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Dominion®

March 30, 2015

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

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VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
NORTH ANNA POWER STATION UNIT 1
CORE OPERATING LIMITS REPORT
NORTH ANNA 1 CYCLE 25 PATTERN BRO REVISION 0

Pursuant to North Anna Technical Specification 5.6.5.d, attached is a copy of the Dominion Core Operating Limits Report for North Anna Unit 1 Cycle 25, Pattern BRO, 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:
COLR-N1C25, Revision 0, Core Operating Limits Report, North Anna Unit 1 Cycle 25 Pattern BRO

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

A001
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ATTACHMENT

COLR-N1C25, Revision 0

CORE OPERATING LIMITS REPORT
North Anna Unit 1 Cycle 25 Pattern BRO

N1C25 CORE OPERATING LIMITS REPORT

INTRODUCTION

The Core Operating Limits Report (COLR) for North Anna Unit 1 Cycle 25 has been prepared in accordance with North Anna Technical Specification 5.6.5. The technical specifications affected by this report are listed below:

TS 2.1.1	Reactor Core Safety Limits
TS 3.1.1	Shutdown Margin (SDM)
TS 3.1.3	Moderator Temperature Coefficient (MTC)
TS 3.1.4	Rod Group Alignment Limits
TS 3.1.5	Shutdown Bank Insertion Limits
TS 3.1.6	Control Bank Insertion Limits
TS 3.1.9	PHYSICS TESTS Exceptions – Mode 2
TS 3.2.1	Heat Flux Hot Channel Factor
TS 3.2.2	Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)
TS 3.2.3	Axial Flux Difference (AFD)
TS 3.3.1	Reactor Trip System (RTS) Instrumentation
TS 3.4.1	RCS Pressure, Temperature, and Flow DNB Limits
TS 3.5.6	Boron Injection Tank (BIT)
TS 3.9.1	Boron Concentration

In addition, a technical requirement (TR) in the NAPS Technical Requirements Manual (TRM) refers to the COLR:

TR 3.1.1	Boration Flow Paths – Operating

The analytical methods used to determine the core operating limits are those previously approved by the NRC and discussed in the documents listed in the References Section.

Cycle-specific values are presented **in bold.** Text in *italics* is provided for information only.

REFERENCES

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

   Methodology for:
   TS 3.1.1 – Shutdown Margin,
   TS 3.1.3 – Moderator Temperature Coefficient,
   TS 3.1.4 – Rod Group Alignment Limits
   TS 3.1.5 – Shutdown Bank Insertion Limits,
   TS 3.1.6 – Control Bank Insertion Limits,
   TS 3.1.9 – Physics Tests Exceptions – Mode 2,
   TS 3.2.1 – Heat Flux Hot Channel Factor,
   TS 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor,
   TS 3.5.6 – Boron Injection Tank (BIT), and
   TS 3.9.1 – Boron Concentration

2. Plant-specific adaptation of WCAP-16009-P-A, "Realistic Large Break LOCA Evaluation Methodology Using the Automated Statistical Treatment of Uncertainty Method (ASTRUM)," as approved by NRC Safety Evaluation Report dated February 29, 2012.

   Methodology for: TS 3.2.1 – Heat Flux Hot Channel Factor

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

   Methodology for: TS 3.2.1 – Heat Flux Hot Channel Factor

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

   Methodology for: TS 3.2.1 – Heat Flux Hot Channel Factor

5. WCAP-12610-P-A, "VANTAGE+ FUEL ASSEMBLY – REFERENCE CORE REPORT," April 1995.

   Methodology for:
   TS 2.1.1 – Reactor Core Safety Limits, and
   TS 3.2.1 – Heat Flux Hot Channel Factor

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

   Methodology for:
   TS 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor, and
   TS 3.4.1 – RCS Pressure, Temperature and Flow DNB Limits

7. VEP-NE-1, Rev. 0.1-A, Relaxed Power Distribution Control Methodology and Associated FQ Surveillance Technical Specifications, August 2003.

   Methodology for:

   TS 3.2.1 – Heat Flux Hot Channel Factor, and

   TS 3.2.3 – Axial Flux Difference

8. WCAP-8745-P-A, Design Bases for the Thermal Overpower ΔT and Thermal Overtemperature ΔT Trip Functions, September 1986.

   Methodology for:

   TS 2.1.1 – Reactor Core Safety Limits, and

   TS 3.3.1 – Reactor Trip System Instrumentation

9. WCAP-14483-A, Generic Methodology for Expanded Core Operating Limits Report, January 1999.

   Methodology for:

   TS 2.1.1 – Reactor Core Safety Limits,

   TS 3.1.1 – Shutdown Margin,

   TS 3.1.4 – Rod Group Alignment Limits,

   TS 3.1.9 – Physics Tests Exceptions – Mode 2,

   TS 3.3.1 – Reactor Trip System Instrumentation,

   TS 3.4.1 – RCS Pressure, Temperature, and Flow DNB Limits,

   TS 3.5.6 – Boron Injection Tank (BIT), and

   TS 3.9.1 – Boron Concentration

10. DOM-NAF-2, Rev. 0.3- P-A, "Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code," including Appendix A, "Qualification of the F-ANP BWU CHF Correlations in the Dominion VIPRE-D Computer Code," Appendix C, "Qualification of the Westinghouse WRB-2M CHF Correlation in the Dominion VIPRE-D Computer Code," and Appendix D, "Qualification of the ABB-NV and WLOP CHF Correlations in the Dominion VIPRE-D Computer Code," September 2014.

