CORE OPERATING LIMITS REPORT
North Anna 2 Cycle 14 Pattern SU
Revision 0

N2C14 CORE OPERATING LIMITS REPORT

1.0 INTRODUCTION

The Core Operating Limits Report (COLR) for North Anna Unit 2 Cycle 14 has been prepared in accordance with Technical Specification 6.9.1.7. The Technical Specifications affected by this report are listed below:

3/4.1.1.4	Moderator Temperature Coefficient
3/4.1.3.5	Shutdown Bank Insertion Limit
3/4.1.3.6	Control Bank Insertion Limits
3/4.2.1	Axial Flux Difference
3/4.2.2	Heat Flux Hot Channel Factor
3/4.2.3	Nuclear Enthalpy Rise Hot Channel Factor and Power Factor Multiplier

The cycle-specific parameter limits for North Anna 2 Cycle 14 for the specifications listed above are provided on the following pages, and were developed using the NRC-approved methodologies specified in Technical Specification 6.9.1.7.

The heat flux hot channel factor surveillance specification 4.2.2.2 requires the application of a cycle dependent function, N(z) to the measured $F_Q(z)$ before comparing it to the 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 necessary to generate this function using the actual EOC burnup distribution that can only be calculated after shutdown of the previous cycle. The N(z) function is presented in Table 1.

The revised $F_Q(z)$ limit applicable for EOC Tavg and power coastdown operation is provided in this COLR.

2.0 OPERATING LIMITS

2.1 Moderator Temperature Coefficient (Specification 3/4.1.1.4)

2.1.1 The moderator temperature coefficient (MTC) limits are:

The BOC/ARO-MTC shall be less positive than or equal to +0.6E-4 $\Delta k/k/^{0}F$ (+6 $pcm/^{0}F$) below 70 percent of RATED THERMAL POWER.

The BOC/ARO-MTC shall be less positive than or equal to 0 (zero) $\Delta k/k/^{0}F$ (0 $pcm/^{0}F$) at or above 70 percent of RATED THERMAL POWER.

The EOC/ARO/RTP-MTC shall be less negative than -5.0E-4 $\Delta k/k/^{0}F$ (-50 $pcm/^{0}F$).

2.1.2 The MTC surveillance limits are:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to -4.0E-4 $\Delta k/k/^{0}F$ (-40 $pcm/^{0}F$).

The 60 ppm/ARO/RTP-MTC should be less negative than or equal to -4.7E-4 $\Delta k/k/^{0}F$ (-47 $pcm/^{0}F$).

Where BOC - Beginning of Cycle
ARO - All Rods Out
EOC - End of Cycle
RTP - RATED THERMAL POWER

2.2 Shutdown Bank Insertion Limit (Specification 3/4.1.3.5)

2.2.1 The shutdown rods shall be withdrawn to at least 229 steps.

2.3 Control Bank Insertion Limits (Specification 3/4.1.3.6)

2.3.1 The control rod banks shall be limited in physical insertion as shown in Figure 1.

2.4 Axial Flux Difference (Specification 3/4.2.1)

2.4.1 The axial flux difference limits are provided in Figure 2a for normal operation (through end of full power reactivity) and Figure 2b for coastdown operation.

2.5 Heat Flux Hot Channel Factor-$F_Q(z)$ (Specification 3/4.2.2)

The change in the FQ limit for coastdown operation is accommodated by defining a variable quantity, FQ_{lim} as indicated below. Then, the following expressions can be used for both normal operation and Tavg coastdown regimes.

$FQ_{lim} = 2.19$, for normal operation at full power;

$FQ_{lim} = 2.15$, for coastdown operation.

