RWST-CAT DRAWDOWN TEST
4/30/80
SURRY #2 - VEPCO-
CALCULATION NO: 12846.07/49

RWST-CAT DRAWDOWN TEST
4/30/80
SURRY #2 - VEPCO-
CALCULATION NO: 12846.07/49

CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

CLIENT & PROJECT: V[illegible] #2	PAGE 1 OF [illegible]
CALCULATION TITLE (Indicative of the Objective): Refueling Water Storage Tank (RWST) — [illegible] Addition Tank (CAT) [illegible] Test - 4/30/80	QA CATEGORY (✓) ☒ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ____ OTHER

CALCULATION IDENTIFICATION NUMBER

J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
[illegible]	Hydraulic	49		

* APPROVALS - SIGNATURE & DATE

PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)	REV. NO. OR NEW CALC. NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION * REQUIRED (✓) YES	NO
[illegible] 5/[illegible] [illegible] 5/[illegible]	R. Criswell 5-20-80	R. Criswell 5-20-80				

DISTRIBUTION *

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT FILES (OR FIRE FILE IF NONE)					

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	12646.07 /49		1 / 11
PREPARER/DATE: C. Piontkowski 5/2/80	REVIEWER/CHECKER/DATE: R. CROWELL 5-20-80	INDEPENDENT REVIEWER/DATE: R. CROWELL 5-20-80	
SUBJECT/TITLE: RWST - CAT DRAWDOWN TEST -- 4/30/80		QA CATEGORY/CODE CLASS: I	

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Attachments:

Reviewer: R. Crowell

CALCULATION SUMMARY

STONE & WEBSTER ENGINEERING CORPORATION

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CLIENT/PROJECT: VEPCO - SURRY #2

QA CATEGORY/CODE CLASS: I.

SUBJECT/TITLE: "RWST - CAT DRAWDOWN TEST - 4/30/80

OBJECTIVE OF CALCULATION

"TO PROCESS THE MEASUREMENTS OF THE 4/30/80 DRAWDOWN TEST BASED ON TEST RESULTS CHECK THE ACCEPTANCE CRITERIA OF THE TEST.

CALCULATION METHOD/ASSUMPTIONS

BASED ON TEST MEASUREMENTS DETERMINE Z_{RWST} VS. TIME, Z_{CAT} VS. TIME AND $H_{SUCTION}$ VS. TIME, THEN DETERMINE q_{CAT}, Q_{RWST} AND Q_{CS}. BASED ON HEAD LOSS MEASURED AND FLOW RATES DETERMINED, CALCULATE THE HEAD LOSS COEF. BETWEEN RWST AND JUNCTION POINT AND CAT AND JUNCTION POINT. CHECK THE HEAD LOSS COEF DETERMINED BASED ON MEASUREMENTS WITH THE CALCULATED HEAD LOSS COEF. CALCULATE THE q_{CAT} AND Z_{CAT} VS. TIME AND COMPARE THE RESULTS WITH THE TEST RESULTS.

SOURCES OF DATA/EQUATIONS

Source of data : Attach. No 6 and strip chart records.

CONCLUSIONS

See page 8-11

REVIEWER(S) COMMENTS

PREPARER	DATE
[illegible]	
REVIEWER/CHECKER	DATE
R. [illegible]	[illegible]
INDEPENDENT REVIEWER	DATE

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PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
C TOMTISONSKI 5/12/80	R CROWELL 5-20-80	R CROWELL 5-20-80

SUBJECT/TITLE: KWU CAT DRAWDOWN TEST 4/30/80

QA CATEGORY/CODE CLASS: J

MEASURED TWST ELEV, CAT ELEV, AND HYDRAULIC GRADE LINE AT JUNCTION POINT, VS. TIME ARE SHOWN IN ATTACHMENT No. 5

THE GRAPHICAL REPRESENTATIONS OF THE ABOVE PARAMETERS ARE SHOWN IN ATTACHMENT No. 1.

BASED ON ACTUAL TWST AND CAT DRAWDOWNS DETERMINED BASED ON MEASUREMENTS AND RECORDED VALUES, THE FLOW RATES FROM TWST, CAT, AND THROUGH THE CS PUMP ARE CALCULATED IN ATTACHMENT No. 2. VALUES FOR CS PUMP FLOW RATE FROM 0 TO 15 MIN WERE READ DIRECTLY FROM THE INTERPOLATED GRAPH OF RECORDED VALUES. THE FLOW RATE FROM CAT (Q_{CAT}) AND THROUGH THE PUMP (Q_{CS}) ARE TABULATED GRAPHICALLY IN ATTACHMENT No. 2. (LHSI CALCULATED VALUES ARE INCLUDED IN THIS ATTACHMENT)

THE PRESSURE DROP THROUGH THE CAT ORIFICE MEASURED DURING THE TEST AND ALSO RECORDED FROM TIME 19 MIN TO 30 MIN IS TABULATED IN ATTACHMENT No. 3.

THE HEAD LOSS COEFFICIENTS BETWEEN TWST AND JUNCTION POINT, CAT TO JUNCTION POINT, CAT PIPING, AND CAT ORIFICE ARE CALCULATED BASED ON TEST MEASUREMENTS IN ATTACHMENT No. 4

USING THE HEAD LOSS COEFFICIENTS, A COMPARISON OF THE FLOW RATE FROM CAT AND CAT ELEVATION ARE CALCULATED ANALYTICALLY IN ATTACHMENT No. 5. THE RESULTS OF THE ANALYTICAL CALCULATIONS ARE GRAPHICALLY COMPARED WITH THE TEST RESULTS IN ATTACHMENT No. 5.

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PREPARER/DATE	REVIEWER/CHECKER/DATE R. CROWELL 5-20-80	INDEPENDENT REVIEWER/DATE R. CROWELL 5-20-80	
SUBJECT/TITLE RWST CAT DRAWDOWN TEST - 4/30/80		QA CATEGORY/CODE CLASS I	

DRAWDOWN TEST RESULTS --

1- General Considerations regarding the Test Measurements

1-a : CAT Drawdown during the test (See Attachment 1 page 5/7)

- The recorded drawdown and the drawdown based on discrete measurements at one minute intervals are in agreement. Since the recorded values are in general one or two inches greater than the discrete measurements, the slight difference in drawdowns can be attributed to the inherent errors of the recording equipment. However, the recorded drawdown and the measured drawdown are, for all practical purposes, two very close curves with the same slopes. Since these slopes determine the flow rates from the CAT, it can be concluded that the CAT drawdown data of the test are reliable and accurate.
- The recorded CAT drawdown clearly shows the non-existence of transients; the change of the drawdown curve slope is gradual at the beginning of the test.

1-b : RWST Drawdown during the test, see Attachment 1 page 6/7

- The recorded drawdown is in agreement with the drawdown based on one-minute-interval measurements. The constant difference (one inch) recorded can be attributed to the margin of uncertainty of the recording equipment. The fact that both drawdowns are very similar and

parallel confirms that the RWST drawdown test data are reliable and sufficiently accurate.

- The recorded RWST drawdown also shows that transients do not take place; there is only one significant change in slope due to LHSI pump shutdown, clearly indicating a significant change of the flow rate from the RWST.

1-c. Hydraulic Grade Line at the Junction Point (see Attachment 1, page 7)

- The recorded values and the one-minute-interval measurements are in sufficient agreement considering an inherent margin of uncertainty of the instruments
- The hydraulic grade line recorded at the junction point unquestionably shows the nonexistence of transients in the RWST-CAT system and demonstrates that the hydraulic phenomenon taking place is governed by the gradual variation of its parameters.

1-d. CAT outlet Head Losses [illegible]

- The recorded values and [illegible] meter measurements are [illegible] considering the error [illegible] the [illegible] subjected to pulsations due to [illegible]

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SUBJECT/TITLE: RWST - CAT DRAWDOWN TEST - 4/30/80

QA CATEGORY/CODE CLASS: I

1-e : Containment Spray Pump Flow Rate (See Attach. #2 pg. 5/6)

- The CS Pump flow rates recorded are based on the pressure drop through an orifice temporarily installed in the CS line and especially designed for the test. However, since the orifice was assembled ad hoc and used without a hydraulic calibration, a post test hydraulic calibration was performed. This calibration used to measure RWST drawdown and CAT drawdown after the LHSI pumps shut down to determine the actual flow rate through the orifice. Based on this calibration and on the pretest calibration of the recording equipment, the CS pump flow rates were determined and graphically represented in Attach. #2 pg. 5/6.

1-f : CAT Flow Rate (See Attach #2 page 6/6)

- The CAT flow rates were determined from the CAT drawdown curve and [illegible] plotted as shown in Attach. #2 [illegible]

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SUBJECT/TITLE RWST-CAT DRAWDOWN TEST - 4/30/80		QA CATEGORY/CODE CLASS	

2 - Test Results

2-a : Head Loss Coef. between RWST and Junction Point

Based on 21 test measurements the average value of this coef. is $k = 0.275 \times 10^{-6}$ Ft/GPM² (See Attach. 2&4)

Based on analytical calculations this coef. is 0.268×10^{-6} Ft/GPM² (Calc. 14 Rev. 1)

Conclusion: The verification of head loss coef. shows that the actual losses are approximately 2.6% greater than their analytical evaluation. This confirms the accuracy of the analytical [illegible]

2-b : CAT Orifice Head Loss Coef.

Based on 18 test measurements the average value of this coef is $k = 2600 \times 10^{-6}$ Ft/GPM² (See Attach. 2&4)

The specification of the CAT orifice [illegible] on a head loss coef. of 2600×10^{-6} Ft/GPM² (See Calc. 31)

Conclusion: The performance of CAT orifice agrees with the specification of the orifice

2-c : Head Loss Coef. between CAT and [illegible]
(without the CAT orifice)

Based on 18 test measurements the average value of this coef. is $k = 540 \times 10^{-6}$ Ft/GPM² (See [illegible]

Based on analytical calculations this coef [illegible]

[illegible] with both [illegible]

[illegible]

is estimated 460×10^{-6} Ft/GPM².

Conclusion: The verification of head loss coef shows that the actual losses through the piping system between CAT and Junction Point are approximately 17% greater than their analytical evaluation. This relative significant discrepancy is possible since the CAT piping system comprises numerous fittings in series

2-e Total Head Loss Coef. between CAT and Junction Point

The total head loss coef between the CAT and Junction Point is the sum of piping loss coef and orifice head loss coef. Based on measurements, the average value is $k = 3140 \times 10^{-6}$ Ft/GPM²

The corresponding calculation [illegible] is 306×10^{-6} Ft/GPM²

Conclusion: The actual head losses [illegible] the CAT and Junction Point are approximately 2.6% greater than their analytical evaluation. This confirms the fact that a system [illegible] using an orifice as a flow control device can be [illegible] with a relative high degree of accuracy.

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SUBJECT/TITLE	QA CATEGORY/CODE CLASS
RWST - CAT DRAWDOWN TEST - 4/30/80	

2-f : Capability of an analytical method to predict the CAT flow rates and the CAT drawdown.

The analytical method used is described in Attach. No 5.

The calculated CAT flow rates and the CAT flow rates determined based on test measurements are represented in Attach. No 5 page 9/10. The calculated CAT drawdown as compared to the measured CAT drawdown is presented in Attach. No 5 page 10/10. From a practical stand point there are no differences between measured and calculated values, and therefore the analytical method can accurately model the RWST - CAT drawdown phenomenon.

2-g. Recommendations regarding the use of the analytical method in the Containment Spray NPSH analysis.

- The analytical method can be used without any reservation, to model the Containment Spray NPSH under any [illegible].
- For conservatism in the NPSH analysis the following head loss coef. are recommended:

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	R.CROWELL 5-20-80	R.CROWELL 5-20-80

SUBJECT/TITLE: RWST-CAT DRAWDOWN TEST - 4/30/80

QA CATEGORY/CODE CLASS:

1: Head Loss Coef. between RWST and Junction Point:

When analyzing Minimum pH:

$K = 0.95\ K_{calculated}$

When analyzing Maximum pH:

$K = 1.05\ K_{calculated}$

2: Head Loss Coef. between CAT and Junction Point including the CAT orifice:

When analyzing Minimum pH:

$K = 1.05\ K_{calculated}$

When analyzing Maximum pH:

$K = 0.95\ K_{calculated}$

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SUBJECT/TITLE RWST - CAT DRAWDOWN TEST 1/30/80		QA CAT. CONT/CODE CLASS I	

TEST MEASUREMENTS -

TIME (MIN	CAT ELEVATION (FT)	RWST ELEVATION (FT)	HGL JUNCTION ELEVATION (FT)
0	—	51.35	—
1	57.31	50.40	49.01
2	56.92	49.79	48.39
3	56.50	49.15	47.76
4	56.02	[illegible]	[illegible]
5	55.63	47.90	46.53
6	55.19	47.27	45.91
7	51.73	46.63	45.44
8	54.27	46.00	44.65
9	53.83	45.38	44.02
10	53.39	44.75	43.40
11	52.91	44.13	42.77
12	52.42	43.46	42.14
13	51.96	[illegible]	[illegible]
14	51.46	[illegible]	[illegible]
15	50.99	41.53	40.33
16	50.50	[illegible]	39.71
17	50.03	40.72	39.44
18	49.53	40.49	39.25
19	49.07	40.25	[illegible]
20	48.59	40.01	[illegible]
21	48.15	39.78	[illegible]
22	47.68	39.54	[illegible]
23	47.24	39.31	38.05
24	46.79	[illegible]	37.81
[illegible]	46.33	[illegible]	[illegible]
[illegible]	45.92	[illegible]	[illegible]
27	45.49	[illegible]	37.11
[illegible]	45.06	[illegible]	[illegible]
[illegible]	44.65	37.90	[illegible]
[illegible]	44.23	[illegible]	[illegible]
[illegible]	43.81	[illegible]	[illegible]
[illegible]	43.41	37.19	[illegible]
[illegible]	43.01	[illegible]	[illegible]
[illegible]	42.59	[illegible]	[illegible]
[illegible]	42.22	[illegible]	[illegible]
[illegible]	41.83	[illegible]	[illegible]
[illegible]	41.45	[illegible]	[illegible]
[illegible]	41.04	[illegible]	[illegible]
[illegible]	40.66	[illegible]	[illegible]
[illegible]	40.24	[illegible]	[illegible]

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SUBJECT/TITLE		QA CATEGORY/CODE CLASS	

TIME (min)	RUST (Ecot)	CAT (ppm)
0	51.39	
1	50.74	
	50.15	
	49.56	
	48.91	
	48.20	
	47.60	
	46.95	
	46.30	
	45.71	
	45.12	
	44.47	
	43.82	
	43.23	
17	42.61	
	41.92	
	41.31	
	40.72	
	40.17	
	39.62	
	39.01	
	38.42	
	37.81	
	37.22	
	36.63	
	36.02	
	35.43	
	34.82	
	34.23	
	33.62	
	33.03	
	32.42	
	31.83	
	31.22	
	30.63	
	30.02	
	29.43	
	28.82	
	28.23	
	27.62	
	27.03	
	26.42	
	25.83	
	25.22	
	24.63	
	24.02	
	23.43	
	22.82	
	22.23	
	21.62	
	21.03	
	20.42	
	19.83	
	19.22	
	18.63	
	18.02	
	17.43	
	16.82	
	16.23	
	15.62	
	15.03	
	14.42	
	13.83	
	13.22	
	12.63	
	12.02	
	11.43	
	10.82	
	10.23	
	9.62	
	9.03	
	8.42	

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[illegible] 5/5/80	[illegible] 5/12/80	R. CROWELL 5-[illegible]-80

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
C.S. PUMP [illegible] PRESSURE (RECORDED VALUES)	I

SURRY DRAWDOWN TEST - APRIL 30, 1980

TIME	CS PUMP SUCTION PRESSURE (psia)
0	22.65
1	22.15
2	22.15
3	21.90
4	21.50
[illegible]	21.30
[illegible]	[illegible]
[illegible]	20.80
8	20.50
9	20.25
10	20.00
11	19.75
[illegible]	19.50
[illegible]	19.15
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	18.40
[illegible]	18.24
[illegible]	18.15
[illegible]	18.05
[illegible]	[illegible]
[illegible]	17.90
[illegible]	17.70
[illegible]	17.60
[illegible]	17.55
[illegible]	17.45
[illegible]	17.40
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

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PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
C. Piontkowski 5/8/80		R. Crowell 5-12-80

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
"RWST - CAT DRAWDOWN TEST" - 4/30/80	I

CONVERSION OF CS PUMP SUCTION PRESSURES IN PSIA TO FT H_2O:

BAROMETRIC PRESSURE = 14.7 psi

$P(psig) = P(psia) - 14.7$

$P(psig) \times 2.308 = P(ft\ H_2O)$

PRESSURE CONVERSION -

TIME (MIN)	CS PUMP PRESSURE (psig)	CS PUMP PRESSURE (ft H_2O)	CS PUMP PRESSURE + HEIGHT OF TRANSDUCER (31.00') (EGL ELEVATION)
0	7.95	18.35	49.35
1	7.75	17.89	48.89
2	7.45	17.19	48.19
3	7.20	16.62	47.62
4	6.80	15.69	46.69
5	6.60	15.23	46.23
6	6.35	14.66	45.66
7	6.10	14.08	45.08
8	5.80	13.39	44.39
9	5.55	12.81	43.81
10	5.30	12.23	[illegible]
11	5.05	11.66	[illegible]
12	4.80	11.08	[illegible]
13	4.45	10.27	41.27
14	4.25	9.81	[illegible]
15	3.95	9.12	[illegible]
16	3.70	8.54	39.54
17	3.54	8.17	[illegible]
18	3.45	7.96	[illegible]
19	3.35	7.73	38.73
20	3.30	7.62	[illegible]
21	3.20	7.39	[illegible]
22	3.05	7.04	[illegible]
23	2.95	6.81	37.81
[illegible]	2.85	6.58	[illegible]
[illegible]	[illegible]	6.35	[illegible]
[illegible]	[illegible]	6.23	[illegible]
[illegible]	[illegible]	5.89	[illegible]
[illegible]	[illegible]	5.65	[illegible]
[illegible]	[illegible]	5.54	[illegible]
[illegible]	[illegible]	5.31	[illegible]
[illegible]	[illegible]	5.05	[illegible]
[illegible]	[illegible]	4.85	[illegible]
[illegible]	[illegible]	4.62	[illegible]
[illegible]	[illegible]	4.27	[illegible]
[illegible]	[illegible]	4.15	[illegible]
[illegible]	[illegible]	3.92	[illegible]
[illegible]	[illegible]	3.58	[illegible]
[illegible]	[illegible]	3.46	[illegible]
[illegible]	1.35	3.12	[illegible]

ELEVATION, FT
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BASED ON RECORDS
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TAKEN AT ONE
MINUTE INTERVALS
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CAT ELEVATION IN FEET VS TIME

ATTACHMENT No. 1
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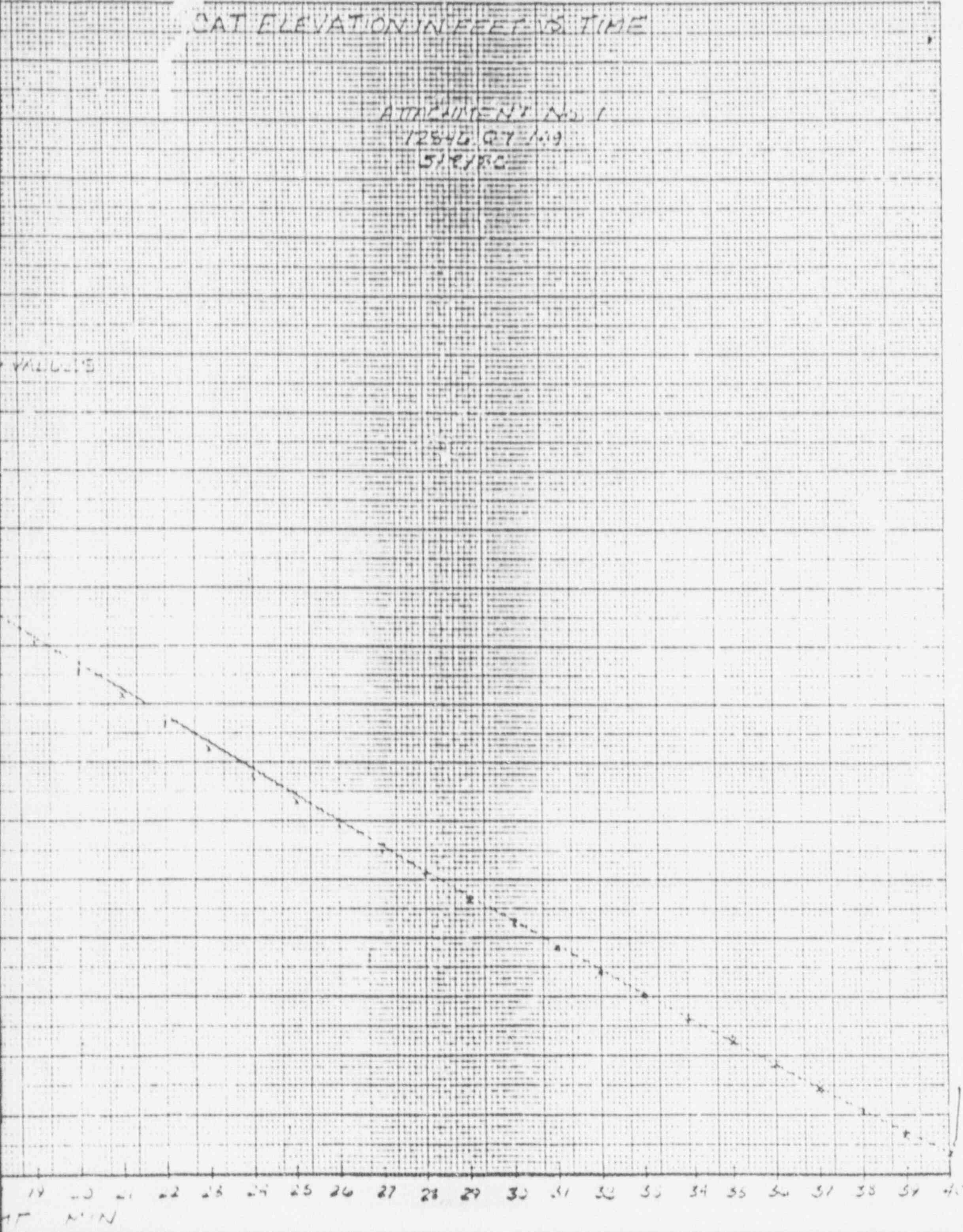
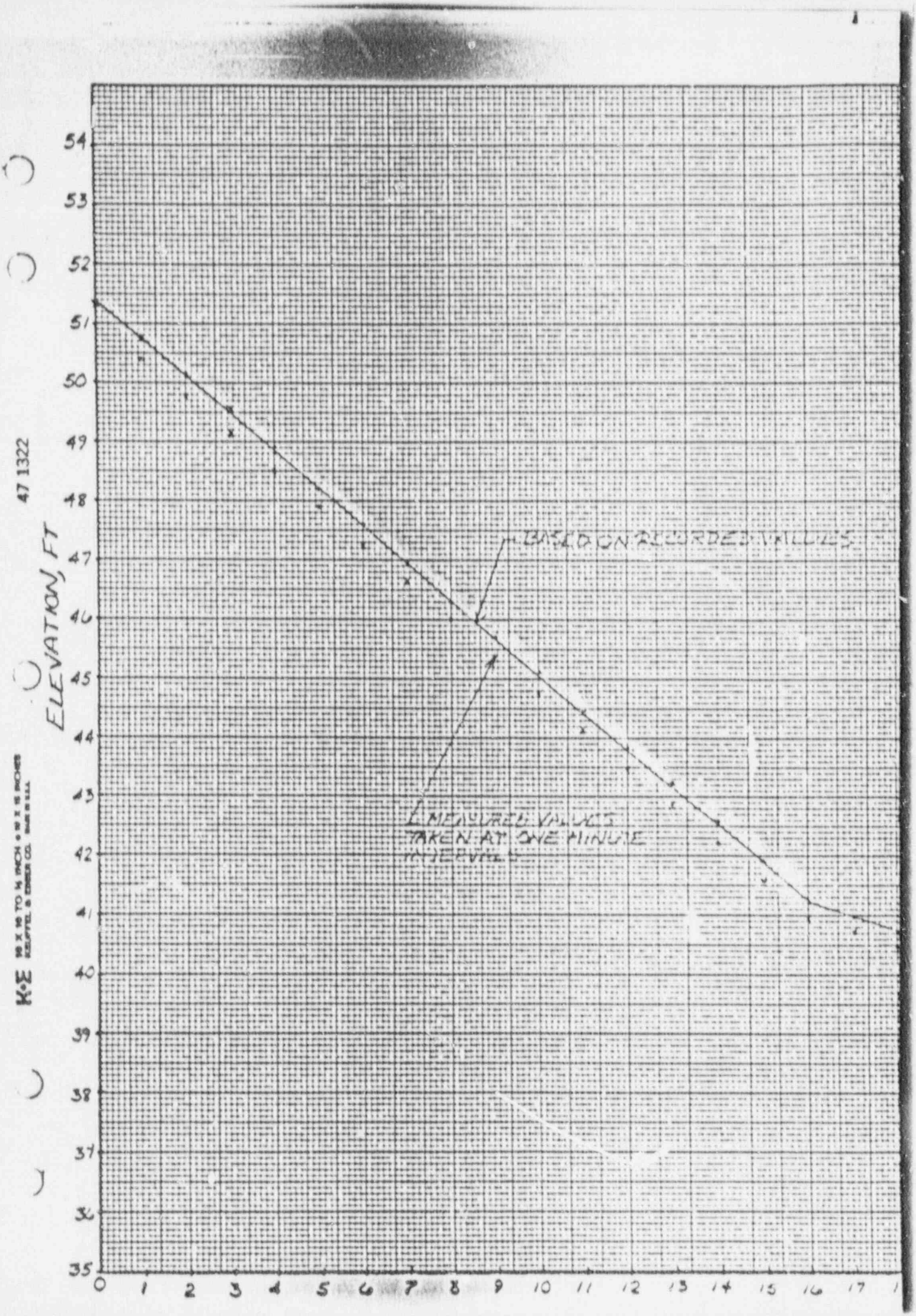
5/12/80

