Virginia Electric and Power Company
Richmond, Virginia 23261

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U.S. Nuclear Regulatory Commission
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Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNIT 1
CYCLE 15 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 Core Operating Limits Report for North Anna Unit 1 Cycle 15 Pattern UJ, Revision 0.

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

Very truly yours,

J. H. McCarthy, Manager
Nuclear Licensing and Operations Support

Attachment

cc: U.S. Nuclear Regulatory Commission
Region II
Atlanta Federal Center
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Mr. M. J. Morgan
NRC Senior Resident Inspector
North Anna Power Station

A001

CORE OPERATING LIMITS REPORT
North Anna 1 Cycle 15 Pattern UJ
Revision 0

N1C15 CORE OPERATING LIMITS REPORT

1.0 INTRODUCTION

The Core Operating Limits Report (COLR) for North Anna Unit 1 Cycle 15 has been 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 15 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 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 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 $\Delta k/k/^0F$ (+6 $pcm/^0F$) below 70 percent of RATED THERMAL POWER.

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

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

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 $\Delta k/k/^0F$ (-40 $pcm/^0F$).

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

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 2.

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 Tavg and 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:

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

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

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

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
N1C15 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 17500 MWD/MTU	17500 to EOC MWD/MTU
10	10.2	1.165	1.165	1.165	1.158	1.158	1.158	1.126
11	10.0	1.163	1.163	1.163	1.157	1.157	1.157	1.127
12	9.8	1.165	1.165	1.165	1.156	1.156	1.156	1.129
13	9.6	1.171	1.171	1.171	1.156	1.156	1.156	1.135
14	9.4	1.174	1.174	1.174	1.152	1.152	1.152	1.142
15	9.2	1.177	1.177	1.177	1.153	1.153	1.153	1.149
16	9.0	1.181	1.181	1.181	1.160	1.160	1.160	1.155
17	8.8	1.185	1.185	1.185	1.172	1.172	1.172	1.160
18	8.6	1.190	1.190	1.190	1.180	1.180	1.180	1.163
19	8.4	1.194	1.194	1.194	1.187	1.187	1.187	1.167
20	8.2	1.196	1.196	1.196	1.193	1.193	1.193	1.173
21	8.0	1.197	1.197	1.197	1.197	1.197	1.196	1.180
22	7.8	1.199	1.199	1.199	1.199	1.199	1.199	1.185
23	7.6	1.201	1.201	1.201	1.200	1.200	1.199	1.188
24	7.4	1.204	1.204	1.204	1.199	1.199	1.198	1.189
25	7.2	1.205	1.205	1.205	1.197	1.197	1.197	1.191
26	7.0	1.204	1.204	1.204	1.193	1.193	1.194	1.193
27	6.8	1.203	1.203	1.203	1.188	1.188	1.194	1.195
28	6.6	1.199	1.199	1.199	1.181	1.181	1.195	1.195
29	6.4	1.194	1.194	1.194	1.173	1.173	1.194	1.194
30	6.2	1.186	1.186	1.186	1.164	1.164	1.190	1.190
31	6.0	1.179	1.179	1.179	1.156	1.156	1.186	1.186
32	5.8	1.167	1.167	1.167	1.146	1.146	1.178	1.178
33	5.6	1.155	1.155	1.155	1.134	1.134	1.170	1.170
34	5.4	1.139	1.139	1.139	1.122	1.122	1.158	1.158
35	5.2	1.119	1.119	1.119	1.108	1.108	1.141	1.141
36	5.0	1.108	1.108	1.108	1.100	1.100	1.127	1.127
37	4.8	1.109	1.109	1.109	1.097	1.097	1.119	1.119
38	4.6	1.113	1.113	1.113	1.101	1.101	1.115	1.115
39	4.4	1.114	1.114	1.114	1.108	1.108	1.114	1.114
40	4.2	1.118	1.118	1.117	1.116	1.116	1.118	1.118
41	4.0	1.122	1.122	1.122	1.122	1.122	1.128	1.128
42	3.8	1.126	1.126	1.127	1.128	1.128	1.136	1.136
43	3.6	1.129	1.129	1.132	1.133	1.133	1.143	1.143
44	3.4	1.130	1.130	1.136	1.136	1.136	1.149	1.149
45	3.2	1.133	1.133	1.140	1.140	1.140	1.153	1.153
46	3.0	1.139	1.139	1.142	1.142	1.142	1.155	1.155
47	2.8	1.148	1.148	1.148	1.147	1.147	1.159	1.159
48	2.6	1.156	1.156	1.156	1.156	1.156	1.168	1.168
49	2.4	1.164	1.164	1.166	1.166	1.166	1.180	1.180
50	2.2	1.171	1.171	1.175	1.175	1.175	1.191	1.191
51	2.0	1.177	1.177	1.183	1.183	1.183	1.201	1.201
52	1.8	1.182	1.182	1.190	1.190	1.190	1.210	1.210

