Catawba Nuclear Station COLR

Catawba Unit 2 Cycle 5

Core Operating Limits Report

November 22, 1991

Duke Power Company

Prepared by: Robert R. St. Clair

Checked by: Kevin P. Waldy

Approved by: R H Clark

QA CONDITION 1

Catawba 2 Cycle 5 Core Operating Limits Report

REVISION LOG

Revision	Effective Date	Effective Pages
Original Issue	22 November 1991	Pages 1 - 15

Catawba 2 Cycle 5 Core Operating Limits Report

1.0 Core Operating Limits Report

This Core Operating Limits Report, (COLR), for Catawba Unit 2, Cycle 5 has been prepared in accordance with the requirements of Technical Specification 6.9.1.9.

The Technical Specifications affected by this report are listed below:

3/4.1.1.3	Moderator Temperature Coefficient
3/4.1.3.5	Shutdown Rod Insertion Limit
3/4.1.3.6	Control Rod Insertion Limit
3/4.2.1	Axial Flux Difference
3/4.2.2	Heat Flux Hot Channel Factor
3/4.2.3	Reactor Coolant System Flow Rate and Nuclear Enthalpy Rise Hot Channel Factor

Catawba 2 Cycle 5 Core Operating Limits Report

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 NRC-approved methodologies specified in Technical Specification 6.9.1.9.

2.1 Moderator Temperature Coefficient (Specification 3/4.1.1.3)

2.1.1 The Moderator Temperature Coefficient (MTC) Limits are:

The MTC shall be less positive than the limits shown in Figure 1. The BOC/ARO/HZP MTC shall be less positive that $0.7 * 10^{-4}$ ΔK/K/°F.

The EOC/ARO/RTP MTC shall be less negative that $-4.1 * 10^{-4}$ ΔK/K/°F.

2.1.2 The MTC Surveillance Limit is:

The 300 PPM/ARO/RTP MTC should be less negative than or equal to $-3.2 * 10^{-4}$ ΔK/K/°F.

Where: BOC stands for Beginning of Cycle
ARO stands for All Rods Out
HZP stands for Hot Zero (Thermal) Power
EOC stands for End of Cycle
RTP stands for Rated Thermal Power

Catawba 2 Cycle 5 Core Operating Limits Report

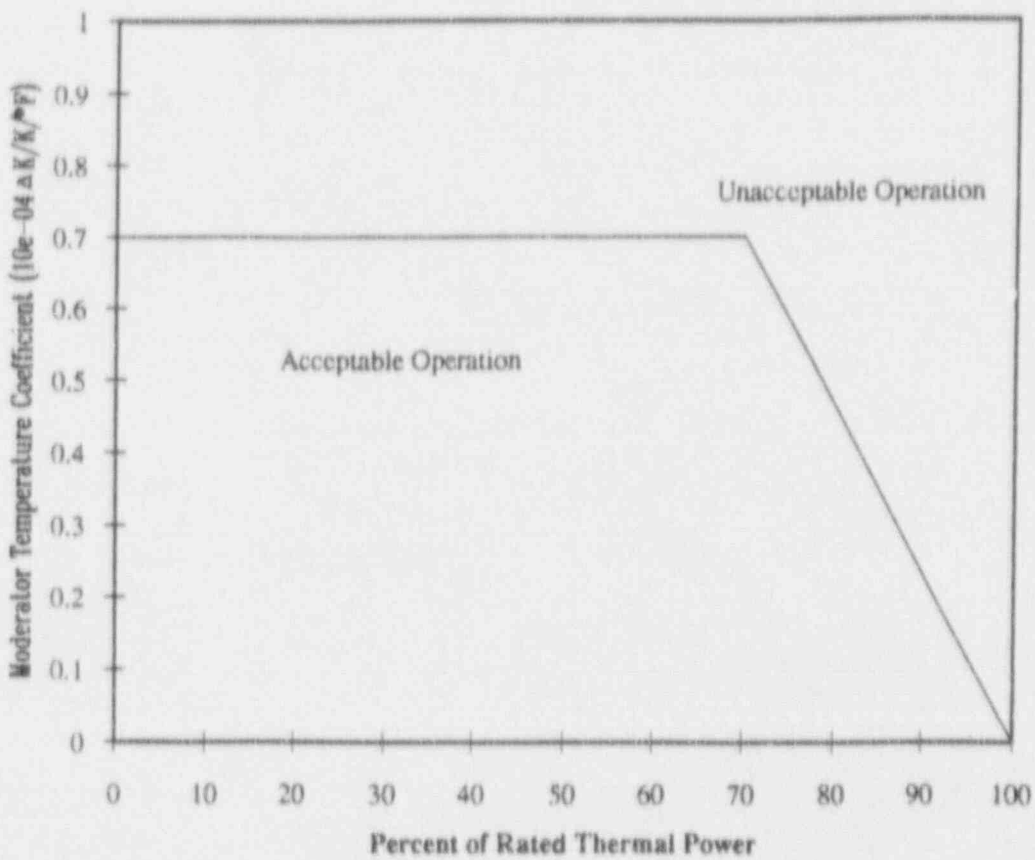


Figure 1

Moderator Temperature Coefficient Versus Power Level

2.2 Shutdown Rod 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2.2.1 The shutdown rods shall be withdrawn to at least 226 steps.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 Rod 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 2.

