BOSTON Edison COMPANY

NUCLEAR OPERATIONS DEPARTMENT
PILGRIM NUCLEAR POWER STATION
Procedure No. TP 82-25

SSW/RBCCW HEAT EXCHANGER TEST PERFORMANCE

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Approved W. J. Bronstein
ORC Chairman

Date 4-27-82

I. PURPOSE

To monitor performance of the SSW system and RBCCW Heat Exchanger to assure that each operable loop of the SSW system can achieve a cooling capability equivalent to 5000 GPM flow at 65°F inlet SSW temperature through the respective RBCCW Heat Exchanger with the associated TBCCW Heat Exchanger throttled. This test will also be used to develop procedural guidance for backwashing and cleaning RBCCW Heat Exchangers.

II. REFERENCE

Report entitled "Cooling Water System Study, Rev. 1 - January 1982", Stone and Webster Engineering Corp.

III. FREQUENCY

This test will be conducted a minimum of four times during the startup from the 1981-1982 outage, as determined by the on-site safety and performance group. A test frequency will be established thereafter as a function of the cleanliness conditions determined from the test data.

IV. PREREQUISITES

A. Two and only two SWW pumps running in the loop which is being tested.

B. Screenwash pump should be off for the loop which is being tested. If this test must be performed and screenwash pumps cannot be secured due to plant conditions the resultant data must be adjusted to account for screenwash flow rate.

C. RBCCW Heat Exchanger for the loop which is being tested must be backwashed just prior to (within 2 hour if practical) start of test.

V. PRECAUTIONS

Prior to start of test, those bearings which are cooled by TBCCW system and which are in alarm at 100% power condition, should be logged and monitored. During the test, TBCCW flow should be restored to normal if any bearing temperature increases more than about 5°F above its 100% power value and is in alarm. This precaution is not applicable during shutdown.

CAUTION: Remove annubar flow element from system tap after performing test.

VI. PROCEDURE

A. Data Collection

NOTE: This test requires data to be collected in the control room, in the screenhouse, and in the auxiliary bay. The procedure is written such that one or both loops can be tested.

SSW Loop A Test

1. Obtain approval of NWE to conduct the test.

1A. Insert annubar flow element into designated test point. (See Data Sheet.)

2. Close MO3808 ("C" SSW Pump Discharge Block Valve) if pump C is not one of the two pumps to be used for the A loop test, or close MO3813 if pump C is one of the two pumps to be used for the A loop test (in which case MO3803 must be open).

3. Regulate SSW flow to 2000 GPM (as indicated by FI6240 on panel C-1) using jog valves MO3801 (TBCCW Heat Exchanger "A" Serv. Water Outlet Valve) and MO3800 (RBCCW Heat Exchanger "A" Serv. Water Outlet Valve).

4. Collect data as indicated on Attachment A.

5. Repeat steps 3 and 4 to obtain data at approximately 3000 GPM, 4000 GPM and 5000 GPM (plant conditions permitting) by further opening jog valve 3800 and throttling down on jog valve 3801.

6. If, after completing step 5, jog valve 3801 is not fully closed, close valve 3801 fully and record max. flow data on Attachment A.

7. Return MO3800 to normal (open).

8. Return MO3801 to normal (open).

9. Return MO3808 and MO3813 to normal.

10. Remove annubar from test point. Cap test point.

SSW Loop B Test

1. Obtain approval of NWE to conduct the test for loop B.

1A. Insert annubar flow element into designated test point.(See Data Sheet.)

2. Close MO3813 ("C" SSW Pump Discharge Block Valve) if pump C is not one of the two pumps to be used for the loop B test, or close MO3308 if pump C is one of the pumps to be used for the loop B test (in which case MO3813 must be open).

3. Regulate SSW flow to 2000 GPM (as indicated by FI6241 on panel C-1) using jog valves MO3805 (TBCCW Heat Exchanger "B" Serv. Water Outlet Valve) and MO3806 (RBCCW Heat Exchanger "B" Serv. Water Outlet Valve).

4. Collect data as indicated on Attachment B.

5. Repeat steps 3 and 4 to obtain data at approximately 3000 GPM, 4000 GPM, and 5000 GPM (plant conditions permitting) by further opening jog valve 3806 and throttling down on jog valve 3805.

