PALADON REVIEW

INTRODUCTION	P. K. DOSHI
GENERIC COMPARISONS	R. D. ANKNEY
PLANT F GENERIC COMPARISONS	D. L. STUCKER
PLANT F CYCLE SPECIFIC BENCHMARKING	D. L. STUCKER
CONCLUSIONS	D. J. HILL

PALADON STATUS

A PALADON TOPICAL - WCAP-9485 WAS SUBMITTED TO THE NRC FOR REVIEW IN DECEMBER, 1978. IN SEPTEMBER, 1979, THE NRC GAVE SER FOR THE FOLLOWING PALADON APPLICATIONS.

- ISOTHERMAL TEMPERATURE COEFFICIENT
- CONTROL ROD WORTHS
- POWER DISTRIBUTION
- CRITICAL BORON CONCENTRATIONS
- DROPPED ROD/BANK PEAKING FACTORS
- N-1 ROD WORTH

ROD SWAP

PALADON IS ALSO RECOGNIZED AS AN APPROVED DESIGN TOOL FOR ROD SWAP. THIS INVOLVES THE USAGE OF PALADON IN 3-D MODE.

PRESENT PLANS FOR PALADON

AN ADDENDUM TO WCAP-9485 WILL BE ISSUED BY JUNE, 1981. THIS ADDENDUM WILL ADDRESS 3-D APPLICATIONS.

USE OF NON-STANDARD METHODS

WESTINGHOUSE NUCLEAR DESIGN PROCEDURES AS WELL AS WESTINGHOUSE RELOAD SAFETY EVALUATION METHODOLOGY (WCAP-9272) PERMIT THE DESIGNERS TO USE NON-STANDARD METHODS PROVIDED THAT THE NON-STANDARD METHODS ARE BENCHMARKED TO STANDARD METHODS AND FOLLOW NORMAL QUALITY ASSURANCE PROCEDURES.

NON-STANDARD METHODS ARE USED FOR

- BETTER CORE REPRESENTATIONS
- MORE ACCURATE METHODS/MODELS
- CODE LIMITATIONS
- EMERGENCY RESPONSE

3D PALADON

OBJECTIVE:

TO PRESENT 3D PALADON DATA WHICH ILLUSTRATES PALADON'S CAPABILITY AS A 3D DESIGN TOOL

SUMMARY OF DISCUSSION:

-- COMPARISONS WITH MEASUREMENT

ROD WORTHS

ROD SWAP RESULTS

PSEUDO-EJECTED ROD INCORE MAPS

-- COMPARISONS WITH STANDARD METHODS

SIMILARITIES AND DIFFERENCES BETWEEN 3D PALADON AND 3D TURTLE

PALADON/TURTLE COMPARISONS FOR ROD EJECTION

PALADON/TURTLE STEAMBREAK COMPARISONS

PALADON/TURTLE $F_{XY}(Z)$ COMPARISONS

AXIAL POWER SHAPE COMPARISONS

3D PALADON MODELS

+ a,c

[

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COMPARISONS WITH MEASUREMENT

CONTROL ROD WORTH COMPARISONS

PLANT	CYCLE	CONFIGURATION	MEASUREMENT*	2-D PALADON (M/P)	3-D PALADON (M/P)
3 Loop A	3	D			
		C			
		B			
		A			
3 Loop B	2	D			
		C			
		B			
		A			
3 Loop C	3	D			
		C			
4 Loop A	1	D			
		C			
		B			
		A			
4 Loop B	1	D			
		C			
		B			
		A			

+ a,c

*Standard Measurement Technique

ROD SWAP ROD WORTH COMPARISONS

MEASURED / PREDICTED

ANK	2-LOOP A CYCLE 7	2-LOOP A CYCLE 8	2-LOOP B CYCLE 6	3-LOOP D CYCLE 2	4-LOOP F CYCLE 1
D					
C					
B					
A					
SA					
SB					
SC					
SD					

+ a,c

COMPARISONS TO PSEUDO-EJECTED ROD INCORE FLUX MAPS

-- PSEUDO-EJECTED ROD MAPS ARE USUALLY TAKEN DURING FIRST CORE STARTUP TESTING

-- ACCURACY OF PSEUDO EJECTED ROD FLUX MAPS IS HINDERED BY LOW FLUX LEVELS, SPATIAL XENON TRANSIENTS, AND THE NEED FOR FULL CORE (HENCE, COARSE MESH) TURTLE INCORE CONSTANTS

-- MEASUREMENT ERRORS ARE LARGER THAN FOR HIGH POWER, STEADY STATE CONDITIONS

-- DESPITE THE ABOVE, COMPARISONS OF 3D-PALADON POWER DISTRIBUTIONS WITH MEASUREMENT SHOW GOOD AGREEMENT

CYCLE 1 PSEUDO-EJECTED ROD COMPARISONS WITH MEASUREMENT

+a,c

Case	TURTLE-INCORE MEASUREMENT $F_{\Delta H}$	TURTLE-INCORE MEASUREMENT LOCATION	3D-PALADON $F_{\Delta H}$	3D-PALADON LOCATION	TURTLE-INCORE MEASUREMENT F_Q	TURTLE-INCORE MEASUREMENT LOCATION	3D-PALADON F_Q	3D-PALADON LOCATION
4 LOOP C CYCLE 1 HZP, B06 EJ. D/0, C/57, B/185								
4 LOOP C CYCLE 1 30 PCT, B06 EJ. D/147								
4 LOOP A CYCLE 1 HZP, D12 EJ. D/0, C/0								
4 LOOP A CYCLE 1 30 PCT, D12 EJ. D/137								
3 LOOP D CYCLE 1 HZP, H14 EJ. D/0, C/114								
4 LOOP B CYCLE 1 HZP, B06 EJ. D/0, C/63								
4 LOOP B CYCLE 1 50 PCT, B06 EJ. D/200								

4 LOOP A CYCLE 1 Westinghouse Non-Proprietary

PSEUDO-EJECTED ROD HOT OCTANT

[ ]

+ a,c

[ ]

$\frac{\text{MEASURED} - \text{PALADON}}{\text{PALADON}} \times 100 = \%$ DIFFERENCE

4 LOOP C CYCLE 1

Westinghouse Non-Proprietary

PSEUDO- EJECTED ROD HOT OCTANT

30 PCT. POWER, D/147, B06 EJECT.

+ a,c

[ ]

$\frac{\text{MEASURED-PALADON}}{\text{PALADON}} \times 100 = \%\text{ DIFFERENCE}$

3 LOOP D CYCLE 1 Westinghouse Non-Proprietary

PSEUDO-EJECTED ROD HOT OCTANT

HZP, D/0, C/114, H14 EJECTED

+ a,c

[redacted]

$\frac{\text{MEASURED - PALADON}}{\text{PALADON}} \times 100 = \%$ DIFFERENC

COMPARISONS WITH STANDARD METHODS

-- 3D PALADON WOULD REPLACE 3D-TURTLE
(2-GROUP COARSE MESH DIFFUSION THEORY MODEL)

-- 3D PALADON APPLICATIONS WOULD CONSIST OF THOSE ITEMS IDENTIFIED IN THE RELOAD METHODOLOGY TOPICAL (WCAP-9272)

-- THESE APPLICATIONS PRIMARILY CONSIST OF:

- STEAMLINE BREAK CALCULATIONS
- HZP ROD EJECTION CALCULATIONS
- $F_{XY}(Z)$ DETERMINATION FOR INPUT TO THE LOSS OF COOLANT ACCIDENT FINAL ACCEPTANCE CRITERIA ANALYSIS

3D-PAL.DON / 3D-TURTLE SIMILARITIES

+ a,c

[

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3D-PALADON / 3D-TURTLE DIFFERENCES

+ a,c

4LOOP E CY2

BØL, HFP, EQ XENON

AVERAGE ASSEMBLY POWER

Westinghouse Non-Proprietary

+ a,c

[redacted]

PALADON
% DIFF
TURTLE

4LOOP E CYCLE 2
EOL, HFP, EQ. XENON
AVERAGE ASSEMBLY POWERS

Westinghouse Non-Proprietary

+ a,c

Bu = 13300 MWD/MTU

PALADON
%DIFF
TURTLE

3D PALADON / 3D TURTLE ROD EJECTION COMPARISONS

THE CRITICAL QUANTITIES ARE F_Q AND $\Delta\rho_{EJ}$

PLANT	CASE	TURTLE F_Q	PALADON F_Q	TURTLE $\Delta\rho_{EJ}$ (% $\Delta\rho$)	PALADON $\Delta\rho_{EJ}$ (% $\Delta\rho$)
3 LOOP D CYCLE 2	BOL, HZP H-14 EJ.				
3 LOOP D CYCLE 2	EOL, HZP H-14 EJ.				
4 LOOP D CYCLE 6	BOL, HZP K-04 EJ.				
4 LOOP D CYCLE 6	EOL, HZP K-04 EJ.				

+ a,c

Westinghouse Non-Proprietary

3 LOOP-D CYZ

EOL H-14 EJECTED HZP

PALADON / TURTLE COMPARISON

ASSEMBLY POWER

+ a,c

$\frac{\text{TURTLE-PALADON}}{\text{PALADON}} \times 100 = \%\text{DIFFERENCE}$

3LOOP-D C42

Westinghouse Non-Proprietary

EOL H-14 EJECTED HZP
PALADON/TURTLE COMPARISON
AXIAL OFFSET

+ a,c

PALADON - URTLE = DIFFERENCE

4LOOP D CYCLE 6
EOL K-6 EJECTED HZP
PALADON/TURTLE COMPARISON
ASSEMBLY POWER

+ a,c

[ ]

$\frac{\text{TURTLE - PALADON}}{\text{PALADON}} \times 100 = \%\ \text{DIFFERENCE}$

4 LOOP D CYCLE 6
EOL K-6 EJECTED HZP
PALADON/TURTLE COMPARISON
ASSEMBLY AXIAL OFFSET

Westinghouse Non-Proprietary

+ a,c

TURTLE-PALADON = DIFFERENCE

3D PALADON / 3D TURTLE HYPOTHETICAL STEAMLINE BREAK COMPARISONS

-- 3D STEAMBREAK CALCULATIONS NORMALLY PROVIDE THE HOT ASSEMBLY AXIAL POWER SHAPE FOR INPUT TO THE THERMAL HYDRAULICS CODE THAT PERFORMS THE DNB CALCULATION

-- 3D STEAMBREAK CALCULATIONS CAN ALSO VERIFY THE REACTIVITY CONSERVATISM OF THE FSAR STEAMLINE BREAK ANALYSIS AND PROVIDE RADIAL POWER DISTRIBUTION FACTORS FOR INPUT TO THE T/H DNB ANALYSIS

HYPOTHETICAL BREAK STATEPOINTS FOR TYPICAL 3 AND 4 LOOP PLANTS

+ a,c

	4 LOOP E INSIDE BRK. WITH POWER	4 LOOP E INSIDE BRK. W/O POWER	3 LOOP D INSIDE BRK. WITH POWER	3 LOOP D INSIDE BRK. W/O POWER
POWER (%)				
PRESSURE (PSI)				
FLOW (GPM)				
COLD LEG TEMP. FOR FAILED LOOP (°F)				
COLD LEG TEMP. FOR REMAINING LOOPS (°F)				
PPM BORON				

*ARTICIFIALLY SET TO ZERO

3D PALADON / 3D TURTLE STEAMLINE BREAK

STATEPOINT REACTIVITY* COMPARISON

	3D-TURTLE (%Δρ)	3D-PALADON (%Δρ)
4 LOOP E WITH POWER		
4 LOOP E W/O POWER		
3 LOOP D WITH POWER		
3 LOOP D W/O POWER		

+ a,c

*REFERENCE CONDITION IS HZP N-1 CONFIGURATION

3LOOP-D C42 Westinghouse Non-Proprietary

W/POWER HYPOTHETICAL STEAMBREAK

PALADON/ TURTLE COMPARISON

ASSEMBLY POWER

+ a,c

$$\frac{\text{TURTLE-PALADON}}{\text{PALADON}} \times 100 = \%\text{DIFFERENCE}$$

3LOOP-D CY2

Westinghouse Non-Proprietary

W/POWER HYPOTHETICAL STEAMBREAK
PALADON/ TURTLE COMPARISON
AXIAL OFFSET

+ a,c

PALADON- TURTLE = DIFFERENCE

Westinghouse Non-Proprietary

4 LOOP E CYCLE 2
W/O POWER HYPOTHETICAL STEAMBREAK
PALADON/TURTLE COMPARISON
ASSEMBLY POWER

+ a,c

[ ]