2.5.1 The $F_Q(Z)$ limits are:

$$F_Q(Z) \leq \frac{FQ_{lim}}{P} * K(Z) \quad \text{for } P > 0.5$$

$$F_Q(Z) \leq 2 * FQ_{lim} * K(Z) \quad \text{for } P \leq 0.5$$

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

K(Z) is provided in Figure 3

2.5.2 The $F_Q(Z)$ surveillance limits are:

$$F_Q(Z)^M \leq \frac{FQ_{lim}}{P} * \frac{K(Z)}{N(Z)} \quad \text{for } P > 0.5$$

$$F_Q(Z)^M \leq 2 * FQ_{lim} * \frac{K(Z)}{N(Z)} \quad \text{for } P \leq 0.5$$

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

K(Z) is provided in Figure 3; and

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

2.6 Nuclear Enthalpy Rise Hot Channel Factor - FΔH(N) and Power Factor Multiplier (Specification 3/4.2.3)

$$F\Delta H(N) \leq 1.49 * \{1 + 0.3 * (1 - P)\}$$

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

Table 1

N2C14 Normal Operation N(z)'s

Node	Height (feet)	0 to 1000 MWD/MTU	1000 to 3000 MWD/MTU	3000 to 5000 MWD/MTU	5000 to 7000 MWD/MTU	7000 to 9000 MWD/MTU	9000 to 17600 MWD/MTU	17600 to EOC MWD/MTU
10	10.2	1.132	1.131	1.145	1.145	1.145	1.144	1.116
11	10.0	1.130	1.130	1.144	1.144	1.144	1.144	1.118
12	9.8	1.128	1.130	1.143	1.143	1.143	1.142	1.120
13	9.6	1.130	1.134	1.142	1.142	1.142	1.142	1.126
14	9.4	1.135	1.137	1.144	1.144	1.144	1.143	1.132
15	9.2	1.143	1.143	1.149	1.149	1.149	1.149	1.143
16	9.0	1.151	1.151	1.153	1.152	1.152	1.157	1.155
17	8.8	1.158	1.158	1.158	1.157	1.157	1.168	1.168
18	8.6	1.164	1.164	1.164	1.163	1.163	1.179	1.179
19	8.4	1.166	1.166	1.169	1.169	1.169	1.189	1.189
20	8.2	1.169	1.168	1.174	1.174	1.174	1.198	1.198
21	8.0	1.168	1.168	1.177	1.177	1.177	1.205	1.205
22	7.8	1.167	1.167	1.181	1.181	1.181	1.211	1.211
23	7.6	1.165	1.165	1.182	1.182	1.182	1.215	1.215
24	7.4	1.163	1.163	1.181	1.181	1.181	1.219	1.219
25	7.2	1.159	1.159	1.178	1.178	1.178	1.220	1.220
26	7.0	1.154	1.154	1.173	1.173	1.173	1.220	1.220
27	6.8	1.147	1.147	1.168	1.168	1.168	1.220	1.220
28	6.6	1.141	1.141	1.162	1.162	1.162	1.216	1.216
29	6.4	1.137	1.137	1.155	1.155	1.155	1.212	1.212
30	6.2	1.132	1.132	1.149	1.149	1.149	1.204	1.204
31	6.0	1.129	1.129	1.145	1.145	1.145	1.196	1.196
32	5.8	1.125	1.125	1.140	1.140	1.140	1.185	1.185
33	5.6	1.120	1.120	1.133	1.133	1.133	1.172	1.172
34	5.4	1.114	1.114	1.124	1.124	1.124	1.157	1.157
35	5.2	1.105	1.105	1.113	1.113	1.113	1.140	1.140
36	5.0	1.098	1.098	1.108	1.108	1.108	1.128	1.128
37	4.8	1.096	[illegible]	1.109	1.110	1.110	1.122	1.122
38	4.6	1.099	1.099	1.111	1.112	1.112	1.123	1.123
39	4.4	1.105	1.105	1.111	1.112	1.112	1.127	1.127
40	4.2	1.112	1.112	1.114	1.111	1.111	1.129	1.129
41	4.0	1.121	1.121	1.121	1.111	1.111	1.130	1.130
42	3.8	1.130	1.130	1.129	1.113	1.113	1.130	1.130
43	3.6	1.140	1.140	1.139	1.119	1.119	1.131	1.131
44	3.4	1.149	1.149	1.149	1.124	1.124	1.135	1.135
45	3.2	1.160	1.160	1.160	1.131	1.131	1.142	1.142
46	3.0	1.171	1.171	1.171	1.139	1.139	1.149	1.149
47	2.8	1.181	1.181	1.181	1.149	1.149	1.160	1.160
48	2.6	1.191	1.191	1.191	1.158	1.158	1.171	1.171
49	2.4	1.200	1.200	1.200	1.167	1.167	1.183	1.183
50	2.2	1.209	1.209	1.209	1.176	1.176	1.194	1.194
51	2.0	1.217	1.217	1.217	1.184	1.184	1.204	1.204
52	1.8	1.224	1.224	1.224	1.191	1.191	1.214	1.214

