REACTOR CONTAINMENT BUILDING

INTEGRATED LEAK RATE TEST

JANUARY, 1983

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION
UNIT NO. 1

TABLE OF CONTENTS

1.0 INTRODUCTION

The Fort Calhoun Station Unit No. 1 reactor containment building was subjected to its third integrated leak rate test during the period from January 6, 1983 to January 10, 1983. The purpose of this test was to demonstrate the acceptability of the containment building leakage rate at a design basis accident internal pressure of 60.0 psig. Testing was performed in conformance with the requirements of 10 CFR Part 50, Appendix J, and Fort Calhoun Station Unit No. 1 Technical Specifications. In addition, the recommendations of ANSI 56.8-1981 and ANSI N45.4-1972, were considered where appropriate.

Leakage rate testing was accomplished at a pressure of 60.0 psig for a period of 10 hours. The 10 hour period was followed by a 4 hour supplemental test for a verification of test instrumentation.

2.0 GENERAL AND TECHNICAL DATA

2.1 General Data

Owner:	Omaha Public Power District
Docket No.	50-285
Location:	Approximately 19 miles north of Omaha, Nebraska
Containment Description	Reinforced concrete cylinder with steel liner, post tensioned in three directions
Date Test Completed	January 10, 1983

2.2 Technical Data

Containment Net Free Volume:	1.05×10^6 ft.^{3}
Design Pressure	60.0 psig
Design Temperature	305°F
Calculated Accident Peak Pressure	60.0 psig
Calculated Accident Peak Temperature	288°F

3.0 ACCEPTANCE CRITERIA

Acceptance criteria established prior to the test and as specified by the Fort Calhoun Station Unit No. 1 Technical Specifications are as follows:

a. The maximum allowable measured leakage rate under DBA conditions, shall not exceed 75 percent of 0.10 percent by weight of the containment air per 24 hours (La) at a pressure of Pa = 60.0 psig.

b. The test accuracy of the Type A test shall be verified by a supplemental test to demonstrate the validity of the measurements. Results of this supplemental test shall be acceptable provided the correlation between the supplemental test data and the Type A test data demonstrates an agreement within 25 percent of La; i.e., 0.025% per day.

4.0 SUMMARY OF EVENTS

4.1 Pressurization and Stabilization Phase

Pressurization of the reactor building containment was started on January 6, 1983. The pressurization rate was approximately 3.0 psi per hour. Containment building pressure reached 60.0 psig at approximately 1800 on January 6, 1983 and pressurization was stopped. At this time, it was determined that the lithium chloride dewcell temperature sensors were not functioning properly because they had not been saturated with lithium chloride solution prior to the start of pressurization.

The reactor containment building was depressurized to 20 psig and the dewcells were saturated. Pressurization was started again at 1600 on January 7, 1983 and then terminated at 0500 on January 8, 1983. After a minor pressure adjustment of the test pressure and a 4 hour stabilization period, the test was started at 1444 on January 8, 1983.

4.2 Integrated Leak Rate Testing Phase

From 1444 to 1614, the measured leakage rate showed a decrease from an initial value of 0.441%/day to 0.032%/day. However, from 1614 until 2029, the leakage rate gradually increased to 0.087%/day which was above the acceptance criteria. Leak detection had been started but only a small leak on a sample line valve which tied into the ILRT pressurization system could be identified. This valve was repaired and the test was restarted at 2229 on January 8, 1983. Again, for the first four hours, the data indicated a very small leakage rate of approximately 0.006%/day. However, from 0229 to 1659, the measured leakage rate gradually increased and then stabilized at a value of 0.079%/day. During this time, leak detection continued and it was determined that the water seal on the steam generators had been lost. The water seal is required since the steam generator manholes seat with pressure in the generator and unseat with pressure in the containment. The water seal was reestablished on the steam generators and the ILRT was restarted at 1744 on January 9, 1983.

4.2 (Continued)

Starting at 1744 on January 9, 1983, the measured leakage rate decreased and stabilized at an acceptable value. At approximately 2330 on January 9, 1983, one RTD indicated erratic behavior (cycling). This sensor was rejected and all previous data sets recalculated with that sensor's input deleted. For the 10 hour period from 1744 on January 9, 1983 to 0314 on January 10, 1983, an acceptable leakage rate for the reactor containment building was obtained.

4.3 Supplemental Leakage Rate Test Phase

Following completion of the 10 hour integrated leak rate test, a leakage rate of 3.5 cfm was imposed on the containment building through the flowmeter at 0444 on January 10, 1983. Leakage rate data was again collected at fifteen minutes for a period of 4 hours. At 0844 on January 10, 1983, the supplemental leakage rate test was successfully completed.

4.4 Depressurization Phase

After all required data was obtained and evaluated, containment building depressurization to 0 psig was started. A post test interior inspection of the containment building at 0 psig was completed with no significant findings.

5.0 METHODS OF ANALYSIS

The absolute method of leakage rate determination was employed during testing at the 60.0 psig pressure level. The Gilbert Associates, Inc. ILRT computer code was utilized which calculates the percent per day leakage rate using the mass point method.

The mass point method of computing leakage rates uses the following ideal gas law equation to calculate the weight of air inside containment for each fifteen minute interval:

$$W = \frac{(144)\ PV}{RT} = \frac{KP}{T}$$

where,

W = mass of air inside containment, lbm

$K = (144)\ V/R = 2.8341143 \times 10^6 \ \frac{\text{lbm - °R - in}^2}{\text{lbf}}$

5.0 (Continued)

P = partial pressure of air, psia

T = average internal containment temperature, °R

$V = 1.05 \times 10^6\ ft^3$

$R = 53.35\ \frac{lbf - ft}{lbm - °R}$

The partial pressure of air, P, is calculated as follows:

$$P = P_T - P_{wv}$$

where,

P_T = True corrected pressure by converting precision pressure gauge readings and averaging, psia

P_{wv} = partial pressure of water vapor determined by converting each of the eight dewcell temperature sensors to dewpoint temperature, averaging the eight dewpoint temperatures and converting the average value to partial pressure of water vapor, psia.

T = containment building air temperature determined by averaging the twenty-nine RTD readings, and converting to degrees Rankine, °R.