    Methodology for:

    TS 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor, and

    TS 3.4.1 – RCS Pressure, Temperature and Flow DNB Limits

11. WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™," July 2006.

    Methodology for:

    TS 2.1.1 – Reactor Core Safety Limits, and

    TS 3.2.1 – Heat Flux Hot Channel Factor

Note: In some instances, the North Anna COLR lists multiple methodologies that are used to verify a single Technical Specification parameter. This is due to the reload verification scope split between Dominion and the fuel vendor.

2.0 SAFETY LIMITS (SLs)

2.1 SLs

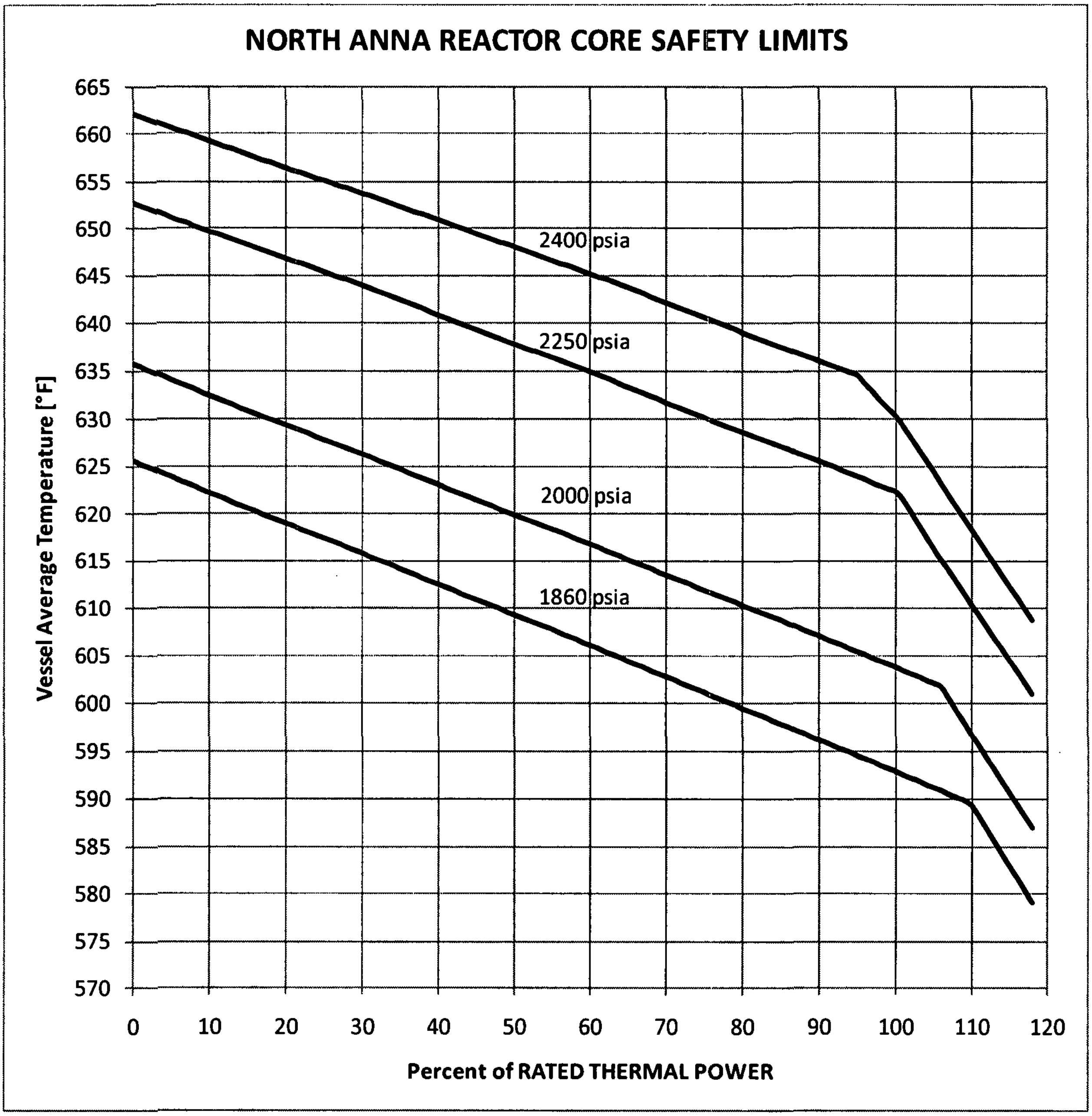
2.1.1 Reactor Core SLs

In MODES 1 and 2, the combination of THERMAL POWER, Reactor Coolant System (RCS) highest loop average temperature, and pressurizer pressure shall not exceed the limits specified in **COLR Figure 2.1-1**; and the following SLs shall not be exceeded.

