Reactor Containment Building Integrated Leak Rate Test

September 26, 1980

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Abstract

This report presents details of the Containment Integrated Leakrate Test successfully performed between June 15 and 20, 1980 at Zion Station, Unit 2. The test was performed in accordance with 10CFR50, Appendix J and the Zion Technical Specifications.

The containment integrated leakrate was found to be 0.007 weight %/day at a test pressure of 28 psig, well within the 0.0465 weight %/day acceptance criteria. The result at the 95% upper confidence limit was 0.019 weight %/day.

A leak of 0.036 weight %/day was imposed on the containment for the supplemental verification test. The instrumentation measured a combined leak of 0.053 weight %/day and 0.064 weight %/day at the 95% upper confidence limit. The difference between the measured combined leak and the imposed plus measured containment leak is 16% of the allowable containment leakrate. The acceptance criteria is that the difference be less than 25%. Thus, the supplemental verification test also meets the acceptance criteria.

Analysis and Interpretation of Type A Test Results

The statistical leakrate was scattered during the first 5 or 6 hours of the test due to the small number of data sets accumulated. The data started falling into place between the 7th and 8th hour of the test. The slope of the leakrate began to flatten out between the 9th and 10th hour of the test. (Event 1 graph 1) Therefore, it was concluded there was a leak out of the containment.

A few hours later the leak in the outer equalizing valve of the personnel air lock was discovered and plugged with a plumbers plug. (Event 2 graph 1) The slope of the leakrate dropped shortly thereafter. Two hours later, the leak in the escape hatch inner equalizing valve was discovered and stopped. (Event 3 graph 1) The leakrate continued to drop. Other points of suspected leakage were checked, but nothing was found leaking.

It was decided to begin a new "24-hour" ILRT when the escape hatch leak was stopped. It was started at data set 122 and graph 1-a was initiated. The leakrate dropped below the limit within 1½ hours and went negative two hours into the test. (Event 1 graph 1a) Then the plumbers plug was removed from the personnel hatch equalizing valve to see what effect it would have on the leakrate. (Event 2 graph 1a) As seen on the graph, the leakrate increased and was above the limit within 45 minutes. Six hours into the new test the plug was reinstalled. (Event 3 graph 1a) The leakrate turned around and was below the limit at 8.5 test hours. The leakrate continued to drop and was negative again at 9.5 test hours.

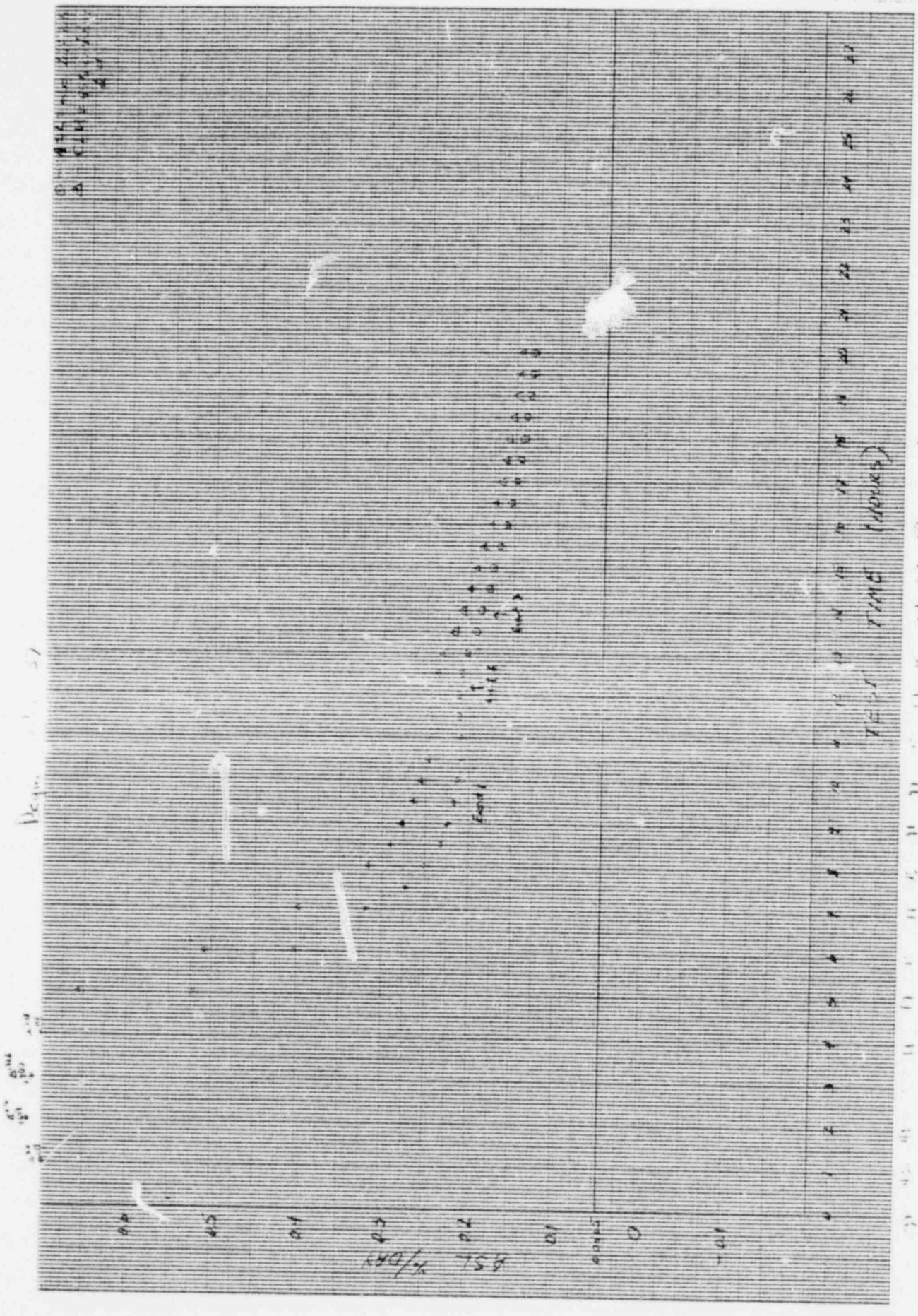
It was evident that the containment was experiencing some sort of mass addition which resulted in a negative leakrate. The sealing water supply between valve AOV-RV0005 and AOV-RV0006 was thought to be the source of the mass addition. The water supply was isolated to these valves at 14 hours test time. (Event 4 graph 1a) The leakrate turned towards a positive number again. Another new "24 hour" test was begun at this event.

Graph 1b is a plot of the final and successful ILRT. Eleven hours into the new test, constant leakrate results were appearing. The test was continued for one more hour to confirm the results being obtained. The test was terminated at hour 12 test time. Since the test had already been running much longer than 24 hours, the requirement to keep the containment pressurized longer than 24 hours had already been met.

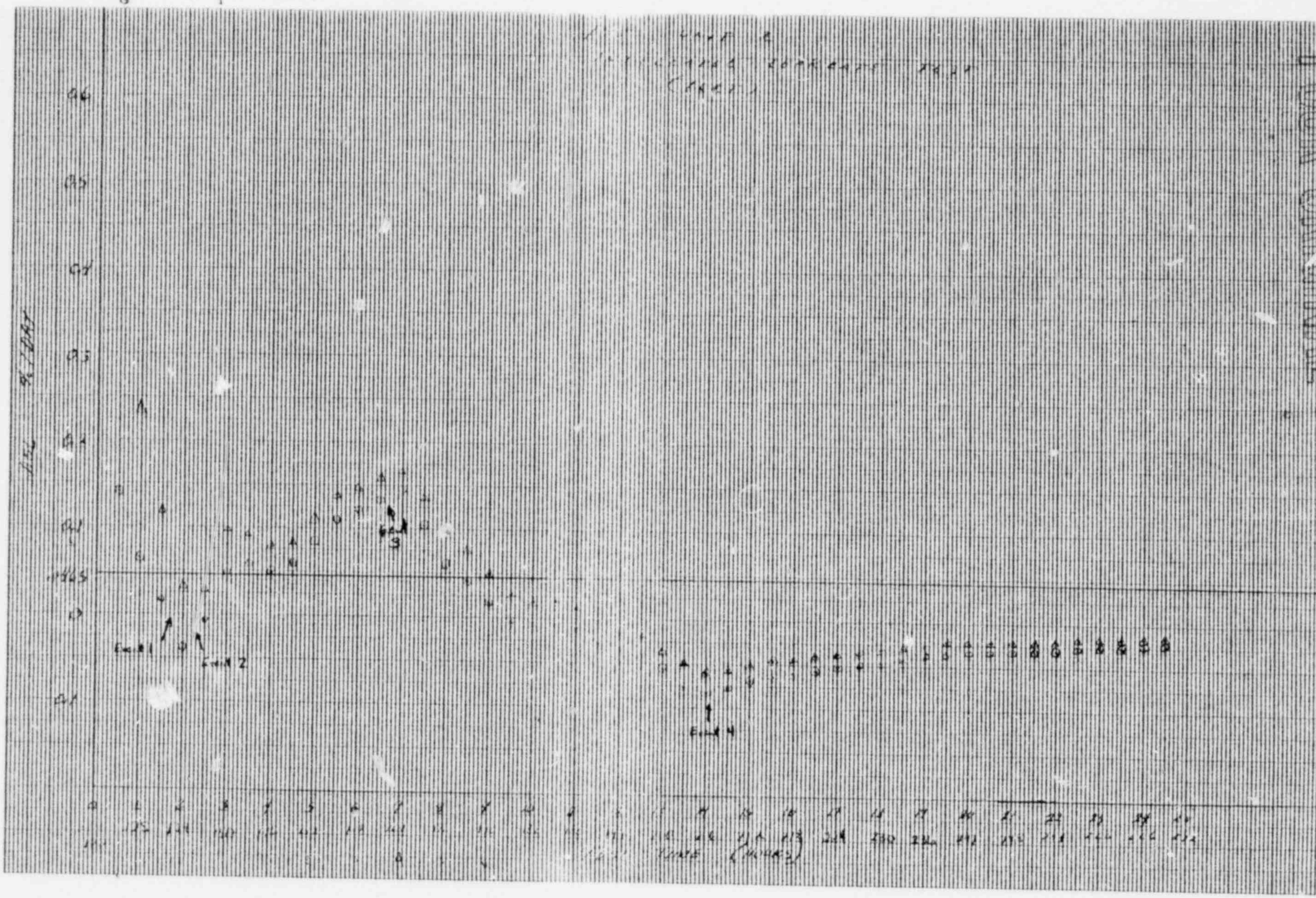
Twelve hours of data were sufficient to determine the leakrate of the containment.

