THE BABCOCK & WILCOX COMPANY
POWER GENERATION GROUP

PRELIMINARY

19

To: DISTRIBUTION

From: P. S. BARTELLS, TECHNICAL STAFF

Cust.: TMI-2 Part of

File No. or Ref.:

Subj.: CORE PRESSURE DROP FOR NATURAL CIRCULATION CALCULATION

Date: APRIL 9, 1979

This letter is cover one customer and one subject only.

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D.H. Roy	E.F. Dowling
R.M. Hiatt	J.M. Knoll
	P.A. Treventi

REFERENCE: MEMO, SAME SUBJECT, APRIL 6, 1979.

ADDITIONAL INFORMATION HAS BEEN OBTAINED FROM TMI WHICH FURTHER SUBSTANTIATES THE CONCLUSIONS PRESENTED IN THE REFERENCED MEMO. BASED ON THIS INFORMATION, AND THE FLOW SPLITS PREDICTED BY THE PUMP CODE, AN 18 PSIA DROP ACROSS VESSEL DOWNCOMER AND CORE (AT PRESENT CONDITIONS AND CORE FLOW OF 4500 lbm/sec) IS INDICATED. Less 27% core flow

ATTACHMENT 1 IS THE TABULATION OF RC LOOP FLOW TRANSMITTER DIFFERENTIAL PRESSURE SIGNALS OBTAINED AT 4:00 a.m., APRIL 9. ATTACHMENT 2 IS THE CONVERSION OF THE TRANSMITTER VOLTAGE MEASUREMENTS TO LOOP FLOWS.

AS A FURTHER CHECK ON THE RESULTS, I HAVE ASKED MIKE KNOLL OF CONTROL ANALYSIS TO ANALYZE THE SAME CASE USING THE SPLIT CODE. IT IS HOPED THIS INFORMATION WILL BE AVAILABLE BY LATER TOMORROW AFTERNOON.

AT THIS POINT I WOULD LIKE TO ACKNOWLEDGE THE EFFORTS OF MIKE KNOLL AND PHIL TREVENTI IN PERFORMING THIS ANALYSIS (WITHOUT WHICH I WOULD STILL BE SETTING UP THE INPUT).

IF ANY ADDITIONAL INFORMATION ON PLANT STATUS (WHICH COULD PROVIDE A FURTHER CHECK ON THESE PREDICTIONS) IS KNOWN TO BE AVAILABLE, PLEASE CONTACT ME IMMEDIATELY.

PSB/DH

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790726 0074

Attachment 2

Conversion of transmitter voltage measurements to flow -

Assumptions:

1. 10 volts = 80×10^6 lbm/hr.
2. 10 volts = 895.8" ΔP

Method 1:

$$W_a = W_d \left(\frac{V_d}{V_a}\right)^{.5} \left(\frac{V_m}{10}\right)^{.5}$$

W_a - actual flow, lb-/sec.

W_d = flow at voltage = 10 volts.

V_d = specific volume at W_d conditions

V_a = specific volume at actual conditions

V_m = measured transmitter voltage, volts.

now:

V_a (460 psia, 280°F) = .01724 ft^3/lb-

V_d (2200 psia, 600°F) = .0232 ft^3/lb-

W_d = 80×10^6 lbm/hr = 22222 lbm/sec

Therefore:

$$W_a = 25778 \left(\frac{V_m}{10}\right)^{.5} \text{ lbm/sec}$$

Method 2:

If: $\Delta P_d = 895.8" = 10$ volts.

$$\Delta P_a = \left(\frac{\Delta P_d}{10}\right) V_m$$

then:

$$W_a = W_d \left(\frac{\rho_a \Delta P_a}{\rho_m \cdot \Delta P_m}\right)^{.5}$$

for: $W_d = 22222$ lbm/sec

$\rho_a = 1/.01724 = 58.005$ lbm/ft^3

$\rho_d = 1/.0232 = 43.103$ lbm/ft^3

and:

$$W_a = 25778 \left(\frac{\Delta P_a}{\Delta P_m}\right)^{.5}$$

Results:

Following are the results of the voltage measurements:

5191.09

HOT LEG A

RPS CHANNEL	V_m (Volts)	ΔP (inches)	W (lbm/sec)
A	1.9998	179.14	11528
C	2.0982	187.96	11808
D	1.7411	155.97	10756

HOT LEG B

RPS CHANNEL	V_m (Volts)	ΔP (inches)	W (lbm/sec)
A	-.7061	63.25	-6850
C	-.7141	63.97	-6889
D	-.6947	62.23	-6794

Loop A Average = 11364 lbm/sec

Loop B Average = -6844 lbm/sec

This calculation has been reviewed and is correct

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BOS 611

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Part of

File No.
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Subj.
CORE PRESSURE DROP FOR NATURAL CIRCULATION CALCULATIONS