$\frac{\text{TURTLE-PALADON}}{\text{PALADON}} \times 100 = \text{\% DIFFERENCE}$

4 LOOP E CYCLE 2

W/O POWER HYPOTHETICAL STEAMBREAK

PALADON/TURTLE COMPARISON

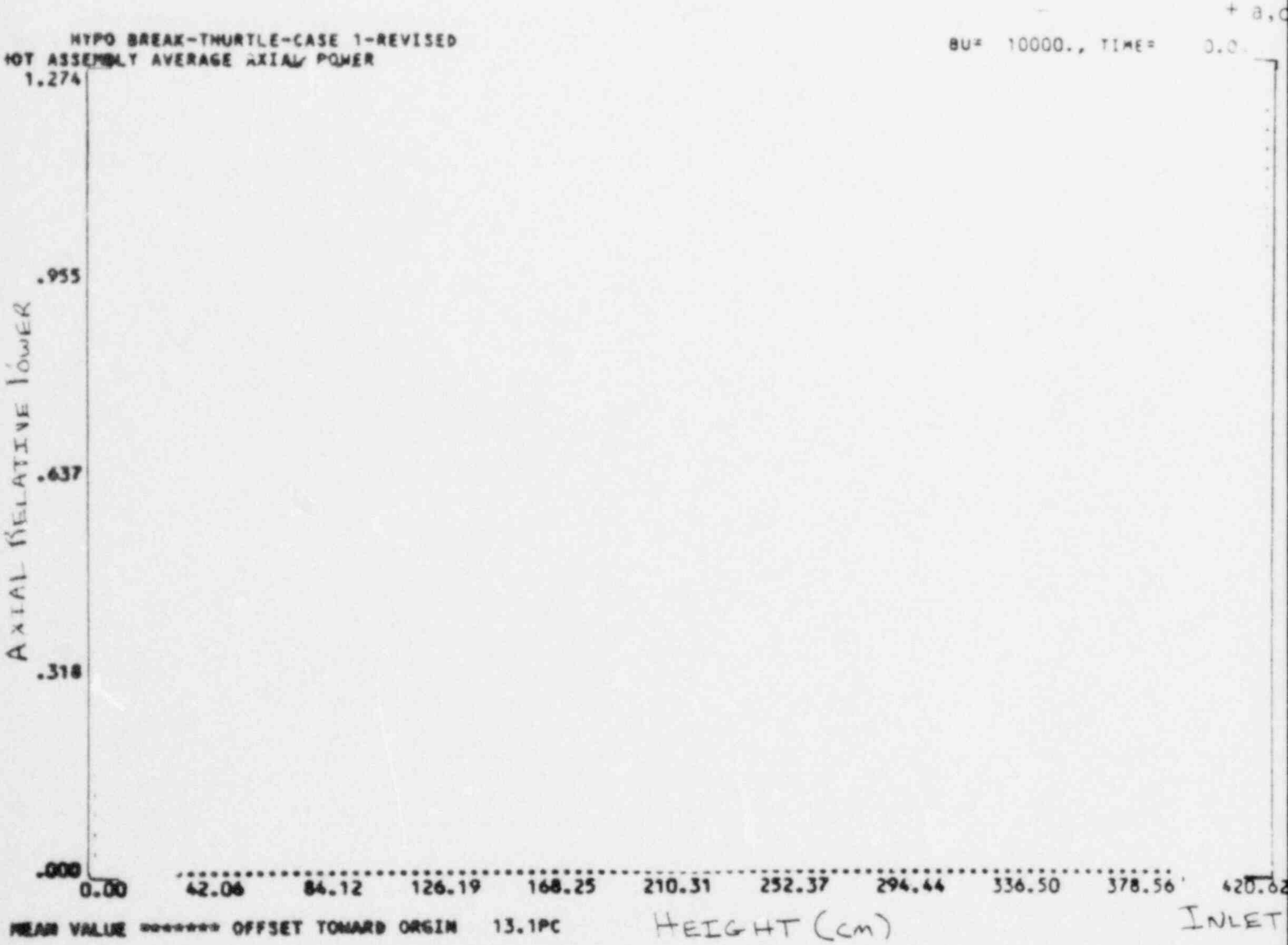
AXIAL OFFSET

+ a,c

TURTLE - PALADON = DIFFERENCE

3-LOOP-D CYCLE 2

W/POWER HYPOTHETICAL BREAK
HOT ASSEMBLY AXIAL POWER SHAPE



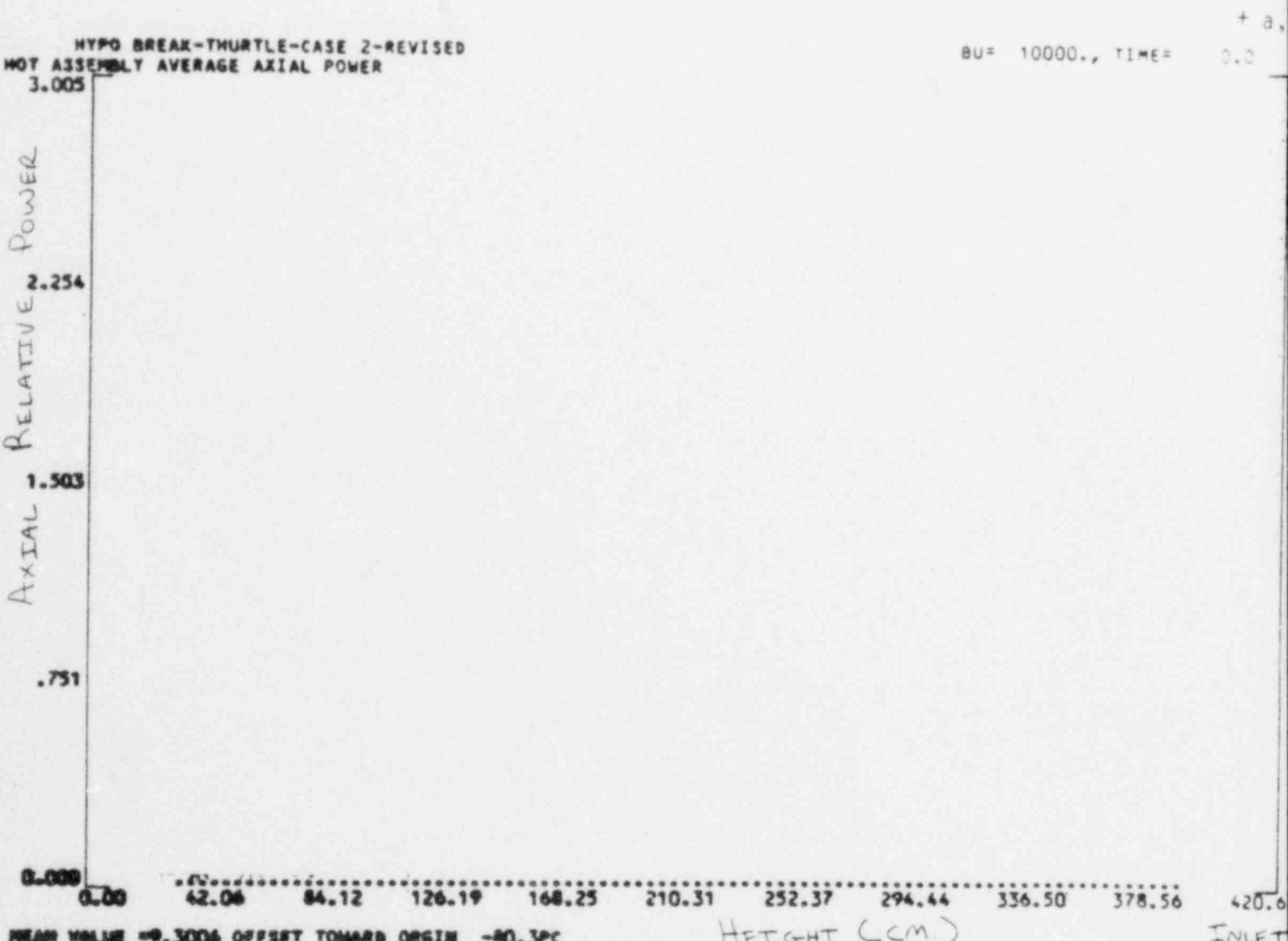
X 3D-PALADON

P 3D-TURTLE

3-Loop-D Cycle 2 Westinghouse Non-Proprietary

W/o Power Hypothetical Break

Hot Assembly Axial Power Shape



X 3D-PALADON

P 3D-TURTLE

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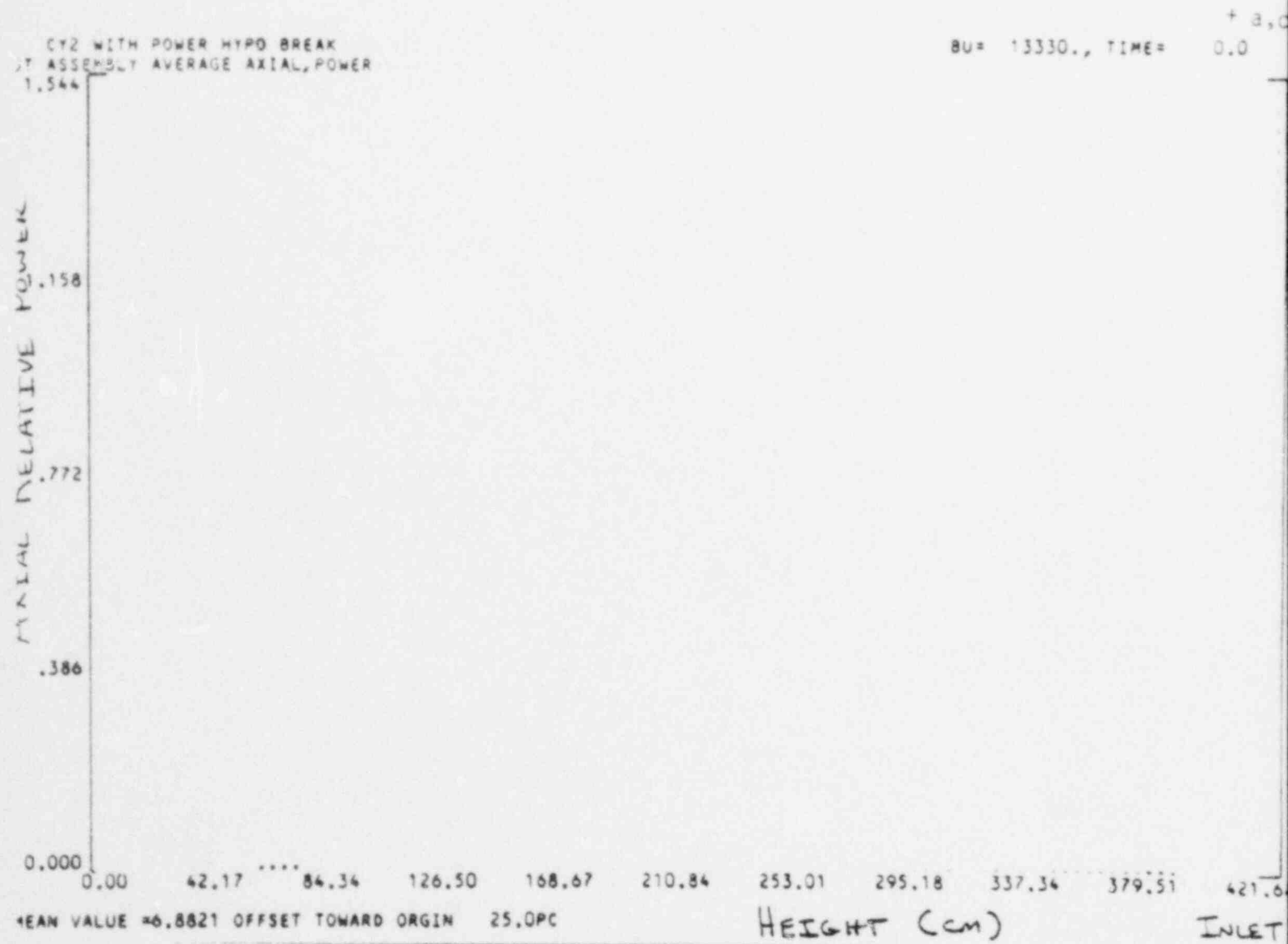
4-LOOP-E CYCLE 2
W/POWER HYPOTHETICAL BREAK
HOT ASSEMBLY AXIAL POWER SHAPE



X 3D-PALADON

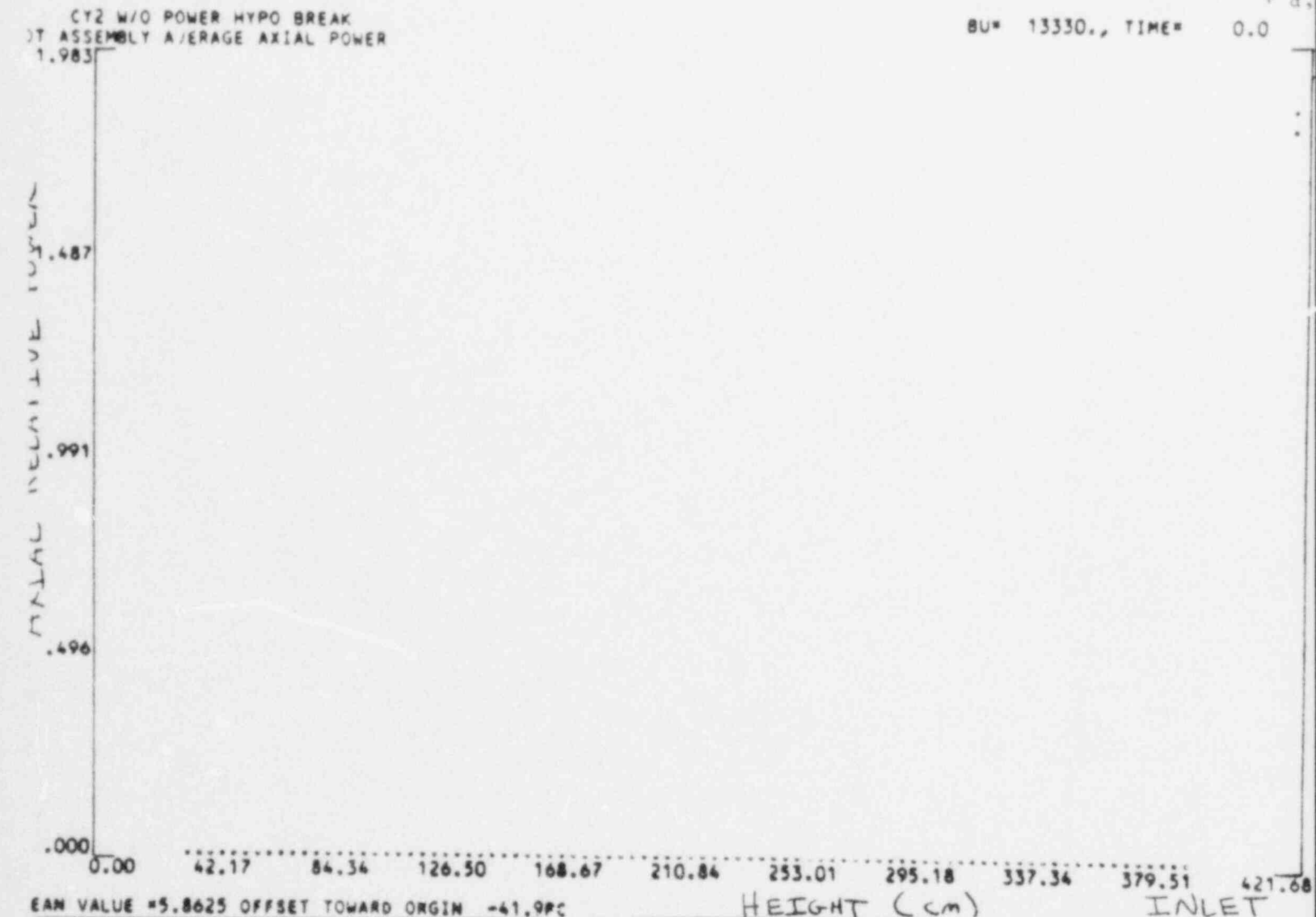
P 3D-TURTLE

4 LOOP-E CYCLE 2 Westinghouse Non-Proprietary

W/O POWER HYPOTHETICAL BREAK

HOT ASSEMBLY AXIAL POWER SHAPE

+ a,



X 3D-PALADON

P 3D-TURTLE

3D PALADON / 3D TURTLE $F_{XY}(Z)$ COMPARISONS

+ a,c

WORK SHEET
WESTINGHOUSE FORM 8295 E

Westinghouse Non-Proprietary

4LOOP-D CY6 AKO HFP

CORE HEIGHT (FT.)	BOL			EOL		
	TURTLE Fxy	PALADON Fxy	TURTLE [illegible]	TURTLE Fxy	PALADON Fxy	TURTLE [illegible]
11.87						
11.49						
10.97						
10.20						
9.27						
8.34						
7.41						
6.47						
5.54						
4.61						
3.68						
2.75						
1.82						
1.05						
.53						
.15						
MEAN TURTLE/PALADON						

+ a,c

4LOOP-D C16 DIN HFP

+ a,c

CORE HEIGHT (FT)	BOL TURTLE Fxy	BOL PALADON Fxy	BOL TURTLE/PALADON	EOL Fxy	EOL PALADON Fxy	EOL TURTLE/PALADON
11.87						
11.49						
10.97						
10.20						
9.27						
8.34						
7.41						
6.47						
5.54						
4.61						
3.68						
2.75						
1.82						
1.05						
.53						
.15						
MEAN TURTLE/PALADON						

3LOOP-D CY2 ARO HFP

CORE HEIGHT (FT.)	BOL TURTLE FXY	BOL PALADON FXY	BOL TURTLE / PALADON	EOL TURTLE FXY	EOL PALADON FXY	EOL TURTLE / PALADON
11.87						
11.49						
10.97						
10.20						
9.27						
8.34						
7.41						
6.47						
5.54						
4.61						
3.68						
2.75						
1.82						
1.05						
.53						
.15						
MEAN TURTLE / PALADON						

+ a,c

WORK SHEET
WESTINGHOUSE FORM 8295 E

Westinghouse Non-Proprieta...

3LOOP D DIN HFP

	BOL			EOL		
	TURTLE Fxy	PALADON Fxy	TURTLE / PALADON	TURTLE Fxy	PALADON Fxy	TURTLE / PALADON
11.87						
11.49						
10.97						
10.20						
9.27						
8.34						
7.41						
6.47						
5.54						
4.61						
3.68						
2.75						
1.82						
1.05						
.53						
.15						
MEAN TURTLE/PALADON						

+ a,c

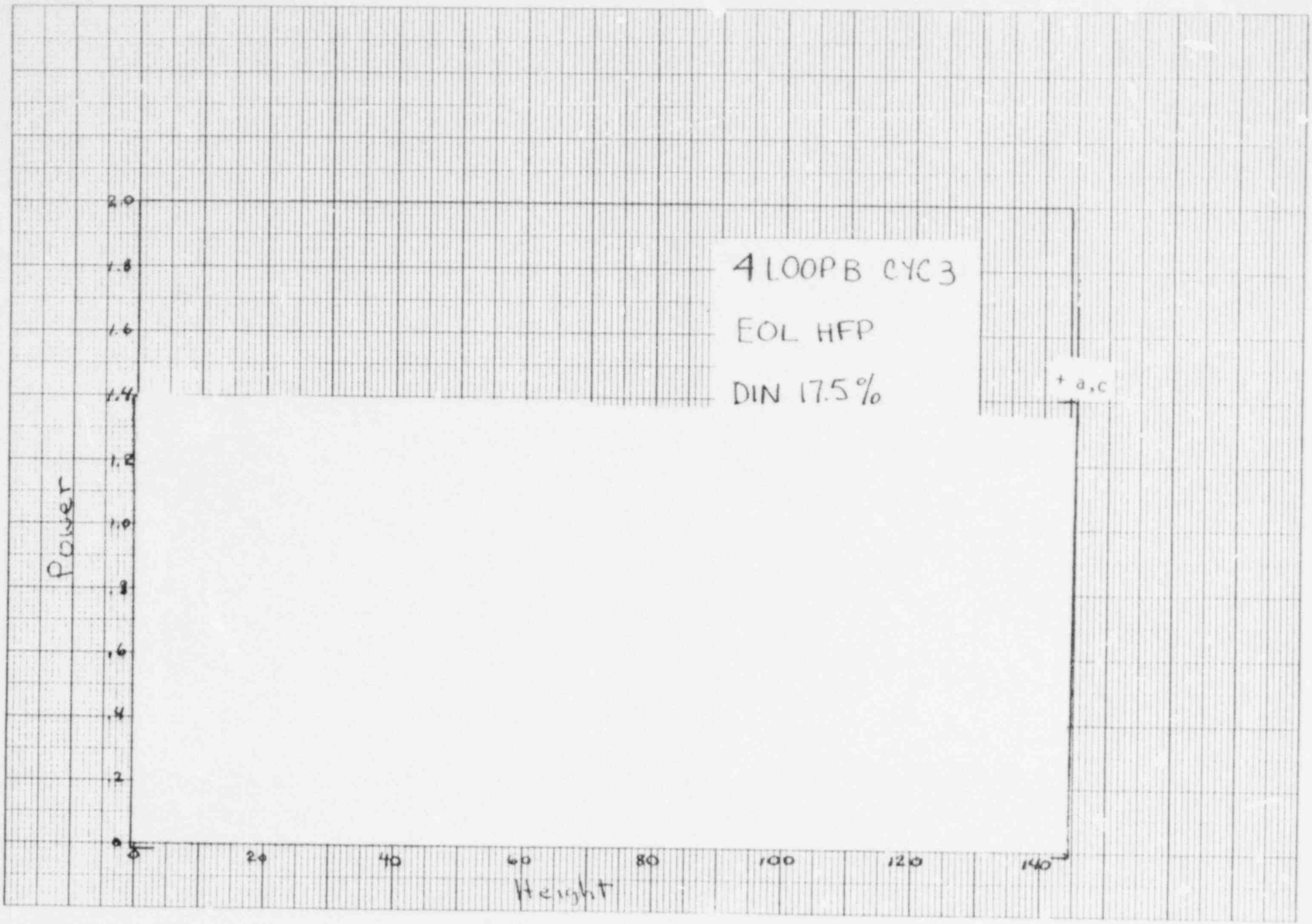
3D PALADON / 3D TURTLE AXIAL POWER SHAPES

