VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

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U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

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License Nos.: DPR-32
DPR-37

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
ANNUAL SUBMITTAL OF TECHNICAL SPECIFICATIONS BASES CHANGES
PURSUANT TO TECHNICAL SPECIFICATION 6.4.J

Pursuant to Technical Specification 6.4.J, "Technical Specifications (TS) Bases Control Program," Dominion Energy Virginia hereby submits changes to the Bases of the Surry Power Station TS implemented between October 1, 2020, and September 30, 2021.

Bases changes to the TS that were not previously submitted to the NRC as part of a License Amendment Request were reviewed and approved by the Facility Safety Review Committee (FSRC). It was determined that the changes did not require a revision to the TS or operating licenses, nor did the changes involve a revision to the Updated Final Safety Analysis Report (UFSAR) or Bases that required Nuclear Regulatory Commission (NRC) prior approval pursuant to 10 CFR 50.59. These changes have been incorporated into the TS Bases. A summary of these changes is provided in Attachment 1.

TS Bases changes that were submitted to the NRC for information along with associated License Amendment Request transmittals, submitted pursuant to 10CFR50.90, were also reviewed and approved by the FSRC. These changes have been implemented with the respective License Amendments. A summary of these changes is provided in Attachment 2.

Current TS Bases pages reflecting the changes discussed in Attachments 1 and 2 are provided in Attachment 3.

If you have any questions regarding this transmittal, please contact Stephen C. Newman, Surry Power Station Licensing Group at (757) 365-3397.

Sincerely,

Johnny Henderson
Director Station Safety and Licensing
Surry Power Station

Attachments:

1. Summary of TS Bases Changes Not Previously Submitted to the NRC
2. Summary of TS Bases Changes Associated with License Amendments
3. Current TS Bases Pages

Commitments made in this letter: None

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Attachment 1

Summary of TS Bases Changes Not Previously Submitted to the NRC

Surry Power Station Units 1 and 2
Virginia Electric and Power Company
(Dominion Energy Virginia)

None.

Attachment 2

Summary of TS Bases Changes Associated with License Amendments

Surry Power Station Units 1 and 2
Virginia Electric and Power Company
(Dominion Energy Virginia)

1. Technical Specifications Amendment (TSA) Nos. 302/302 (implemented 5/4/2021)

   This amendment revised the Surry Power Station Units 1 and 2 TS Figures 3.1-1 and 3.1-2, "Surry Units 1 and 2 Reactor Coolant System Heatup Limitations" and "Surry Units 1 and 2 Reactor Coolant System Cooldown Limitations," respectively, to:

   1) Update the cumulative core bumup applicability limit (Effective Full Power Years; EFPY) from 48 to 68 EFPY, and

   2) Revise and relocate the limiting material property basis from the TS figures to the TS Basis. The cumulative core burnup applicability limit was also updated for the Low Temperature Overpressure Protection System (LTOPS) Setpoint, and
   LTOPS Enabling Temperature (T-enable) at Surry Units 1 and 2.

   The associated TS Bases changes (pages 3.1-9 through 3.1-12) were part of a License Amendment Request (Ref.: Licensing Basis Design Change Request / Technical Specification Change Request (LBDCR/ TSCR) 456, approved on 12/8/2020.

   Because of related evaluations performed for the Subsequent License Renewal (SLR) application (SLRA), this amendment and bases were implemented concurrently with the approved SLR amendment (TSA 303, 303) on 5/4/2021.

Attachment 3

Current TS Bases Pages

- TS Bases pages 3.1-9 through 3.1-12

Surry Power Station Units 1 and 2
Virginia Electric and Power Company
(Dominion Energy Virginia)

Heatup and cooldown limit curves are calculated using a bounding value of the nil-ductility reference temperature, RT_{NDT}, at the end of 68 Effective Full Power Years (EFPY) for Units 1 and 2. The heatup and cooldown limit curves were calculated using the most limiting value of RT_{NDT} (228.4°F) which occurred at the 1/4-T, 0° azimuthal location in the Unit 1 intermediate-to-lower shell circumferential weld. The limiting RT_{NDT} at the 1/4-T location in the core region is greater than the RT_{NDT} of the limiting unirradiated material. This ensures that all components in the Reactor Coolant System will be operated conservatively in accordance with applicable Code requirements.