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BASED ON RECORDED VALUES
MEASURED VALUES
TAKEN AT ONE MINUTE

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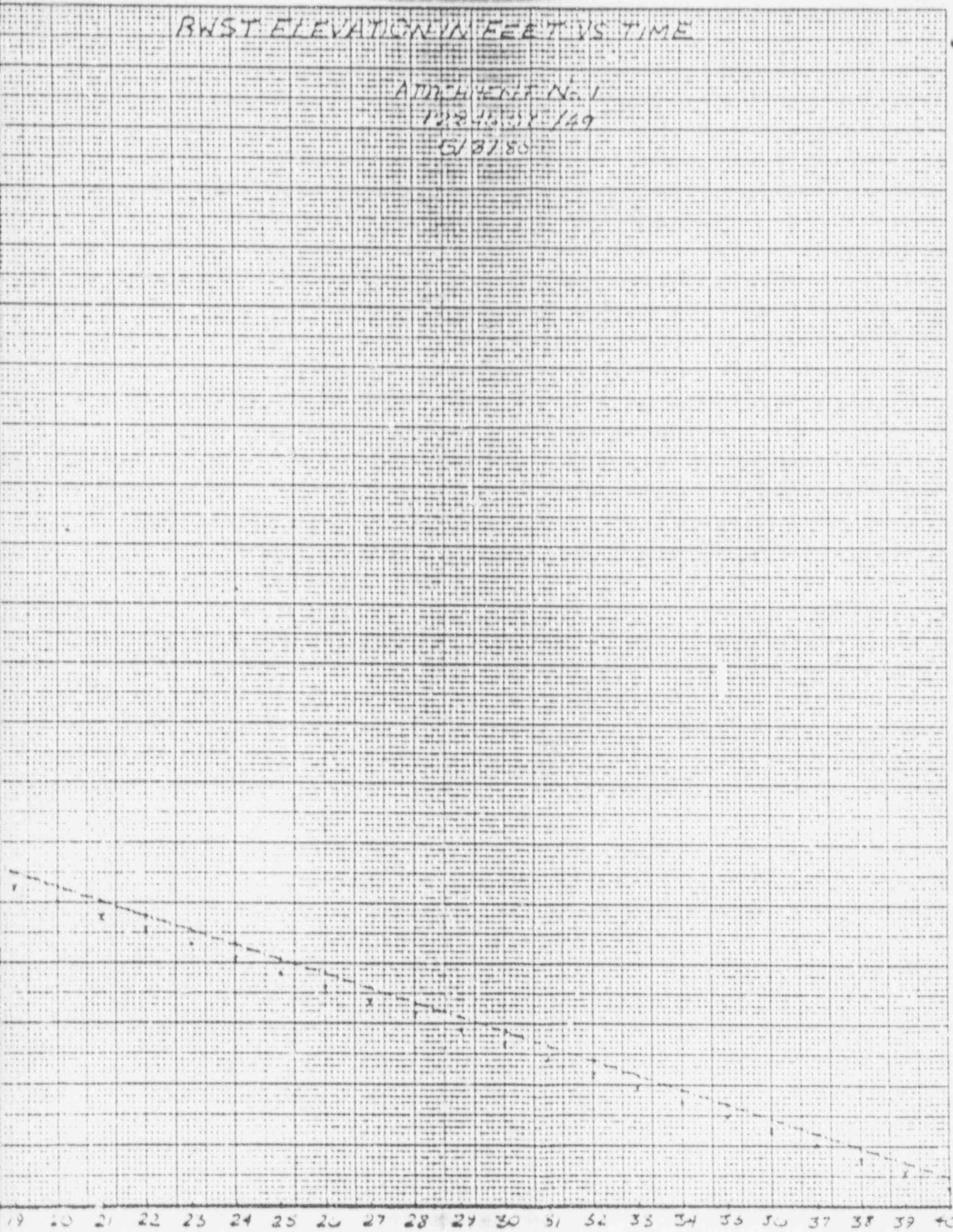

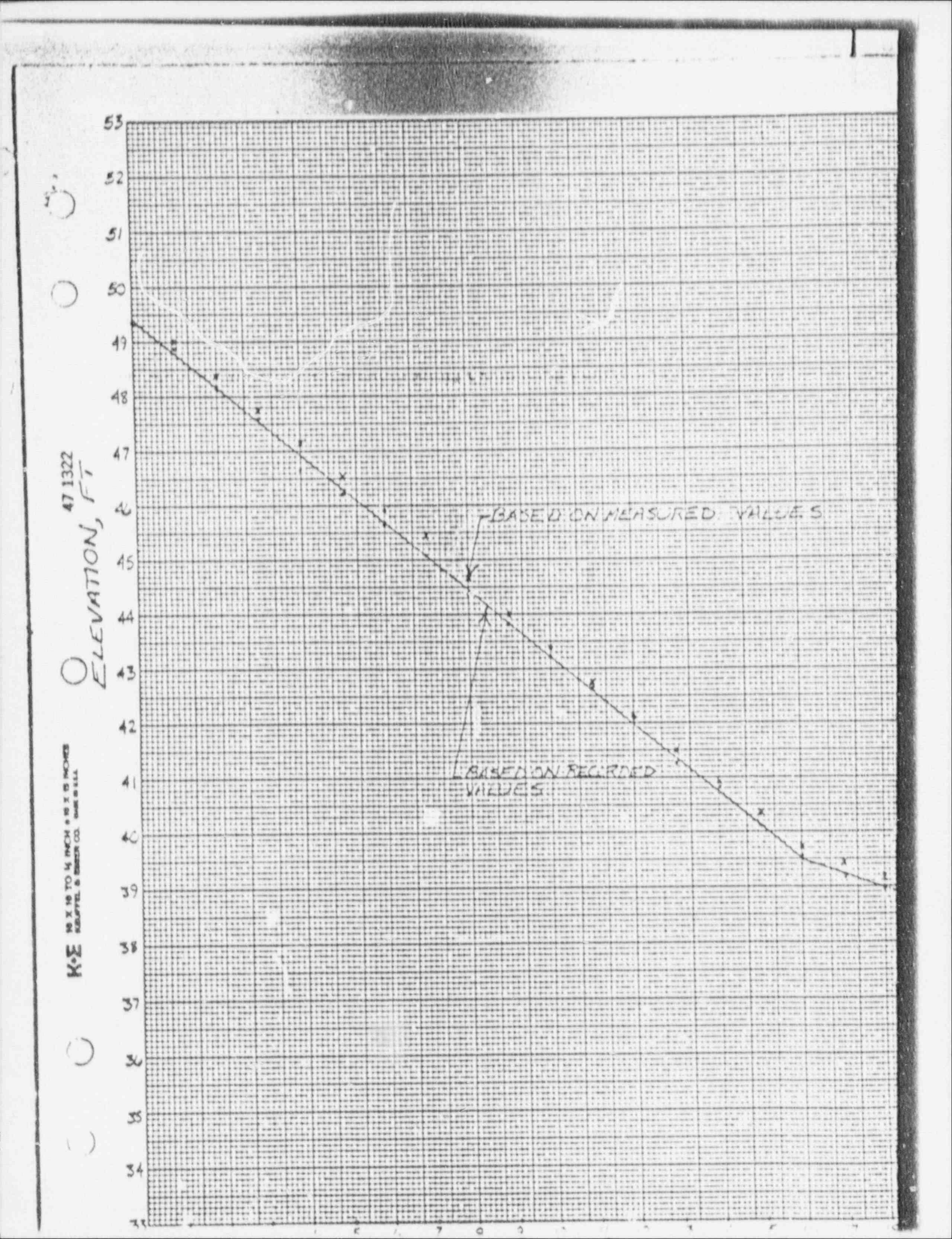
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BASED ON MEASURED VALUES
BASED ON RECORDED VALUES

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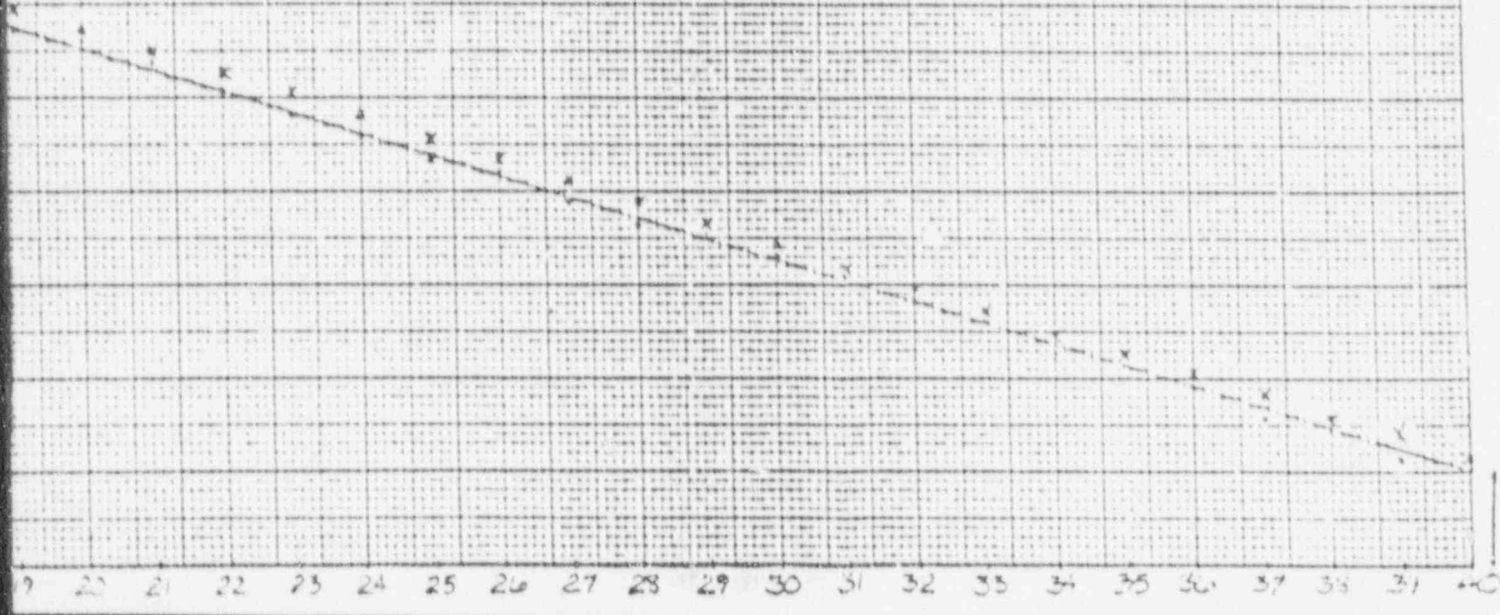
HGL JUNCTION ELEVATION IN FT VS TIME

ATTACHMENT No. 1
12 REG 97/49
5/18/80



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PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
C. [illegible] 5/8/80	[illegible]	R. [illegible] 5-12-80

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
RWST - CAT DRAWDOWN TEST - 4/30/80	[illegible]

TIME (MIN)	CAT ELEVATION (FT)	RWST ELEVATION (FT)
0	57.87	51.39
2	[illegible]	[illegible]
4	[illegible]	[illegible]
6	55.33	47.58
8	54.43	[illegible]
10	53.52	[illegible]
12	52.57	43.77
14	51.59	42.50
16	50.60	41.23
18	49.65	40.75
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	39.79
24	46.90	39.31
[illegible]	[illegible]	[illegible]
[illegible]	45.15	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	41.05	35.95
[illegible]	40.30	35.47

ΔT (MIN)	RWST ΔELEV (FT)	RWST ΔVOLUME (GAL)	RWST FLOWRATE Q_{RWST} (GPM)	CAT ΔELEV (FT)	CAT [illegible] (GAL)	Q_{CAT} ([illegible])	[illegible]	[illegible]
2	1.27	10774	5387	0.82	96.21	48.10	2131	[illegible]
2	1.27	10774	5337	0.85	99.73	[illegible]	[illegible]	[illegible]
2	1.27	10774	5387	0.87	102.07	51.04	2125	[illegible]
2	1.27	10774	5387	0.90	105.59	[illegible]	2120	[illegible]
2	1.27	10774	5387	0.91	106.77	53.38	2116	[illegible]
2	1.27	10774	[illegible]	0.95	111.46	[illegible]	[illegible]	[illegible]
2	1.27	10774	[illegible]	0.98	114.98	57.49	2105	[illegible]
2	1.27	10774	5387	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	0.48	[illegible]	2036	0.95	111.46	[illegible]	[illegible]	[illegible]
2	0.48	4072	2036	0.95	[illegible]	[illegible]	[illegible]	[illegible]
2	0.48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	0.48	4072	[illegible]	0.90	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	4072	2036	0.90	[illegible]	[illegible]	[illegible]	[illegible]
2	0.48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CALCULATION SHEET

J.O./W.O./CALCULATION NO.	REVISION	PAGE
12846.0178/491	1	2/10

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
T Bennett / May 8, 1980		R.C.POWELL 5-12-80

SUBJECT/TITLE: C.S Flow adjusted calibration
Surrydrow down test April 29 1980

GA CATEGORY/CODE CLASS: I

Time (min)	C.S Flow (gpm) RECORDED VALUES
0	2130
1	2133
2	2133
3	2127
4	2123
5	2123
6	2120
7	2120
8	2110
9	2113
10	2113
11	2110
12	2106
13	2103
14	2103
15	2100
16	2096
17	2096
18	2100
19	2093
20	2089
21	2089
22	2089
23	2089
24	2086
25	2086
26	2086
27	2086
28	2086
29	2086
30	2086
31	2083
32	2079
33	2083
34	2083
35	2083
36	2083
37	2083
38	2083
39	2079
40	2079

CALCULATION SHEET	J.O./W.O./CALCULATION NO. 12846.03/49	REVISION	PAGE 3/6
PREPARER/DATE C. PIONTKOWSKI 5/8/80	REVIEWER/CHECKER/DATE [illegible]	INDEPENDENT REVIEWER/DATE K. CROWELL 5-12-80	
SUBJECT/TITLE RWST - CAT DRAWDOWN TEST 4/30/80		QA CATEGORY/CODE CLASS I	

LHSI CALCULATION:

$Q_{SI} = Q_{BA} + Q_{RWST\ CONTAINMENT}$ $\qquad$ $Q_{RWST\ TOTAL} = 5377$ GPM (0-16 MIN)

[illegible] Q_{BA}

TIME (MIN)	[illegible] (GPM)	Q_{BA} (GPM)	[illegible] (GPM)	[illegible]
0				
	2131	48.10	2023	3304
2				
	2128	49.86	2078	3309
4				
	2125	51.04	2074	3313
6				
	2120	52.80	2067	3320
8				
	2116	53.58	2063	3324
10				
	2111	55.73	2055	3332
12				
	2105	57.49	2049	3339
14				
	2099	58.08	2041	3346
16				

CALCULATION SHEET

J.O./W.O./CALCULATION NO.	REVISION	PAGE
149		[illegible]

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
[illegible] 5/3/80		R. CROWELL 5-12-80

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
RWST - CAT [illegible] TEST - 4/30/80	

CALCULATION OF CS PUMP [illegible]

$Q = 2036$ GPM - [illegible]

Q = 0 GPM

Q = 2036 GPM [illegible] TO [illegible]

[illegible] 2036 + 55.73 = 2092 GPM

Q_{CS} = **2092 GPM**

CALCULATION OF FLOW RATE FOR CAT, q_{CAT}

$(\Delta ELEV \times V_{CAT}) \div \Delta T = q_{CAT}$

$\Delta ELEV$ = 0.82 FT
V_{CAT} = 117.326 GAL/FT
ΔT = 2 MIN

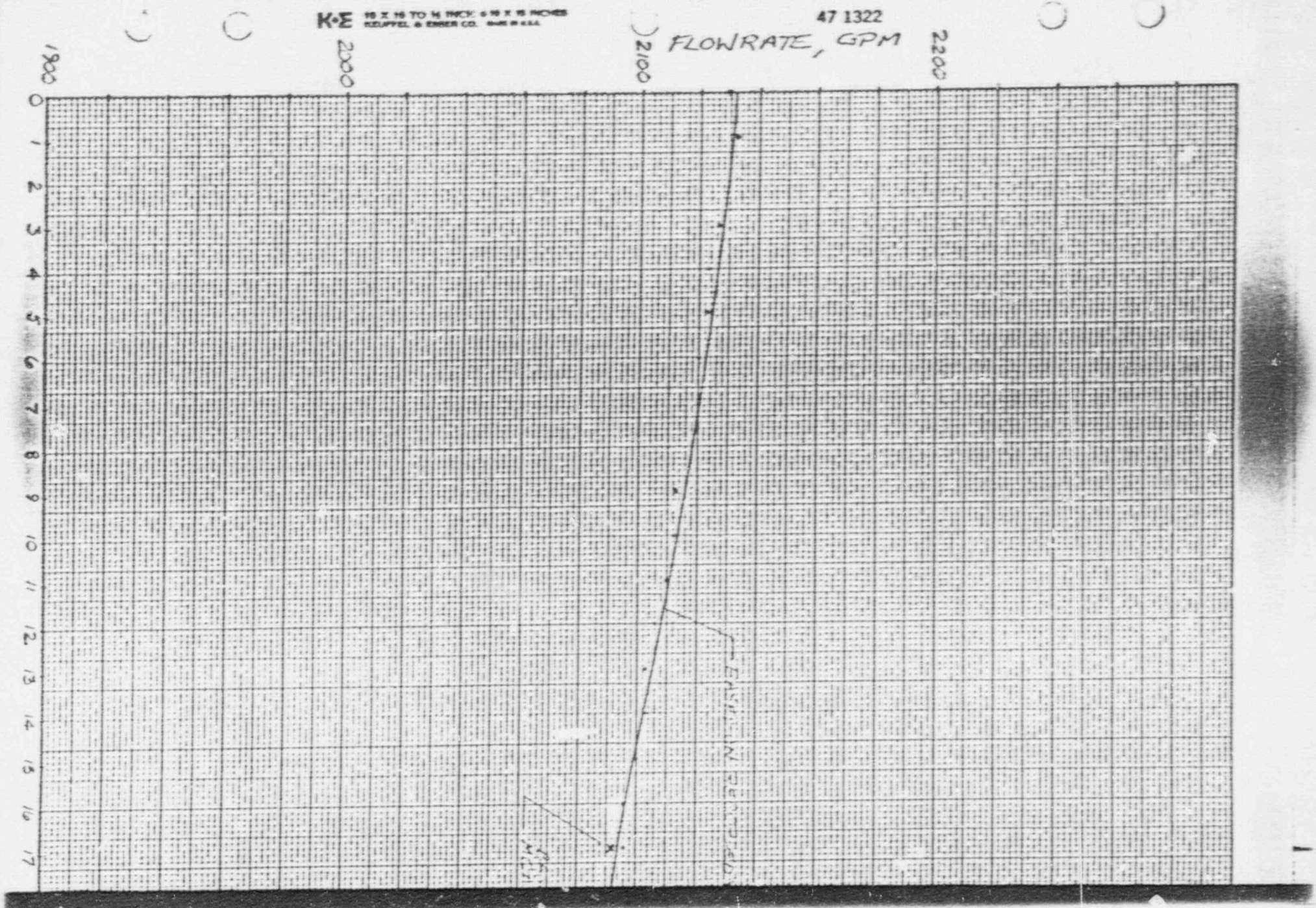
$(0.82 \times 117.326) \div 2$ = 48.10 = q_{CAT}

CALCULATION OF FLOW RATE FOR RWST, Q

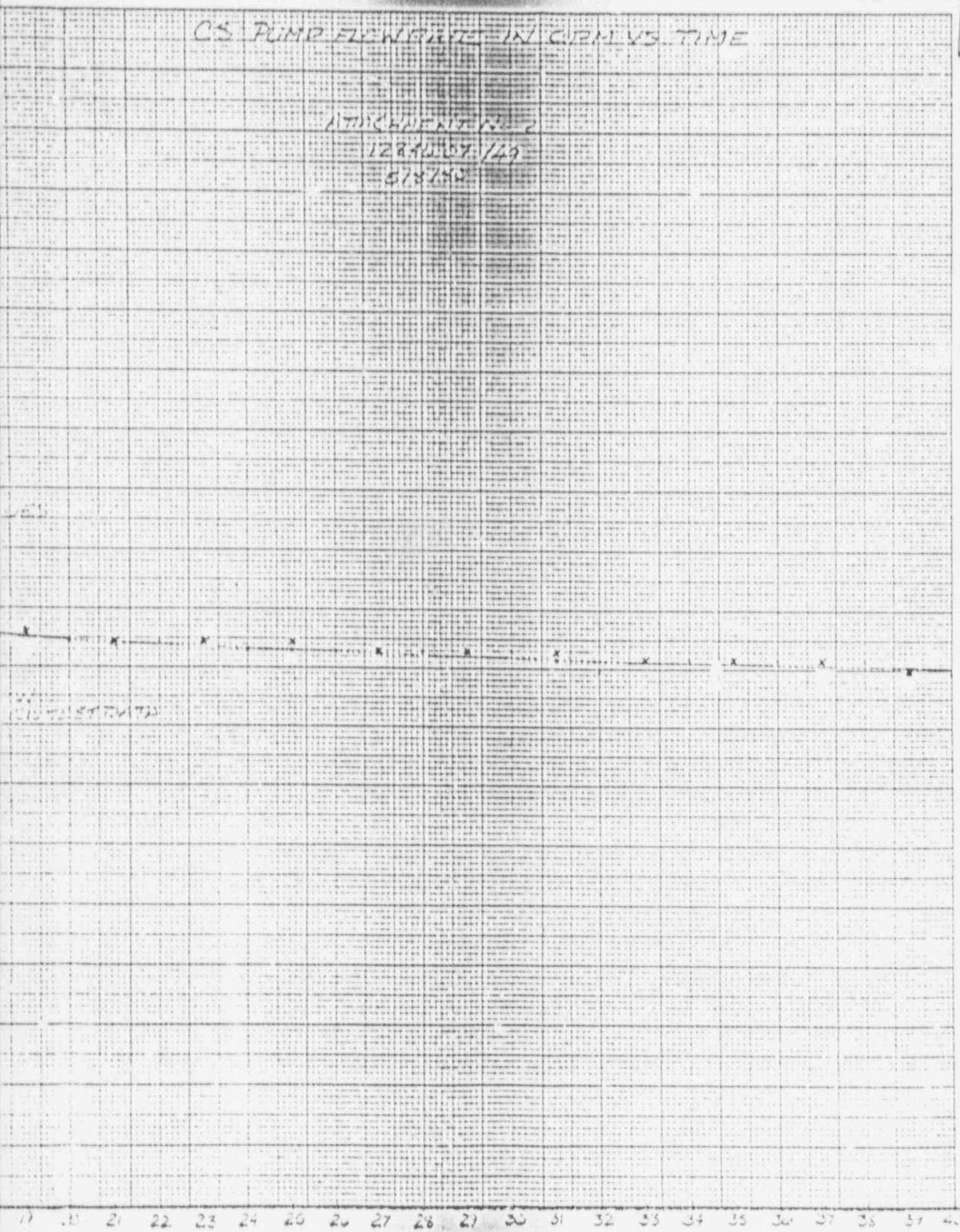
$(\Delta ELEV \times V_{RWST}) \div \Delta T = Q$

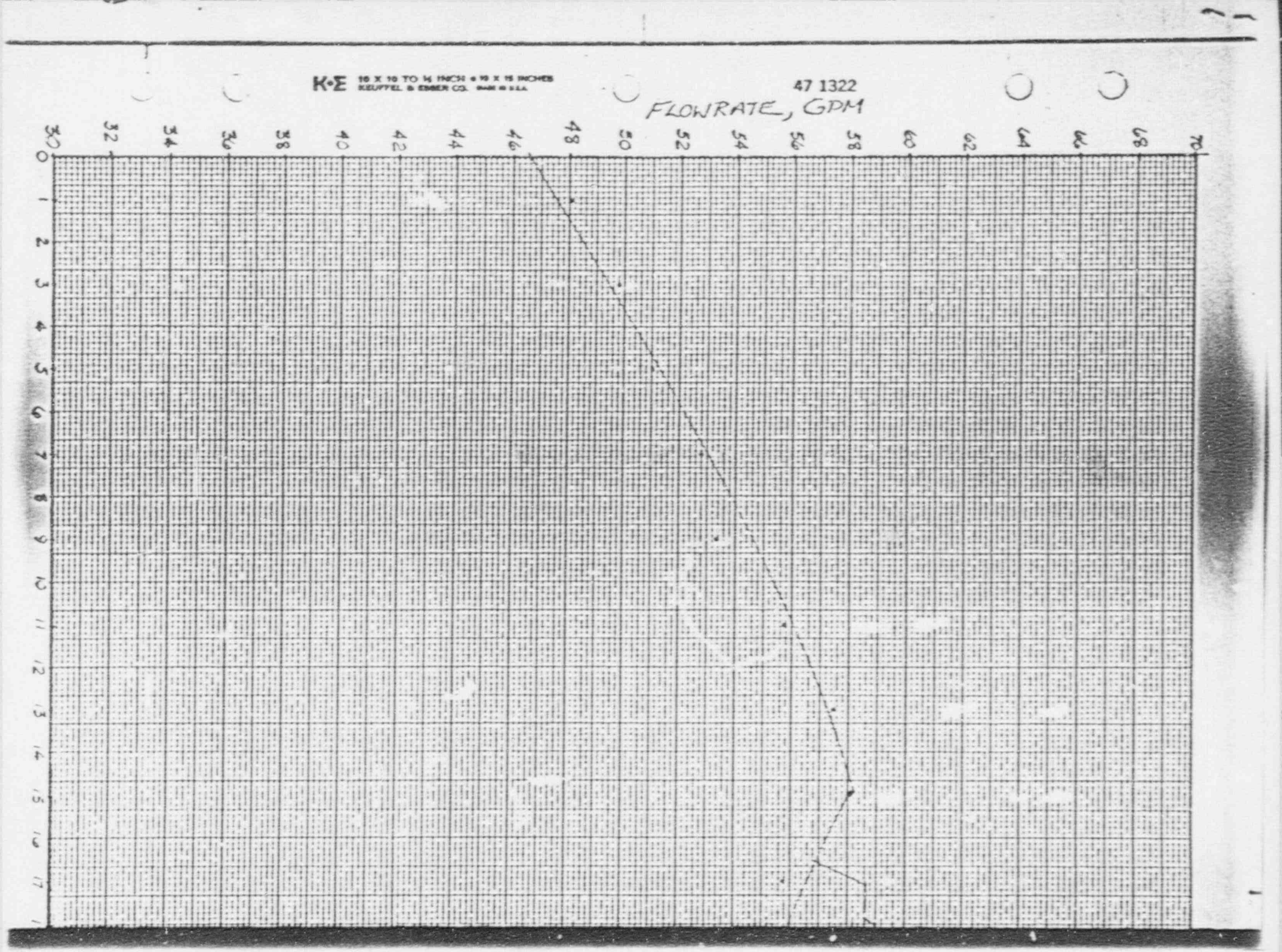
$\Delta ELEV$ = 1.27 FT
V_{RWST} = 8183.75 GAL/FT
ΔT = 2 MIN.