-- ANOTHER APPLICATION OF 3D MODELS IS THE CREATION OF 1D MODELS

[ ]+a,c

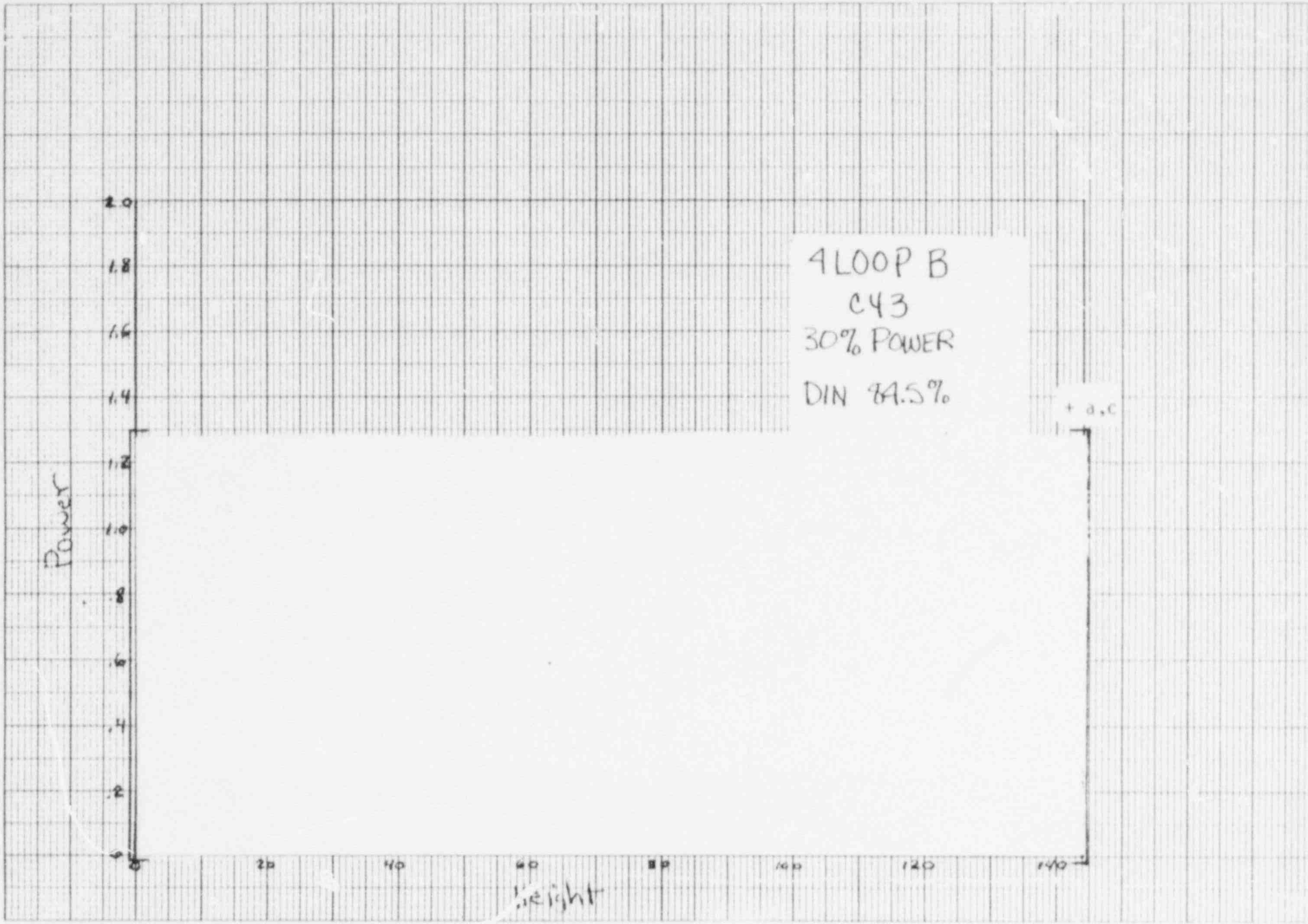
-- THE FOLLOWING FIGURES SHOW CORE AVERAGE AXIAL POWER SHAPES FOR VARIOUS POWER LEVELS AND CONTROL ROD CONFIGURATIONS IN A TYPICAL 4-LOOP PLANT

Westinghouse Non-Proprietary

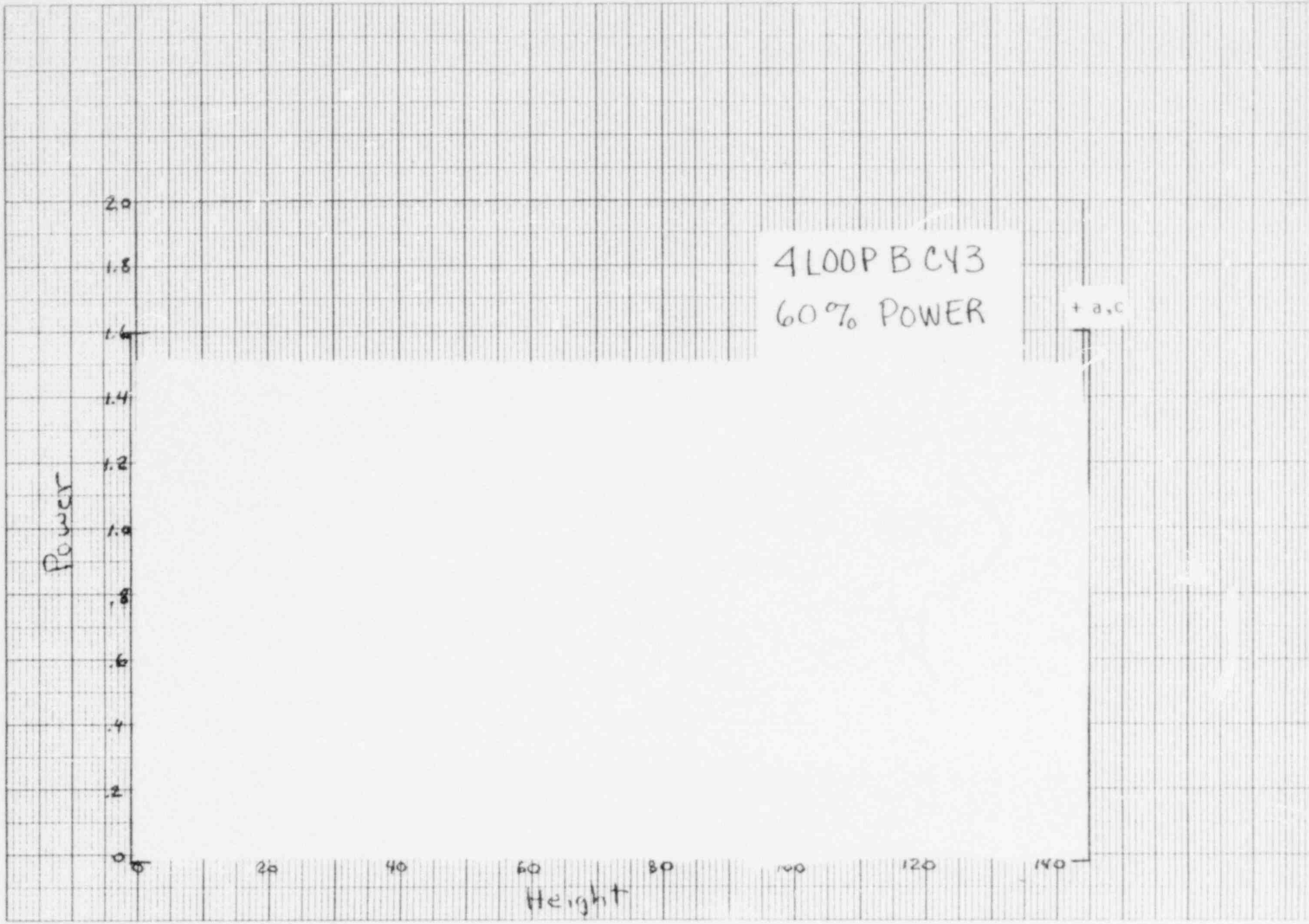


K•E 10 X 10 TO ½ INCH KEUFFEL & ESSER CO. 46 1320

Westinghouse Non-Proprietary

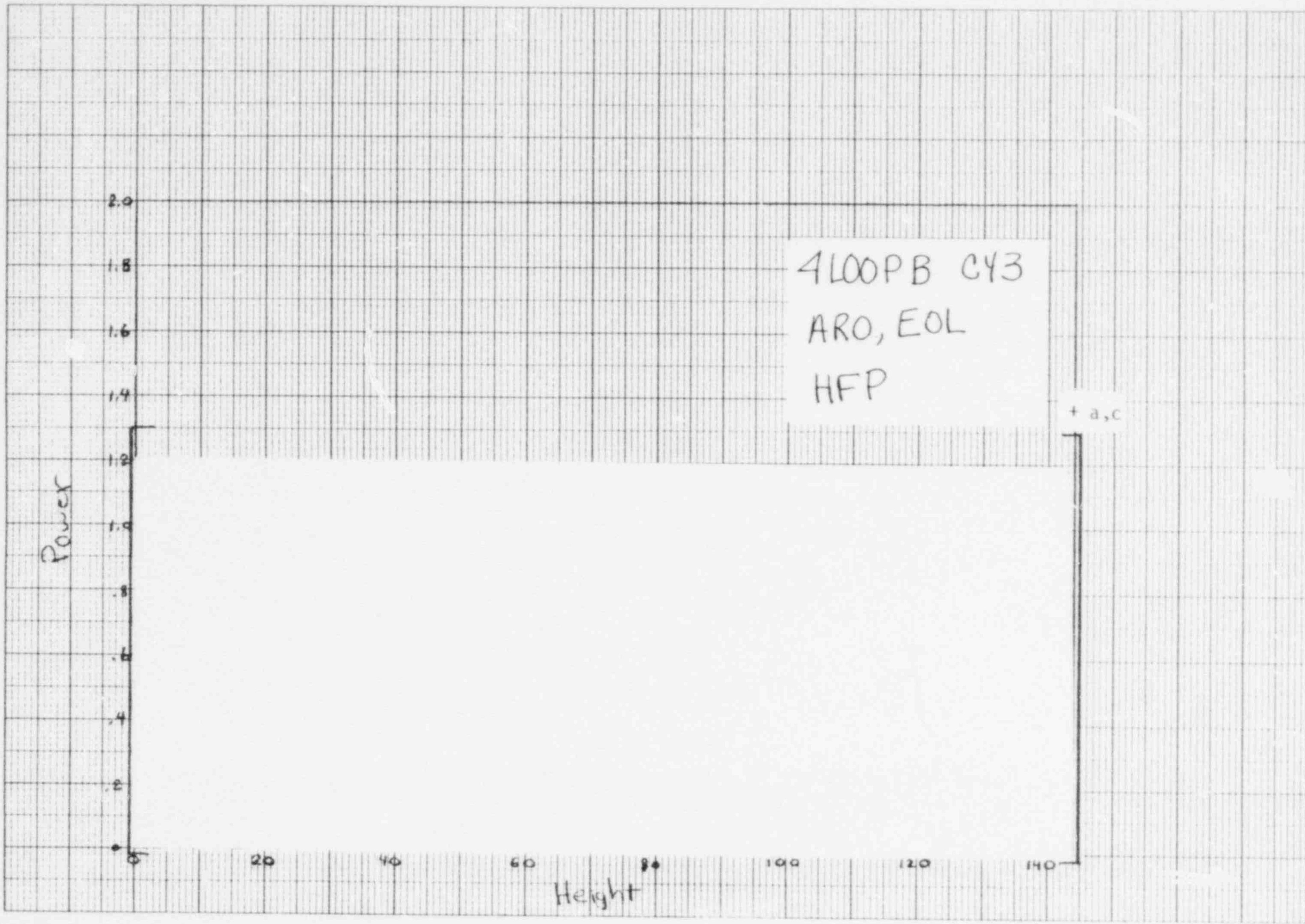


Westinghouse Non-Proprietary

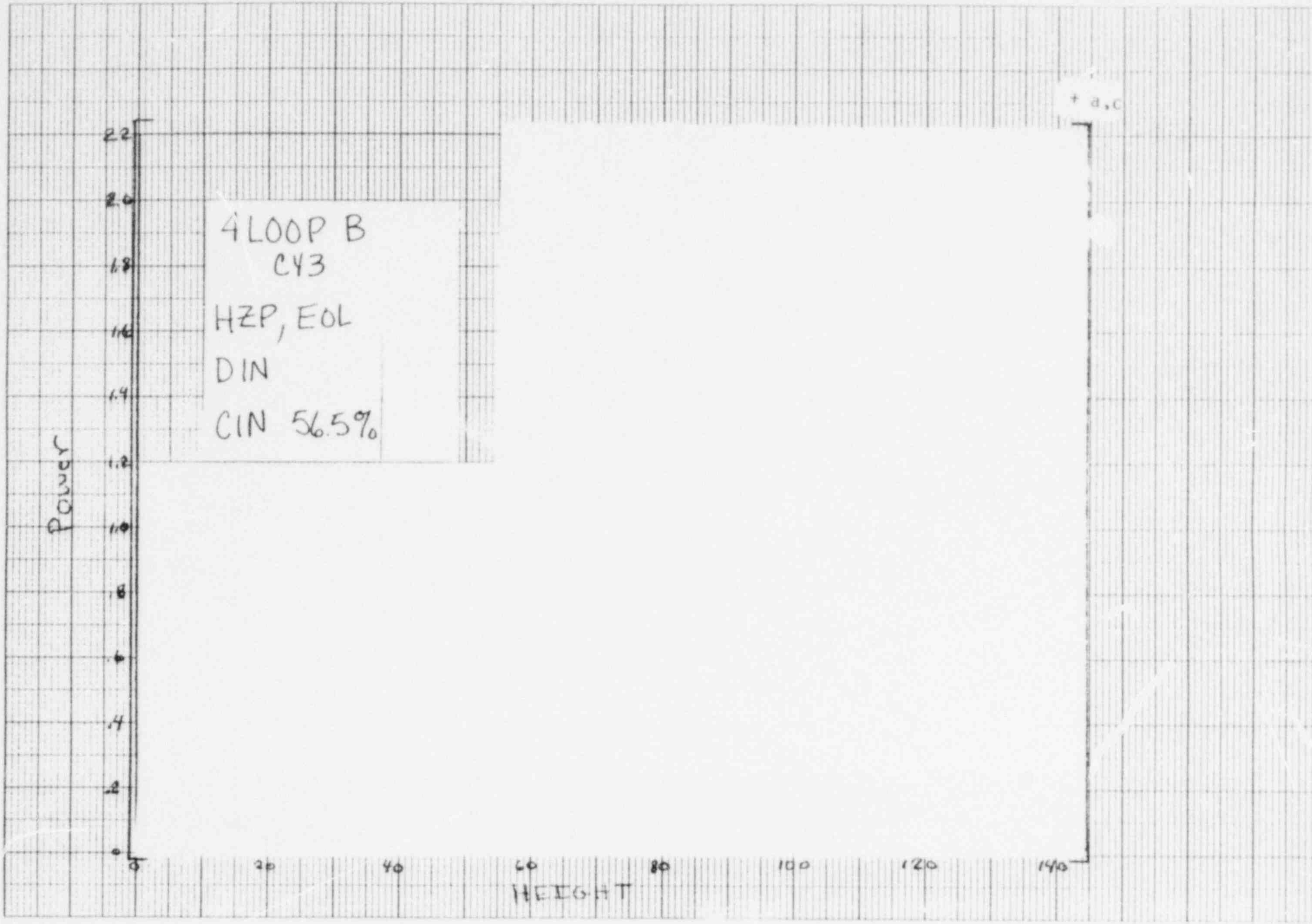


K+E KEUFFEL & ESSER CO. 46 1320

Westinghouse Non-Proprietary



Westinghouse Non-Proprietary



PLANT A CYCLE 3 ASSEMBLY POWERS

BOL HFP S_B IN (DROPPED BANK)

℄

+ a,c

℄

℄

PLANT A CYCLE-3 N-1 POWER DISTRIBUTIONS

BOL HZP

Westinghouse Non-Proprietary

R P N M L K J H G F E D C B A

+ a,c

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

PLANT A CYCLE 3 ASSEMBLY POWERS

EOL N-1

Westinghouse Non-Proprietary

R P N M L K J H G F E D C B A

+ a,c

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

PLANT A CYCLE 3 ASSEMBLY POWERS

EOL HZP N-2 Westinghouse Non-Proprietary

R P N M L K J H G F E D C B A

+ a,c

PLANT A CYCLE 3 ASSEMBLY POWERS

BOL HFP D IN H-4 EJECTED

Westinghouse Non-Proprietary

R P N M L K J H G F E D C B A

+a,c

8
9
10
11
12
13
14
15

PLANT A CYCLE 3 ASSEMBLY POWERS
BOL, HFP E-11 DROPPED

Westinghouse Non-Proprietary

R P N M L K J H G F E D C B A

+ a,c

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

PLANT A CYCLE 3 ASSEMBLY POWERS

EOL CREDIBLE STEAMBREAK

R P N M L K J H G F E D C B A

+a,c

[ ]

