



**North
Atlantic**

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The Northeast Utilities System

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

Seabrook Station
Cycle 8 Core Operating Limits Report

North Atlantic Energy Service Corporation (North Atlantic) is enclosing the Cycle 8 Core Operating Limits Report (COLR) for Seabrook Station pursuant to Technical Specification 6.8.1.6.c. Cycle 8 operation of Seabrook Station is scheduled to commence in the near future as North Atlantic is nearing completion of the seventh refueling outage.

Should you require further information regarding this report, please contact Mr. James M. Peschel, Manager-Regulatory Programs at (603) 773-7194.

Very truly yours,

NORTH ATLANTIC ENERGY SERVICE CORP.

Ted C. Feigenbaum
Executive Vice President and
Chief Nuclear Officer

cc: H. J. Miller, NRC Region I Administrator
V. Nerses, NRC Project Manager, Project Directorate I-2
R. K. Lorson, NRC Senior Resident Inspector

A001

ENCLOSURE TO NYN-00100

RE-21 CORE OPERATING LIMITS REPORT

CYCLE 8

COLR

RE DEPT SUPERVISOR

Paul V. Gung

11/22/00

OPERATIONS MANAGER

[Signature]

11/22/00

SIGNATURE

DATE

REVISION 01-08-00

1.0 Core Operating Limits Report

This Core Operating Limits Report for Seabrook Station Unit 1, Cycle 8 has been prepared in accordance with the requirements of Technical Specification 6.8.1.6.

The Technical Specifications affected by this report are:

- | | | |
|----|---------|--|
| 1) | 2.2.1 | Limiting Safety System Settings |
| 2) | 3.1.1.1 | Shutdown Margin Limit for MODES 1, 2, 3, 4 |
| 3) | 3.1.1.2 | Shutdown Margin Limit for MODE 5 |
| 4) | 3.1.1.3 | Moderator Temperature Coefficient |
| 5) | 3.1.3.5 | Shutdown Rod Insertion Limit |
| 6) | 3.1.3.6 | Control Rod Insertion Limits |
| 7) | 3.2.1 | Axial Flux Difference |
| 8) | 3.2.2 | Heat Flux Hot Channel Factor |
| 9) | 3.2.3 | Nuclear Enthalpy Rise Hot Channel Factor |

2.0 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 6.8.1.6.

2.1 Limiting Safety System Settings: (Specification 2.2.1)

2.1.1 Cycle Dependent Overtemperature ΔT Trip Setpoint Parameters and Function Modifier:

2.1.1.1 $K_1 = 1.180$

2.1.1.2 $K_2 = 0.021 / ^\circ\text{F}$

2.1.1.3 $K_3 = 0.0011 / \text{psig}$

$T =$ Measured RCS T_{avg} ($^\circ\text{F}$), and

$T' =$ Indicated RCS T_{avg} at RATED THERMAL POWER (Calibration temperature for ΔT instrumentation, $\leq 588.5^\circ\text{F}$).

$P' =$ Nominal RCS operating pressure, 2235 psig

2.1.1.4 Channel Total Allowance (TA) = N.A.

2.1.1.5 Channel Z = N.A.

2.1.1.6 Channel Sensor Error (S) = N.A.

2.1.1.7 Allowable Value – The channel's maximum Trip Setpoint shall not exceed its computed Trip Setpoint by more than 0.5% of ΔT span. Note that 0.5% of ΔT span is applicable to OTAT input channels ΔT , T_{avg} and Pressurizer Pressure; 0.25% of ΔT span is applicable to ΔI .

2.1.1.8 $f_1(\Delta I)$ is a function of the indicated difference between top and bottom detectors of the power-range neutron ion chambers; with nominal gains to be selected based on measured instrument response during plant startup tests calibrations such that:

- (1) For $q_t - q_b$ between -20% and +4%, $f_1(\Delta I) \geq 0$; where q_t and q_b are percent RATED THERMAL POWER in the upper and lower halves of the core, respectively, and $q_t + q_b$ is the total THERMAL POWER in percent RATED THERMAL POWER;
- (2) For each percent that the magnitude of $q_t - q_b$ exceeds -20%, the ΔT Trip Setpoint shall be automatically reduced by $\geq 3.1\%$ of its value at RATED THERMAL POWER.
- (3) For each percent that the magnitude of $q_t - q_b$ exceeds +4%, the ΔT Trip Setpoint shall be automatically reduced by $\geq 2.44\%$ of its value at RATED THERMAL POWER.

See figure 5.

2.1.1.9 $\tau_1 \geq 8$ seconds

2.1.1.10 $\tau_2 \leq 3$ seconds

2.1.1.11 $\tau_3 = 0$ seconds

2.1.1.12 $\tau_4 \geq 33$ seconds

2.1.1.13 $\tau_5 \leq 4$ seconds

2.1.1.14 $\tau_6 = 0$ seconds

2.1.2 Cycle Dependent Overpower ΔT Trip Setpoint Parameters and Function Modifier:

2.1.2.1 $K_4 = 1.121$

2.1.2.2 $K_5 = 0.020 / ^\circ\text{F}$ for increasing average temperature and $K_5 = 0.0$ for decreasing average temperature.

2.1.2.3 $K_6 = 0.00175 / ^\circ\text{F}$ for $T > T''$ and $K_6 = 0.0$ for $T \leq T''$, where:

$T =$ Measured RCS T_{avg} ($^\circ\text{F}$), and

$T'' =$ Indicated T_{avg} at RATED THERMAL POWER (Calibration temperature for ΔT instrumentation, ≤ 587.5 $^\circ\text{F}$).