The weight of air is plotted versus time for the 10 hour test and for the 4 hour supplemental test. The computer code fits the locus of these points to a straight line using a linear least squares fit. The equation of the linear least squares fit line is of the form $\overline{W} = B + At$ where A is the slope in lb per hour and B is the weight at time zero and are defined by the following expressions:

$$B = \frac{\Sigma t_i^2\ \Sigma W_i - \Sigma t_i\ \Sigma t_i W_i}{S_{xx}}$$

$$A = \frac{N\ \Sigma t_i W_i - \Sigma t_i\ \Sigma W_i}{S_{xx}}$$

where,

$$S_{xx} = N\ \Sigma t_i^{\ 2} - (\Sigma t_i)^2$$

5.0 (Continued)

The weight percent leakage per day can then be determined from the following equation:

$$\text{wt. \%/Day} = \frac{-2400\ A}{B}$$

where the negative sign is used since A is a negative slope to express the leakage rate as a positive quantity.

6.0 DISCUSSION OF RESULTS

6.1 Results at 60 psig

Data obtained during the integrated leak rate test at 60 psig indicated the following maximum changes (highest reading to lowest reading) during the 10 hour test period:

Variable	Maximum Change
P_T	0.070 psia
P_{wv}	0.002 psia
T	0.62°F

The method used in calculating the mass point leakage rate is defined in Section 5.0. The result of this calculation is a mass point leakage rate of 0.043 %/day. Corrections due to changes in net free volume, i.e., 0.005, reduce this value to 0.038 %/day.

The 95 percent confidence interval associated with this leakage rate is 0.009 percent per day. Thus, the leakage rate at the upper bound of the 95 percent confidence interval becomes

UCL = 0.038 + 0.009

UCL = 0.047 %/day

The measured leakage rate and the measured leakage rate at the upper bound of the 95 percent confidence level are well below the acceptance criteria of 0.075 percent per day (0.75 L_a). The mass point leakage rate versus time plot (see Appendix C) shows that the measured leakage rate decreased to a value below the acceptance criteria approximately 2.5 hours into the test and stabilized at a value below the acceptance criteria for the duration of the 10 hour leak test. Therefore, the reactor containment building leakage rate at the calculated design basis accident pressure of 60.0 psig is acceptable.

6.2 Supplemental Test Results

After conclusion of the 10 hour test at 60.0 psig, flowmeter FI-1 was placed in service and a flow rate, corrected for pressure and temperature conditions of 3.35 scfm was established. This flow rate is equivalent to a leakage rate of 0.093 percent per day. After the flow was established, it was not altered for the duration of the supplemental test.

The measured leakage rate (L_c) during the supplemental test was calculated to be 0.121 percent per day using the mass point method of analysis. Correcting for changes in net free volume reduces this value to 0.111 percent by weight per day.

The building leakage rate during the verification test is then determined as follows:

$L_{am}' = L_c - L_o$

$L_{am}' = 0.111$ %/day - 0.093 %/day

$L_{am}' = 0.018$ %/day

where:

L_{am}' = measured leakage rate of reactor containment building for verification test

L_c = measured composite leakage rate consisting of the reactor containment building leakage rate plus the imposed leakage rate

L_o = imposed leakage rate

6.3 Results Comparison

Comparing the supplemental test leakage rate with the corrected measured building leakage rate during the 10 hour test yields the following:

$L_{am} - L_{am}'$ = (0.038) - (0.018) = .020 %/day

The difference between the building leakage rates is 0.020 %/day which is below the acceptance criteria of .025 %/day. Therefore, test instrumentation acceptability has been verified.

7.0 REFERENCES

a. ST-CONT-7, "Type "A" Test (Containment", Fort Calhoun Station Unit No. 1 Test Procedure.

b. Code of Federal Regulations, Title 10, Part 50, Appendix J.

7.0 REFERENCES (Continued)

c. ANSI N45.4-1972, "Leakage Rate Testing of Containment Structures for Nuclear Reactors", American Nuclear Society, March 16, 1972.

d. ILRT, Computer Code, Gilbert Associates, Inc.

e. ANSI/ANS-56.8-1981, "Containment System Leakage Testing Requirements," American Nuclear Society, February 19, 1981.

f. Fort Calhoun Station Unit No. 1 Technical Specifications.

APPENDICES

APPENDIX A

SCHEMATIC ARRANGEMENT OF TEST INSTRUMENTATION

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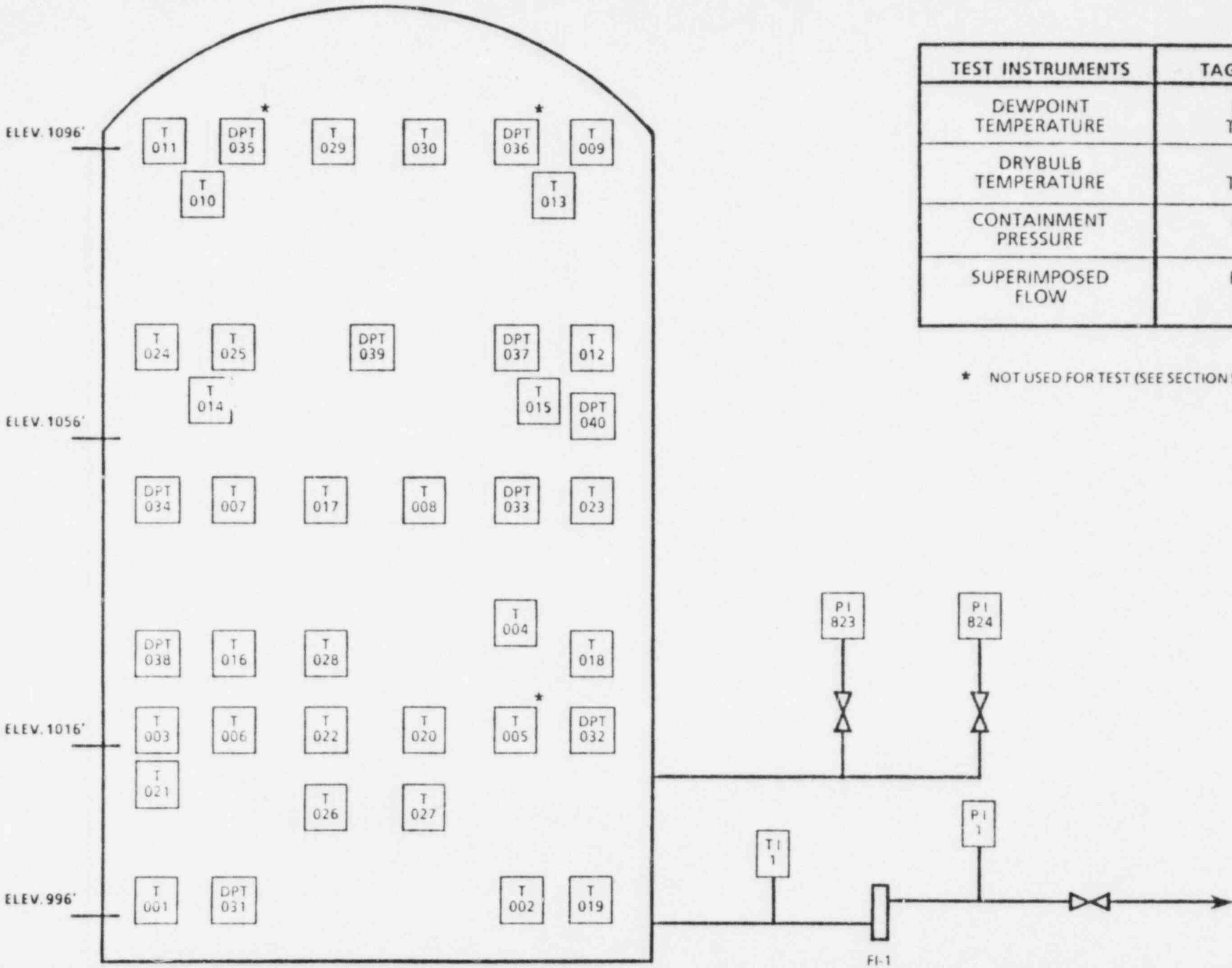