6. If, after completing step 5, jog valve 3805 is not fully closed, close valve 3805 fully and record max. flow data on Attachment B.

7. Return MO3806 to normal (open).

8. Return MO3805 to normal (open).

9. Return MO3808 and MO3813 to normal.

10. Remove annubar from test point. Cap test point.

11. Return all data to Shift Technical Advisor for evaluation.

B. Calculations

1. Calculate the Heat Exchanger ΔP, by taking the difference in gage readings and subtracting 2.24 psi for each flow point and plot on Ht Exchanger ΔP vs. Flow Curve (Example - Attachment D).

2. For each flow point calculate $\Delta P/Q^2$ and plot versus SSW inlet temperature (Example - Attachment E).

3. Perform calculations on Attachment C for maximum flow point only and plot on hydraulic grade line curve (Attachment F).

4. For max flow point, calculate $\Delta P/Q^2$ and plot versus inlet temperature (Example - Attachment E). Use this point to compare to acceptance criteria. Points which lie below - left of design curve are $>$5000GPM equivalent flow at 65°F SSW inlet temperature.

VII. ACCEPTANCE CRITERIA

Acceptance Level	A Loop	B Loop	Corrective Action
Acceptable: (Max flow >5000 GPM equivalent at 65°F.	_____	_____	None
Unacceptable: (Max flow <5000 GPM equivalent at 65°F	_____	_____	Backwash & Retest. If still unacceptable, declare loop inoperable - remove RBCCW Ht. Exch. and Clean.

Watch Engineer Notified: _____ Date _____
Performance Engineer or STA

Watch Engineer Acknowledged: _____ Date _____
Watch Engineer

MR Issued _____

ATTACHMENT A
SSW PERFORMANCE TEST DATA - LOOP A

Date: _____ By: _____

Time: _____

CONTROL ROOM	2000 GPM	3000 GPM	4000 GPM	5000 GPM	MAX FLOW
SSW Loop A Inlet Temp. (Computer Point M077)					
Seawater Level-East (LI 3831A) Ft.					
SSW Flow Loop A (FI 6240) GPM					
SSW Pump Pressi Loop A (PI 3828) PSI					
SALT SERVICE AUXILIARY BAY					
Press. Indicator at PX3839A					
Press. Indicator at FE6240					
Press. Indicator at PX3844					
ΔP Indicator RBCCW Ht. Exch. A					
REEN HOUSE					
SSW Pump "A" Dis. Press PI3802					
SSW Pump "B" Dis Press. PI3807					
SSW Pump "C" Dis. Press. PI3312					
Actual Seawater Level Below Grate at El. 11'0"					
Screenwash Pp 213B Suction Pressure*					
Discharge Pressure*					

**MCC B-15
***MCC B-10 (C.S.R.)
* Record if ON only

ADDITIONAL DATA (SSW BAY)

Annubar FI @ FE 6240 (GPM)					
Annubar FI @ TI 3872 (GPM)					
SSW Pump A AMPS **					
SSW Pump B AMPS **					
SSW Pump C AMPS ***					

ADDITIONAL DATA (SCREENHOUSE)

Annubar FI @ DISCHARGE HDR. (GPM)					

ATTACHMENT B

SSW PERFORMANCE TEST DATA - LOOP "B"

Date: _____ By: _____

Time: _____

CONTROL ROOM	2000 GPM	3000 GPM	4000 GPM	5000 GPM	MAX FLOW
SSW Loop B Inlet Temp. (Computer Point M078)					
Seawater Level-West (LI 3831B) Ft.					
SSW Flow Loop B (FI 6241) GPM					
SSW Pump Press. Loop B (PI 3829) PSI					
SALT SERVICE AUXILIARY BAY					
Press. Indicator at PX3839B					
Press. Indicator at FE6241					
Press. Indicator at PX3848					
△P Indicator RBCCW Ht. Exch B					
CREEN HOUSE					
SSW Pump "C" Dis. Press. PI3812					
SSW Pump "D" Dis. Press. PI3817					
SSW Pump "E" Dis. Press. PI3822					
Actual Seawater Level Below Grate at El. 11'0"					
Screenwash Pump 213A Suction Pressure*					
Discharge Pressure*					