2.1.2.4 Channel Total Allowance (TA) = N.A.

- 2.1.2.5 Channel Z = N.A.
- 2.1.2.6 Channel Sensor Error (S) = N.A.
- 2.1.2.7 Allowable Value – The channel's maximum Trip Setpoint shall not exceed its computed Trip Setpoint by more than 0.5% of ΔT span. Note that 0.5% of ΔT span is applicable to OPAT input channels ΔT and T_{avg} .
- 2.1.2.8 $f_2(\Delta I)$ is disabled.
- 2.1.2.9 τ_1 as defined in 2.1.1.9, above.
- 2.1.2.10 τ_2 as defined in 2.1.1.10, above.
- 2.1.2.11 τ_3 as defined in 2.1.1.11, above.
- 2.1.2.12 τ_6 as defined in 2.1.1.14, above.
- 2.1.2.13 $\tau_7 \geq 10$ seconds.
- 2.2 Shutdown Margin Limit for MODES 1, 2, 3, and 4: (Specification 3.1.1.1)
 - A) The Shutdown Margin shall be greater than or equal to 1.3% $\Delta K/K$, in MODES 1, 2, 3.
 - B) The Shutdown Margin shall be greater than or equal to 2.0% $\Delta K/K$, in MODE 4.
- 2.3 Shutdown Margin Limit for MODE 5: (Specification 3.1.1.2)

The Shutdown Margin shall be greater than or equal to 2.0% $\Delta K/K$.
- 2.4 Moderator Temperature Coefficient: (Specification 3.1.1.3)
 - 2.4.1 The Moderator Temperature Coefficient (MTC) shall be less positive than $+2.77 \times 10^{-5}$ $\Delta K/K/^\circ F$ for Beginning of Cycle Life (BOL), All Rods Out (ARO), Hot Zero Thermal Power conditions.
 - 2.4.2 MTC shall be less negative than -5.0×10^{-4} $\Delta K/K/^\circ F$ for End of Cycle Life (EOL), ARO, Rated Thermal Power conditions.
 - 2.4.3 The 300 ppm ARO, Rated Thermal Power MTC shall be less negative than -4.1×10^{-4} $\Delta K/K/^\circ F$ (300 ppm Surveillance Limit).
- 2.5 Shutdown Rod Insertion Limit: (Specification 3.1.3.5)
 - 2.5.1 The shutdown rods shall be fully withdrawn. The fully withdrawn position is defined as the interval within 225 steps withdrawn to the mechanical fully withdrawn position inclusive.

- 2.6 Control Rod Insertion Limits: (Specification 3.1.3.6)
- 2.6.1 The control rod banks shall be limited in physical insertion as specified in Figure 1.
- 2.7 Axial Flux Difference: (Specification 3.2.1)
- 2.7.1 The indicated AFD must be within the Acceptable Operation Limits specified in Figure 2.
- 2.8 Heat Flux Hot Channel Factor : (Specification 3.2.2)
- 2.8.1 $F_{Q}^{RTP} = 2.50$
- 2.8.2 $K(Z)$ is specified in Figure 3.
- 2.8.3 $W(Z)$ is specified in Figures 4.1 to 4.4 and in Table 1. The $W(Z)$ data is applied over the cycle as follows:
- | | |
|------------------------------|---|
| BU < 150 MWD/MTU, | linear extrapolation of 150 and 3,000 MWD/MTU $W(Z)$ data. |
| 150 < BU < 3,000 MWD/MTU, | quadratic interpolation of 150, 3,000, and 10,000 MWD/MTU $W(Z)$ data. |
| 3,000 ≤ BU ≤ 15,875 MWD/MTU, | quadratic interpolation of 3,000, 10,000, and 15,875 MWD/MTU $W(Z)$ data. |
| BU > 15,875 MWD/MTU, | linear extrapolation of 10,000 and 15,875 MWD/MTU $W(Z)$ data. |
- 2.8.4 The $F_{Q(Z)}^M$ penalty factor is 1.020 for the entire cycle.
- 2.9 Nuclear Enthalpy Rise Hot Channel Factor: (Specification 3.2.3)
- 2.9.1 $F_{\Delta H}^N \leq F_{\Delta H}^N(RTP) \times [1 + PF \times (1 - P)]$
where $P = \text{THERMAL POWER} / \text{RATED THERMAL POWER}$.
- 2.9.2.a For $F_{\Delta H}^N$ measured by the fixed incore detectors:
 $F_{\Delta H}^N(RTP) = 1.585$ for the V5H fuel
 $F_{\Delta H}^N(RTP) = 1.536$ for the V5H (w/ IFMs) fuel
- 2.9.2.b For $F_{\Delta H}^N$ measured by the movable incore detectors:
 $F_{\Delta H}^N(RTP) = 1.587$ for the V5H fuel
 $F_{\Delta H}^N(RTP) = 1.540$ for the V5H (w/ IFMs) fuel
- 2.9.3 Power Factor Multiplier for $F_{\Delta H}^N = PF = 0.3$ for all fuel types.