2.4 Axial Flux Difference (Specification 3/4.2.1)

2.4.1 The AXIAL FLUX DIFFERENCE (AFD) Limits are provided in Figure 3.

2.4.2 The target band during base load operation is not applicable for Catawba 2 Cycle 5.

2.4.3 The minimum allowable power level for Base Load Operation (APL^{ND}) is not applicable for Catawba 2 Cycle 5.

Catawba 2 Cycle 5 Core Operating Limits Report

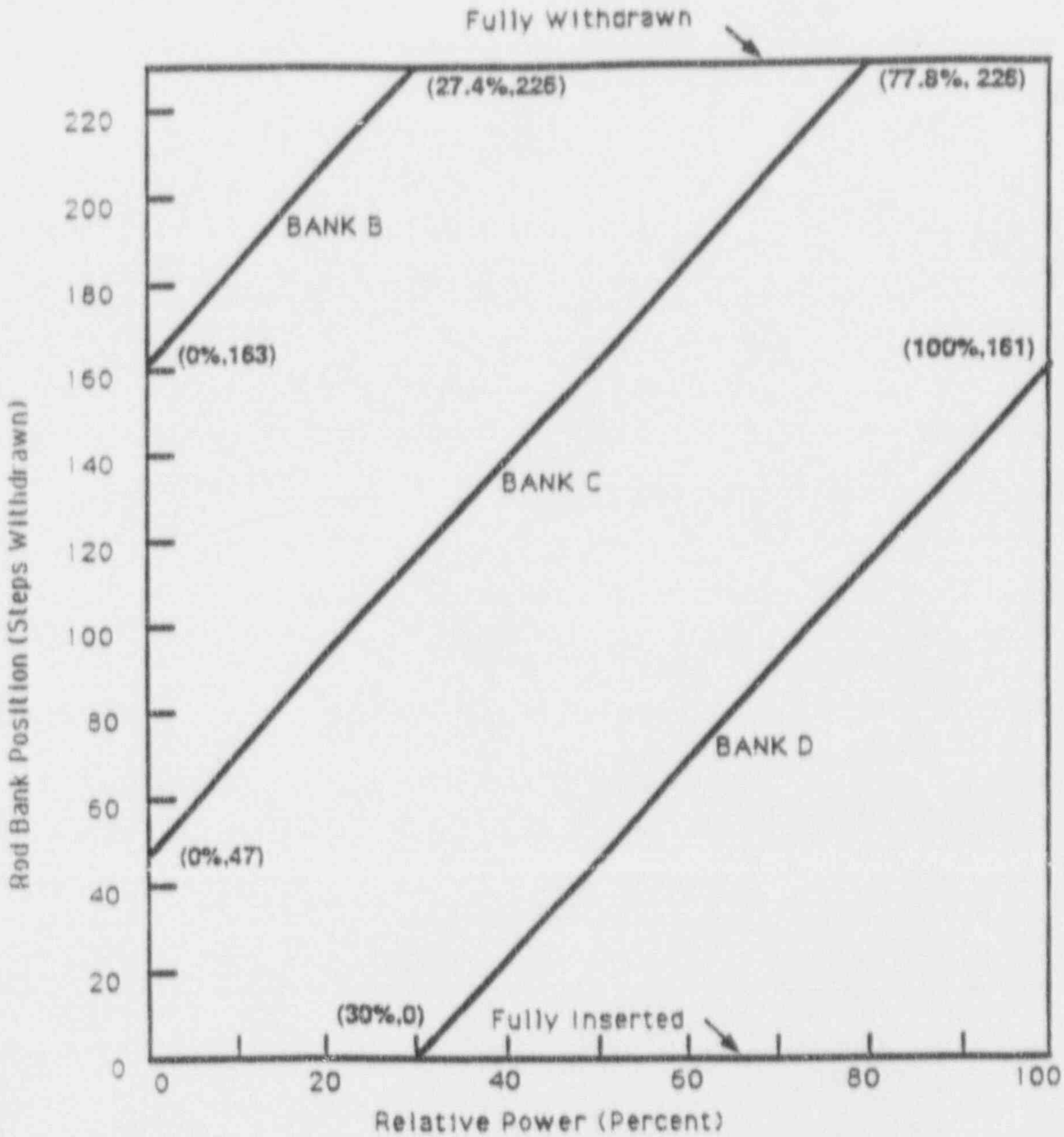


Figure 2

Control Rod Bank Insertion Limits Versus Percent Rated Thermal Power

Catawba 2 Cycle 5 Core Operating Limits Report

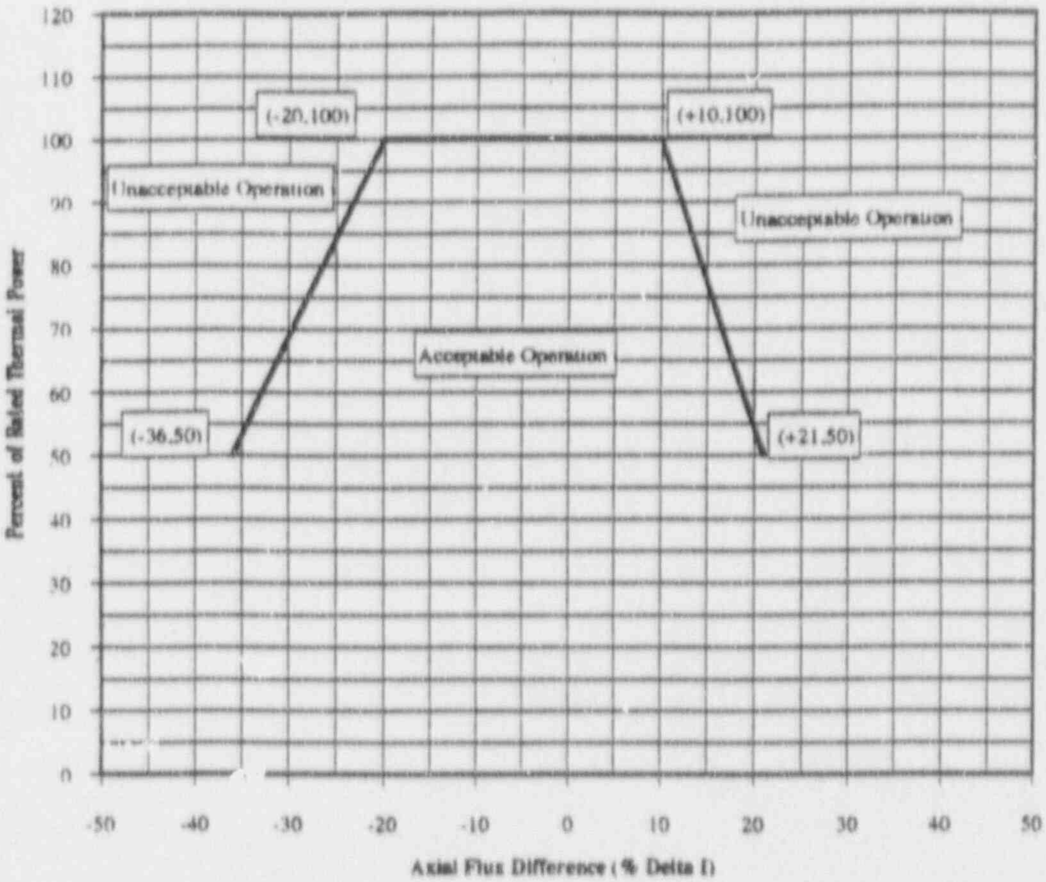


Figure 3

Percent of Rated Thermal Power Versus Axial Flux Difference Limits

2.5 <u>Heat Flux Hot Channel Factor</u> - $F_Q(Z)$ (Specification 3/4.2.2)