**MCC B-14

***MCC B-10 (C.S.R.)

*Record if ON only

ADDITIONAL DATA (SSW BAY)

Annubar FI @ FE 6241 (GPM)					
Annubar FI @ FI 3849 (GPM)					
SSW Pump C AMPS***					
SSW Pump D AMPS**					
SSW Pump E AMPS**					

ADDITIONAL DATA (SCREENHOUSE)

Annubar FI @ DISCHARGE HDR. (GPM)					

ATTACHMENT C
SSW MAX FLOW CALCULATION
AND HYDRAULIC GRADE LINE

I. MAX FLOW CALCULATION

A. Average tide level _____ ft.

B. Salt Service Water Pumps

Pump (Specify Off)	Discharge Pressure	TDH Fresh Water (C. Below)	Total Flow from pump curve (upper line on Attachment G)
P-208A	_____psig	_____Ft	_____GPM
P-208B	_____psig	_____Ft	_____GPM
P-208C	_____psig	_____Ft	_____GPM
		A Loop	_____GPM
P-208C	_____psig	_____Ft	_____GPM
P-208D	_____psig	_____Ft	_____GPM
P-208E	_____psig	_____Ft	_____GPM

C. Pump TDH (fresh water)

TDH = [(Pump Disc. Press. X 2.239) + 30.6 - ave. tide.] x 1.03 + 0.8 ft.

D. Screenwash Flow Diversion. PERFORM ONLY IF screenwash pump remained in serivce.

P213B discharge press _____psi P213A discharge press _____psi

P213B suction press _____psi P213A suction press _____psi

P213B ΔP _____psi P213 ΔP _____psi

P213B Head ΔP x 2.307 = _____Ft P213A Head ΔP x 2.307 = _____Ft

P213B Flow from Attachment H _____GPM P213B Flow from Attachment H _____GPM

Flow Adjustment:

A Loop Max Flow = A Loop Flow from B above _____ - P213B flow _____ = _____GPM

B Loop Max Flow = B Loop Flow from B above _____ - P213A flow _____ = _____GPM

II. P/Q^2 CALCULATION

	A Loop	B Loop
1. Max Flow (Attach C, Sect I)	_____GPM	_____GPM
2. Δ P RBCCW Ht Exch (Attach A or B)	_____psi	_____psi
3. $\Delta P/Q^2$ - ②/①^2	_____$\frac{10^{-6}\text{psi}}{\text{GPM}^2}$	_____$\frac{10^{-6}\text{psi}}{\text{GPM}^2}$
4. SSW Inlet Temp (Attach A or B)	_____°F	_____°F

