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Dominion®

October 28, 2013

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

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Docket No. 50-280
License No. DPR-32

**VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)**
**SURRY POWER STATION UNIT 1**
**CORE OPERATING LIMITS REPORT**
**SURRY 1 CYCLE 26 PATTERN APX REVISION 0**

Pursuant to Surry Technical Specification (TS) 6.2.C, attached is a copy of Dominion's Core Operating Limits Report (COLR) for Surry Unit 1 Cycle 26, Pattern APX, Revision 0.

If you have any questions or require additional information, please contact Mr. Gary Miller at (804) 273-2771.

Sincerely,

T. R. Huber, Director
Nuclear Licensing and Operations Support
Dominion Resources Services, Inc. for
Virginia Electric and Power Company

Attachment:
Core Operating Limits Report, Surry 1 Cycle 26 Pattern APX

Commitment Summary: There are no new commitments contained in this letter.

A001
NRR

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COLR-S1C26, Revision 0

# CORE OPERATING LIMITS REPORT

Surry 1 Cycle 26 Pattern APX

October 2013

## 1.0 INTRODUCTION

This Core Operating Limits Report (COLR) for Surry Unit 1 Cycle 26 has been prepared in accordance with the requirements of Surry Technical Specification 6.2.C.

The Technical Specifications affected by this report are:

TS 2.1 – Safety Limit, Reactor Core
TS 2.3.A.2.d – Overtemperature ΔT
TS 2.3.A.2.e – Overpower ΔT
TS 3.1.E - Moderator Temperature Coefficient
TS 3.12.A.1, TS 3.12.A.2, TS 3.12.A.3 and TS 3.12.C.3.b.1(b) - Control Bank Insertion Limits
TS 3.12.A.1.a, TS 3.12.A.2.a, TS 3.12.A.3.c and TS 3.12.G – Shutdown Margin
TS 3.12.B.1 and TS 3.12.B.2 - Power Distribution Limits
TS 3.12.F – DNB Parameters
TS Table 4.1-2A – Minimum Frequency for Equipment Tests: Item 22 – RCS Flow

## 2.0 REFERENCES

1. VEP-FRD-42, Rev. 2.1-A, "Reload Nuclear Design Methodology," August 2003.

   Methodology for:
   TS 3.1.E - Moderator Temperature Coefficient
   TS 3.12.A.1, TS 3.12.A.2, TS 3.12.A.3 and TS 3.12.C.3.b.1(b) - Control Bank Insertion Limit
   TS 3.12.A.1.a, TS 3.12.A.2.a, TS 3.12.A.3.c and TS 3.12.G – Shutdown Margin
   TS 3.12.B.1 and TS 3.12.B.2 - Heat Flux Hot Channel Factor and Nuclear Enthalpy Rise Hot Channel Factor
   TS 3.12.F – DNB Parameters
   TS Table 4.1-2A – Minimum Frequency for Equipment Tests: Item 22 – RCS Flow

2. WCAP-16009-P-A, "Realistic Large Break LOCA Evaluation Methodology Using the Automated Statistical Treatment of Uncertainty Method (ASTRUM)," (Westinghouse Proprietary), January 2005.

   Methodology for:
   TS 3.12.B.1 and TS 3.12.B.2 - Heat Flux Hot Channel Factor

3. WCAP-10054-P-A, "Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code," (Westinghouse Proprietary), August 1985.

   Methodology for:
   TS 3.12.B.1 and TS 3.12.B.2 - Heat Flux Hot Channel Factor

4. WCAP-10079-P-A, "NOTRUMP, A Nodal Transient Small Break and General Network Code," (Westinghouse Proprietary), August 1985.

   Methodology for:
   TS 3.12.B.1 and TS 3.12.B.2 - Heat Flux Hot Channel Factor

5. WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Report," (Westinghouse Proprietary), April 1995.

   Methodology for:
   TS 3.12.B.1 and TS 3.12.B.2 - Heat Flux Hot Channel Factor

6. WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO," (Westinghouse Proprietary), July 2006.

   Methodology for:
   TS 3.12.B.1 and TS 3.12.B.2 - Heat Flux Hot Channel Factor

7. VEP-NE-2-A, Rev. 0, "Statistical DNBR Evaluation Methodology," June 1987.

   Methodology for:
   TS 3.12.B.1 and TS 3.12.B.2 - Nuclear Enthalpy Rise Hot Channel Factor

8. VEP-NE-3-A, Rev. 0, "Qualification of the WRB-1 CHF Correlation in the Virginia Power COBRA Code," July 1990.

   Methodology for:
   TS 3.12.B.1 and TS 3.12.B.2 - Nuclear Enthalpy Rise Hot Channel Factor

9. DOM-NAF-2, Rev. 0.2-P-A, "Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code," including Appendix B, "Qualification of the Westinghouse WRB-1 CHF Correlation in the Dominion VIPRE-D Computer Code," August 2010.

