MODERATOR TEMPERATURE COEFFICIENT

LIMITING CONDITION FOR OPERATION

3.1.1.4 The moderator temperature coefficient (MTC) shall be:

a. For the all rods withdrawn, beginning of core life condition $\leq 0.6 \times 10^{-4}$ $\Delta k/k/°F$ below 70 percent RATED THERMAL POWER $\leq 0.0 \times 10^{-4}$ $\Delta k/k/°F$ at or above 70 percent RATED THERMAL POWER

b. Less negative than -4.4×10^{-4} $\Delta k/k/°F$ for the all rods withdrawn, end of core life at RATED THERMAL POWER.

APPLICABILITY: Specification 3.1.1.4.a - MODES 1 and 2* only#
Specification 3.1.1.4.b - MODES 1, 2 and 3 only#

ACTION:

a. With the MTC more positive than the limit of 3.1.1.4.a above:

1. Establish and maintain control rod withdrawal limits sufficient to restore the MTC to within its limit within 24 hours or be in HOT STANDBY within the next 6 hours. These withdrawal limits shall be in addition to the insertion limits of Specification 3.1.3.6.

2. Maintain the control rods within the withdrawal limits established above until subsequent measurement verifies that the MTC has been restored to within its limit for the all rods withdrawn condition.

3. Prepare and submit a Special Report to the Commission pursuant to Specification 6.9.2 within 10 days, describing the value of the measured MTC, the interim control rod withdrawal limits and the predicted average core burnup necessary for restoring the positive MTC to within its limit for the all rods withdrawn condition.

b. With the MTC more negative than the limit of 3.1.1.4b above, be in HOT SHUTDOWN within 12 hours.

*With $K_{eff} \geq 1.0$

#See Special Test Exception 3.10.3

SURVEILLANCE REQUIREMENTS

4.1.1.4 The MTC shall be determined to be within its limits during each fuel cycle as follows:

a. The MTC shall be measured and compared to the BOL Limit of Specification 3.1.1.4a, above, prior to initial operation above 5% of RATED THERMAL POWER, after each fuel loading.

b. The MTC shall be measured at any THERMAL POWER and compared to -3.3×10^{-4} $\Delta k/k/°F$ (all rods withdrawn, RATED THERMAL POWER condition) within 7 EFPD after reaching an equilibrium boron concentration of 300 ppm. In the event this comparison indicated the MTC is more negative than -3.3×10^{-4} $\Delta k/k/°F$, the MTC shall be remeasured, and compared to the EOL MTC limit of specification 3.1.1.4.b, at least once per 14 EFPD during the remainder of the fuel cycle.[1]

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(1) Once the equilibrium boron concentration (all rods withdrawn, RATED THERMAL POWER condition) is 60 ppm or less, further measurement of the MTC in accordance with 4.1.1.4.b may be suspended providing that the measured MTC at an equilibrium boron concentration of ≤ 60ppm is less negative than -4.0×10^{-4} $\Delta k/k/°F$.

3/4.1.1.4 MODERATOR TEMPERATURE COEFFICIENT (MTC) (Continued)

conditions other than those explicitly stated will require extrapolation to those conditions in order to permit an accurate comparison.

The most negative MTC value equivalent to the most positive moderator density coefficient (MDC), was obtained by incrementally correcting the MDC used in the FSAR analyses to nominal operating conditions. These corrections involved subtracting the incremental change in the MDC associated with a core condition of all rods inserted (most positive MDC) to an all rods withdrawn condition and, a conversion for the rate of change of moderator density with temperature at RATED THERMAL POWER conditions. This value of the MDC was then transformed into the limiting MTC value -4.4×10^{-4} $\Delta k/k/°F$. The MTC value of -3.3×10^{-4} $\Delta k/k/°F$ represents a conservative value (with corrections for burnup and soluble boron) at a core condition of 300 ppm equilibrium boron concentration and is obtained by making these corrections to the limiting MTC value -4.4×10^{-4} $\Delta k/k/°F$.

Once the equilibrium boron concentration falls below about 60 ppm, dilution operations take an extended amount of time and reliable MTC measurements become more difficult to obtain due to the potential for fluctuating core conditions over the test interval. For this reason, MTC measurements may be suspended provided the measured MTC value at an equilibrium full power boron concentration $\leq$ 60 ppm is less negative than -4.0×10^{-4} delta k/k/°F. The difference between this value and the limiting MTC value of -4.4×10^{-4} delta k/k/°F conservatively bounds the maximum credible change in MTC between the 60 ppm equilibrium boron concentration (all rods withdrawn, RATED THERMAL POWER conditions) and the licensed end of cycle, including the effect of rods, boron concentration, burnup, and end-of-cycle coastdown.