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

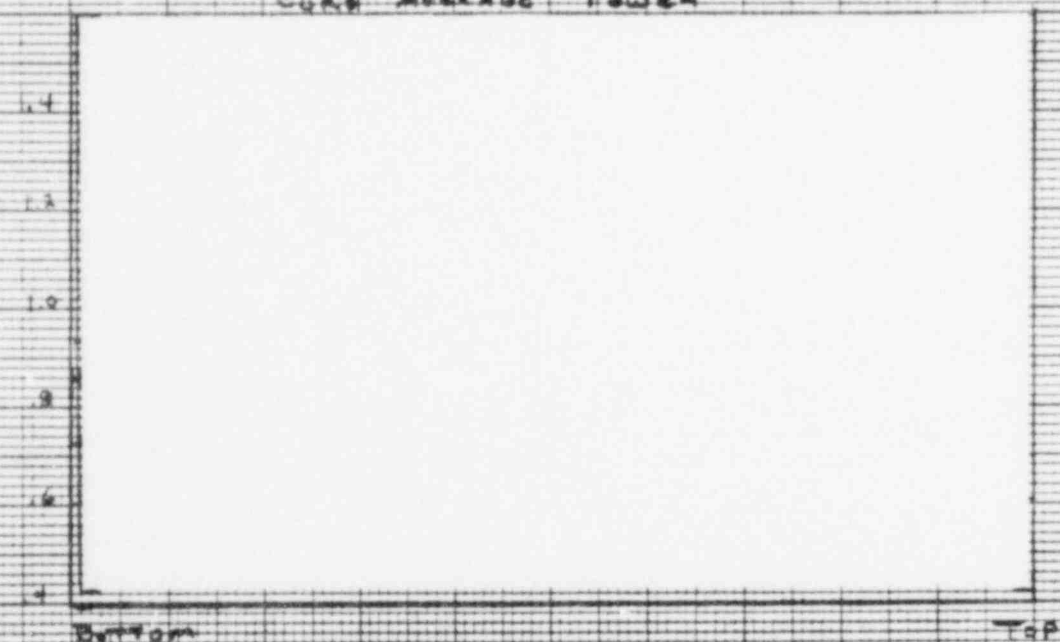
PLANT A

AXIAL POWER DISTRIBUTIONS

HYPOTHETICAL STEAM BREAK CASE

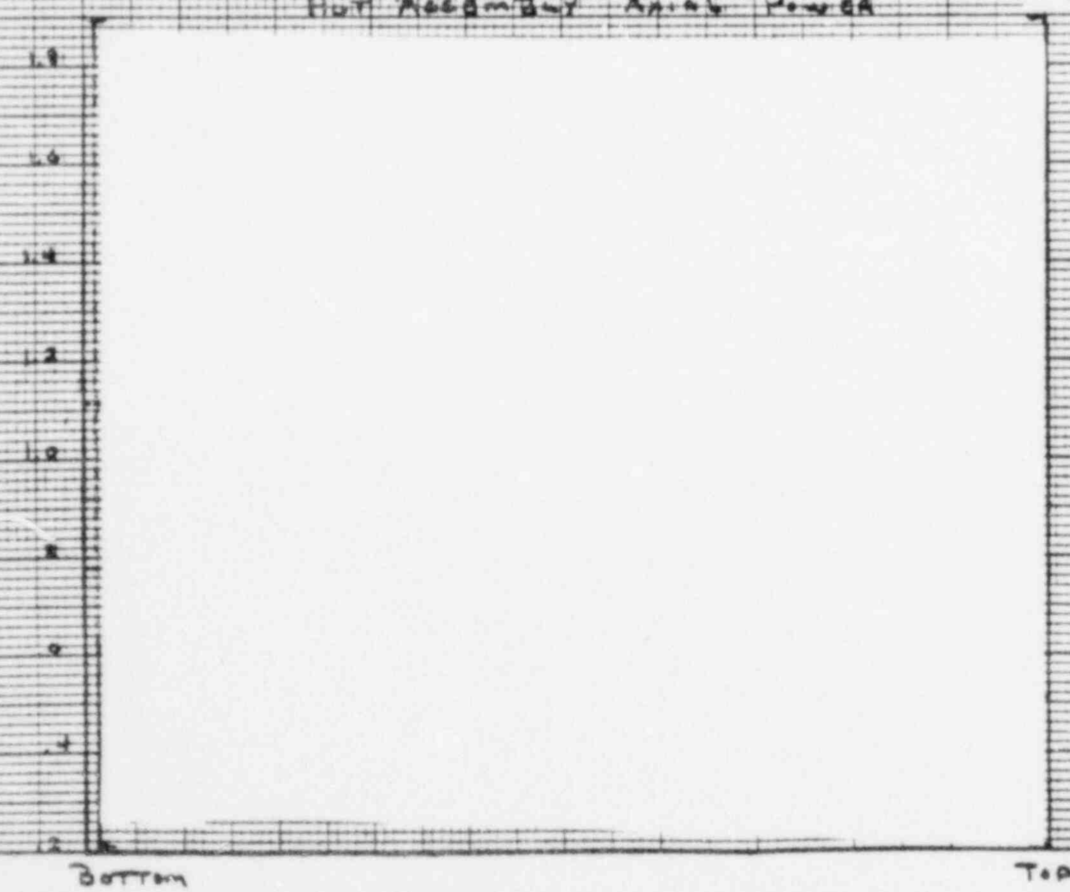
+ a,c

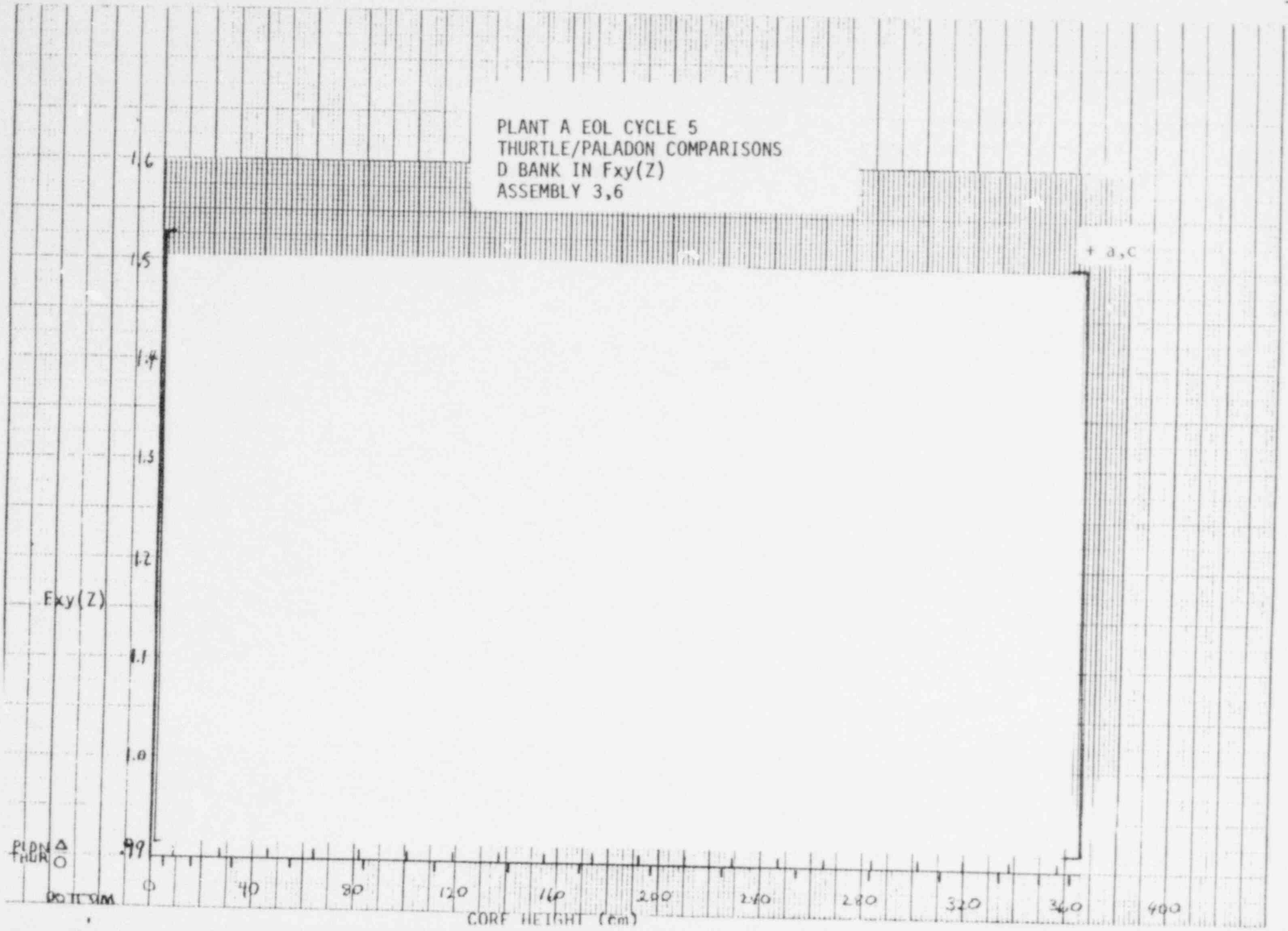
CORE AVERAGE POWER



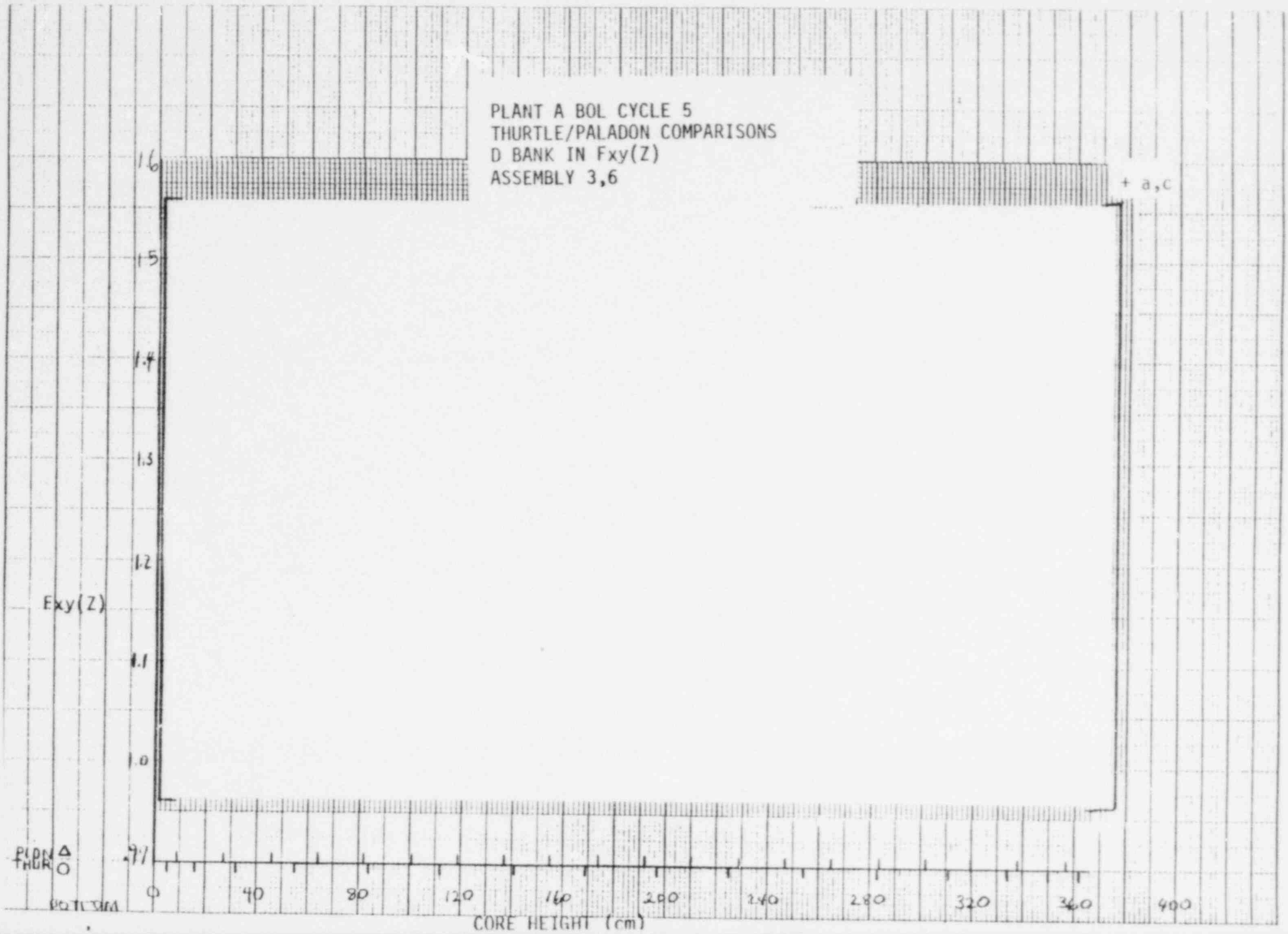
+ a,c

HOT ASSEMBLY AXIAL POWER

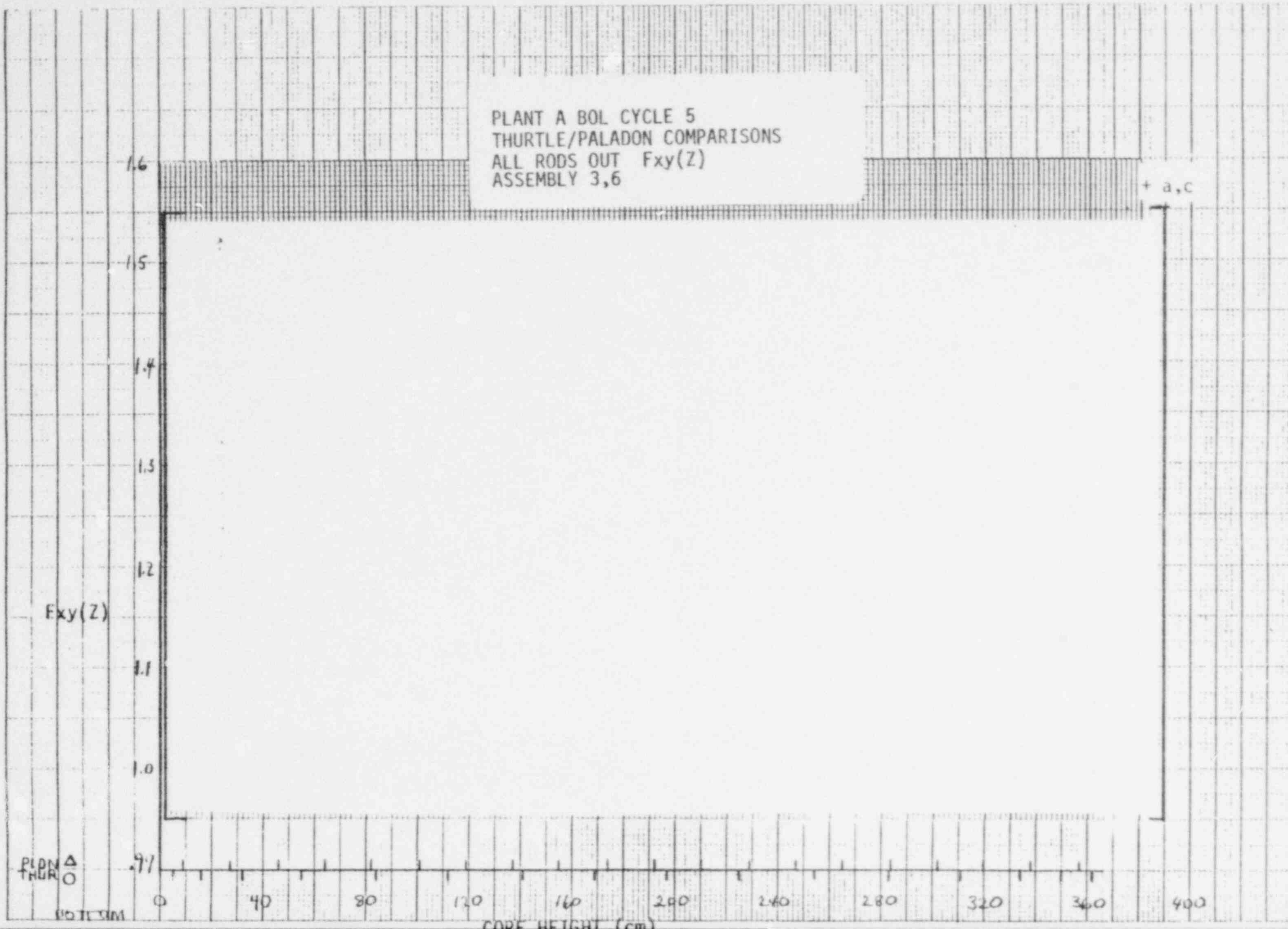


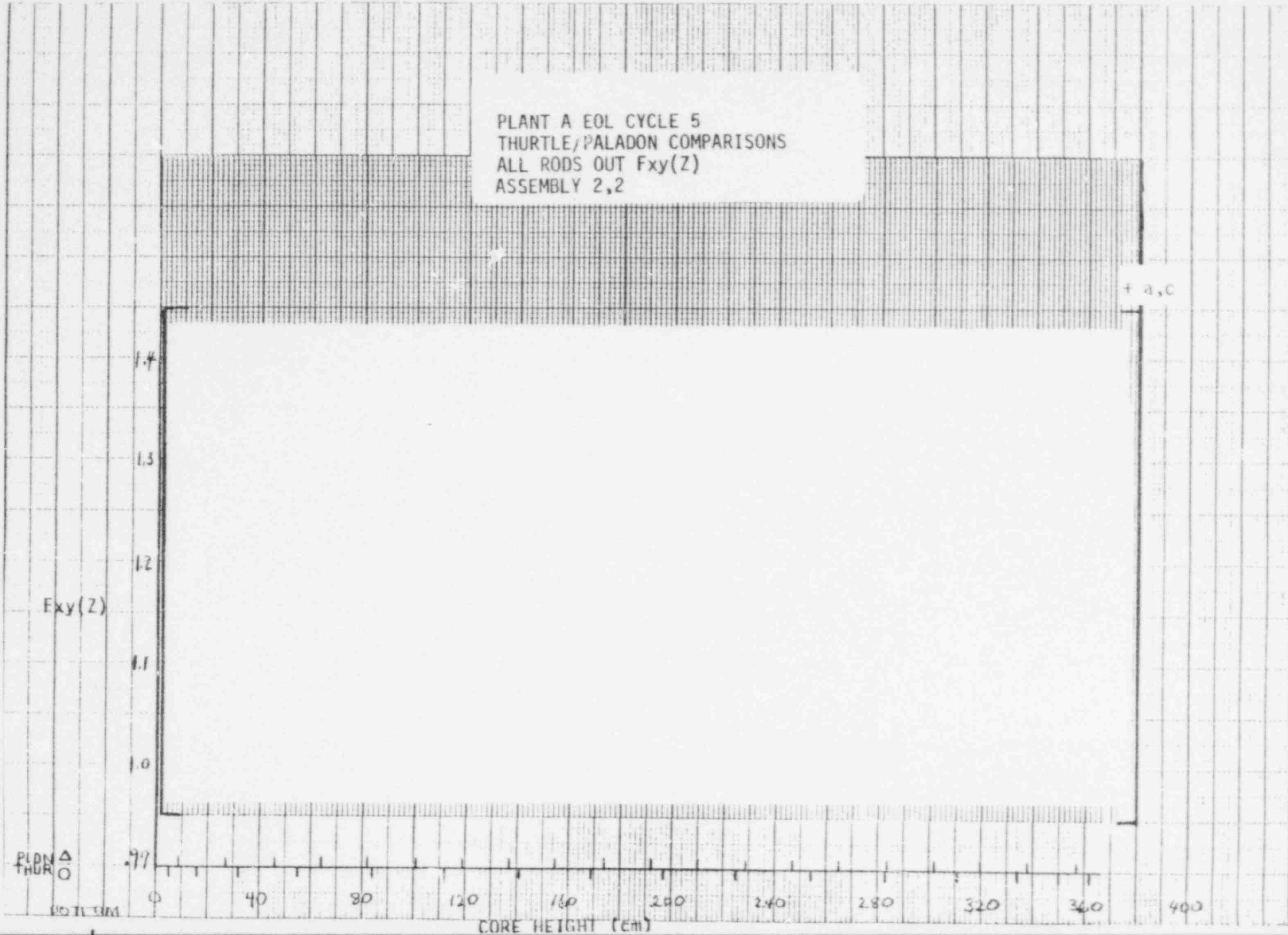

PLANT A EOL CYCLE 5
THURTLE/PALADON COMPARISONS
D BANK IN Fxy(Z)
ASSEMBLY 3,6
+ a,c
Fxy(Z)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
.99
PLDN △
THUR ○
0
40
80
120
160
200
240
280
320
360
400
BOTTOM
CORE HEIGHT (cm)