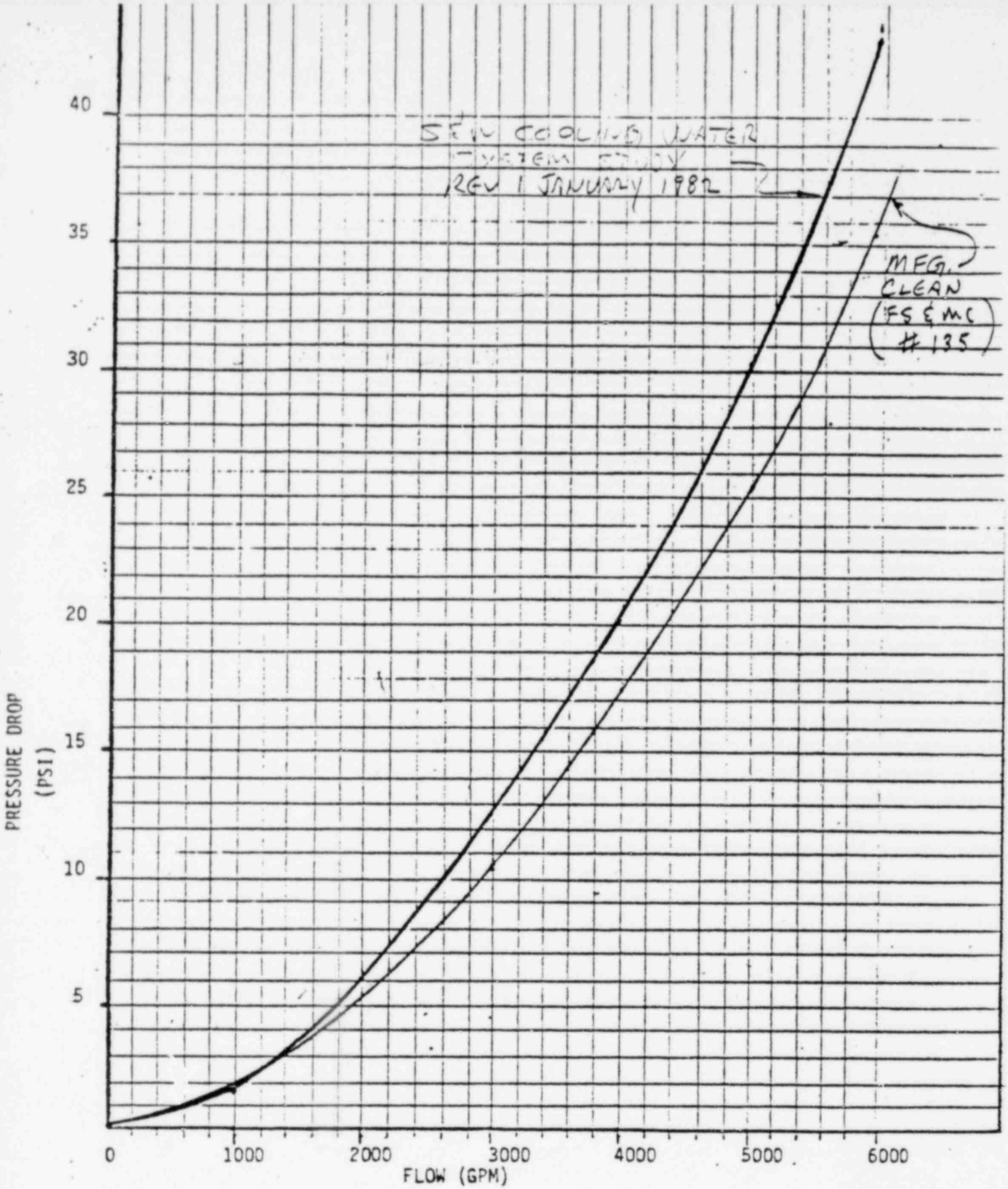
III. HYDRAULIC GRADE LINE POINTS

	A Loop	B Loop
1. Pump TDH (Salt Water)		
$TDH_{(sw)}$ = TDH/Ave/1.03	_____Ft	_____Ft
2. Header Pressure:		
H = (P gage X 2.239) + 29.5 - ave. tide	_____Ft	_____Ft
3. Aux Bay Inlet:		
H = (P gage X 2.239) + 14.0 - ave. tide	_____Ft	_____Ft
4. Local Pressure at flow element:		
H = (P gage X 2.239) + 8.0 - ave. tide	_____Ft	_____Ft
5. Pressure/Vacuum Point:		
H = (± vac gage x 2.239) + 16.0 - ave. tide	_____Ft	_____Ft

(NOTE! P Vac gage = in Hg X 0.491 This point is often at vacuum)