Figure 1
Control Bank Insertion Limits
Versus Thermal Power

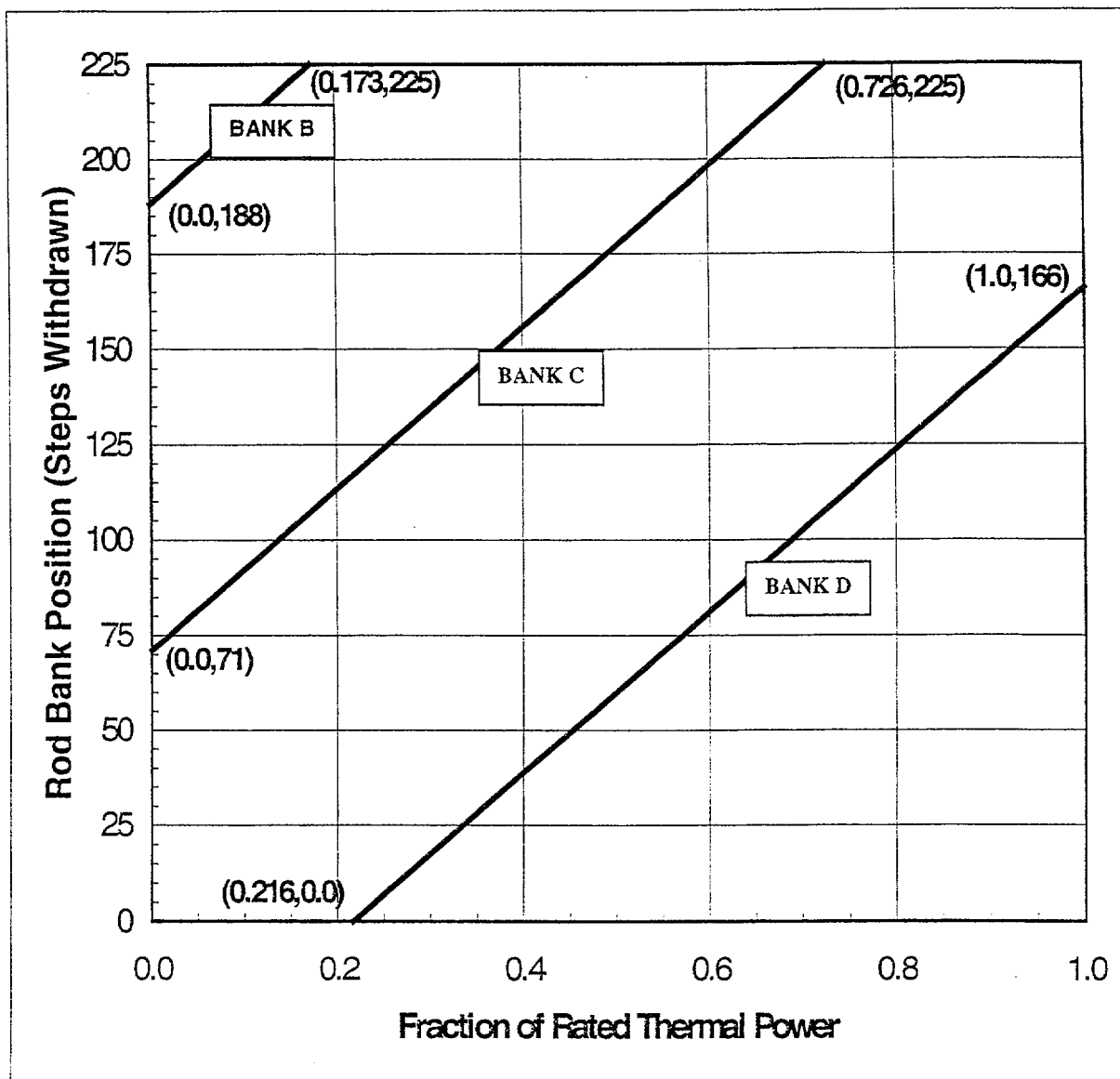
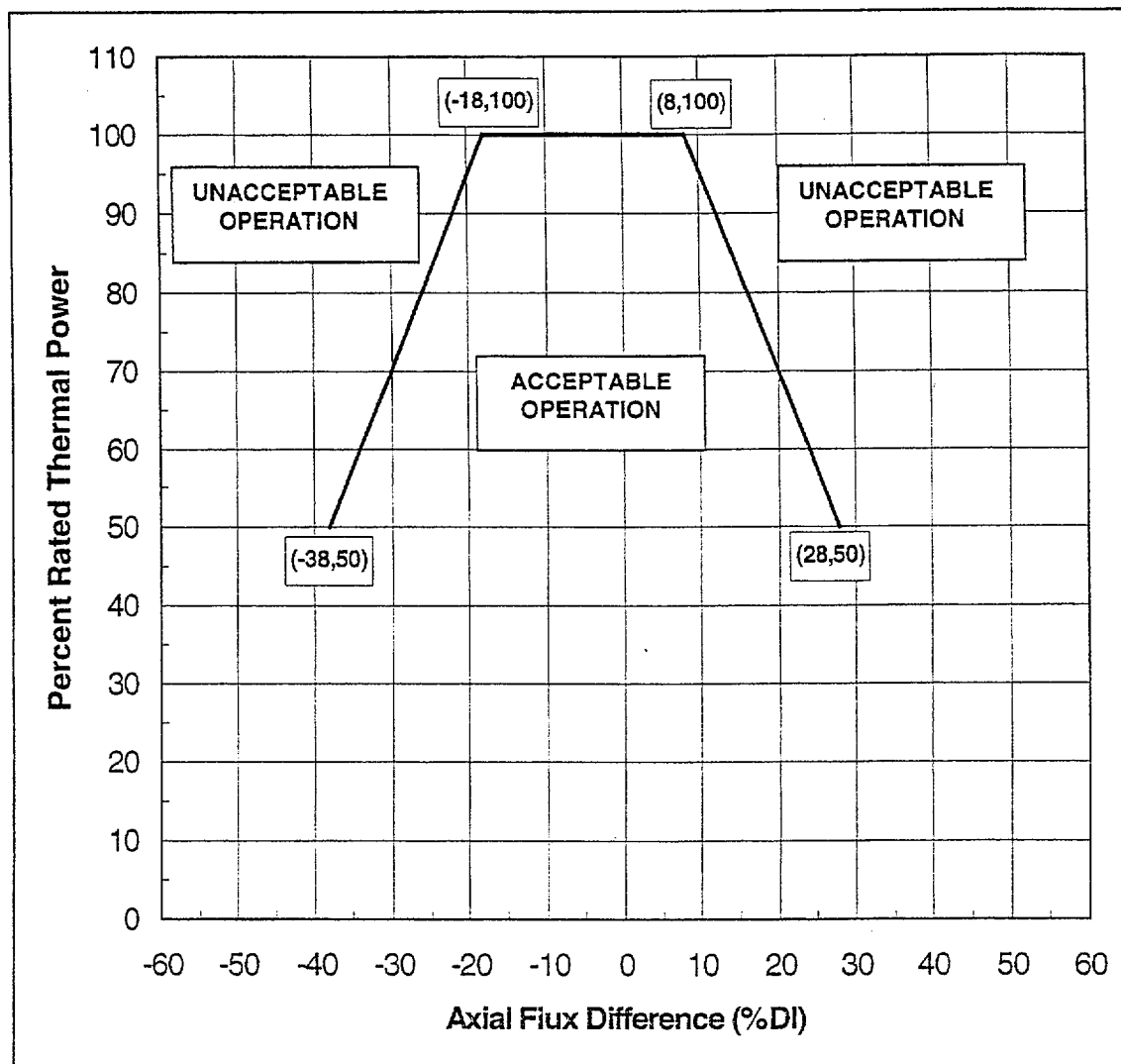