   Methodology for:
   TS 3.12.B.1 and TS 3.12.B.2 - Nuclear Enthalpy Rise Hot Channel Factor

10. WCAP-8745-P-A, "Design Bases for Thermal Overpower Delta-T and Thermal Overtemperature Delta-T Trip Function," September 1986.

    Methodology for:
    TS 2.3.A.2.d – Overtemperature ΔT
    TS 2.3.A.2.e – Overpower ΔT

## 3.0 OPERATING LIMITS

The cycle-specific parameter limits for the specifications listed in Section 1.0 are presented in the following subsections. These limits have been developed using the NRC-approved methodologies specified in Technical Specification 6.2.C and repeated in Section 2.0.

### 3.1 Safety Limit, Reactor Core (TS 2.1)

The Reactor Core Safety Limits are presented in **Figure A-1**.

### 3.2 Overtemperature ΔT (TS 2.3.A.2.d)

$$\Delta T \leq \Delta T_0 \left[K_1 - K_2 \left(\frac{1 + t_1 s}{1 + t_2 s}\right)(T - T') + K_3(P - P') - f(\Delta I)\right]$$

Where:

$\Delta T$ is measured RCS $\Delta T$, °F.

$\Delta T_0$ is the indicated $\Delta T$ at RATED POWER, °F.

s is the Laplace transform operator, $sec^{-1}$.

T is the measured RCS average temperature ($T_{avg}$), °F.

T' is the nominal $T_{avg}$ at RATED POWER, ≤ **573.0°F**.

P is the measured pressurizer pressure, psig.

P' is the nominal RCS operating pressure ≥ **2235 psig**.

$K_1 \leq$ **1.1425** $K_2 \geq$ **0.01059** /°F $K_3 \geq$ **0.000765** /psig

$t_1 \geq$ **29.7** seconds $t_2 \leq$ **4.4** seconds

$f(\Delta I) \geq$ **0.0268** $\{-24 - (q_t - q_b)\}$, when $(q_t - q_b) <$ **-24.0%** RATED POWER

**0**, when **-24.0%** RATED POWER ≤ $(q_t - q_b)$ ≤ **+8.0%** RATED POWER

**0.0188** $\{(q_t - q_b) -$ **8.0**$\}$, when $(q_t - q_b) >$ **+8.0%** RATED POWER

Where $q_t$ and $q_b$ are percent RATED POWER in the upper and lower halves of the core, respectively, and $q_t + q_b$ is the total THERMAL POWER in percent RATED POWER.

**3.3 <u>Overpower ΔT</u>** (TS 2.3.A.2.e)

$$\Delta T \leq \Delta T_0 \left[K_4 - K_5\left(\frac{t_3 s}{1 + t_3 s}\right)T - K_6(T - T') - f(\Delta I)\right]$$

Where:

$\Delta T$ is measured RCS $\Delta T$, °F.

$\Delta T_0$ is the indicated $\Delta T$ at RATED POWER, °F.

s is the Laplace transform operator, $sec^{-1}$.

T is the measured RCS average temperature ($T_{avg}$), °F.

T' is the nominal $T_{avg}$ at RATED POWER, ≤ **573.0°F**.

$K_4 \leq$ **1.0965**

$K_5 \geq$ **0.0198** /°F for increasing $T_{avg}$

≥ **0** /°F for decreasing $T_{avg}$

$K_6 \geq$ **0.001074** /°F for T > T'

≥ **0** for T ≤ T'

$t_3 \geq$ **9.0** seconds

f(ΔI) = as defined above for OTΔT

**3.4 <u>Moderator Temperature Coefficient</u>** (TS 3.1.E)

The Moderator Temperature Coefficient (MTC) limits are:

+6.0 pcm/°F at less than 50 percent of RATED POWER, and

+6.0 pcm/°F at 50 percent of RATED POWER and linearly decreasing to 0 pcm/°F at RATED POWER

**3.5 <u>Control Bank Insertion Limits</u>** (TS 3.12.A.1, TS 3.12.A.2, TS 3.12.A.3, and TS 3.12.C.3.b.1(b))

3.5.1 The control rod banks shall be limited in physical insertion as shown in **Figure A-2**.

3.5.2 The rod insertion limit for the A and B control banks is the fully withdrawn position as shown on **Figure A-2**.

3.5.3 The rod insertion limit for the A and B shutdown banks is the fully withdrawn position as shown on **Figure A-2**.

**3.6 <u>Shutdown Margin</u>** (TS 3.12.A.1.a, TS 3.12.A.2.a, TS 3.12.A.3.c and TS 3.12.G)

Shutdown margin (SDM) shall be ≥ **1.77** %Δk/k.