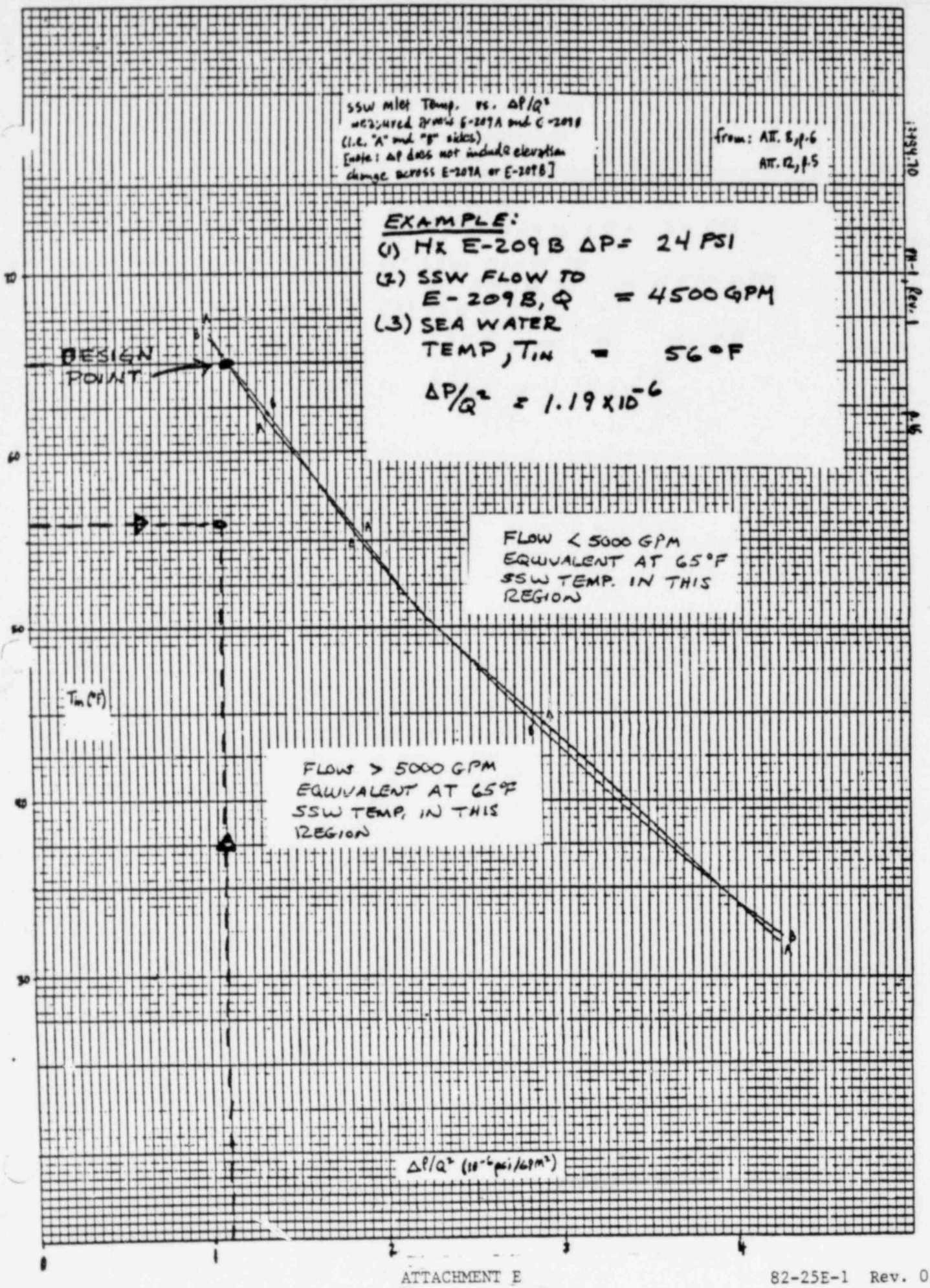
6. ΔP Heat Exchanger

ΔH = P gage x 2.239 - 5 ft..	_____Ft	_____Ft



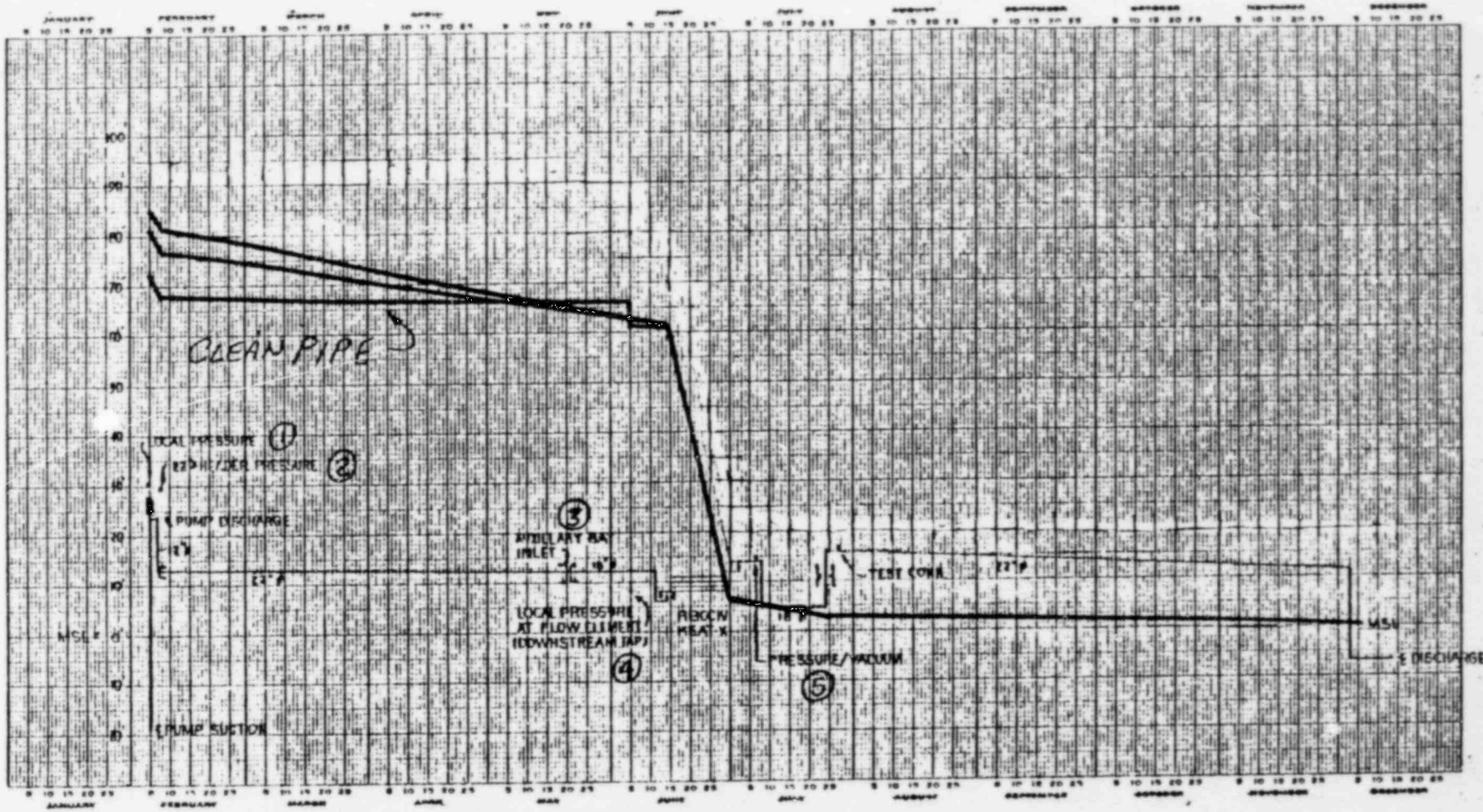
Hx Pressure Loss vs. Flow For
RBCCW Hxs (CLEAN)

ATTACHMENT D


SSW inlet Temp. vs. ΔP/Q²
measured across E-209A and C-209B
(i.e. "A" and "B" sides)
[note: ΔP does not include Q elevation
change across E-209A or E-209B]
from: Att. B, p.6
Att. 12, p.5
EXAMPLE:
(1) Hx E-209B ΔP = 24 PSI
(2) SSW FLOW TO
E-209B, Q = 4500 GPM
(3) SEA WATER
TEMP, T_IN = 56°F
ΔP/Q² = 1.19 x 10⁻⁶
DESIGN
POINT
FLOW < 5000 GPM
EQUIVALENT AT 65°F
SSW TEMP. IN THIS
REGION
FLOW > 5000 GPM
EQUIVALENT AT 65°F
SSW TEMP. IN THIS
REGION
T_in (°F)
ΔP/Q² (10⁻⁶ psi/GPM²)
70
60
50
40
30
0
1
2
3
4

ATTACHMENT F

BOSTON EDISON COMPANY PILGRIM STATION UNIT #1
SALT SERVICE WATER SYSTEM
HYDRAULIC GRADE LINE



NOTE:

FRICTION LOSS, h_f BASED ON 50°F γ=.103 H_2O 2500 GPM/PUMP FLOW FOR CLEAN STEEL PIPE WITH $\frac{1}{16}$" RED RUBBER LINER

SCALE
VERTICAL 1"=20'
HORIZONTAL 1"=40'

