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Dominion®

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

Serial No. 10-691
NL&OS/GDM: R0
Docket No. 50-281
License No. DPR-37

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION UNIT 2
CYCLE 23 CORE OPERATING LIMITS REPORT, REVISION 2

Pursuant to Surry Technical Specification (TS) 6.2.C, enclosed is a copy of Dominion's Core Operating Limits Report (COLR) for Surry Unit 2 Cycle 23 Pattern BOA, Revision 2. This revision to the COLR incorporates updates to TS references, reactor core safety limits, overtemperature ΔT and overpower ΔT setpoints, power distribution limits, and departure from nucleate boiling (DNB) parameters consistent with implementation of recently approved TS amendments 269 and 270.

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

Sincerely,

C. L. Funderburk, Director
Nuclear Licensing and Operations Support
Dominion Resources Services, Inc. for
Virginia Electric and Power Company

Enclosure

Commitment Summary: There are no new commitments as a result of this letter.

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COLR-S2C23, Revision 2

CORE OPERATING LIMITS REPORT
Surry 2 Cycle 23 Pattern BOA

1.0 INTRODUCTION

This Core Operating Limits Report (COLR) for Surry Unit 2 Cycle 23 has been prepared in accordance with the requirements of 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, 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 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), June 1990

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

6. 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

7. 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

8. 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.

3.1 Safety Limit, Reactor Core (TS 2.1)

3.1.1 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:

ΔT is measured RCS ΔT, °F.

ΔT_0 is the indicated ΔT 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 $\leq (q_t - q_b) \leq$ **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 Overpower ΔT (TS 2.3.A.2.e)

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

Where: ΔT is measured RCS ΔT, °F.

ΔT_0 is the indicated ΔT 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**.

$K_4 \le$ **1.0965**

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

≥ **0** /°F for decreasing T_{avg}

$K_6 \ge$ **0.001074** /°F for T > T′

≥ **0** for T ≤ T′

$t_3 \ge$ **9.0** seconds

f(ΔI) = as defined above for OTΔT

3.4 Moderator Temperature Coefficient (TS 3.1.E)

3.4.1 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 Control Bank Insertion Limits (TS 3.12.A.1, TS 3.12.A.2 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 Shutdown Margin (TS 3.12.A.1.a, TS 3.12.A.2.a and TS 3.12.G)

3.6.1 Whenever the reactor is subcritical the shutdown margin (SDM) shall be ≥ **1.77** %Δk/k.

3.7 <u>Power Distribution Limits</u> (TS 3.12.B.1 and TS 3.12.B.2)

3.7.1 Heat Flux Hot Channel Factor - FQ(z)

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

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

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

3.7.1.1 *CFQ* = 2.32

3.7.1.2 *K*(*z*) is provided in Figure A-3

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

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

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

3.7.2.1 *CFDH* = 1.56 for Surry Improved Fuel (SIF)

3.7.2.2 *PFDH* = 0.3

3.8 <u>DNB Parameters</u> (TS 3.12.F and TS Table 4.1-2A)

3.8.1 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 and ≥ **276,000 gpm**