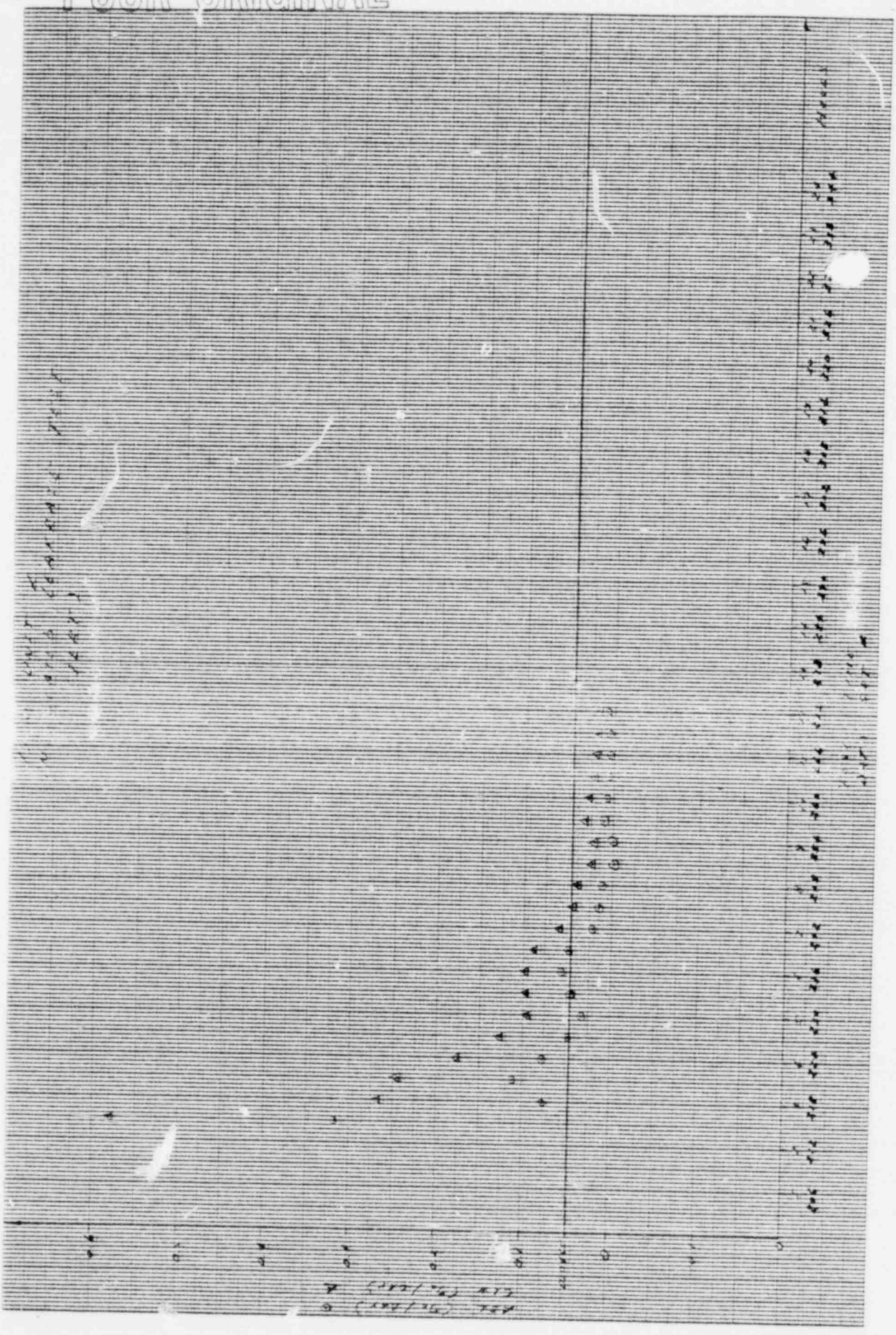
The water leakage past valve AOV-RV0005 was the source of the negative leak during the test. The volume between valves AOV-RV0005 and AOV-RV0006 was pressure tested during TSS 47 (IVSW Leak Test) with water and with air during a special IVSW test before the ILRT. Both tests indicated only a small amount of leakage past these valves. The containment leakrate was so small that the small amount of water leakage past AOV-RV0005 into the containment had a large effect on the test results.

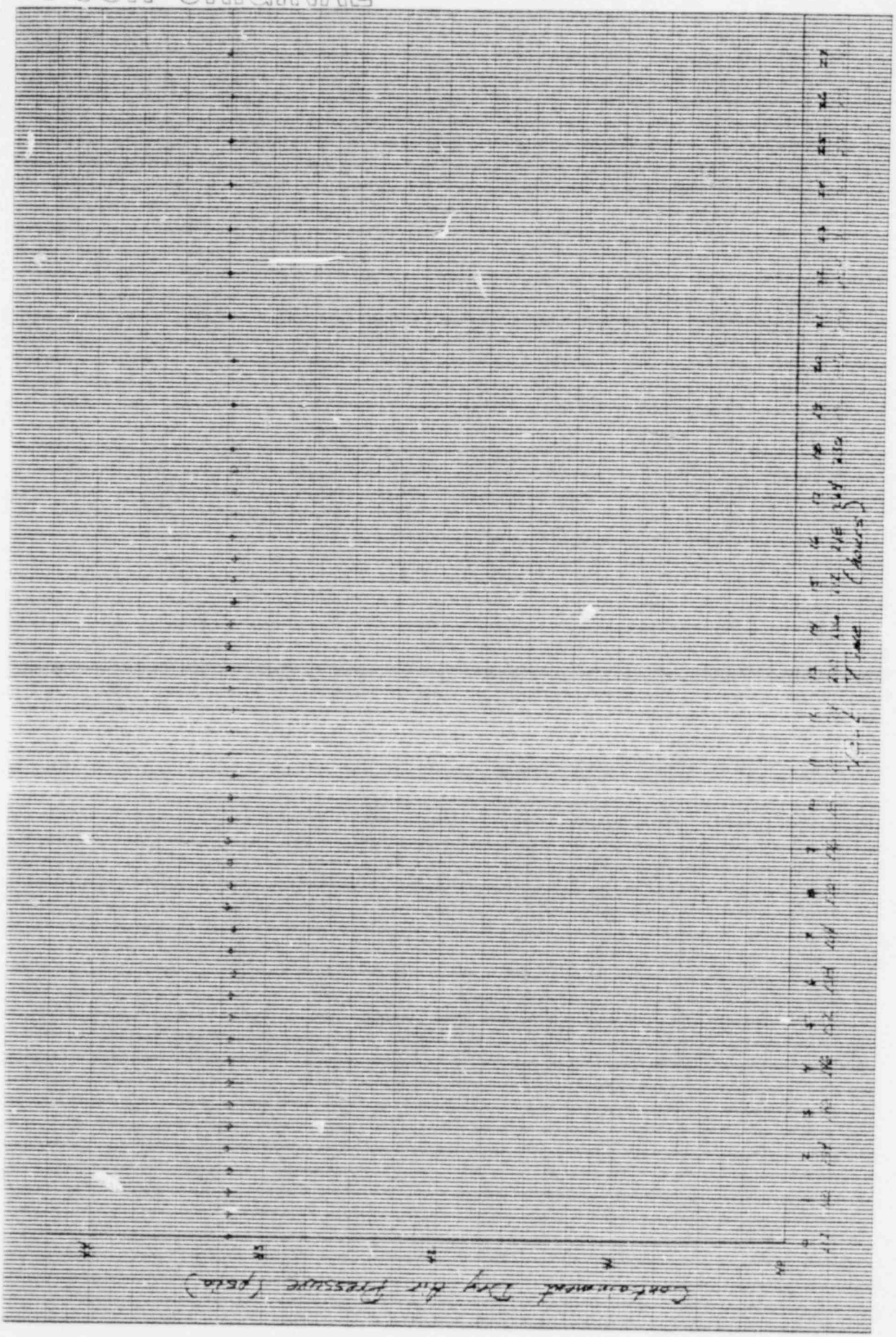
The Zion Unit 2 containment has a very small integrated leakrate. The leakrate measured during this test is nearly seven times less than the allowable leakage of the containment. When compared with the results of the last ILRT performed in February of 1977, the leakrate measured during this test is only .002% greater that the results of the previous test. It can be concluded that the U-2 containment has maintained its leaktight condition over the past 3 years.