$(1.27 \times 8183.75) \div 2$ = 5[illegible]

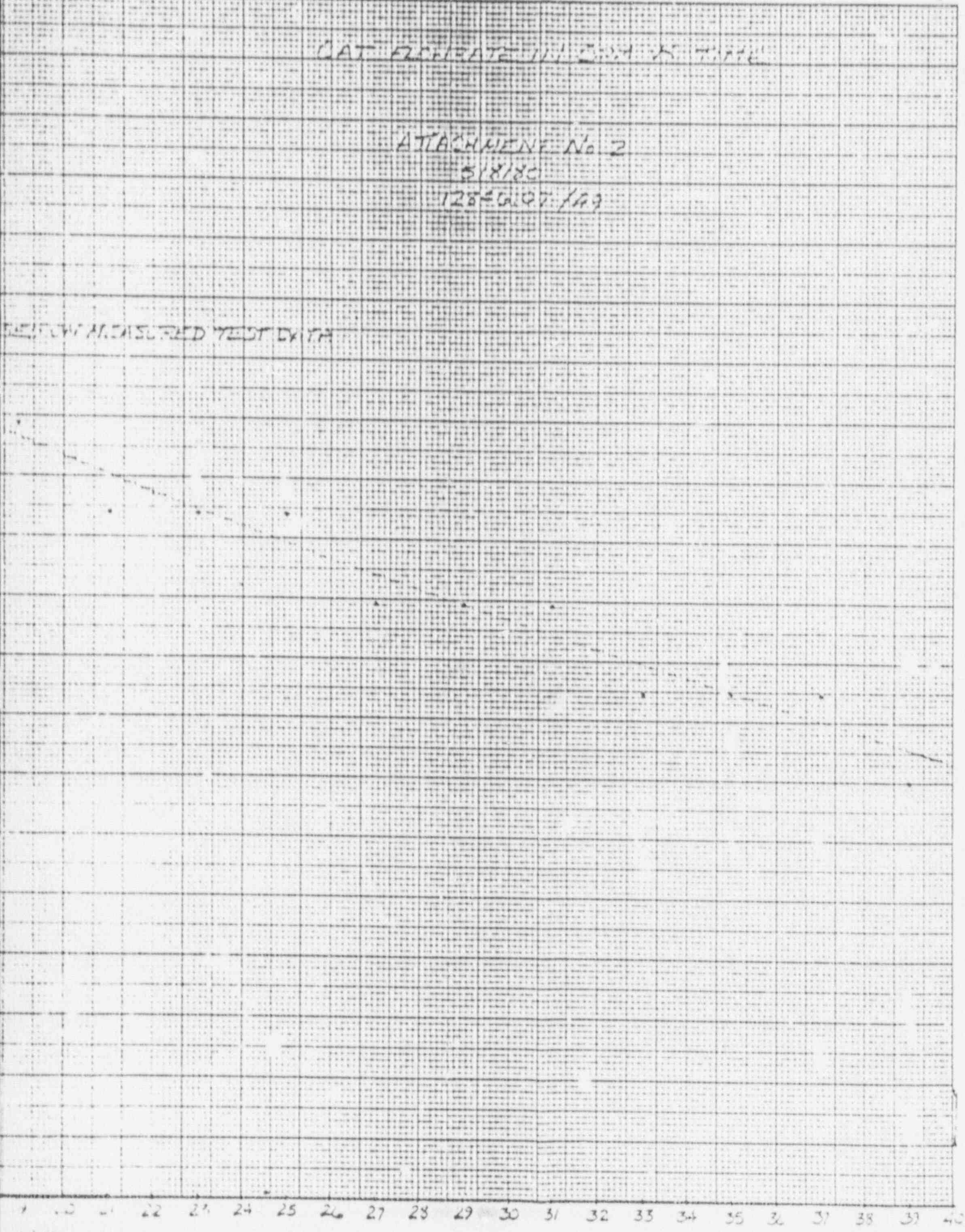

K•E
47 1322
FLOWRATE, GPM
1900
2000
2100
2200
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

R. CROWELL 5-12-60
P 5/6




K&E 10 X 10 TO ½ INCH • 10 X 15 INCHES
KEUFFEL & ESSER CO.
47 1322
FLOWRATE, GPM
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
70
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

R. CROWELL 5-12-80
P. 6/6



CALCULATION SHEET

J.O./W.O./CALCULATION NO.	REVISION	PAGE
[illegible]/49		1/3

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
T B C[illegible] 5/5/80	[illegible]	R Criswell

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
RWST [illegible] DRAWDOWN TEST - 3/25/80	

97.0
94.4
92.0
90.0
88.2
86.0
[illegible]
[illegible]
81.0
79.0
77.6
76.0
[illegible]
72.4
70.0

CALCULATION SHEET

J.O./W.O./CALCULATION NO.	REVISION	PAGE
[illegible] /49		2/5

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
[illegible] 5/12/80		R. Crowell

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
[illegible] CAT [illegible] TEST 4/30/80	

ΔP CAT LINE ORIFICE (TEST MEASUREMENTS)

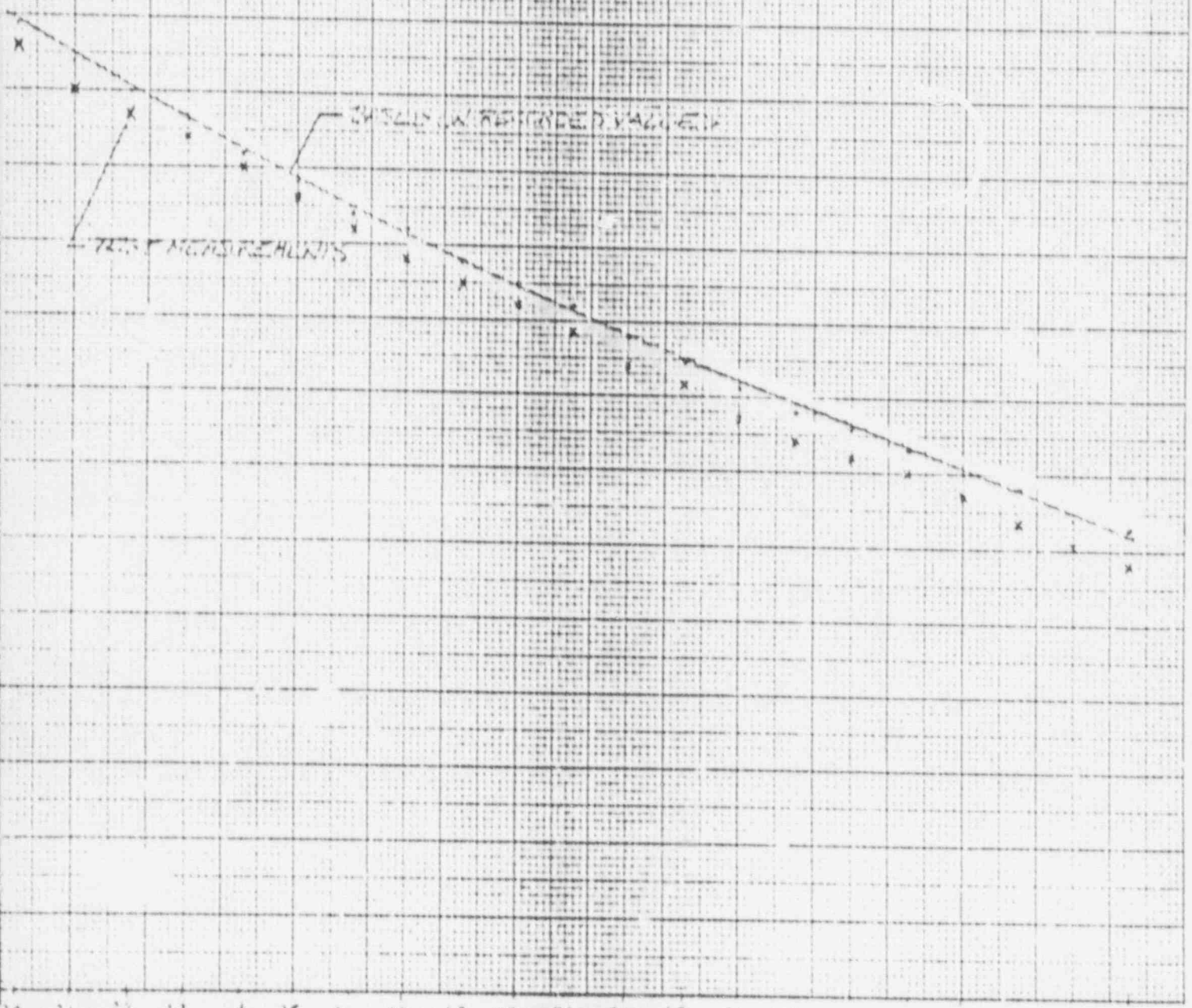
TIME (min)	CAT ΔP (in. H_2O)
0	—
1	—
2	80
3	—
4	—
5	85
6	87
7	89
8	90-91
9	92
10	94
11	95
12	96.5
13	98
14	99
15	—
16	—
17	—
18	—
19	95
20	93
21	90
22	88.5
23	87
24	85
[illegible]	83
[illegible]	81
[illegible]	79
[illegible]	77.5
[illegible]	76
[illegible]	74.25
[illegible]	72
[illegible]	70.75
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	59

10 X 10 TO ½ INCH • 10 X 15 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
K•E
47 1322
ΔP (IN. WATER) CAT LINE ORIFICE
INTERPOLATED CURVE
100
90
80
70
60
50
40
30
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
0

R. CADWELL 5-12-80

ATTACHMENT No. 3
P. 3/3

CAT ORIFICE HEADLOSSES
VEPCO SURRY #2
JOB NO. 12846.07 /A9



12846.07 / ?? — ?

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
C. PIONTKOWSKI 5/6/80	T. C. POWELL 5-13-80	F. C. POWELL 5-13-80

SUBJECT/TITLE: "KWST - CAT DRAWDOWN TEST - 4/30/80

QA CATEGORY/CODE CLASS: I

TIME	CAT ELEV	KWST ELEV	HEADER ELEV	[illegible]	[illegible]	[illegible] (GPM)	VELOCITY [illegible] (FPS)	$\frac{V^2}{2g}$ (FT)	[illegible]	[illegible]	HEADER [illegible] (FT)	HEAD LOSS COEF CAT-KWST	CAT ORIFICE HEAD LOSS COEF	CAT [illegible] HEAD LOSS COEF
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	57.27	51.3?	42.40?	—	4?.60	2132	6.05	0.57	1.42	3.26×10^-7	7.90?	—	—	—
[illegible]	51.05	51.2?	[illegible]	6.54	[illegible]	2130	6.04	0.57	1.35	3.11×10^-7	[illegible]	3.50×10^-3?	2.76×10^-3	7.4×10^-4
[illegible]	50.00?	48.?5	?.90	6.90	[illegible]	2126	6.03	0.56	1.59	3.22×10^-7	8.74	3.44×10^-3	2.72×10^-3	7.2×10^-4
[illegible]	55.35	47.57	45.70	7.25	52.20	2123	6.02	0.56	1.32	3.07×10^-7	9.07	3.35×10^-3	2.66×10^-3	6.7×10^-4
[illegible]	54.43	46.31	44.47	7.50	53.70	2118	6.01	0.56	1.28	3.00×10^-7	9.40	3.25×10^-3	2.59×10^-3	6.6×10^-4
[illegible]	53.52	45.64	43.22	7.83	55.40	2113	5.99	0.56	1.26	2.97×10^-7	9.74	3.17×10^-3	2.55×10^-3	6.2×10^-4
3	52.57	43.77	42.00	8.07	56.70	2108	5.98	0.56	1.21	2.87×10^-7	10.01	3.11×10^-3	2.51×10^-3	6.0×10^-4
4	51.59	42.50	40.75	8.25	57.80	2102	5.96	0.55	1.20	2.87×10^-7	10.29	3.08×10^-3	2.47×10^-3	6.1×10^-4
[illegible]	50.60	41.23	39.50	—	57.??	2096	5.95	0.55	1.18	2.83×10^-7	10.55	—	—	—
[illegible]	[illegible]	40.75	39.00	—	55.35	2091	5.93	0.55	1.20	2.89×10^-7	10.10	—	—	—
[illegible]	[illegible]	?.27	?.54	7.85?	54.70	2087	5.93	0.55	1.18	2.85×10^-7	9.61	3.21×10^-3	2.63×10^-3	5.5×10^-4
[illegible]	47.50?	[illegible]	38.10	[illegible]	53.60?	[illegible]	[illegible]	0.54	1.15	2.77×[illegible]	[illegible]	3.20×10^-3?	2.63×10^-3	5.7×10^-4?
[illegible]	46.90?	[illegible]	37.65	[illegible]	[illegible]	[illegible]	[illegible]	.54	1.12	2.70×10^-7	8.71	3.17×10^-3	2.62×[illegible]	5.5×[illegible]
[illegible]	[illegible]	38.??	37.20	[illegible]	5?.35	[illegible]	5.92	.54	1.09	2.65×10^-7	8.26	3.15×10^-3	2.6?×10^-3	5.2×10^-4
[illegible]	[illegible]	38.39?	36.72	[illegible]	53.35?	2084?	[illegible]	0.54	1.09	2.65×[illegible]	7.89	3.1?×10^-3	2.60×[illegible]	5.1×[illegible]
[illegible]	[illegible]	[illegible]	36.35?	[illegible]	[illegible]	[illegible]	[illegible]	.54	1.03	2.45×10^-7	7.46	3.0?×[illegible]	[illegible]	4.7×[illegible]
[illegible]	[illegible]	[illegible]	35.85	[illegible]	[illegible]	[illegible]	5.91	.54	1.00	2.41×10^-7	7.26	[illegible]	2.55×[illegible]	4.5×[illegible]
[illegible]	5?.5?	[illegible]	35.31	5.30?	41.40?	2082	5.91	0.54	0.98	2.36×10^-7	6.72	2.98×10^-3	2.58×[illegible]	4.0×10^-4

	CAT [illegible] ELEV	FIRST ELEV	[illegible] ELEV	[illegible]	[illegible] 8 cm	[illegible]	VELOCITY [illegible]	$\frac{V^2}{2g}$	HEAD LOSS [illegible]	HEAD LOSS COEF [illegible]	HEAD LOSS [illegible]	HEAD LOSS COEF CAT-JUNCT	CAT ORIFICE HEAD LOSS COEF	CAT RING HEAD LOSS COEF
[illegible]	(FT)	(FT)	(FT)	(FT)	(GPM)	(GPM)	(FPS)	(FT)	(FT)	(FT/GPM²)	(FT)	(FT/GPM²)	(FT/GPM²)	(FT/GPM²)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
[illegible]	41.35	35.43	34.90	5.57	46.50	2082	5.91	0.54	0.99	2.38×10^{-7}	6.41	2.96×10^{-3}	[illegible]	[illegible]$\times10^{-4}$
[illegible]	41.05	35.75	34.46	5.23	45.60	2081	5.90	0.54	0.95	2.29×10^{-7}	6.05	2.91×10^{-3}	[illegible]	5.5×10^{-4}
[illegible]	40.30	35.47	34.00	5.08	44.60	2081	5.90	0.54	0.93	2.24×10^{-7}	5.76	2.89×10^{-3}	[illegible]	5.4×10^{-4}
								HEAD	AVG. LOSS COEFFICIENT	2.75×10[illegible]	AVG. [illegible] *	3.41×10^{-3}	2.00×10^{-3}	5.40×10^{-4}

* THE AVERAGE HEAD LOSS COEFFICIENT FOR CAT-JUNCT, CAT ORIFICE, AND CAT RING IS BASED ON THE TIME INCREMENTS THAT RAW DATA WAS AVAILABLE FOR CAT ORIFICE HEAD LOSS. THEREFORE, THE AVERAGE DID NOT INCLUDE TIME 0, 16, OR 12 MINUTES FOR THESE CATEGORIES.

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
[illegible] 5/1/83	R. CHOWELL 5-13-83	[illegible]

128 [illegible] / 44

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
[illegible] CURVE - [illegible]	1

[illegible] COEFFICIENT [illegible] -

[illegible] CALCULATION [illegible]

[illegible] = V^2 [illegible] h_1

[illegible]

VELOCITY [illegible] = $\frac{Q_{SS}}{A_{PIPE}}$ A_{PIPE} [illegible] FT.

CAT [illegible] HEAD LOSS COEFFICIENT [illegible]

CAT ELEV - HGL - JUNCT ELEV = $\frac{V^2}{2g}$ [illegible] h_2

CAT - JUNCT HEADLOSS COEFFICIENT [illegible]

CAT [illegible] LOSS COEFFICIENT -

h_3 [illegible] ON CURVE OF RECO[illegible]
VALUES OBTAINED FOR [illegible]

CAT [illegible] HEAD LOSS COEF [illegible]

CAT [illegible] LOSS COEFFICIENT -

[illegible] = CAT PIPING HEAD [illegible]

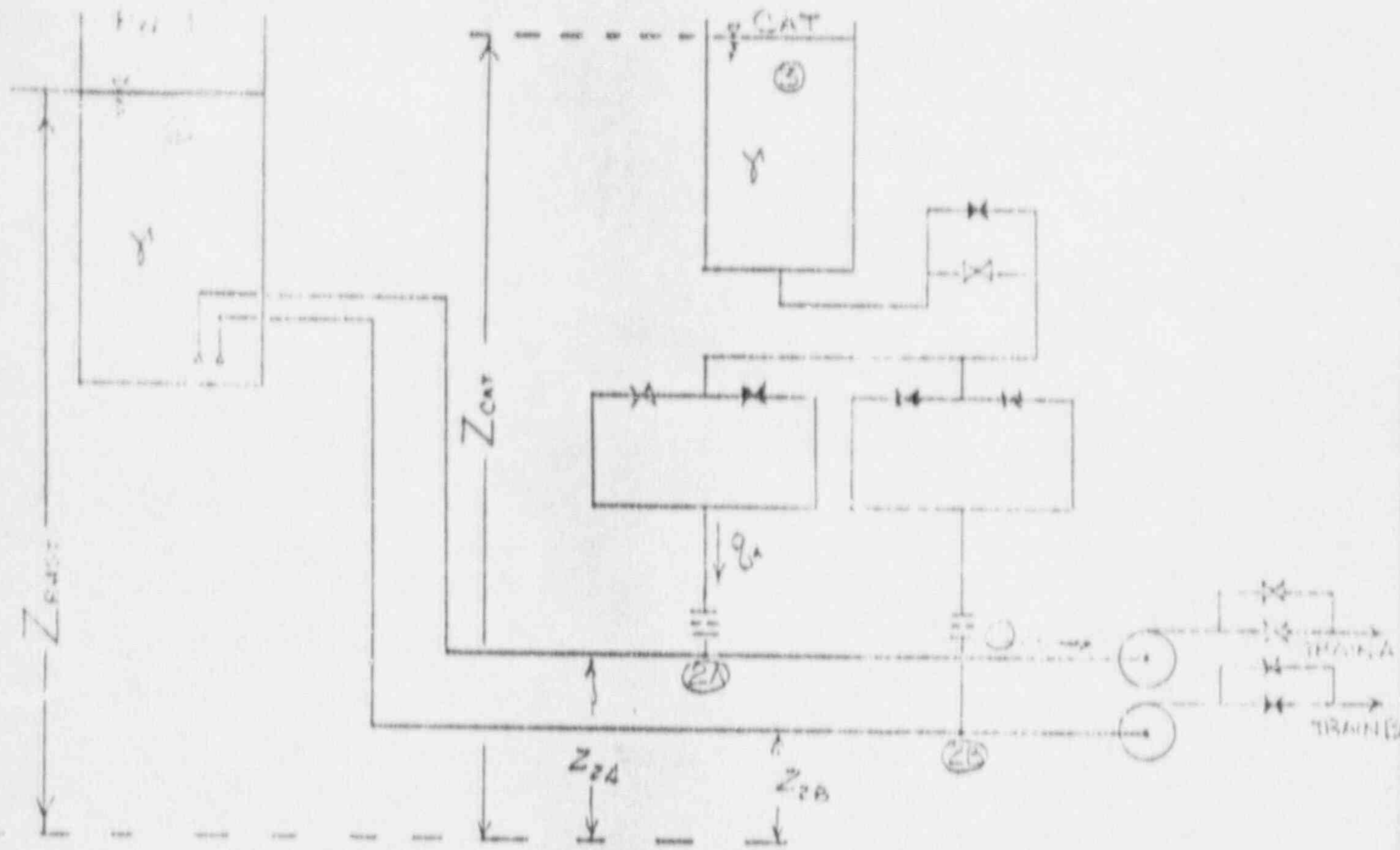
W.O./W.O./CALCULATION NO.		
12846.01 (A)		1/13

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
[illegible] 5/4/80	P. CROWELL 5-13-80	[illegible] 5-13-80

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
[illegible] TEST [illegible]	

[illegible] CAT [illegible] (q_A) AND [illegible]

[illegible]



EQUATIONS -

BERNOULLI EQ BETWEEN ① AND 2A :

$$Z_{RWST} = Z_{2A} + \frac{P_{2A}}{\gamma'} + \frac{V_{2A}^2}{2g} + K_{1\text{-}2A}'(Q_{CS} - q_A)^2 \qquad (1)$$

BERNOULLI EQ BETWEEN ③ AND 2A :

$$Z_{CAT} = Z_{2A} + \frac{P_{2A}}{\gamma'} + \frac{V_{2A}^2}{2g} + K_{3\text{-}2A}\, q_A^2 \qquad (2)$$

$$Z_{RWST} = Z_{CAT} + K_{1\text{-}2A}'(Q_{CS}^2 - 2Q_{CS}q_A + q_A^2) - K_{3\text{-}2A}\, q_A^2$$

$$(K_{1\text{-}2A} - K_{3\text{-}2A})q_A^2 - 2K_{1\text{-}2A}Q_{CS}q_A + Z_{RWST} - Z_{CAT} + K_{1\text{-}2A}Q_{CS}^2 = 0$$

4910(1)	12846.07 /49	REVISION	PAGE 11/10
PREPARER/DATE 5/9/83	REVIEWER/CHECKER/DATE R. CROWELL 5/10/83	INDEPENDENT REVIEWER/DATE R. CROWELL 5/10/83	
SUBJECT/TITLE ... IN TEST 1/8/80		QA CATEGORY/CODE CLASS	

$$\frac{\ldots \sqrt{(K_{1\text{-}2A}Q_{CS})^2 - (K_{3\text{-}2A} - K_{1\text{-}2A})(Z_{RHSI} - Z_{CAT} + K_{\ldots} \ldots)}}{K_{3\text{-}2A} - K_{1\text{-}2A}}$$

$$\begin{cases} q_A(i+1) = \dfrac{-K_{1\text{-}2A}Q_{CS}(i+1) + \sqrt{(K_{1\text{-}2A}Q_{CS}(i+1))^2 - (K_{3\text{-}2A} - K_{1\text{-}2A})(\ldots - Z_{\ldots} + K_{\ldots})}}{K_{3\text{-}2A} - K_{1\text{-}2A}} \\ Z_{CAT}(i+1) = Z_{CAT}(i) - \dfrac{q_A(i) \cdot \Delta t}{\pi D_{CAT}^2/4} \end{cases}$$

$D_{CAT} = 4' - 5\frac{3}{8}"$ (BASED ON DRAWING 11448-FV-42A)

$$Z_{CAT}(i+1) = Z_{CAT}(i) - \frac{q_A(i)/7.4805 \cdot \Delta t_{MIN}}{\frac{\pi}{4} \times 4.4?75^2}$$

$$Z_{CAT}(i+1) = Z_{CAT}(i) - 0.00852327 \cdot q_A(i) \times \Delta t_{MIN}$$

$K_{1\text{-}2A} = 0.275 \times 10^{-6}$ FT/GPM² → FROM ATTACHMENT No. 4

$K_{3\text{-}2A} = 3.141 \times 10^{-6}$ FT/GPM² → FROM ATTACHMENT No. 4

CALCULATION SHEET

J.O./W.O./CALCULATION NO.	REVISION	PAGE
12246.07 149		/16

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
[illegible] 5/4/80	R. CROWELL 5-13-80	R. CROWELL 5-13-80

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
[illegible] 4/30/80	1

CALCULATION OF $q_{cm}(\alpha+1)$ VALUES AND $Z_{cm}(\alpha+1)$ VALUES

USING THE FOLLOWING EQUATIONS $q_{cm}(\alpha+1)$ AND $Z_{cm}(\alpha+1)$

$q_{cm}(\alpha+1) = -87.559 \times 10^{4} \times Q_{cs}(\alpha+1) +$ [illegible]

$$\sqrt{\left[87.559 \times 10^{4} \times Q_{cs}(\alpha+1)\right]^2 + \frac{Z_{cm}(\alpha) - Z_{[illegible]}(\alpha+1)}{3140.725} - \frac{[illegible]}{3140.725} \times \Delta t_{\alpha+1} \times q_{cm}(\alpha) + 87.559 \times 10^{4} \times Q_{cs}^{2}(\alpha+1)}$$

$$Z_{cm}(\alpha+1) = Z_{cm}(\alpha) - 0.0085235 \times \Delta t_{\alpha+1} \times q_{cm}(\alpha)$$

$\alpha = 0$

$$q_{cm}(1) = -87.559 \times 10^{4} \times 2132 + \sqrt{.034742 + \frac{57.87 - [illegible]}{3140.725} \times 0 + 87.559 \times 10^{4} \times (2132)^2} = \underline{[illegible]}$$

$$Z_{cm}(1) = 57.87 - 0 = \underline{57.87}$$

$\alpha = 1$

$$q_{cm}(2) = -87.559 \times 10^{4} \times 2130 + \sqrt{.034818 + \frac{57.87 - 52.[illegible]}{3140.725} - [illegible]5.127(49.12) + 87.559 \times 10^{4} \times [illegible]} = \underline{50.77}$$

$$Z_{cm}(2) = 57.87 - 0.017047\,(49.12) = \underline{57.03}$$

$\alpha = 2$

$$q_{cm}(3) = -87.559 \times 10^{4} \times 2126 + \sqrt{.034652 + \frac{57.03 - [illegible]}{3140.725} \times 10^{4} - 5.[illegible](50.77) + 87.559 \times 10^{4} \times ([illegible])^2} = 50.[illegible]$$

$$Z_{cm}(3) = 57.03 - 0.017047\,(50.77) = \underline{5[illegible]}$$

[illegible]	V.O./W.O./CALCULATION NO. 12846.07/49	REVISION	PAGE 4/10
PREPARER/DATE [illegible] 5/9/80	REVIEWER/CHECKER/DATE R. CROWELL 5-13-80	INDEPENDENT REVIEWER/DATE R. CROWELL 5-13-80	
SUBJECT/TITLE RWST [illegible] DRAWDOWN TEST 4/30/80		QA CATEGORY/CODE CLASS I	

$i = 3$

$$q_{var}(4) = -87.559\times10^{-6} * 2123 + \sqrt{.034554 + \frac{5[illegible]}{3[illegible].725} + 87.559\times10^{-6}*(2123)^2} = 5[illegible].15$$

$Z_{[illegible]} \ldots - 0.017047(52.[illegible]) = \underline{55.27}$

$i = 4$

$$q_{[illegible]}(5) = -87.559\times10^{-6} * 2118 + \sqrt{.034392 + \frac{55.27 [illegible]}{[illegible].725} [illegible] 5.422(53.15) + 87.559\times10^{-6}*(2118)^2} = \underline{54.19}$$

$Z_{[illegible]}(\cdot) = 55.27 - 0.017047(53.15) = \underline{54.3[illegible]}$

$i = 5$

$$q_{[illegible]}(6) = -87.559\times10^{-6} * 2113 + \sqrt{.034230 + \frac{54.36 [illegible]}{3[illegible]} [illegible](54.19) + 87.559\times10^{-6}*(2113)^2} = 55.[illegible]$$

$Z_{[illegible]}(6) = 54.36 - 0.017047(54.19) = \underline{53.4[illegible]}$

$i = 6$

$$q_{[illegible]}(7) = -87.559\times10^{-6} * 2108 + \sqrt{.034[illegible] + \frac{53.4[illegible]}{[illegible]} [illegible] 3.22 [illegible](55.[illegible]) + 87.55[illegible] [illegible]}$$

$Z_{[illegible]}(7) = [illegible] - 0.017047(55.17) = [illegible]$

$i = 7$

$$q_{[illegible]}(8) = [illegible]\times10^{-6} * 2102 + \sqrt{.033[illegible] + [illegible] + 87.55[illegible] [illegible]}$$

$Z_{[illegible]}(8) = [illegible] - 0.017047(5[illegible]) = [illegible]$

J.O./W.O./CALCULATION NO.	REVISION	PAGE
12846.07 /49		5/10

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
[illegible] 5/9/80	R. CROWELL 5-13-80	R. CROWELL 5-13-80