Figure 2
Axial Flux Difference Operating Limits
Versus Thermal Power



Note: $\%DI = \%\Delta I$

Figure 3
K(Z) Versus Core Height

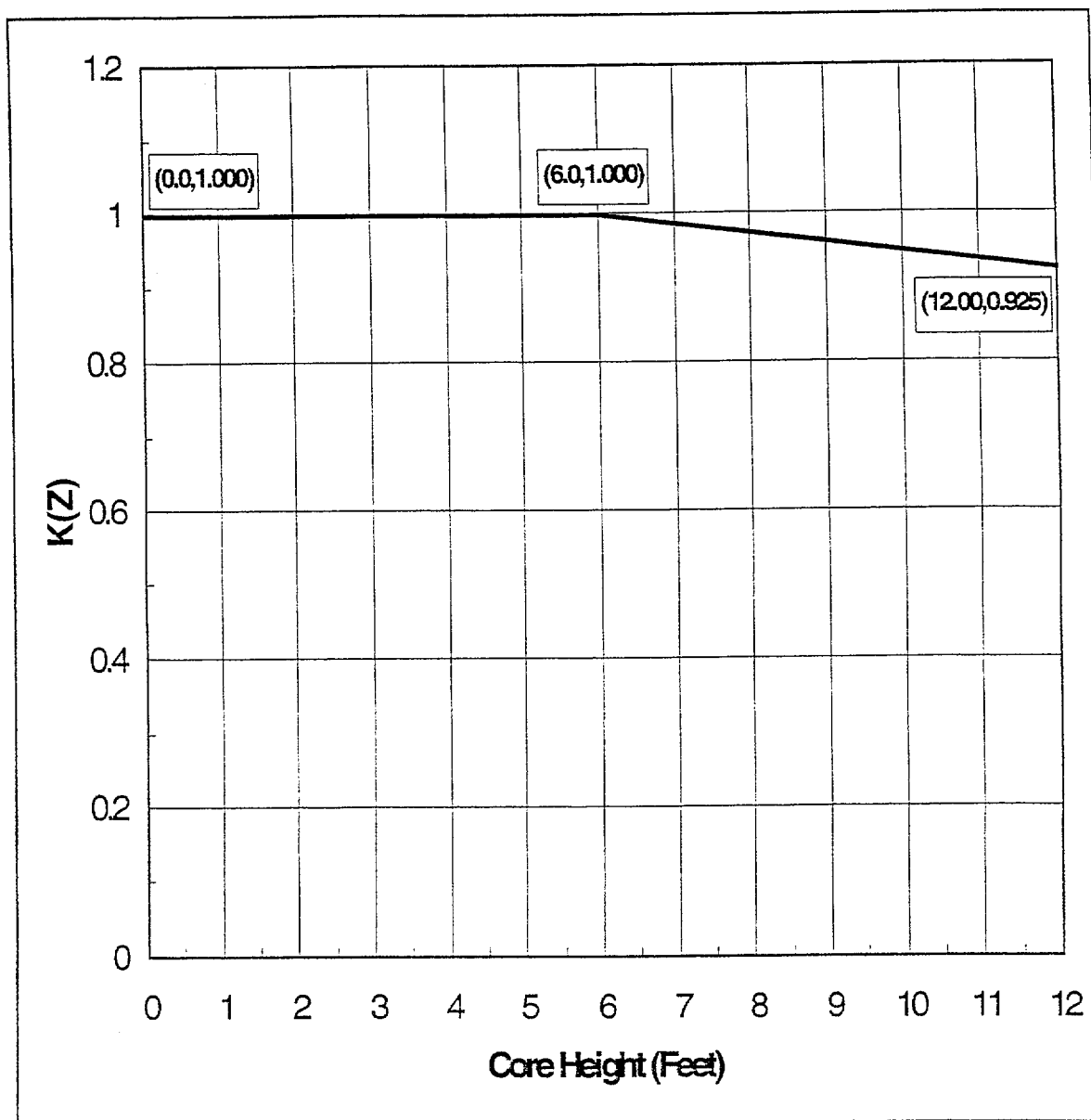


Figure 4.1
W(Z) Versus Core Height
150 MWD/MTU

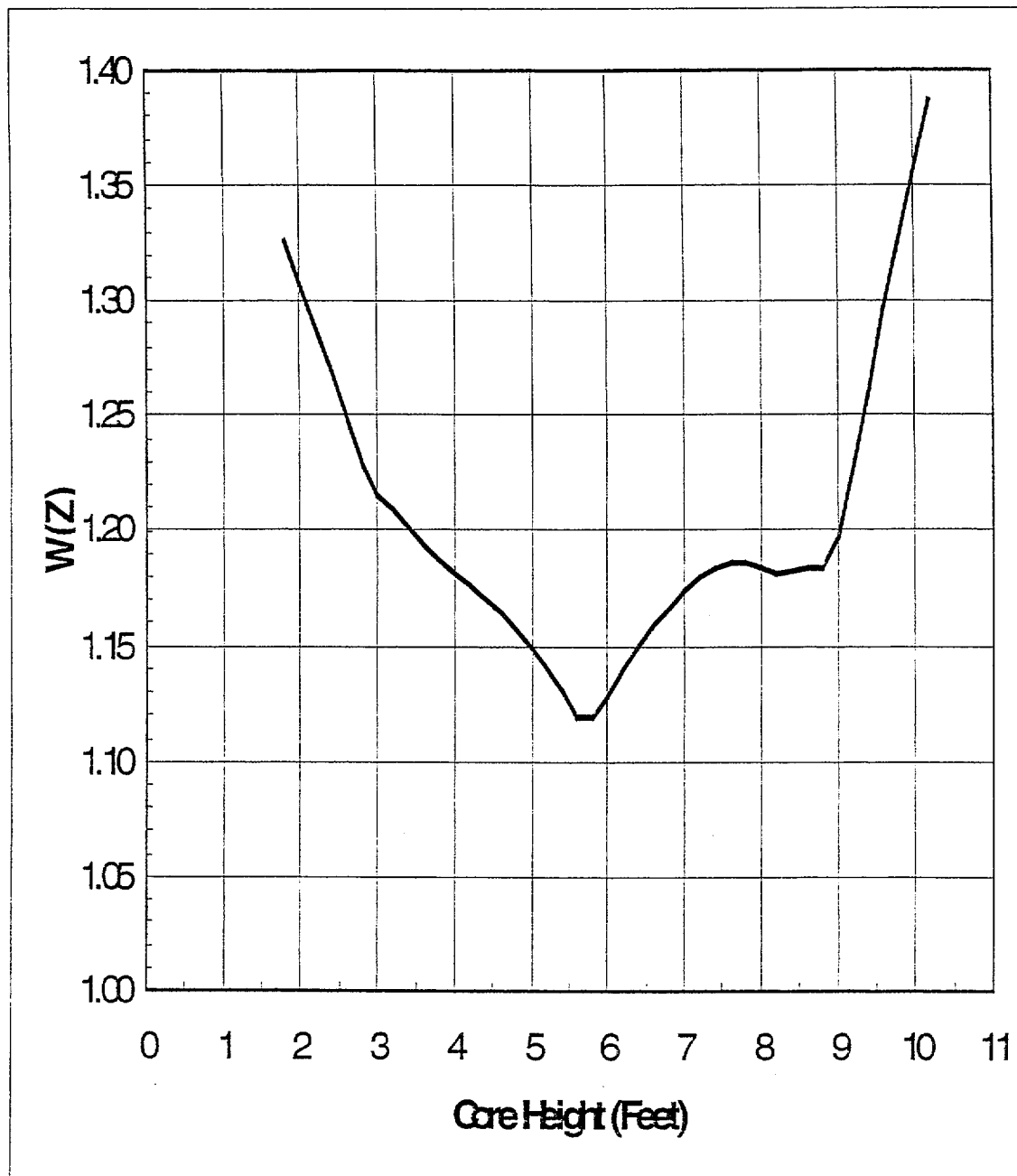


Figure 4.2
W(Z) Versus Core Height
3,000 MWD/MTU

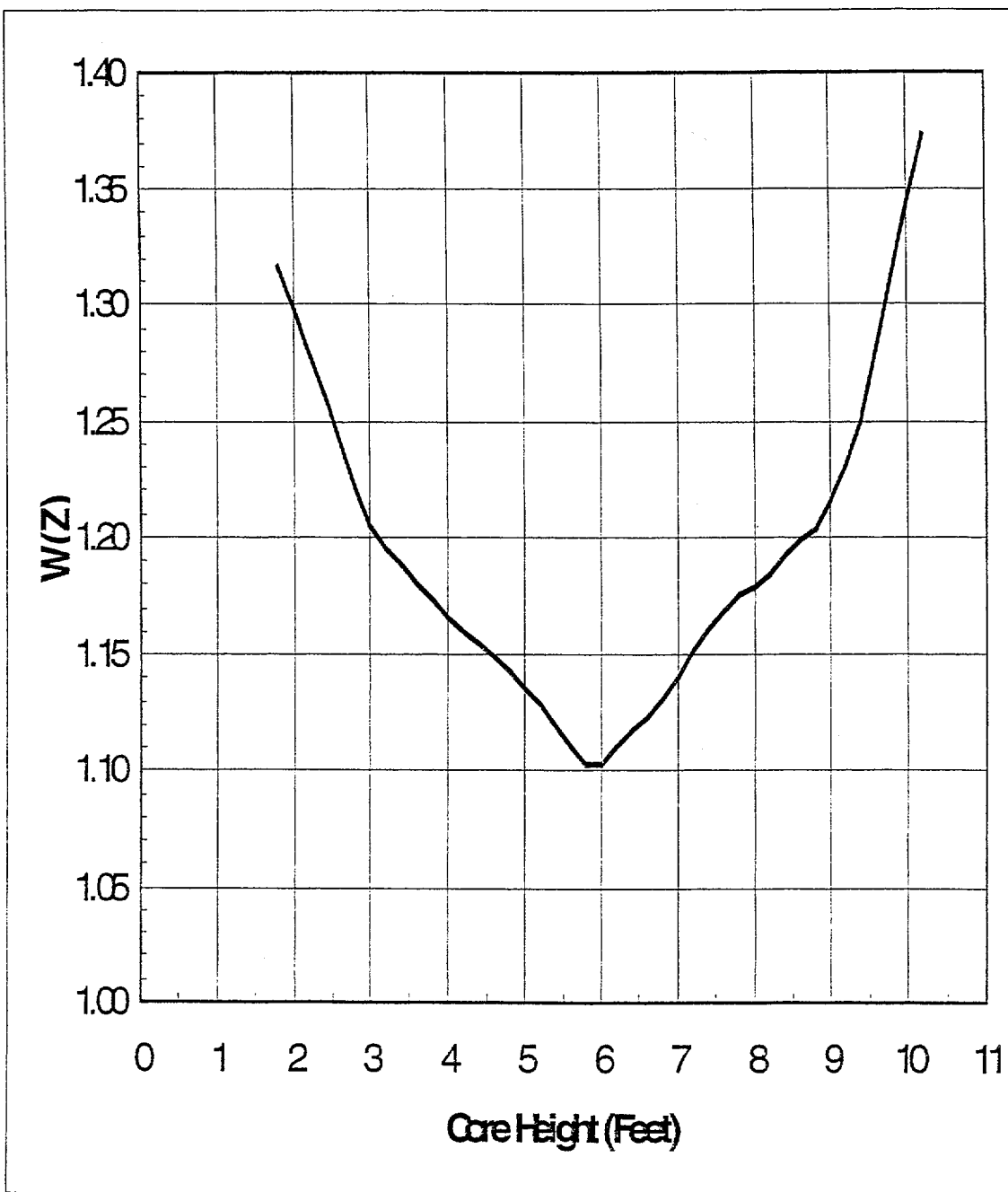


Figure 4.3
W(Z) Versus Core Height
10,000 MWD/MTU

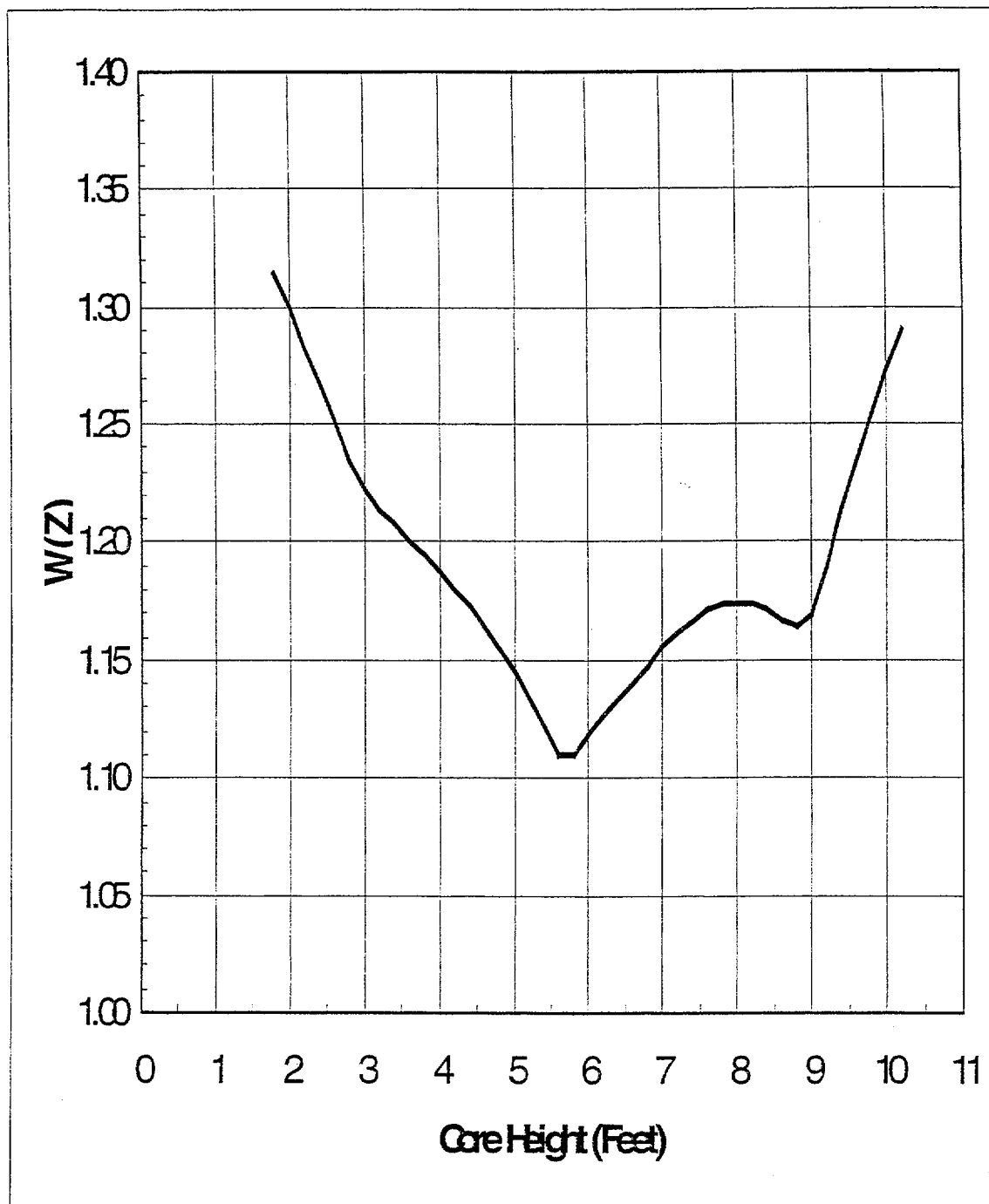


