement CE-NPSD-911 are consistent with the changes modeled in the NRC approved CE-NPSD-911 and other industry precedents. The proposed change, therefore, differs from the specific text proposed in TSTF-406. Specifically, a new Note 3 is added to surveillance requirement (SR) 3.1.4.2 that reads as follows:

> "The MTC verification at 2/3 of expected core burnup is not required if the results of the measurement at 40 EFPD are within a tolerance of± $0.16*10E^{-4}$ $\Delta k/k/°F$ from the corresponding design values."

The proposed Note is more technically consistent with the underlying analysis than the TSTF-406 Note text that refers to a tolerance band of $\pm 0.16*10E^{-4}$ $\Delta\rho/°F$ of the respective limits in the COLR. In addition, the use of the units $\Delta k/k/°F$, as compared to $\Delta\rho/°F$ used in TSTF-406, is consistent with the units used in the LCO. The revised TS pages were formatted, with appropriate page breaks, to facilitate operator use.

3.0 REGULATORY ANALYSIS

3.1 No Significant Hazards Consideration Determination

Arizona Public Service Company (APS) has reviewed the proposed no significant hazards consideration determination (NSHCD) published in the *Federal Register* as part of the consolidated line item improvement process (CLIIP). APS has concluded that the proposed NSHCD presented in the Federal Register notice is applicable to the Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2 and 3 and is hereby incorporated by reference to satisfy the requirements of 10 CFR 50.91(a) for the TSTF-486 proposed changes. In addition, the following NSHCD is provided to reflect the TSTF-406.

APS has determined that the proposed TS amendment changes related to TSTF-406 do not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c). This determination is based on evaluation with respect to the specific criteria of 10 CFR 50.92(c) as follows:

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

   Response: No.

   A change is proposed to eliminate the measurement of end-of-cycle (EOC) moderator temperature coefficient (MTC) if the beginning-of-cycle (BOC) measurements are within a given tolerance to the predicted value. MTC is not an initiator of any accident previously evaluated. Consequently, the probability of an accident previously evaluated is not significantly increased.

   The EOC MTC value is an important assumption in determining the consequences of accidents previously evaluated. The analysis presented in the Topical Report determined that the EOC MTC will be within limits if the BOC measured MTC values are within a given tolerance of the measured values. Therefore, the EOC MTC will continue to be within limits and the consequences of accidents will continue to be as previously evaluated. Therefore, the consequences of an accident previously evaluated are not significantly increased by this change.

   Based on the above, the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

   Response: No.

   A change is proposed to eliminate the measurement of EOC MTC if the BOC measurements are within a given tolerance to the predicted value. The proposed change does not involve a physical alteration of the plant (no new or different type of equipment will be installed) or a change in the methods governing normal plant operation.

   Based on the above, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

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

   Response: No.

   A change is proposed to eliminate the measurement of EOC MTC if the BOC measurements are within a given tolerance to the predicted value. The Topical Report concluded that the risk of not measuring the EOC MTC is acceptably small provided that the BOC measured values are within a specific tolerance of the predicted values.

   Therefore, the proposed amendment does not involve a significant reduction in a margin of safety.

Based on the above, APS concludes that the proposed amendment does not involve a 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.

3.2 Verification and Commitments

As discussed in the notice of availability published in the *Federal Register* on September 6, 2007, for this TS improvement, APS verifies the applicability of TSTF-486 to PVNGS Units 1, 2 and 3, and commits to establishing Technical Specification Bases for TS 3.1.4 as proposed in TSTF-486, Revision 2, and documented in Attachment 4 of this submittal. APS also will implement the conditions and limitations of the NRC staff safety evaluation for WCAP-16011.

The proposed TSTF-486 change revises SR 3.1.3.1 in the digital Combustion Engineering standard technical specifications (NUREG-1432) (i.e., PVNGS 3.1.4.1) 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 TS 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-A. The Bases modifications clarify the relationship between the MTC limits specified in the Core Operating Limits Report (COLR) and the maximum positive MTC value specified in the LCO. The UFSAR will be revised, pursuant to 10 CFR 50.71(e), to update the description of the performance of rod worth or symmetry testing following each refueling outage. The UFSAR update will reflect the elimination of rod worth or symmetry testing when the applicability requirements of WCAP-17787 are met.