Figure 1

Control Rod Bank Insertion Limits

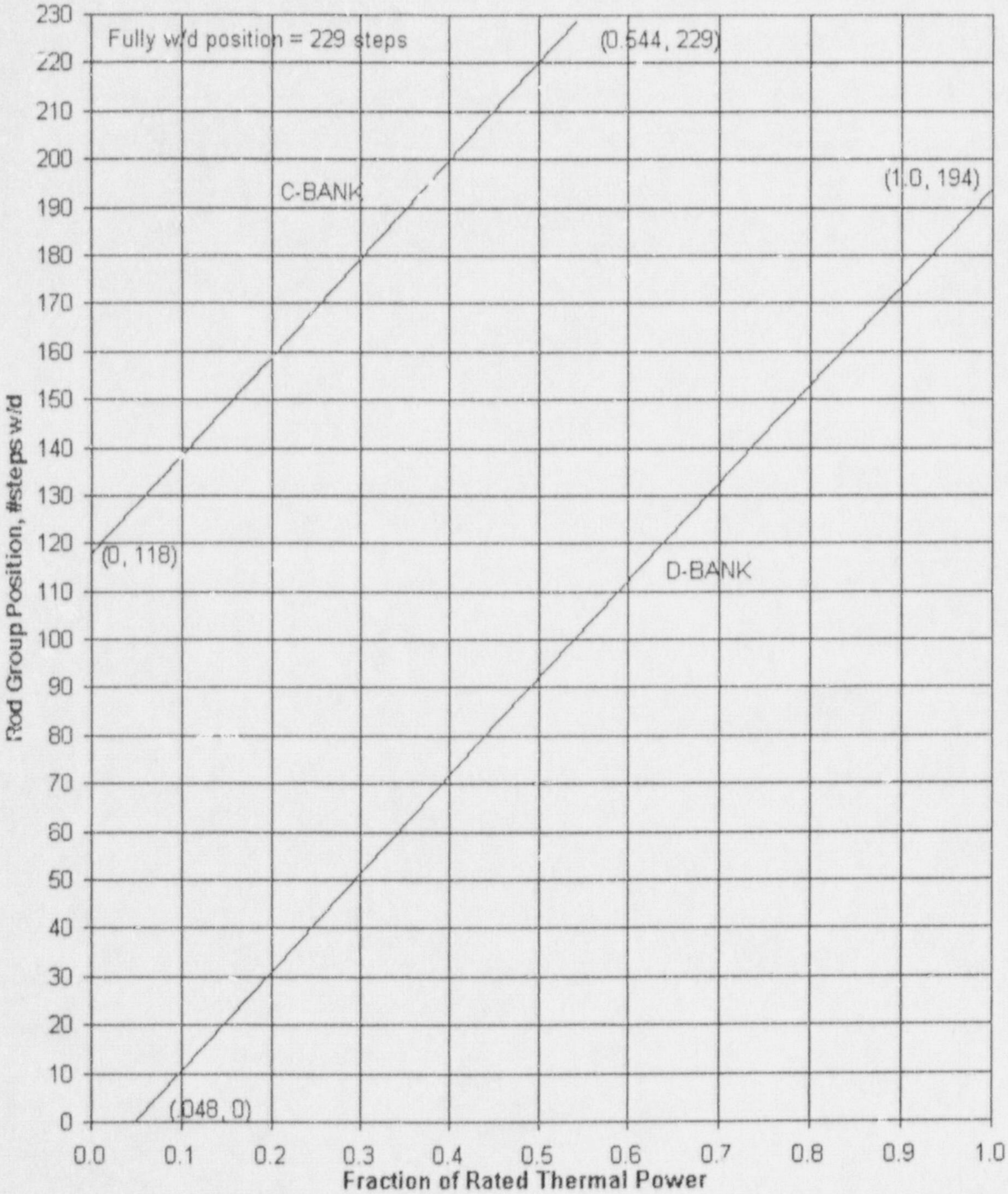

Figure 2a
N2C14 Axial Flux Difference Limits
Normal Operation
Through End of Full Power Reactivity