Westinghouse Non-Proprietary

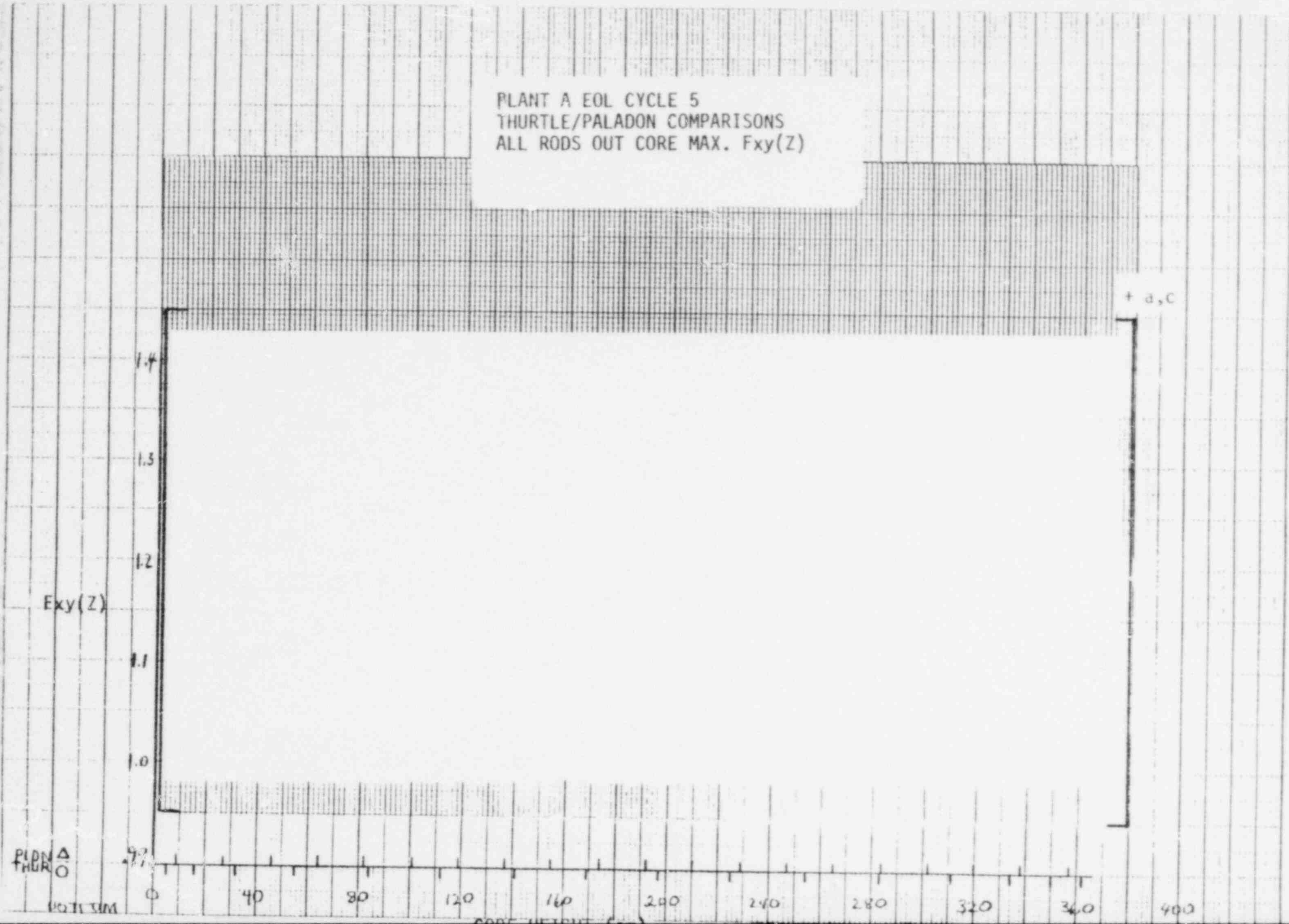


Westinghouse Non-Proprietary

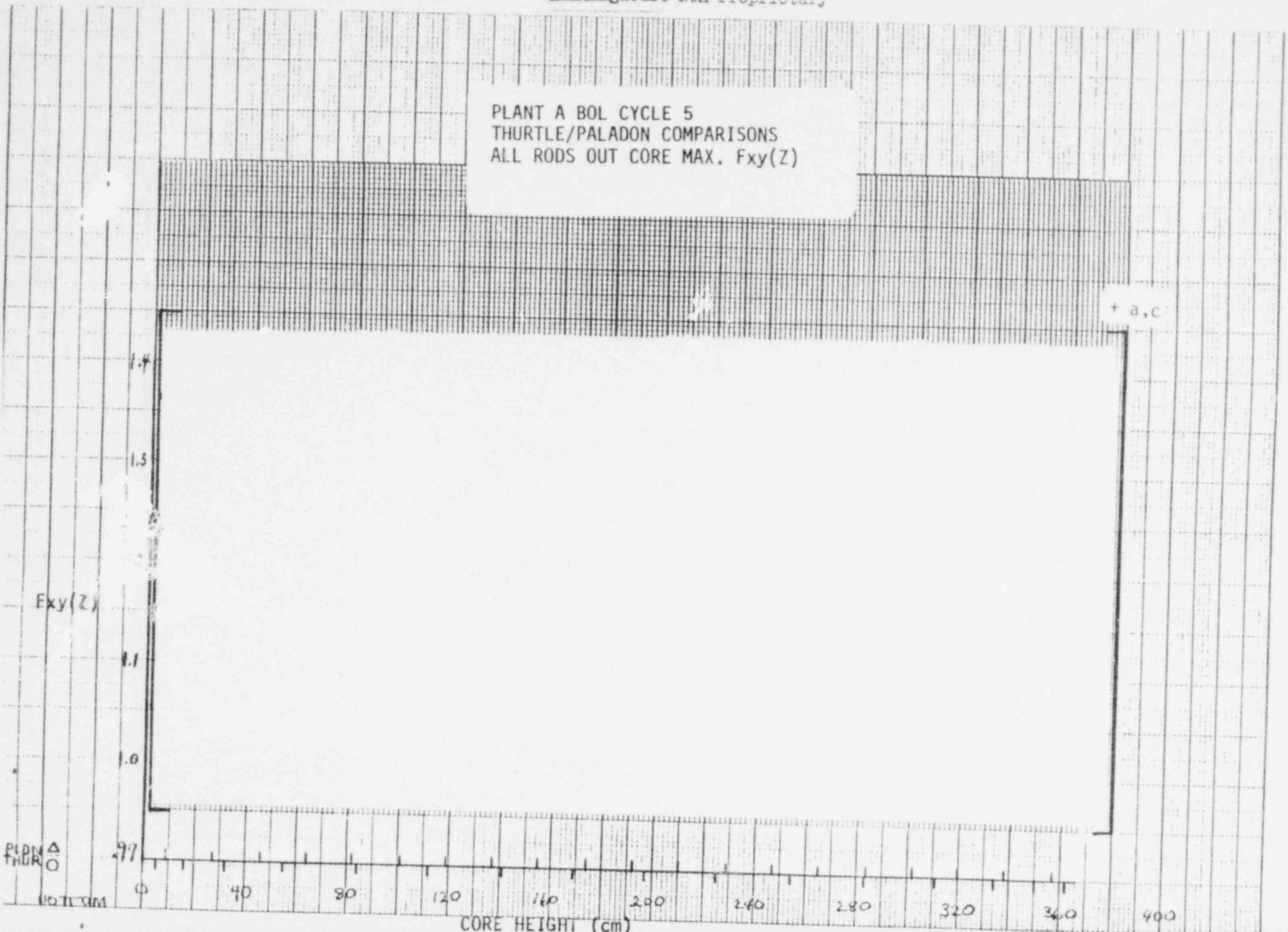



PLANT A EOL CYCLE 5
THURTLE/PALADON COMPARISONS
ALL RODS OUT Fxy(Z)
ASSEMBLY 2,2
+ a,c
Fxy(Z)
1.4
1.3
1.2
1.1
1.0
.97
PLDN Δ
THUR O
BOTTOM
0
40
80
120
160
200
240
280
320
360
400
CORE HEIGHT (cm)

Westinghouse Non-Proprietary



Westinghouse Non-Proprietary



REGIONWISE CORE LOADING PATTERN

PLANT A CYCLE 8

Westinghouse Non-Proprietary

R P N M L K J H G F E D C B A

+ a,c

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

FIGURE 1

FIGURE 3

PLANT A $F_{\Delta H}$ 3D PALADON/THURTLE COMPARISON HFP, ARO

BU = 6000 MWD/MTU

+ a,c

1 2 3 4 5 6 7 8

1

2

3

4

5

6

7

8

FIGURE 4

PLANT A $F_{\Delta H}$ 3D PALADON/THURTLE COMPARISON HFP, D-IN

BU = 1000 MWD/MTU

+ a,c

1 2 3 4 5 6 7 8

1

2

3

4

5

6

7

8

FIGURE 2

,CANT A $F_{\Delta H}$ 3D PALADON/THURTLE COMPARISON HFP, ARO

BU = 1000 MWD/MTU

+ a,c

1 2 3 4 5 6 7 8

1

2

3

4

5

6

7

8

FIGURE 5

PLANT R $F_{\Delta H}$ 3D PALADON/THURTLE COMPARISON HFP, D-IN

+ a,c

BU = 6000 MWD/MTU

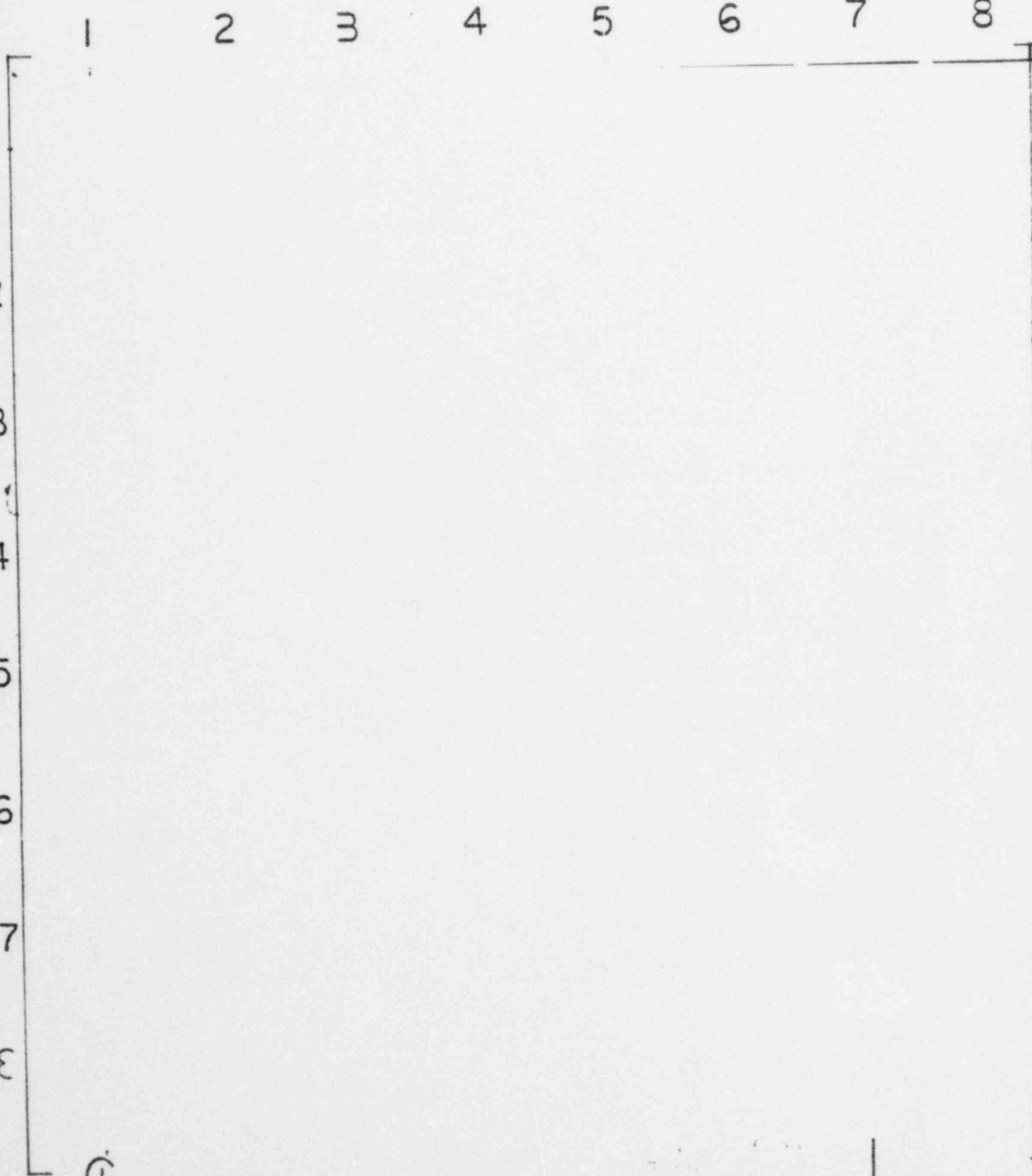
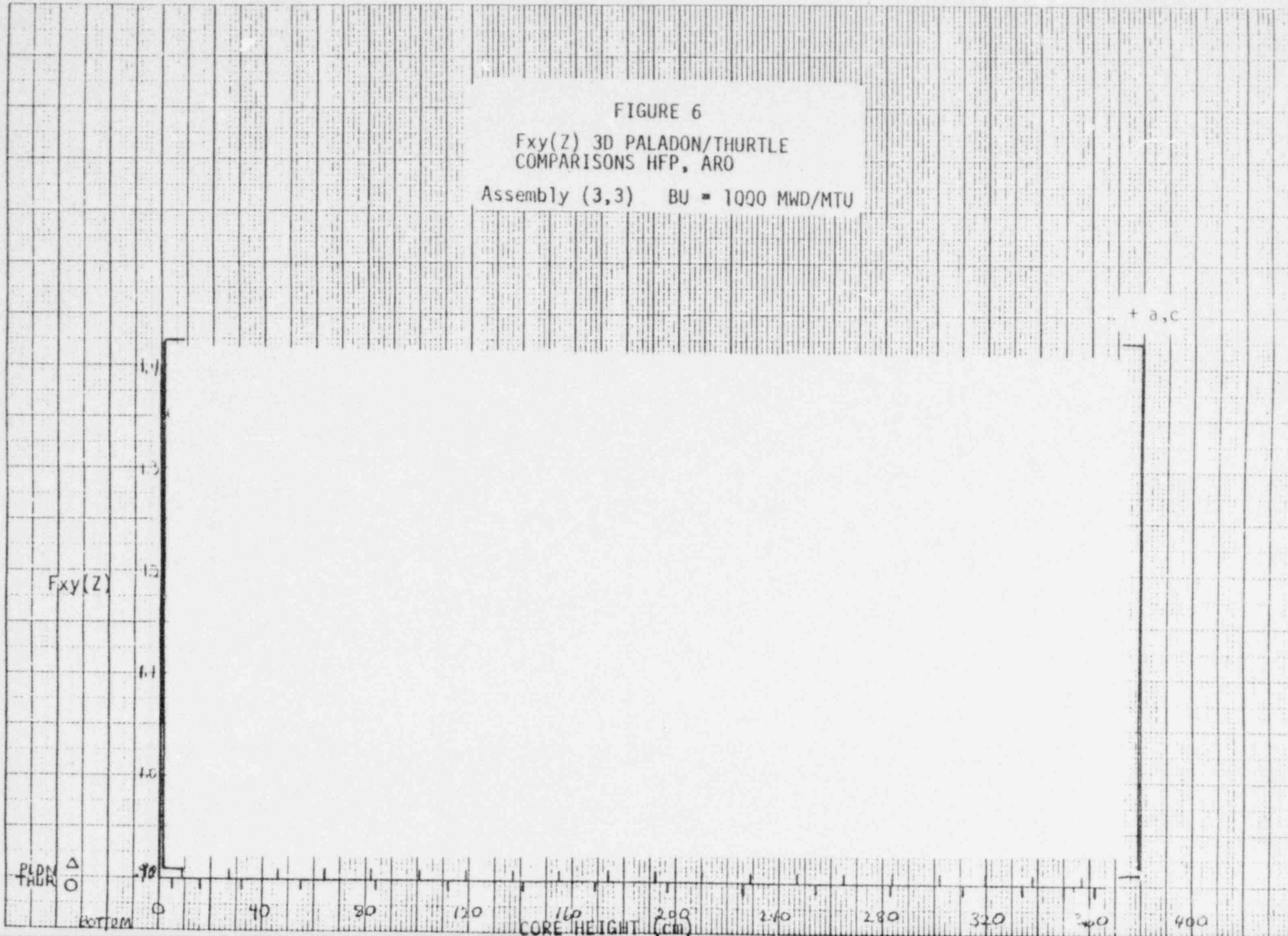