2.1.1.1 The departure from nucleate boiling ratio (DNBR) shall be maintained greater than or equal to the 95/95 DNBR criterion for the DNB correlations and methodologies specified in the References Section.

2.1.1.2 The peak fuel centerline temperature shall be maintained < 5080°F, decreasing by 58°F per 10,000 MWD/MTU of burnup, for Westinghouse fuel.

COLR Figure 2.1-1



3.1 REACTIVITY CONTROL SYSTEMS

3.1.1 SHUTDOWN MARGIN (SDM)

LCO 3.1.1 SDM shall be ≥ **1.77 % Δk/k.**

3.1.3 Moderator Temperature Coefficient (MTC)

LCO 3.1.3 The MTC shall be maintained within the limits specified below. The upper limit of MTC is **+0.6 x 10^{-4} Δk/k/°F**, when < 70% RTP, and **0.0 Δk/k/°F** when ≥ 70% RTP.

The BOC/ARO-MTC shall be ≤ **+0.6 x 10^{-4} Δk/k/°F** (upper limit), when < 70% RTP, and ≤ **0.0 Δk/k/°F** when ≥ 70% RTP.

The EOC/ARO/RTP-MTC shall be less negative than **–5.0 x 10^{-4} Δk/k/°F** (lower limit).

The MTC surveillance limits are:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to **–4.0 x 10^{-4} Δk/k/°F** [Note 2].

The 60 ppm/ARO/RTP-MTC should be less negative than or equal to **–4.7 x 10^{-4} Δk/k/°F** [Note 3].

SR 3.1.3.2 Verify MTC is within **–5.0 x 10^{-4} Δk/k/°F** (lower limit).

Note 2: If the MTC is more negative than **–4.0 x 10^{-4} Δk/k/°F**, SR 3.1.3.2 shall be repeated once per 14 EFPD during the remainder of the fuel cycle.

Note 3: SR 3.1.3.2 need not be repeated if the MTC measured at the equivalent of equilibrium RTP-ARO boron concentration of ≤ 60 ppm is less negative than **–4.7 x 10^{-4} Δk/k/°F.**

3.1.4 Rod Group Alignment Limits

Required Action A.1.1 Verify SDM to be ≥ **1.77 % Δk/k.**

Required Action B.1.1 Verify SDM to be ≥ **1.77 % Δk/k.**

Required Action D.1.1 Verify SDM to be ≥ **1.77 % Δk/k.**

3.1.5 Shutdown Bank Insertion Limits

LCO 3.1.5 Each shutdown bank shall be withdrawn to at least **227** steps.

Required Action A.1.1 Verify SDM to be ≥ **1.77 % Δk/k**.

Required Action B.1 Verify SDM to be ≥ **1.77 % Δk/k**.

SR 3.1.5.1 Verify each shutdown bank is withdrawn to at least **227** steps.

3.1.6 Control Bank Insertion Limits

LCO 3.1.6 Control banks shall be limited in physical insertion as shown in **COLR Figure 3.1-1**. Sequence of withdrawal shall be A, B, C and D, in that order; and the overlap limit during withdrawal shall be **99** steps.

Required Action A.1.1 Verify SDM to be ≥ **1.77 % Δk/k**.

Required Action B.1.1 Verify SDM to be ≥ **1.77 % Δk/k**.

Required Action C.1 Verify SDM to be ≥ **1.77 % Δk/k**.

SR 3.1.6.1 Verify estimated critical control bank position is within the insertion limits specified in **COLR Figure 3.1-1**.

SR 3.1.6.2 Verify each control bank is within the insertion limits specified in **COLR Figure 3.1-1**.