**3.7 Power Distribution Limits** (TS 3.12.B.1 and TS 3.12.B.2)

3.7.1 Heat Flux Hot Channel Factor - FQ(z)

$$FQ(z) \leq \frac{CFQ}{P} K(z) \; for \; P > 0.5$$

$$FQ(z) \leq \frac{CFQ}{0.5} K(z) \; for \; P \leq 0.5$$

$$where: P = \frac{THERMAL\ POWER}{RATED\ POWER}$$

$CFQ = 2.5$

$K(z) = 1.0$ for all core heights, z

3.7.2 Nuclear Enthalpy Rise Hot Channel Factor - FΔH(N)

$$F\Delta H(N) \leq CFDH * \{1 + PFDH(1 - P)\}$$

$$where: P = \frac{THERMAL\ POWER}{RATED\ POWER}$$

$CFDH = 1.56$

$PFDH = 0.3$

**3.8 DNB Parameters** (TS 3.12.F and TS Table 4.1-2A)

Departure from Nucleate Boiling (DNB) Parameters shall be maintained within their limits during POWER OPERATION:

- Reactor Coolant System $T_{avg}$ ≤ **577.0 °F**
- Pressurizer Pressure ≥ **2205 psig**
- Reactor Coolant System Total Flow Rate ≥ 273,000 gpm (Tech Spec Limit) and ≥ **276,000 gpm** (COLR Limit)

