VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

October 9, 2001

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Serial No.:	01-632
NL&OS/MM	
Docket No.:	50-338
License No.:	NPF-4

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNIT 1
CYCLE 16 CORE OPERATING LIMITS REPORT

Pursuant to North Anna Technical Specification 6.9.1.7.d, attached is a copy of the Virginia Electric and Power Company's (Dominion) Core Operating Limits Report for North Anna Unit 1 Cycle 16 Pattern UY.

No new commitments are intended by this letter. If you have any questions or require additional information, please contact us.

Very truly yours,

S. P. Sarver, Director
Nuclear Licensing and Operations Support

Attachment

cc: U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth St. SW, Suite 23 T85
Atlanta, Georgia 30303-8931

Mr. M. J. Morgan
NRC Senior Resident Inspector
North Anna Power Station

A001

CORE OPERATING LIMITS REPORT
North Anna 1 Cycle 16 Pattern UY
Rev 0

September 2001

Virginia Electric and Power Company (Dominion)

N1C16 CORE OPERATING LIMITS

1.0 INTRODUCTION

The Core Operating Limits (COLR) for North Anna Unit 1 Cycle 16 were prepared in accordance with North Anna Unit 1 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 1 Cycle 16 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 non-equilibrium multiplier, 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 based on 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 reduced $F_Q(z)$ 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 $\Delta k/k/°F$ (+6 pcm/°F) below 70 percent of RATED THERMAL POWER.

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

The EOC/ARO/RTP-MTC shall be less negative than -5.0E-4 $\Delta k/k/°F$ (-50 pcm/°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 $\Delta k/k/°F$ (-40 pcm/°F).

The 60 ppm/ARO/RTP-MTC should be less negative than or equal to -4.7E-4 $\Delta k/k/°F$ (-47 pcm/°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 226 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 2.

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

The change in the FQ limit for temperature coastdown is accommodated by defining a variable limit, 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 flux map immediately preceding EOC temperature coastdown and during subsequent power 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:

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

NAPS 1 & 2 Safety Evaluation No. 99-SE-OT-26 Rev 1, 08/05/1999

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

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

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)

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

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

[##] Ref: ET NAF 2001-0103 Rev 0, 9/21/2001

Table 1
N1C16 Normal Operation N(z)

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 17900 MWD/MTU	17900 to EOC MWD/MTU
10	10.2	1.185	1.185	1.185	1.142	1.142	1.142	1.116
11	10.0	1.182	1.182	1.182	1.141	1.141	1.141	1.117
12	9.8	1.178	1.178	1.178	1.139	1.139	1.139	1.122
13	9.6	1.176	1.176	1.176	1.139	1.139	1.139	1.132
14	9.4	1.178	1.178	1.178	1.140	1.140	1.141	1.140
15	9.2	1.184	1.184	1.184	1.144	1.144	1.147	1.147
16	9.0	1.191	1.191	1.191	1.146	1.146	1.152	1.153
17	8.8	1.196	1.196	1.196	1.149	1.149	1.158	1.158
18	8.6	1.200	1.200	1.200	1.155	1.155	1.163	1.163
19	8.4	1.200	1.200	1.200	1.161	1.161	1.169	1.169
20	8.2	1.200	1.200	1.200	1.165	1.165	1.175	1.175
21	8.0	1.200	1.200	1.200	1.167	1.167	1.180	1.180
22	7.8	1.200	1.200	1.200	1.169	1.169	1.183	1.183
23	7.6	1.199	1.199	1.199	1.169	1.169	1.186	1.186
24	7.4	1.198	1.198	1.198	1.168	1.168	1.188	1.188
25	7.2	1.195	1.195	1.195	1.166	1.166	1.190	1.190
26	7.0	1.190	1.190	1.190	1.161	1.161	1.190	1.190
27	6.8	1.185	1.185	1.185	1.156	1.156	1.188	1.188
28	6.6	1.177	1.177	1.177	1.150	1.150	1.183	1.183
29	6.4	1.168	1.168	1.168	1.145	1.145	1.176	1.176
30	6.2	1.157	1.157	1.157	1.139	1.139	1.166	1.166
31	6.0	1.145	1.145	1.144	1.135	1.135	1.160	1.160
32	5.8	1.132	1.132	1.133	1.131	1.131	1.154	1.154
33	5.6	1.115	1.115	1.124	1.125	1.125	1.150	1.150
34	5.4	1.105	1.105	1.118	1.118	1.118	1.144	1.144
35	5.2	1.099	1.099	1.107	1.108	1.108	1.133	1.133
36	5.0	1.102	1.102	1.104	1.104	1.104	1.124	1.124
37	4.8	1.107	1.107	1.107	1.106	1.106	1.120	1.120
38	4.6	1.114	1.114	1.114	1.110	1.110	1.121	1.121
39	4.4	1.119	1.119	1.119	1.113	1.113	1.125	1.125
40	4.2	1.123	1.123	1.122	1.117	1.117	1.129	1.129
41	4.0	1.125	1.125	1.125	1.123	1.123	1.132	1.132
42	3.8	1.126	1.126	1.128	1.127	1.127	1.137	1.137
43	3.6	1.128	1.128	1.132	1.132	1.132	1.142	1.142
44	3.4	1.131	1.131	1.134	1.134	1.134	1.146	1.146
45	3.2	1.136	1.136	1.138	1.138	1.138	1.149	1.149
46	3.0	1.141	1.141	1.145	1.145	1.145	1.151	1.151
47	2.8	1.146	1.146	1.155	1.155	1.155	1.155	1.154
48	2.6	1.150	1.150	1.163	1.163	1.163	1.162	1.158
49	2.4	1.154	1.154	1.172	1.172	1.172	1.172	1.166
50	2.2	1.160	1.160	1.179	1.179	1.179	1.179	1.173
51	2.0	1.166	1.166	1.187	1.187	1.187	1.187	1.183
52	1.8	1.171	1.171	1.196	1.196	1.196	1.195	1.193