TEST INSTRUMENTS	TAG NUMBERS
DEWPOINT TEMPERATURE	DPT-031 THRU 040
DRYBULB TEMPERATURE	T-001 THRU 030
CONTAINMENT PRESSURE	PI-823 & 824
SUPERIMPOSED FLOW	FI-1, PI-1, &TI-1

* NOT USED FOR TEST (SEE SECTION 5.4)

APPENDIX B
REDUCED LEAKAGE DATA

APPENDIX B

REDUCED TEST DATA

Date	Time	(1) Containment Pressure (psia)	(1) Containment Partial Pressure Water Vapor (psia)	(1) Containment Temperature (°R)	(2) Weight of Containment Air (lbm)
1/9/83	1714	75.753	.231	548.97	389,886.47
	1729	75.755	.231	548.97	389,899.69
	1744	75.757	.231	549.05	389,856.31
	1759	75.760	.231	549.08	389,843.91
	1814	75.762	.230	549.08	389,863.50
	1829	75.764	.231	549.12	389,842.59
	1844	75.765	.231	549.14	389,834.97
	1859	75.763	.231	549.14	389,821.81
	1914	75.763	.231	549.10	389,851.03
	1929	75.764	.231	549.09	389,867.63
	1944	75.766	.231	549.10	389,865.66
	1959	75.769	.231	549.13	389,856.47
	2014	75.770	.231	549.14	389,860.44
	2029	75.773	.231	549.13	389,878.31
	2044	75.775	.231	549.18	389,857.97
	2059	75.775	.231	549.22	389,825.19
	2114	75.777	.230	549.23	389,841.78
	2129	75.779	.230	549.22	389,846.65
	2144	75.781	.231	549.26	389,831.28
	2159	75.783	.231	549.29	389,818.69
	2214	75.785	.231	549.29	389,828.97
	2229	75.787	.231	549.33	389,809.00
	2244	75.789	.231	549.32	389,830.84
	2259	75.791	.231	549.34	389,825.72
	2314	75.793	.231	549.35	389,823.94
	2329	75.795	.231	549.37	389,826.22

(1) These values have been rounded-off for inclusion in this table.
(2) These values are computer generated utilizing double precision.

APPENDIX B

REDUCED TEST DATA

Date	Time	(1) Containment Pressure (psia)	(1) Containment Partial Pressure Water Vapor (psia)	(1) Containment Temperature (°R)	(2) Weight of Containment Air (lbm)
1/9/83	2344	75.797	.231	549.38	389,829.41
	2359	75.799	.231	549.40	389,825.34
1/10/83	0014	75.800	.231	549.39	389,835.53
	0029	75.802	.231	549.41	389,827.56
	0044	75.804	.231	549.47	389,798.78
	0059	75.806	.232	549.50	389,784.75
	0114	75.807	.232	549.50	389,790.88
	0129	75.809	.232	549.50	389,798.09
	0144	75.812	.232	549.52	389,802.50
	0159	75.814	.232	549.50	389,822.50
	0214	75.815	.232	549.54	389,802.34
	0229	75.817	.232	549.53	389,817.09
	0244	75.819	.231	549.56	389,807.69
	0259	75.821	.231	549.59	389,801.44
	0314	75.823	.231	549.58	389,819.03
			SUPERIMPOSED TEST		
	0444	75.832	.232	549.66	389,806.56
	0459	75.834	.233	549.69	389,787.56
	0514	75.835	.232	549.68	389,806.91
	0529	75.836	.232	549.70	389,795.59
	0544	75.835	.231	549.77	389,746.31
	0559	75.837	.231	549.77	389,756.56
	0614	75.839	.231	549.75	389,773.69
	0629	75.840	.231	549.82	389,733.93

(1) These values have been rounded-off for inclusion in this table.
(2) These values are computer generated utilizing double precision.

APPENDIX B

REDUCED TEST DATA

Date	Time	(1) Containment Pressure (psia)	(1) Containment Partial Pressure Water Vapor (psia)	(1) Containment Temperature (°R)	(2) Weight of Containment Air (lbm)
1/10/83	0644	75.840	.232	549.85	389,707.66
	0659	75.842	.232	549.88	389,694.38
	0714	75.840	.232	549.88	389,685.28
	0729	75.838	.232	549.84	389,708.00
	0744	75.841	.231	549.83	389,733.25
	0759	75.844	.231	549.82	389,754.09
	0814	75.846	.231	549.83	389,760.28
	0829	75.848	.231	549.91	389.714.28
	0844	75.850	.231	549.89	389,734.59

(1) These values have been rounded-off for inclusion in this table.
(2) These values are computer generated utilizing double precision.