The reactor vessel materials have been tested to determine their initial RT_{NDT}; the results are presented in UFSAR Section 4.1. Reactor operation and resultant fast neutron (E greater than 1 MEV) irradiation can cause an increase in the RT_{NDT}. Therefore, an adjusted reference temperature, based upon the copper and nickel content of the material and the fluence was calculated in accordance with the recommendations of Regulatory Guide 1.99, Revision 2 "Effects of Residual Elements on Predicted Radiation Damage to Reactor Vessel Materials." The heatup and cooldown limit curves of Figures 3.1-1 and 3.1-2 include predicted adjustments for this shift in RT_{NDT} at the end of 68 EFPY for Units 1 and 2 (as well as adjustments for location of the pressure sensing instrument).

Surveillance capsules will be removed in accordance with the requirements of ASTM E185-82 and 10 CFR 50, Appendix H. The surveillance specimen withdrawal schedule is shown in the UFSAR. The heatup and cooldown curves must be recalculated when the ΔRT_{NDT} determined from the surveillance capsule exceeds the calculated ΔRT_{NDT} for the equivalent capsule radiation exposure, or when the service period exceeds 68 EFPY for Units 1 and 2 prior to a scheduled refueling outage.

Allowable pressure-temperature relationships for various heatup and cooldown rates are calculated using methods derived from Appendix G in Section III of the ASME Boiler and Pressure Vessel Code as required by Appendix G to 10 CFR Part 50.

The general method for calculating heatup and cooldown limit curves is based upon the principles of the linear elastic fracture mechanics (LEFM) technology. In the calculation procedures a semi-elliptical surface defect with a depth of one-quarter of the wall thickness, T, and a length of one and one half T is assumed to exist at the inside of the vessel wall as well as at the outside of the vessel wall. The dimensions of this postulated crack, referred to in Appendix G of ASME Section III as the reference flaw, amply exceed the current capabilities of inservice inspection techniques. Therefore, the reactor operation limit curves developed for this reference crack are conservative and provide sufficient safety margins for protection against non-ductile failure. To assure that the radiation embrittlement effects are accounted for in the calculation of the limit curves, the most limiting value of the nil ductility reference temperature, RT_{NDT}, is used and this includes the radiation-induced shift, ΔRT_{NDT}, corresponding to the end of the period for which heatup and cooldown curves are generated.

The approach for calculating the allowable limit curves for various heatup and cooldown rates in the 1986 Edition of the ASME Code specifies that the total stress intensity factor, K_I, for the combined thermal and pressure stresses at any time during heatup or cooldown cannot be greater than the reference stress intensity factor, K_{IR}, for the metal temperature at that time. K_{IR} is obtained from the reference fracture toughness curve, defined in Appendix G to the ASME Code. The K_{IR} curve is given by the equation:

$$K_{IR} = 26.78 + 1.223 \exp [0.0145(T - RT_{NDT} + 160)] \quad (1)$$

where K_{IR} is the reference stress intensity factor as a function of the metal temperature T and the metal nil ductility reference temperature RT_{NDT}. Thus, the governing equation for the heatup-cooldown analysis is defined in Appendix G of the ASME Code as follows:

$$C\,K_{IM} + K_{It} \leq K_{IR} \quad (1)$$

where, K_{IM} is the stress intensity factor caused by membrance (pressure) stress.

K_{It} is the stress intensity factor caused by the thermal gradients

K_{IR} is provided by the code as a function of temperature relative to the RT_{NDT} of the material.

C = 2.0 for level A and B service limits, and

C = 1.5 for inservice hydrostatic and leak test operations.