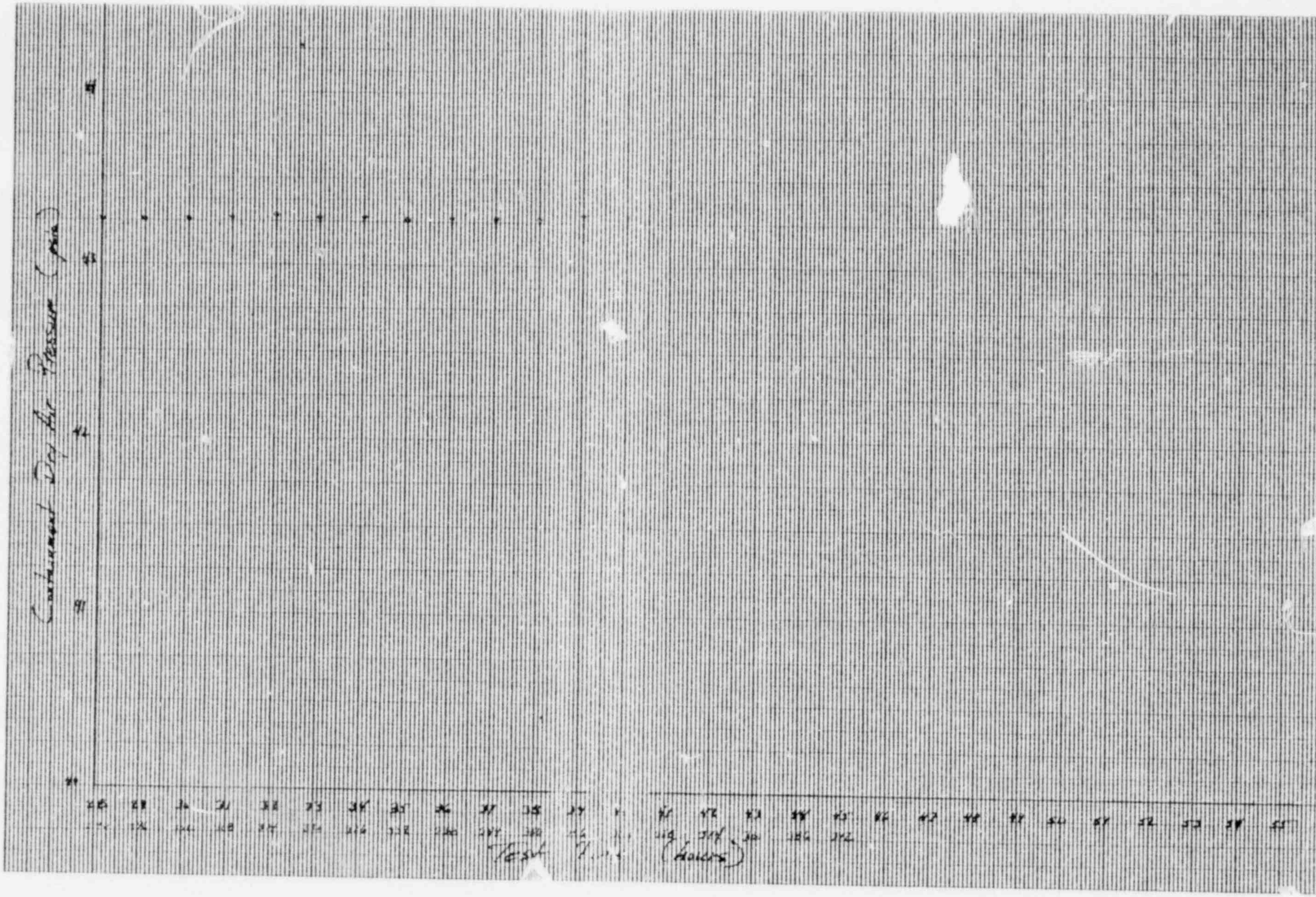


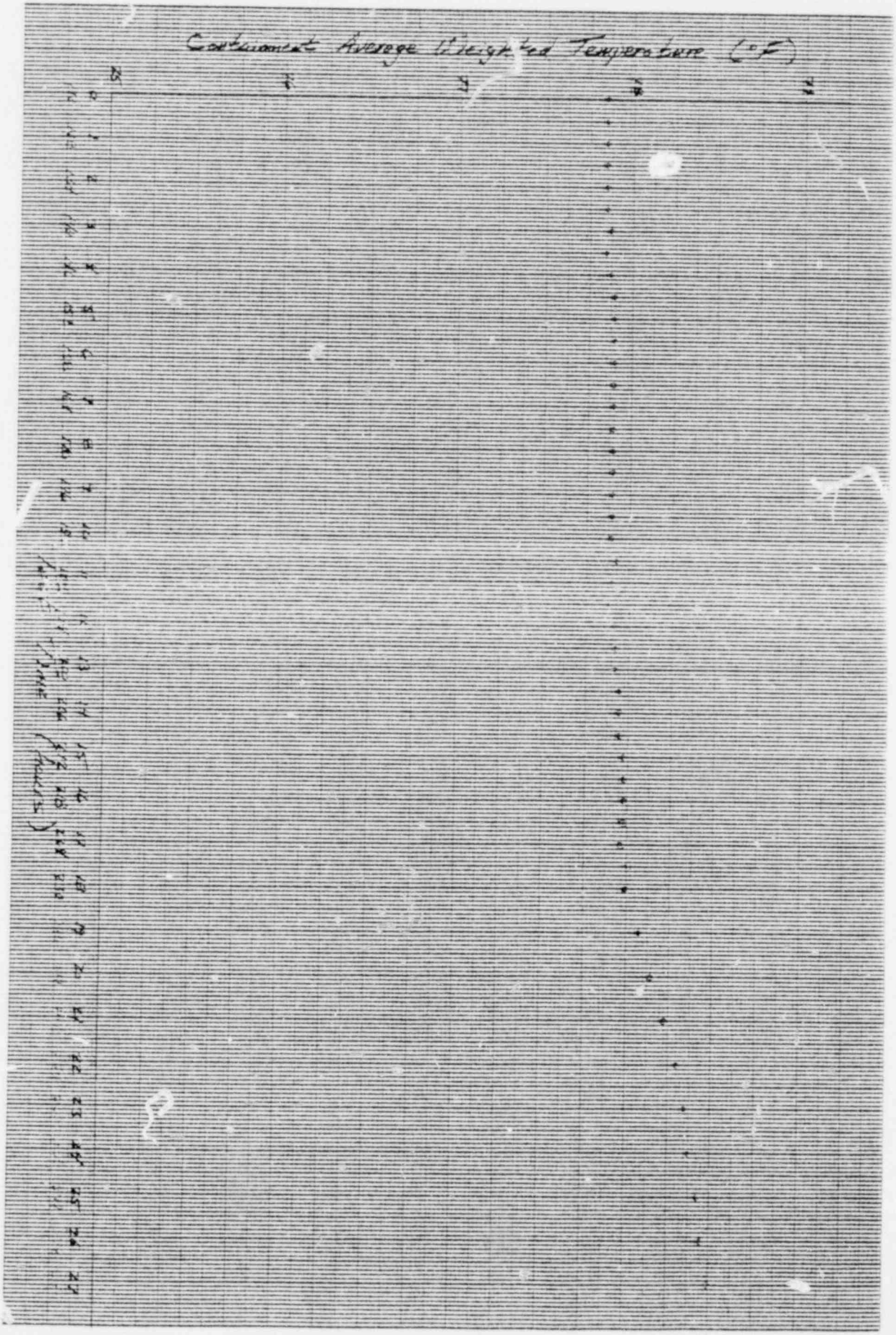
Begin DATA 122

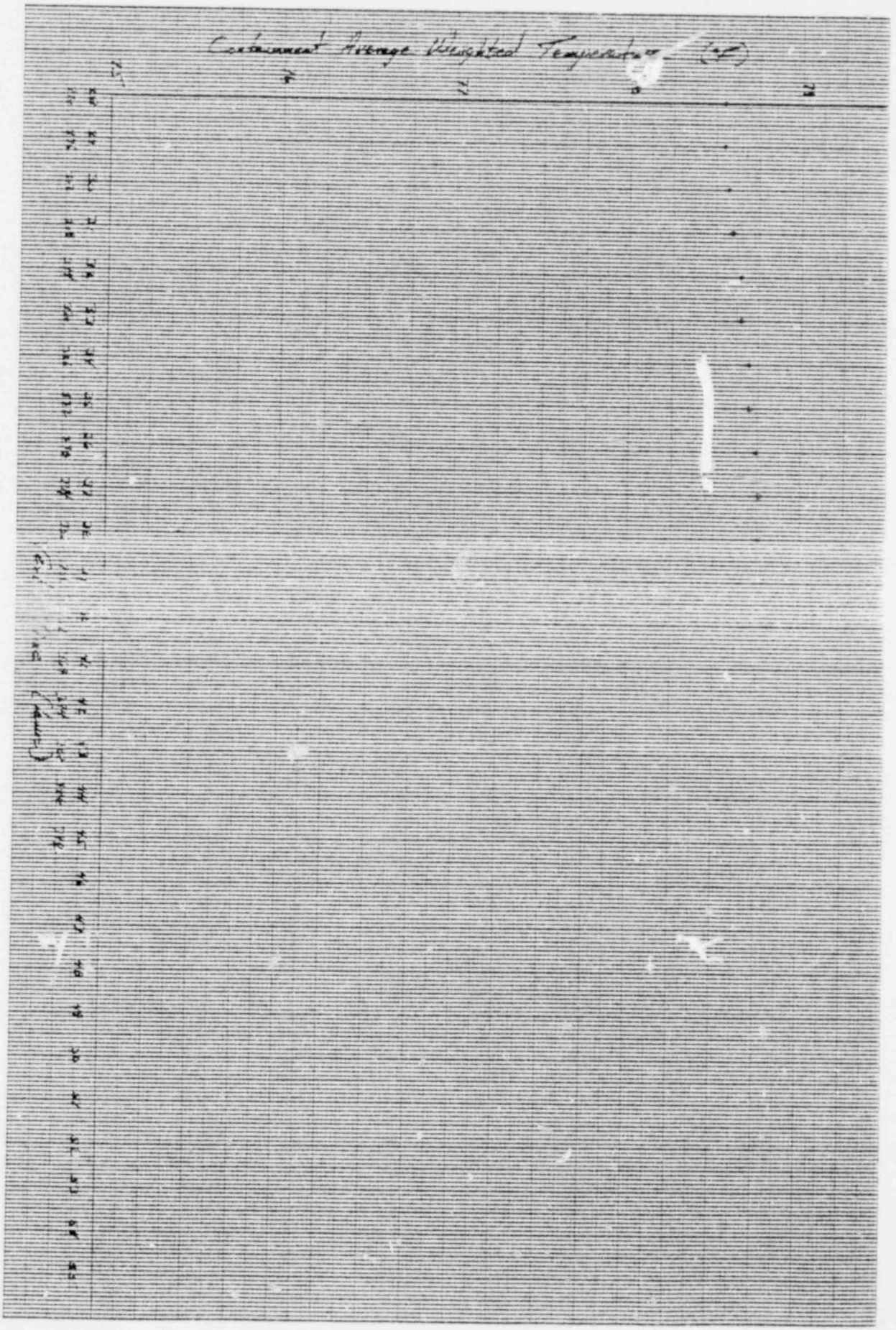










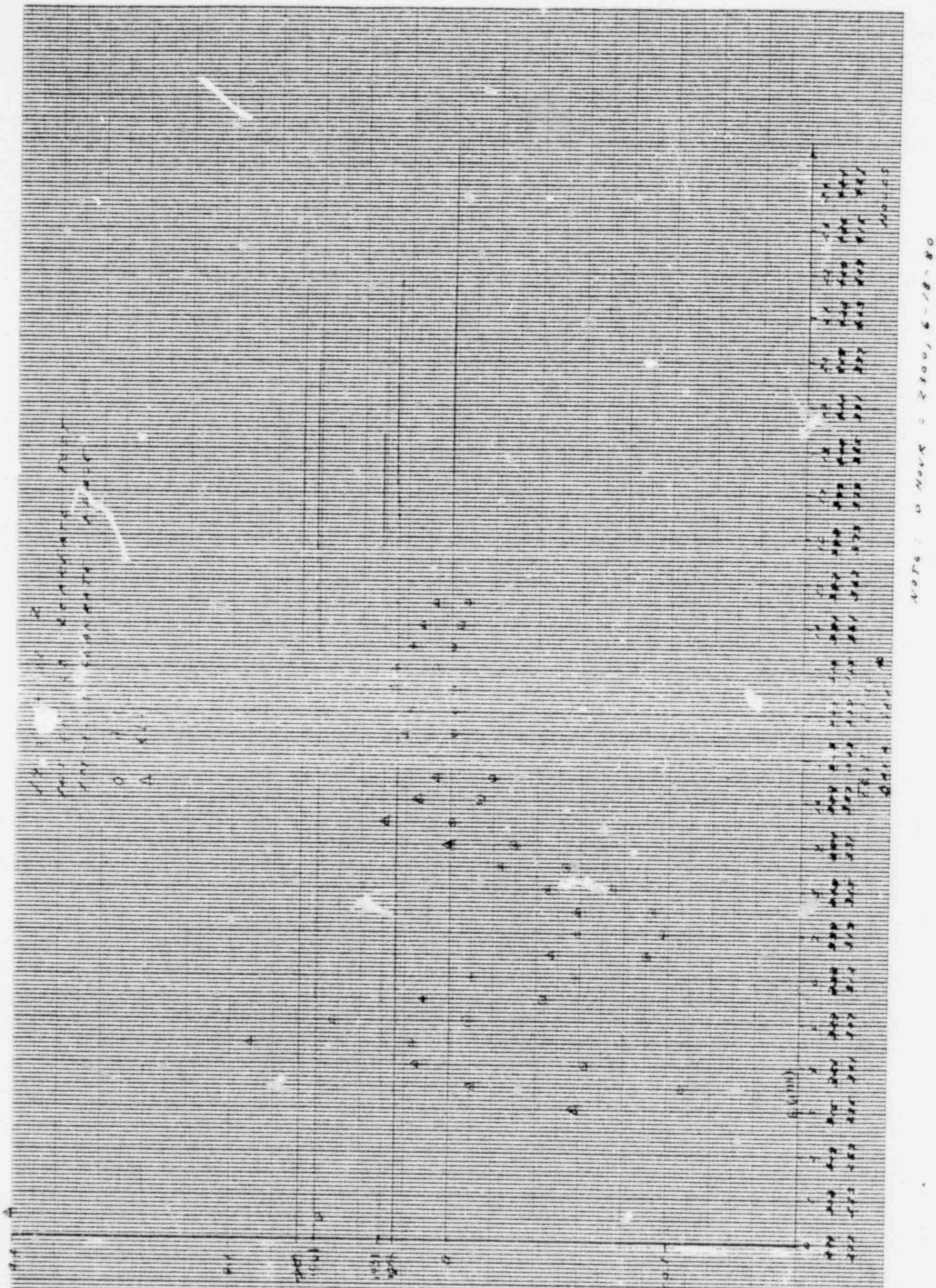


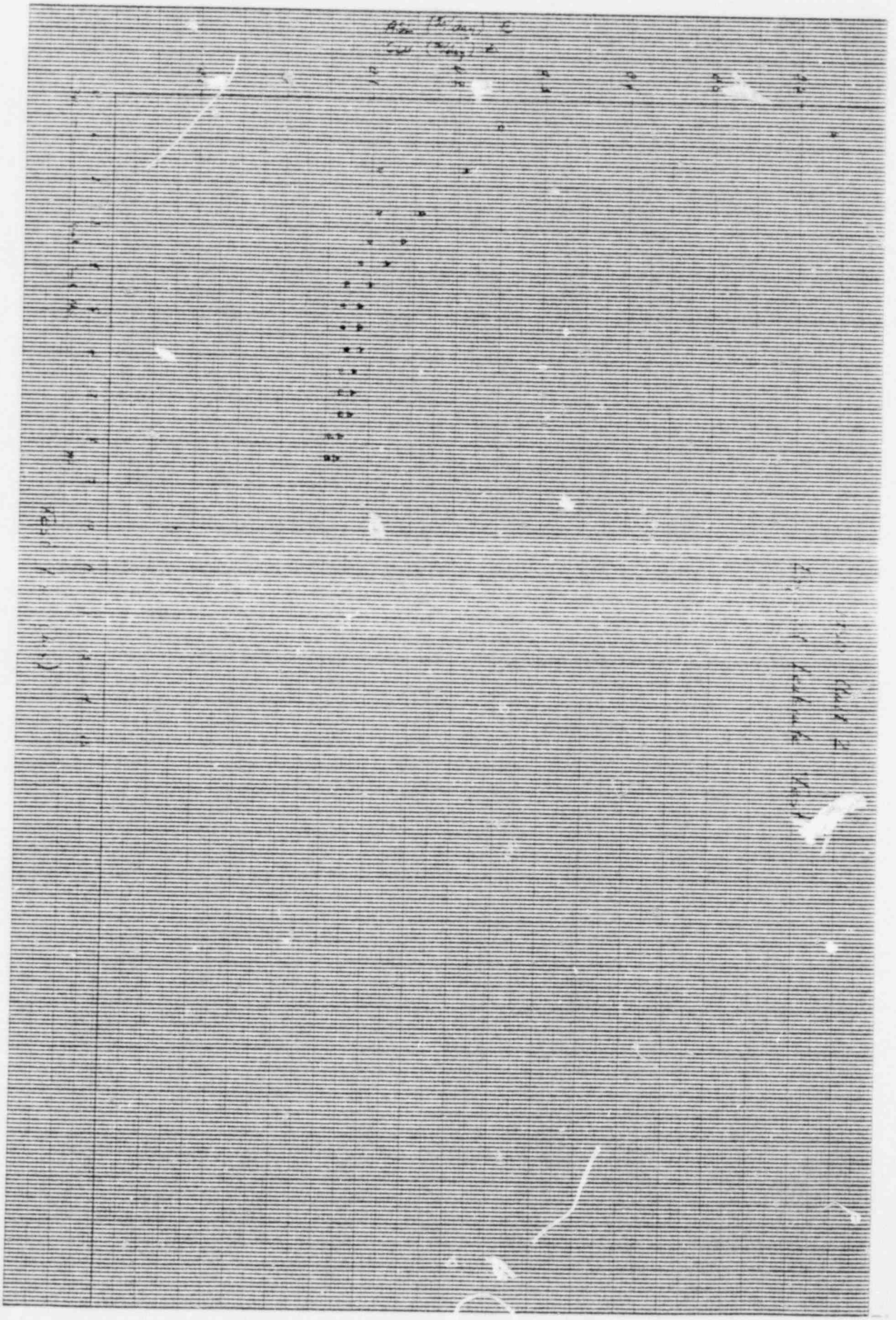
Analysis and Interpretation of Supplemental Verification Test Results

A 2.0 scfm leak (.036%/day) as measured by the rotometer was imposed on the containment. The leakrate plot obtained during the first 10.5 hours of this test was scattered in and out of the acceptable tolerance band for no apparent reason. Nothing else was changing during this time. When the raw data was looked at closer, it was evident that positive and negative pressure spikes on the order of 15 to 20 counts were occurring on the precision pressure gauges. These spikes, noticed on the output tapes from the DAS, were occurring at random intervals during this test. This caused the containment dry air mass calculation to change significantly. The oscillation in the leakrate results, as shown on graph 4, were caused by the pressure gauge problem.

The cause for the pressure gauge problems is not known, but water droplets which might have formed in the sensing line may have entered the quartz bourdon tube capsule to cause the problem. As soon as the problem was discovered the pressure standard used to calibrate the precision pressure gauges was connected to a containment pressure sensing line.

A new supplemental verification test was begun at data set 340 (graph 4a) using the pressure standard instead of the 2 gauges. Eight hours later, successful results were obtained and the test was terminated at 8.33 test hours. The successful results of this test demonstrate the validity of the leakage rate test measurements.





Test Log for

U-2 Containment ILRT

6-15-80 - 6-20-80

Sunday, 6-15-80

1700	Valve line-ups completed. Procedure signed off.
2030	Attempted to start both compressors. Had oil pump problems.

Monday, 6-16-80

0030	Started West compressor. Attempted start on east compressor, 4KV breaker problem, compressor tripped. Contacted OAD, will check problem in AM since 4KV feed is common to both compressors.
0045	Discovered RV0008 leaking thru, spinning purge exhaust fans backwards. Cranked down on valve, but still leaks.
0200	Received fire detection alarms in the containment. Containment pressure ≈ 2 psig.
0330	Filled pressurizer from 38% → 70%. Partial clear done on seal injection and normal charging to fill it.
0830	Other compressor started.
0930	Both compressors tripped on 2nd stage temperature high.
1130	Discovered AOV-RV0005,6 went closed, dead heading the compressors. The fuses to some containment isolation valves were mistakenly pulled and that affected RV0005 & 6 (fail close valves).
1300	Both compressors started again.
1930	Eastcompressor tripped due to low N_2 pressure.
2000	East compressor back on.
2130	Containment at 41 psia. Filled pressurizer again.
2145	B RCFC tripped. Decided to leave it off.
2215	Stopped compressors. Containment at 43 psia.
2340	Containment sample completed per test procedure.

Tuesday, 6-17-80

0315	Found multiplexer cable penetration leaking.
0630	Outer airlock door closed. Airlock equalized with containment pressure.