$$F_Q(Z) \leq \frac{F_Q^{RTP} * K(Z)}{P} \qquad \text{for } P > 0.5$$

$$F_Q(Z) \leq \frac{F_Q^{RTP} * K(Z)}{0.5} \qquad \text{for } P \leq 0.5$$

where: $P = \dfrac{\text{Thermal Power}}{\text{Rated Thermal Power}}$

2.5.1 $F_Q^{RTP} = 2.32$

2.5.2 K(Z) is provided in Figure 4.

2.5.3 W(Z) values are provided in Figures 5 through 7.

2.5.4 Base load W(Z)'s are not applicable for Catawba 2 Cycle 5.

Catawba 2 Cycle 5 Core Operating Limits Report

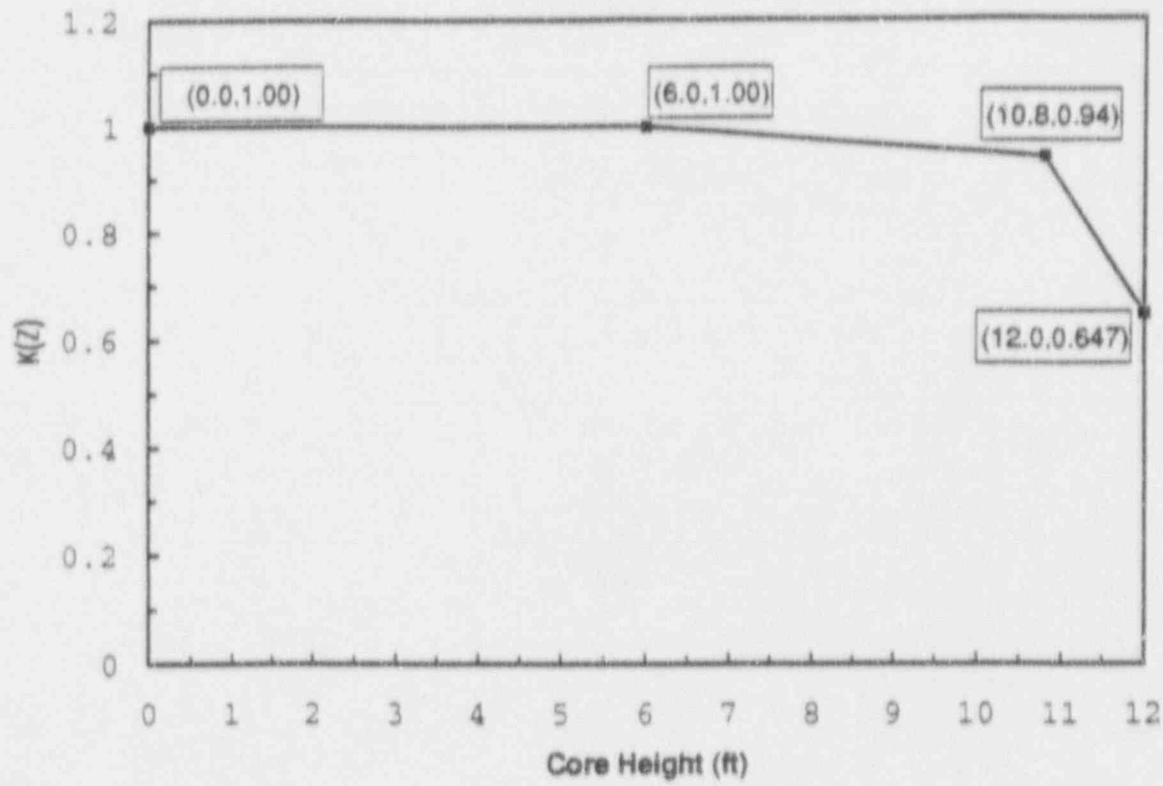
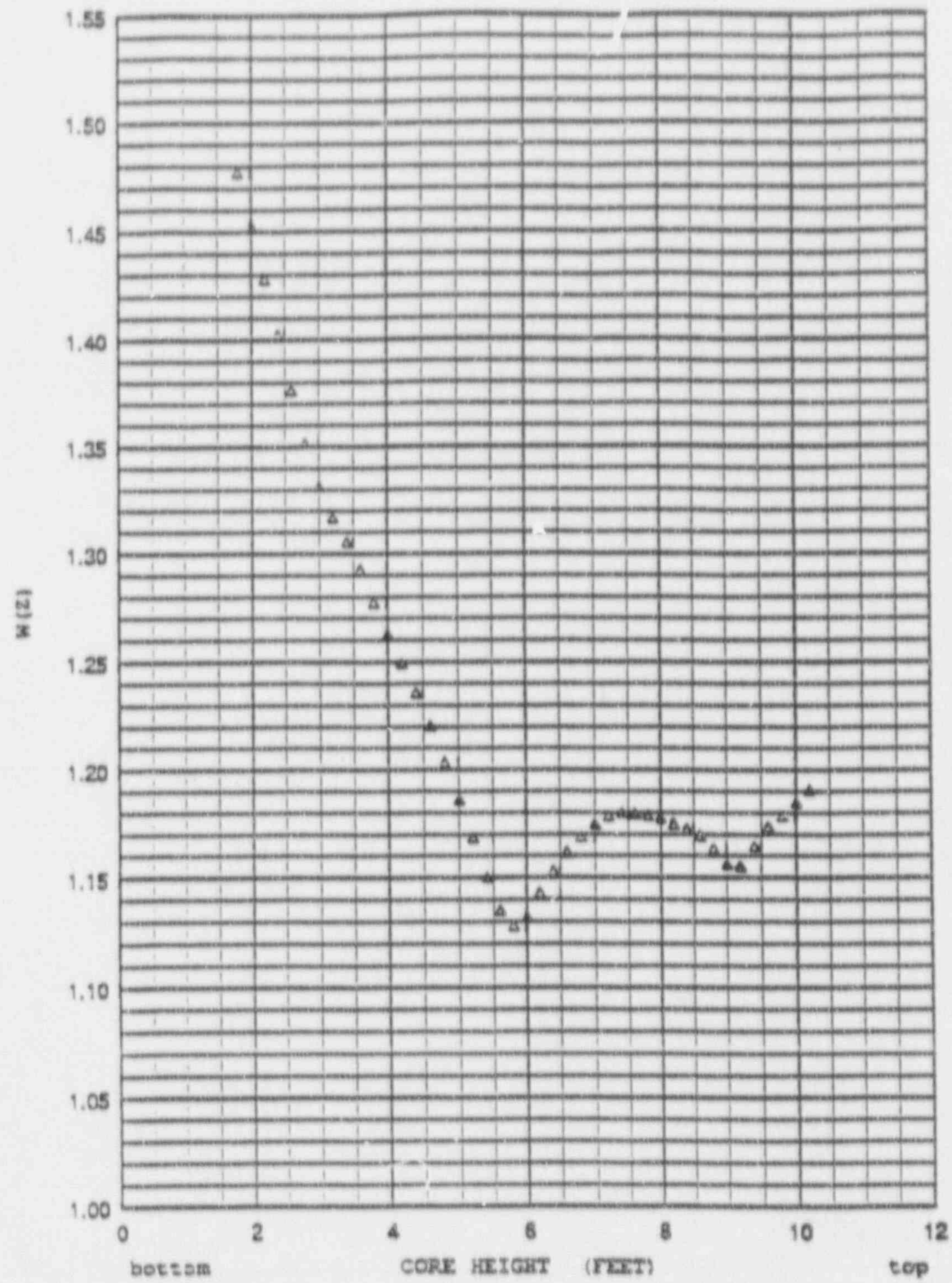