APPENDIX C

LEAKAGE RATE

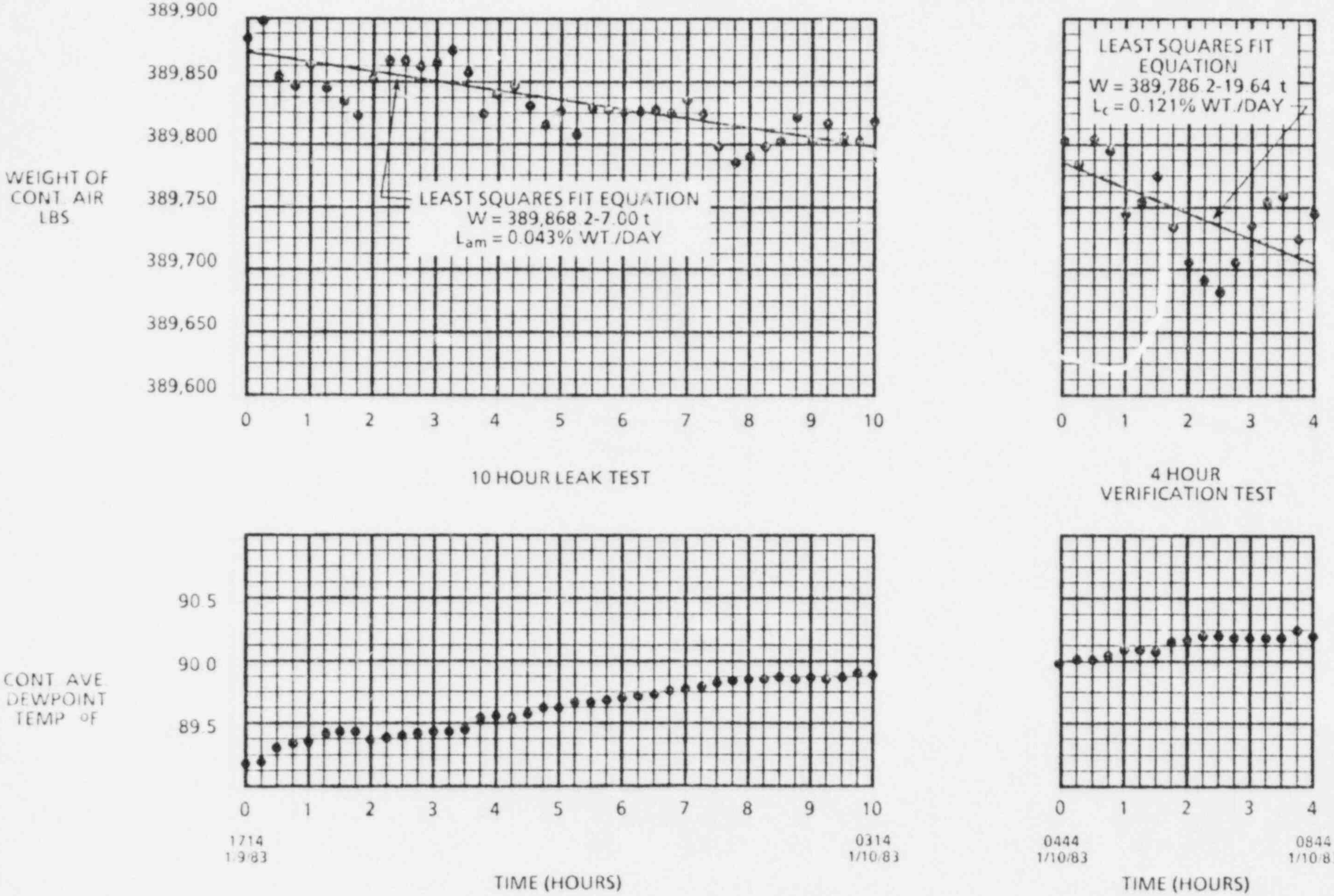
TEST GRAPHS

APPENDIX C

TABLE OF CONTENTS

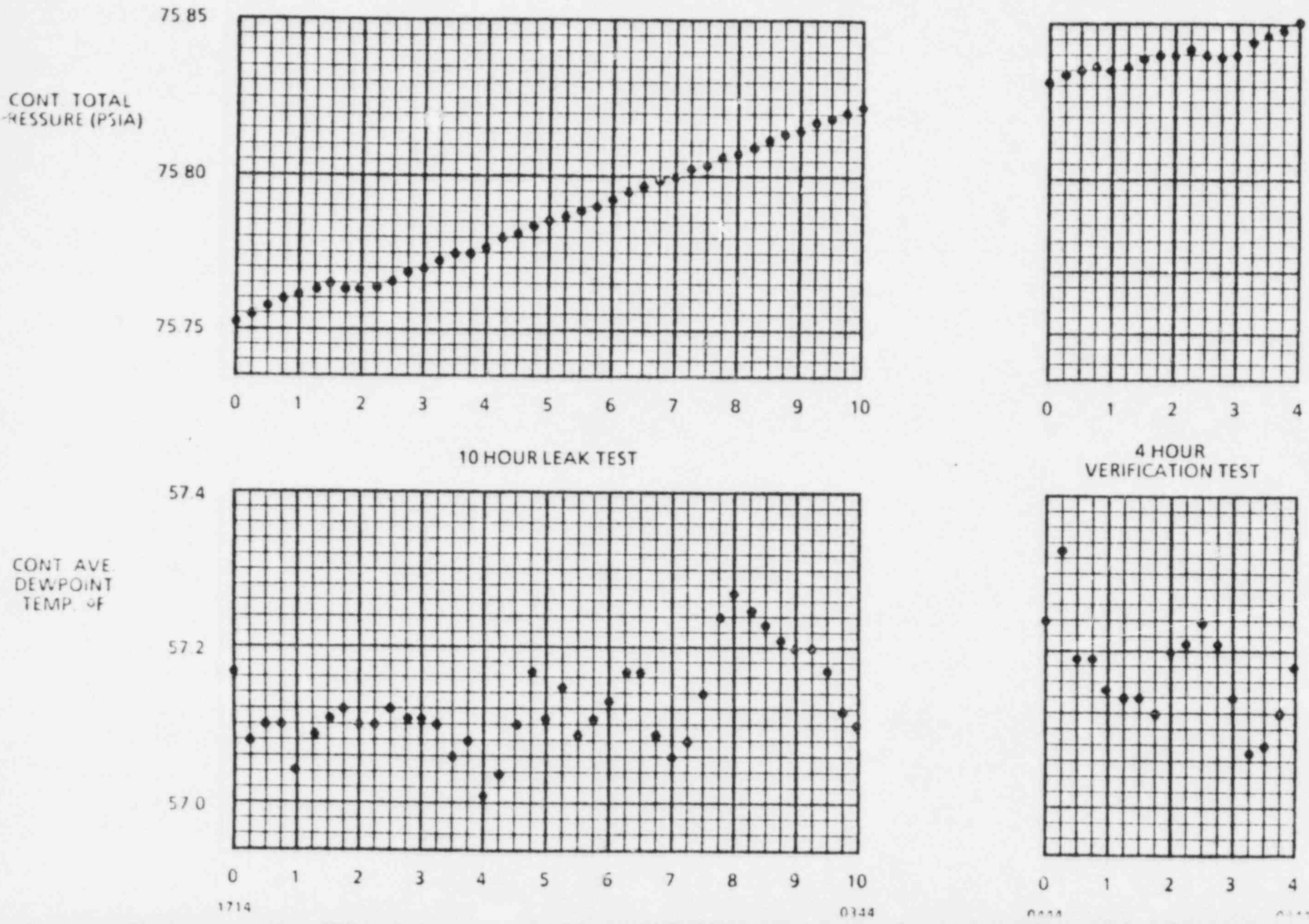
APPENDIX C

WEIGHT OF CONTAINMENT AIR AND CONTAINMENT AVERAGE TEMPERATURE VERSUS TIME



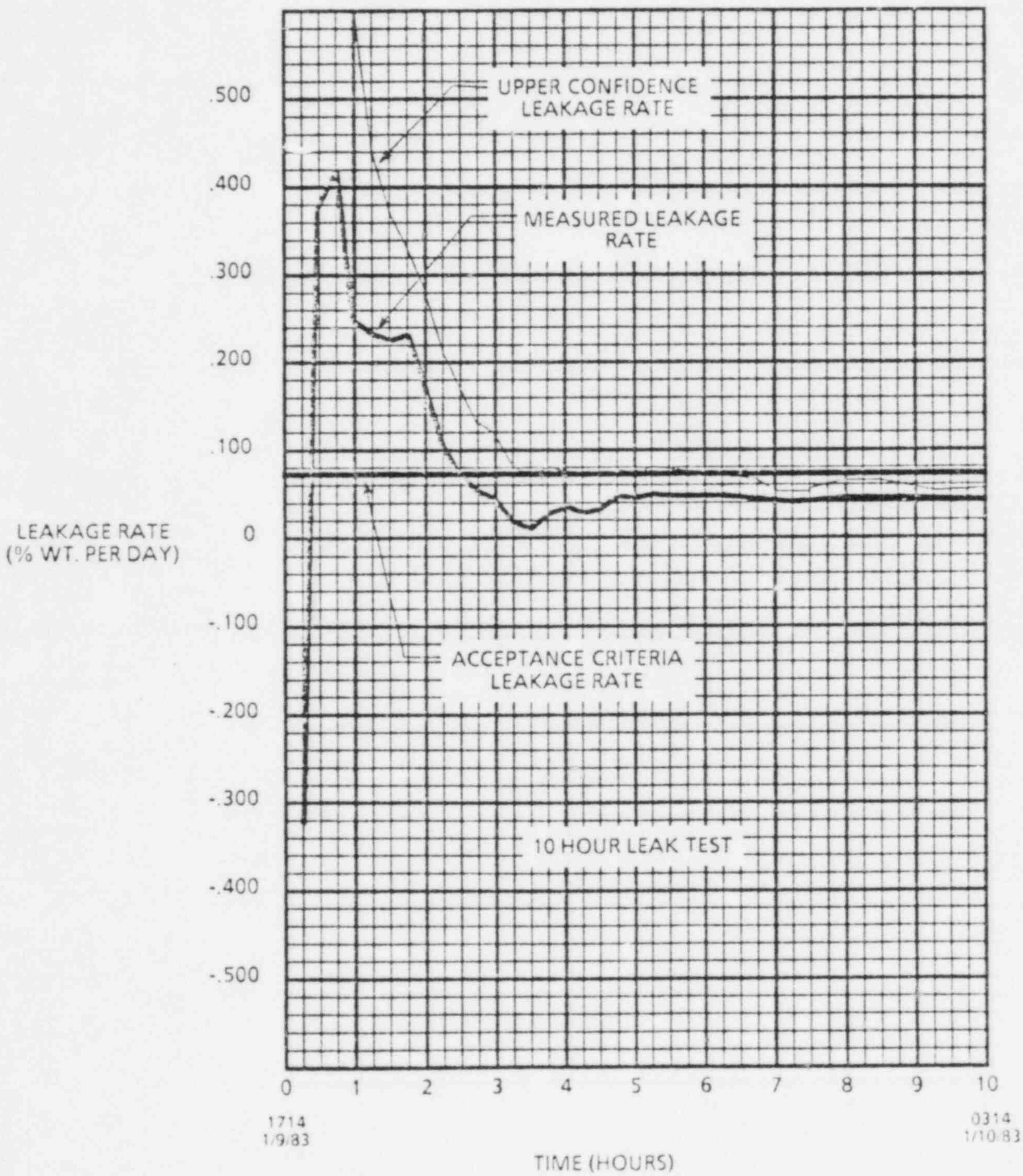
APPENDIX C

CONTAINMENT TOTOL PRESSURE AND CONTAINMENT AVERAGE DEWPOINT TEMPERATURE VERSUS TIME



APPENDIX C

MASS POINT LEAKAGE RATE VERSUS TIME



APPENDIX D

APPENDIX D
nstrument Error Analysis

1.0 INSTRUMENTATION

1.1 Drybulb Temperature Indicating System

Components:

a. Resistance Temperature Detectors

Quantity	29
Manufacturer	Hy-Cal Engineering
Type	100 ohm Platinum
Range	60 to 100°F (calibrated)
Accuracy	± 0.1°F
*Sensitivity	± 0.1°F
Repeatability	± 0.1°F

*Sensitivity is the smallest value which will cause a one digit change in the readout.

b. Digital Temperature Indicator

Quantity	1
Manufacturer	Digitec
Type	Model 3000 Datalogger
Accuracy	± 0.19°F
Repeatability	± 0.05°F

1.2 Dewpoint Temperature Indicating System

Components:

a. Dewpoint Sensors

Quantity	8
Manufacturer	Foxboro
Type	Model 2701 RG
Range	0 to 200°F
Accuracy	± 1°F
*Sensitivity	±0.01°F
Repeatability	± 0.5°F

*Sensitivity is the smallest value which will cause a one digit change in the readout.

b. Digital Temperature Indicator

Quantity	1
Manufacturer	Digitec
Type	Model 3000 Datalogger
Accuracy	± 0.19°F
Repeatability	± 0.05°F

1.3 Pressure Monitoring System

Precision Pressure Gauges

Quantity	2
Manufacturer	Mensor Corporation
Type	Model 16721
Range	0 to 100 psia
Accuracy	± 0.015 psia
*Sensitivity	± 0.001 psia
Repeatability	± 0.0005 psia

*Sensitivity is the smallest value which will cause a one digit change in the readout.