1600	Determined from accumulated data that there is a leak out of the containment. Began referencing systematic troubleshooting procedure to check for location of leak.
1630	Checked personnel hatch outer cable penetration and equalizing valve. The penetration was okay. The equalizing valve didn't appear to be leaking any more than when the test was started. Measured leak still greater than allowed.
1715	Checked water pressure between RV0005,6. Pressure okay.
1900	Decided to try to stop leak in personnel hatch outer equalizing valve.
1915	A plumbers plug was placed in the discharge part of the outer equalizing valve to stop the leak. It worked.
1930	Increased water pressure between RV0005,6. It had fallen to 15 psig.
2000	Isolated 2VC8405 (letdown). Checked main steam line pressure gauges, no leakage. Found very small leak in IW header (IW21).
2015	Snooped outer personnel airlock, no leakage.
2055	Snooped escape lock. Found a large leak in the escape lock inner equalizing valve. Closed the outer escape lock door and equalized the airlock with the containment pressure.
2100-2300	Checking other points of suspected leakage. Found nothing leaking.
2300	Containment leakrate below limit.
2330	Plumbers plug was removed from the outer personnel airlock equalizing valve.

Wednesday, 6-18-80

0130	Containment leakrate increasing above limit.
0330	Re-installed plumbers plug.
0530	Containment leakrate below limit.
0630	Containment leakrate negative.
1130	Shut off water supply between AOV-RV0005,6.
1145	Containment leakrate turning around towards positive. Started new "24 hour" ILRT.
2140	ILRT terminated. Acceptance criteria met. Average statistical leakrate (ASL) = 0.007 %/day. Upper confidence limit leakrate (CLU) = .019 %/day.
2220	Obtained containment air sample per procedure.
2230	Imposed a 2.00 scfm leak (0.036 %/day) on the containment for the supplemental verification test.

Thursday, 6-19-80

0500	Observed problems with precision pressure gauges.
0830	Installed pressure standard for precision pressure gauges on third containment pressure sensing line.
0930	Started new supplemental verification test using pressure standard.
1750	Terminated supplemental verification test. Acceptance criteria met.
1800	Performing valve line-up necessary for stroking Recirc. Sump valves MOV-SI8811 A, B.
1900	Stroked recirc. sump valves successfully. Performed release calculation for blowdown of containment. (1.06×10^8 ft^3/min. maximum release rate)
2000	Performing valve line-up for containment blowdown.
2145	Began containment blowdown.

Friday, 6-20-80

0600	Blowdown completed .
0630	Entered containment for post-test inspection. Found the following:

0630 con't	Containment sump level ≈ 1 in. over the top. RCDT spilling water out of the vent. ≈ 3/4 in. water on the floor outside the missile barrier for ≈ 3 ft. from the missile barrier outward.
0715	Post test inspection complete.
0730	Released containment to operating. Test completed.

Summary Analysis of Type B and Type C Test Results

The following table is a summary list of the periodic Type B and Type C tests that were performed since the last Type A test in February, 1977. The results indicate that the isolation capability of all the components tested has not degraded with time.