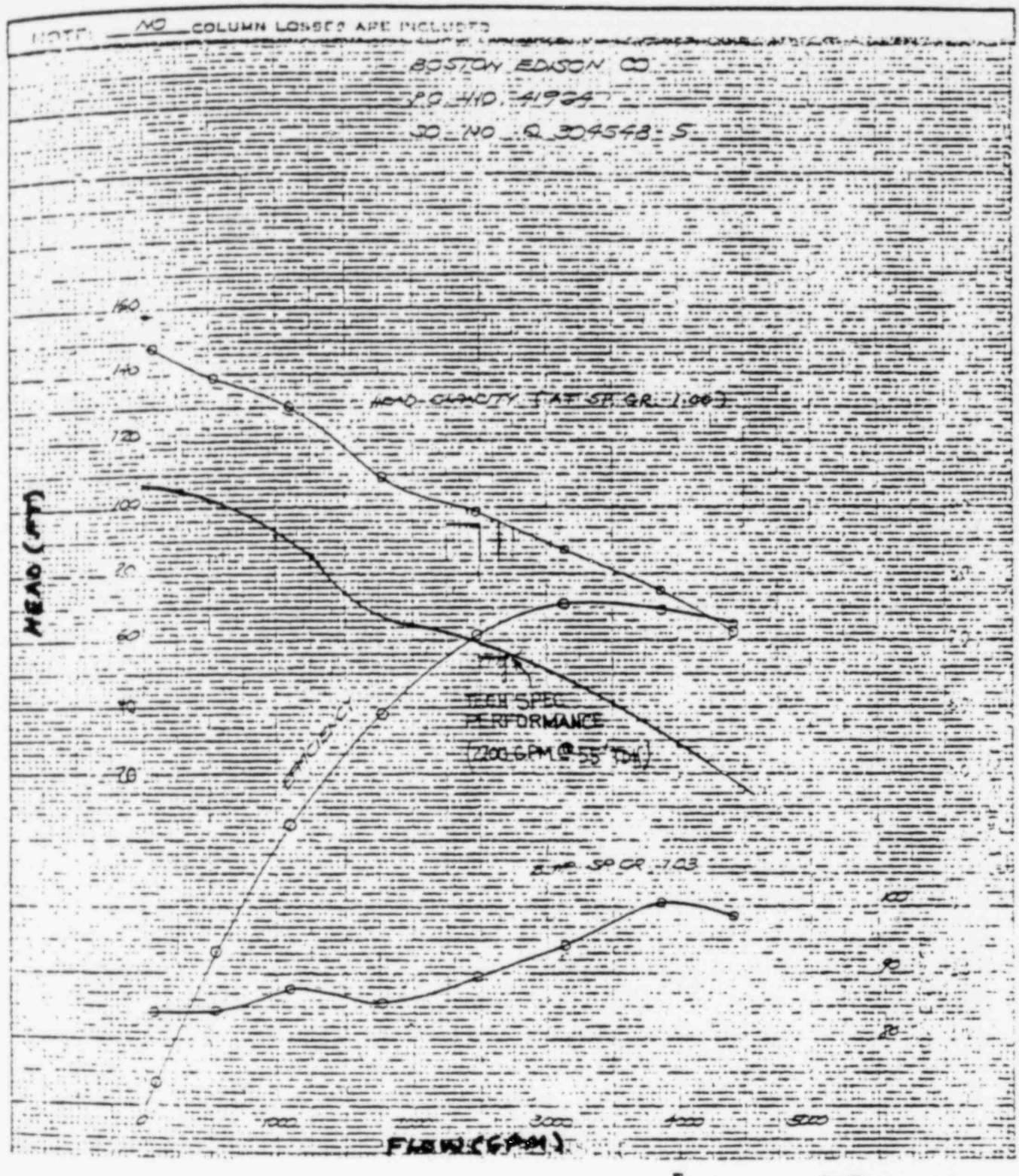
(1) RBCCW HX only After Backwash)

* Piping from Pump Discharge to Inlet of RBCCW HX.

82-25F-1 Rev. 0

ATTACHMENT G

CURVES SHOW APPROXIMATELY THE CHARACTERISTICS WHEN PUMPING CLEAR NON-AERATED WATER. NO GUARANTEE IS MADE EXCEPT FOR THE RATED POINT



IMPELLER CLOSED

10 3/8 DIA.

12-14-78 BY J.B.