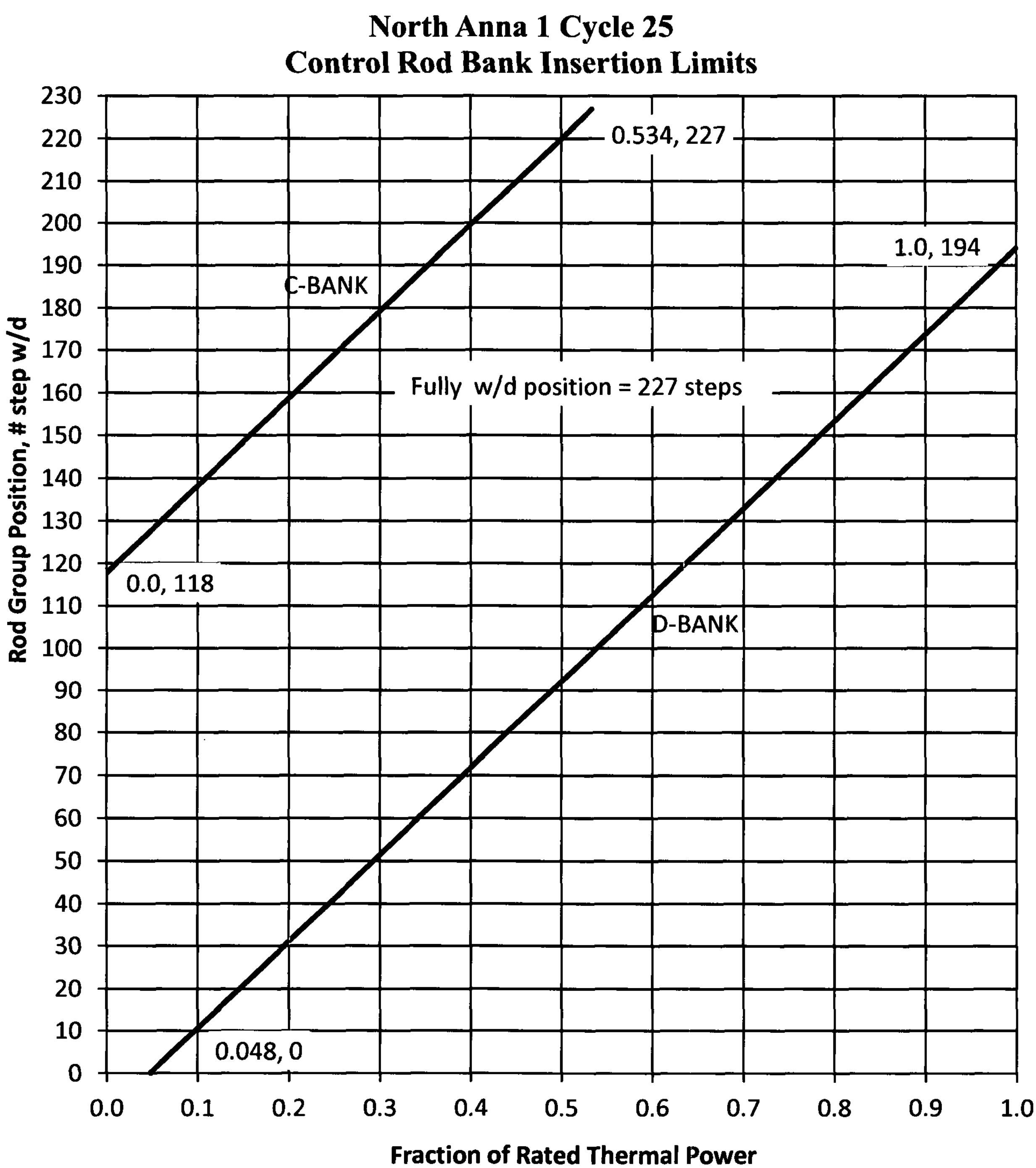
SR 3.1.6.3 Verify each control bank not fully withdrawn from the core is within the sequence and overlap limits specified in **LCO 3.1.6 above**.

3.1.9 PHYSICS TESTS Exceptions – MODE 2

LCO 3.1.9.b SDM is ≥ **1.77 % Δk/k**.

SR 3.1.9.4 Verify SDM to be ≥ **1.77 % Δk/k**.

COLR Figure 3.1-1



3.2 POWER DISTRIBUTION LIMITS

3.2.1 Heat Flux Hot Channel Factor ($F_Q(Z)$)

LCO 3.2.1 $F_Q(Z)$, as approximated by $F_Q^M(Z)$, shall be within the limits specified below.

CFQ = 2.32

The Measured Heat Flux Hot Channel Factor, $F_Q^M(Z)$, shall be limited by the following relationships:

$$F_Q^M(Z) \leq \frac{CFQ}{P}\frac{K(Z)}{N(Z)} \qquad for\ P>0.5$$

$$F_Q^M(Z) \leq \frac{CFQ}{0.5}\frac{K(Z)}{N(Z)} \qquad for\ P\leq 0.5$$

where: $P = \dfrac{THERMAL\ POWER}{RATED\ THERMAL\ POWER}$; and

K(Z) is provided in **COLR Figure 3.2-1**
N(Z) is a cycle-specific non-equilibrium multiplier on $F_Q^M(Z)$ to account for power distribution transients during normal operation, provided in **COLR Table 3.2-1.**

The discussion in the Bases Section B 3.2.1 for this LCO requires the application of a cycle dependent non-equilibrium multiplier, N(Z), to the CFQ limit. N(Z) accounts for power distribution transients encountered during normal operation. As function N(Z) is dependent on the predicted equilibrium $F_Q(Z)$ and is sensitive to the axial power distribution, it is typically generated from the actual EOC burnup distribution that can only be obtained after the shutdown of the previous cycle. The cycle-specific N(Z) function is presented in **COLR Table 3.2-1**.