	1978	1979	1980
Total Type B Leakage (scfh)	48.5	22.48	6.26
Total Type C Leakage (scfh)	34.4	17.77	0.6
Total airlock seals leakage (10 psig test) (scfh)	1.2	0.15	0.07

The following is a cumulative list of Type B and Type C leakages by individual components:

Type C Components

Valve (s)	Leakage (scfh)	Date Tested
2MOV-CS0003	15.2	3-30-78
	1.32	4-10-79
	0	5-28-80
2MOV-CS0005	0.5	3-30-78
	3.11	4-10-79
	0.15	5-28-80
2MOV-CS0007	9.3	3-30-78
	..23	4-10-79
	0.08	5-30-80
2PR0029	1.1	3-30-78
	2.84	4-06-79
	0.12	6-05-80
2PR0030	0.9	3-30-78
	2.62	4-06-79
	0	6-04-80
2IA01A,B	1.8	3-30-78
	2.46	4-09-79
	0.04	6-14-80

Type C Components con't

2DT9157	2.0	3-30-78
	0.84	4-04-79
	0.16	6-11-80
2AOV-RV0001→4	0.1	3-30-78
	0.23	4-04-79
	0.04	5-15-80
2FCV-PR24A,B	3.5	3-30-78
2PR0007,8,9,11,12,13,	2.12	4-06-79
15,16,17,19,20,21	0.01	5-31-80

Type B Components

Electrical Penetrations	Leakage (scfh)	Date Tested
Zone 1	8.0	3-30-78
	0.05	3-06-79
	0.16	5-13-80
Zone 2	9.2	3-30-78
	0.05	3-06-79
	0.11	5-13-80
Zone 3	8.2	3-30-78
	0.07	3-06-79
	0.09	5-13-80
Zone 4	2.4	3-30-78
	0.41	3-06-79
	0.29	5-13-80
Mechanical Penetrations		
Zone 1J	2.7	3-30-78
	1.07	3-22-79
	0	5-13-80
Zone 1B	2.4	3-30-78
	3.7	4-04-79
	0	6-11-80
Zone 2J	0.7	3-30-78
	3.09	3-14-79
	0	5-13-80
Zone 3D	2.9	3-30-78
	1.05	3-16-79
	0	5-13-80
Zone 3K	2.2	3-30-78
	5.57	3-14-79
	0	5-13-80
Zone 4B	4.7	3-30-78
	2.79	3-16-79
	0.12	5-27-80
Zone 4H	1.6	3-30-78
	3.68	3-19-79
	0	5-14-80

Type B Components con't	Leakage (scfh)	Date Tested
Volume between doors on Personnel Airlock	0.1	3-30-78
	0.54	4-12-79
	0.01	1-14-80
	4.96	6-14-80
	2.30	7-10-80
Volume between doors on Escape Hatch	3.4	3-30-78
	0.31	4-12-79
	0.02	1-14-80
	0.53	6-14-80
	0.16	6-30-80
Personnel Lock Seals (10 psig test)	0	3-30-78
	0.12	4-12-79
	0.39	1-14-80
	0.01	6-13-80
Escape Hatch Seals (10 psig test)	1.2	3-30-78
	0.03	4-12-79
	0.06	1-14-80
	0.06	6-12-80
Equipment Hatch Seal	0.1	4-12-79
	0.06	1-14-80
	0	6-13-80

Calculation of "As Left" Leakage of the Personnel Hatch and Escape Hatch

Following the ILRT, the inner equalizing valve of the escape hatch and the outer equalizing valve of the personnel hatch were repaired. A Type C local leakrate test was performed at 25 psig on each hatch to determine their "As Left" leakage. These leakages are to be added to the measured containment integrated leakrate to obtain the total integrated leakrate of the Unit 2 containment.

As Left Leakage

Personnel Hatch: .0475 scfh
Escape Hatch: .0817 scfh

(.0475 scfh + .0817 scfh) x 24 hrs. = 3.101 scfd

$$\frac{3.101}{7332347 \text{ scf @ 25 psig}} \times 100\% = .00004\ \%/\text{day}$$

The "As Left" leakage of .00004 %/day is an insignificant amount to be added to the measured integrated leakrate of .007 %/day. Therefore, the total containment integrated leakrate remains at .007 %/day.

Calculation of Induced Leak for the Supplemental Verification Test

Volume of containment = 2715000 $ft.^3$

Volume of air in standard cubic feet at 25 psig:

$$2715000 \left(\frac{25 + 14.7}{14.7} \right) = 7332347 \text{ scf}$$

Allowable containment leakage L_T = .0621 %/day

In SCFM:

L_T = .000621 (7332347) = 4553.4 SCFD

$$L_T = \frac{4553.4}{24(60)} = 3.16 \text{ SCFM}$$

Allowable measured leakage L_{tm} is:

$$L_{tm} = .75\ L_T = .75(3.16) = \underline{2.37} \text{ SCFM}$$

Induced leak should be between 2 and 3 scfm.

2 scfm was chosen.

Calculation of Supplemental Verification Test Acceptance Criteria

Measured containment leakrate - .007 %/day

Induced leakrate - .036 %/day

Measured combined leakrate - .053 %/day

Allowable containment leakrate (L_T) .0621 %/day

$$\text{Percent } L_T = \left| \frac{.053 - .036 - .007}{.0621} \right| \times 100\% = 16\%$$

$16\% < 25\%$

The difference between the supplemental test data and the Type A test data is within .25 L_T.

Figure of Merit Calculation

$$FOM = \frac{24}{h} \times (10^2) \left[2\left(\frac{e_{pt}}{p}\right)^2 + 2\left(\frac{e_{pv}}{p}\right)^2 + 2\left(\frac{e_t}{T}\right)^2\right]^{\frac{1}{2}}$$

E = sensor repeatability error

$\mathcal{E}$ = readout error

h = 24 hrs. P = 43.2 psia T = 537.8 ^{o}R

e = measurement of change of parameter error

$$e_{pt} = \frac{\left[(E_{pt})^2 + (\mathcal{E}_{pt})^2\right]^{\frac{1}{2}}}{\sqrt{\#\text{ of sensors}}}$$

E_{pt} = .001 = 0

# of sensors = 2

$$e_{pt} = \frac{\left[(.001)^2 + (0)^2\right]^{\frac{1}{2}}}{\sqrt{2}} = \underline{.00071}$$

$$e_{pv} = \frac{\left[(E_{pv})^2 + (\mathcal{E}_{pv})^2\right]^{\frac{1}{2}}}{\sqrt{\#\text{ of sensors}}}$$

E_{pv} = .00232 $\mathcal{E}_{pv}$ = .000056

# of sensors = 10

$$e_{pv} = \frac{\left[(.00232)^2 + (.000056)^2\right]^{\frac{1}{2}}}{\sqrt{10}} = \underline{.00073}$$

$$e_t = \frac{\left[(E_t)^2 + (\mathcal{E}_t)^2\right]^{\frac{1}{2}}}{\sqrt{\#\text{ of sensors}}}$$

E_t = .1 $\mathcal{E}_t$ = .006

$$e_t = \frac{\left[(.1)^2 + (.006)^2\right]^{\frac{1}{2}}}{\sqrt{28}} = \underline{.01893}$$

$$FOM = \frac{24}{24} \times (10)^2 \left[2\left(\frac{.00071}{43.2}\right)^2 + 2\left(\frac{.00073}{43.2}\right)^2 + 2\left(\frac{.01893}{537.8}\right)^2\right]^{\frac{1}{2}}$$

$$= 10^2 \left[5\times10^{-10} + 6\times10^{-10} + 2.5\times10^{-9}\right]^{\frac{1}{2}}$$

$$FOM = \underline{6 \times 10^{-3}}$$

Since the FOM is less than .25 L_T (.0155), the instrumentation is acceptable.

TEMPERATURE SURVEY

DATE - 6/15/80 TIME - 10:50 AM UNIT 2 ILRT

PERFORMED BY - T.L. SCHUSTER

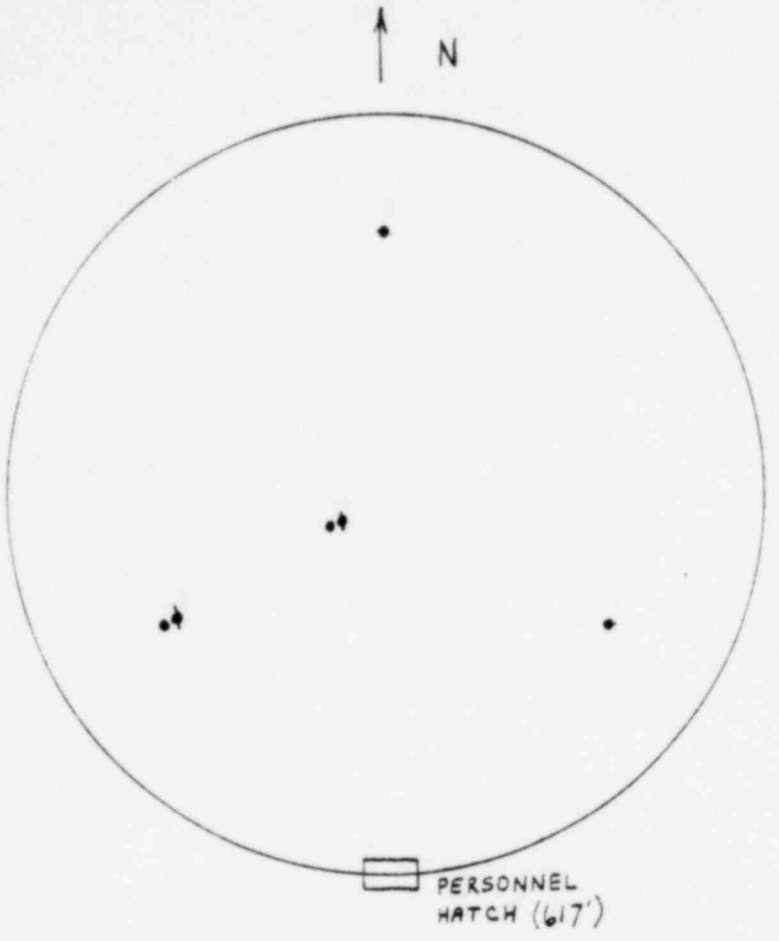
@ 560' LEVEL	4 pts inside M.B.	4 pts outside M.B.
	① 75°F @ RCP 2D	① 78°F @ E21
	② 76°F @ SG 2C	② 73°F @ E11-13
	③ 76°F @ RCP 2B	③ 74°F @ E28
	④ 76°F @ E22 inside	④ 73°F @ E29-3

@ 592' LEVEL	4 pts inside M.B	4 pts outside M.B.
	① 77°F @ SG 2B-2C	① 72°F @ E31
	② 77°F @ RCP 2C	② 74°F @ E29
	③ 77°F @ RCP 2A	③ 75°F @ E26
	④ 78°F @ RCP 2B	④ 72°F @ E34