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

3/4.1.1.5 MINIMUM TEMPERATURE FOR CRITICALITY

This specification ensures that the reactor will not be made critical with the Reactor Coolant System average temperature less than 541°F. This limitation is required to ensure 1) the moderator temperature coefficient is within its analyzed temperature range, 2) the protective instrumentation is within its normal operating range, and 3) the P-12 interlock is above its setpoint.

3/4.1.2 BORATION SYSTEMS

The boron injection system ensures that negative reactivity control is available during each mode of facility operation. The components required to perform this function include 1) borated water sources, 2) charging pumps, 3) separate flow paths, 4) boric acid transfer pumps, 5) associated heat tracing systems, and 6) an emergency power supply from OPERABLE diesel generators.

ATTACHMENT 2

PROPOSED TECHNICAL SPECIFICATIONS CHANGES - UNIT 2

REACTIVITY CONTROL SYSTEMS

MODERATOR TEMPERATURE COEFFICIENT

LIMITING CONDITION FOR OPERATION

3.1.1.4 The moderator temperature coefficient (MTC) shall be:

a. For the all rods withdrawn, beginning of core life condition $\leq 0.6 \times 10^{-4}$ $\Delta k/k/°F$ below 70 percent RATED THERMAL POWER $\leq 0.0 \times 10^{-4}$ $\Delta k/k/°F$ at or above 70 percent RATED THERMAL POWER

b. Less negative than -4.4×10^{-4} $\Delta k/k/°F$ for the all rods withdrawn, end of core life at RATED THERMAL POWER.

APPLICABILITY: Specification 3.1.1.4.a - MODES 1 and 2* only#
Specification 3.1.1.4.b - MODES 1, 2 and 3 only#

ACTION:

a. With the MTC more positive than the limit of 3.1.1.4.a above, operations in MODES 1 and 2 may proceed provided:

1. Control rod withdrawal limits are established and maintained sufficient to restore the MTC to less positive than 0 delta k/k/°F within 24 hours or be in HOT STANDBY within the next 6 hours. These withdrawal limits shall be in addition to the insertion limits of Specification 3.1.3.6.

2. The control rods are maintained within the withdrawal limits established above until subsequent measurement verifies that the MTC has been restored to within its limit for the all rods withdrawn condition.

3. Prepare and submit a Special Report to the Commission pursuant to Specification 6.9.2 within 10 days, describing the value of the measured MTC, the interim control rod withdrawal limits and the predicted average core burnup necessary for restoring the positive MTC to within its limit for the all rods withdrawn condition.

b. With the MTC more negative than the limit of 3.1.1.4.b above, be in HOT SHUTDOWN within 12 hours.

*With $K_{eff} \geq 1.0$

#See Special Test Exception 3.10.3

SURVEILLANCE REQUIREMENTS

4.1.1.4 The MTC shall be determined to be within its limits during each fuel cycle as follows:

a. The MTC shall be measured and compared to the BOL Limit of Specification 3.1.1.4.a, above, prior to initial operation above 5% of RATED THERMAL POWER, after each fuel loading.

b. The MTC shall be measured at any THERMAL POWER and compared to -3.3×10^{-4} delta k/k/°F (all rods withdrawn, RATED THERMAL POWER condition) within 7 EFPD after reaching an equilibrium boron concentration of 300 ppm. In the event this comparison indicated the MTC is more negative than -3.3×10^{-4} delta k/k/°F, the MTC shall be remeasured, and compared to the EOL MTC limit of specification 3.1.1.4.b, at least once per 14 EFPD during the remainder of the fuel cycle.[1]

(1) Once the equilibrium boron concentration (all rods withdrawn, RATED THERMAL POWER condition) is 60 ppm or less, further measurement of the MTC in accordance with 4.1.1.4.b may be suspended providing that the measured MTC at an equilibrium boron concentration of ≤ 60ppm is less negative than -4.0×10^{-4} $\Delta k/k/°F$.

3/4.1.1.4 MODERATOR TEMPERATURE COEFFICIENT (MTC)

The limitations on MTC are provided to ensure that the value of this coefficient remains within the limiting conditions assumed for this parameter in the FSAR accident and transient analyses.