Figure 1

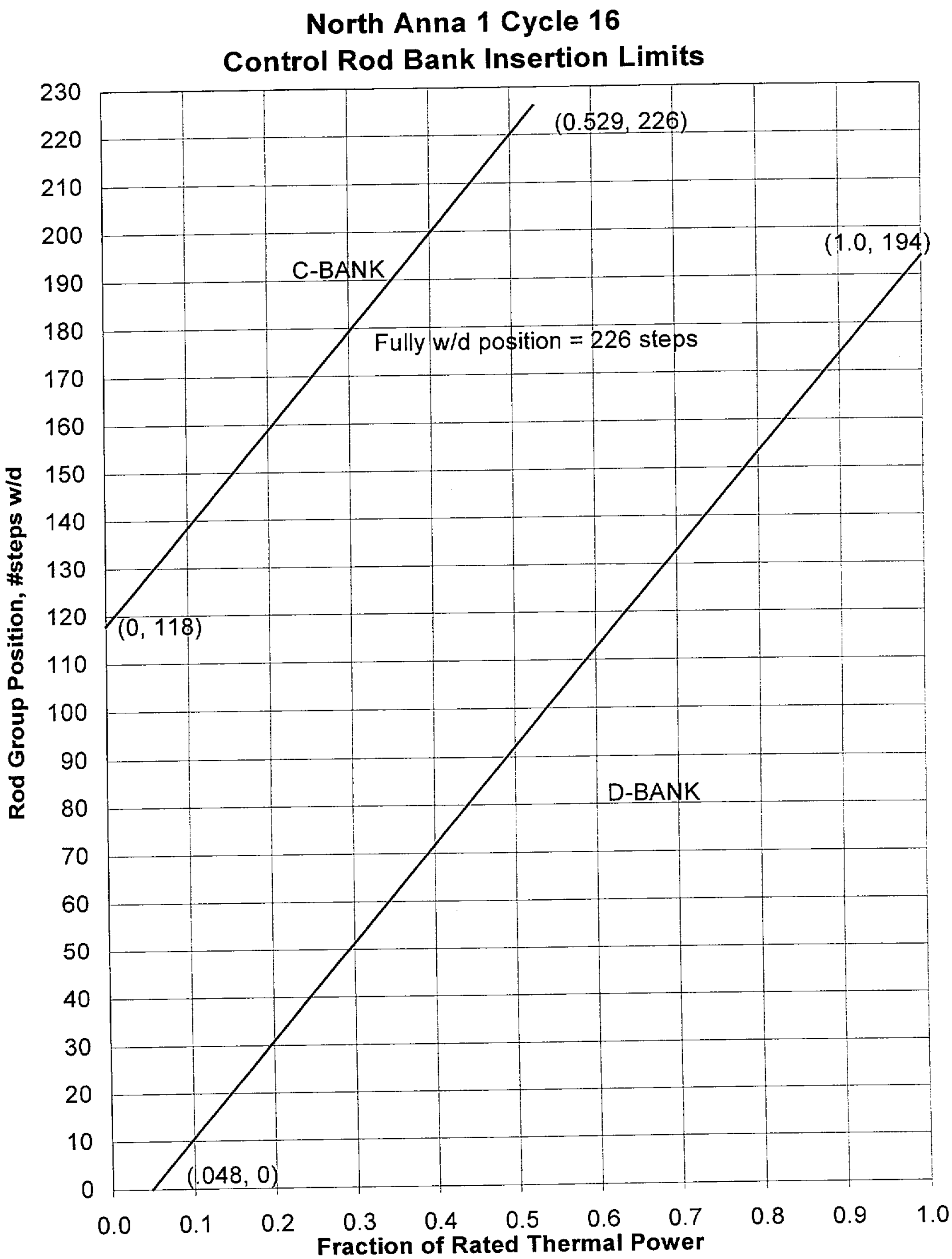

North Anna 1 Cycle 16
Control Rod Bank Insertion Limits
(0.529, 226)
(1.0, 194)
C-BANK
Fully w/d position = 226 steps
(0, 118)
D-BANK
(.048, 0)
Rod Group Position, #steps w/d
Fraction of Rated Thermal Power
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Figure 2