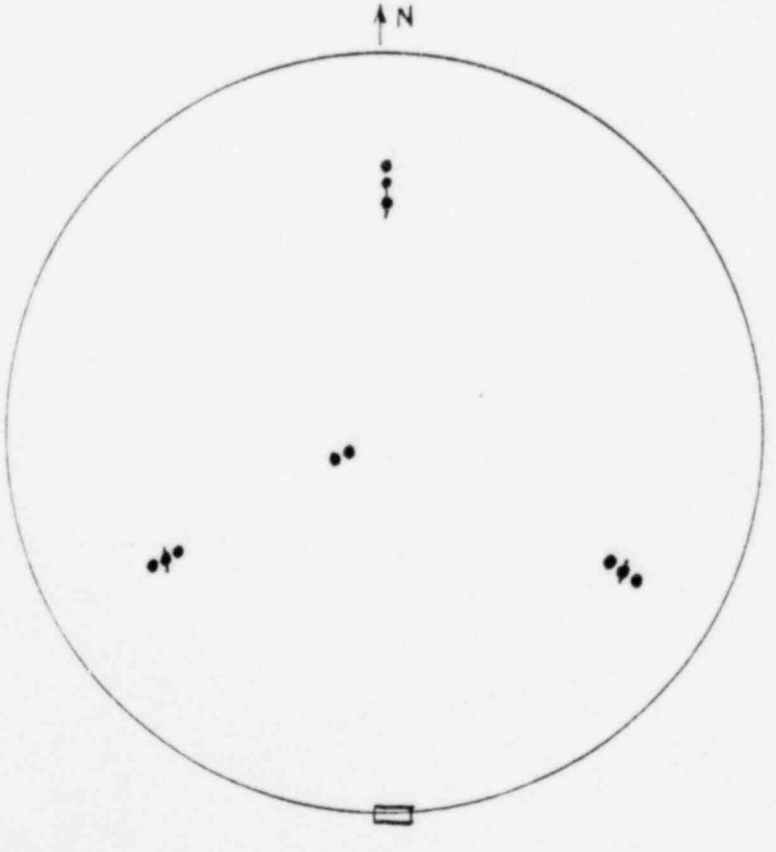
@ 617' LEVEL	4 points
	① 77°F @ Cont Wall SG 2A
	② 77°F @ Cont Wall SG 2B
	③ 77°F @ Cont Wall SG 2C
	④ 77°F @ Cont Wall SG 2D

On the polar crane — all four points taken were at 77°F

Terrel K Schuster
6/15/80

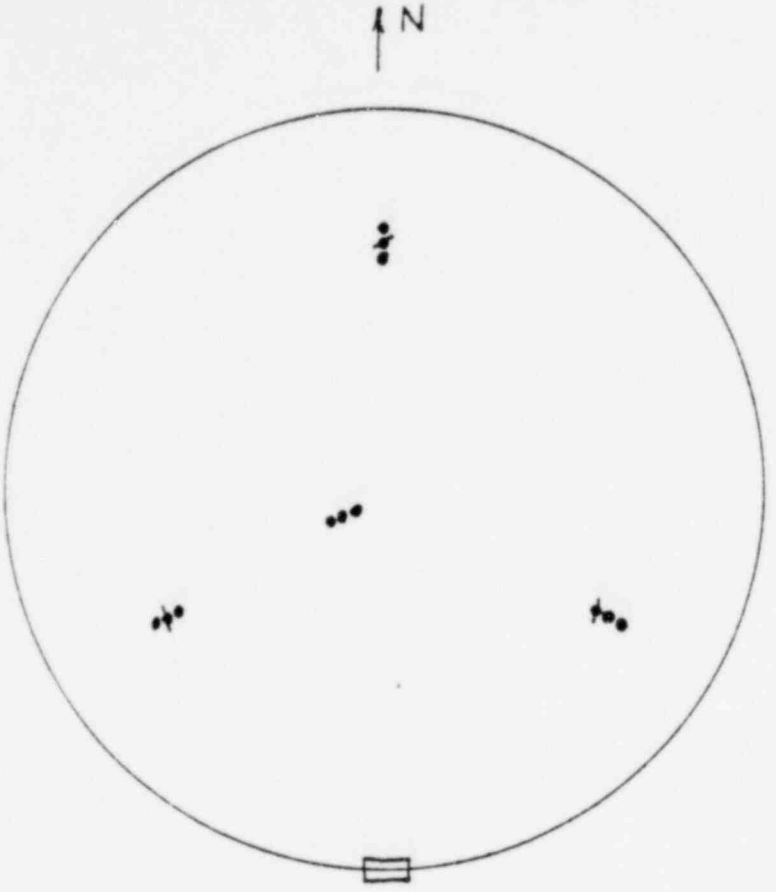


SUBVOLUME 1
ELEV. 735' - RTD's
ELEV. 734' - DEWCELLS

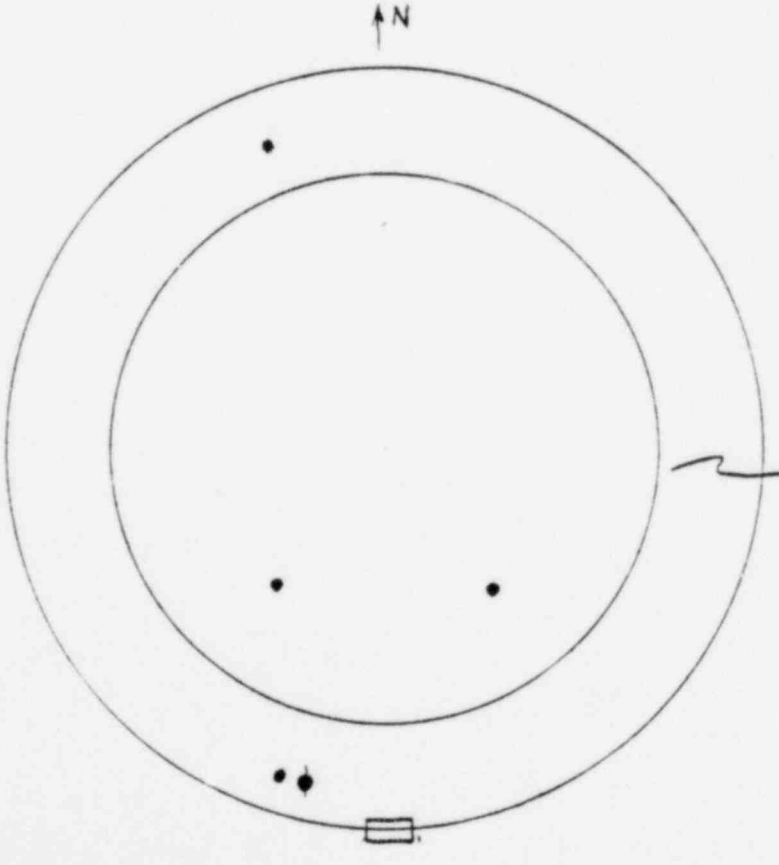


SUBVOLUME 2
RTD's - 710', 690'
DEWCELLS - 700'

RTD • DEWCELL ♦



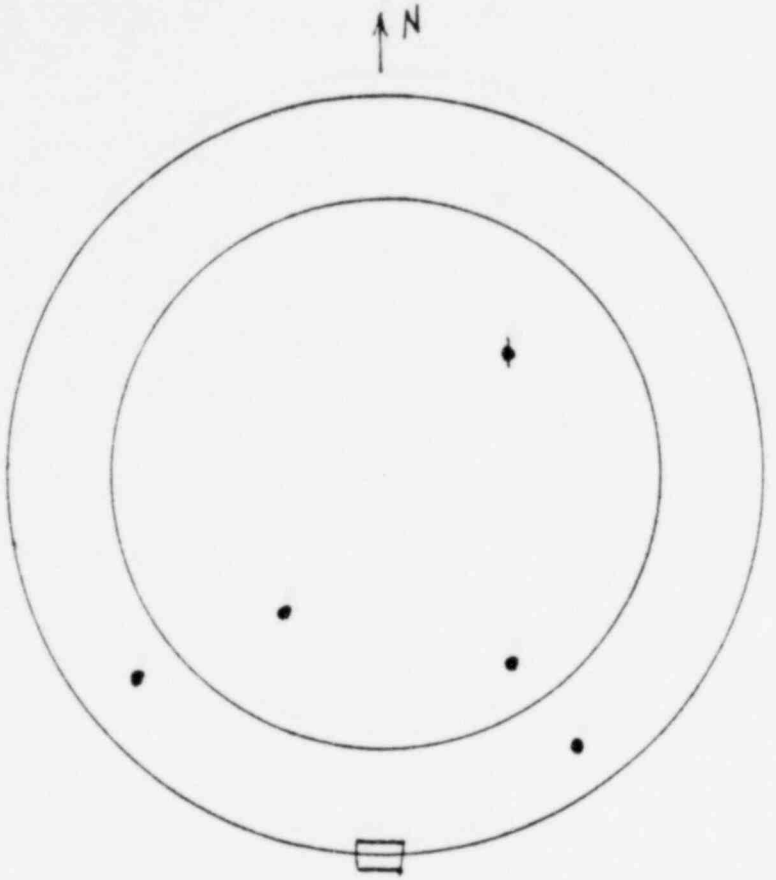
SUBVOLUME 3
RTDs - 650', 640', 645'
DEWCELLS - 645'



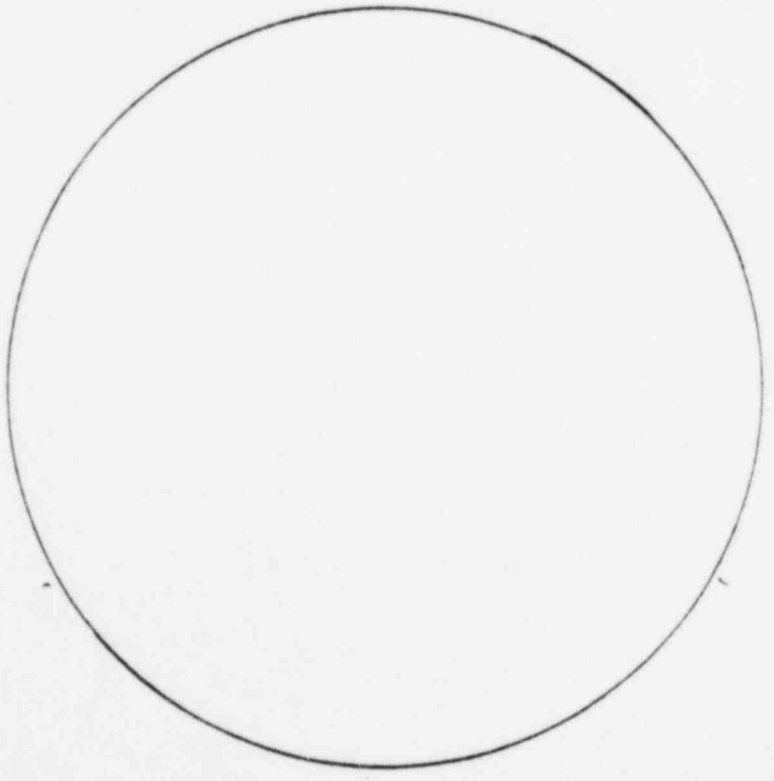
SUBVOLUME 4, 5
RTDs - 592'
DEWCELLS - 592'