At any time during the heatup or cooldown transient, K_{IR} is determined by the metal temperature at the tip of the postulated flaw, the appropriate value for RT_{NDT}, and the reference fracture toughness curve. The thermal stresses resulting from temperature gradients through the vessel wall are calculated and then the corresponding thermal stress intensity factor, K_{It}, for the reference flaw is computed. From Equation (2) the pressure stress intensity factors are obtained and, from these, the allowable pressures are calculated.

The heatup limit curve, Figure 3.1-1, is a composite curve which was prepared by determining the most conservative case, with either the inside or outside wall controlling, for any heatup rate up to 60°F per hour. The cooldown limit curves of Figure 3.1-2 are composite curves which were prepared based upon the same type analysis with the exception that the controlling location is always the inside wall where the cooldown thermal gradients tend to produce tensile stresses while producing compressive stresses at the outside wall. The cooldown limit curves are valid for cooldown rates up to 100°F/hr. The heatup and cooldown curves were prepared based upon the most limiting value of the predicted adjusted reference temperature at the end of 68 EFPY for Units 1 and 2. The adjusted reference temperature was calculated using materials properties data from the B&W Owners Group Master Integrated Reactor Vessel Surveillance Program (MIRVSP) documented in the most recent revision to BAW-1543 and reactor vessel neutron fluence data obtained from plant-specific analyses.

The technical basis for the data points and the associated RT_{NDT} values used to generate the heatup and cooldown curves is provided in WCAP-14177 (Reference 2) and were determined to be applicable to the 48 EFPY period of extended operation under first license renewal. The associated RT_{NDT} values used to calculate the heatup and cooldown curves provided in WCAP-14177 (Reference 2) are based upon the Surry Unit 1 Intermediate to Lower Shell Circ Weld:

1/4-T, 228.4°F and

3/4-T, 189.5°F

The heatup and cooldown curves for operation through 48 EFPY were based upon the K_{Ir} methodology. These heatup and cooldown curves were subsequently evaluated using the K_{Ic} methodology for Subsequent License Renewal (SLR) at 68 EFPY in WCAP-18243-NP (Reference 3).

The limiting reactor vessel materials at 68 EFPY were determined to be the Surry Unit 1 Lower Shell Longitudinal Weld L2 at 1/4-T and the Surry Unit 2 Intermediate to Lower Shell Circumferential Weld at 3/4-T. The associated RT_{NDT} values calculated at 68 EFPY are:

1/4-T, 219.4°F and

3/4-T, 179.8°F

The data points and the associated RT_{NDT} values used to generate the heatup and cooldown curves in TS Figures 3.1-1 and 3.1-2, respectively, are conservative based upon use of the K_{Ic} methodology. Therefore, the heatup and cooldown curves did not require revision as a result of SLR. However, the fluence applicability is updated from 48 EFPY to 68 EFPY.

The reactor boltup temperature is defined in 10 CFR 50, Appendix G as "The highest reference temperature of the material in the closure flange region that is highly stressed by the bolt preload." The reactor vessel may be bolted up at a temperature greater than the initial RT_{NDT} of the material stressed by the boltup (e.g., the vessel flange). As noted on Figures 3.1-1 and 3.1-2, the limiting boltup temperature is 10°F. An administrative minimum boltup temperature limit greater than 10°F is imposed in station procedures to ensure the Reactor Coolant System temperatures are sufficiently high to prevent damage to the reactor vessel closure head/vessel flange during the removal or installation of reactor vessel head bolts. The limiting boltup temperature and the administrative minimum boltup temperature limit are in effect when the reactor vessel head bolts are under tension.

References

(1) UFSAR, Section 4.1, Design Bases

(2) WCAP-14177, "Surry Units 1 and 2 Heatup and Cooldown Limit Curves for Normal Operation," (October 1994)

(3) WCAP-18243, Rev. 2, "Surry Units 1 and 2 Heatup and Cooldown Limit Curves for Normal Operation," (July 2018)