COLR Table 3.2-1

N1C25 Normal Operation N(Z)

NODE	HEIGHT (FEET)	0 to 1000 MWD/MTU	1000 to 2000 MWD/MTU	2000 to 3000 MWD/MTU	3000 to 4000 MWD/MTU	4000 to 5000 MWD/MTU	5000 to 7000 MWD/MTU	7000 to 9000 MWD/MTU
10	10.2	1.086	1.105	1.104	1.115	1.115	1.133	1.133
11	10.0	1.086	1.103	1.103	1.114	1.114	1.132	1.132
12	9.8	1.088	1.102	1.104	1.112	1.112	1.132	1.132
13	9.6	1.093	1.104	1.107	1.110	1.110	1.135	1.135
14	9.4	1.095	1.107	1.111	1.113	1.113	1.136	1.136
15	9.2	1.098	1.113	1.116	1.120	1.120	1.139	1.141
16	9.0	1.104	1.121	1.124	1.128	1.128	1.147	1.153
17	8.8	1.109	1.128	1.131	1.135	1.135	1.156	1.166
18	8.6	1.112	1.132	1.134	1.139	1.139	1.160	1.170
19	8.4	1.114	1.133	1.134	1.140	1.140	1.163	1.172
20	8.2	1.116	1.134	1.135	1.140	1.140	1.170	1.178
21	8.0	1.116	1.134	1.134	1.139	1.139	1.174	1.182
22	7.8	1.115	1.132	1.132	1.138	1.138	1.175	1.183
23	7.6	1.112	1.129	1.129	1.133	1.133	1.173	1.181
24	7.4	1.107	1.125	1.125	1.127	1.127	1.169	1.178
25	7.2	1.103	1.119	1.119	1.121	1.121	1.165	1.177
26	7.0	1.101	1.114	1.114	1.115	1.115	1.161	1.177
27	6.8	1.099	1.111	1.112	1.113	1.113	1.160	1.178
28	6.6	1.099	1.110	1.110	1.110	1.110	1.156	1.177
29	6.4	1.098	1.101	1.099	1.098	1.099	1.143	1.171
30	6.2	1.097	1.092	1.084	1.083	1.088	1.127	1.161
31	6.0	1.097	1.089	1.077	1.077	1.085	1.120	1.159
32	5.8	1.097	1.089	1.073	1.073	1.083	1.114	1.153
33	5.6	1.095	1.083	1.057	1.057	1.071	1.097	1.135
34	5.4	1.093	1.081	1.052	1.049	1.064	1.085	1.119
35	5.2	1.091	1.084	1.060	1.052	1.065	1.080	1.114
36	5.0	1.093	1.091	1.075	1.064	1.071	1.083	1.114
37	4.8	1.099	1.099	1.086	1.075	1.077	1.088	1.114
38	4.6	1.108	1.109	1.099	1.087	1.086	1.095	1.113
39	4.4	1.117	1.117	1.109	1.098	1.097	1.101	1.111
40	4.2	1.124	1.123	1.117	1.105	1.104	1.103	1.108
41	4.0	1.130	1.130	1.124	1.111	1.110	1.104	1.108
42	3.8	1.143	1.141	1.138	1.127	1.126	1.116	1.113
43	3.6	1.158	1.155	1.155	1.147	1.147	1.136	1.124
44	3.4	1.167	1.164	1.165	1.157	1.157	1.145	1.133
45	3.2	1.174	1.173	1.173	1.162	1.162	1.150	1.144
46	3.0	1.185	1.187	1.187	1.174	1.174	1.159	1.151
47	2.8	1.199	1.203	1.203	1.189	1.189	1.170	1.159
48	2.6	1.213	1.218	1.218	1.203	1.203	1.182	1.164
49	2.4	1.227	1.232	1.232	1.217	1.217	1.193	1.174
50	2.2	1.239	1.245	1.245	1.230	1.230	1.204	1.192
51	2.0	1.250	1.256	1.256	1.242	1.242	1.213	1.203
52	1.8	1.261	1.268	1.268	1.253	1.253	1.222	1.204

These decks are generated for normal operation flux maps that are typically taken at full power ARO. Additional N(z) decks may be generated, if necessary, consistent with the methodology described in the RPDC topical (Reference 7). EOR is defined as Hot Full Power End of Reactivity.