Figure 4

K(Z), Normalized $F_Q(Z)$ as a Function of Core Height

Catawba 2 Cycle 5 Core Op‹ rating Limits Report

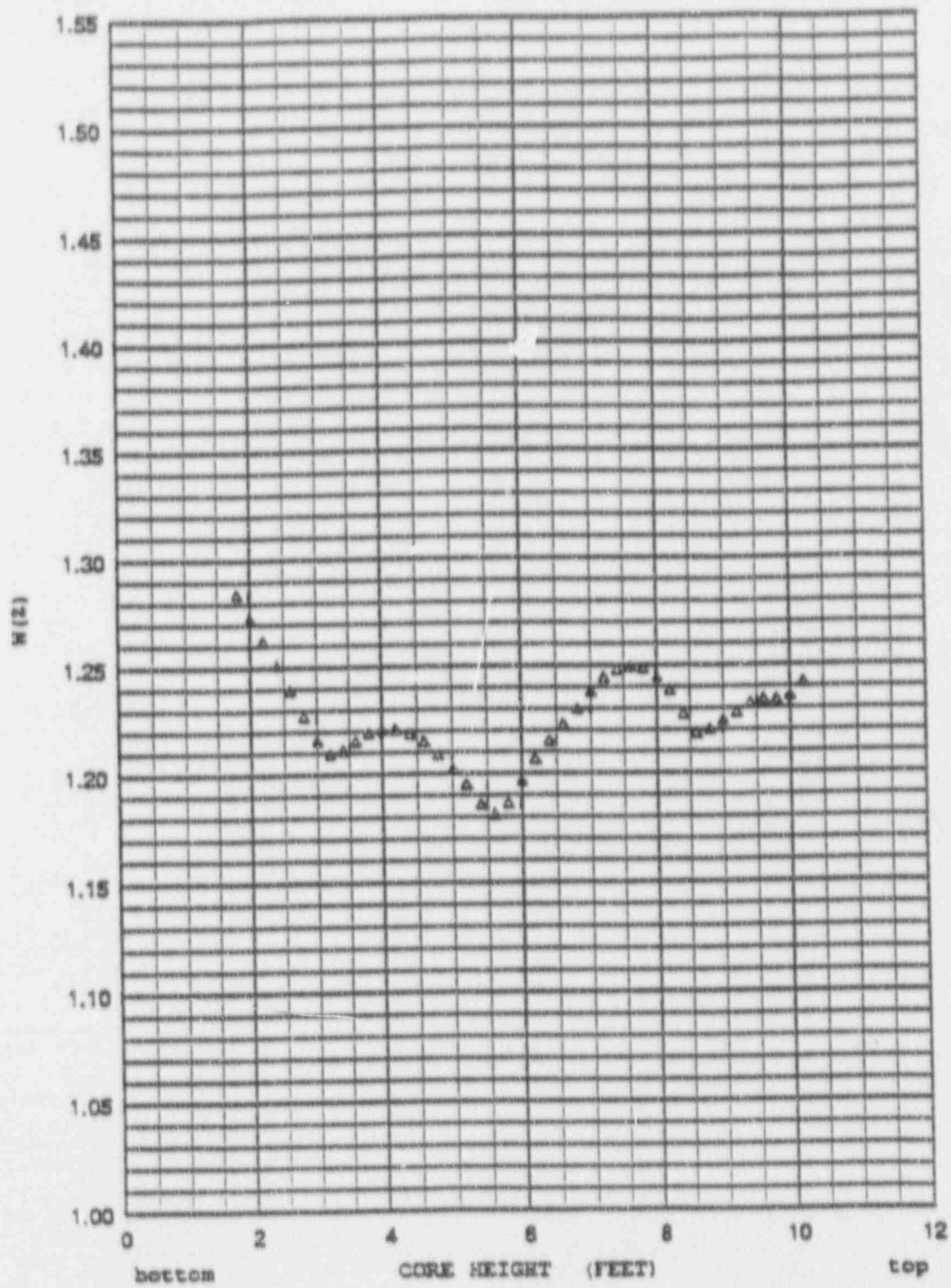


HEIGHT (FEET)	BOL W(Z)
* 0.00	1.0000
* 0.20	1.0000
* 0.40	1.0000
* 0.60	1.0000
* 0.80	1.0000
* 1.00	1.0000
* 1.20	1.0000
* 1.40	1.0000
* 1.60	1.0000
1.80	1.4776
2.00	1.4533
2.20	1.4283
2.40	1.4026
2.60	1.3766
2.00	1.3519
3.00	1.3318
3.20	1.3169
3.40	1.3055
3.60	1.2925
3.80	1.2776
4.00	1.2630
4.20	1.2496
4.40	1.2359
4.60	1.2205
4.80	1.203[illegible]
5.00	[illegible]
5.20	[illegible]
5.40	[illegible]
5.60	[illegible]
5.80	[illegible]
6.00	1.1325
6.20	1.1432
6.40	1.1530
6.60	1.1617
6.80	1.1690
7.00	1.1747
7.20	1.1787
7.40	1.1804
7.60	1.1796
7.80	1.1787
8.00	1.1775
8.20	1.1747
8.40	1.1723
8.60	1.1694
8.80	1.1637
9.00	1.1565
9.20	1.1550
9.40	1.1647
9.60	1.1734
9.80	1.1787
10.00	1.1848
10.20	1.1909
* 10.40	1.0000
* 10.60	1.0000
* 10.80	1.0000
* 11.00	1.0000
* 11.20	1.0000
* 11.40	1.0000
* 11.60	1.0000
* 11.80	1.0000
* 12.00	1.0000