Figure A-1

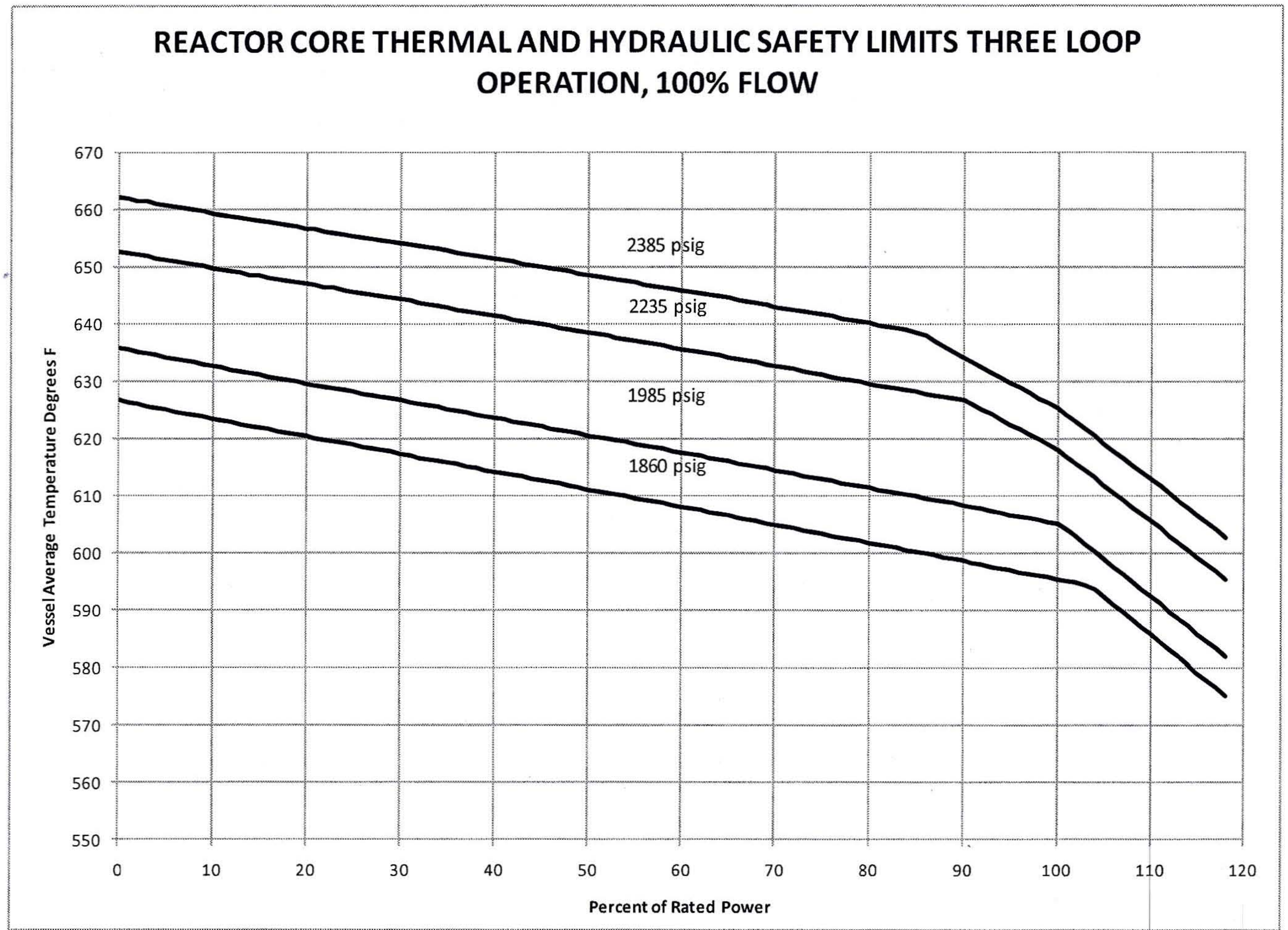

REACTOR CORE THERMAL AND HYDRAULIC SAFETY LIMITS THREE LOOP OPERATION, 100% FLOW
Vessel Average Temperature Degrees F
Percent of Rated Power
2385 psig
2235 psig
1985 psig
1860 psig
670
660
650
640
630
620
610
600
590
580
570
560
550
0
10
20
30
40
50
60
70
80
90
100
110
120