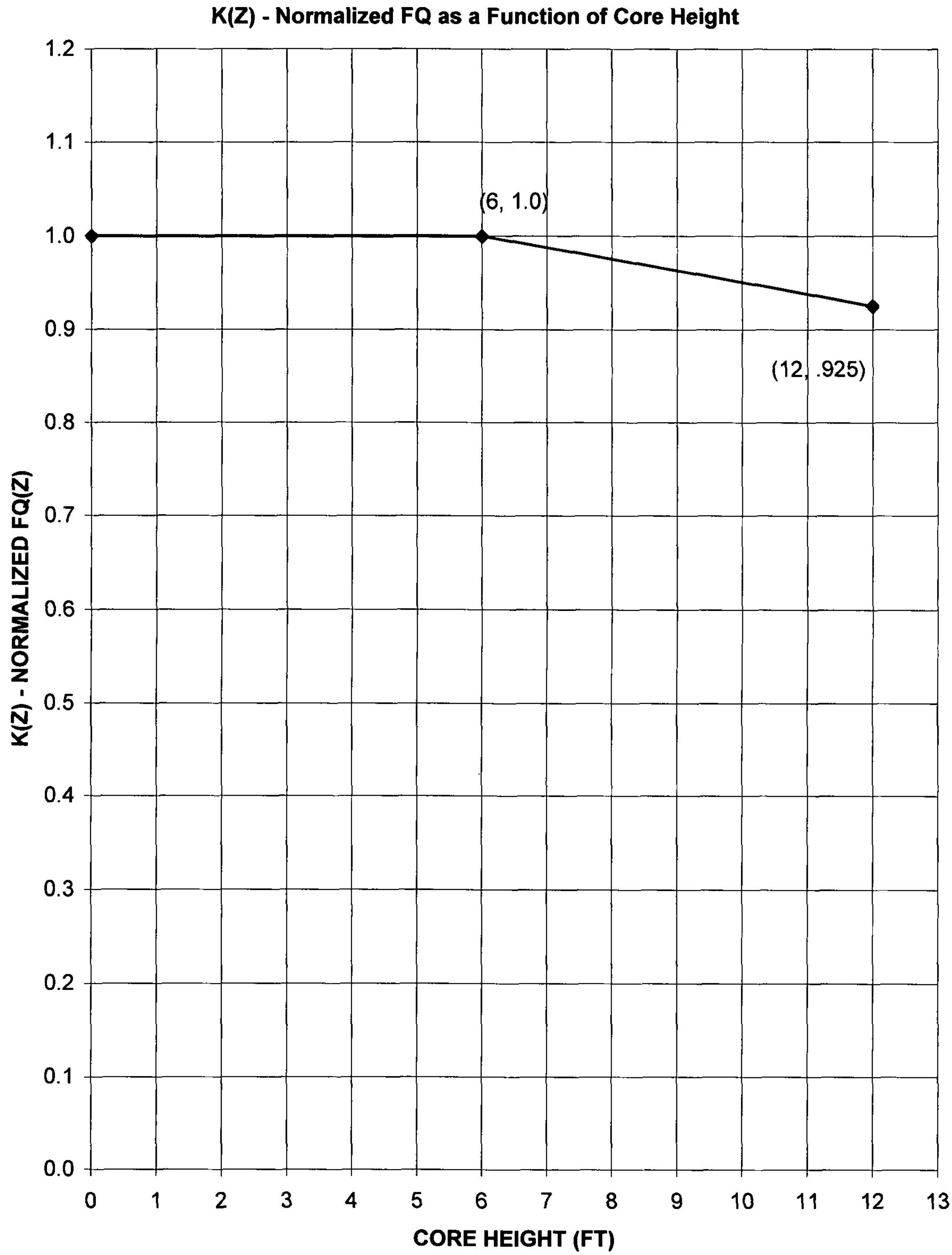
COLR Table 3.2-1 (continued)

N1C25 Normal Operation N(Z)

NODE	HEIGHT (FEET)	9000 to 11000 MWD/MTU	11000 to 13000 MWD/MTU	13000 to 15000 MWD/MTU	15000 to 17000 MWD/MTU	17000 to 19000 MWD/MTU	19000 to EOR MWD/MTU
10	10.2	1.134	1.134	1.123	1.123	1.093	1.093
11	10.0	1.134	1.134	1.123	1.123	1.093	1.093
12	9.8	1.132	1.132	1.121	1.120	1.099	1.098
13	9.6	1.132	1.132	1.119	1.119	1.108	1.107
14	9.4	1.133	1.131	1.113	1.115	1.113	1.112
15	9.2	1.140	1.135	1.116	1.119	1.119	1.121
16	9.0	1.153	1.143	1.137	1.138	1.131	1.138
17	8.8	1.166	1.152	1.161	1.161	1.144	1.157
18	8.6	1.170	1.155	1.167	1.167	1.148	1.163
19	8.4	1.172	1.160	1.173	1.173	1.156	1.172
20	8.2	1.178	1.170	1.188	1.188	1.175	1.192
21	8.0	1.182	1.178	1.199	1.199	1.189	1.206
22	7.8	1.182	1.180	1.202	1.202	1.192	1.209
23	7.6	1.182	1.182	1.209	1.209	1.196	1.214
24	7.4	1.182	1.186	1.221	1.221	1.205	1.223
25	7.2	1.182	1.187	1.229	1.229	1.211	1.228
26	7.0	1.182	1.186	1.230	1.230	1.213	1.228
27	6.8	1.183	1.186	1.232	1.232	1.215	1.228
28	6.6	1.182	1.187	1.231	1.231	1.213	1.227
29	6.4	1.176	1.188	1.229	1.229	1.208	1.226
30	6.2	1.167	1.187	1.224	1.224	1.199	1.224
31	6.0	1.165	1.188	1.224	1.224	1.195	1.226
32	5.8	1.159	1.184	1.218	1.218	1.192	1.223
33	5.6	1.142	1.174	1.201	1.201	1.189	1.214
34	5.4	1.128	1.161	1.184	1.183	1.185	1.204
35	5.2	1.125	1.156	1.176	1.176	1.182	1.200
36	5.0	1.123	1.146	1.164	1.166	1.176	1.192
37	4.8	1.118	1.131	1.142	1.152	1.167	1.180
38	4.6	1.113	1.116	1.133	1.143	1.156	1.164
39	4.4	1.111	1.107	1.138	1.142	1.146	1.149
40	4.2	1.109	1.108	1.145	1.145	1.143	1.136
41	4.0	1.109	1.116	1.151	1.150	1.147	1.130
42	3.8	1.110	1.124	1.155	1.154	1.150	1.131
43	3.6	1.115	1.129	1.157	1.157	1.152	1.139
44	3.4	1.122	1.133	1.158	1.157	1.151	1.143
45	3.2	1.133	1.135	1.157	1.157	1.151	1.151
46	3.0	1.143	1.137	1.153	1.156	1.155	1.162
47	2.8	1.152	1.137	1.151	1.160	1.163	1.176
48	2.6	1.154	1.136	1.150	1.164	1.169	1.183
49	2.4	1.159	1.139	1.155	1.175	1.179	1.193
50	2.2	1.175	1.147	1.168	1.189	1.194	1.210
51	2.0	1.185	1.155	1.179	1.202	1.209	1.226
52	1.8	1.186	1.156	1.183	1.210	1.219	1.237