FIGURE 6

Fxy(Z) 3D PALADON/THURTLE COMPARISONS HFP, ARO

Assembly (3,3) BU = 1000 MWD/MTU



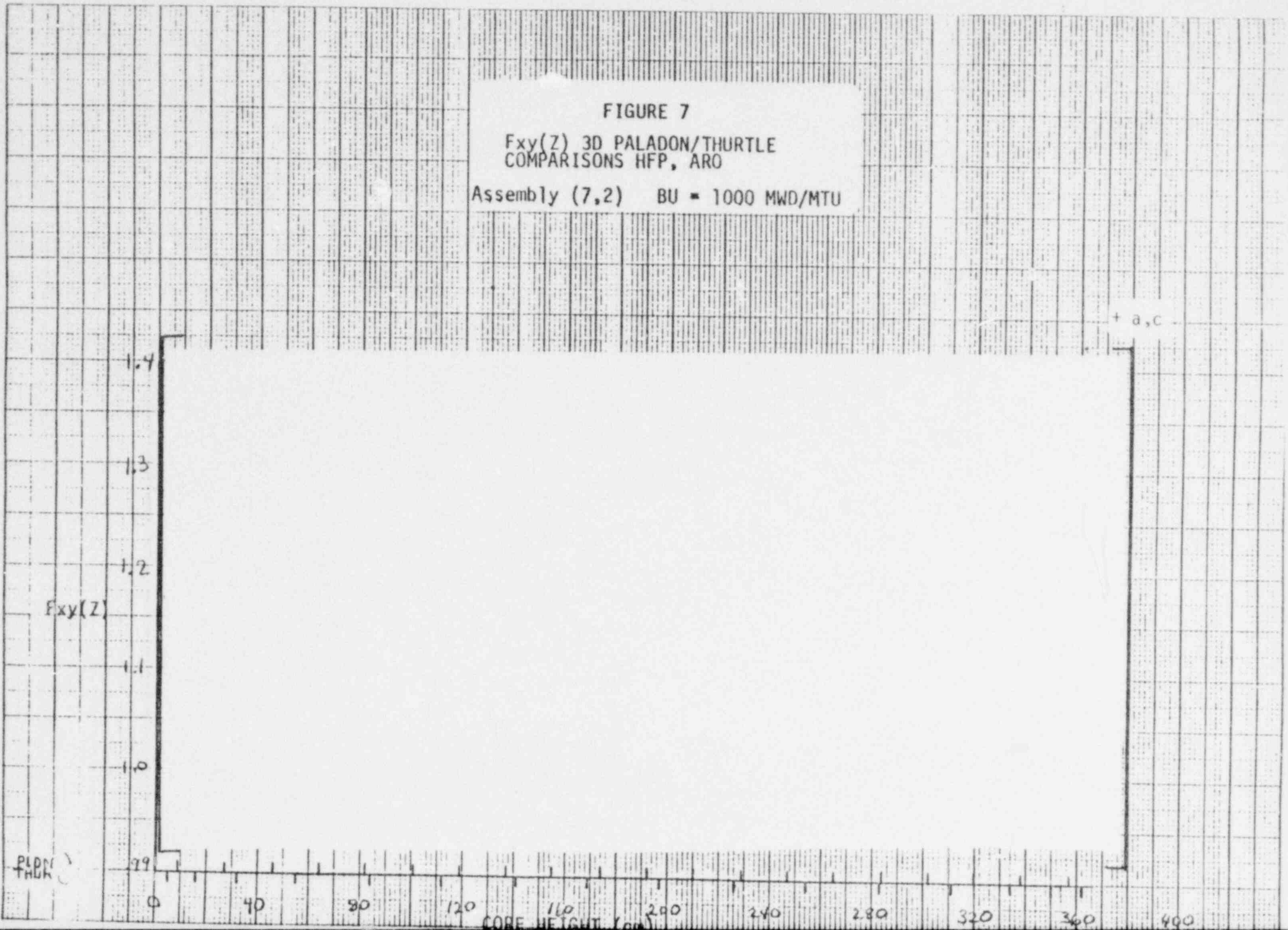


FIGURE 7

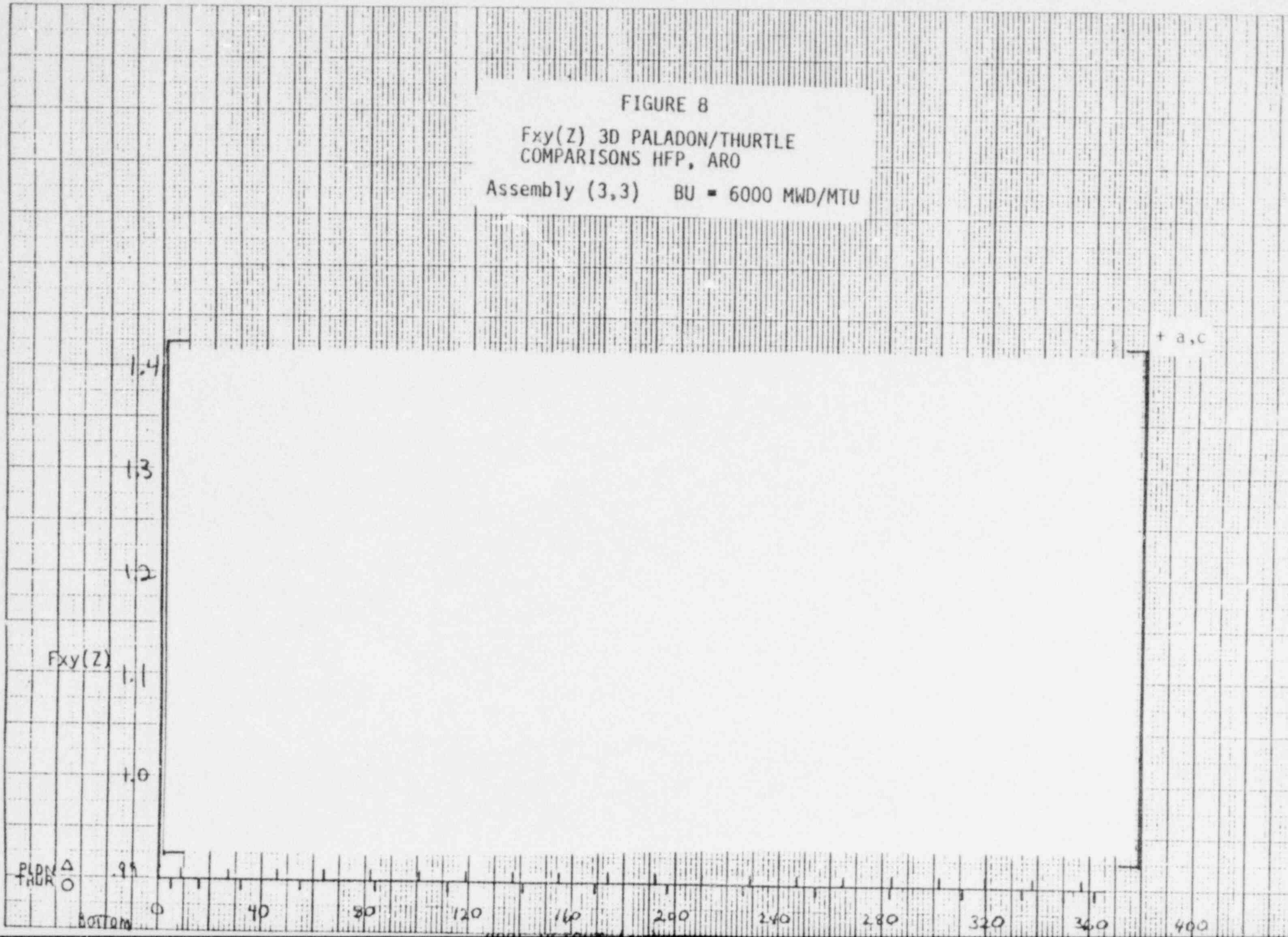
Fxy(Z) 3D PALADON/THURTLE COMPARISONS HFP, ARO