4.0 ENVIRONMENTAL EVALUATION

APS has reviewed the environmental evaluation included in the model safety evaluation dated August 29, 2007, as part of the CLIIP. APS has concluded that the staff's findings presented in that evaluation are applicable to PVNGS Units 1, 2, and 3, and the evaluation is hereby incorporated by reference for this application.

5.0 REFERENCES

1. WCAP-16011-NP-A, *Startup Test Activity Reduction (STAR) Program,* Revision 0, dated February 2005 (ADAMS Accession number ML050660118)
2. CE-NPSD-911-A and Amendment 1-A, *Analysis of Moderator Temperature Coefficients in Support of a Change in the Technical Specification End of Cycle Negative MTC Limit, dated* September 15, 2000 (ADAMS Accession number ML003752592)

ATTACHMENT 2

PROPOSED TECHNICAL SPECIFICATION CHANGES

Proposed Technical Specification Changes

TS Pages
(Markup Pages)

3.1.4-1
3.1.4-2
3.1.4-3

3.1 REACTIVITY CONTROL SYSTEMS

3.1.4 Moderator Temperature Coefficient (MTC)

LCO 3.1.4 The MTC shall be maintained within the limits specified in the COLR, and a maximum positive limit that varies linearly from 0.5 E-4 $\Delta k/k/°F$ at 0% RTP to 0.0 $\Delta k/k/°F$ at 100% RTP.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. MTC not within limits.	A.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.4.1	----------NOTE---------- This Surveillance is not required to be performed prior to entry into MODE 2. ----------	
	Verify MTC is within the upper limit specified in the COLR.	Prior to entering MODE 1 after each fuel loading

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.1.4.1 (continued)	AND ------NOTE----- Only required to be performed when MTC determined prior to entering MODE 1 is verified using adjusted predicted MTC ---------- Each fuel cycle within 7 EFPD of reaching 40 EFPD core burnup
SR 3.1.4.2 ----------NOTES---------- 1. This Surveillance is not required to be performed prior to entry into MODE 1 or 2. 2. If the MTC is more negative than the ~~COLR~~ limit specified in the COLR when extrapolated to the end of cycle, SR 3.1.4.2 may be repeated. Shutdown must occur prior to exceeding the minimum allowable boron concentration at which MTC is projected to exceed the lower limit. 3. The MTC verification at 2/3 of expected core burnup is not required if the results of the measurement at 40 EFPD are within a tolerance of ± 0.16*10E-4 $\Delta k/k/°F$ from the corresponding design values. ----------	

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.1.4.2 (continued) 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 AND Each fuel cycle within 7 EFPD of reaching $\frac{2}{3}$ 2/3 of expected core burnup

ATTACHMENT 3

REVISED TECHNICAL SPECIFICATION PAGES

TS Pages
(Clean Pages)

3.1.4-1
3.1.4-2
3.1.4-3

3.1 REACTIVITY CONTROL SYSTEMS

3.1.4 Moderator Temperature Coefficient (MTC)

LCO 3.1.4 The MTC shall be maintained within the limits specified in the COLR, and a maximum positive limit that varies linearly from 0.5 E-4 $\Delta k/k/°F$ at 0% RTP to 0.0 $\Delta k/k/°F$ at 100% RTP.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. MTC not within limits.	A.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.4.1	----------NOTE---------- - This Surveillance is not required to be performed prior to entry into MODE 2. ----------	
	Verify MTC is within the upper limit specified in the COLR.	Prior to entering MODE 1 after each fuel loading AND ------NOTE----- Only required to be performed when MTC determined prior to entering MODE 1 is verified using adjusted predicted MTC ---------- Each fuel cycle within 7 EFPD of reaching 40 EFPD core burnup

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SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.1.4.2	----------NOTES---------- 1. This Surveillance is not required to be performed prior to entry into MODE 1 or 2. 2. If the MTC is more negative than the limit specified in the COLR when extrapolated to the end of cycle, SR 3.1.4.2 may be repeated. Shutdown must occur prior to exceeding the minimum allowable boron concentration at which MTC is projected to exceed the lower limit. 3. The MTC verification at 2/3 of expected core burnup is not required if the results of the measurement at 40 EFPD are within a tolerance of ± 0.16*10E-4 Δk/k/°F from the corresponding design values. ----------	
	Verify MTC is within the lower limit specified in the COLR.	Each fuel cycle within 7 EFPD of reaching 40 EFPD core burnup AND Each fuel cycle within 7 EFPD of reaching 2/3 of expected core burnup

ATTACHMENT 4

REGULATORY COMMITMENTS

The following table identifies those actions committed to by Arizona Public Service Company (APS) in this document for the Palo Verde Nuclear Generating Station (PVNGS). Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments. Please direct questions regarding these commitments to Robert K. Roehler, Licensing Section Leader, at (623) 393-5241.