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
FIRST [illegible] BALLOON TEST 4/30/80	I

$i = 8$

$$q_{...}(9) = -87.559 \times 10^{-6} * 2096 + \sqrt{.033641 + \frac{5...}{3840 \cdot 7.5} ... 5.127(58...) + 87.559 \times 10^{-6} * (2096)^2} = 57.77$$

$$Z_{...} = ...24 - 0.017047(56.77) ...$$

$i = 9$

$$q_{...}(...) = ...87.559 \times 10^{-6} * 2091 + \sqrt{.033520 + \frac{... 49.25}{3840 \cdot 7.5} ... \cdot 4.(5...) + 87.559 \times 10^{-6} * (2091)^2} = ...$$

$$Z_{...}(...) = 50.57 - 0.017047(57.77) = 49.58$$

$i = 10$

$$q_{...}(11) = -87.559 \times 10^{-6} * 2089 + \sqrt{.033456 + \frac{49.59 ...}{3840 \cdot 7.5} ... 5.127(56.88) + 87.559 \times 10^{-6} (...)^2} = 54.99$$

$$Z_{...}(11) = 49.59 - 0.017047(56.88) = 48.63$$

$i = 11$

$$q_{...}(12) = ...87.559 \times 10^{-6} * 2088 + \sqrt{.033424 + \frac{48.63 - 50.72}{...} ... 5.127(54.99) + 87.559 ... (2088)^2} = 53...$$

$$Z_{...}(12) = 48.63 - 0.017047(54.99) = 47.69$$

$i = 12$

$$q_{...}(13) = ... * 2087 + \sqrt{.033392 + \frac{47... 48.8...}{3840 ...} ... + 87.559 ...} ...$$

$$Z_{...}(13) = 47.69 - 0.017047(53.06) = 46.78$$

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PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
[illegible] 5/9/80	R. CROWELL 5-13-80	R. CROWELL 5-13-80

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
[illegible] 4/30/80	7

i = 13

$q_{cm}(14) = -87.559\times10^{-6} * 2086 + \sqrt{.033360 + \frac{[illegible]}{[illegible] 725} * [illegible] (51.31) + 87.559\times10^{-6} * (2086)^2} = 51.08$

Z_{cm} [illegible] .017047 (51.[illegible]) [illegible]

---

i = 14

$q_{cm}(15) = -87.559\times10^{-6} * 2084 + \sqrt{.033296 + \frac{[illegible]}{[illegible]} * [illegible] (51.08) + 87.559\times10^{-6} * (2084)^2} = [illegible]$

$Z_{cm}(15) = 45.89 - 0.017047 (51.08) = 45.[illegible]$

---

i = 15

$q_{cm}(16) = -87.559\times10^{-6} * 2084 + \sqrt{.033296 + [illegible] + 87.559 [illegible] (2084)^2} = [illegible]$

$Z_{cm}(16)$ [illegible] .017047 ([illegible]) = [illegible].17

---

i = 16

$q_{cm}(17) = -87.559\times10^{-6} * 2083 + \sqrt{.033264 + [illegible] (48.67) + 87.559 [illegible]} = [illegible]$

$Z_{cm}(17)$ [illegible] .017047 (48.67) = [illegible].34

---

i = 17

$q_{cm}(18)$ [illegible]

$Z_{cm}(18) = [illegible].34 - 0.017047 ([illegible]) = [illegible]$

	VOTWS/CALCULATION NO. 12876.07/24	REVISION	PAGE 7/10
PREPARER/DATE C [illegible] 5/9/80	REVIEWER/CHECKER/DATE R. CROWELL 5-13-80	INDEPENDENT REVIEWER/DATE R. CROWELL 5-13-80	
SUBJECT/TITLE RWST - CAT DRAWDOWN TEST - 4/30/80		QA CATEGORY/CODE CLASS	

i = 16

$$q_{m}(16) = 87.559 \times 10^{-6} \times 2082 \sqrt{.033253 + \frac{4[illegible]}{3[illegible] \times 25} [illegible] + 87.559 \times 10^{-6} \times (2082)^2} = 45.32$$

$$Z_{i} = 42.53 - 0.017047(46.39) = 41.74$$

i = 17

$$q_{m}(17) = 87.559 \times 10^{-6} \times 2081 \sqrt{.033201 + \frac{41.74 - 35.[illegible]}{3[illegible]} \times 10^{[illegible]} \cdot 5.42 [illegible] + 87.559 \times 10^{-6} (2081)^2} = 44.28}$$

$$Z_{i}(17) = 41.74 - 0.017047(45.32) = 40.97$$

i = [illegible]

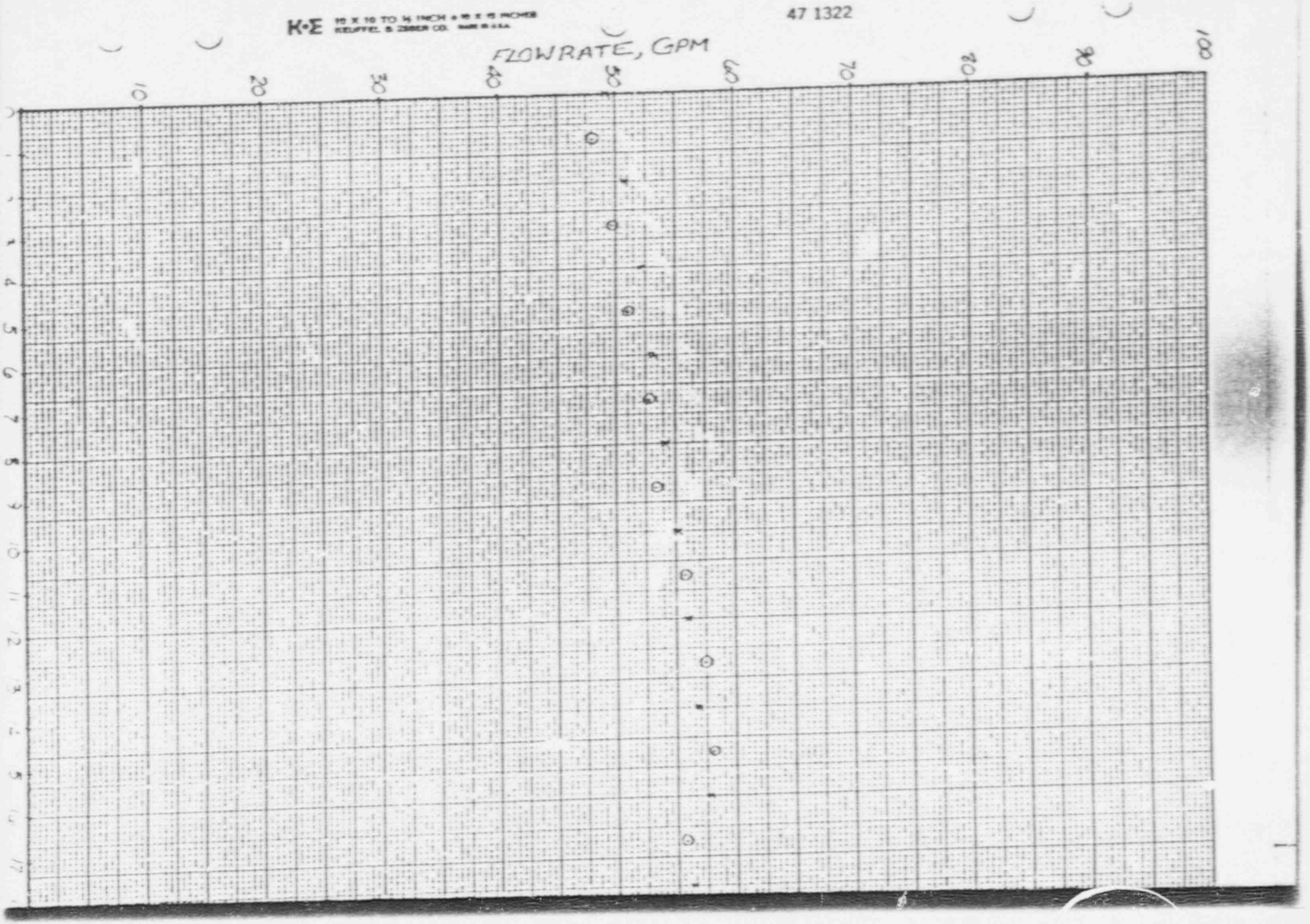
$$q_{m}(21) = 87.559 \times 10^{-6} \times 2081 \sqrt{.033201 + [illegible] (44.28) + 87.559 \times [illegible]}$$

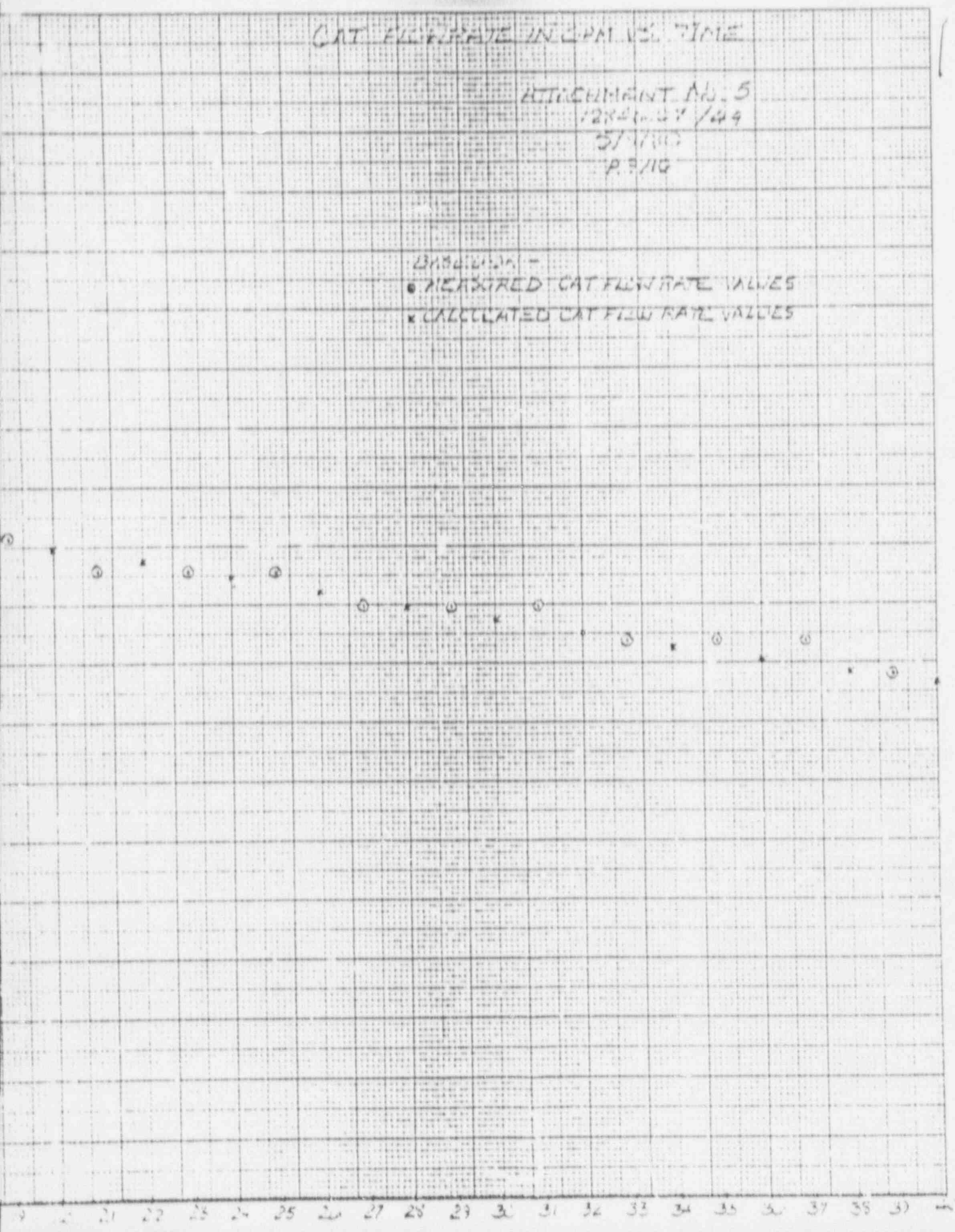
$$Z_{i} = 40.97 - 0.017047(44.28) = [illegible]$$

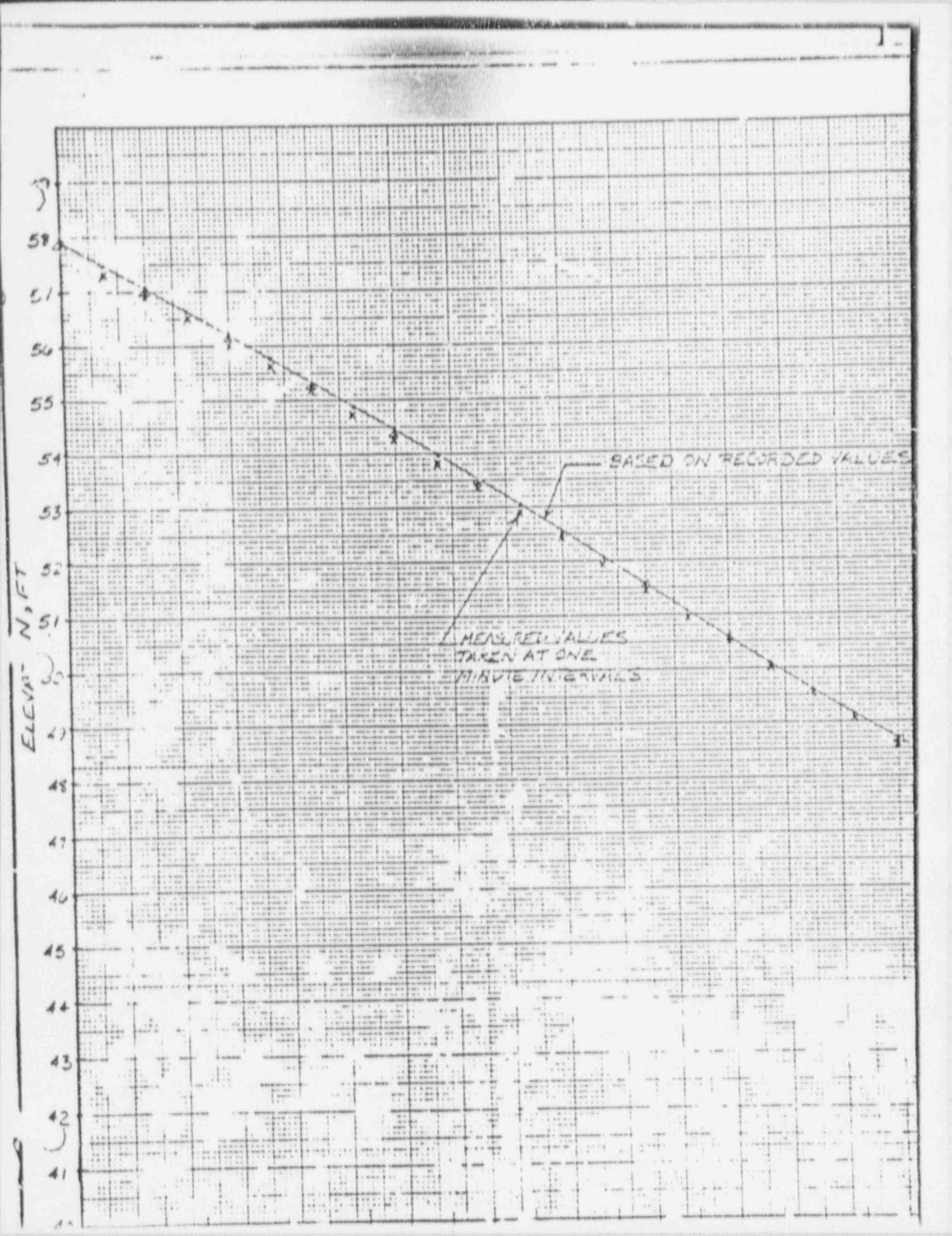
	12846.07 /49	REVISION	PAGE 8/10
PREPARER/DATE C. [illegible] 5/9/80	REVIEWER/CHECKER/DATE R. CROWELL 5-13-80	INDEPENDENT REVIEWER/DATE R. CROWELL 5-13-80	
SUBJECT/TITLE [illegible] BRAKDOWN TEST - 4/30/80		QA CATEGORY/CODE CLASS 7	

[illegible] TABLE OF GENERATED Z_{CA} [illegible]

i	T (MIN)	$Z_{RWST}(i+1)$ (FT)	$Q_{CA}(i+1)$ (GPM)	$Z_{CA}(i+1)$ (1.12)	[illegible] (i+1) (2.12)
0	0	51.39	2132	57.77	47.42
1	2	50.12	2130	57.03	50.77
2	4	48.85	2126	56.16	52.01
3	6	47.58	2123	55.21	53.15
4	8	46.31	2118	54.26	54.19
5	10	45.04	2113	[illegible]	[illegible]
6	12	43.77	2108	[illegible]	[illegible]
7	14	42.50	2102	[illegible]	[illegible]
8	16	41.23	2096	[illegible]	[illegible]
9	18	40.75	2091	[illegible]	[illegible]
10	[illegible]	40.27	2089	[illegible]	[illegible]
11	[illegible]	39.79	2088	47.60	[illegible]
[illegible]	[illegible]	39.31	2087	46.78	52.31
[illegible]	[illegible]	38.83	2086	[illegible]	[illegible]
[illegible]	[illegible]	38.35	2084	[illegible]	[illegible]
[illegible]	[illegible]	37.87	2084	[illegible]	[illegible]
[illegible]	[illegible]	37.39	2083	[illegible]	[illegible]
[illegible]	[illegible]	36.91	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	36.43	2082	[illegible]	[illegible]
[illegible]	[illegible]	35.95	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	35.47	[illegible]	[illegible]	[illegible]

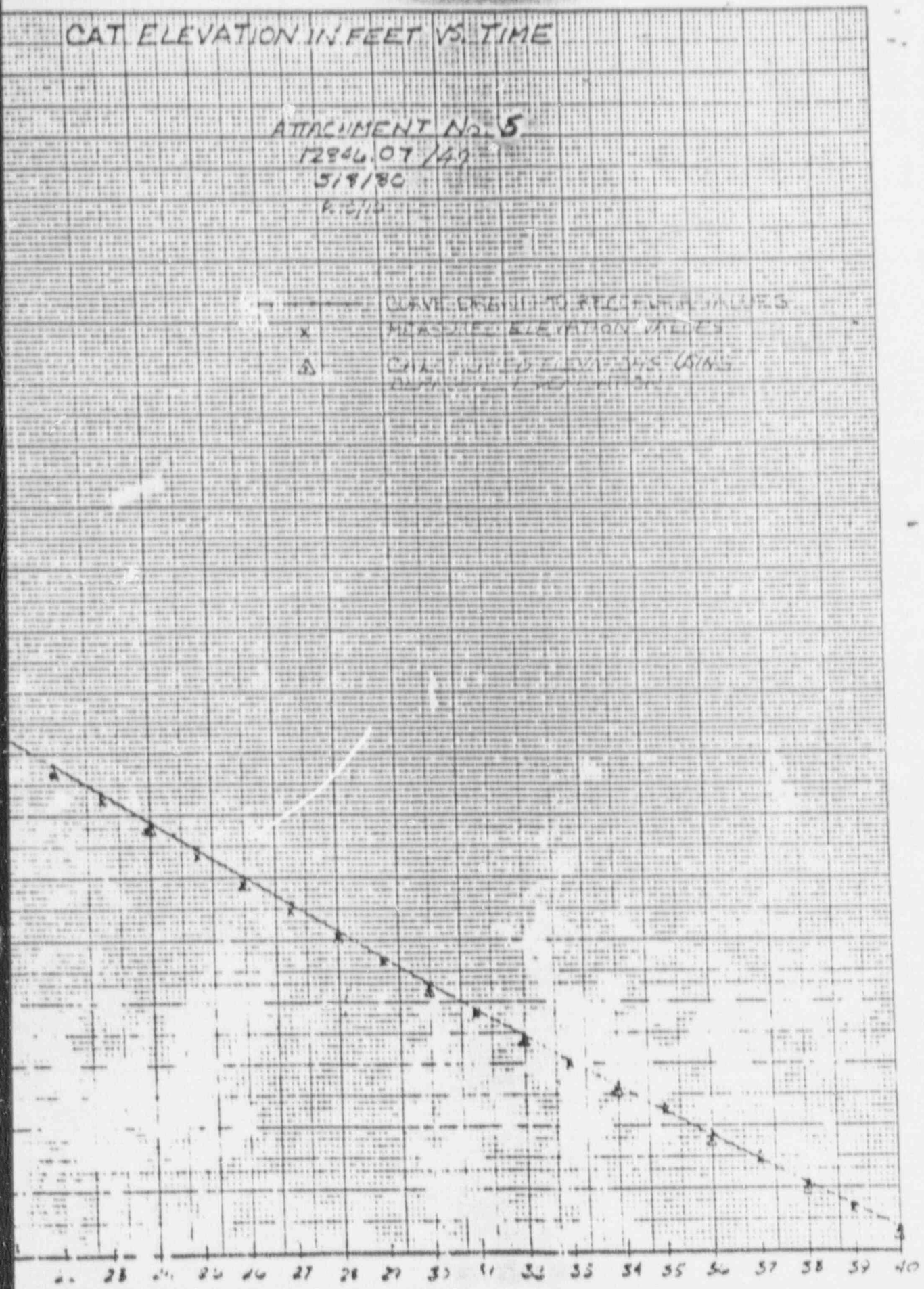

K·E
47 1322
FLOWRATE, GPM
10
20
30
40
50
60
70
80
90
100


CAT FLOWRATE IN GPM VS. TIME
ATTACHMENT NO. 5
MEASURED CAT FLOW RATE VALUES
CALCULATED CAT FLOW RATE VALUES


ELEVATION, FT
59
58
57
56
55
54
53
52
51
50
49
48
47
46
45
44
43
42
41
BASED ON RECORDED VALUES
MEASURED VALUES TAKEN AT ONE MINUTE INTERVALS

CAT. ELEVATION IN FEET VS. TIME

ATTACHMENT No. 5
12846.07/49
5/9/80



RWST-CAT DRAWDOWN TEST - 4/30/80 — Page 1/65

Calc. No. 12846.07 /49 — ATTACHMENT No. 6

FIELD CHANGE

STEAM GENERATOR REPLACEMENT PROJECT–SURRY POWER STATION

VIRGINIA ELECTRIC AND POWER COMPANY

TITLE OF DESIGN CHANGE OR ETA: CONTAINMENT SPRAY MODIFICATION	DESIGN CHANGE OR ETA NO: DC 77-9
REVISION NO: 93 / REVISION DATE: 5-2-80	UNIT NO: 2
REVIEWED BY RESIDENT ENGINEER – CONSTRUCTION: Leo Viens for Tilcon 4-30-80	DATE: 4-30-80
REVIEWED BY LEAD ENGINEER: H.E. Carroll for F.T. Ochetti	DATE: 4-30-80
REVIEWED BY QUALITY CONTROL: [signature] for F.L. Poole	DATE: 4-30-80
REVIEWED BY PROJECT ENGINEER: H.E. Carroll	DATE: 4-30-80
REVIEWED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE: CHAIRMAN'S SIGNATURE:	DATE:

FIELD CHANGE DESCRIPTION: (THE DESCRIPTION SHALL CONSIST OF: 1. REASON FOR CHANGE AND 2. DESCRIPTION OF CHANGE.)

1.) REASON FOR CHANGE:

PROCEDURE 210/W2 STEP 6.1.1 REQUIRES SPECIFIC VALUES AS LISTED BELOW FOR RWST AND CAT CHEMISTRY. ACTUAL VALUES AS LISTED BELOW FOR RWST AND CAT WATER VARY FROM THAT SPECIFIED.

REQUIRED	ACTUAL RWST	ACTUAL CAT
pH @25°C 4.0-5.6	4.88	6.18
C_B <3000	2162	1828
CL 0.15 PPM (MAX)	<.05	.66
F 0.15 PPM (MAX)	<.1	<.1

2.) DESCRIPTION OF CHANGE:

SYSTEM WILL NOT BE AFFECTED BY CHEMISTRY DEVIATION. RECORD ACTUAL CHEMISTRY VALUES, MAKE REFERENCE TO THIS FIELD CHANGE BY NOTATION, SIGN OFF STEP AND PROCEED TO STEP 6.1.2

3639

?2/65
12846.07/49

FIELD CHANGE
STEAM GENERATOR REPLACEMENT PROJECT—SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

TITLE OF DESIGN CHANGE OR ETA: CONTAINMENT SPRAY MODIFICATION		DESIGN CHANGE OR ETA NO: DC 77-9
REVISION NO: 9-2	REVISION DATE: 4-30-80	UNIT NO: 2
REVIEWED BY RESIDENT ENGINEER — CONSTRUCTION	Leo Vieira for Talani 4-30-80	DATE: 4-30-80
REVIEWED BY LEAD ENGINEER	Joseph O. Eastwood for F. C. Corbett	DATE: 4-30-80
REVIEWED BY QUALITY CONTROL	[signature] for F.L. Rentz	DATE: 4/31/80
REVIEWED BY PROJECT ENGINEER:	J.E. Currey	DATE: 4-30-80
REVIEWED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE: CHAIRMAN'S SIGNATURE:		DATE:

FIELD CHANGE DESCRIPTION: (THE DESCRIPTION SHALL CONSIST OF: 1. REASON FOR CHANGE AND 2. DESCRIPTION OF CHANGE.)

1.) REASON FOR CHANGE:

PROCEDURE PIO/U2 DOES NOT HAVE PROCEDURAL STEPS FOR PERFORMING A POST TEST CALIBRATION CHECK.

2.) DESCRIPTION OF CHANGE

INCORPORATE THE ATTACHED POST TEST INSTRUMENT CALIBRATION PROCEDURE INTO PIO/U2

3626

6. Perform a calibration loop check of each test loop for the RWST & CAT draw-down test as follows:

5/2/80 1 Isolate transducer/transmitter (as applicable for loop sensor) from source, drain sensor and sensing line(s) between isolation valve and sensor.

NOTE: For RWST & CAT level loops and LHSI pump "B" flow loop skip STEP 2 and proceed to STEP 3. For all other test loops proceed to STEP 4 after completion on step 2.

5/2/80 2 Disconnect transducer/transmitter (as applicable for loop sensor) from sensing line(s) and connect a pressure source to sensing line connection of sensor.

5/2/80 3 Connect a pressure source to transmitter test connection.

5/2/80 4 Adjust transducer/transmitter (as applicable for loop sensor) input pressure to devices lower range limit, mid range point and upper range limit as identified on the sensor's calibration data sheet. Record input pressures on recorder paper at tracing when required input pressures are obtained.