**Figure A-1**

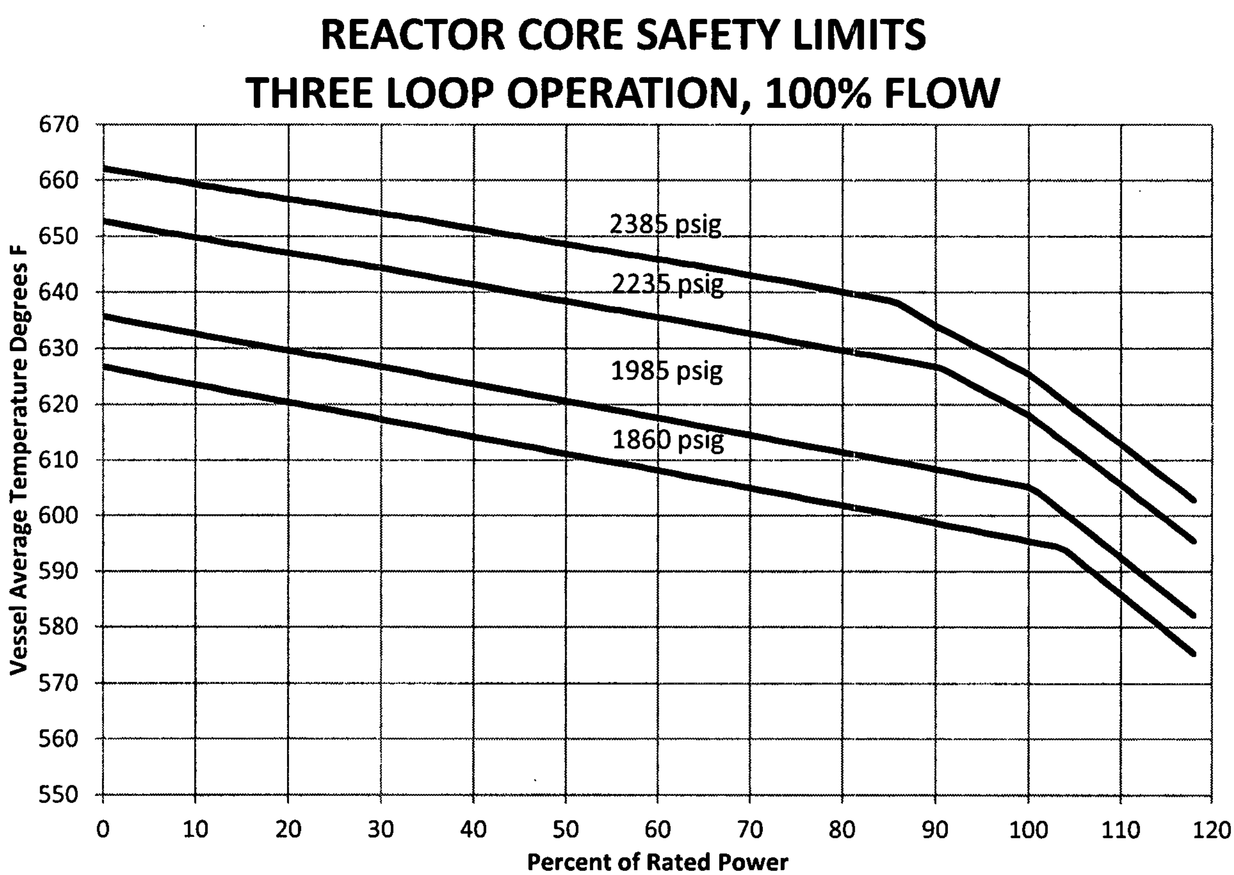
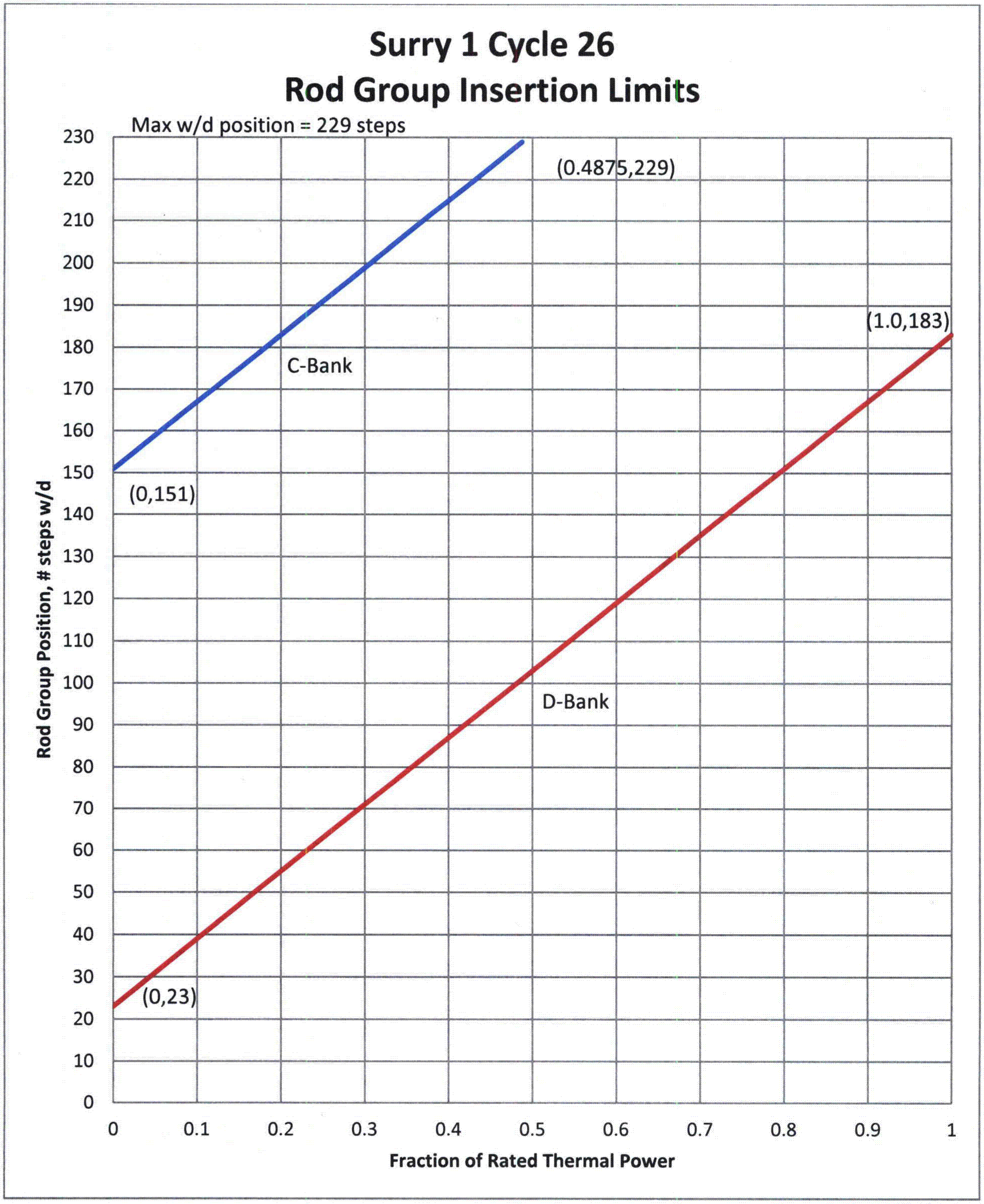

REACTOR CORE SAFETY LIMITS
THREE LOOP OPERATION, 100% FLOW
2385 psig
2235 psig
1985 psig
1860 psig
Vessel Average Temperature Degrees F
670
660
650
640
630
620
610
600
590
580
570
560
550
0
10
20
30
40
50
60
70
80
90
100
110
120
Percent of Rated Power

**Figure A-2**


Surry 1 Cycle 26
Rod Group Insertion Limits
Max w/d position = 229 steps
(0.4875,229)
(1.0,183)
C-Bank
(0,151)
D-Bank
(0,23)
Rod Group Position, # steps w/d
Fraction of Rated Thermal Power
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1