REGULATORY COMMITMENTS	DUE DATE/EVENT
APS will establish Technical Specification Bases for TS 3.1.4 consistent with those shown in the license amendment.	Complete and implement with approved license amendment implementation.
APS will include verification of the applicability requirements in appropriate site startup testing procedures. APS will include guidance in the procedures to ensure that the safety analysis and STAR applicability requirements are satisfied when STAR test results fall outside the test criteria. If the safety analysis or STAR applicability requirements are not satisfied, the STAR program for the affected fuel cycle will not be used.	Complete and implement with approved license amendment implementation.
APS will submit a summary report following the first application of STAR at PVNGS that will: (a) identify the core design method used, (b) compare the measured and calculated values and the differences between these values to the corresponding core design method uncertainties and (c) show compliance with the STAR applicability requirements. If the application of STAR is unsuccessful, APS will identify the reasons why the STAR application failed.	Within 90-days of completion of the first application of STAR at PVNGS.

ATTACHMENT 5

PROPOSED TECHNICAL SPECIFICATION BASES PAGES CHANGES

TS Bases Pages
(Markup Pages)

B 3.1.4-1
B 3.1.4-2
B 3.1.4-3
B 3.1.4-4
B 3.1.4-5
B 3.1.4-6

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.4 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 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 and temperatures 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 burnable absorbers, either fixed lumped poison rods or poisons distributed within selected fuel rods 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.

(continued)

BASES (continued)

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.

Reference 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 most positive 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, such as very large soluble boron concentrations, to ensure the accident results are bounding.

Accidents that cause core overheating, either by decreased heat removal or increased power production, must be evaluated for results when the MTC is positive. Reactivity accidents that cause increased power production include the control element assembly (CEA) withdrawal transient from either subcritical or full THERMAL POWER. The limiting overheating event relative to plant response is based on the Loss of Condenser Vacuum event (Ref. 3). The most limiting event with respect to a positive MTC is a CEA withdrawal accident from a subcritical or low (hot zero) power condition, also referred to as a startup accident (Ref. 4).

Accidents that cause core overcooling must be evaluated for results when the MTC is most negative. The event that produces the most rapid cooldown of the RCS, and is therefore the most limiting event with respect to the negative MTC, is a steam line break (SLB) event. Following the reactor trip for the postulated EOC SLB event, the large moderator temperature reduction combined with the large negative MTC may produce reactivity increases that are as much as the shutdown reactivity. When this occurs, a substantial fraction of core power is produced with all CEAs inserted, except the most reactive one, which is assumed withdrawn. Even if the reactivity increase produces slightly subcritical conditions, a large fraction of core power may be produced through the effects of subcritical neutron multiplication.

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BASES (continued)

APPLICABLE SAFETY ANALYSES (continued)

MTC values are bounded in reload safety evaluations assuming steady state conditions at BOC and EOC. A middle of cycle (MOC) 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.

The MTC satisfies Criterion 2 of 10 CFR 50.36 (c)(2)(ii).

LCO

LCO 3.1.4 requires the MTC to be within the positive and negative limits specified in ~~limits of~~ 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 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 accidents, such as the uncontrolled CEA

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BASES (continued)

APPLICABILITY (continued)

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 except for a MSLB in MODE 3. In this case, the analysis assumes worst case MTC, with the ECCS systems mitigating the event.

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

SURVEILLANCE REQUIREMENTS

SR 3.1.4.1 and SR 3.1.4.2

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.

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 3.1.4.1 may be met prior to entering MODE 1 after each fuel

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BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.1.4.1 and SR 3.1.4.2 (continued)

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) of 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 of reaching 40 EFPD of core burnup is not required for SR 3.1.4.1.

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 of (before or after) reaching 40 EFPD ~~effective full power days~~ and a $^{2}/_{3}$ 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.