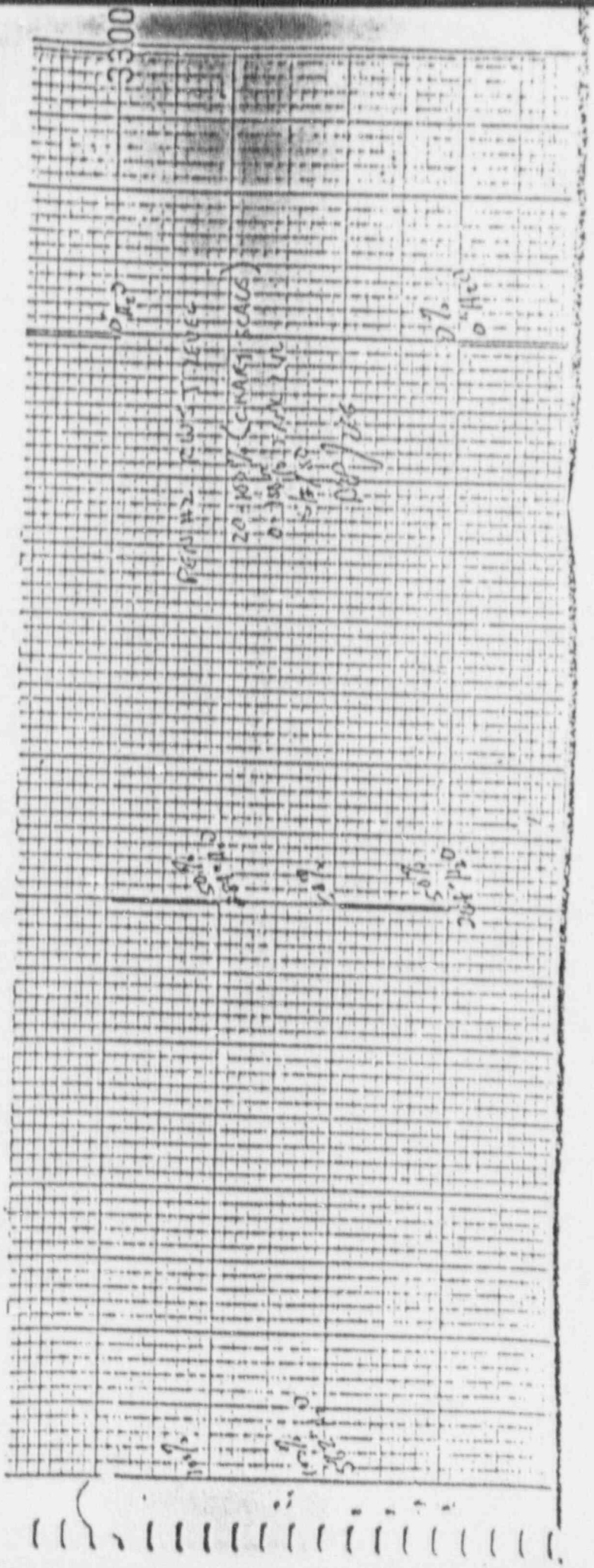
5/2/80 5 Technicians performing check to sign and date each recorder tracing.

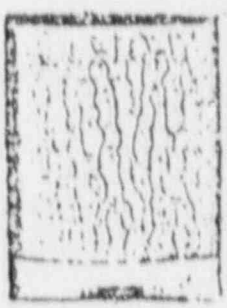
5/2/80 6 Attach recorder tracing to applicable calibration data sheet.

Completed by [signature]

Date 5/2/80

12-16-07/49





Blow-Down Test Loop RWST LEVEL LT-CS-200B

Data Sheet 4.1

Equipment	Cal Due
SQC No 18	6/80
SQC P76	6/80

RECORDER CHECK

INPUT VDC	% DESIRED	ACTUAL
1.000	20	___
2.000	40	___
3.000	60	___
4.000	80	___
5.000	100	___
3.000	60	___
1.000	20	___

TRANSMITTER CHECK

SIMULATED INCHES	INPUT VOLTS DES.	INPUT VOLTS ACT.
0	1.000	___
	2.000	___
284	3.000	___
	4.000	___
568	5.000	___
	3.000	___
0	1.000	___

Recorder Pen # 2 Transmitter Serial # ___

Recorder Serial # 044743

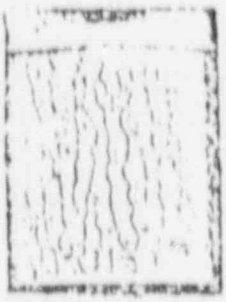
Recorder Preamplifier Serial # 042420 Transmitter Mfr ROSEMOUNT

Transmitter Equipment # MODEL 1152LL

Recorder Mfr GOULD

Instrument Technician [signature] [signature] Date 5/2/80 5/2/80

3



Draw-Down Test Loop CHEM. ADD. TANK LEVEL

Data Sheet 4.2

	EQUIPMENT	Cal Due
...um	SOC V018	5/80
...age	SOC P76	6/80

RECORDER CHECK

INPUT VDC	% DESIRED	ACTUAL
1.000	20	___
2.000	40	___
3.000	60	___
4.000	80	___
5.000	100	___
3.000	60	___
1.000	20	___

TRANSMITTER CHECK

SIMULATED INCHES	INPUT VOLTS DES.	INPUT VOLTS ACT.
0	1.000	___
	2.000	___
216	3.000	___
	4.000	___
432	5.000	___
	3.000	___
0	1.000	___

Recorder Pen # 1 Transmitter Serial # 6906A5348A98

Recorder Serial # 044743

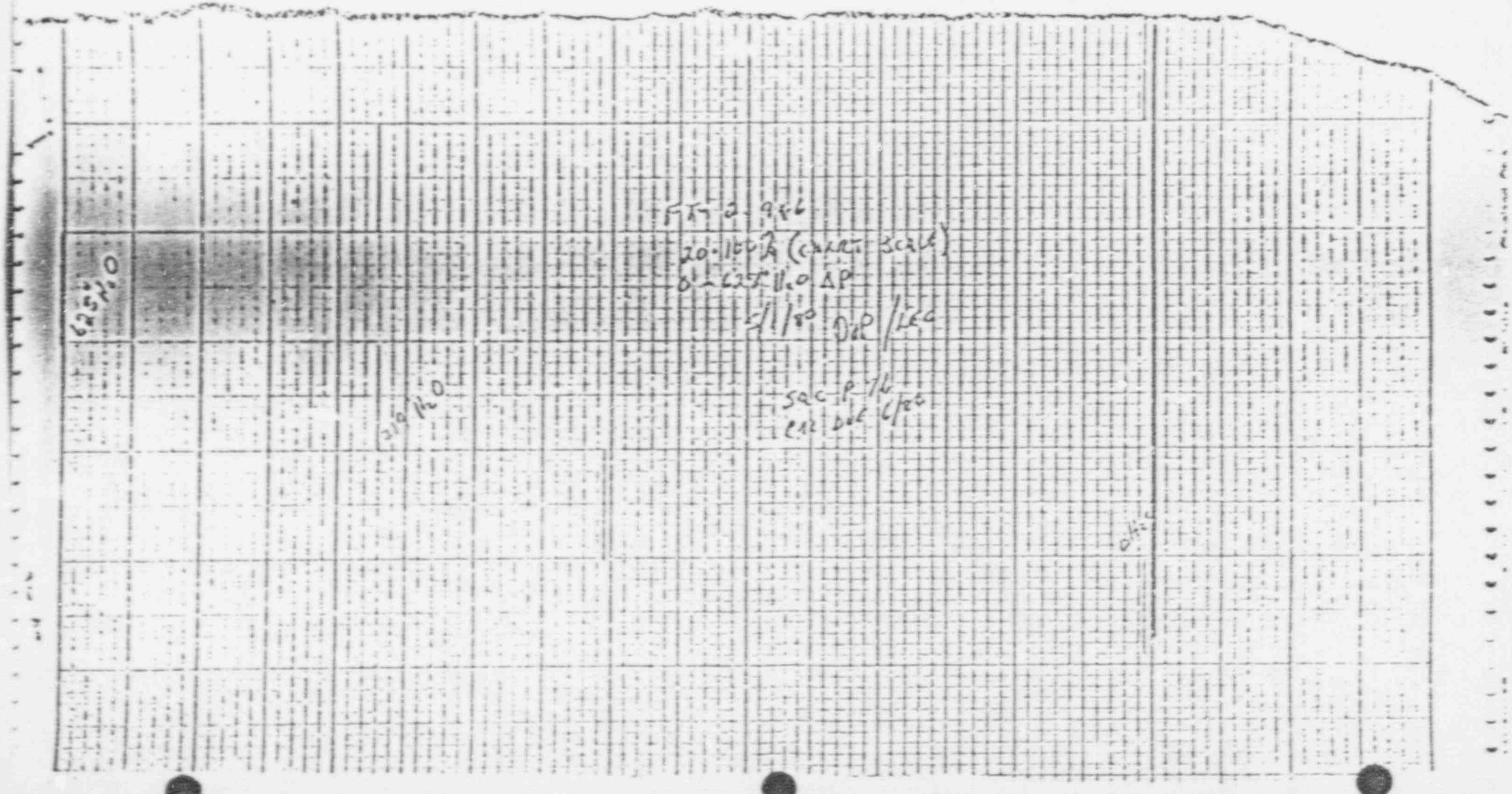
Recorder Preamplifier Serial # 044293 Transmitter Mfr FISHER-PORTER

Transmitter Equipment # ~~Fisher Por~~ 13D2446RB

Recorder Mfr GOULD

Instrument Technician [signature] [signature] Date 5/2/80 5/2/80

3



625 H_2O
(chart scale)
ΔP
5/1/80

...aw-Down Test Loop Low Head Safety Inj. Flow FT-2-946 ... 7/17

Data Sheet 4.3

Equipment	Cal Due
...m SQC-VO-18	5/80
...ange SQC-P-76	6/80

Recorder Check

Input VDC	% Desired	Actual
1.000	20	___
2.000	40	___
3.000	60	___
4.000	80	___
5.000	100	___
3.000	60	___
1.000	20	___

Transmitter Check

Simulated Inches	Input Volts Des.	Act.
0	1.000	___
	2.000	___
314	3.000	___
	4.000	___
628	5.000	___
	3.000	___
0	1.000	___

Recorder Pen # 1 Transmitter Serial # 690UA4843A2S

Recorder Serial # 041577

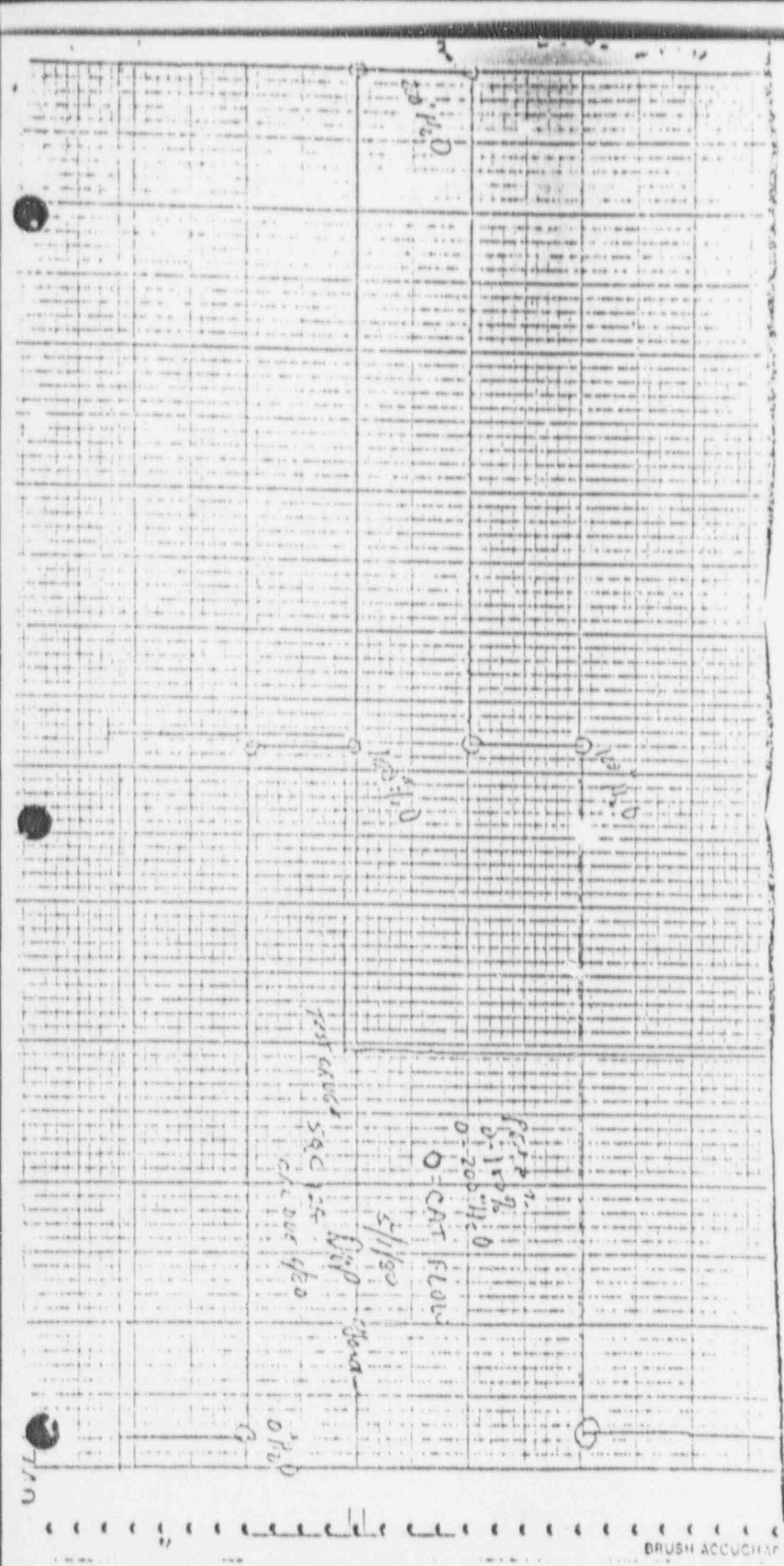
Recorder Preamplifier Serial # 040050 Transmitter Mfr FISHER PORTER

Recorder Mfr Gould Transmitter Equipment # 10B2496...

Instrument Technician [signature] Date 5/1/80

[signature] 5/1/80

3


BRUSH ACCUCHART

Blow-Down Test Loop — Cont. Spray Pump "A" Suction Flow From CST

Data Sheet 4.4

Equipment	Cal Due
DPC-US-18	5/80
DPC-124	6/80

Recorder Check

INPUT VDC	% DESIRED	% ACTUAL
1.000	20	____
2.000	40	____
3.000	60	____
4.000	80	____
5.000	100	____
3.000	60	____
1.000	20	____

Transmitter Check

Simulated Inches	Input Volts DES.	Input Volts ACT.
0	1.000	____
	2.000	____
100	3.000	____
	4.000	____
200	5.000	____
	3.000	____
0	1.000	____

Demodulator Mfr Vally Dine

Demodulator Ser # 040437

Demodulator Dial Settings

Zero 1.57

Span 6.98

Recorder Pen # 2

Recorder Serial # 052467

Recorder Preamplifier Serial # 034476

Recorder Mfr Gould

Transmitter Serial # 040430

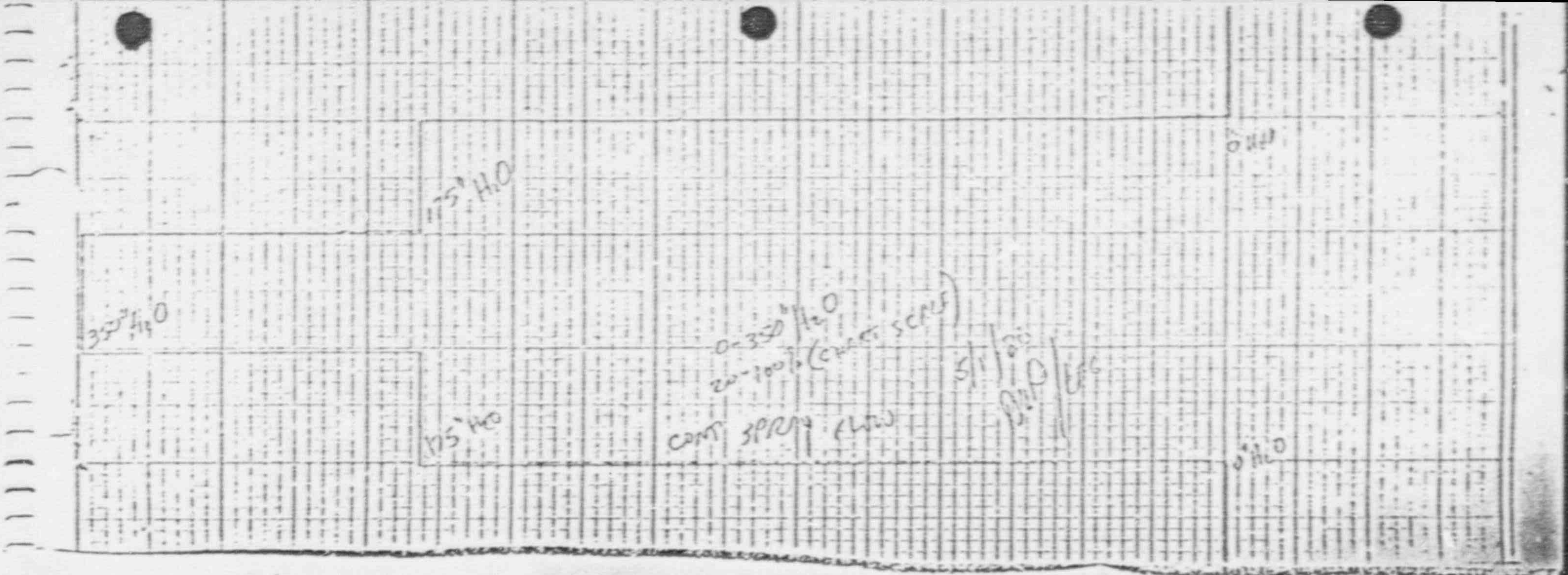
Transmitter Mfr Vally Line

Transmitter Equipment # 0630

Instrument Technician [signature] Date 5/1/80

5/1/80

3


350" H_2O
175" H_2O
175" H_2O
0-350" H_2O
20-100% (CHART SCALE)
CONT SPRAY FLOW
5/1/80
0" H_2O
0" H_2O

Test Equipment — Cal Due

DVM 222-00-18 — 5/80

Gage 300-94 — 6/80

Recorder Chart

Input Change (V-DC)	% of Chart (DESIRED)	% of Chart (ACTUAL)
1.0	20	20
2.0	40	39.5
3.0	60	59
4.0	80	79
5.0	100	99
3.0	60	57
1.0	0	0

Multiplier/Divider Chart

Input (V-DC)	Output (DESIRED)	Output (ACTUAL)
1.0	1.000	1.009
2.0	3.000	3.020
3.0	3.828	3.833
4.0	4.464	4.480
5.0	5.000	5.014
3.0	3.828	3.838
1.0	1.000	1.009

Recorder Pen * — 2

Recorder Serial * — 041599

Recorder Preamplifier Serial * — [illegible]

Recorder Mfr — Gulf

Multiplier/Divider Serial * — D0150

Multiplier/Divider Mfr — Westinghouse/Hagan

Transmitter Serial * — 115724

Transmitter Model * — 1152DP

Transmitter Mfr — Rosemount

Instrument Technician [signature] Date 5/1/80

[signature] 5/1/80

Draw-Down 125: Loop — Containment Steam Press. Transmitter PT-555

Data Sheet 4.6

Equipment		Cal Due
DVM:	SQC V015	5/20
Gauge:	SQC P43	7/30

Recorder Pen #: 1

Recorder Serial #: 054467

Recorder Preamplifier Serial #: 084804

Recorder Mfr: Gould

Recorder Check

Input VDC	% Desired	Actual
0	0	
1.00	20	
2.00	40	
3.00	60	
4.00	80	
5.00	100	
2.00	20	
0	0	

Bridge Amplifier Serial #: 084297

Bridge Amplifier Mfr: Gould

Bridge Amplifier Check

Simulated PSIA	Recorder Input % Desired	Actual
14.7	~~1.47~~ 29.4%	
	2.00	
30	3.00 60%	
	4.00	
50	5.00 100%	
	3.00	
14.7	~~1.47~~ 29.4%	

Transducer Mfr: Statham

Transducer Ser #: 038081

Mfr Equip #: 26030

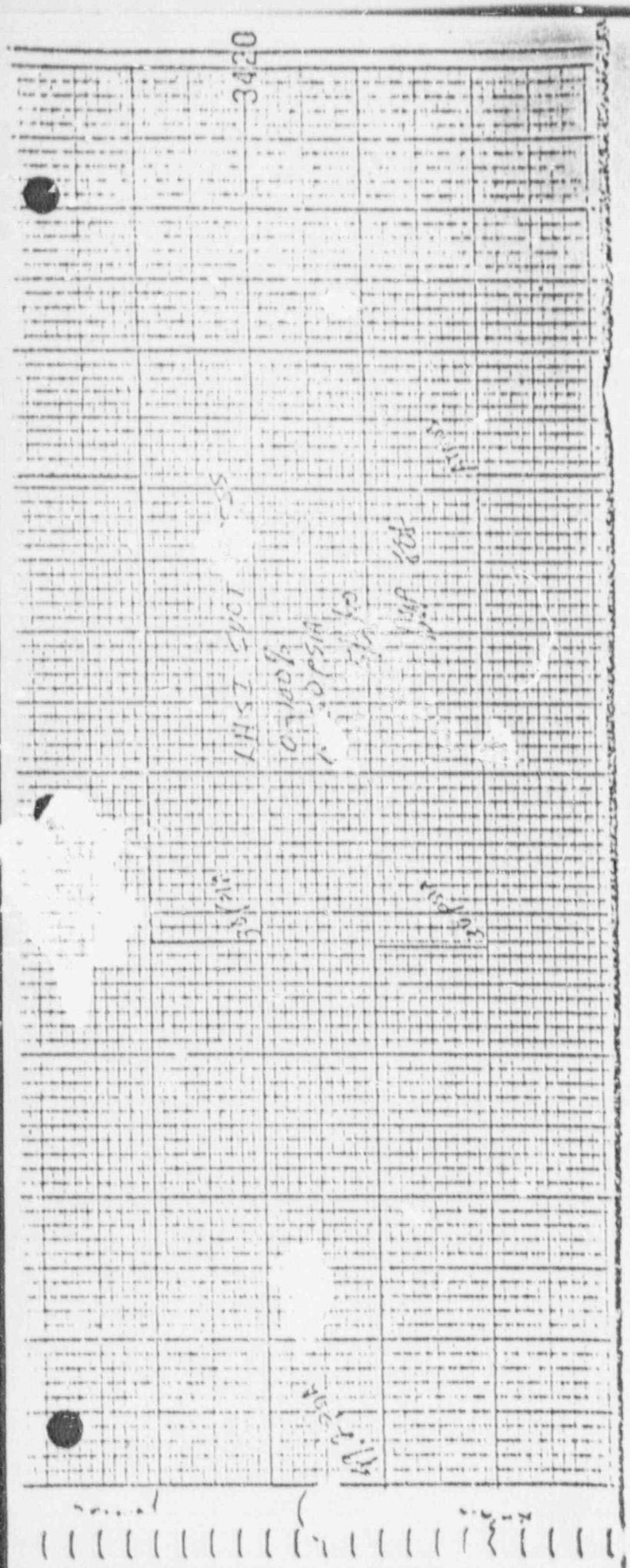
Bridge Amplifier Dials

% Full Load: 10?

Calibrate: 3.55

Zero Suppression Coarse: 4.01 Vernier: 2.12

~~Gain~~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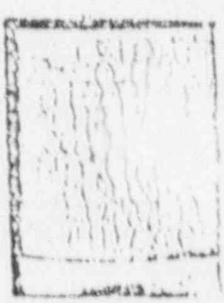


-aw-Down Test Loop Low Head Safety Inj. Pump "B" Suction Pressure

Data Sheet 4.7.

Equipment		Cal Due
...m:	SCC V01	5/80
...ge:	SCC P4	7/80

...rder Pen # 1
...rder Serial # 040046
...rder Preamplifier Serial # 084474
...rder Mfr Gould

Recorder Check

Input VDC	% Desired	Actual
0	0	___
1.00	20	___
2.00	40	___
3.00	60	___
4.00	80	___
5.00	100	___
2.00	20	___
0	0	___

...dge Amplifier Serial # 079962 ~~071712~~ DIP
...dge Amplifier Mfr Gould

Transducer Ser # 033025
Transducer Mfr Statham
Transducer Model # PA255TC?-50-350

Bridge Amplifier Check

Simulated PSIA	Recorder Input Desired	Actual
14.7	~~1.47~~ 29%	___
	2.00	___
30	3.00 60%	___
	4.00	___
50	5.00 100%	___
	3.00	___
14.7	~~1.47~~ 29%	___

Bridge Amplifier Dials

% Full Load 100
Calibrate 6.82
Zero Suppression Coarse +.01 Vernier 0.57

~~Comm~~ [signature] 5/2/80

[signature] 5/2/80

- B

12/16 07/84

Draw-Down Test Loop

Data Sheet 4.8

Equipment	Cal Due
SOC V013	5/50
SOC P2	7/50

Recorder Check

Input VDC	% Desired	% Actual
0	0	
2.50	25	
5.00	50	
7.50	75	
10.00	100	
5.00	50	
0	0	

Demodulator Check

Psig Simulated Inches H2O	Recorder Input Desired	Actual
0 psig	0	
	2.50	
75 psig	5.00	
	7.50	
150 psig	10.00	
	5.00	
0 psig	0	

DEMODULATOR SERIAL # 041578
DEMODULATOR MFR VALYDINE
TRANSDUCER SERIAL # 12757A
TRANSDUCER MFR 040598
MODEL # DP15

Demodulator Dials

Zero	0.0
Span	4.05

Recorder Pen #	2
Recorder Serial #	040046
Recorder Preamplifier Serial #	084477
Recorder Mfr	Gould

Instrument Technician [signature] Date 5/2/50

[signature] 5/2/50

Rosemount 1152DP
S/N 115724
Calibrated with SQC-94

M/D INPUT	ΔP
.998	0
0.000	87.5
2.999	175
4.005	262.5
5.008	350
2.998	175
.998	0

FIELD CHANGE
STEAM GENERATOR REPLACEMENT PROJECT–SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

TITLE OF DESIGN CHANGE OR ETA: 1	CONTAINMENT SPRAY MODIFICATION	DESIGN CHANGE OR ETA NO.: 2	77-9
REVISION NO.: 3	91	REVISION DATE: 4	4-30-80
UNIT NO.: 5	2		
REVIEWED BY RESIDENT ENGINEER – CONSTRUCTION 6	J.E. Carroll for Leo Vieira	DATE: 7	4-30-80
REVIEWED BY LEAD ENGINEER 8	[signature]	DATE: 9	4-30-80
REVIEWED BY QUALITY CONTROL 10	R.F. Saunders	DATE: 11	4-30-80
REVIEWED BY PROJECT ENGINEER 12	J.E. Carroll	DATE: 13	4-30-80
REVIEWED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE CHAIRMAN'S SIGNATURE: 14		DATE: 15	

FIELD CHANGE DESCRIPTION: (THE DESCRIPTION SHALL CONSIST OF: 1. REASON FOR CHANGE AND 2. DESCRIPTION OF CHANGE.) 16

1. Reason for Change:

The transducer used to detect flow in the C.S. drawdown test line was found to be defective. A transmitter (Rosemount) will be installed in its place. Changes are required to the calibration portion of procedure P-10-U2.

2. Description of Change:

See attached instructions – Subsection 4.5, steps 4.5.1 thru 4.5.9.