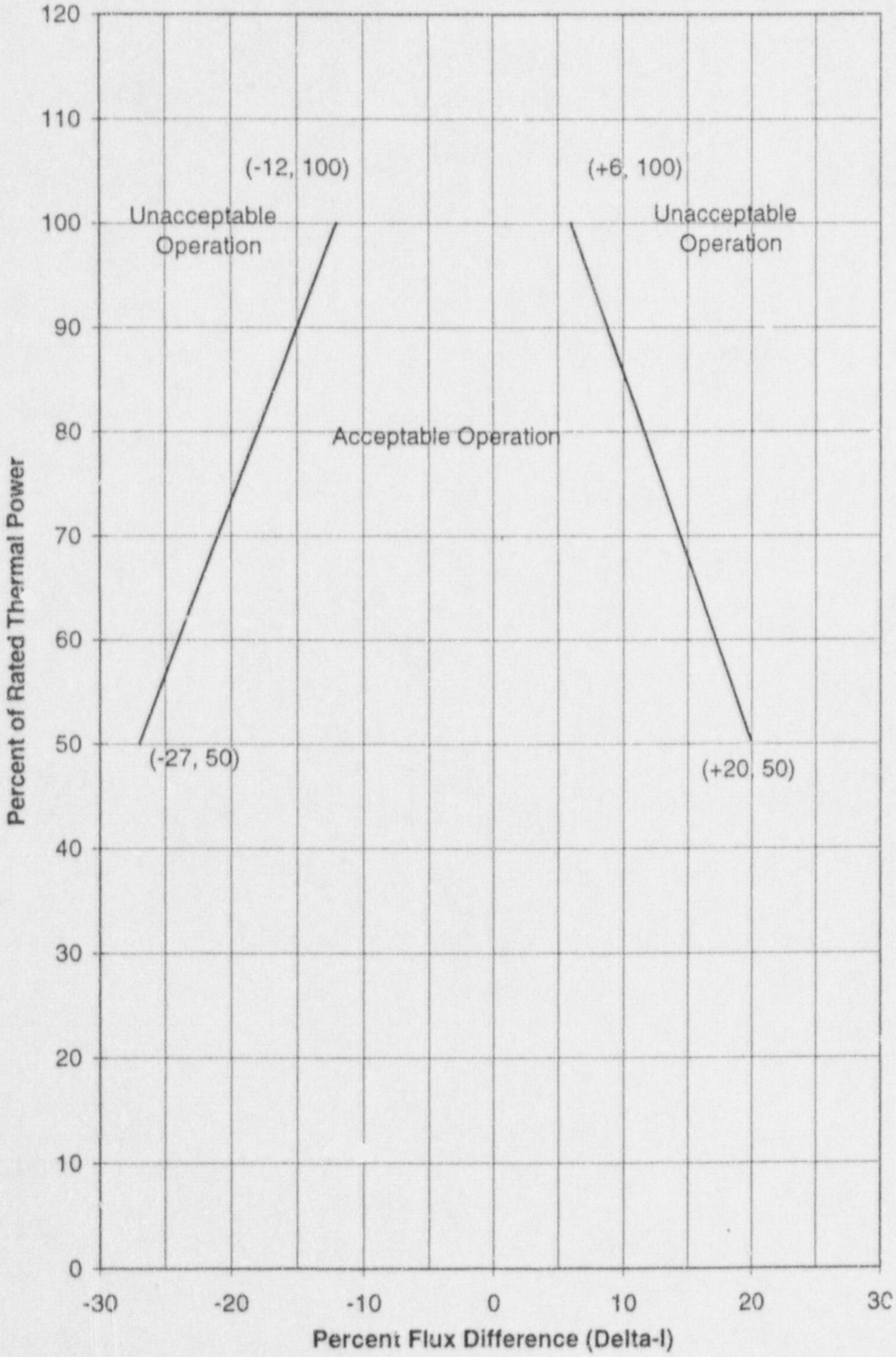

Figure 2b
N2C14 Axial Flux Difference Limits
Coastdown Operation