Figure 1

N1C15 Control Rod Bank Insertion Limits

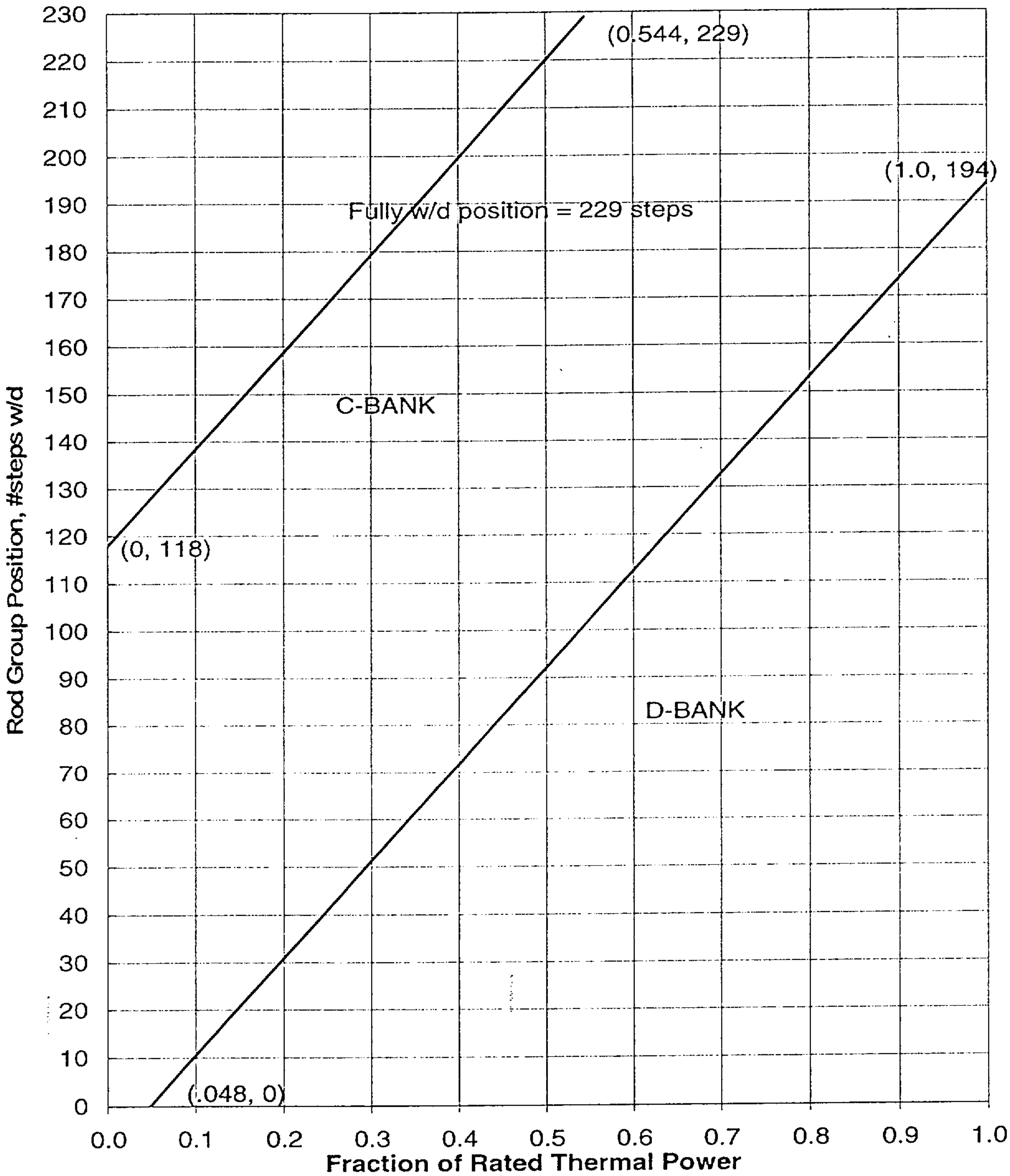


Figure 2

North Anna 1 Cycle 15
Axial Flux Difference Limits