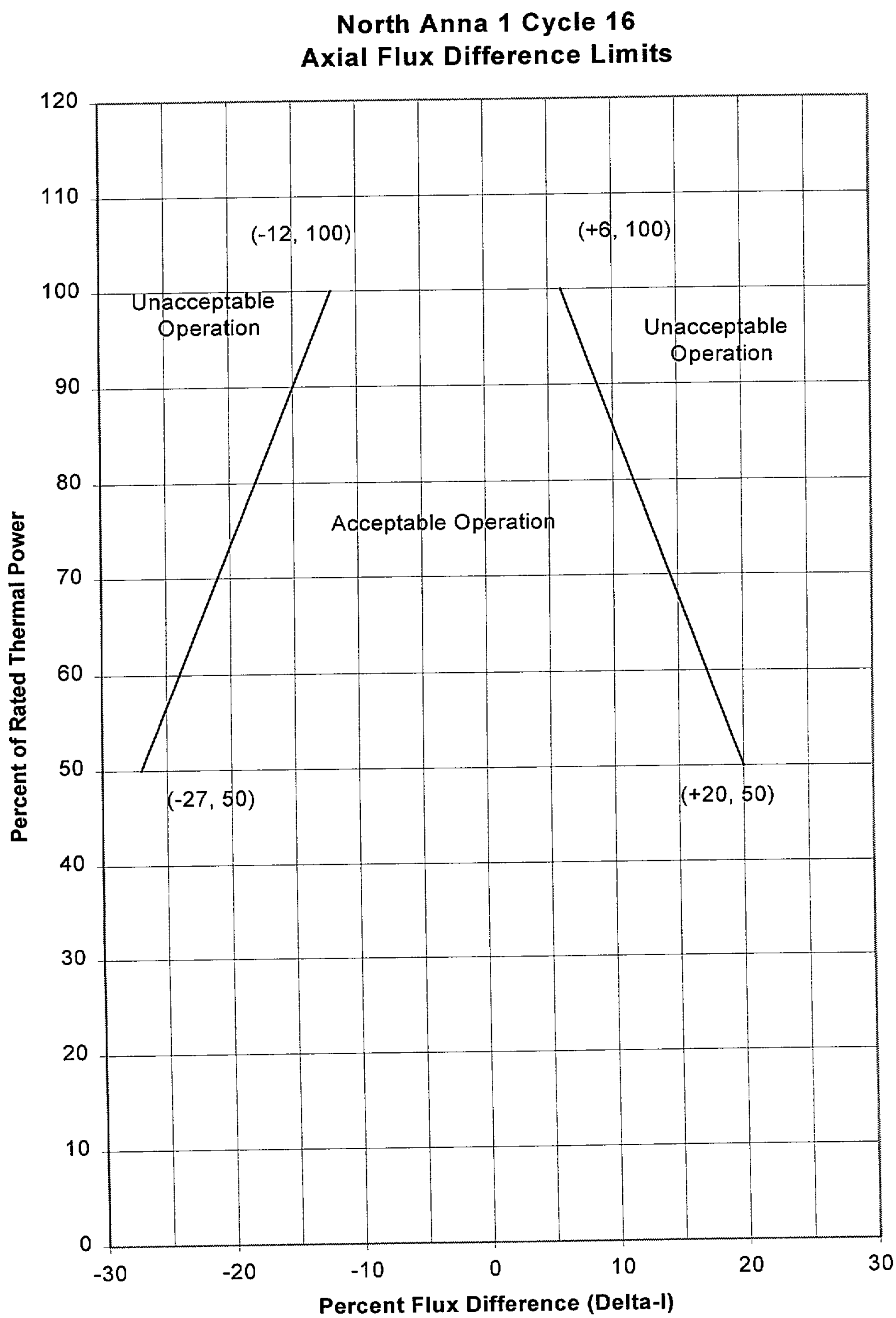
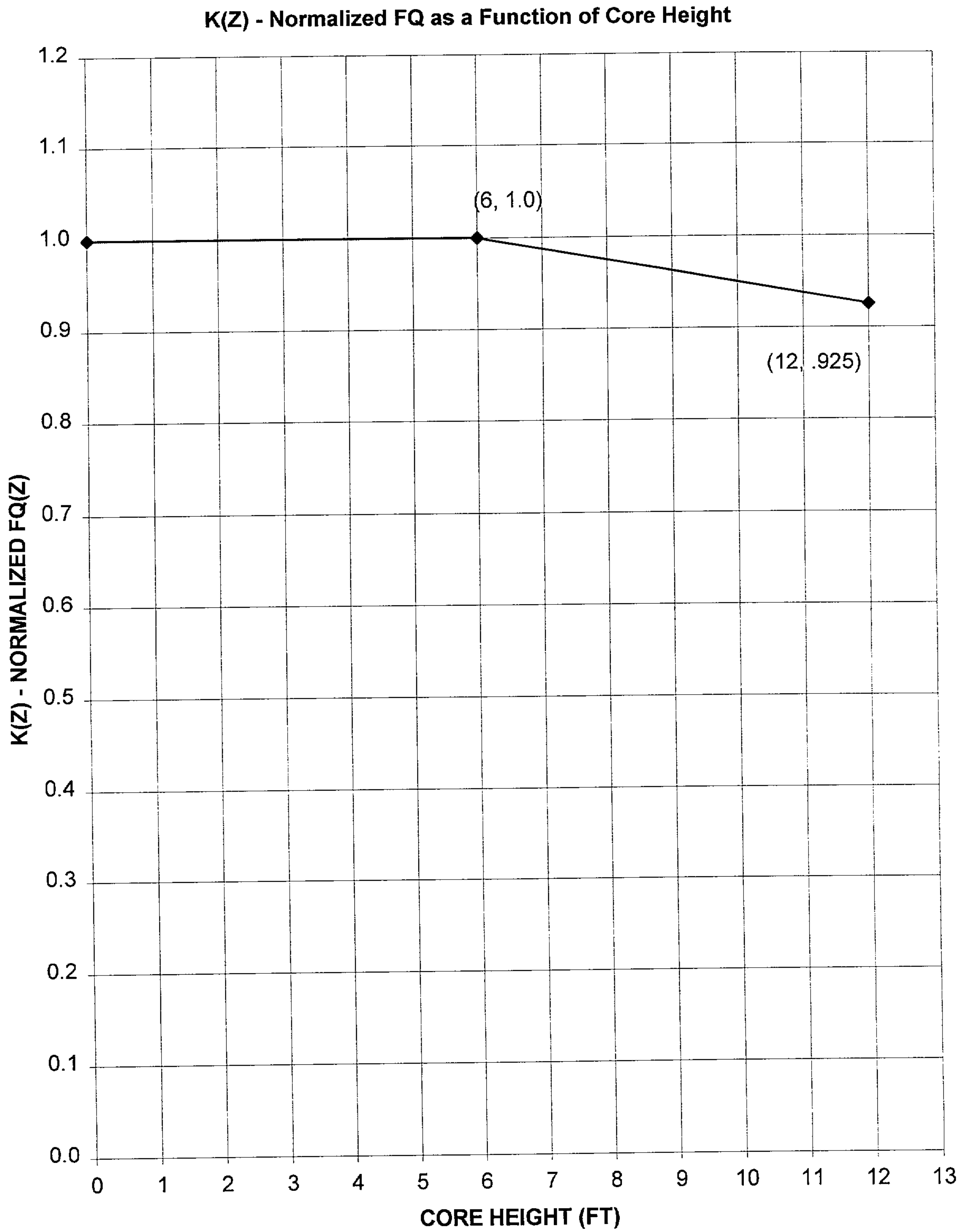

North Anna 1 Cycle 16
Axial Flux Difference Limits
120
110
100
90
80
70
60
50
40
30
20
10
0
-30
-20
-10
0
10
20
30
Percent of Rated Thermal Power
Percent Flux Difference (Delta-I)
(-12, 100)
(+6, 100)
Unacceptable Operation
Unacceptable Operation
Acceptable Operation
(-27, 50)
(+20, 50)

Figure 3


K(Z) - Normalized FQ as a Function of Core Height
K(Z) - NORMALIZED FQ(Z)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
(6, 1.0)
(12, .925)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
CORE HEIGHT (FT)