Figure 4.4
W(Z) Versus Core Height
15,875 MWD/MTU

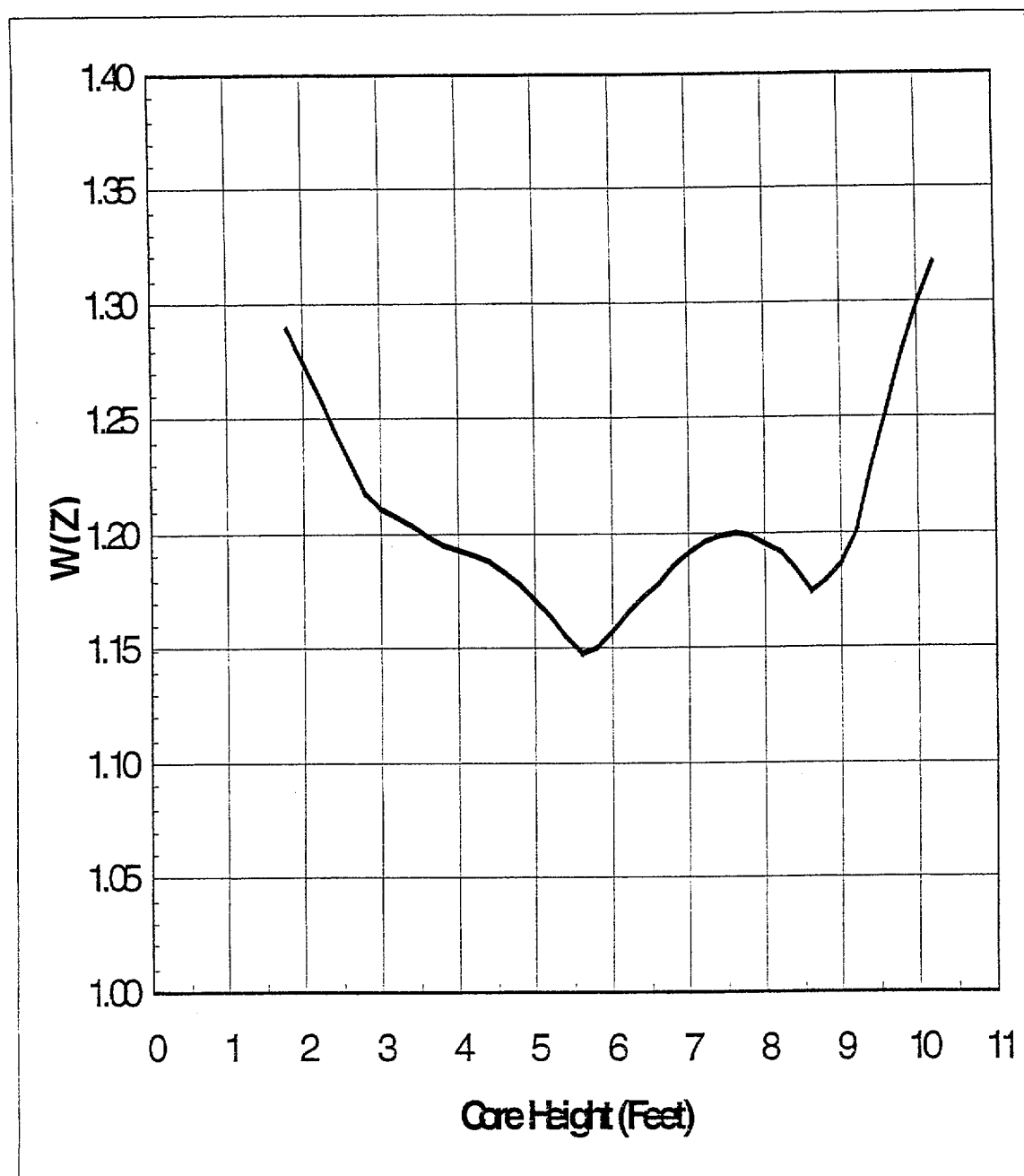


Figure 5

$f_1(\Delta I)$ Function

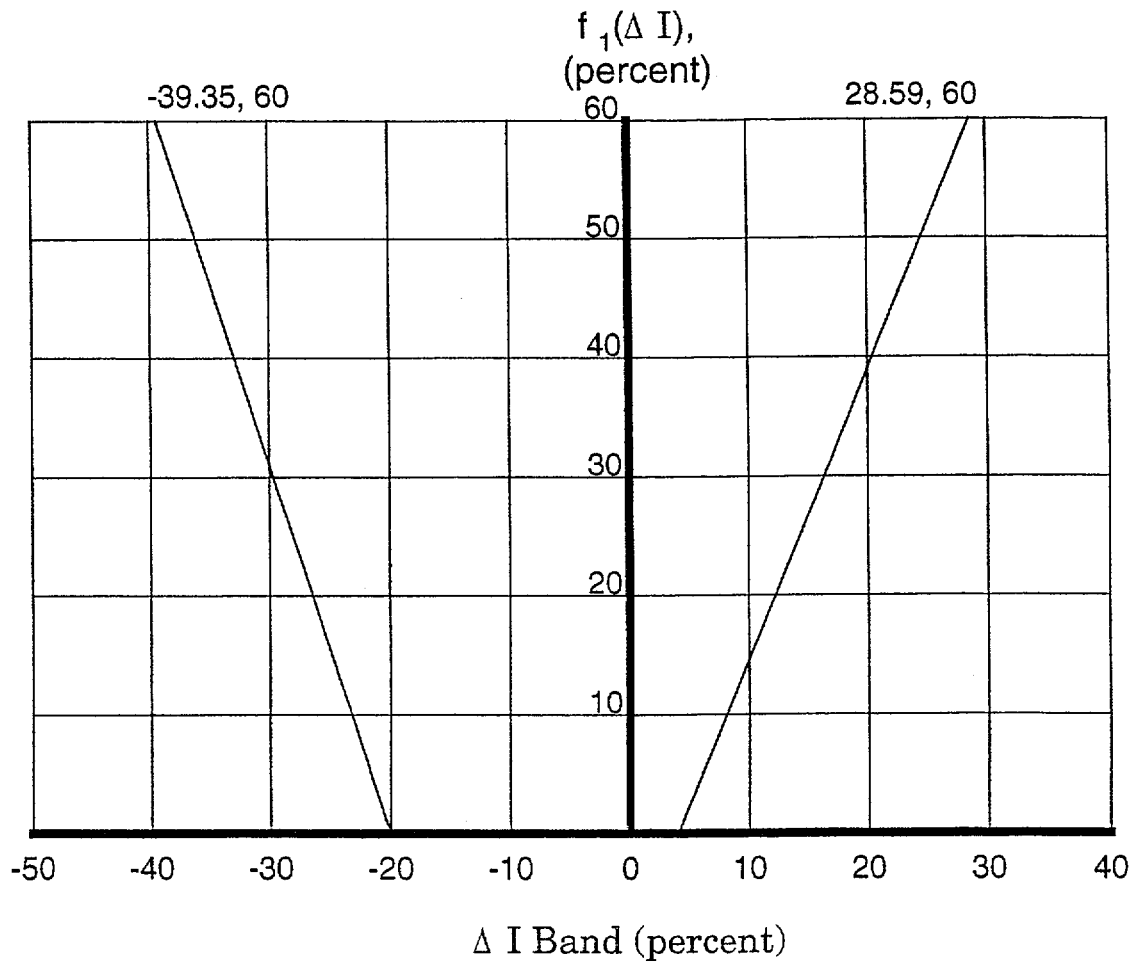


Table 1
W(Z, BU) Versus Axial Height

HEIGHT	W(Z,BU)			
Z (Feet)	150 MWD/MTU	3000 MWD/MTU	10000 MWD/MTU	15875 MWD/MTU
≤1.60	1.0000	1.0000	1.0000	1.0000
1.80	1.3258	1.3165	1.3147	1.2887
2.00	1.3072	1.2985	1.2994	1.2748
2.20	1.2883	1.2797	1.2832	1.2601