The MTC values of this specification are applicable to a specific set of plant conditions; accordingly, verification of MTC values at conditions other than those explicitly stated will require extrapolation to those conditions in order to permit an accurate comparison.

The most negative MTC value equivalent to the most positive moderator density coefficient (MDC), was obtained by incrementally correcting the MDC used in the FSAR analyses to nominal operating conditions. These corrections involved subtracting the incremental change in the MDC associated with a core condition of all rods inserted (most positive MDC) to an all rods withdrawn condition and, a conversion for the rate of change of moderator density with temperature at RATED THERMAL POWER conditions. This value of the MDC was then transformed into the limiting MTC value -4.4×10^{-4} delta k/k/°F. The MTC value of -3.3×10^{-4} delta k/k/°F represents a conservative value (with corrections for burnup and soluble boron) at a core condition of 300 ppm equilibrium boron concentration and is obtained by making these corrections to the limiting MTC value -4.4×10^{-4} delta k/k/°F.

Once the equilibrium boron concentration falls below about 60 ppm, dilution operations take an extended amount of time and reliable MTC measurements become more difficult to obtain due to the potential for fluctuating core conditions over the test interval. For this reason, MTC measurements may be suspended provided the measured MTC value at an equilibrium full power boron concentration ≤ 60 ppm is less negative than -4.0×10^{-4} delta k/k/°F. The difference between this value and the limiting MTC value of -4.4×10^{-4} delta k/k/°F conservatively bounds the maximum credible change in MTC between the 60 ppm equilibrium boron concentration (all rods withdrawn, RATED THERMAL POWER conditions) and the licensed end of cycle, including the effect of rods, boron concentration, burnup, and end-of-cycle coastdown.

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

3/4.1.1.5 MINIMUM TEMPERATURE FOR CRITICALITY

This specification ensures that the reactor will not be made critical with the Reactor Coolant System average temperature less than 541°F. This limitation is required to ensure 1) the moderator temperature coefficient is within its analyzed temperature range, 2) the protective instrumentation is within its normal operating range, and 3) the P-12 interlock is above its setpoint, 4) the pressurizer is capable of being in an OPERABLE status with a steam bubble, and 5) the reactor pressure vessel is above its minimum RT_{NDT} temperature.

ATTACHMENT 3

SAFETY EVALUATION
END OF CYCLE, MODERATOR TEMPERATURE COEFFICIENT LIMIT

Virginia Electric and Power Company has performed an evaluation of a proposed change to the Technical Specifications limit for the most negative end-of-cycle (EOC) moderator temperature coefficient (MTC) for North Anna Units 1 and 2. The proposed limit is based on the current UFSAR value of EOC moderator density coefficient adjusted to hot full power operating conditions using the procedure described in the Technical Specifications Bases. This change envelops both the current plant operating conditions, which represents a 7.5°F increase in Tave above the initial licensed condition, and the proposed core uprate (2893 MWT) operating condition.

The North Anna Technical Specifications require that the MTC be confirmed as the fuel cycle approaches the 0 ppm boron concentration end point of EOC conditions. The negative EOC MTC limit is currently -4.0×10^{-4} delta k/k/°F in the North Anna Technical Specifications (Section 3.1.1.4.b). The value of the EOC MTC is measured upon reaching an equilibrium boron concentration of 300 ppm. The current Technical Specification value for this measurement point is -3.1×10^{-4} delta k/k/°F (Section 4.1.1.4.b). If the measured MTC is within this value no further checks of MTC against the EOC negative MTC limit are necessary. If the measured MTC at the 300 ppm boron check point violates the Technical Specification value, operation of the unit may continue if MTC measurements are taken at least every 14 effective full power days and found to be within the -4.0×10^{-4} delta k/k/°F EOC limit.

Currently, this limit is based on the plant's initial licensed conditions. The proposed Technical Specification change would update the EOC MTC limit such that it is appropriate for either current plant operating conditions (with a Tavg 7.5°F above initial licensed conditions) or the proposed core power uprate that has been submitted to the NRC for approval.

Bases Section 3/4.1.1.4 of the Technical Specifications identifies the source for the MTC limit and the conversions used to derive the value for measurement comparison at the 300 ppm equilibrium boron concentration point. The most negative MTC value is based on the limiting moderator density coefficient, (MDC), used in the Chapter 15 FSAR analyses:

- This MDC value (see UFSAR Table 15.1-2) is first incrementally adjusted to allow for changing the core from the all-rods-inserted condition, upon which the safety analysis is based, to an all-rods-withdrawn condition consistent with actual measurement conditions.