Figure A-2

SURRY UNIT 2 CYCLE 23
ROD GROUP INSERTION LIMITS

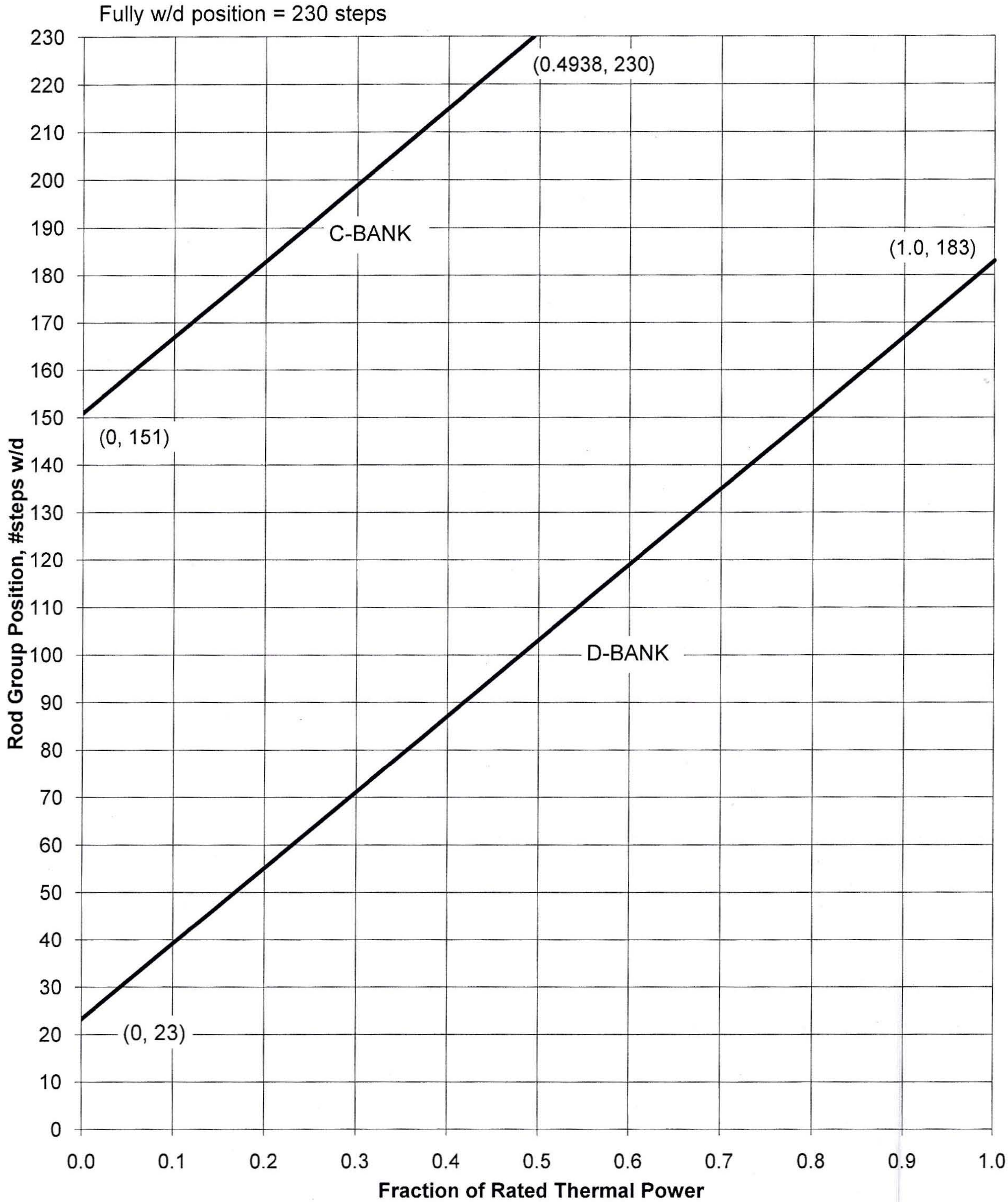
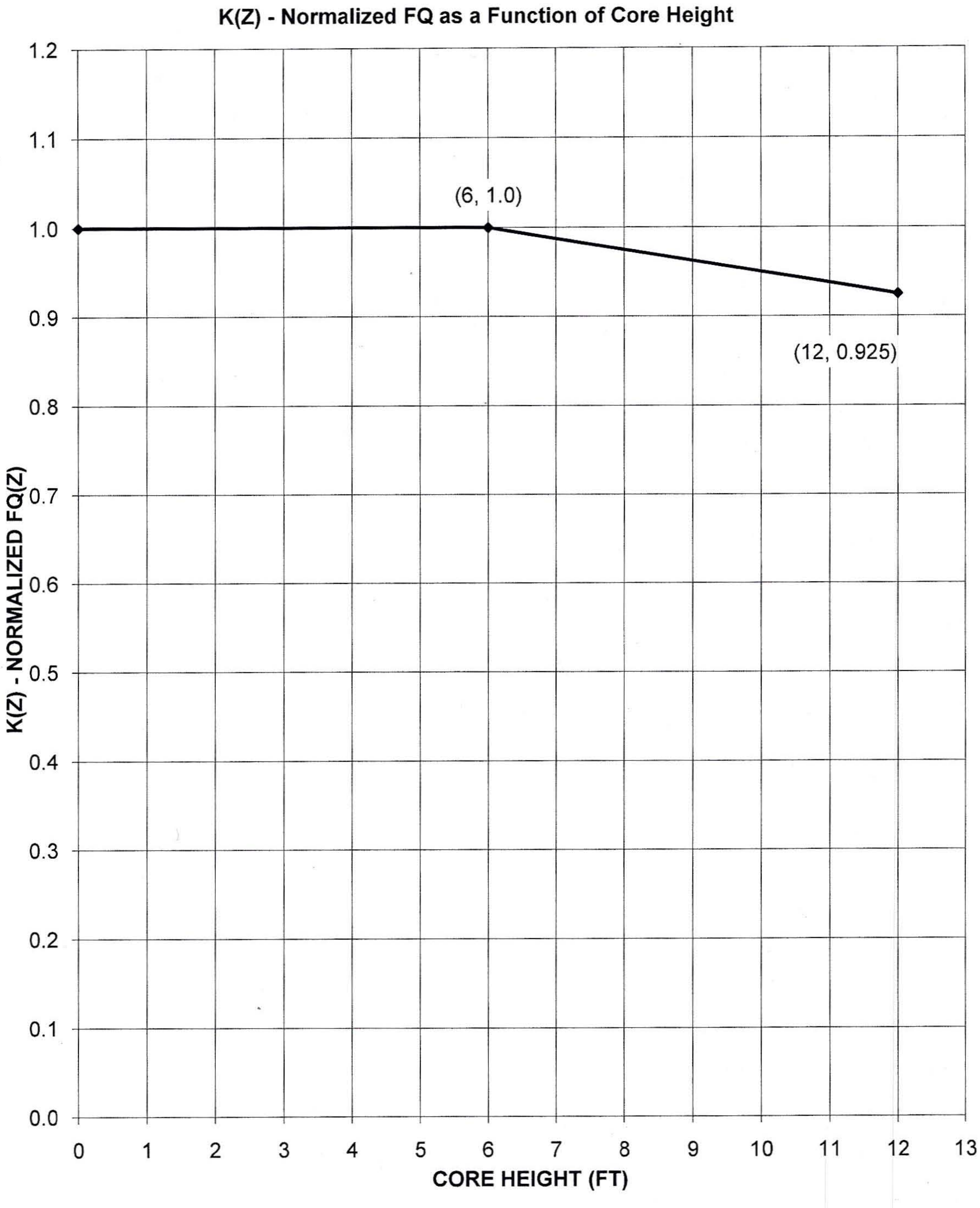


Figure A-3


K(Z) - Normalized FQ as a Function of Core Height
K(Z) - NORMALIZED FQ(Z)
CORE HEIGHT (FT)
(6, 1.0)
(12, 0.925)
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
0 1 2 3 4 5 6 7 8 9 10 11 12 13