2.40	1.2689	1.2604	1.2665	1.2452
2.60	1.2493	1.2410	1.2501	1.2311
2.80	1.2282	1.2208	1.2348	1.2184
3.00	1.2151	1.2049	1.2223	1.2112
3.20	1.2088	1.1947	1.2139	1.2077
3.40	1.2016	1.1877	1.2076	1.2033
3.60	1.1938	1.1809	1.2001	1.1983
3.80	1.1869	1.1731	1.1940	1.1947
4.00	1.1816	1.1657	1.1878	1.1928
4.20	1.1767	1.1600	1.1806	1.1908
4.40	1.1708	1.1553	1.1728	1.1875
4.60	1.1641	1.1495	1.1642	1.1832
4.80	1.1568	1.1431	1.1549	1.1778
5.00	1.1486	1.1359	1.1447	1.1713
5.20	1.1400	1.1281	1.1341	1.1637
5.40	1.1302	1.1196	1.1224	1.1550
5.60	1.1195	1.1104	1.1104	1.1479
5.80	1.1190	1.1033	1.1104	1.1502
6.00	1.1281	1.1033	1.1182	1.1582
6.20	1.1398	1.1097	1.1266	1.1663
6.40	1.1496	1.1171	1.1337	1.1728
6.60	1.1587	1.1236	1.1402	1.1787
6.80	1.1671	1.1311	1.1477	1.1857
7.00	1.1743	1.1411	1.1554	1.1920
7.20	1.1798	1.1518	1.1620	1.1962
7.40	1.1837	1.1609	1.1673	1.1989
7.60	1.1858	1.1688	1.1713	1.1997
7.80	1.1861	1.1754	1.1737	1.1987
8.00	1.1831	1.1795	1.1746	1.1956
8.20	1.1815	1.1843	1.1738	1.1910
8.40	1.1829	1.1922	1.1714	1.1839
8.60	1.1832	1.1982	1.1672	1.1749
8.80	1.1838	1.2038	1.1645	1.1794
9.00	1.1970	1.2157	1.1697	1.1872
9.20	1.2257	1.2313	1.1897	1.2012
9.40	1.2611	1.2502	1.2133	1.2293
9.60	1.2961	1.2830	1.2350	1.2540
9.80	1.3282	1.3153	1.2551	1.2769
10.00	1.3566	1.3438	1.2729	1.2982
10.20	1.3872	1.3737	1.2905	1.3172
≥10.40	1.0000	1.0000	1.0000	1.0000