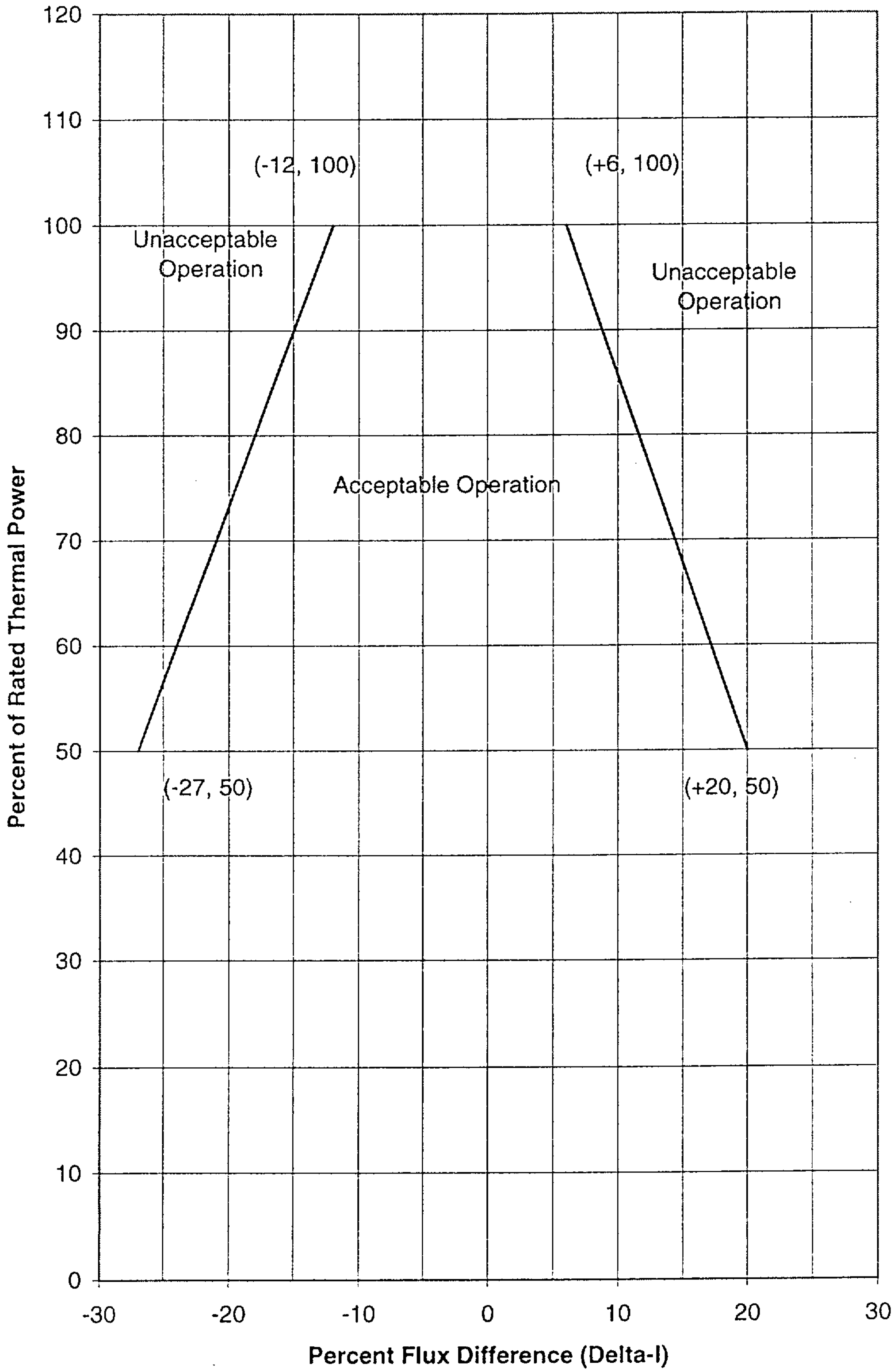
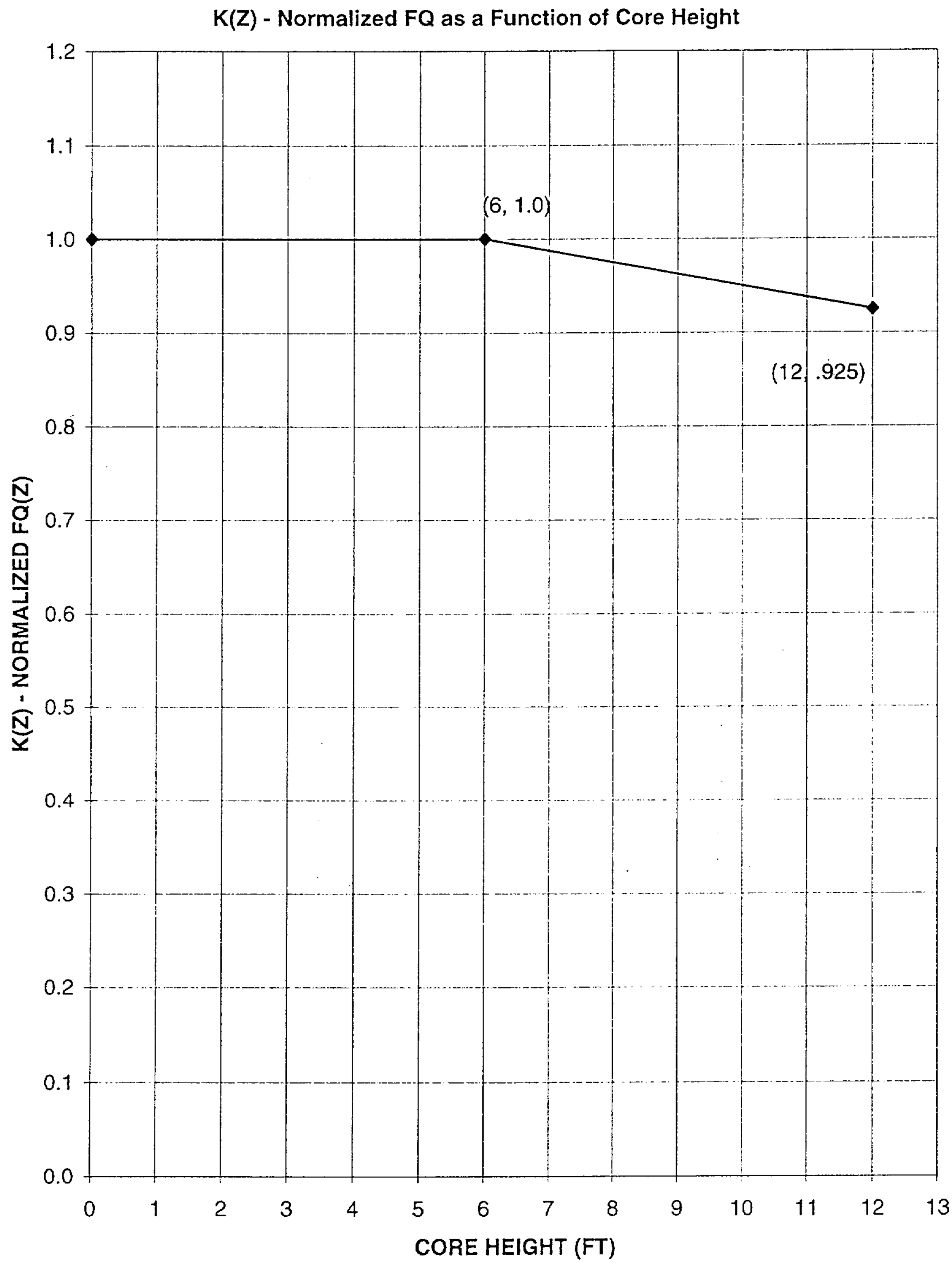


Figure 3


K(Z) - Normalized FQ as a Function of Core Height
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
K(Z) - NORMALIZED FQ(Z)
(6, 1.0)
(12, .925)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
CORE HEIGHT (FT)