Assembly (7,2) BU = 1000 MWD/MTU

FIGURE 8

Fxy(Z) 3D PALADON/THURTLE
COMPARISONS HFP, ARO

Assembly (3,3) BU = 6000 MWD/MTU



Westinghouse Non-Proprietary

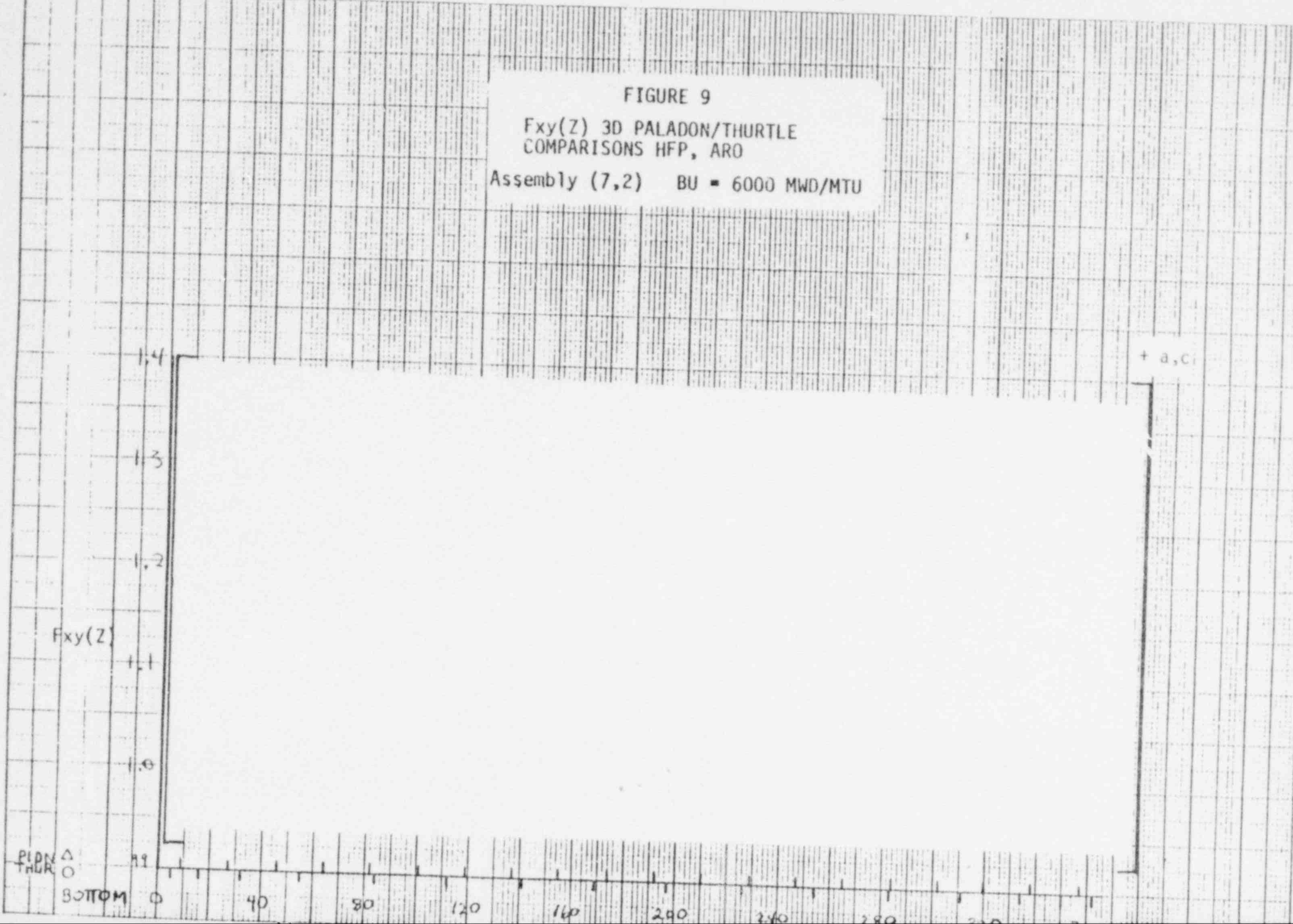


FIGURE 9

Fxy(Z) 3D PALADON/THURTLE COMPARISONS HFP, ARO

Assembly (7,2) BU = 6000 MWD/MTU

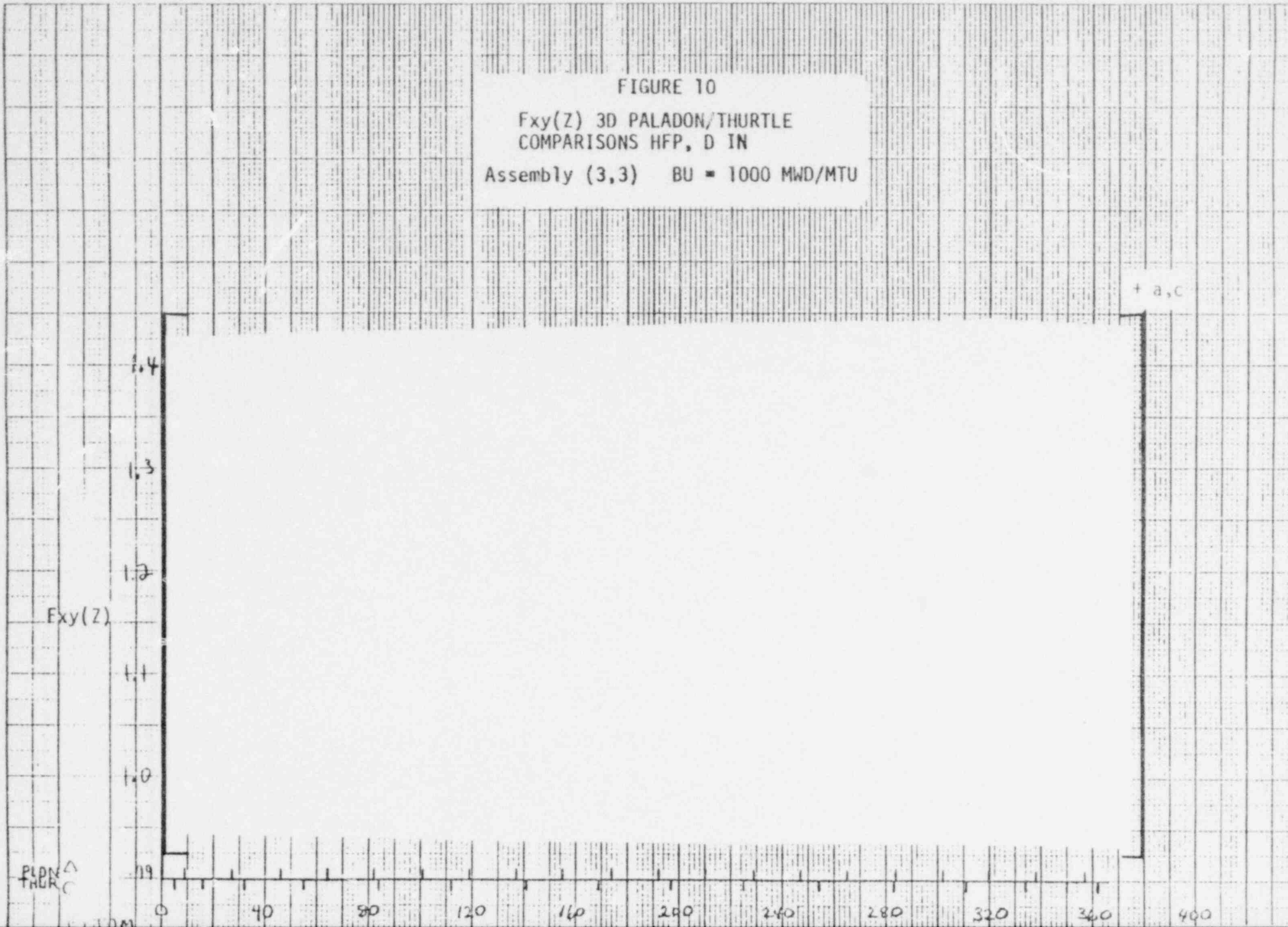


FIGURE 10

Fxy(Z) 3D PALADON/THURTLE COMPARISONS HFP, D IN

Assembly (3,3) BU = 1000 MWD/MTU

FIGURE 11

Fxy(Z) 3D PALADON/THURTLE
COMPARISONS HFP, D IN

Assembly (7,2) BU = 1000 MWD/MTU

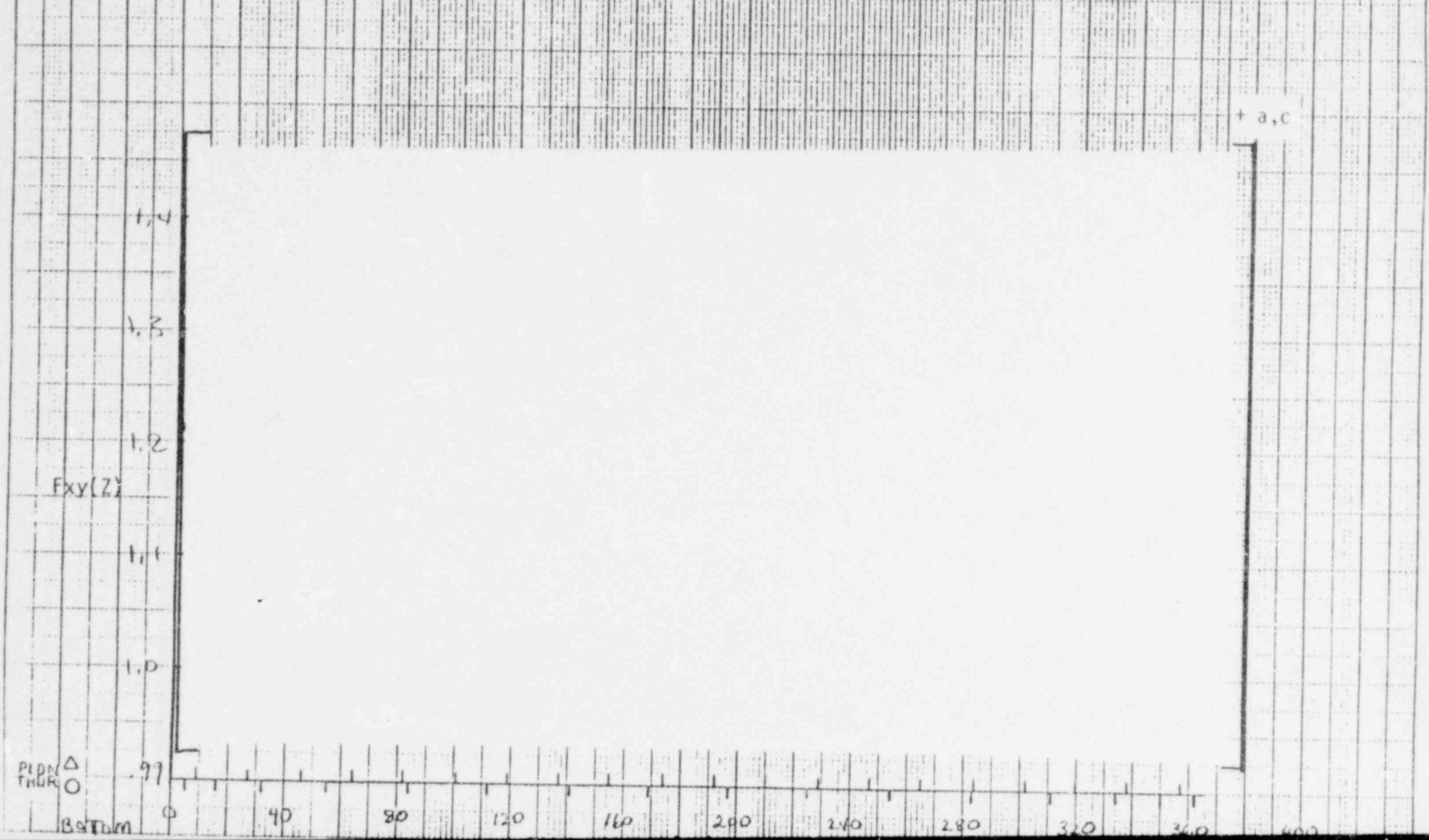


FIGURE 12

Fxy(Z) 3D PALADON/THURTLE COMPARISONS HFP, D IN

Assembly (3,3) BU = 6000 MWD/MTU

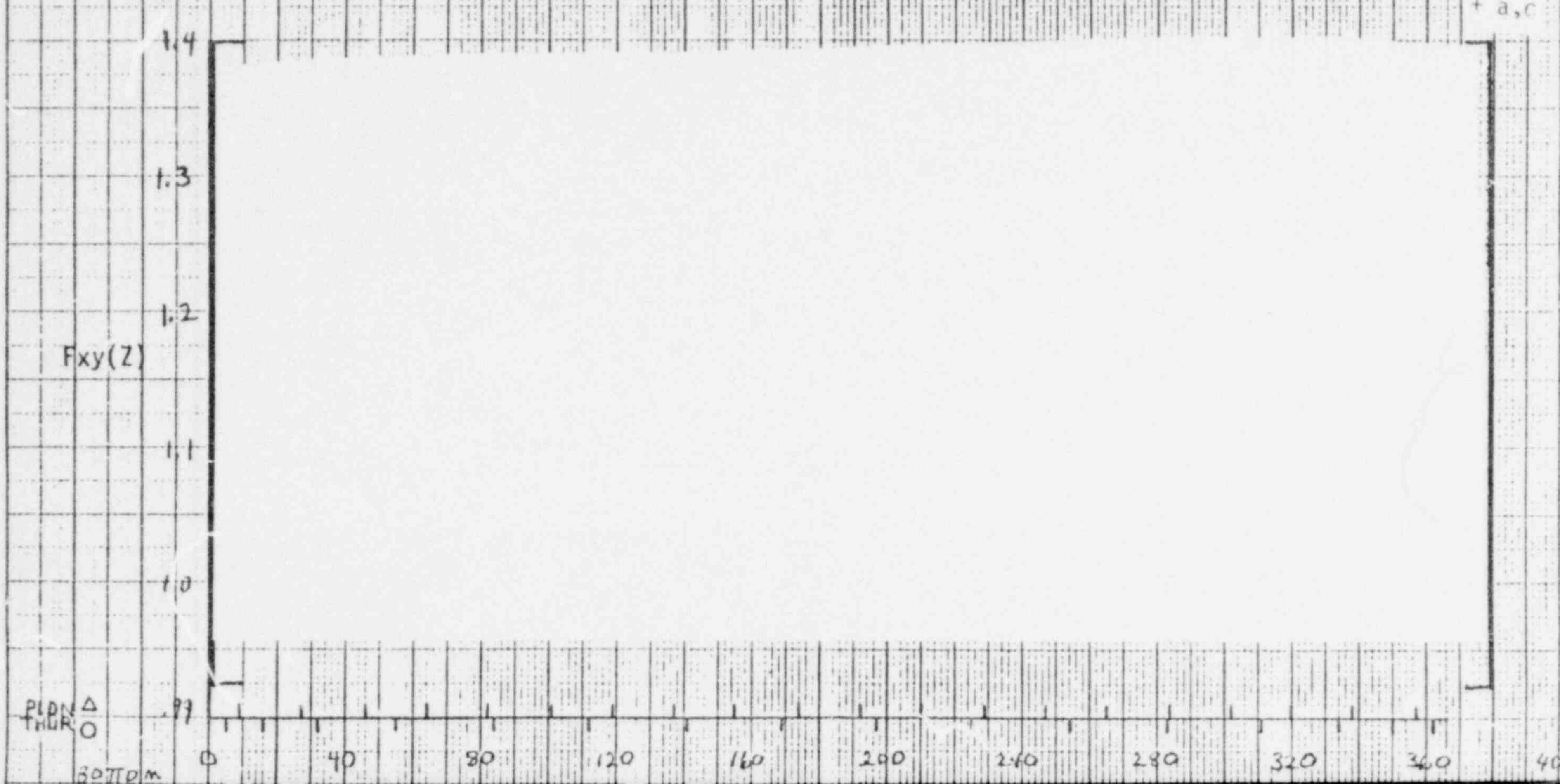
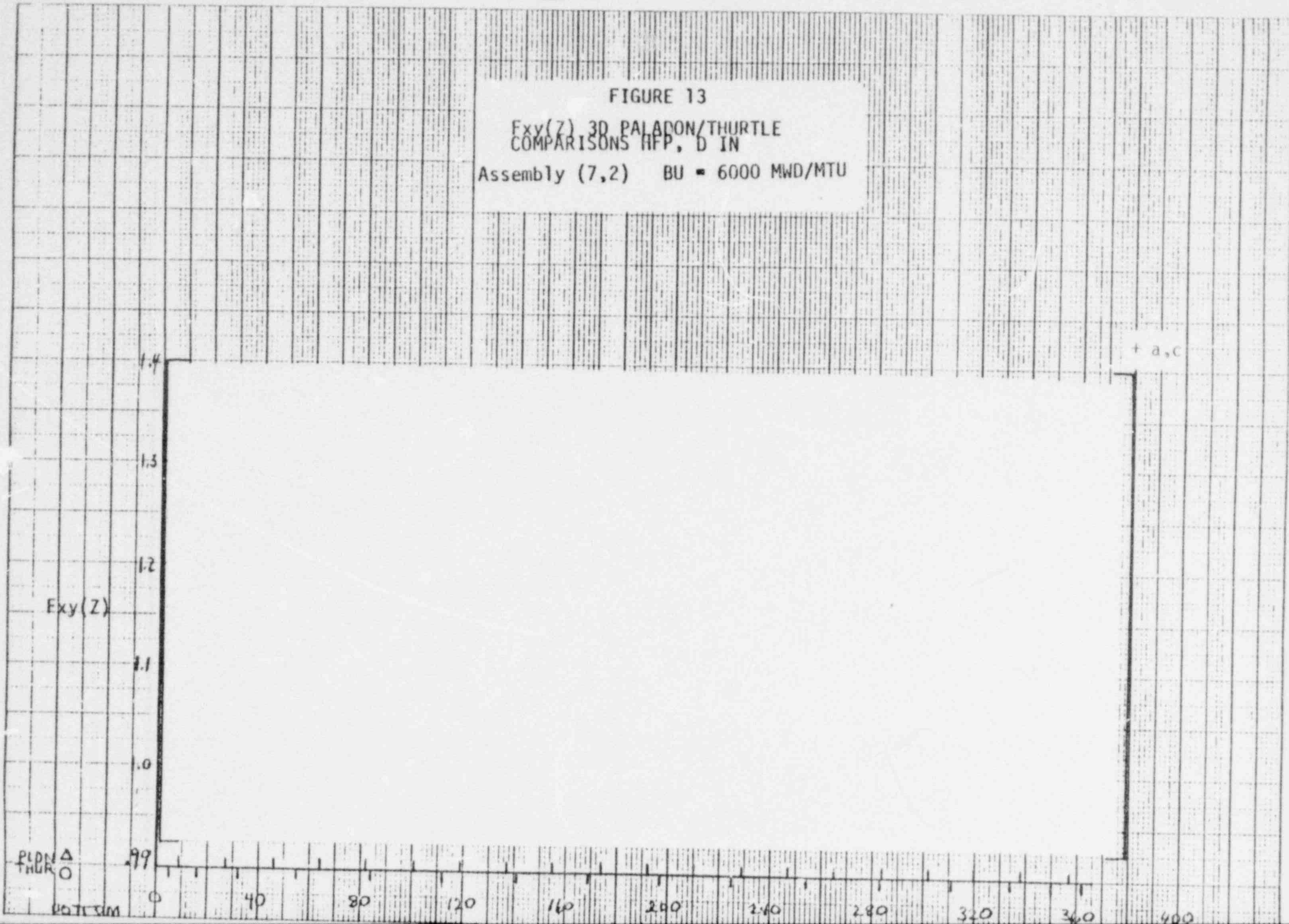
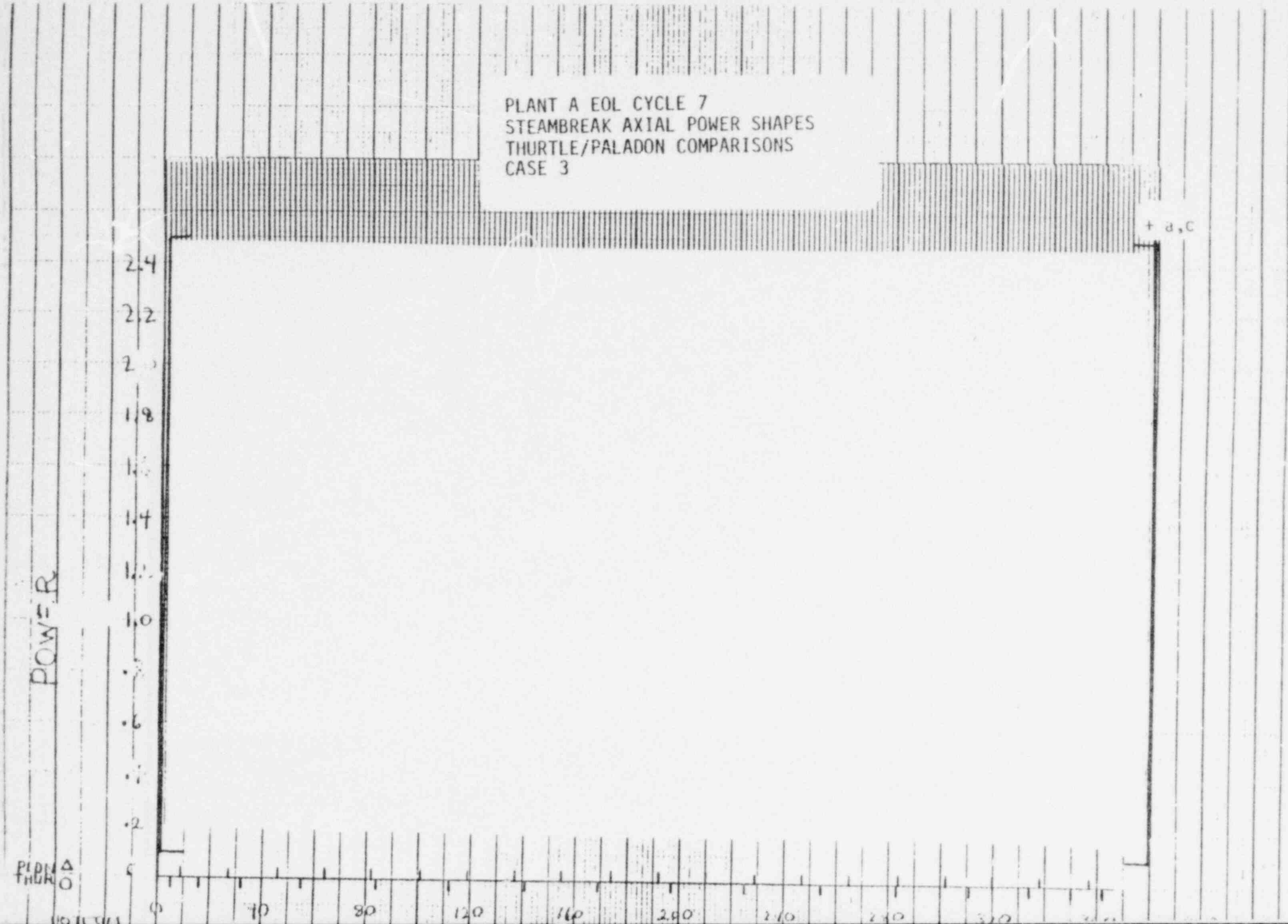


FIGURE 13

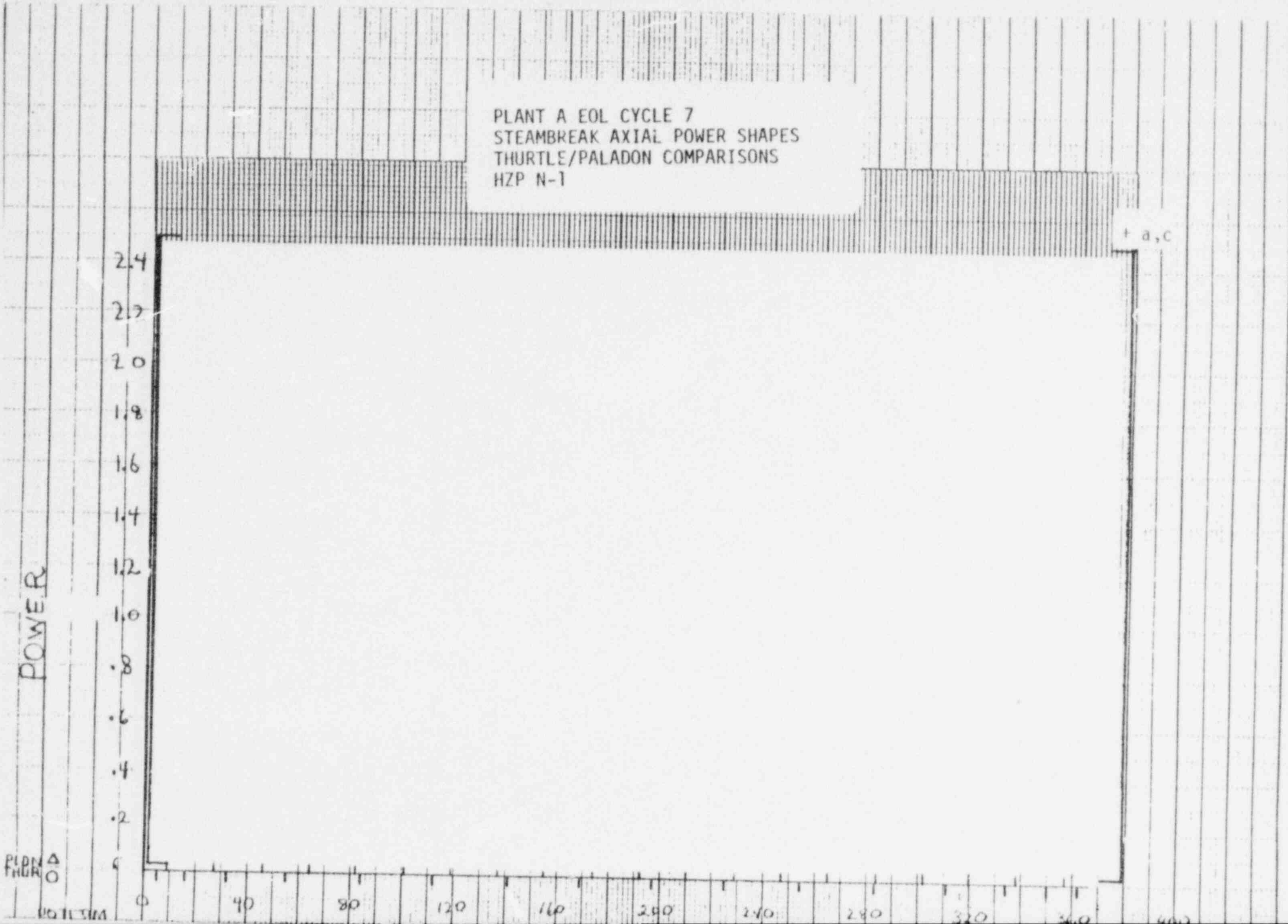
Fxy(Z) 3D PALADON/THURTLE COMPARISONS HFP, D IN