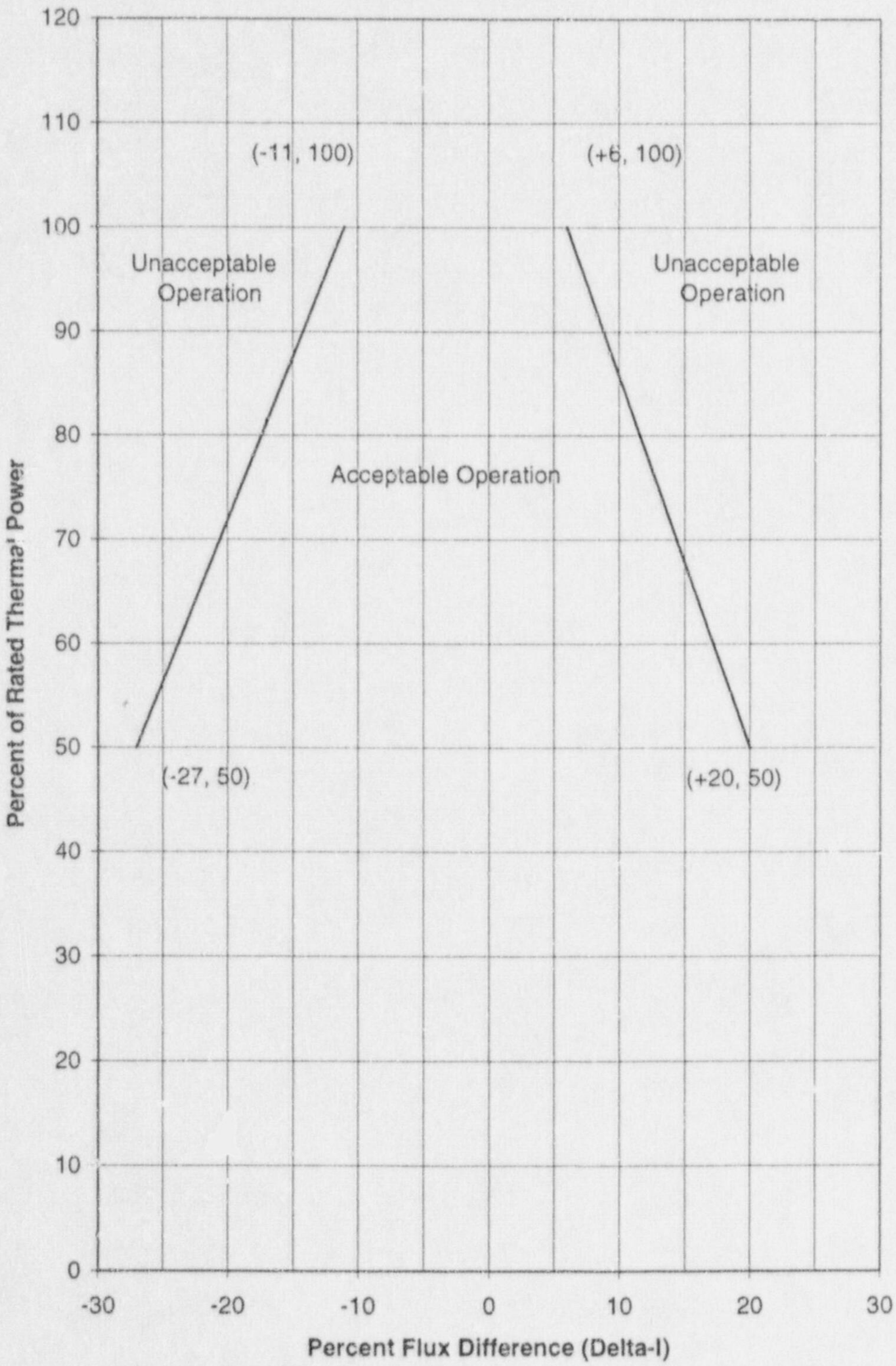

Figure 3
K(Z) - Normalized FQ as a Function of Core Height