These decks are generated for normal operation flux maps that are typically taken at full power ARO. Additional N(z) decks may be generated, if necessary, consistent with the methodology described in the RPDC topical (Reference 7). EOR is defined as Hot Full Power End of Reactivity.

COLR Figure 3.2-1



3.2.2 Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)

LCO 3.2.2 $F^N_{\Delta H}$ shall be within the limits specified below.

$$\mathbf{F^N_{\Delta H} \leq 1.587\{1 + 0.3(1 - P)\}}$$

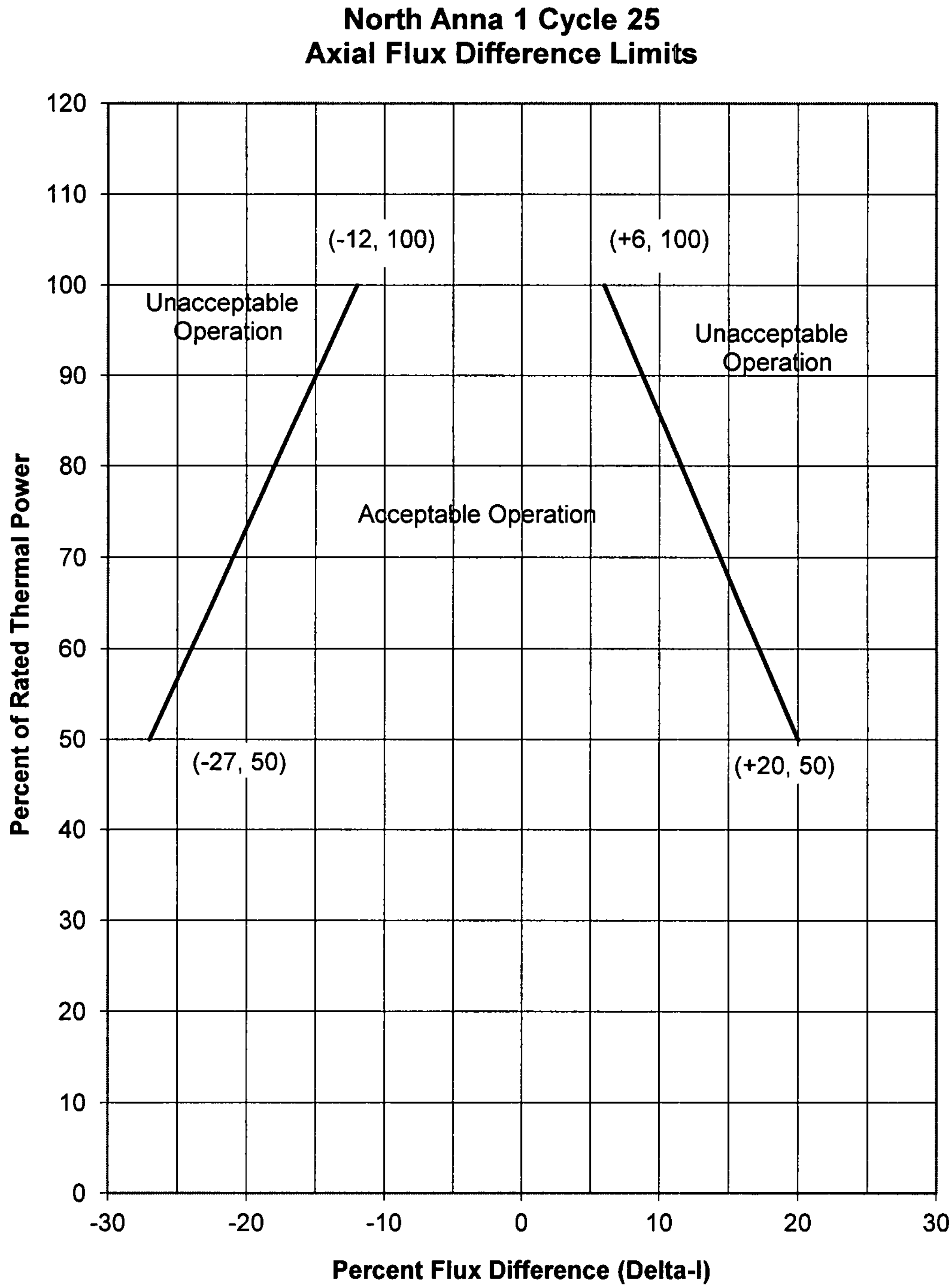
where: $P = \dfrac{THERMAL\ POWER}{RATED\ THERMAL\ POWER}$

SR 3.2.2.1 Verify $F^N_{\Delta H}$ is within limits specified above.