FIELD CHANGE
SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

ATTACH TO: FIELD CHANGE CS CHEMICAL ADDITION FLOW AND LHSI VENTURI FLOW VERIFICATION TEST

DESIGN CHANGE NO. 77-9/8-10-U2

FIELD CHANGE (CONTINUED):

INITIALS/DATE

4.5 Calibration of Containment Spray Flow Loop.

PJ, 4/30/80 — 4.5.1 Repeat steps 4.1.1 through 4.1.4 except record on data sheet 4.5

NOTE: Steps 4.5.2 and 4.5.3 to be done in instrument shop prior to installing instruments into test loop.

PJ, 4/30/80 — 4.5.2 Connect power supply to be used in test loop to Rosemount 1152 transmitter and 250Ω resistor in series with transmitter across power supply output.

PJ, 4/30/80 — 4.5.3 Connect a power source to transmitter input, vary input pressure to values listed on data sheet 4.5. Calibrate transmitter for a 1-5VDC drop across the 250Ω calibration resistor as required by data sheet in accordance with manufacturer's instructions. Record voltages on data sheet 4.5.

NOTE: Steps 4.5.4 thru 4.5.9 to be done after instrumentation is installed in test loop

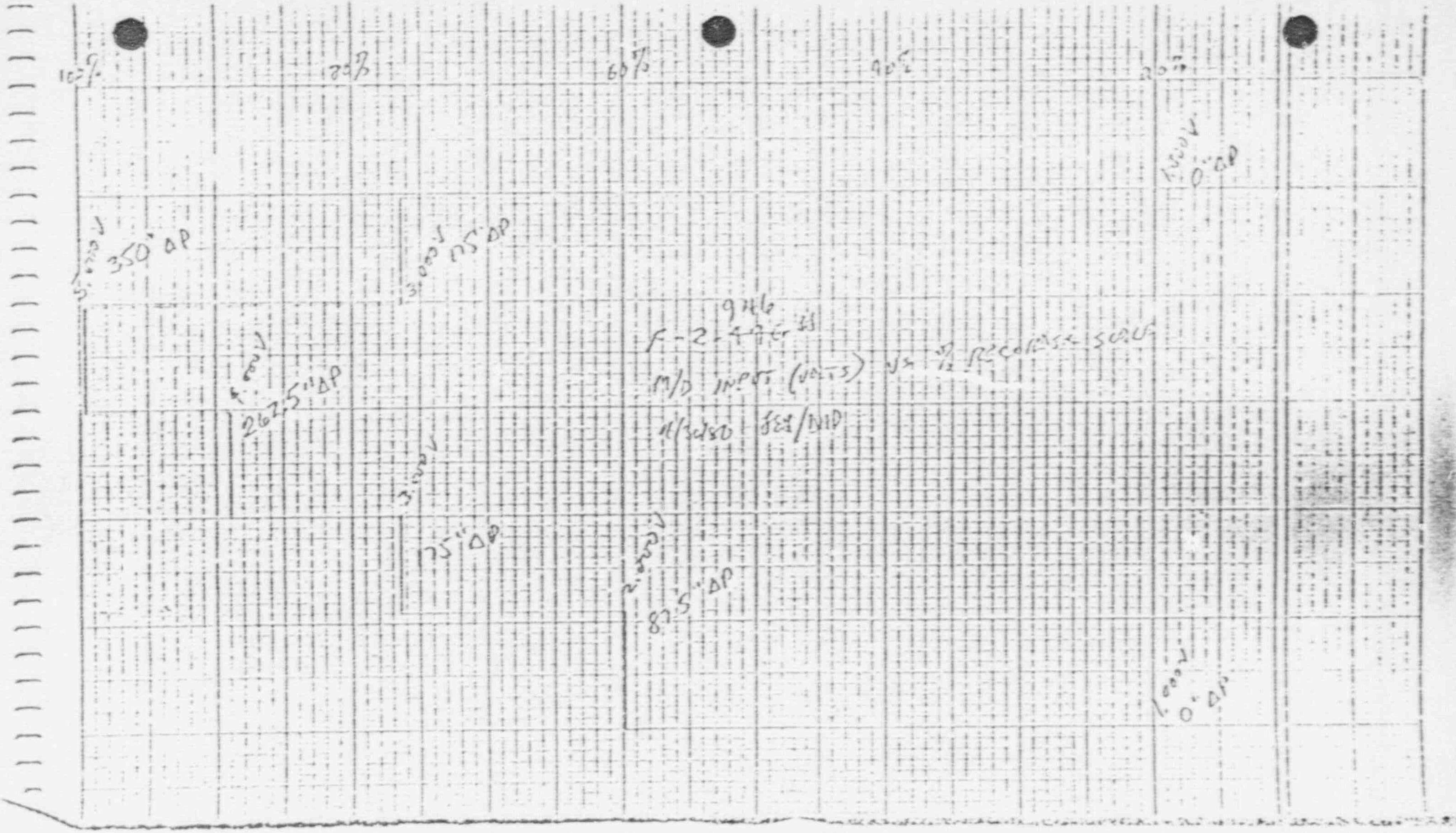
PJ, 4/30/80 — 4.5.4 Disconnect leads from 45 VDC power supply and to input of multiplied/divider (square root converter)

NOTE: Do not remove 250Ω resistor from multiplier/divider input.

PJ, 4/30/80 — 4.5.5 Connected a 100K ohm potentiometer between (+) output terminal of power supply and (+) input terminal of multiplier/divider.
Connect (-) output terminal of power supply to (-) input terminal of multiplier/divider.

PJ, 4/30/80 — 4.5.6 Connect a digital voltmeter across input to multiplier/divider.
Connect a digital voltmeter across input to recorder input.

PJ, 4/30/80 — 4.5.7 Vary input voltage to multiplier/divider to values equivalent to input pressure listed on data sheet 4.5. Record multiplier/divider and recorder input voltages on data sheet 4.5. Mark recorder paper to note equivalent pressure reading at points where required voltages are obtained. Attach the recorder trace to data sheet 4.5.



100%
80%
60%
40%
20%
350" ΔP
175" ΔP
262.5" ΔP
87.5" ΔP
0" ΔP
0" ΔP
M/D INPUT

FIELD CHANGE
SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

ATTACH TO: FIELD CHANGE CS CHEMICAL ADDITION FLOW AND LHSI VENTURI FLOW VERIFICATION TEST

DESIGN CHANGE NO.: 77-9/P-10-U2

FIELD CHANGE (CONTINUED):

INITIALS/DATE		
BS, 4/29/80	4.5.8	Affix a calibration sticker to the recorder controls locking them in place.
BS, 4/29/80	4.5.9	Disconnect potentiometer wiring and DVM's installed in steps 4.5.5 and 4.5.6. Reconnect power supply and multiplier/divider to test loop.

Submitted By: [signature]

Date: 4/30/80

FIELD CHANGE

STEAM GENERATOR REPLACEMENT PROJECT - SURRY POWER STATION

VIRGINIA ELECTRIC AND POWER COMPANY

1 TITLE OF DESIGN CHANGE OR ETA: CONTAINMENT SPRAY MODIFICATION		2 DESIGN CHANGE OR ETA NO: 77-9
3 REVISION NO: 90	4 REVISION DATE: 4-30-80	5 UNIT NO: 2
6 REVIEWED BY RESIDENT ENGINEER - CONSTRUCTION: L. D. Phillips		7 DATE: 4-30-80
8 REVIEWED BY LEAD ENGINEER: William H Fitts		9 DATE: 4-30-80
10 REVIEWED BY QUALITY CONTROL: L. S. Lussier		11 DATE: 4-30-80
12 REVIEWED BY PROJECT ENGINEER: H.E. Carroll		13 DATE: 4-29-80
14 REVIEWED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE: CHAIRMAN'S SIGNATURE:		15 DATE: APR 30 1980

16 FIELD CHANGE DESCRIPTION: (THE DESCRIPTION SHALL CONSIST OF: 1. REASON FOR CHANGE AND 2. DESCRIPTION OF CHANGE.)

1.) REASON FOR CHANGE:

THE FOLLOWING CHANGES ARE REQUIRED TO P10/U2 IN ORDER TO PROVIDE CLARIFICATION AND CORRECTED TEST POINTS.

2.) DESCRIPTION OF CHANGE:

INCORPORATE THE ATTACHED REVISED PAGES OF P10/U2 INTO THE PROCEDURE AS APPROVED ON 4-28-80. (PAGES 2, 3 AND 4; ATTACHMENT IV PG 1&2)

DELETE UNREVISED PAGES AFFECTED BY THIS CHANGE

FIELD CHANGE
STEAM GENERATOR REPLACEMENT PROJECT–SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

1 TITLE OF DESIGN CHANGE OR ETA:	2 DESIGN CHANGE OR ETA NO:
Containment Spray System	77-9

3 REVISION NO:	4 REVISION DATE	5 UNIT NO:
89	4-28-80	2

6 REVIEWED BY RESIDENT ENGINEER – CONSTRUCTION	H.C. Hurt	7 DATE: 4-28-80
8 REVIEWED BY LEAD ENGINEER	William H Gee	9 DATE: 4-28-80
10 REVIEWED BY QUALITY CONTROL	*TEC ~~T.E. Cosh~~ William L. Willis	11 DATE: 4-28-80
12 REVIEWED BY PROJECT ENGINEER:	T.E. Cassell	13 DATE: 4-28-80
14 REVIEWED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE: CHAIRMAN'S SIGNATURE:	M Wilson	15 DATE: 4/28/80

16 FIELD CHANGE DESCRIPTION: (THE DESCRIPTION SHALL CONSIST OF: 1. REASON FOR CHANGE AND 2. DESCRIPTION OF CHANGE.)

1 Reason ADDITIONAL INFORMATION DESIRED CONCERNING TEST CONDUCTED BY P-8-U2

2 Description INSERT TEST PROCEDURE P-10-U2 INTO THE FINAL DESIGN IMPLEMENTATION & TESTING.

FIELD CHANGE
STEAM GENERATOR REPLACEMENT PROJECT–SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

TITLE OF DESIGN CHANGE OR ETA: CONTAINMENT SPRAY MODIFICATION	DESIGN CHANGE OR ETA NO: 77-9
REVISION NO: 88 / REVISION DATE: April 26, 1980	UNIT NO: Unit ~~I and~~ II
REVIEWED BY RESIDENT ENGINEER — CONSTRUCTION: [signature] for E.J. R...	DATE: 4-28-80
REVIEWED BY LEAD ENGINEER: [signature] for ...	DATE: 4-28-80
REVIEWED BY QUALITY CONTROL: [signature]	DATE: 4/28/80
REVIEWED BY PROJECT ENGINEER: H.E. Carroll	DATE: 4-28-80
REVIEWED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE CHAIRMAN'S SIGNATURE: [signature]	DATE: 4/25/80

FIELD CHANGE DESCRIPTION: (THE DESCRIPTION SHALL CONSIST OF: 1. REASON FOR CHANGE AND 2. DESCRIPTION OF CHANGE.)

1. Reason For Change:

   Procedure P-~~8~~ 10, Containment Spray RWST/CAT Drawdown Test and LHSI Venturi Test" does not contain procedures for calibration of test instrumentation.

2. Description Of Change:

   Incorporate the attached calibration procedure as attachment 6 to procedure ~~P-8~~ P-10

Originated By H.E. Carroll

Date 4-28-80

INSTRUMENTATION CALIBRATION PROCEDURE FOR THE CONTAINMENT SPRAY RWST / CAT DRAWDOWN AND LHSI FLOW VENTURI TEST

1.0 Purpose

The purpose of this addendum is to provide instructions for and documentation of the calibration of all instrumentation used during the Drawdown Test.

2.0 References

2.1 Nuclear Power Station Quality Assurance Manual, Surry Power Station

2.2 Rosemount Model 1152 Instruction Manual 4235

2.3 Fisher Porter Bulletin 10B2495

2.4 Validyne Instruction Manual Model CD15 Carrier Demodulator

2.5 Gould DC Bridge Preamplifier Model 13 4615 30 Manual

2.6 Gould Model 110 Strip Chart Recorder Manual

2.7 Westinghouse Instruction Bulletin IB-127-112

3.0 Precautions

~~3.1 The Shift Supervisor / Control Room Operator~~

___SJ___ 3.1 Prior to calibrating any permanent station instrumentation obtain permission from the Shift Supervisor and Control Room Operator.

___SJ___ 3.2 Insure the test equipment used in has been calibrated in accordance with the IQC program by verification of date on calibration sticker.

___SJ___ 3.3 The person performing this procedure must be a qualified Nuclear Instrument Technician.

4.0 Instructions

LT-CS-2058

4.1 Calibration of AUST Level Transmitter and Level Indication on Mould Strip Chart

4.1.1 Remove the input leads on the back of the recorder for the pen to be used.

4.1.2 Connect a DC power supply and digital voltmeter to the recorder input.

4.1.3 Vary the power supply from 0-5 VDC and calibrate the recorder in accordance with instruction manual. Record data as required on data sheet 4.1.

4.1.4 ~~Reconnect~~ Disconnect the power supply and reconnect the input wiring.

4.1.5 Isolate the level transmitter, drain the line between the isolation valve and the transmitter and connect a pressure source to the test fitting.

4.1.6 Adjust the input pressure to the values on the data sheet and calibrate the transmitter for a 1-5 VDC input to the recorder in accordance with manufacturers manual. Record the final recorder input voltages on ~~the~~ data sheet 4.1.

~~4.1.7 Vary the simulated pressure as specified on data sheet 4.1 and record on the recorder trace~~

4.1.7 Set the simulated pressure to the values on the data sheet 4.1 and mark the recorder paper when these values are obtained. Attach ~~the~~ the recorder trace to data sheet 4.1.

4.1.8 Affix a calibrated sticker to the recorder controls locking them in place.

4.1.9 Remove pressure source from the test fitting and place transmitter back in service by shutting the test valve and opening the transmitter isolation valve.

LT-CS-201

4.2 Calibration of CAT Level Transmitter and Level Indication on Level Strip Chart

4.2.1 Repeat steps 4.1.4 through 4.1.9 for the CAT Level Transmitter except record data on data sheet 4.2.

4.3 Calibration of LHSI Pump "B" Discharge Flow Transmitter FT-2-946, Square Root Extractor and Flow Indication on Flow Strip Chart.

4.3.1 Repeat steps 4.1.1 through 4.1.4 for the appropriate pen except record data on data sheet 4.3.

4.3.2 Disconnect the input ~~wiring~~ wiring to the multiplier/divider and connect a DC power supply and digital voltmeter to input #1.

4.3.3 Connect a digital voltmeter to the recorder input jacks.

4.3.4 Vary the input voltage from 1-5 VDC in 1.000 volt steps and calibrate the multiplier/divider in accordance with manufacturers manual, record the final results on data sheet 4.3.

4.3.5 Disconnect the test equipment on the multiplier/divider input and reconnect the input wiring.

4.3.6 Isolate the transmitter and connect a pressure source to the HP side.

4.3.7 Connect a digital voltmeter to the multiplier/divider input jacks.

4.3.8 Vary the pressure as required by data sheet 4.3 and calibrate the transmitter in accordance with the manufacturer's manual. Record the final results on data sheet 4.3.

4.3.9 Set the simulated pressures to the values on the data sheet and mark the recorder paper when these values are obtained. Attach the recorder trace to data sheet 4.3.

4.3.10 Disconnect all test equipment and return the transmitter to service.

4.3.11 Affix a calibrated sticker to all controls locking them in place.

4.4 Calibration of Containment Ecean Dunn "A" Suction Flow Indication

4.4.1 Repeat steps 4.1.1 through 4.1.4 for the appropriate pressure transmitter using 0-10 VDC span and data sheet 4.4

4.4.2 Connect a test pressure source to the transducer

4.4.3 Calibrate the carrier demodulator in accordance with manufacturer's manual recording data as required on data sheet 4.4.

4.4.4 Set the simulated pressures to the values on the data sheet 4.4 and mark the recorder paper when these values are obtained. Attach the recorder trace to data sheet 4.4

4.4.5 Remove all test equipment and return the transducer to service.

4.4.6 Affix a calibrated sticker to all controls locking them in place.

P. 2-165
12-8-1.. 07/19

4.5 Calibration of Containment Spray Flow Indication and Square Root Extractor

4.5.1 Repeat steps 4.1.1 through 4.1.4 except record data on data sheet 4.5.

4.5.2 Repeat steps 4.3.2 through 4.3.5 except record data on data sheet 4.5.

4.5.3 Repeat steps 4.4.2 through 4.4.5 except record data on data sheet 4.5.

4.5.4 Affix a calibrated stickers to all controls locking them in place.

4.6 Calibration of Containment Spray Pump "A" Suction Pressure Indication

4.6.1 Repeat steps 4.1.1 through 4.1.4 for the appropriate pen except record data on data sheet 4.6.

~~4.6.2 Set the simulated~~

4.6.2 Connect a test pressure source to the transducer.

4.6.3 Set the simulated pressure to the values on the data sheet and adjust the bridge amplifier to obtain 0-5 VDC at the recorder input. Record the final values on data sheet 4.6.

4.6.4 Set the simulated pressure to the values on the data sheet and mark the recorder paper when these values are obtained. Attach the recorder trace to data sheet 4.6.

4.6.5 Remove all test equipment and return the transducer to service.

4.6.6 Affix a calibrated stickers to all controls locking them in place

12440.07/1.2

4.7 Calibration of LHSI Pump "B" Suction Pressure Indication

4.7.1 Repeat steps 4.6.1 through 4.6.6 for the appropriate pen except record data on data sheet 4.7.

4.8 Calibration of LHSI Pump "B" Discharge Pressure Indication

4.8.1 Repeat steps 4.4.1 through 4.4.5 for the appropriate pen except record data on data sheet 4.8

5.0 Acceptance Criteria

~~5.1 [illegible]~~

5.1 This calibration is acceptable if the final recorder trace are within ±2% of desired.

Completed By: [signature]

Date: 4/30/80

~~Approved:~~

Approved: [signature]

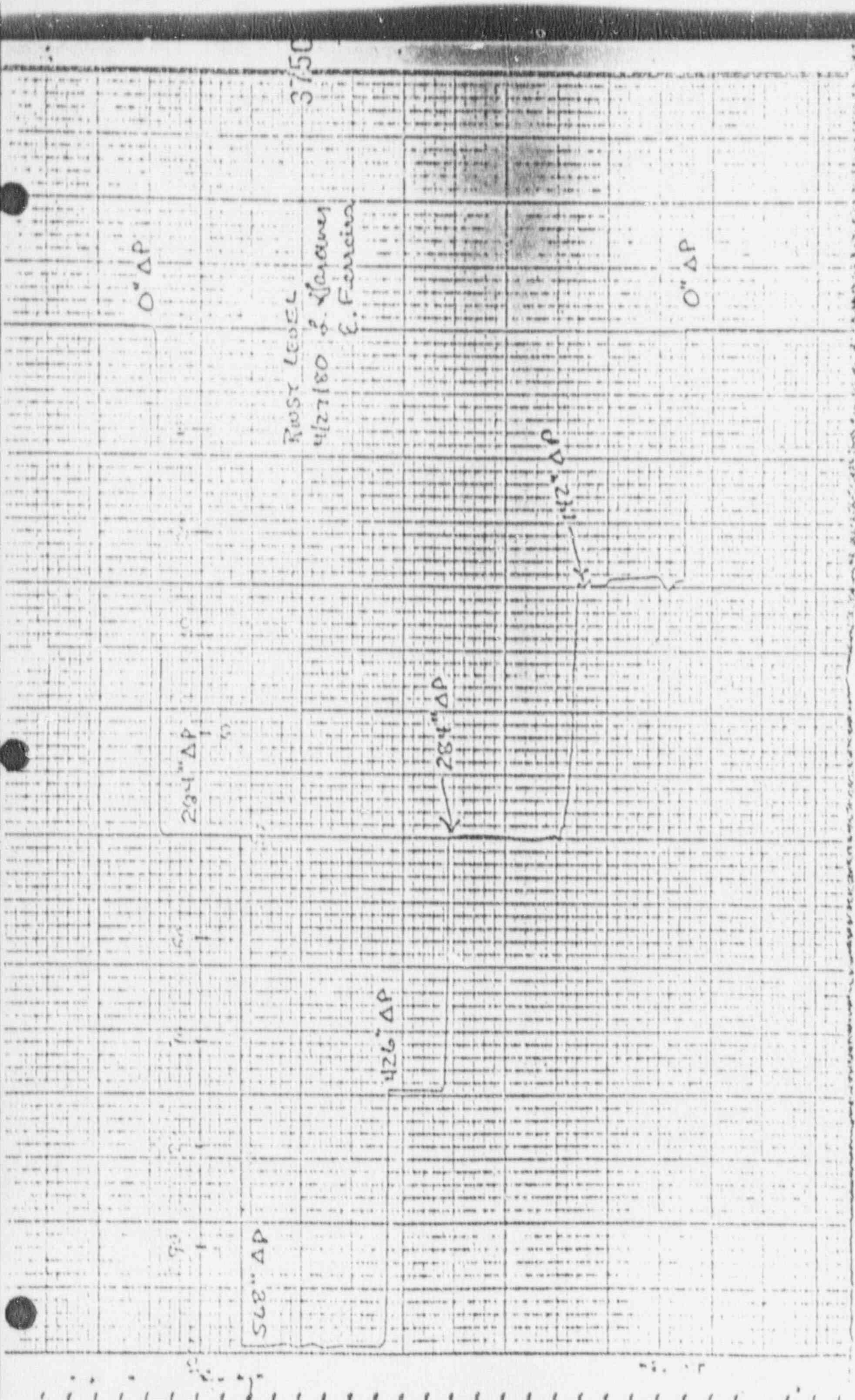
Chairman Station Nuclear Safety and Operating Committee

Date: 4/28/80

Recommend Approval: [signature]

Date: 7-28-80

85


3750
RUST LEVEL
4/27/80
E. Ferreira
0" ΔP
0" ΔP
142" ΔP
284" ΔP
284" ΔP
426" ΔP
568" ΔP

12.46.07/49

Data Sheet 4.1

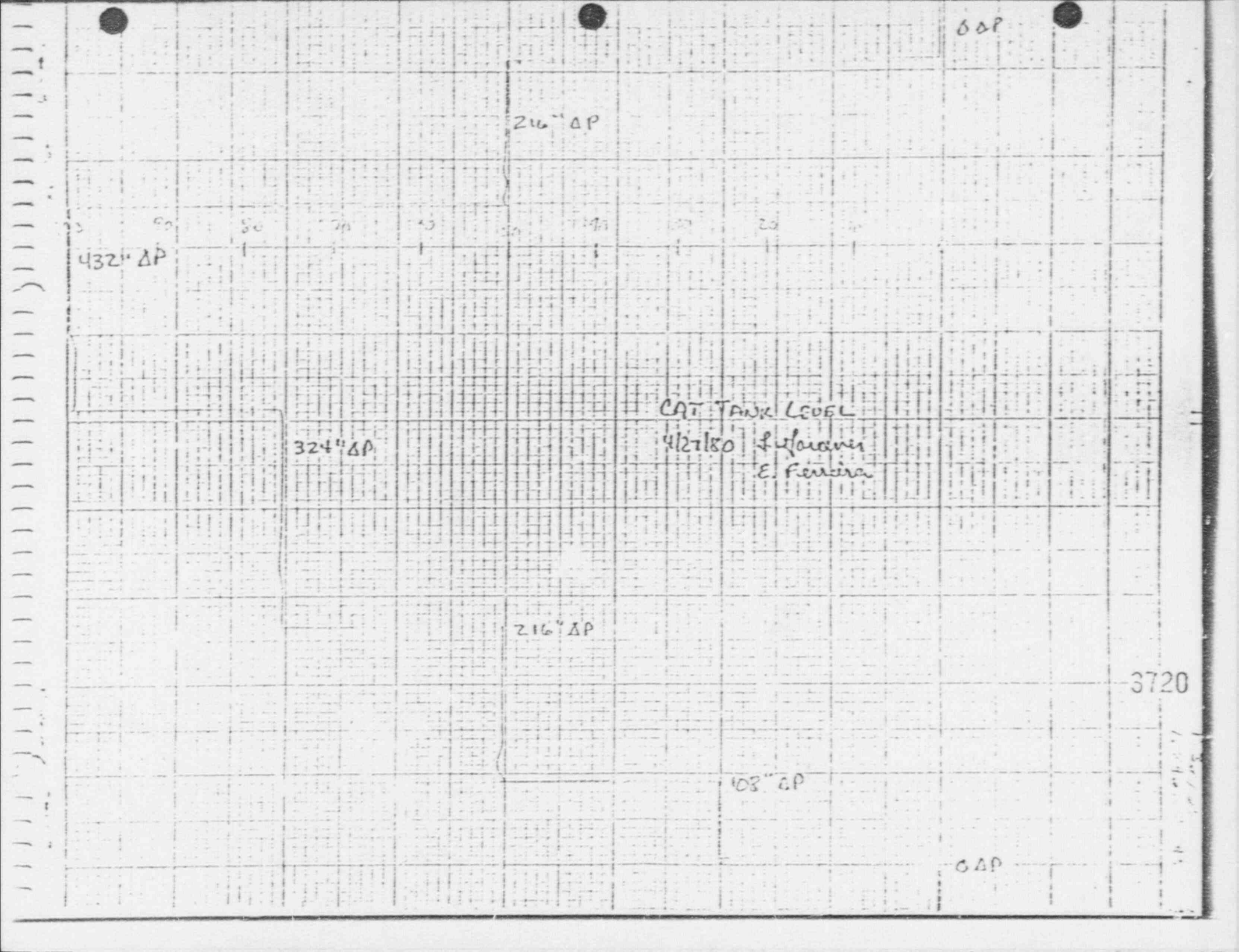
Test Equipment		Cal Due
DVM	SDC-VO-18	5/80
Gauge	SDC-P-76	6/80

Recorder Check

Input VDC	% DESIRED	ACTUAL
1.000	20	20
2.000	40	40
3.000	60	60
4.000	80	80
5.000	100	100
3.000	60	60
1.000	20	20

Transmitter Check

Simulated Inches	Input Volts DES.	ACT.
0	1.000	1.000
142	2.000	2.008
284	3.000	3.003
426	4.000	4.001
568	5.000	4.992
284	3.000	3.001
0	1.000	1.000


6 ΔP
216" ΔP
432" ΔP
CAT TANK LEVEL
4/27/80 Fujiwara
E. Ferreira
324" ΔP
216" ΔP
3720
108" ΔP
6 ΔP