SR 3.1.4.2 is modified by a Note that indicates performance is not required prior to entering MODE 1 or 2. Although this Surveillance is applicable in MODES 1 and 2, the reactor must be critical before the Surveillance can be completed. Therefore, entry into the applicable MODE prior to accomplishing the Surveillance is necessary.

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BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.1.4.1 and SR 3.1.4.2 (continued)

SR 3.1.4.2 is modified by a second 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. An extrapolation to the end of cycle is only required if the measurement at 2/3 cycle is performed.

SR 3.1.4.2 is modified by a third Note, which indicates that the Surveillance, which determines MTC 2/3 expected core burnup is only required if the MTC determined in SR 3.1.4.1 and at 40 EFPD are not within 0.16*10E-4 $\Delta k/k/°F$ of the corresponding design values. For cycles that meet the applicability requirements given in Reference 5, the MTC verification of MTC at 2/3 expected core burnup is not required if the result of the measurement at 40 EFPD is within a tolerance of 0.16*10E-4 $\Delta k/k/°F$ of the corresponding design value.

REFERENCES

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

2. UFSAR, Section 15.0.

3. UFSAR, Section 15.2.

4. UFSAR, Section 15.4.

5. WCAP-17787, "Palo Verde Nuclear Generating Station STAR Program Implementation."

6. CE-NPSD-911, "Analysis of Moderator Temperature Coefficients in Support of a Change in the Technical Specification End-of-Cycle MTC Limit", September 2000.

ATTACHMENT 7

***Near End of Cycle (EOC) MTC Elimination Informational Benchmark,* August 13, 2013**

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162-13763-PSH
August 13, 2013

Dear Andrew Cecchetti:

Subject: Near End of Cycle (EOC) Moderator Temperature Coefficient (MTC) Surveillance Elimination Informational Benchmark

Enclosed is Palo Verde's two-thirds expected core burnup surveillance MTC elimination informational benchmark. This informational benchmark used NRC approved CASMO/SIMULATE methodology. The Attachment provides the benchmark that will need to be transmitted to the NRC prior to eliminating the need to measure the MTC upon reaching two-thirds of expected core burnup.

If you have any further comments or questions please feel free to contact me at 623-393-5144 or via e-mail at phillip.hoffspiegel@aps.com.

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Phillip S. Hoffspiegel
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Attachment: 1) "Near End of Cycle (EOC) MTC Elimination Informational Benchmark"

Distribution (with Attachment):
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Attachment

Near End of Cycle (EOC) MTC Elimination Informational Benchmark

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William McDonald

Near EOC MTC Elimination Informational Benchmark

Since the licensing of Arizona Public Service Company (APS) to perform its own reload design calculations, there has been an ongoing effort to replace the CE DIT/ROCS nuclear design package with the Studsvik equivalent NRC-approved for Palo Verde CASMO/SIMULATE package. This transition was implemented in such a way as to maintain the current approved CE safety analysis methodology and plant Technical Specifications. As part of the transition effort, an extensive benchmarking effort was performed to assure that the uncertainties for the Studsvik code suite were within the allowances assumed in the CE Safety Analysis methodology. The CASMO/SIMULATE nuclear code system is now used for the licensing analyses of Palo Verde Units 1, 2, and 3. The Safety Evaluation Report (SER) for the change in nuclear design methodology (given in Reference 1) approved the use of CASMO/SIMULATE as a replacement for DIT/ROCS for nuclear design and analysis of Palo Verde.

However, it was noted that the SER for CE methodology topical (CE NPSD-911-A, Amendment 1-A), used by several CE plants to justify elimination of the End-of-Cycle Moderator Temperature Coefficient (EOC MTC) measurement, contained a requirement that if any methodology other than the CE methodology were used for the purpose of EOC MTC test elimination, then appropriate Isothermal Temperature Coefficient (ITC) benchmark information should be submitted to the NRC. This letter provides these benchmarks. Note that this benchmark is being provided for information only. It is Palo Verde's position that the Palo Verde specific SER approving the use of CASMO/SIMULATE (Reference 1), provides the necessary approval to use CASMO/SIMULATE for all nuclear analysis applications where DIT/ROCS had previously been used. This includes EOC MTC elimination methodology (CE NPSD-911-A, Amendment 1-A).