1.4 Supplemental Testing Flow Monitoring System

Flowmeter

Quantity	1
Manufacturer	Fisher-Porter
Type	Model 087-615-588
Range	0.4 to 4 scfm at 60 psig and 80°F
Accuracy	± 1% of full scale

1.5 Schematic Arrangement

The arrangement of the four measuring system summarized above is depicted in Appendix A. Drybulb temperature sensors were placed throughout the reactor containment building volume to permit monitoring of internal temperature variations at 30 locations. Dewpoint temperature sensors were placed at 10 locations to permit monitoring of the reactor containment partial pressure of water vapor.

2.0 ERROR ANALYSIS

Utilizing the methods, techniques and assumptions in Appendix G to ANS 56.8-1981, the ISG formula was computed for the absolute method as follows:

a. Conditions

L_a = 0.1%/day

P = 75.786 psia

T = 89.60°F

T_{dp} = 57.13°F

t = 10 hours

b. Total Absolute Pressure: e_p

No. of sensors: 2

Range: 0 to 100 psia

Sensor sensitivity error (E_p): ± 0.001 psia

Measurement system error (ε_p): ± 0.0005 psia

$$e_p = \pm \left[(E_p)^2 + (\varepsilon_p)^2 \right]^{1/2} \Big/ \left[\text{no. of sensors} \right]^{1/2}$$

$$e_p = \pm \left[(1 \times 10^{-3})^2 + (5 \times 10^{-4})^2 \right]^{1/2} \Big/ \left[2 \right]^{1/2}$$

$$e_p = \pm 7.91 \times 10^{-4} \text{ psia}$$

c. Water Vapor Pressure: e_{pv}

No. of sensors: 8

Range: 0 to 200°F

Sensor sensitivity error (E_{pv}): ± 0.01°F

Measurement system error (ε_{pv}) excluding sensor: ± 0.05°F

2.0 ERROR ANALYSIS (Continued)

c. (Continued)

At a dewpoint temperature of 57.13°F, the equivalent water vapor pressure change (as determined from the steam tables) is 8.3×10^{-3} psia per °F.

$E_{pv} = \pm\ 0.01°F \cdot (8.3 \times 10^{-3}$ psia per °F$)$

$E_{pv} = \pm\ 8.3 \times 10^{-5}\ kg/cm^2$

$\epsilon_{pv} = \pm\ 0.05°F \cdot (8.3 \times 10^{-3}$ psia per °F$)$

$\epsilon_{pv} = \pm\ 4.15 \times 10^{-4}$ psia

$$e_{pv} = \pm \left[(E_{pv})^2 + (\epsilon_{pv})^2 \right]^{1/2} \Big/ \left[\text{no. of sensors} \right]^{1/2}$$

$$e_{pv} = \pm \left[(8.3 \times 10^{-5})^2 + (4.15 \times 10^{-4})^2 \right]^{1/2} \Big/ \left[8 \right]^{1/2}$$

$e_{pv} = \pm\ 1.50 \times 10^{-4}$ psia

d. Temperature

No. of sensors: 29

Range (calibrated): 60 to 110°F

Sensor sensitivity error (E_T): ± 0.01°F = ± 0.01°R

Measurement system error (ϵ_T), excluding sensor: ± 0.05°F = 0.09°R

$$e_T = \pm \left[(E_T)^2 + (\epsilon_T)^2 \right]^{1/2} \Big/ \left[\text{no. of sensors} \right]^{1/2}$$

$$e_T = \pm \left[(.01)^2 + (.05)^2 \right]^{1/2} \Big/ \left[29 \right]^{1/2}$$

$e_T = \pm\ 9.47 \times 10^{-3}$ °R

2.0 ERROR ANALYSIS (Continued)

e. Instrumentation Selection Guide (ISG)

$$ISG = \pm \frac{2400}{t} \left[2 \left(\frac{e_p}{P}\right)^2 + 2 \left(\frac{e_{pv}}{P}\right)^2 + 2 \left(\frac{e_T}{T}\right)^2 \right]^{1/2}$$

$$ISG = \pm \frac{2400}{10} \left[2 \left(\frac{7.91x10^{-4}}{75.786}\right)^2 + 2 \left(\frac{1.50x10^{-4}}{75.786}\right)^2 + 2 \left(\frac{9.47x10^{-3}}{549.29}\right)^2 \right]^{1/2}$$

$$ISG = \pm 240 \quad (2.18 \times 10^{-10} + 7.84 \times 10^{-12} + 5.94 \times 10^{-10}) \quad 1/2$$

$$ISG = \pm 0.007 \text{ \%/day}$$

The ISG formula does not exceed 0.25 L_a (0.025%/day) and it is therefore concluded that the instrumentation selected was acceptable for use in determining the reactor containment integrated leakage rate.

1982/1983 Refueling Outage Type B and C
Local Leak Rate Test Summary

As part of the 1982/1983 refueling outage, local leak rate tests were performed on the reactor containment building penetrations in accordance with the Fort Calhoun Station Technical Specifications, (Section 3.5), and 10 CFR 50, Appendix J. The testing was performed to identify, measure, and if required, initiate maintenance on potential reactor containment leakage paths; and to ensure the total measured leakage does not exceed the Technical Specification limit of 0.6 L_a, (L_a = Leakage Allowable and .6 L_a = 62,951 standard cubic centimeters per minute). The initial "as found" local leakage which contributes toward the .6 L_a limit and as measured from all local leakage paths was 52,070.68 SCCM. (The individual leak rates for each penetration are tabulated on the attached Tables I thru VI). The final "after maintenance" leak rate was 9,848.71 SCCM.

The Type B tests were conducted by pressurizing the local containment penetration boundaries with air or nitrogen (air for the mechanical penetrations-nitrogen for the electrical penetrations) to Pa, 60 psig accident pressure, and measuring the flow rate which is required to maintain the test volume at Pa. This flow rate is assumed to be the local containment leak rate. The leak rate measurement system uses a series of calibrated rotameters to determine the leakage.