Figure 5
Catawba Unit 2 Cycle 5
RAOC W(Z) at 150 MWD/MTU

Top and Bottom 15% excluded as per Tech. Spec. 4.2.2.2.G

Catawba 2 Cycle 5 Core Operating Limits Report

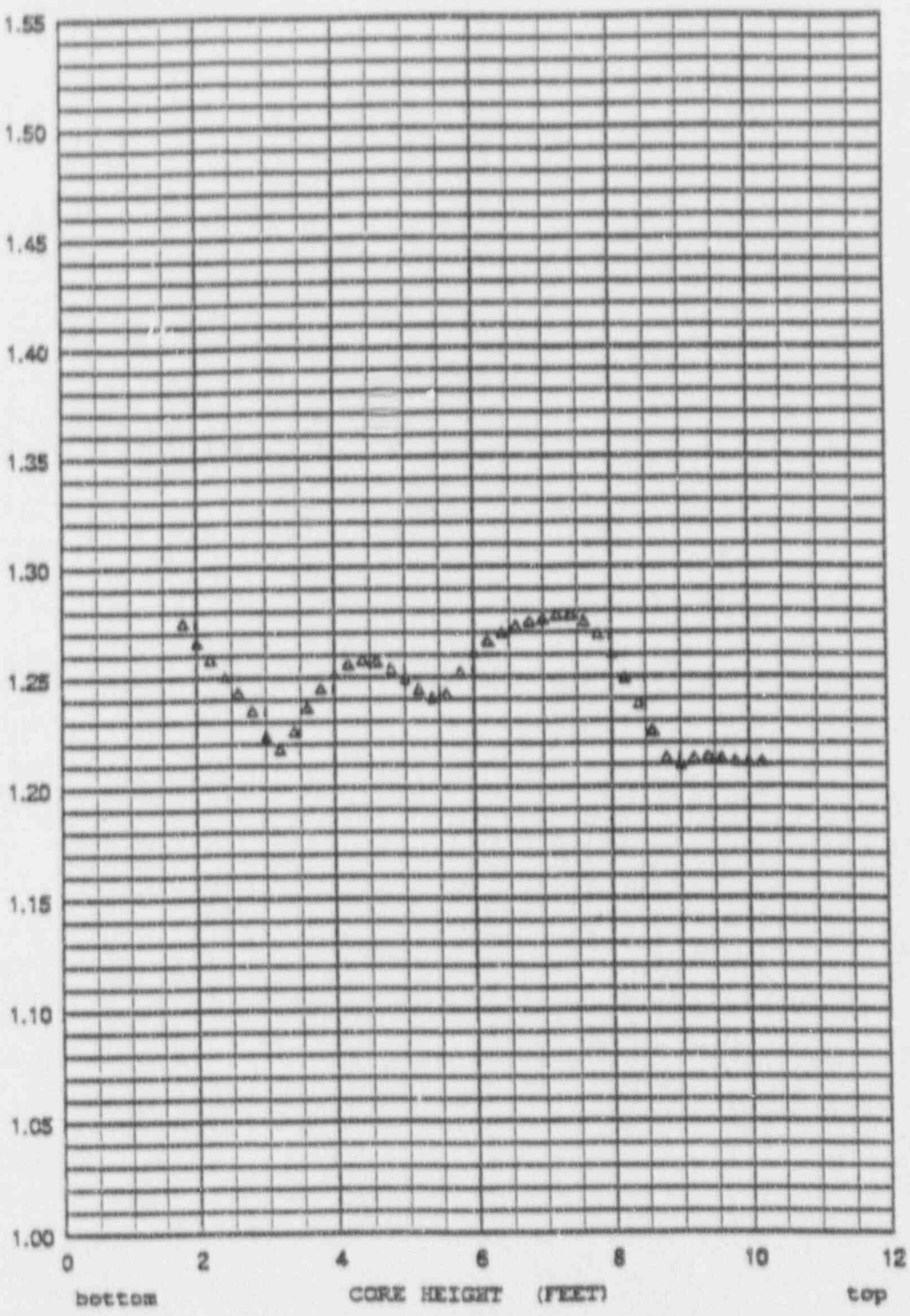


HEIGHT (FEET)	MOL W(Z)
* 0.00	1.0000
* 0.20	1.0000
* 0.40	1.0000
* 0.60	1.0000
* 0.80	1.0000
* 1.00	1.0000
* 1.20	1.0000
* 1.40	1.0000
* 1.60	1.0000
1.80	1.2844
2.00	1.2735
2.20	1.2624
2.40	1.2512
2.60	1.2396
2.80	1.2274
3.00	1.2159
3.20	1.2097
3.40	1.21[illegible]4
3.60	1.2157
3.80	1.2193
4.00	1.2209
4.20	1.2207
4.40	1.2188
4.60	1.2150
4.80	1.2091
5.00	1.2022
5.20	1.1[illegible]
5.40	1.[illegible]
5.60	[illegible]
5.80	1.[illegible]
6.00	1.[illegible]
6.20	1.2070
6.40	1.215[illegible]
6.60	1.222[illegible]
6.80	1.230[illegible]
7.00	1.238[illegible]
7.20	1.244[illegible]
7.40	1.248[illegible]
7.60	1.249[illegible]
7.80	1.248[illegible]
8.00	1.244[illegible]
8.20	1.238[illegible]
8.40	1.227[illegible]
8.60	1.218[illegible]
8.80	1.220[illegible]
9.00	1.224[illegible]
9.20	1.228[illegible]
9.40	1.232[illegible]
9.60	1.234[illegible]
9.80	1.233[illegible]
10.00	1.235[illegible]
10.20	1.241[illegible]
* 10.40	1.000
* 10.60	1.000
* 10.80	1.000
* 11.00	1.000
* 11.20	1.000
* 11.40	1.000
* 11.60	1.000
* 11.80	1.000
* 12.00	1.000

Figure 6
Catawba Unit 2 Cycle 5
RAOC W(Z) at 8000 MWD/MTU

Top and Bottom 15% excluded as per Tech. Spec. - 2.2.2.G

Catawba 2 Cycle 5 Core Operating Limits Report



HEIGHT (FEET)	EOL W(Z)
* 0.00	1.000
* 0.20	1.000
* 0.40	1.000