A review was conducted of the NRC's approval of Palo Verde's change from DIT/ROCS to CASMO/SIMULATE. Specifically, the safety evaluation associated with Amendment No. 132 to Facility Operating License No. NPF-41, Amendment No. 132 to Facility Operating License No. NPF-51, and Amendment No. 132 to Facility Operating License No. NPF-74 for the Palo Verde Nuclear Generating Station, Units 1, 2, and 3, respectively, was reviewed to determine what specific language the NRC used to approve acceptability of CASMO/SIMULATE. The following are direct extracts from the NRC's SER:

> *"In its application, the licensee compares the CASMO-4/SIMULATE-3 predictions of key physics parameters against plant data. In this comparison, the licensee used data from PVNGS Units 1, 2, and 3 and from critical experiments.*
>
> *The licensee intends to use the CASMO-4/SIMULATE-3 programs in licensing applications, including calculations for startups, generation of physics input for safety analyses, qualification and quantification of reliability factors, and applications to operations and reload safety evaluations of PVNGS Units 1, 2, and 3. The licensee used several cycles of data to benchmark the licensee's CASMO-4/SIMULATE-3 model for each Unit for a total of 23 cycles, including both initial reload cores. These data covered a variety of fuel types, operating conditions, and core loading patterns.*
>
> *The licensee analyzed the plants over a wide range of conditions from cold (ambient) temperature to hot full power operation. The licensee found good agreement between the measured and the calculated values, as set forth in the attachment to its application.*

For each parameter compared, a sample mean and standard deviation of the observed differences were calculated. Based on the agreement between the measured and calculated values, the staff has determined that the licensee has validated its proposed applications of these computer programs for analysis of the PVNGS Units 1, 2, and 3."

From the regulatory language in the SER for Palo Verde, CASMO/SIMULATE is an acceptable core design methodology. The SER specifically allows the use of CASMO/SIMULATE as a replacement for DIT/ROCS and approves the methodology for steady-state physics calculations for Palo Verde. As noted in the language, there is good agreement between the measured and calculated values.

CE NPSD-911-A, Amendment 1-A has specific requirements with regard to the ITC/MTC uncertainty of the core design methods. Specifically, it requires that:

a) The ITC/MTC 95/95 uncertainty is less than or equal to 1.6 pcm/°F.
b) Sufficient design margin exist to accommodate the uncertainty. The uncertainty used in the plant safety analyses is 1.6 pcm/°F.
c) The variance in the residual error in the ITC prediction from the BOC tests pool with those from the near EOC tests.

Benchmarks that were performed in support of the transition of Palo Verde to CASMO/SIMULATE confirm that the MTC predictive uncertainty for CASMO/SIMULATE is within the acceptance value of 1.6 pcm/°F and the variance at BOC and near EOC pool. The Palo Verde Safety Analyses employ a conservative ITC uncertainty of 1.6 pcm/°F.

A summary of these benchmarks is documented as Table 1 for informational purposes to show that CASMO/SIMULATE is acceptable for performing the surveillances described in CE NPSD-911-A, Amendment 1-A.

Based on the above information, it has been confirmed that the CASMO/SIMULATE code system is an acceptable replacement for the DIT/ROCS code system for the methodology described in CE NPSD-911-A, Amendment 1-A, and is applicable to all the Palo Verde units. The response to NRC question #4 on Page A3 of CE NPSD-911-A, Amendment 1-A, "If utilities perform the calculations, what codes will they use?" further substantiates this conclusion.

References:

1. Letter: Jack N. Donohew, Senior Project Manager (NRC) to Gregg R. Overbeck, Senior Vice President (APS) dated March 20, 2001, "Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3 – Issuance of Amendments on CASMO-4/SIMULATE-3 (TAC NOS. MA9279, MA9280, and MA9281)."

2. CE NPSD-911-A and Amendment 1-A, "Analysis of Moderator Temperature Coefficients in Support of Change in the Technical Specifications End-of-Cycle Negative MTC Limits," September 15, 2000.

Table 1
Comparison of CASMO/SIMULATE and DIT/ROCS ITC Benchmarks
(Difference between Measurement and Prediction)

Code Package:	Number of Measurements	Standard Deviation	K Multiplier	95/95 Tolerance Limit	Reference
CASMO/SIMULATE	70	0.066×10^{-4} $\Delta\rho$/°F	2.299	0.152×10^{-4} $\Delta\rho$/°F	Reference 1
DIT/ROCS	71	0.077×10^{-4} $\Delta\rho$/°F	1.987	0.153×10^{-4} $\Delta\rho$/°F	Reference 2