The Type B tests were conducted to measure the leakage through the containment mechanical and electrical penetration seals, and containment building resilient sealed penetrations. These tests were conducted as part of the Fort Calhoun Station Surveillance test program. All tests, by which the following leak rate data was obtained, are filed at the Fort Calhoun Station as QA documents.

The Fuel Transfer Tube leak rate test (ST-CONT-2, F.4) was conducted on 12/31/82 and on 3/22/83. The measured results are tabulated on Table I (attached). Measured leakage does contribute toward the .6 L_a limit.

The electrical penetration leakage was measured as per ST-CONT-2, F.5, using nitrogen as a pressure media. Results are tabulated in Table IV (attached). Measured leakage of the electrical penetrations also contributes to the .6 L_a leakage limit.

The mechanical penetration sleeving was leak tested in accordance with ST-CONT-2, F.2. Results are tabulated on Table V (attached) and contribute to the .6 L_a maximum allowable leakage limit.

The equipment hatch leak rate was tested as outlined in surveillance test ST-CONT-2, F.3. Tests were performed prior to its initial removal and following each replacement; results are tabulated in Table II (attached). Leakage does contribute towards the .6 L_a maximum allowable leakage limit.

The personnel air lock leak rate was tested in accordance with ST-CONT-2, F.1 (the reduced pressure test); these daily tests are on file at the Fort Calhoun Station. The personnel air lock (P.A.L.) was also tested three times since the previous refueling outage (once each six months per ST-CONT-2, F.2). Leakage is tabulated in Table III and does contribute towards the .6 L_a leakage limit.

Type C tests were performed to measure the leakage of containment isolation valves. (Refer to Surveillance Tests ST-CONT-3, F.1, F.2, and F.3). These tests are conducted using air as the test medium; with the exception of penetrations M-16, M-94, M-95, and M-97, which use water as the test medium.

Results of leak rates performed are tabulated on Table VI (attached).

The mechanical sleeves, valves, or other containment penetrations which required significant maintenance are as follows: sleeve M-383-3 and sleeve M-383-4, and valve penetrations M-42, M-58-1, M-79, M-87 and M-88. The work done on each of the penetrations is described below:

M-383-3 - (Safety Injection Recirculation - "Submarine Hull" mechanical sleeve) - Measured leakage at this particular sleeve was found to be 31,148.70 SCCM on 12/18/82. Maintenance order 17707 was immediately issued to investigate and repair the leakage problem. Subsequently, it was discovered that the "submarine hull" manway had been leaking excessively due to very loose manway bolts. The manway flange/bolts were tightened down and a leak rate was measured again on 12/27/82. Leakage measured 12/27/82 was found to be 0 SCCM.

M-383-4 - (Safety Injection Recirculation - "Submarine Hull" mechanical sleeve) - Measured leakage at this sleeve was found to be 400 SCCM on 12/18/82. Although this leakage is not excessive and maintenance was not needed for leakage correction, the HCV-383-4 containment isolation valve contained within the submarine hull needed to have limit switch adjustment. Thus, per M.O. No. 19285, the manhole cover was taken off, maintenance on the limit switches was accomplished, a new manhole gasket was installed, and the manhole flange tightened. A subsequent leak rate measured 3/20/83 verified 0 SCCM leakage at this sleeve.

M-42 - (200 PSI Nitrogen header to containment) - Initial leak rate measured through this penetration (on 12/20/82) was found to be 2,000 SCCM. This is the maximum allowable leakage specified in Table I of ST-CONT-3, F.1 for penetration M-42. Thus, Maintenance Order No. 17727 was written to repair isolation valve HCV-2603A. Upon completion of HCV-2603A repair, a leak rate for penetration M-42 was again obtained. Maintenance Order No. 18077 was initiated for HCV-2603B valve repair. The valve was repaired and a final leak rate of 0 SCCM was measured on 2/25/83.

M-58-1 (Hydrogen Analyzer Isolation Valve) - Initial leak rate measured on penetration M-58 via Test 1 (which tests the inside-reactor-containment isolation valve HCV-884A) revealed a leak rate of 4,000 SCCM. Work was performed on valve HCV-884A (basically resetting the stroke by lengthening the valve stem) under M.O. No. 18696 and leak rate was remeasured 2/22/83. Results revealed a leakage of 5,000 SCCM. Further work on HCV-884A under M.O. No. 18696 was accomplished including a complete valve overhaul and a leak rate was measured again 3/25/83. Final leakage measured 3/25/83 was found to be 0 SCCM.

M-79 (Fill and Makeup to Pressurized Quench Tank) - Initial leak rate on 12/20/82 for penetration M-79 was found to be 2,000 SCCM. Maximum leakage allowable per ST-CONT-3, F.1 is 5,000 SCCM. However, M.O. No. 17171 was initiated for possible valve repair. Subsequently, HCV-1560A was rebuilt/repaired and retested for leakage 12/30/82. Final leakage measured on 12/30/82 was 1.37 SCCM.

M-87 and M-88 - (Containment Purge Inlet and Exhaust Valves) - Initial leak rates for these penetrations were measured 12/10/82 and were as follows: M-87-2,400 SCCM, M-88-900 SCCM. The purge valves were then opened for operational requirements and again closed just prior to the Type A integrated leak rate test. At that time (1/6/83) leak rates were again measured for the penetrations M-87 and M-88 are tabulated as follows: M-87-2,900 SCCM, M-88-6,050 SCCM. After the integrated leak rate test the purge valves were again opened for operational needs, and closed for the final time 3/28/83. At this time, the penetrations were unable to hold 60 psig as required for the Type C leak rate tests. Therefore, the valve seats were adjusted on valves HCV-742A/B/C and D and the leak rates were remeasured. Final results of the 3/28/83 leak rate were as follows: M-87-9 SCCM, M-88-1,000 SCCM.