Date
APRIL 6, 1979 10:10 PM

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An analysis (using the PUMP code) was performed earlier this week to estimate core flow blockage. Vessel (i.e. core and bypass) flow resistance was varied over a wide range and the change in loop flow rates, core flow rates and vessel delta P were calculated. The results are tabulated below: (* means unblocked core)

R_V	ΔP_V	W_V	W_{HLA}	W_{HLB}
1.712*	1.6*	10170*	12810*	-2643*
3.5	2.98	9450	12690	-3244
7.0	5.05	8596	12500	-3900
10.0	6.45	8095	12380	-4281
15.0	8.22	7443	12200	-4752
30.0	11.89	6291	11870	-5580
60.0	15.79	5136	11510	-6376

Where:

R_V = downcomer + core + bypass flow resistance, $(psia)/(lbm/sec)^2 \times 10^8$

ΔP_V = pressure drop across core + bypass, psia

W_V = core + bypass flow rate, lbm/sec

W_{HLA} = hot leg flow rate, active loop, lbm/sec

W_{HLB} = hot leg flow rate, idle loop, lbm/sec

an be seen from the tabulated results, the active loop flow is not a ong function of the vessel resistance. This is due to the high reverse lows through the idle pumps. However, the reverse flow through the idle loop is a strong function of the vessel resistance. Prior to this afternoon, I had been under the impression that no method existed for calculation of reverse flow in the idle loop. Recent information from the I&C group shows this not the case. As early as last weekend they estimated the reverse flow to be -14.5% which translates to -6444 lb/sec. A further check today results in an estimate of -6797 lb/sec. Based on the tabulated data, the vessel pressure drop is at least 16 psia.

Additional evidence to back up this is the indicated flow in the active loop which is consistently indicating 49-50% of nominal which translates to approx. 11,000 lbm/sec.

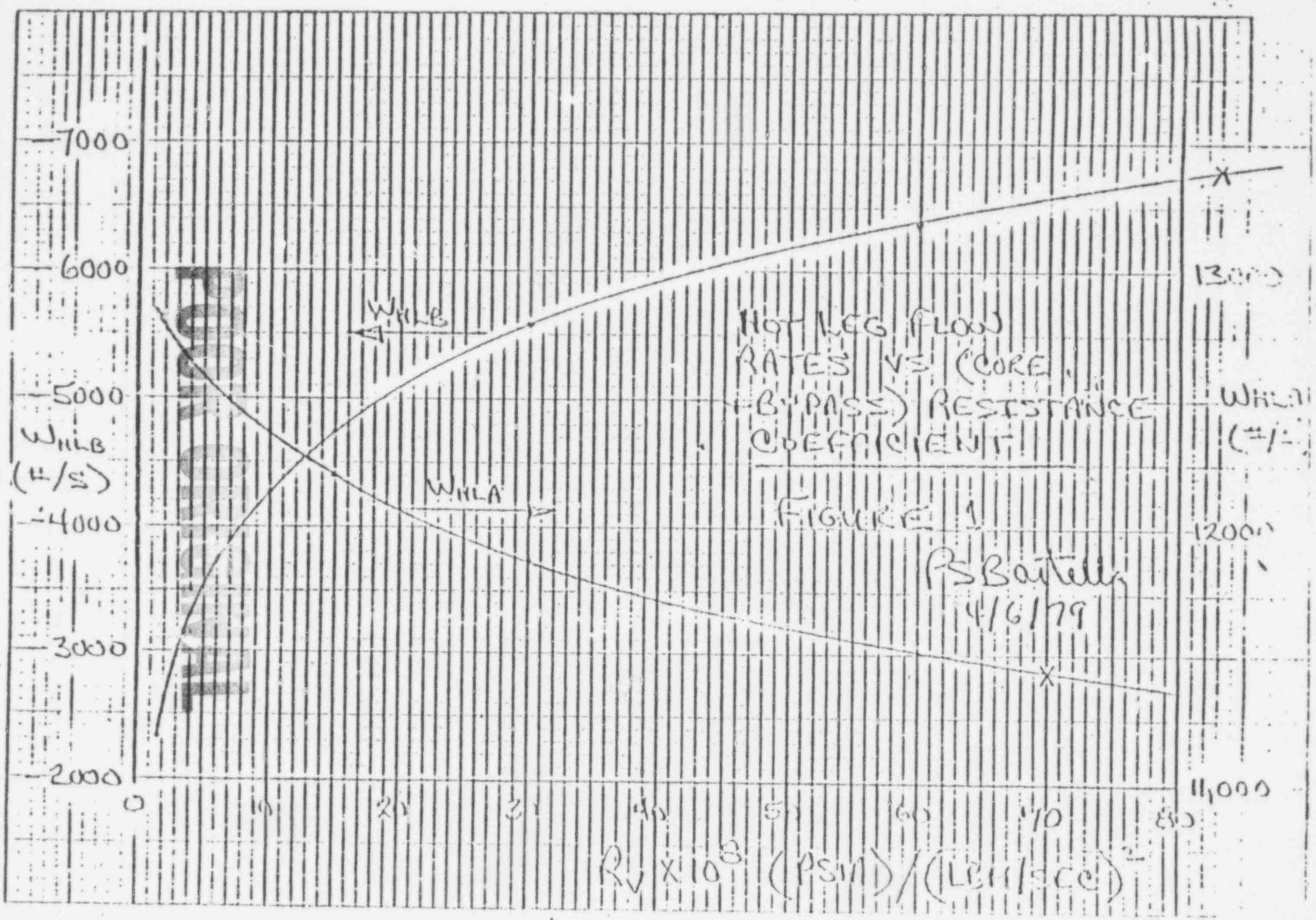
Separate calculations by Jim Veenstra and Larry Losh (see attachments) on 4/4/79 place measured flow in the active loop at 88,350 GPM (based on Gentille delta P = 173"), which is a flow rate of 11,445 lbm/sec.