Assembly (7,2) BU = 6000 MWD/MTU

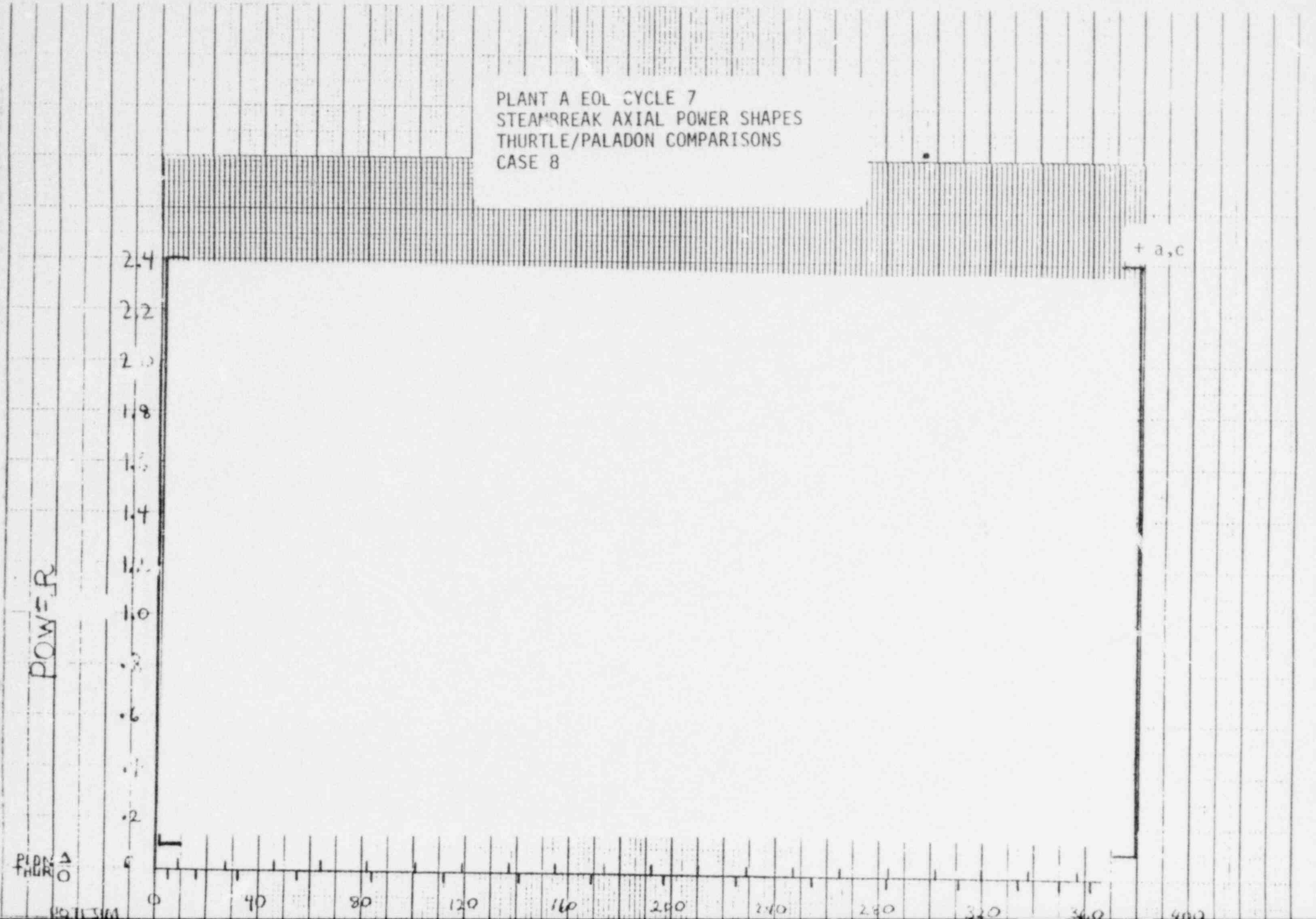



PLANT A EOL CYCLE 7
STEAMBREAK AXIAL POWER SHAPES
THURTLE/PALADON COMPARISONS
CASE 3
+ a,c
POWER
2.4
2.2
1.8
1.4
1.0
.6
.2
PLDN Δ
THUR O
0
40
80
120
160
200

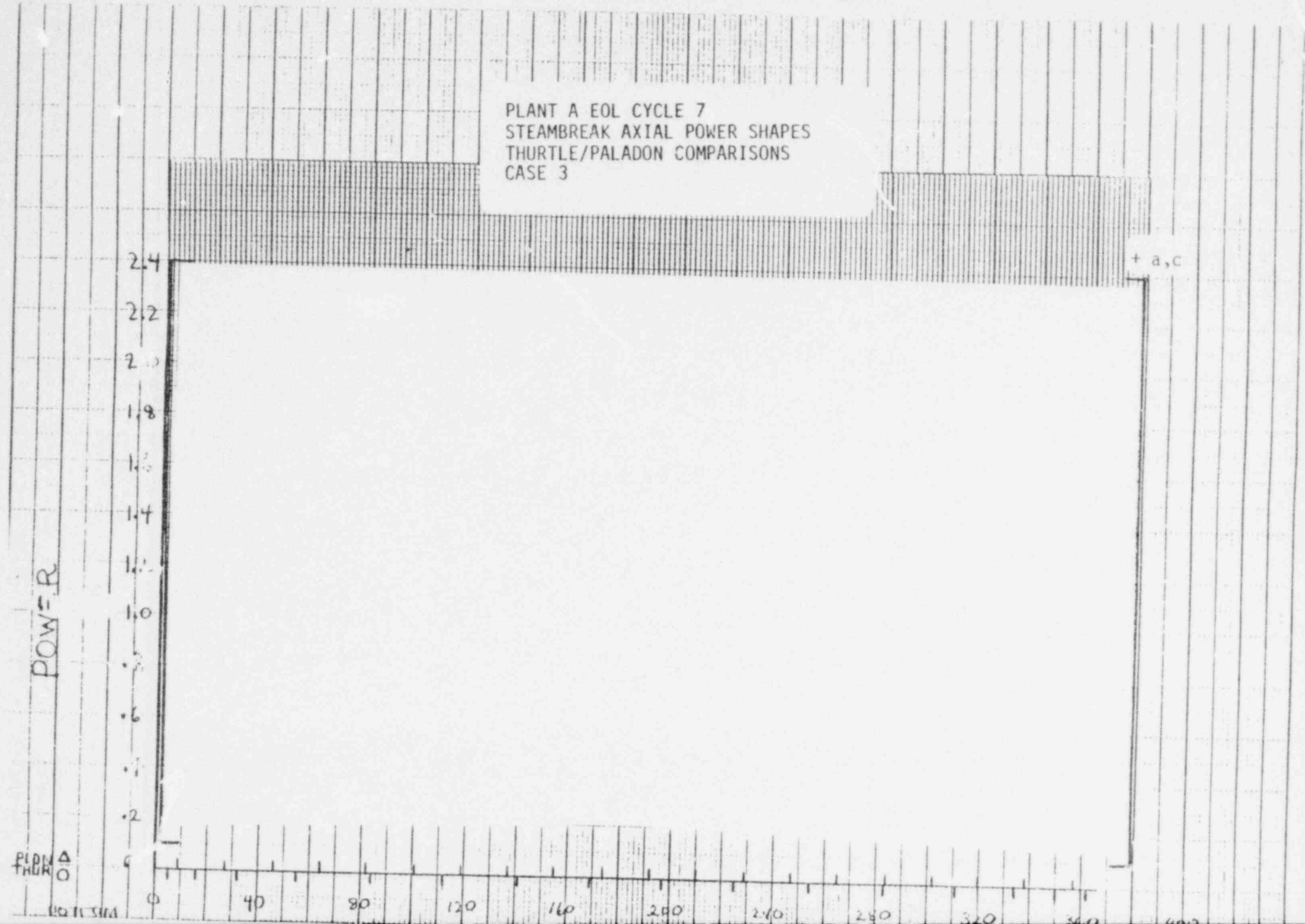
Westinghouse Non-Proprietary

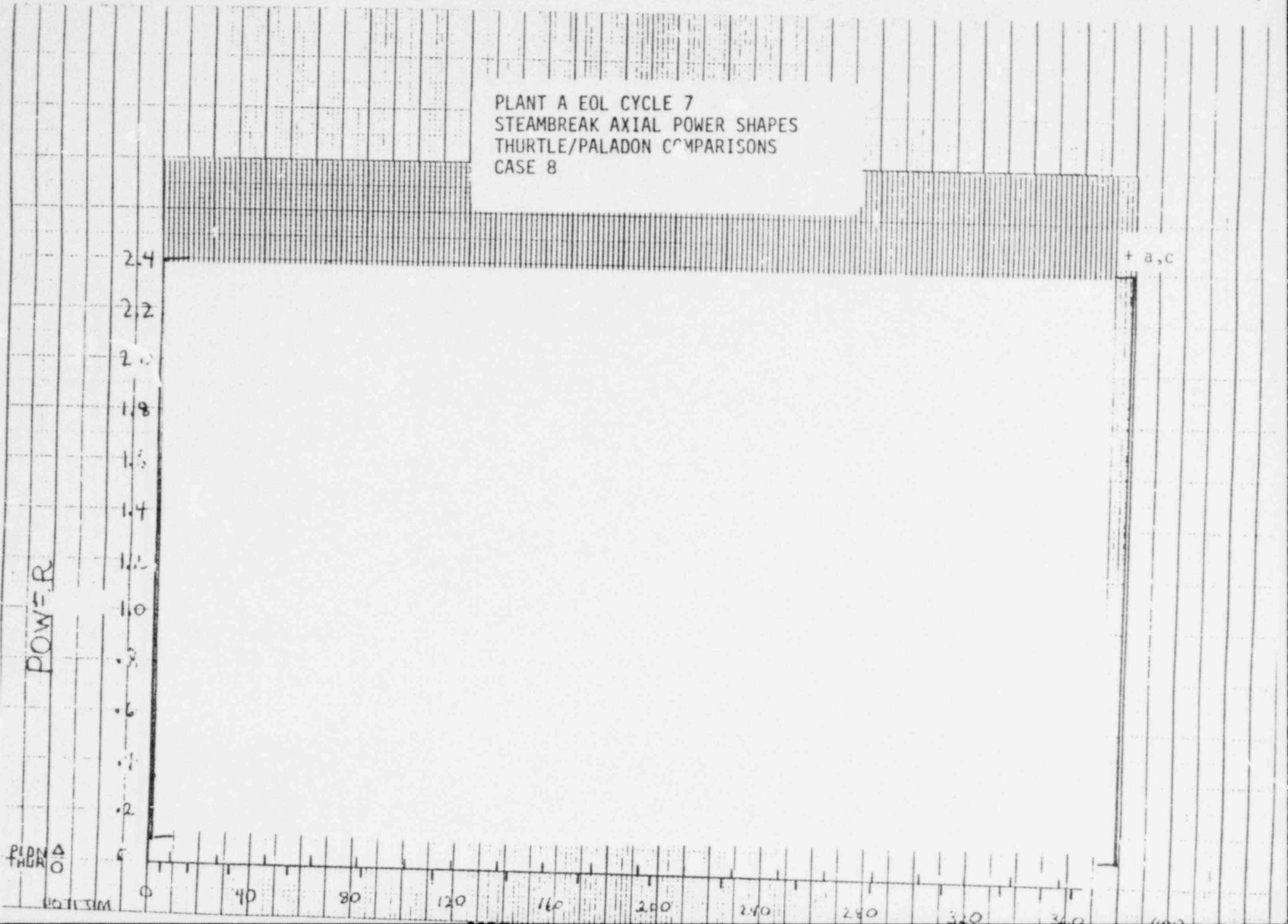


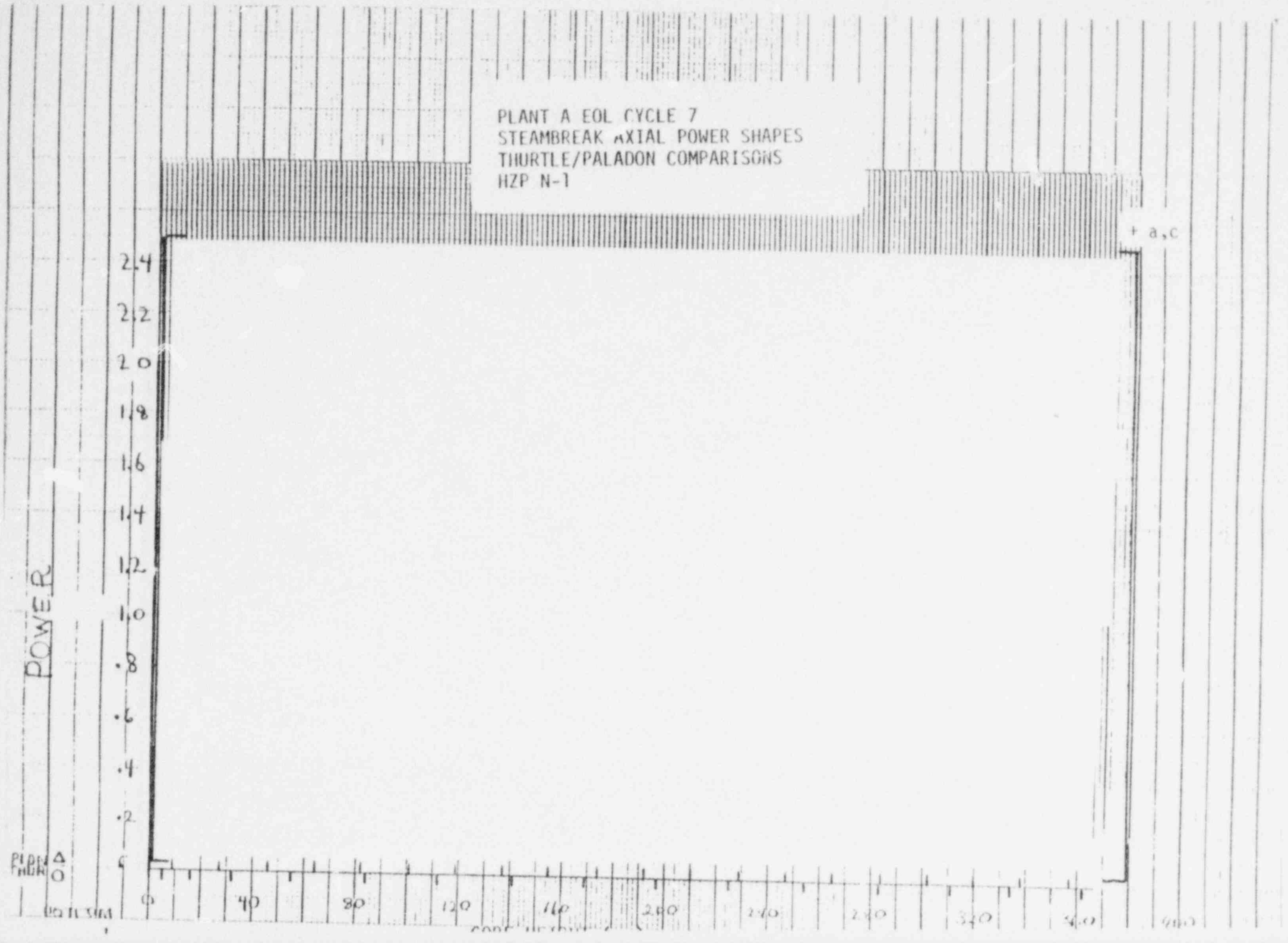
Westinghouse Non-Proprietary



Westinghouse Non-Proprietary




PLANT A EOL CYCLE 7
STEAMBREAK AXIAL POWER SHAPES
THURTLE/PALADON COMPARISONS
CASE 8
+ a,c
POWER
PLDN △
THUR ○
BOTTOM
2.4
2.2
1.8
1.4
1.0
.6
.2
0
40
80
120
160
200
240
280
320
360


PLANT A EOL CYCLE 7
STEAMBREAK AXIAL POWER SHAPES
THURTLE/PALADON COMPARISONS
HZP N-1
+ a,c
POWER
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
PLDN Δ
THUR O
0
40
80
120
160
200
240
280
320
360
400

CONCLUSIONS

- EXCELLENT AGREEMENT HAS BEEN SHOWN WITH 2-D PALADON RELATIVE TO OTHER METHODS AND MEASUREMENTS

- EXCELLENT AGREEMENT HAS BEEN SHOWN WITH 3-D PALADON RELATIVE TO OTHER METHODS AND MEASUREMENTS
  - EJECTED ROD
  - STEAM LINE BREAK
  - FXY(Z)
  - ASSORTED ROD AND UNRODDED RADIAL AND AXIAL POWER SHAPES

- GENERIC AND PARTICULAR BENCHMARKING OF 3-D PALADON ON A PARTICULAR PLANT HAS BEEN SHOWN