TABLE I

TYPE B TEST

Fuel Transfer Tube Leak Rate Test - (ST-CONT-2, F.4)

As found leakage measured 12/31/82 = 3.84 SCCM

As left leakage measured 3/22/83 = 3.10 SCCM

TABLE II

TYPE B TEST

Equipment Hatch "O" Seal Test - (ST-CONT-2, F.3)

As Found	As Left
12/16/82 - 0 SCCM	0 SCCM
01/14/83 - 0 SCCM	0 SCCM
01/19/83 - 0 SCCM	0 SCCM
03/26/83 - 3.44 SCCM	3.44 SCCM

TABLE III

TYPE B TEST

Personnel Air Lock Leak Rate Test (ST-CONT-2, F.2)

Date Tested	Leakage Measured
1/29/82	3,200 cc
7/27/82	4,200 cc
4/12/83	3,150 cc

TABLE IV

TYPE B TEST

Electrical Penetrations - (ST-CONT-2, F.5)

Penetration	As Found (SCCM)	As Left (SCCM)
A-1	0	0
A-2	0	0
A-4	0	0
A-5	0	0
A-6	0	0
A-7	0	0
A-8	0	0
A-9	0	0
*A-10	0	0
A-11	0	0
B-1	0	0
B-2	0	0
B-4	40.3	0
B-5	0	0
B-6	0	0
B-7	0	0
B-8	0	0
B-9	0	0
B-10	0	0
B-11	0	0
C-1	0	0
C-2	0	0
C-4	0	0
C-5	0	0
C-6	0	0

Penetration	As Found (SCCM)	As Left (SCCM)
C-7	0	0
C-8	0	0
C-9	0	0
C-10	0	0
C-11	0	0
D-1	0	0
D-2	0	0
D-4	0	0
D-5	0	0
D-6	0	0
D-7	0	0
D-8	0	0
D-9	0	0
D-10	0	0
*D-11	0	0
E-1	0	0
E-2	0	0
E-4	0	0
E-5	0	0
E-6	0	0
E-7	0	0
E-8	0	0
E-9	0	0
E-10	0	0
**E-11	0	0
F-1	0	0
F-2	0	0
F-4	0	0

Penetration	As Found (SCCM)	As Left (SCCM)
F-5	0	0
F-6	0	0
F-7	0	0
F-8	0	0
F-9	0	0
F-10	0	0
F-11	0	0
G-1	0	0
G-2	0	0
G-3	0	0
G-4	0	0
H-1	0	0
H-2	0	0
H-3	0	0
H-4	0	0
E-HCV-383-3A	0	0
E-HCV-383-3B	0	0
E-HCV-383-4A	0	0
E-HCV-383-4B	0	0
TOTALS	40.3	0

* These penetrations were tested per ST-CONT-2, F.5 and also tested after installation of the penetrations installed as part of modification MR-FC-81-99, Part III.

** This penetration was tested per ST-CONT-2, F.5 and also as per part of modification FC-82-123. However, in both cases leakage is 0 SCCM.

TABLE V

TYPE B TEST

Mechanical Sleeve Leak Rate (ST-CONT-2, F.6)

Penetration	As Found (SCCM)	As Left (SCCM)
M-1	0	0
M-2	0	0
M-3	0	0
M-4	0	0
M-5	0	0
M-6	0	0
M-7	0	0
M-8	0	0
M-9	0	0
M-10	0	0
M-11	0	0
M-12	0	0
M-13	0	0
M-14	0	0
M-15	0	0
M-16	0	0
M-17	0	0
M-18	0	0
M-19	0	0
M-20	0	0
M-21	0	0
M-22	0	0
M-23	0	0
M-24	0	0

Penetration	As Found (SCCM)	As Left (SCCM)
M-25	0	0
M-26	0	0
M-27	0	0
M-28	0	0
M-29	0	0
M-30	0	0
M-31	2.06	2.06
M-32	0	0
M-33	0	0
M-34	0	0
M-35	0	0
M-36	0	0
M-37	0	0
M-38	0	0
M-39	0	0
M-40	0	0
M-41	0	0
M-42	0	0
M-43	0	0
M-44	0	0
M-45	0	0
M-46	0	0
M-47	0	0
M-48	5.51	5.51
M-49	0	0
M-50	0	0
M-51	0	0
M-52	38.62	38.62
M-53	0	0

Penetration	As Found (SCCM)	As Left (SCCM)
M-54	0	0
M-55	0	0
M-56	0	0
M-57	0	0
M-58	0	0
M-59	0	0
M-60	0	0
M-61	0	0
M-62	0	0
M-63	0	0
M-64	0	0
M-65	0	0
M-66	0	0
M-67	0	0
M-68	0	0
M-69	0	0
M-70	0	0
M-71	0	0
M-72	0	0
M-73	0	0
M-74	0	0
M-75	0	0
M-76	0	0
M-77	0	0
M-78	0	0
M-79	0	0
M-80	0	0

Penetration		As Found (SCCM)	As Left (SCCM)
M-81		0	0
M-82		0	0
M-83		0	0
M-84		0	0
M-85		13.20	13.20
M-86		0	0
M-87		0	0
M-88		0	0
M-89		0	0
M-90		0	0
M-91		0	0
M-92		0	0
M-93		0	0
M-94		300	300
M-95		1000	1000
M-96		500	500
M-97		0	0
M-98		0	0
M-99		0	0
M-383-3		31,148.7	0
M-383-4		400	0
	TOTALS	33,408.09 SCCM	1,859.39 SCCM

TABLE VI

PIPING

TYPE C TEST

Penetration	As Found (SCCM)	As Left/After Maintenance (SCCM)
M-2	0	0
M-7	0	0
M-8	0	0
M-11	80.0	0
M-13	80.0	0
M-14	23.52	23.52
M-15	4.11	0
M-18	150	0
M-19	5.88	0
M-20	0	0
M-22	0	0
M-24	0	0
M-25	3.52	3.52
M-30	35.51	35.0
M-31-1	2.06	2.06
M-31-2	0	0
M-38-1	0	0
M-38-2	5.0	5.0
M-39	17.58	3.79

Penetration	As Found (SCCM)	As Left/After Maintenance (SCCM)
M-40-1	0	0
M-40-2	0	0
M-42	2000	0
M-43	0	0
M-45	1.03	5.38
M-46-1	5.0	5.0
M-46-2	3.46	3.46
M-47-1	0	0
M-47-2	0	0
M-48-1	280	280
M-48-2	5.38	5.38
M-50-1	0	0
M-50-2	31.35	31.35
M-51-1	0	0
M-51-2	22.69	22.69
M-52-1	5.0	0
M-52-2	0	0
M-53	4.82	2.75
M-57-1	0	0
M-57-2	0	0
M-58-1	4000	0
M-58-2	0	0
M-69	0	0
M-72	0	0
M-73	0	0
M-74	2.06	2.06

Penetration		As Found (SCCM)	As Left/After Maintenance (SCCM)
M-79		2000	1.37
M-80		.68	.68
M-86		2100	2100
M-87		2400	0
M-88		900	1000
M-89		1300	1300
HCV-383-3		0	0
HCV-383-4		0	0
	TOTALS	15,468.45 SCCM	4,832.88 SCCM