- The second conversion translates the MDC value in delta $k/k/(g/cm^3)$ to MTC in delta k/k/°F. A derivative of water density with respect to temperature at core operating conditions is used to make this conversion. The result is the Technical Specification EOC negative MTC limit.

- The final conversion translates the EOC negative MTC limit into a Technical Specification value at the 300 ppm equilibrium boron concentration measurement point. Conservative corrections for MTC change due to burnup and soluble boron concentration are used.

The resulting EOC negative MTC limit and negative MTC value at the 300 ppm equilibrium boron concentration measurement point are -4.4×10^{-4} delta k/k/°F and -3.3×10^{-4} delta k/k/°F, respectively. The differences between these values and the current Technical Specification limits are primarily due to a difference in the derivative of water density with respect to temperature at the current core operating conditions.

Once the equilibrium boron concentration falls below about 60 ppm, dilution operations take an extended amount of time due to the large required volume of dilution water. For example, dilution of the RCS from 50 ppm to 40 ppm requires charging of about 17,000 gallons of primary grade water and would require over 2 hours. These extended dilution times make reliable MTC measurements difficult to obtain due to any of a variety of fluctuations in the system conditions which could take place over this time interval.

As a result of this difficulty, we are proposing a change to Specification 4.1.1.4.b to eliminate further MTC measurements provided a measurement of 60 ppm equilibrium boron (all rods withdrawn, rated thermal power conditions) is less negative than -4.0×10^{-4} delta k/k/°F. Calculations have shown that for this condition the -4.4×10^{-4} delta k/k/°F limit will always be met at the licensed end of cycle, conservatively accounting for the effects of control rods, burnup, boron concentration and end of cycle coastdown.

The proposed changes to Technical Specifications 3.1.1.4.b, 4.1.1.4.b, and Bases 3/4.1.1.4 for North Anna Units 1 & 2 are provided as Attachments 1 and 2 to this package.

The proposed Technical Specifications continue to ensure that the acceptance criteria for the North Anna UFSAR accident analyses are met. The current North Anna UFSAR accident analyses were reviewed and it has been concluded that none of the accidents are impacted by this proposed change. The limiting value used in the UFSAR safety analysis is the positive MDC limit value, and this value is not changed by the proposed Technical Specifications. Thus, the current analyses remain bounding.

It has been demonstrated that the proposed change in the EOC MTC limit from -4.0×10^{-4} delta k/k/°F to -4.4×10^{-4} delta k/k/°F is acceptable from a safety and licensing standpoint. The proposed change has been reviewed against the criteria of 10 CFR 50.59 and does not involve an unreviewed safety question. The specific bases for this determination are as follows:

1. The probability of occurrence or the consequences of accidents important to safety and previously evaluated in the safety analysis is not increased. The limiting value of the MDC used in the transient analyses has not changed and the current accident analyses remain bounding.

2. The possibility for an accident or malfunction of a different type than any evaluated in the Safety Analysis Report is not created. This change does not affect any

of the physical components in any of the plant systems and therefore does not produce any new or unique accident precursors.

3. The margin of safety, as defined in the basis for the affected Technical Specifications, is not changed. Since the analyses remain bounding, there is no reduction in the plant safety margin involved.

The change in the EOC MTC from -4.0×10^{-4} delta k/k/°F to -4.4×10^{-4} delta k/k°F does not pose a significant hazards consideration as defined in 10 CFR 50.92. This is based on example vi of those types of license amendments that are considered unlikely to involve significant hazards considerations. Example vi (48 FR 14870) partially states, "A change which either may result in some increase to the probability or consequences of a previously analyzed accident or may reduce in some way a safety margin, but where the results of the change are clearly within all acceptable criteria with respect to the systems or components specified in the Standard Review Plan". This change merely 1) adjusts the MTC limit to reflect the most limiting uprated core operating conditions combined with the MDC used in the safety analysis and 2) provides a more operationally sound but still conservative method of ensuring that the MTC limit will not be violated at end of cycle. Thus, the analyses presented in the UFSAR, based on the unchanged MDC, remain limiting and the appropriate safety margins are maintained. As discussed above, the proposed Technical Specification amendment would not:

1. Involve a significant increase in the probability or consequences of an accident previously evaluated, or

2. Create the possibility of a new or different kind of accident than previously evaluated, or

3. Involve a significant reduction in a margin of safety.