Data Sheet 4.2

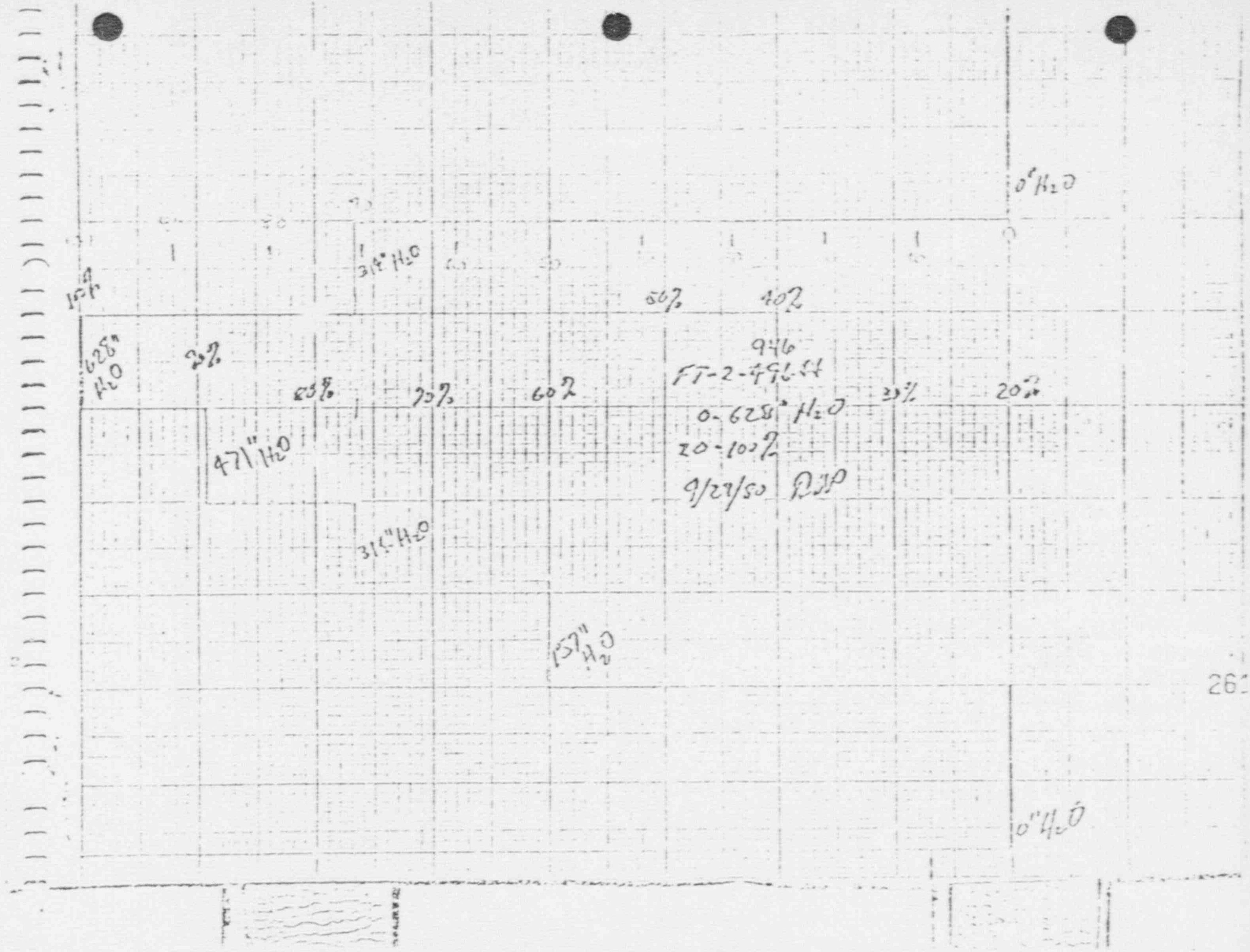
Test Equipment	Cal Due
DVM: 920-UD-18	5/80
Gauge: 920-P-76	6/80

Recorder Check

Input VDC	% Desired	Actual
1.000	20	20
2.000	40	40
3.000	60	60
4.000	80	80
5.000	100	100
3.000	60	60
1.000	20	20

Transmitter Check

Simulated Inches		% Desired	Actual
0	1.000	20 %	1.005
108	2.000	40 %	2.003
216	3.000	60 %	3.013
324	4.000	80 %	4.017
432	5.000	100 %	5.015
216	3.000	60 %	3.015
0	1.000	0 %	1.001



0" H_2O
31.4" H_2O
50%
40%
628" H_2O
10%
83%
73%
60%
946
FT-2-496-44
30%
20%
0-628" H_2O
20-100%
471" H_2O
9/29/50
31.4" H_2O
157" H_2O
0" H_2O

Data Sheet 43

Test Equipment		Cal Due
DVM:	SDC-UD-13	5/80
Gauge:	SQS-P-76	6/80

RECORDER CHECK

INPUT VDC	O/D Desired	Actual
1.000	20	20
2.000	40	40
3.000	60	60
4.000	80	80
5.000	100	100
3.000	60	60
1.000	60	0
	0	

MULTIPLIER DIVIDER CHECK

INPUT VDC	OUTPUT Desired	Actual
1.000	1.000	.998
2.000	3.000	2.996
3.000	3.828	3.829
4.000	4.464	4.468
5.000	5.000	5.005
3.000	~~3.282~~ 3.828	3.829
1.000	1.000	.998

TRANSMITTER CHECK

Simulated Inches	Volts Desired	Actual
0	1.005	1.005
157	2.000	2.006
314	3.000	3.005
471	4.000	4.004
628	5.000	5.006
314	3.000	3.005
0	1.000	1.005

100" H_2O

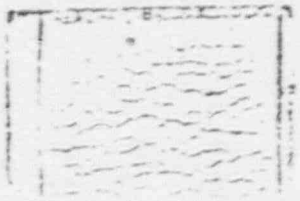
200" H_2O

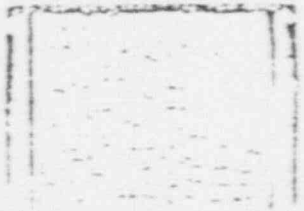
"A" Cont. Spray Suction Flow
4/27/30 V. Jacob
E. Ferreira

150" H_2O

100" H_2O

50" H_2O





Data Sheet 4.4

Test Equipment		Cal Due
DVM:	SDC-VO-18	5/80
Source:	SQC-127	6/80

Recorder Check

Input VDC	% Desired	Actual
0	0	0
2.50	25	25
5.00	50	50
7.50	75	75
10.00	100	100
5.00	50	50
0	0	0

Demodulator Check

Simulated Inches	Recorder Input Desired	Actual
0	0	.002
50	2.50	2.481
100	5.00	4.980
150	7.50	7.487
200	10.00	10.005
100	5.00	4.998
0	0	.002

Demodulator Dials

Zero	1.87
Span	6.00

(11)

Data Sheet 4.5

Test Equipment		Cal Due
DVM:	SQL-VO-18	5/80
Gauge:	SQC-P-94	6/80

Recorder Checks

Input VDC	o/p Desired	Actual
1.000	20	21
2.000	40	40.5
3.000	60	60.5
4.000	80	80
5.000	100	100
3.000	60	60.5
1.000	20	21

Multiplier / Divider Checks

Input VDC	Output Desired	Actual
1.000	1.000	1.006
2.000	3.000	3.014
3.000	3.828	3.845
4.000	4.464	4.480
5.000	5000	5.014
3.000	3828	3.844
1.000	1.000	1.006

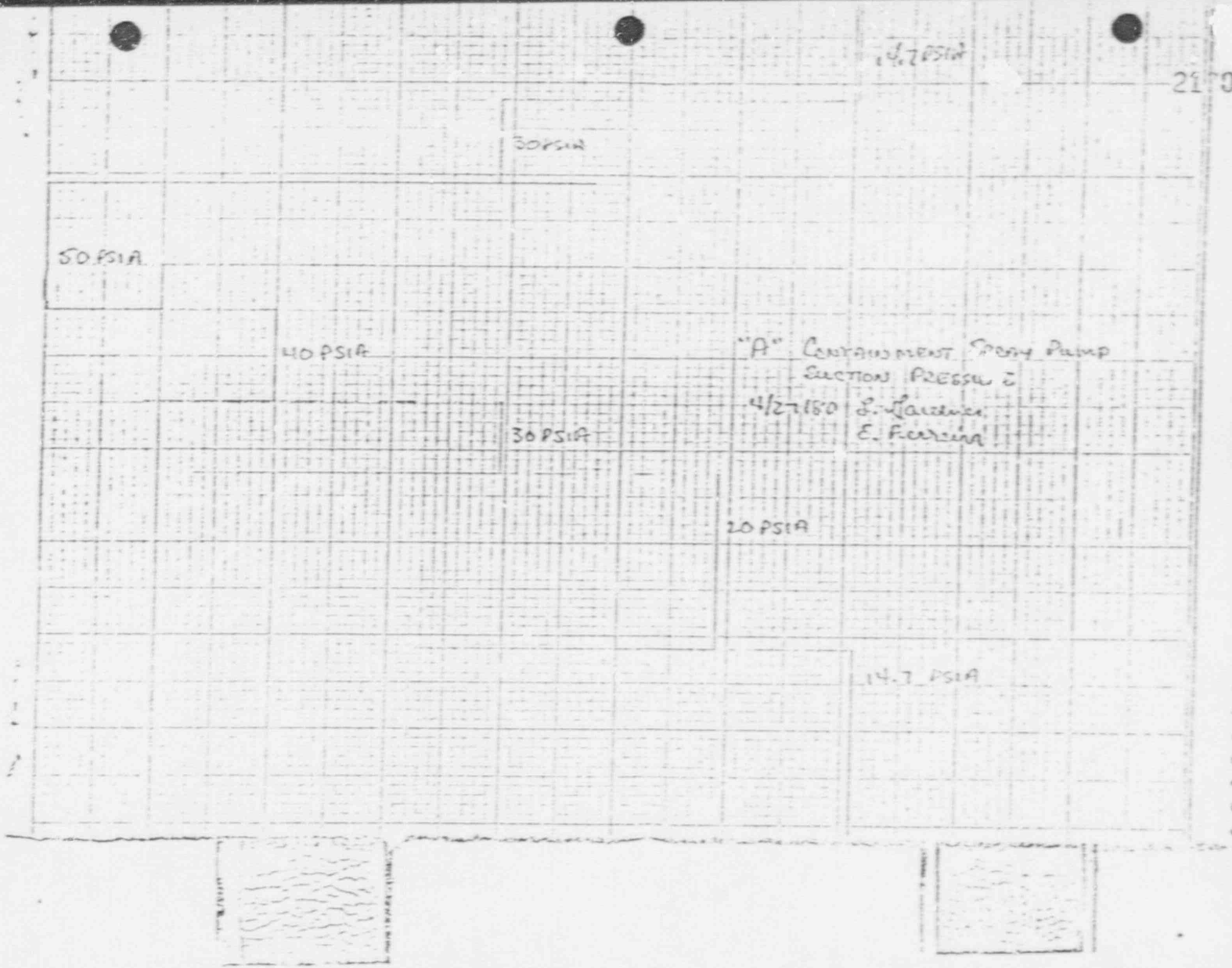
Transmitter Demodulator Checks

Simulated Inches	m/o Desired	Input Actual
0	1.000	.998
87.5	2.000	2.000
175.0	3.000	2.999
262.5	4.000	4.005
350.0	5.000	5.005
175.0	3.000	2.999
0	1.000	998

Demodulator Dials

Zero	NA
Span	NA

Readout 1152
S/N 115724



"A" Containment Spray Pump
Suction Pressure
4/27/80
14.7 PSIA
30 PSIA
50 PSIA
40 PSIA
30 PSIA
20 PSIA
14.7 PSIA

(17)

Data Sheet 4.6

Test Equipment		Cal Date
DVM:	SDC-VD-18	5/80
Gauge:	SDC-P-43	5/80

Recorder Check

Input VDC	% Desired	Actual
0	0	0
1.00	20	20
2.00	40	40
3.00	60	60
4.00	80	80
5.00	100	100
2.00	20	20
0	0	0

Bridge Amplifier Check

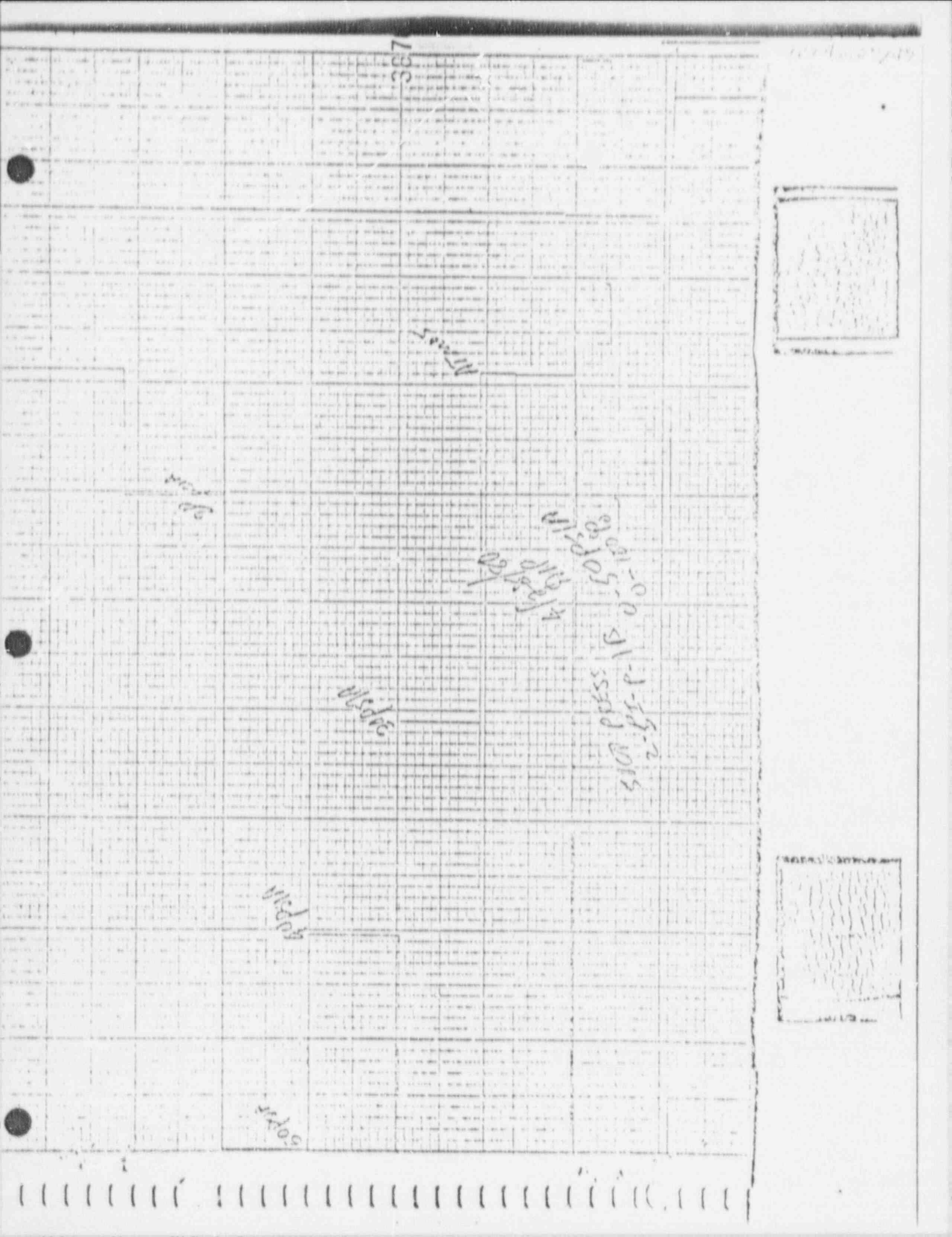
Simulated PSIA	Recorder Imp. at Desired	Actual
14.7	2.94 ~~7.47~~ FS	2.936
20	4.00 ~~2.00~~ FS	4.116
30	6.00 ~~3.00~~ FS	6.053
40	8.00 ~~4.00~~ FS	8.010
50	10.00 ~~5.00~~ FS	10.007
30	6.00 ~~3.00~~ FS	6.117
14.7	2.94 ~~7.47~~ FS	2.934

Bridge Amplifier Dials

% Full Load	100
Calibrate	3.53

Zero Suppression Coarse +1 Vernier 2.12

~~Cont~~



12942 07/19

Data Sheet 4.7

Test Equipment		Cal Due
DVM :	SQC-VO-13	5/80
Gauge :	SQC-P-76	6/80

Recorder Check

Input VDC	% Desired	Actual
0	0	0.5
1.00	20	20.5
2.00	40	40
3.00	60	60
4.00	80	80
5.00	100	100
3.00	60	60
0	0	0.5

Bridge Amplifier Check

Simulated PSIA	% Desired	Actual
14.7	~~1.47~~ 29.2	29
20	~~2.00~~ 40	41
30	~~3.00~~ 60	61
40	~~4.00~~ 80	81
50	~~5.00~~ 100	100
30	~~3.00~~ 40	41
14.7	~~1.47~~ 29.2	29

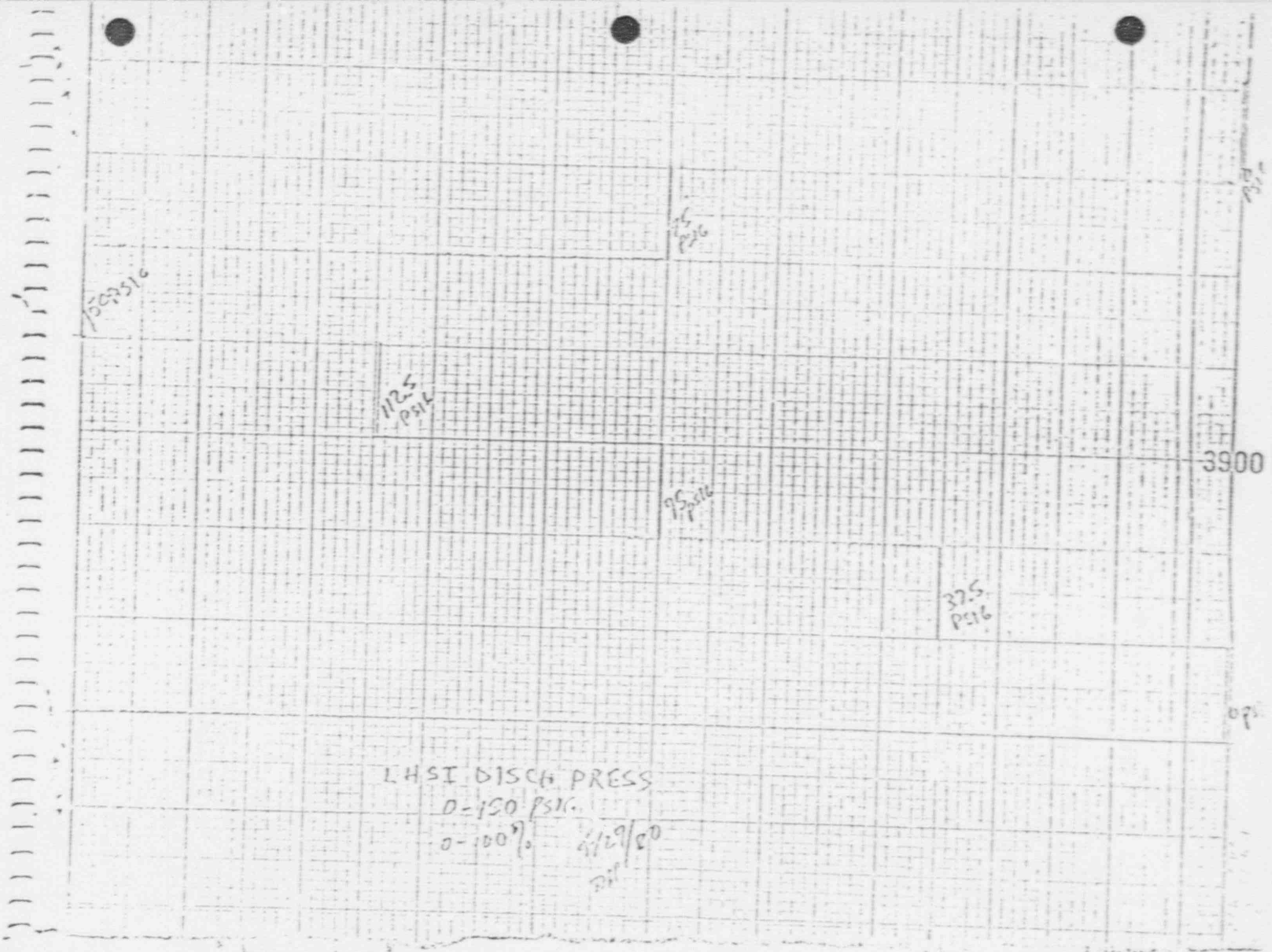
Bridge Amplifier Dials

% Full Load 100

Calibrate 6.82

Zero Suppression Coarse 4.01 Vernier 050

5



1500 PSIG
112.5 PSIG
75 PSIG
95 PSIG
37.5 PSIG
3900
LHSI DISCH PRESS
0-150 PSIG
0-100%

Data Sheet 48

Test Equipment		Cal Due
DVM:	SDC-40-18	5/80
Comp:	SDC-P-8	7/80

Recorder Check

Input VDC	% Desired	Actual
0	0	0
2.50	25	25
5.00	50	50
7.50	75	75
10.00	100	100
5.00	50	50
0	0	0

Demodulator Check

Simulated Inches	Recorder % Desired	Input Actual
0	0	.5
~~30~~ 37.5	~~0~~ 25	25
75	5.00 50	50
112.5	7.50 75	74.5
150	~~10.00~~ 100	100
75	5.00 50	50
0	0	.5

Demodulator Dials

Zero 0

Span 4.05

Rcvr OFFSET -0.12

FIG. 5.6.12A

FINAL DESIGN IMPLEMENTATION AND TESTING

SURRY POWER STATION

VIRGINIA ELECTRIC AND POWER COMPANY

1	2
	DESIGN CHANGE NO: 77-9/P-10-U2
DESIGN CHANGE TITLE: CONTAINMENT SPRAY CHEMICAL ADDITION FLOW AND LHSI VENTURI FLOW VERIFICATION TEST	4 UNIT NO: 2

3 DESIRED IMPLEMENTATION DATE:

5 FINAL DESIGN CONTROLLING PROCEDURE:

6 PROCEDURE SHALL CONSIST OF: 1. PURPOSE; 2. INITIAL CONDITIONS; 3. PRECAUTIONS; 4. INSTRUCTIONS;

☐ COPY ATTACHED

7 FINAL DESIGN TESTING:

PROCEDURE SHALL CONSIST OF: 1. PURPOSE; 2. INITIAL CONDITIONS; 3. PRECAUTIONS; 4. INSTRUCTIONS; 5. ACCEPTANCE CRITERIA.

COPY ATTACHED: ☐ MECHANICAL TESTING ☐ ELECTRICAL TESTING ☐ INSTRUMENT TESTING ☐ CHEMICAL TESTING

8 FINAL DESIGN CONTROLLING AND TESTING PROCEDURES:

9 SUBMITTED BY PROJECT ENGINEER: James A Veil	10 DATE: 4-23-80
11 REVIEWED BY DESIGN CONTROL ENGINEER: [signature]	12 DATE: 4-24-80
13 RECOMMENDED APPROVED BY SUPERVISOR-ENGINEERING SERVICES: M. P. Lowicki	14 DATE: 4-25-80
15 REVIEWED BY QUALITY CONTROL: [signature]	16 DATE: 4-28-80
17 APPROVED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE: CHAIRMAN'S SIGNATURE: J L Wilson	18 DATE: 4/28/80

19 REMARKS:

ATTACH TO: FINAL DESIGN CONTINUING PROCEDURE / TESTING PROCEDURE: CS CHEMICAL ADDITION FLOW AND LHSI VENTURI FLOW VERIFICATION TEST | DESIGN CHANGE NO.: 77-9/P-10-U2

CONTAINMENT SPRAY CHEMICAL ADDITION FLOW AND LHSI VENTURI FLOW VERIFICATION TEST

1.0 PURPOSE

1.1 The purpose of this procedure is to verify that the Chemical Addition Tank Flow Rate and the Cold Leg Low Head Safety Injection Flow Rate is within design values.

2.0 REFERENCES

2.1 OP-7.1 Safety Injection System
2.2 OP-7.2 Containment Spray System
2.3 OP-4.1 Controlling Procedure for Refueling

2.4 Drawings

2.4.1	11548-FM-89A & B	Valve Operating Numbers, Safety Injection System
2.4.2	11548-FM-84A	Valve Operating Numbers, Containment and Recirculation Spray System
2.4.3	11448-FKS-11	Valve Operating Numbers DC-77-9

3.0 SPECIAL EQUIPMENT

3.1 Temporary test piping per DC-77-9
3.2 Multi-Channel Recorder per Attachment IV

4.0 INITIAL CONDITIONS

INITIALS/DATE

JN / 4-30-80 4.1 Containment Spray Hydro and Flush complete (DC-77-09/P-2-U2).

JN / 4-30-80 4.2 LHSI 100 hr test complete. (DC-78-S35/P-2-U2).

[illegible] / 4-30-80 4.3 Review of existing tags on LHSI and CS systems has been performed and any requiring removal have been so removed.

[illegible] / 4-30-80 4.4 Communications established and tested between control room and containment refueling cavity and data takers.

[illegible] / 4-30-80 4.5 Refueling water storage tank and Chemical Addition Tank available and filled with refueling water to a level of 55 ft 6 in elevation or greater. Level must be at an even 6 in interval of elevation.

[illegible] / 4-30-80 4.6 Shift Supervisor has authorized commencement of this test.
SHIFT SUPERVISOR

JN / 4-30-80 4.7 Radiation Work Permist issued RWP No. 966.

JN / 4-30-80 4.8 Part I of Attachment I complete.

INITIALS/DATE

4.0 INITIAL CONDITIONS (CONT'D)

4.9 QC HOLD (STATION)

Safety Injection System is available for service per OP-7.1. Completed O.P. forms verified and deviations noted on this procedure. (NOTE ATTACHED COPY OF PROCEDURE DEVIATION FOR OP. 7.1)

4.10 QC HOLD (STATION)

Containment Spray System is available for service per OP-7.2 Completed OP forms verified and deviations noted on this procedur (NOTE ATTACHED COPY OF PROCEDURE DEVIATION FOR OP-7.2)

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Personnel performing this procedure shall read and be thoroughly familiar with its contents. Sign attached signature list (Attachment II).

5.2 Personnel not directly connected with the test will be excluded from the test areas.

6.0 PROCEDURE

6.1 Preparation

NOTE: Steps 6.1.1 through 6.1.6 may be performed out of sequence

6.1.1 Sample water in RWST (2-CS-TK-1) and CAT (2-CS-TK-2) perform chemical analysis and record results:

	REQUIRED VALUES	ACTUAL VALUES RWST	ACTUAL VALUES CAT
pH	@25 °C 4.0 - 5.6	4.33	6.73
C_B	< 3000	2163	1845
Cl	0.15 ppm (max)	<.05	.66
F	0.15 ppm (max)	<.1	<.1

6.1.2 QC HOLD

Install and calibrate instrumentation per Attachment IV. VERIFY Attachment IV complete.

6.1.3 Install spectacle flange in the "blank" position downstream of check valve 2-CS-13.

6.1.4 Remove bonnet internals from check valve 2-CS-13 and install the test piping per DC-77-9.

TESTING PROCEDURE:
INITIALS/DATE

6.0 PROCEDURE (CONT'D)

INITIALS/DATE	Step	
4/??/80 REFUELING SUPERVISOR	6.1.5	Perform or verify as being performed OP-4.1 steps which shall permit cavity flooding.
	NOTE:	The refueling cavity will be filled using this test procedure inlieu of OP-7.1.
4/30/80	6.1.6	Close the following valves: 2-CS-MOV-2033 & D; 2-CS-116
4-30-80	6.1.7	Open the following valves: 2-CS-MOV-202B; 2-SI-307 (Suction transducer); 2-CS-126; 2-CS-118; 2-SI-259; 2-SI-308; 2-SI-309; 2-CS-117

6.2 Chemical Addition Tank Flow Verification

NOTE: The following steps will start the "B" Train Safety Injection Pump and "A" Containment Spray pump, pumping into the refueling cavity. The Containment Spray must be stopped at the 27' 6" mark of the refueling cavity. The Safety Injection pump will be stopped at an earlier point in the test.