The attached figures indicate that the core and bypass pressure drop is between 16.7 and 17.7 psia. Allowing for conservatism, I would recommend the use of 18 psia for natural circulation calcuations. Additionally, I would estimate available core + bypass flow at present conditions to be 4600 to 4800 lbm/sec.

I have asked John Castanes to obtain up-to-date readings on Gentille delta P's as a further check on this analysis. He has been in contact with BMCo and they feel that the transmitter accuracy is very good.

ATTACHMENT
PSB:jws

P Bartlett



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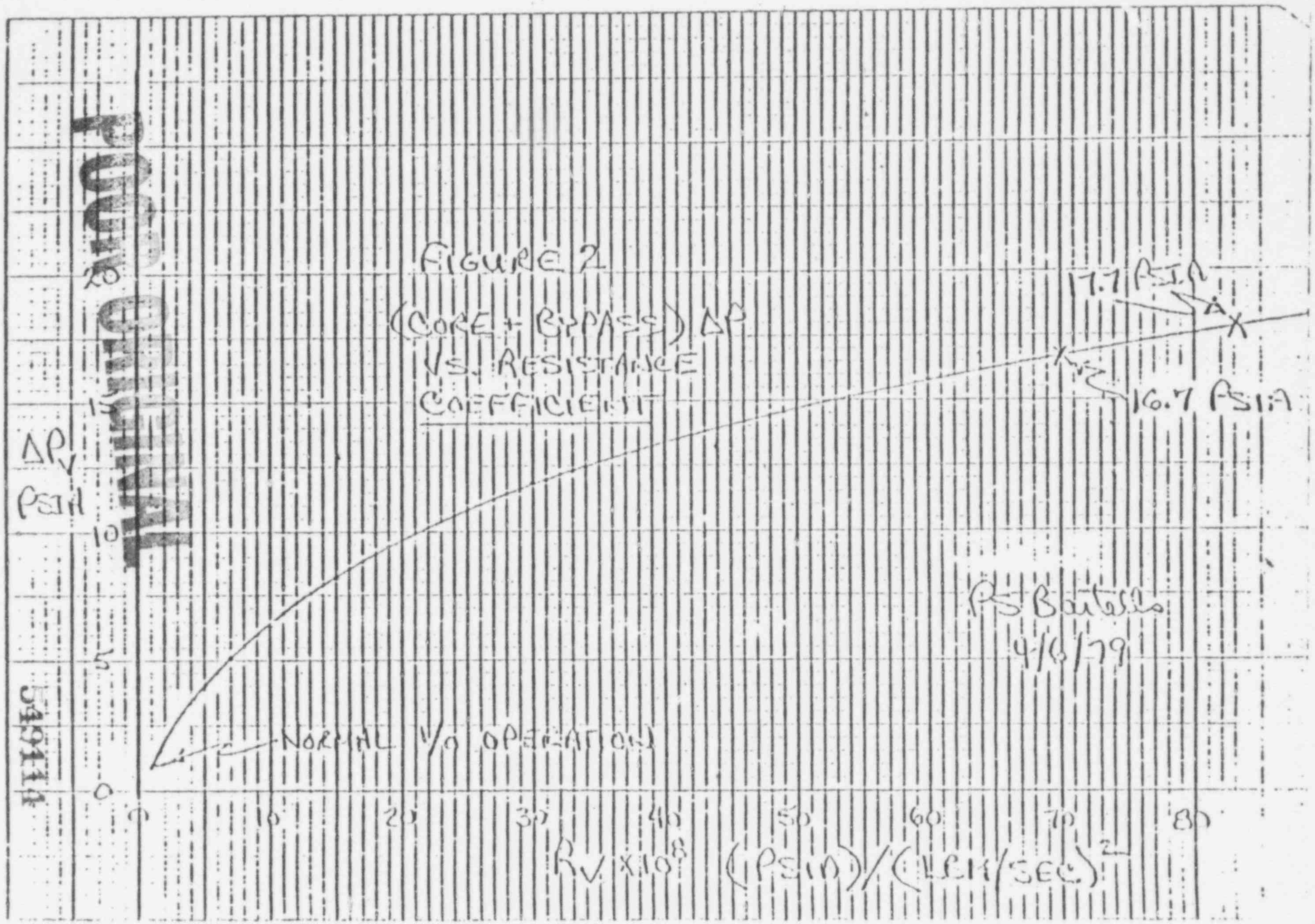