* 0.60	1.000
* 0.80	1.000
* 1.00	1.000
* 1.20	1.000
* 1.40	1.000
* 1.60	1.000
1.80	1.27
2.00	1.26
2.20	1.25
2.40	1.25
2.60	1.24
2.80	1.23
3.00	1.22
3.20	1.21
3.40	1.22
3.60	1.23
3.80	1.24
4.00	1.25
4.20	1.25
4.40	1.25
4.60	1.25
4.80	1.25
5.00	1.24
5.20	1.24
5.40	1.24
5.60	1.24
5.80	1.
6.00	
6.20	
6.40	
6.60	1.
6.80	1.27
7.00	1.27
7.20	1.27
7.40	1.27
7.60	1.27
7.80	1.26
8.00	1.26
8.20	1.24
8.40	1.23
8.60	1.22
8.80	1.21
9.00	1.21
9.20	1.21
9.40	1.21
9.60	1.21
9.80	1.21
10.00	1.21
10.20	1.21
* 10.40	1.00
* 10.60	1.00
* 10.80	1.00
* 11.00	1.00
* 11.20	1.00
* 11.40	1.00
* 11.60	1.00
* 11.80	1.00
* 12.00	1.00

Figure 7
Catawba Unit 2 Cycle 5
RAOC W(Z) at 13000 MWD/MTU

Top and Bottom 15% excluded as per Tech. Spec. 4.2.2.2.G

Catawba 2 Cycle 5 Core Operating Limits Report

2.6 RCS Flow Rate and Nuclear Enthalpy Rise Hot Chennel Factor - $F^N_{\Delta H}$ (Specification 3/4.2.3)

$$R = \frac{F^N_{\Delta H}}{F^{RTP}_{\Delta H} * (1 + MF_{\Delta H} * (1-P))}$$

where: $P = \frac{\text{Thermal Power}}{\text{Rated Thermal Power}}$

2.6.1 $F^{RTP}_{\Delta H} = 1.49$

2.6.2 $MF_{\Delta H} = 0.3$

2.6.3 The Acceptable Operation Region from the combination of Reactor Coolant System total flow and R is provided in Figure 8.

Catawba 2 Cycle 5 Core Operating Limits Report

Penalties of 0.1% for undetected feedwater venturi fouling and measurement uncertainties of 2.1% for flow and 4.0% for incore measurement of $F^N_{\Delta H}$ are included in this figure.