INITIALS/DATE	Step	
4/30/80 (Co-Ordy)	6.2.1	Perform instrument check to verify control settings as applicable per calibration data sheets. Verify sufficient paper is on recorder for test.
	NOTE:	The above 6.2.1 step must not be performed more than four (4) hours prior to commencement of the test.
4-30-80	6.2.2	Start the recorders and the following pumps and open the following valve. 2-CS-P-1A (CS pump "A"); MOV-CS-2013 CS pump disch. valve.
4-30-80	6.2.3	Place CS flow transducer in service and throttle the valve in the temporary CS test piping until a flow of 2000 gpm ± 100 gpm is achieved as read on the test flow recorder.

ATTACH TO: FINAL DESIGN CONTINUING PROCEDURE: CS CHEMICAL ADDITION FLOW AND LHSI VENTURI FLOW VERIFICATION TEST | DESIGN CHANGE NO.: 77-9/P-10-02

EXISTING PROCEDURE:

INITIALS/DATE

6.0 PROCEDURE (CONT'D)

6.2.4 LHSI Flow Verification

6.2.4.1 Start LHSI pump 2-SI-P-1B and open MOV-SI-2390C.

6.2.4.2 Start official time and data taking per Attachment III. Continue to take data at one (1) minute intervals.

6.2.5 As the refueling water storage tank level reaches a point 6'-6" below the CAT level:

6.2.5.1 Restart official time and data taking per Attachment III.

6.2.5.2 Open MOV-CS-203D CAT isolation valve.

6.2.6 Stop the LHSI pump 2-SI-P-1B after an elapsed time of 13 minutes on the official stop watch.

6.2.7 When refueling cavity is full, stop the CS pump 2-CS-P-1A and close MOV-CS-201B, and MOV-CS-203D.

6.2.8 Label the recordings made during this test with the procedure numbers, date, time and amplitude scales. The recordings shall be placed in an envelope that shall be kept with the Master Copy of this procedure.

6.3 Acceptance Criteria

6.3.1 This test shall be acceptable if the level and flow parameters meet the requirements of the pre-test report of 2/26/80.

___/___ 6.3.2 Results acceptable.

6.4 Restoration

___/___ 6.4.1 Drain and remove the test piping installed in step 6.1.4. Reinstall bonnet and internals in check valve 2-CS-13.

___/___ 6.4.2 Reinstall the spectacle flange in the "OPEN" position downstream of check valve 2-CS-13.

___/___ 6.4.3 Remove test instrumentation per Attachment IV.

NOTE: If CS test piping is required for the Engineered Safety Features Functional Test, do not perform steps 6.4.1, and 6.4.2.

___/___ 6.4.4 Part II of Attachment I complete.

Completed By: _____

Date: _____

ATTACHMENT 1

ATTACHMENT 1

ZONE III - Fuel Building Containment Safety-Related Work Areas.

PART I - Before starting and during the course of the job.

INITIALS		
VM	A.	Suitable trash containers, such as poly bags or metal containers are at the job site.
N/A	B.	Combustible materials have been removed from the area if burning or welding operations are to be performed.
N/A	C.	Clean and dirty areas for storage of materials have been set up especially when working on Safety-Related System.
N/A	D.	Clean exterior surface of components free of foreign debris, especially Boric Acid Residue.
N/A	E.	Establish accountability log for control of tools and equipment entering the clean area if a possibility exists that this material might inadvertantly enter any system.
N/A	F.	The surrounding area should be adequately protected.
N/A	G.	Installation of plugs, caps, or tethering of tools shall be used to prevent foreign material from entering systems.
N/A	H.	The housekeeping requirements shall be periodically checked by either First Line Supervision or QA.

PART II - After the completion of the job.

INITIALS		
	A.	Ensure removal of all material from the system (tank, pipe, etc.) prior to closing out the system.
	B.	All unused materials have been removed.
	C.	Equipment and tools have been removed.
	D.	Ensure accountability of all tools and equipment upon their removal by use of a log designated for that purpose.
	E.	The trash collection containers have been removed.
	F.	The final job site clean up and/or decon has been performed.

FINAL DESIGN TESTING
SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

ATTACH TO: FINAL DESIGN CONTINUING PROCEDURE CS CHEMICAL ADDITION FLOW AND LHSI VENTURI FLOW VERIFICATION TEST | 77-9/P-10-02

ATTACHMENT II

SIGNATURE LIST

SIGNATURE	DATE
Joseph M. Pickrell Jr.	4/30/80
[illegible]	4/30/80
William B. [illegible]	4/25/80
[illegible]	4/30/80
[illegible]	4/30/80
[illegible]	4/30/80
[illegible]	4-30-80
[illegible]	4-30-80

ATTACH TO FINAL DESIGN CONTINUING PROCEDURE: CS CHEMICAL ADDITION FLOW AND LHSI VENTURI FLOW VERIFICATION TEST | DESIGN CHANGE NO.: 77-9/P-10-112

EXISTING PROCEDURE:

ATTACHMENT III

1. Data Takers

Chemical Addition Tank Level [illegible]

Refueling Water Storage Tank Level [illegible]

Containment Spray Pump Disch. Press [illegible]

LHSI Suction Pressure [illegible]

LHSI Pump Flow Rate [illegible]

LHSI Pump Disch. Pressure [illegible]

RWST Temperature [illegible]

CAT Temperature [illegible]

CS Pump Suction Jet. Head [illegible]

LHSI Venturi Downstream Pressure A [illegible]

B [illegible]

C [illegible]

2. Initial Tank Parameters

Refueling Water Storage Tank Temperature 28°C °F

Chemical Addition Tank Temperature 23°C °F

Refueling Water Storage Tank Specific Gravity 1.002

Chemical Addition Tank Specific Gravity 1.0025

3. Data to be taken at one minute intervals during run;

TIME	CAT LEVEL	RWST LEVEL	C.S. PP. DISCH. P. PSIG	LHSI PP SUCT. P. PSIA	LHSI FLOW VOLTS	LHSI PP DISCH. P.	CS. PP. JCT. P.	ΔP CAT LINE ORIFICE	LHSI LEG A PSIG	LHSI LEG B PSIG	LHSI LEG C PSIG
0	57'11½"	56'6¼"	123	45.8	3.76	** 8.2	57' 10¼"	*			
1	57'11½"	56'3⅛"	123	43.0	3.76	16.1	54' 9⅝"		25	30	27
2	57'11½"	55'8"	122	43.8	3.74	19.6	54' 2¾"		29	29.5	28
3	57'11½"	55'0⅛"	122	44.4	3.73	20.2	53' 5⅛"		31.2	30.6	28.5
4	57'11½"	54'4¾"	123	43.7	3.69	20.6	52' 11⅜"		32.6	31.3	28.6
5	57'11½"	53'7¼"	123	42.1	3.74	20.6	52' 3¾"		34.1	30.9	27.5
6	57'11½"	53'1¾"	123	42.4	3.70	21.2	51' 8¼"		34.6	31.6	30
7	57'11½"	52'6¼"	123	41.6	3.66	21.4	51' 1⅝"		35	30	31
8	57'11½"	51'10⅛"	123	41.4	3.74	21.4	50' 4⅞"		35.8	31.6	31
0		51'4¼"	123	39.7	3.77	—					
1	57'3¾"	50'4¾"	123	39.7	3.77	21.6	49' 0⅛"	—	37.0	32.0	32.
2	56'11"	49'9⅛"	122	41.7	3.81	21.8	48' 4⅝"	* 80"	37.0	33.0	33.1
3	56'6"	49'1¾"	122	40.1	3.77	21.9	47' 9⅛"	—	37.3	33.0	33.4
4	56'0¼"	48'6¼"	123	40.9	3.66	21.9	47' 1⅞"	—	37.4	34.5	31.6
5	55'7⅛"	47'10¾"	123	41.3	3.5	22.0	46' 6⅜"	85"	37.6	34.4	32.0
6	55'2¼"	47'3¼"	123	39.5	3.75	22.2	45' 10⅞"	87"	38.2	34.5	32.6

* ΔP ORIFICE READINGS OSCILATED ± 2" - LAST 15 READINGS ± 1"

** LHSI DISCH PRESSURE GAGE NOT CORRECT

3. Data to be taken at one minute intervals during run:

TIME	CAT LEVEL	RUST LEVEL	C.S. PP. DISCH. P.	LHSI PP SUCT. P. SUCT. P.	LHSI FLOW	LHSI PP DISCH. P.	CS. PP. JCT. P.	ΔP CAT LINE ORIFICE	LHSI LEG A	LHSI LEG B	LHSI LEG C
7	54'8 3/4"	46'7 1/2"	123	39.7	3.83	22.4	45'5 1/4"	89"	38.5	34.8	32.5
8	54'3 1/4"	46'0"	123	37.6	3.99	22.6	44'7 3/4"	90-91"	38.5	34.5	32.5
9	53'10"	45'4 1/2"	123	40.2	3.69	22.7	44'0 1/4"	92"	38.5	34.8	32.6
10	53'4 5/8"	44'8 3/4"	123	38.4	3.79	22.8	43'4 3/4"	94"	38.7	35.1	33.0
11	52'10 3/8"	44'1 1/2"	123	40.4	3.77	23.0	42'9 1/4"	95"	39.1	35.5	33.8
12	52'5"	43'5 3/4"	123	38.8	3.99	23.1	42'1 5/8"	96.5"	39.9	35.8	34.0
13	51'11 1/2"	42'10 1/2"	123	37.1	3.77	23.2	41'6"	98"	40.1	36.2	34.1
14	51'5 1/2"	42'2 1/2"	120	37.6	3.88	23.3	40'10 3/4"	99"	40.2	36.5	34.3
15	50'11 7/8"	41'7"	120	38.1	3.71	23.4	40'4"	—	40.6	36.8	34.4
LHSI 2-51-P-10 OFF 16	50'6"	40'11 1/2"	118	37.6	3.45	23.4	39'8 1/2"	—	40.7	36.8	34.4
17	50'0 3/5"	40'8 5/8"	118	4446	0.99	pump starts	39'5 1/4"	—	30.5	28.5	24.0
CAT ORIFICE ON 18	49'6 3/8"	40'5 7/8"	117	44.32	1.000		39'2 3/8"	—	28.2	25.2	24.6
19	49'0 3/5"	40'3"	116	44.22	↓		38'11 1/2"	95"	27.1	25.5	25.8
20	48'7 1/8"	40'0 1/8"	116	44.13			38'8 3/4"	93"	26.6	25.5	26.0
21	48'1 3/4"	39'9 3/8"	116	44.00			38'6"	90"	26.5	25.5	25.9
22	47'8 1/8"	39'6 1/2"	116	43.91			38'3 1/4"	88.5"			
23	47'2 7/8"	39'3 3/4"	116	43.78			38'0 5/8"	87"			

3. Data to be taken at one minute intervals during [illegible]m;

TIME	CAT LEVEL	RUST LEVEL	C.S. PP. DISCH. P.	LHSI PP SUCT. P. SUCT. P.	LHSI FLOW	LHSI PP DISCH. P.	CS. PP. JCT. P.	ΔP CAT LINE ORIFICE	LHSI LEG A	LHSI LEG B	LHSI LEG C
24	46' 9 1/8"	39' 0 7/8"	116	43.67	1.000		37' 9 3/4"	95"			
25	46' 4"	38' 10"	116	43.56	↓		37' 7"	83"			
26	45' 11"	38' 7 1/4"	116	43.46			37' 4 1/4"	81"			
27	45' 5 1/8"	38' 4 1/8"	115	43.35			37' 1 1/8"	79"			
28	45' 0 1/4"	38' 1 5/8"	115	43.24			36' 10 1/4"	77.5"			
29	44' 7 1/4"	37' 10 1/4"	115	43.12			36' 8"	76"			
30	44' 2 1/4"	37' 8"	115	43.03			36' 5 1/8"	74.25"			
31	43' 9 1/4"	37' 5 1/4"	115	42.93			36' 2 1/4"	72"			
32	43' 4 1/8"	37' 2 1/4"	115	42.81			35' 11 1/2"	70.75"			
33	43' 0 1/8"	36' 11 1/8"	115	42.72			35' 8 5/8"	68.5"			
34	42' 7 1/8"	36' 8 1/8"	115	42.60			35' 5 7/8"	67"			
35	42' 2 1/8"	36' 5 1/8"	115	42.50			35' 3 1/4"	66"			
36	41' 10"	36' 3"	115	42.40			35' 0 5/8"	65"			
37	41' 5 1/8"	36' 1/2"	115	42.30			34' 10"	63.5"			
38	41' 0 1/8"	35' 9 1/4"	115	42.18			34' 7"	61.75"			
39	40' 8 1/4"	35' 6 1/8"	115	42.08			34' 4 1/2"	60.25"			
STOP CS FLOW 40	40' 3 1/4"	35' 3 1/8"	115	41.9			≈34' 1 3/4"	59"			

RWST = 14%
Rx Cav ≈ 23 1/2'

TEST INSTRUMENTATION

ATTACHMENT IV

INITIALS/DATE

NOTE: The following may be performed in any order.

F.D.C. / [illegible] Connect a dual channel recorder (Gould 110 or equiv.) to the following instruments:

1) Chemical Addition Tank Level (LT-CS-201)
2) Refueling Water Storage Tank Level (LT-CS-200A)

NOTE: Recorder must be connected in series with the transmitter loop and a 250 ohm resistor.

F.D.C. / [illegible] Attach a 0-50 psia pressure transducer to the test valve installed in the Containment Spray Pump suction line at the Chemical Addition Line junction. This "junction pressure transducer" shall be connected to a dual channel recorder (Gould 110 or equiv.)

F.D.C. / [illegible] Attach a 1" tygon hose to the instrument connection on the junction pressure transducer, LT-CS-200A and LT-CS-201. These hoses shall be run vertically with metal tape scales for use as a level glass.

F.D.C. / [illegible] Attach a 0-200 in H_2O D/P transducer across the restrictive orifice in the CAT line. This "CAT LINE DROP" transducer shall be connected to the second channel of the dual recorder used for the junction pressure.

F.D.C. / [illegible] Attach a 0-150 psig pressure transducer to the discharge of LHSI pump LHSI pump 2-SI-P-1B at PI-2944. Connect this LHSI pump B discharge pressure transducer to a dual channel recorder (Gould 110 or equiv).

F.D.C. / [illegible] Attach a 0-50 psia pressure transducer on the suction of the "B" LHSI pump to the other channel of the recorder used for "B" LHSI pump discharge.

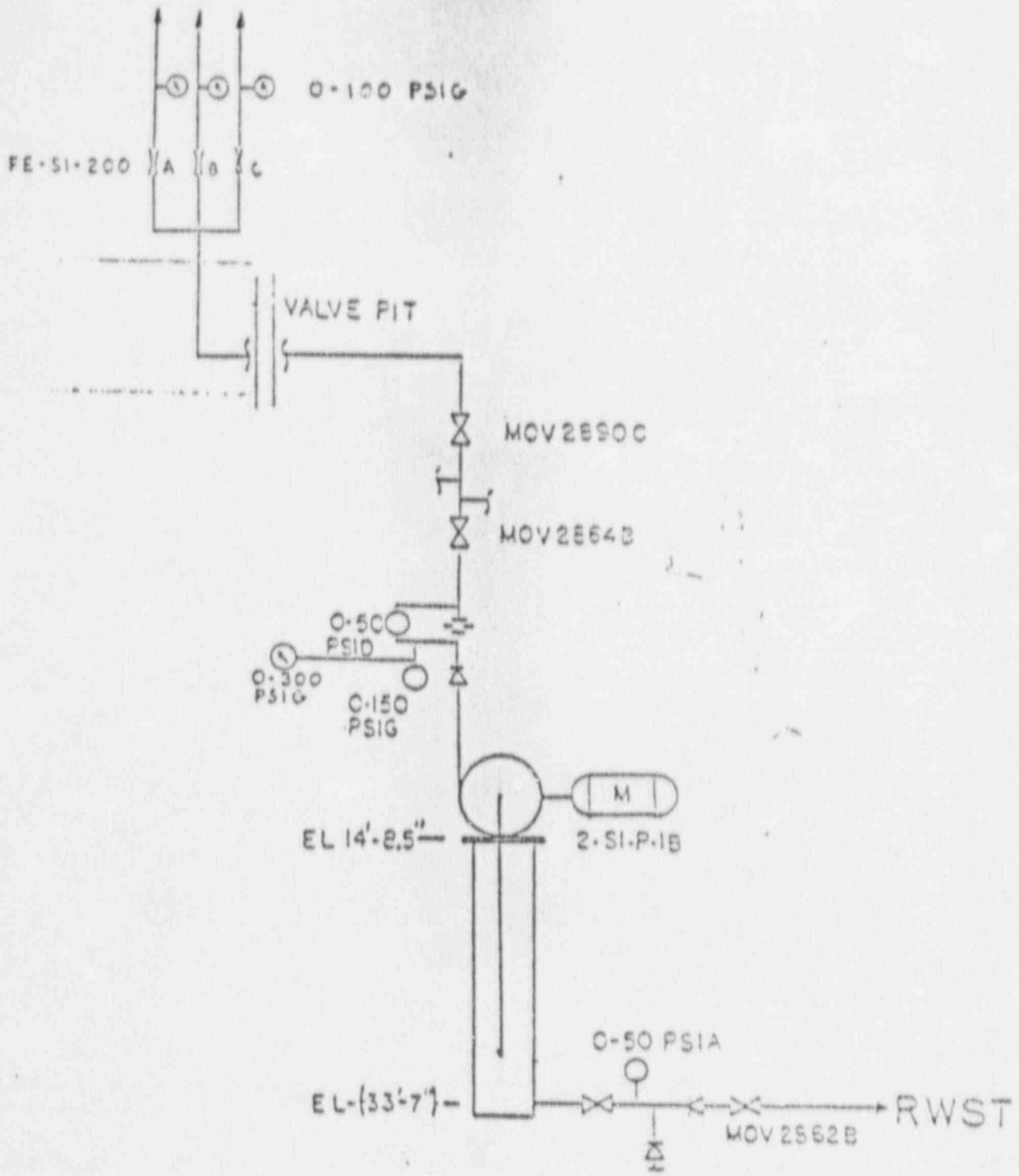
F.D.C. / [illegible] Attach recorder through square root converter to FT-2946 on discharge of LHSI pump "B".

F.D.C. / [illegible] Attach a 0-350 in H_2O differential pressure transmitter across the "A" CS test line flow element on the operating level of the containment. Connect this "CS FLOW" to the second channel of the recorder used for LHSI "B" flow. Connection shall be via a square root converter.

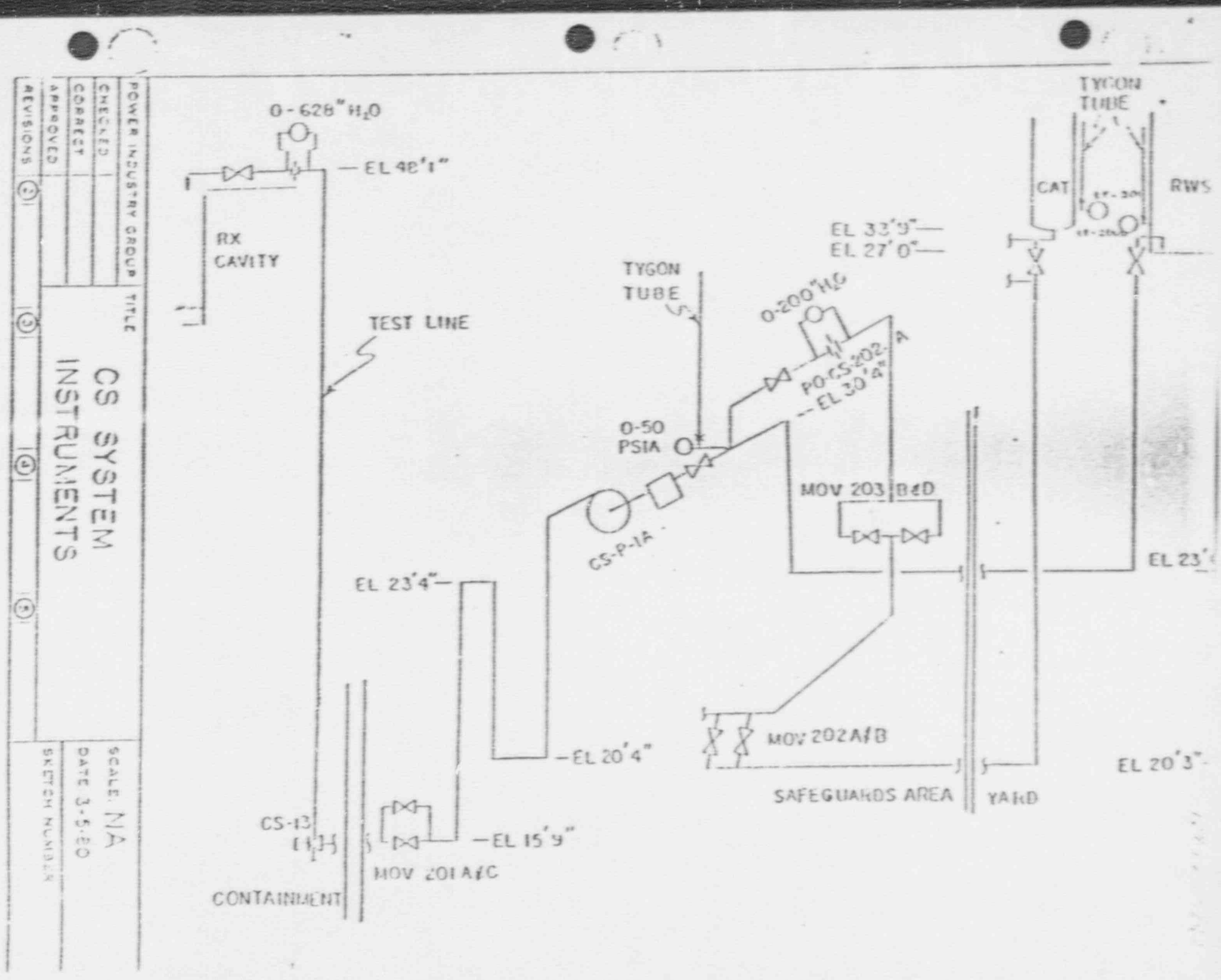
F.D.C. / [illegible] Connect recorder event markers together to a common push button control.

NOTE: Recorders shall be located in Safeguards Building on benches.

F.D.C. / [illegible] Upon completion of test, remove all test equipment installed above.



POWER INDUSTRY GROUP	TITLE		
CHECKED		SI SYSTEM INSTRUMENTS	SCALE: NA
CORRECT			DATE: 3-5-80
APPROVED			SKETCH NUMBER
REVISIONS (2)	(3)	(4)	(5)


0-628" H_2O
EL 48'1"
RX CAVITY
TEST LINE
TYGON TUBE
0-200"H2O
PO-CS-202
EL 30'4"
0-50 PSIA
CS-P-1A
MOV 203 B&D
EL 33'9"
EL 27'0"
TYGON TUBE
CAT
RWS
EL 23'4"
EL 20'4"
MOV 202A/B
SAFEGUARDS AREA
YARD
EL 20'3"
CS-13
MOV 201A/C
EL 15'9"
CONTAINMENT
POWER INDUSTRY GROUP
TITLE
CS SYSTEM INSTRUMENTS
CHECKED
CORRECT
APPROVED
REVISIONS
SCALE: NA
DATE 3-5-80
SKETCH NUMBER

VIRGINIA ELECTRIC AND POWER COMPANY

DATE: 4/25/80 | PROCEDURE NO.: OP 7.1 | UNIT NO.: 2

[illegible] ☒ YES ☐ NO

[illegible]: H.C. Crummey — DATE: 4/27/80

[illegible] SIGNATURE: Acting H.C. Crummey — DATE: 4/29/80

[illegible] SIGNATURE: [signature] — DATE: 4-30-80

DESCRIPTION OF DEVIATION:

STEP NO.	DEVIATION
NA	TV-SI-200 CLOSED VICE OPEN — TAGGED OUT
	2-SI-185 CLOSED VICE OPEN
	MOV-2864A CLOSED VICE OPEN - TAGGED OUT
	2-SI-303 CLOSED VICE OPEN - P.T. 16.4 TEST
	2-SI-345 OPEN VICE CLOSED - P.T. 16.4 TEST
	2-SI-320 CLOSED VICE OPEN - P.T. 16.4 TEST
	2-SI-377 NOT PERFORMED
	MOV-2864B CLOSED VICE OPEN

REASON FOR DEVIATION:

2-SI-185 NORMAL POSITION SHOULD BE CLOSED

2-SI-377 DOES NOT EXIST

MOV-2864B PROVIDES DOUBLE VALVE PROTECTION WHILE RCS IS AT ATMOS. TO PREVENT DRAINING RWST TO RCS

RETURN TO CLAY CRUMMEY AFTER SNSOC REVIEW

REVIEWED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE/APPROVED BY STATION MANAGER

[illegible]

[signature]

APPROVED BY STATION MANAGER — DATE: APR 30 1980

0 603.37

PROCEDURE DEVIATION
SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

DATE: 4-16-80	PROCEDURE NO.: 7.1	UNIT NO.: 2
IS PERMANENT CHANGE REQUIRED? ☐ YES ☒ NO		
OPERATOR'S SIGNATURE: [signature]		DATE: 4-16-80
SHIFT SUPERVISOR'S SIGNATURE: [signature]		DATE: 4/17/80
COGNIZANT SUPERVISOR'S SIGNATURE: [signature]		DATE:

DESCRIPTION OF DEVIATION:

STEP NO.	DEVIATION
2-SI-233	open vice closed
2-SI-199	closed vice open
NA	TV-2884 A, B, C closed vice open

REASON FOR DEVIATION:

2-SI-233 Tagged out

2-SI-199 Tagged out ALHSI

TV-2884 A, B, C - BIT is not being recirculated

RETURN TO CLAY CRUMMEY AFTER SNSOC REVIEW

REVIEWED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE:

CHAIRMAN'S SIGNATURE: J L Wilson   DATE: APR 17 1980

RECOMMENDATION: Approved

APPROVED BY STATION MANAGER: J L Wilson   DATE:

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PROCEDURE DEVIATION
SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

1 of 1

1 DATE: 4/24/80 | 2 PROCEDURE NO.: OP 7.2 | 3 UNIT NO.: 2

4 IS PERMANENT CHANGE REQUIRED? ☐ YES ☒ NO

5 REPORTED BY: T. Kunkle | DATE: 4/24/80

6 SHIFT SUPERVISOR'S SIGNATURE: [signature] | 7 DATE: 4/25/80

8 OPERATIONS SUPERVISOR'S SIGNATURE: [signature] | 9 DATE: 4/25/80

10 DESCRIPTION OF DEVIATION:

STEP NO.	DEVIATION
N.A.	2-CS-6 Tagged open to mechanics
	2-CS-8 Tagged open to mechanics
	2-CS-10 Tagged open to mechanics
→	2-CS-12 Line to pressure transmitter disconnected - NO equivalent installed
	MOV-CS-201C Tagged out to mechanics
	MOV-CS-201D Tagged out to mechanics
	2-CS-91 DOES NOT EXIST
↓	↓

11 REASON FOR DEVIATION: See above

RETURN TO CLAY COUNSEL AFTER SAFOS COMPLETED

12 REVIEWED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE/APPROVED BY STATION MANAGER

13 RECOMMENDATIONS/COMMENTS:

APPROVED BY STATION MANAGER: [signature] DATE: APR 30 1980