MISSILE BARRIER

RTD • DEWCELL •



SUBVOLUME 4,5
RTD's - 560'
DEWCELLS - 560'



VOLUMETRICS
1025 W. ARBOR VITAE • INGLEWOOD, CALIFORNIA 90301
PHONE (213) 641 3747

PI-1

Gauge s.n. 970		Tube Range: 0-100 psia	s.n. 1140
Room Temp: 70°F	Tube Temp: 50°C	Reference Pressure: 110 m Torr	
Calibrated by: KAA/ZG	Date: 4-17-80	Calibration Std. No. Model 07726 S.N. 101	

	Pressure (true) psia	Gauge Reading counts	Pressure = Gauge Reading x M + C	
			M	C
1	5	4869		
2	10	9747		
3	15	14651		
4	20	19549		
5	25	24452		
6	30	29345		
7	35	34251		
8	40	39153		
9	45	44043	1.020490897	.0500250487
10	50	48960		
11	55	53860		
12	60	58757		
13	65	63670		
14	70	68601		
15	75	73526		
16	80	78563		
17				
18				
19				
20				
21				
22				
23				

VOLUMETRICS
1025 W. ARBOR VITAE • INGLEWOOD, CALIFORNIA 90301
PHONE (213) 641-3747

PI-2

Gauge s.n. 971		Tube Range: 0-100 psia	s.n. 1517
Room Temp: 70°F	Tube Temp: 50°C	Reference Pressure: 110 m Torr	
Calibrated by: KAA / ZG	Date: 4-17-80	Calibration Std. No. Model 07726 S.N. 101	

	Pressure (true) psia	Gauge Reading counts	Pressure = Gauge Reading x M + C	
			M	C
1	5	4979		
2	10	9958		
3	15	14941		
4	20	19922		
5	25	24903		
6	30	29854		
7	35	34785		
8	40	39740		
9	45	44663		
10	50	49595	1.012206121	-0.2165714448
11	55	54511		
12	60	59426		
13	65	64350		
14	70	69273		
15	75	74195		
16	80	79227		
17				
18				
19				
20				
21				
22				
23				

RTD Buffer Amp Calibration

Channel	RTD	60°	90°	120°
0	0	58.47	90.18	119.88
1	1	59.29	89.98	120.03
2	2	59.23	90.70	120.06
3	7	58.66	90.10	119.98
4	4	58.97	90.13	120.14
5	5	59.45	90.14	120.11
6	6	59.32	89.93	120.09
7	11	59.25	89.97	120.05
8	8	58.98	89.92	120.00
9	9	59.46	90.18	120.09
10	10	59.53	90.00	119.98
11	15	58.66	89.92	120.06
12	17	59.37	90.14	120.06
13	23	59.01	89.97	120.00
14	15'	59.72	90.01	120.03
15	26	58.68	90.12	120.02
16	16	59.72	90.00	120.01
17	27	59.04	90.03	120.15
18	28	58.76	90.90	120.07
19	19	59.51	90.18	120.04
20	20	58.94	90.73	120.05
21	3	58.91	90.08	120.46
22	12	59.28	90.06	120.79

RTD Buffer Amp Calibration con't

Channel	RTD	60°	90°	120°
23	13	59.46	90.28	119.91
24	22	59.74	91.05	120.14
25	4'	59.05	90.09	119.95
26	14	59.05	90.15	120.06
27	21	59.50	90.23	119.97
28	25	59.74	90.05	120.14

Calibrated by: Kenneth A. Ringer 6-3-80

All channels were within acceptable tolerance bands.

RTD Buf[illegible] Amp Calibration

Channel	Dewcell	84.54°	73.64°	67.18°
30	1	83.89	73.11	67.82
31	2	84.12	73.29	67.64
32	3	84.13	73.11	67.65
33	5	84.38	73.21	67.38
34	6	83.54	73.68	68.16
35	10	84.19	72.97	67.40
		85.56	75.83	64.4[illegible]
36	4	86.13	75.33	64.90
37	7	84.86	75.13	65.14
38	8	85.49	75.00	65.20
39	9	85.52	75.22	64.96

Calibrated by: Kenneth A. Ainger 6-12-80

All channels were within acceptable tolerance bands.

RTD Temperature-Resistance Values

RTD	60° Ω	60° °F	90° Ω	90° °F	120° Ω	120° °F
0	106.303	58.59	113.225	90.05	119.778	120.01
1	106.573	59.35	113.212	89.92	119.794	120.09
2	106.645	59.28	113.451	90.64	119.882	120.10
3	106.487	58.93	113.247	90.05	119.923	120.48
4	106.657	58.97	113.435	90.12	120.027	120.15
5	106.620	59.51	113.269	90.07	119.836	120.17
6	106.529	59.38	113.154	89.87	119.749	120.15
7	106.473	58.66	113.269	90.11	119.809	119.97
8	106.488	59.02	113.177	89.88	119.756	120.04
9	106.665	59.44	113.316	90.20	119.878	120.06
10	106.633	59.54	113.242	89.97	119.825	120.00
11	106.620	59.32	113.275	89.91	119.856	120.12
12	106.561	59.33	113.233	90.01	119.972	120.84
13	106.554	59.49	113.231	90.25	119.731	119.94
14	106.519	59.07	113.256	90.14	119.822	120.08
15	106.458	58.68	113.219	89.90	119.822	120.08
16	106.628	59.75	113.202	89.97	119.788	120.03
17	106.567	59.36	113.237	90.15	119.790	120.05
19	106.607	59.54	113.275	90.13	119.828	120.07
20	106.594	58.91	113.485	90.75	119.902	120.03
21	106.633	59.57	113.315	90.14	119.852	120.05
22	107.045	59.77	113.863	91.02	120.272	120.18
23	106.649	59.06	113.357	89.92	119.931	120.06
25	106.699	59.73	113.260	90.05	119.853	120.13

RTD Temperature-Resistance Values con't

RTD	60° Ω	60° °F	90° Ω	90° °F	120° Ω	120° °F
26	106.465	58.73	113.287	90.08	119.857	120.06
27	106.466	59.01	113.193	90.07	119.805	120.12
28	106.383	58.74	113.348	90.93	119.748	120.05
15'	106.780	59.78	113.360	89.95	119.965	120.10
4'	106.686	59.15	113.425	89.98	119.975	120.05

Calibrated by: Kenneth A. Ainge 6-4-80

DC#	84.54°=	73.64 °F	67.18 °F	
1	277.75 Ω 84.55mv	272.45 Ω 72.93mv	269.86 Ω 67.20mv	Board # 9 installed in slot #1, Board #1 unstable
2	276.32 Ω 84.56mv	271.19 Ω 73.11mv	268.53 Ω 67.14 mv	
3	276.59 Ω 84.51 mv	271.33 Ω 72.93 mv	268.74 Ω 67.20 mv	
5	275.60 Ω 84.52 mv	270.42 Ω 73.14 mv	267.73 Ω 67.22 mv	
6	277.46 Ω 84.56 mv	272.63 Ω 73.46 mv	269.94 Ω 67.23 mv	Board #10 installed in slot #6, Board #6 zero not attainable
10	275.56 Ω 84.47 mv	270.29 Ω 72.92 mv	267.69 Ω 67.20 mv	Board #6 installed in slot #10 operates ok with DC # 10
	85.56 °F	75.33 °F	64.40 °F	
4	277.49 Ω 85.56 mv	272.24 Ω 74.80 mv	267.21 Ω 64.44 mv	
7	278.72 Ω 85.47 mv	273.82 Ω 74.95 mv	268.82 Ω 64.37 mv	
8	278.81 Ω 85.60 mv	273.59 Ω 74.61 mv	268.76 Ω 64.39 mv	Check this board before exit
9	277.65 Ω 85.62 mv	272.67 Ω 74.39 mv	267.75 Ω 64.30 mv	Board #1 unstable installed in # 9

Wheatstone Bridge # L774337
GR 1433-W decade Resistor Sta No 021
Fluke 560CA Sta No 213

Performed
1-31-80 → 2-7-80
J Swalen

FISCHER & PORTER

GROWTH WITH A PURPOSE *through worldwide excellence in instrumentation*

Commonwealth Edison Co.
Dresdon Nuclear Power Station
C/O Storeroom RR# 1
Morris, IL 60450

Date: 11 April 1979
Subject: CERTIFICATION
Ref: 7903A9328R1 (2R7706A9209R2)

FLOWMETER CALIBRATION ACCURACY CERTIFICATE

A. METER IDENTIFICATION:

(1) Customer Purchase Order Number 501163 REL DR18.
(2) F&P Serial Number 7903A9328R1 (2R7706A9209R2).
(3) Model Number 10A3555.

B. CALIBRATION SPECIFICATIONS:

(1) Date: 11 April 1979.
(2) Flow Range 11.1 To .9. Units SCFM.
(3) Metering Fluid Air.

(a) Viscosity 0.0181 CPS.
(b) Specific Gravity 1.0 60/60 F. Density 0.0012 gms/cc.
(c) Temperature 14.7 PSIA.
(d) Pressure 70° F.

C. ACCURACY: ± 1 % of Max. flow.

D. CALIBRATION FACILITIES:

1) The equipment and associated procedures used in the calibration of said meter are in accordance with Mil-C-45662A.
   (a) Through establishment of values of physical constants for primary standards using tools of NBS accuracy pedigree.
   (b) Through direct, dynamic comparison of Fischer & Porter and NBS flow facilities using Fischer & Porter Turbine Flowmeters as transfer standards. NBS Test No. 213.31/193098.
   (c) Through inter-laboratory comparison of compatible Fischer & Porter flow facilities.

Very truly yours,

Albert W. Hernandez

Albert W. Hernandez
Manager, Fluids Quality Control

AWH/mdt

Calibration Report

Commonwealth Edison Co.

Electronics Instrument Laboratory

System Operational Analysis Department QA 104213D

Instrument: FLOWMETER Station DRESDEN

Mfg.: FISCHER & PORTER S/N 2R7706A 9209 R2 Group TECH STAFF

Model# 10A3555-S Prop# DIS-41 Cal. Date 4-79

Next Calibration 4-81 Last Calibration 4-78 Charge # 51015

Calibration Reference 104 003T By F. M. N.

Repairs: NONE

Standards — ,S/N NA ; — ,S/N NA

— ,S/N NA ; — ,S/N NA

As Received Calibration			As Left Calibration		
INSTRUMENT RANGE	INSTRUMENT READING	TRUE STANDARD	INSTRUMENT RANGE	INSTRUMENT READING	TRUE STANDARD

THE ABOVE INSTRUMENT WAS CALIBRATED AND FOUND TO BE WITHIN MANUFACTURERS TOLERANCES. TRACEABLE TO NATIONAL BUREAU OF STANDARDS

SEE DATA FOR DETAILS

FORM CTV. 3

VOLUMETRICS

CERTIFICATE OF CALIBRATION

Attention: COMMONWEALTH EDISON CO. Date: 1/3/80

Test Title:

References:

Purchase Order No.	730266
Volumetrics Job No.	5958
Serial Number	1904
Government Contract No.	---

Gentlemen:

This is to certify that the enclosed Test Data Sheets contain correct and true data obtained in the performance of the test program as set forth in your Purchase Order.