3.2.3 AXIAL FLUX DIFFERENCE (AFD)

LCO 3.2.3 The AFD in % flux difference units shall be maintained within the limits specified in **COLR Figure 3.2-2**.

COLR Figure 3.2-2



3.3 INSTRUMENTATION

3.3.1 Reactor Trip System (RTS) Instrumentation

TS Table 3.3.1-1 Note 1: Overtemperature ΔT

The Overtemperature ΔT Function Allowable Value shall not exceed the following nominal trip setpoint by more than 2% of ΔT span, with the numerical values of the parameters as specified below.

$$\Delta T \leq \Delta T_0 \left\{ K_1 - K_2 \frac{(1+\tau_1 s)}{(1+\tau_2 s)} [T - T'] + K_3 (P - P') - f_1(\Delta I) \right\}$$

where:
- ΔT is measured RCS ΔT, °F
- ΔT_0 is the indicated ΔT at RTP, °F
- s is the Laplace transform operator, sec^{-1}
- T is the measured RCS average temperature, °F
- T′ is the nominal T_{avg} at RTP, **≤ 586.8 °F**
- P is the measured pressurizer pressure, psig
- P′ is the nominal RCS operating pressure, **≥ 2235 psig**

$K_1 \leq$ **1.2715** $K_2 \geq$ **0.02174 /°F** $K_3 \geq$ **0.001145 /psig**

τ_1, τ_2 = time constants utilized in the lead-lag controller for T_{avg}

$\tau_1 \geq$ **23.75 sec** $\tau_2 \leq$ **4.4 sec**

$(1+\tau_1 s)/(1+\tau_2 s)$ = function generated by the lead-lag controller for T_{avg} dynamic compensation

$f_1(\Delta I) \geq$ **0.0291**{-13.0 – ($q_t - q_b$)}	when ($q_t - q_b$) < **–13.0%** RTP
0	when **–13.0%** RTP ≤ ($q_t - q_b$) ≤ **+7.0%** RTP
0.0251{($q_t - q_b$) – **7.0**}	when ($q_t - q_b$) > **+7.0%** RTP

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

TS Table 3.3.1-1 Note 2: Overpower ΔT

The Overpower ΔT Function Allowable Value shall not exceed the following nominal trip setpoint by more than 2% of ΔT span, with the numerical values of the parameters as specified below.

$$\Delta T \leq \Delta T_0 \left\{ K_4 - K_5 \left[\frac{\tau_3 s}{1+\tau_3 s} \right] T - K_6 [T - T'] - f_2(\Delta I) \right\}$$

where: ΔT is measured RCS ΔT, °F.

ΔT_0 is the indicated ΔT at RTP, °F.

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

T is the measured RCS average temperature, °F.

T′ is the nominal T_{avg} at RTP, **≤ 586.8 °F.**

$K_4 \leq$ **1.0865**

$K_5 \geq$	**0.0198 /°F** for increasing T_{avg}	$K_6 \geq$	**0.00162 /°F**	when T > T′
	0 /°F for decreasing T_{avg}		**0 /°F**	when T ≤ T′

τ_3 = time constant utilized in the rate lag controller for T_{avg}

$\tau_3 \geq$ **9.5 sec**

$\tau_3 s/(1+\tau_3 s)$ = function generated by the rate lag controller for T_{avg} dynamic compensation

$f_2(\Delta I)$ = **0, for all ΔI.**

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.1 RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits

LCO 3.4.1 RCS DNB parameters for pressurizer pressure, RCS average temperature, and RCS total flow rate shall be within the limits specified below:

a. Pressurizer pressure is greater than or equal to **2205 psig**;

b. RCS average temperature is less than or equal to **591 °F**; and

c. RCS total flow rate is greater than or equal to **295,000 gpm**.

SR 3.4.1.1 Verify pressurizer pressure is greater than or equal to **2205 psig**.

SR 3.4.1.2 Verify RCS average temperature is less than or equal to **591 °F**.

SR 3.4.1.3 Verify RCS total flow rate is greater than or equal to **295,000 gpm**.

SR 3.4.1.4 -----------------------------NOTE--
Not required to be performed until 30 days after ≥ 90% RTP.

Verify by precision heat balance that RCS total flow rate is ≥ **295,000 gpm**.

3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

3.5.6 Boron Injection Tank (BIT)

Required Action B.2 Borate to a SDM ≥ **1.77 % Δk/k at 200 °F**.

3.9 REFUELING OPERATIONS

3.9.1 Boron Concentration

LCO 3.9.1 Boron concentrations of the Reactor Coolant System (RCS), the refueling canal, and the refueling cavity shall be maintained ≥ **2600 ppm**.

SR 3.9.1.1 Verify boron concentration is within the limit specified above.

TRM 3.1 REACTIVITY CONTROL SYSTEMS

TR 3.1.1 Boration Flow Paths – Operating

Required Action D.2 Borate to a SHUTDOWN MARGIN ≥ **1.77 % Δk/k at 200 °F,** after xenon decay.