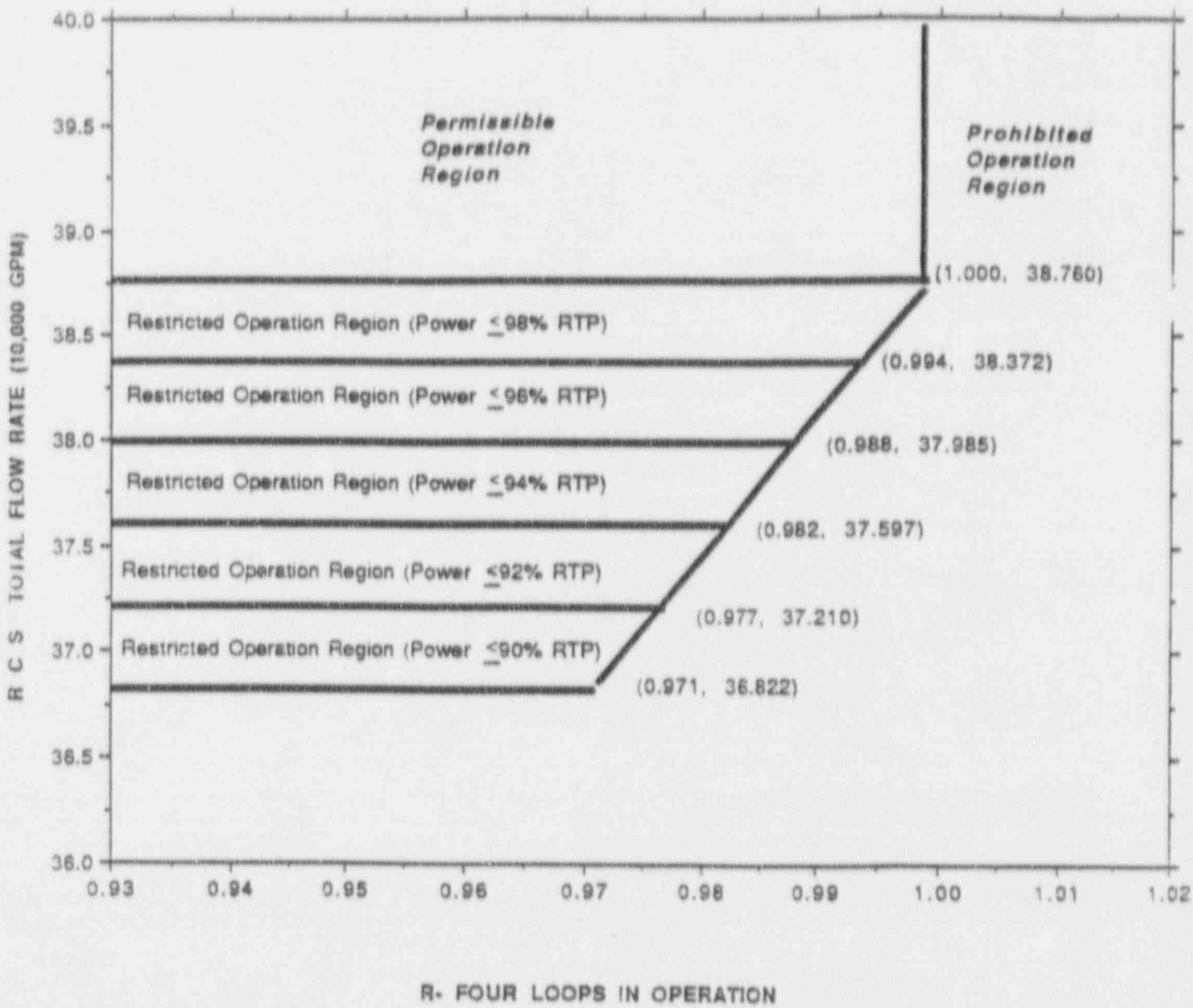


Figure 8
RCS Flow vs. R-Four Loops in Operation

DOCUMENT CONTROL NO. CNEI-0400-15

REVISION NO. 0

TITLE: CATAWBA 2 CYCLE 5
SNACORE Theorectical Factors

		SIGN OFF DATE
PREPARED BY	Sandra L. Abbey	12/19/91
CHECKED BY	ML Elder	12/19/91
APPROVED BY	[illegible]	12/19/91

QA CONDITION 1

DATE: 1-6-92
REVISED BY: jmj

December 18, 1991

G. P. Horne, Reactor Engineer
Catawba Nuclear Station

Subject: Catawba 2 Cycle 5 SNACORE Theoretical Factors

The C2C5 Theoretical Factors have been generated and stored in VAX account CAT::PROD$SND. The filenames and their respective burnup ranges are listed in the attachment. The factors have received an engineering review within Nuclear Design as documented in calculation file CNC-1553.05-00-0134. A copy of this calculation file will be sent to G. P. Horne.

Please contact me at 382-1667 if you have any problems or questions.

Sandra L. Abbey

S. L. Abbey, Associate Engineer
Nuclear Engineering
Nuclear Services

cc: K. S. Canady
R. H. Clark
R. R. St. Clair
M. L. Elder

Attachment

C2C05 Theoretical Factor Files

Theoretical Factor File	Exposure Range	Number of Assemblages
SNDUHZP.DAT	BOC	482
SNDU30P.DAT	BOC	482
SNDU150.DAT	BOC 325	519
SNDU500.DAT	326-750	519
SNDU1K.DAT	751-1500	519
SNDU2K.DAT	1501-2500	576
SNDU3K.DAT	2501-3500	576
SNDU4K.DAT	3501-4500	576
SNDU5K.DAT	4501-5500	605
SNDU6K.DAT	5501-6500	605
SNDU7K.DAT	6501-7500	605
SNDU8K.DAT	7501-8500	605
SNDU9K.DAT	8501-9500	599
SNDU10K.DAT	9501-10500	599
SNDU11K.DAT	10501-11500	599
SNDU12K.DAT	11501-12500	599
SNDU13K.DAT	12501-13500	561
SNDU14K.DAT	13501-14500	561
SNDU15K.DAT	14501-15500	561
SNDU16K.DAT	15501-16700	561

Note: All Theoretical Factors sets contain two axial configurations. Sets SNADUHZP.DAT and SNADU30P.DAT are for approximately 0% RTP and 30% RTP conditions, respectively.