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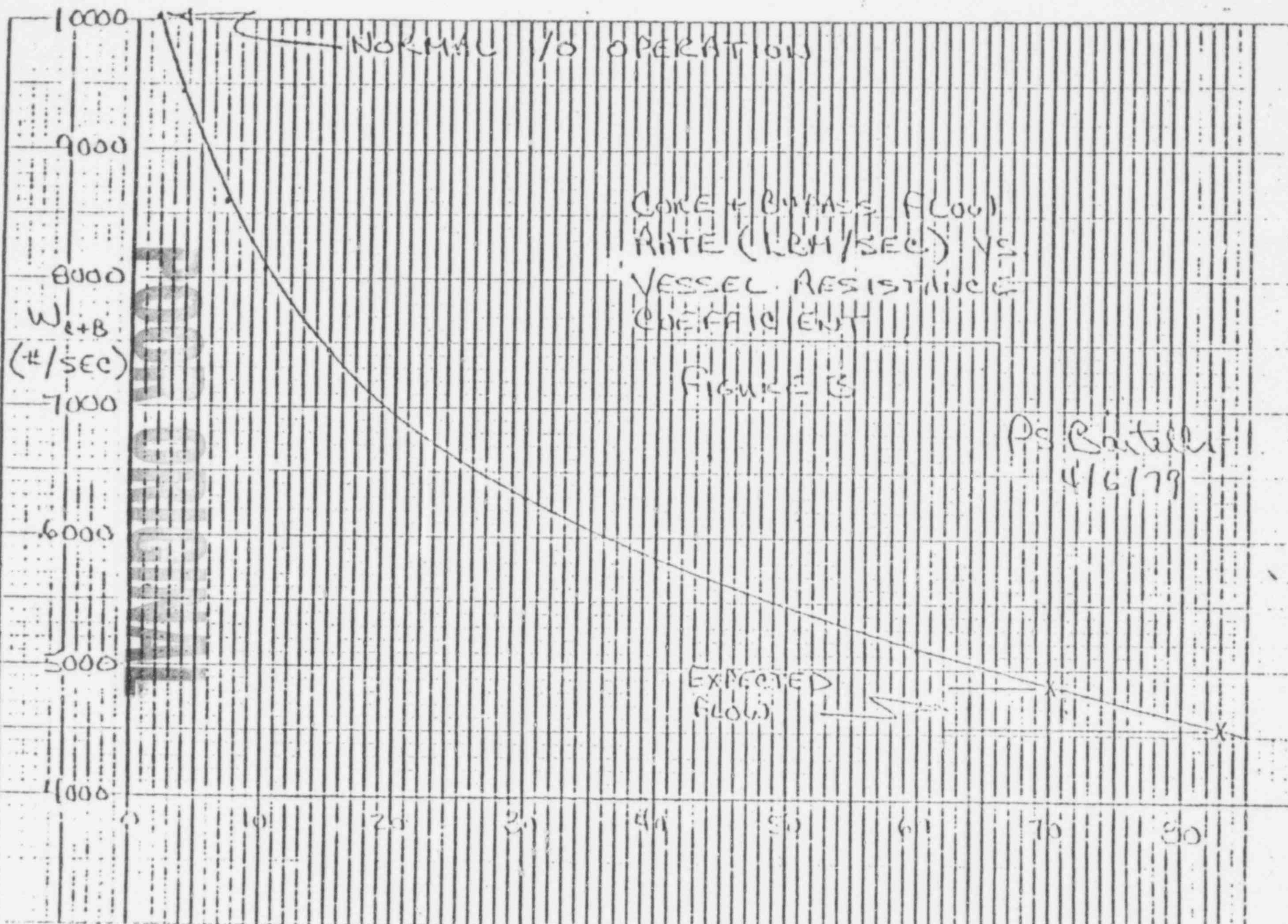

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