GOULDS PUMPS
VERTICAL PUMP DIVISION
INDUSTRY, CALIFORNIA

PERFORMANCE ONE STAGE

12.16 DHLC

DEEP WELL TURBINE PUMP

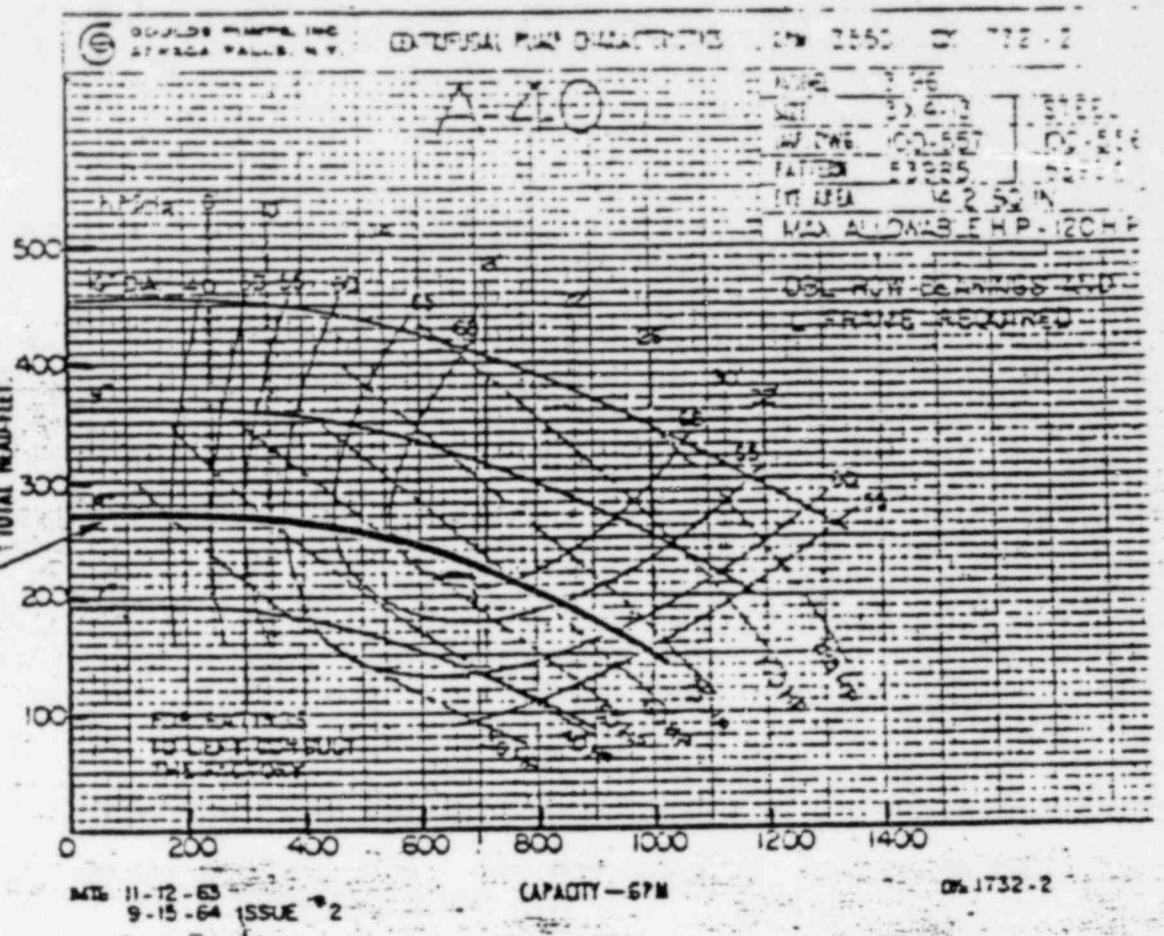
1770

R.P.M.

7-78-577

82-25G-1 Rev. 0

SCREENWASH PUMP CAPACITY CURVE



GOULDS SERIAL 7BBA93J-J-2, LIQUID SEA WATER, TEMP. 75
CUSTOMER, BECHTEL CORPORATION, CUST. PO. 6498, W. J. A.
EQUIP. NO. P. 213, A&B, SERVICE, SP. GR.

M14A-30-1