Instrumentation used in obtaining this data has been calibrated using standards which are traceable to the National Bureau of Standards

Calibration Procedure: (MANUFACTURER'S SPECIFICATION)

Reference Standards Used:

EQUIPMENT NO.	CALIBRATION DATE	DUE DATE
REF. STD No.3902/54	12/13/79	6/13/80

Enclosures: Data Sheets (1 Pages)

Quality Control Approval:

R. JOHNSON

VFORM-10024

VOLUMETRICS
1025 W. ARBOR VITAE • INGLEWOOD, CALIFORNIA 90301
PHONE: (213) 641-3747

Gauge s.n.1061		Tube Range: 0-100PSIA	s.n.1904
Room Temp: 73°F	Tube Temp: 50.7°C	Reference Pressure: 0.1 MTORR	
Calibrated by: T.F.	Date: 1/3/80	Calibration Std. No. 3902154	

	Pressure (true)	Gauge Reading	Pressure = Gauge Reading x M + C	
			M	C
1	0.000	0.000		
2	4.9920	5.035	0.99146	0.000
3	9.9840	10.057	0.99403	-0.013
4	14.9760	15.085	0.99284	-0.001
5	19.9679	20.110	0.99341	-0.010
6	24.9596	25.126	0.99516	-0.045
7	29.9515	30.142	0.99520	-0.046
8	34.9434	35.130	1.00078	-0.214
	39.9353	40.160	0.99243	0.079
10	44.9273	45.147	1.00100	-0.265
11	49.9192	50.102	1.00745	-0.556
12	54.8999	55.067	1.00316	-0.341
13	59.8908	60.042	1.00320	-0.343
14	64.8816	65.010	1.00459	-0.427
15	69.8726	69.985	1.00322	-0.337
16	74.8635	74.948	1.00562	-0.506
17	79.8545	79.924	1.00301	-0.310
18	84.8455	84.898	1.00342	-0.343
19	89.8365	89.880	1.00181	-0.206
20	94.8275	94.850	1.00423	-0.423
	99.8185	99.828	1.00261	-0.270
22				
23				

VOLUMETRICS

CERTIFICATE OF CALIBRATION

Attention: COMMONWEALTH EDISON CO. Date: 1/25/80

Test Title: DEWPOINT

References:

Purchase Order No.	919393
Volumetrics Job No.	5959
Serial Number	101
Government Contract No.	---

Gentlemen:

This is to certify that the enclosed Test Data Sheets contain correct and true data obtained in the performance of the test program as set forth in your Purchase Order.

Instrumentation used in obtaining this data has been calibrated using standards which are traceable to the National Bureau of Standards

Calibration Procedure: _____

Reference Standards Used:

EQUIPMENT NO.	CALIBRATION DATE	DUE DATE
VMC 203	10/25/79	4/25/80
VMC 301	3/27/79	3/27/81

Enclosures: Data Sheets (2 Pages)

Quality Control Approval:

C B Dreike

C.B. DREIKE

VFORM-10024

VOLUMETRICS
1025 WEST ARBOR VITAE
INGLEWOOD, CALIFORNIA 90301
PHONE: (213) 641-3747

REPORT NUMBER: 5959

REQUESTER: COMMONWEALTH EDISON CO. DATE: 1/25/80

MODEL: 07731 SERIAL NUMBER: 101

REFERENCE: 919393 MEDIA: --

CERTIFIED ACCURACY: .01 OHM TEMPERATURE: 72°F

OHM METER CALIBRATION

STANDARD	AS FOUND	AS LEFT	
0.00	0.000	0.000	
50.00	49.993	49.993	
100.00	99.995	99.995	
110.00	110.001	110.001	
120.00	120.004	120.004	
130.00	130.005	130.005	
140.00	140.005	140.005	

NOTE: All standards used in this test report are traceable to the United States Bureau of Standards, Washington, D.C.

COMMENTS: STANDARD USED IS VMC-203 PRECISION DECADE RESISTOR.

TECHNICIAN: T. Ferguson T. FERGUSON QUALITY CONTROL: C.B. Dreike C.B. DREIKE

VOLUMETRICS
1025 WEST ARBOR VITAE
INGLEWOOD, CALIFORNIA 90301
PHONE: (213) 641-3747

REPORT NUMBER: 5959

REQUESTER: COMMONWEALTH EDISON CO. DATE: 1/25/80

MODEL: 07731 SERIAL NUMBER: 101

REFERENCE: 919393 MEDIA: AIR

CERTIFIED ACCURACY: .60°F TEMPERATURE: 72°F

DEWPOINT CALIBRATION

VMC-301	S/N 101 DEWPOINT CALIBRATOR
52.2°F	51.90°F
75.1°F	74.82°F

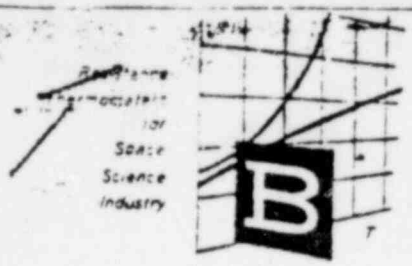
RESISTANCE VALUES	S/N 101 DEWPOINT CALIBRATOR
100.00	32.00
119.59	122.00
136.33	199.99
	S/N 101 RTD Calibrator
106.15	59.96
112.70	90.09
119.22	119.97

NOTE: All standards used in this test report are traceable to the United States Bureau of Standards, Washington, D.C.

COMMENTS: CALIBRATION WAS PERFORMED AS DESCRIBED IN IN THE RTD AND DEWCELL CALIBRATOR MANUAL. IN ADDITION THE ABOVE POINTS WERE VERIFIED AGAINST VMC-301 DEWPOINT STANDARD. RESISTANCE STANDARD USED IS VMC-203

TECHNICIAN: T. Ferguson
T. FERGUSON

QUALITY CONTROL: C.B. Dreike
C.B. DREIKE



BURNS ENGINEERING INC.

10201 Bren Road East Minnetonka, Minnesota 55343
(Suburban Minneapolis)
Telephone 935-4400 • Area Code 612

Drawing & Instructional Literature Transmittal

To: ___ .umetrics
___ 25 West Arbor Vitae
Inglewood, CA 90301

Attn: Bill Metcalf

Reference
Customer: Volumetrics
Customer P.O. # 80975-3000
Customer P.O./I.D. Job No: 9010

BURNS ENGINEERING, INC. Job Number 25818

Gentlemen:

Enclosed please find documents requested per the above reference as identified below.

Drawings:

_____ Copies and/or (one) reproducible of each drawing number _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____.

Instructional Literature:

_____ Copies of Form #077232 "Instruction Manual #740" for Resistance Thermometers.

_____ Copies of Form #077230 "Installation & Operating Instructions #772" for Thermocouples.

_____ Copies of Form #077214 "Instruction Manual Model C-200" Resistance to Millivolt Converter.

1 Copies of Form #0878190 - Calibration Report

_____ Copies of _____

Spare Parts List:

_____ Copies and/or (one) reproducible of the priced (not priced) Spare Parts List for model numbers or part numbers: _____

Above Material Submitted

By: Judy Miller Date: February 12, 1980

BURNS ENGINEERING INC.

10201 Bren Road East 34 Minnetonka, Minnesota 55343
(Suburban Minneapolis)
Telephone 935 4400 • Area Code 612

CALIBRATION REPORT

The Resistance Temperature Device (RTD) described below has been calibrated by Burns Engineering, Inc. and the results are tabulated below. In addition, a R vs T table has been generated using the procedure outlined in NBS Monograph IPTS-68. These data are also reproduced below.

CALIBRATION DATA

TEMPF
32.000
RESIS
100.000

TEMPF
100.000
RESIS
114.874

TEMPF
212.000
RESIS
138.998

CALCULATED TABLE

RESIS	TEMPF
100.000	032
100.220	033
100.440	034
100.660	035
100.880	036
101.100	037
101.319	038
101.539	039
101.759	040
101.979	041
102.198	042
102.418	043
102.637	044
102.857	045
103.076	046
103.296	047
103.515	048
103.735	049

CALIBRATION DATE February 6, 1980

CUSTOMER Volumetrics

PURCHASE ORDER 80975-3000

MODEL NUMBER WPP0G1-5½-4A

SERIAL NUMBER 76448

[illegible]	954	050		117.047	110		130.006
[illegible]	4.173	051		117.264	111		130.220
[illegible]	4.393	052		117.481	112		130.435
104.612		053		117.698	113		130.650
104.831		054		117.915	114		130.865
105.050		055		118.132	115		131.080
105.269		056		118.349	116		131.294
105.489		057		118.566	117		131.509
105.708		058		118.782	118		131.723
105.927		059		118.999	119		131.938
106.146		060		119.216	120		132.153
106.365		061		119.433	121		132.367
106.583		062		119.649	122		132.581
106.802		063		119.866	123		132.796
107.021		064		120.082	124		133.010
107.240		065		120.299	125		133.225
107.459		066		120.515	126		133.439
107.677		067		120.732	127		133.653
107.896		068		120.948	128		133.867
108.115		069		121.165	129		134.082
108.333		070		121.381	130		134.296
108.552		071		121.598	131		134.510
108.770		072		121.814	132		134.724
108.989		073		122.030	133		134.938
109.207		074		122.246	134		135.152
109.426		075		122.462	135		135.366
109.644		076		122.679	136		135.580
109.862		077		122.895	137		135.794
110.081		078		123.111	138		136.008
110.299		079		123.327	139		136.222
110.517		080		123.543	140		136.436
110.735		081		123.759	141		136.649
110.954		082		123.975	142		136.863
111.172		083		124.191	143		137.077
111.390		084		124.406	144		137.290
111.608		085		124.622	145		137.504
111.826		086		124.838	146		137.717
112.044		087		125.054	147		137.931
112.262		088		125.269	148		138.144
112.480		089		125.485	149		138.358
112.698		090		125.701	150		138.571
112.915		091		125.916	151		138.785
113.133		092		126.132	152		138.998
113.351		093		126.347	153		139.211
113.569		094		126.563	154		139.425
113.786		095		126.778	155		139.638
114.004		096		126.994	156		139.851
114.221		097		127.209	157		140.064
114.439		098		127.424	158		
114.657		099		127.640	159		
114.874		100		127.855	160		
115.091		101		128.070	161		
115.309		102		128.285	162		
115.526		103		128.501	163		
115.744		104		128.716	164		
115.961		105		128.931	165		
116.178		106		129.146	166		
116.395		107		129.361	167		
116.613		108		129.576	168		
116.830		109		129.791	169		