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NORTHERN STATES POWER COMPANY

MONTICELLO NUCLEAR GENERATING PLANT

REPORT TO THE

UNITED STATES ATOMIC ENERGY COMMISSION

DIRECTORATE OF LICENSING

LICENSE NO. DPR - 22

REACTOR CONTAINMENT BUILDING

INTEGRATED LEAK TEST

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1. Introduction

1.1 Purpose of Containment Leakage Test

As stated in 10 CFR 50, Appendix J, primary containment leakage tests are conducted to assure that:

a) Leakage through the primary reactor containment and systems and components penetrating primary containment shall not exceed allowable leakage rate values as specified in the Technical Specifications or associated Bases.

b) Periodic surveillance of reactor containment penetrations and isolation valves is performed so that proper maintenance and repairs are made during the service life of the containment, and systems and components penetrating primary containment.

Results of containment leakage tests are reported to the Directorate of Licensing, USAEC, following each periodic containment integrated leakage test (Type A test). This report must include:

a) Analysis and interpretation of the Type A test results.

b) Results and analysis of the supplemental verification test employed to demonstrate the validity of the leakage rate test measurements.

1.2 Testing Requirements

1.2.1 Frequency of Testing

Type A tests are scheduled in accordance with Paragraph 4.7.A.2 (d) of the Monticello Technical Specifications. Testing is required at the following intervals:

a) During the first refueling outage.

b) Within 24 months of the test in (1) above.

c) Within 48 months of the test in (2) above and every 48 months thereafter.

In the event that any testing (local or integrated)yields a leak rate in excess of L_t = 1.2 weight percent of the contained air per 24 hours at the test pressure P_t= 41 psig, the condition must be corrected and the testing schedule reverts to:

a) At the first refueling outage following the retest made (local or integrated) to correct the excess leakage.

b) Within 24 months of the test in (1) above.

c) Within 48 months of the test in (2) above and every 48 months thereafter.

A block valve was provided in the solenoid valve exhaust port and the containment was re-pressurized to 42 psig. Conditions were determined to be sufficiently stable for meaningful and consistent data by 1520. Data was logged hourly and a point-to-point calculation of leakage rate was plotted to detect possible spurious readings. At 2120 on May 14, 30 hours of usable data had been collected and the integrated containment leakage rate test was considered complete.

The controlled bleed verification of the test accuracy was begun at 2125. At 0425 on May 15, sufficient data had been collected to verify the accuracy of the integrated leakage rate test within the allowable accuracy of 10 CFR 50, Appendix J.

The containment was depressurized through the dr well and torus 2-inch vent lines to the Standby Gas Treat ment System. At 1715 on May 15, depressurization was comple ed and the containment was inspected. No damage was discovered.

4. Summary of Test Calculations

4.1 Containment Volume Calculations

The containment volume calculation was based on determination of pressure rise resulting from introduction of a measured quantity of air into the containment during pressurization to 42 psig. The calculation utilized the perfect gas law as corrected for the water vapor present.

a) Containment Volume Calculation Derivation

The initial air density ρ_1 is given by

$$\rho_1 = \frac{M_1}{V} = \frac{(P_1 - \bar{P}_{v1})}{R\ \bar{T}_1}$$

The final air density ρ_2 is given by

$$\rho_2 = \frac{M_1 + M_a}{V} = \frac{(P_2 - \bar{P}_{v2})}{R\ \bar{T}_2}$$

Where

ρ = Density - lbm/ft^3

M = Mass - lbm

V = Volume - ft^3

R = Gas Constant - ft^{3}psi/lbm^{o}R

$\bar{T}$ = Average containment temperative - ^{o}R

P = Containment pressure - psia

$\bar{P}_V$ = Average containment vapor pressure - psia

As gas flow is referred to on a volume basis at a specified condition M_a can be written as

$$M_a = V_a \rho_a$$

Where

V_a = Gas Volume Added - ft^3

ρ_a = Standard Density at 14.7 psia and 519.7 ^oR - lbm/ft^3

Combining the aforementioned equations yields the following equation for the containment volume

$$V = \frac{\rho_a \; V_a}{\left[\frac{(P_2 - \bar{P}_{v2})}{R \bar{T}_2} - \frac{(P_1 - \bar{P}_{v1})}{R \bar{T}_1} \right]}$$

Containment pressure, average vapor pressure, and average temperature were provided by the installed test equipment. The amount of air added to the containment was determined over an 8 hour period while pressurizing for the integrated leak rate test. A Turbo Meter and TEM Factor with a least counts readability of 1000 ft^3 were used. Test data and results are presented in Appendix D.

4.2 Type A Calculations

Each hour during the integrated containment leakage test and during the accuracy verification test, the following calculations were made to determine the point-to-point method leak rate.

a) Containment Absolute Pressure

CONTAINMENT PRESSURE (psia) = $P_{BAR} + P_{PI-2}$

P_{BAR} = Local Barometric Pressure (psia)

P_{PI-2} = Drywell Wallace Tiernan Gauge Pressure (psig)

b) Containment Average Temperature (^OR) =

$$\sum_{i=1}^{i=20} w_i t_i + 459.72$$

w_i = Weighting factor for RTD_i from (tables 1 & 2)

t_i = Computer reading of RTD_i (^OF)

c) Containment Average Vapor Pressure

WEIGHTED AVERAGE CONTAINMENT VAPOR PRESSURE (inches water) =

$$\sum_{i=1}^{i=6} w_{vi} \, P_{vi}$$

w_{vi} = weighting factor for dewcel i (Tables 1 & 2)

P_{vi} = Computer reading (inches water) for dewcel i

d) Containment - Reference Chamber Δp

CONTAINMENT - REF CHAMB DIFF PRES (inches water) =

$$L_{RL} - L_{LL}$$

L_{RL} = Right leg level (inches) of DPI-1

L_{LL} = Left leg level (inches) of DPI-1

e) Leak Rate Calculation

CONTAINMENT LEAKAGE RATE (WT%/24-HR) =

$$\frac{2400}{h}\left[\frac{T_1}{T_2}\frac{(\Delta P_2 + P_{v2})}{(P_1 - P_{v1})} - \frac{\Delta P_1 + P_{v1}}{P_1 - P_{v1}}\right]$$

T_1 = Average absolute containment temperature at start of interval (^oR)

T_2 = Average absolute containment temperature at end of interval (^oR)

ΔP_1 = Containment-ref chamb dp at start of interval (inches water)

ΔP_2 = Containment-ref chamb dp at end of interval (inches water)

P_{v1} = Containment vapor pressure at start of interval (inches water)

P_{v2} = Containment vapor pressure at end of interval (inches water)

P_1 = Absolute containment pressure at start of interval (inches water)

h = Length of interval (hours)

Derivation of the leakage rate equation may be found in ANSI N-45.4-1972, Appendix B.

The purpose of the hourly calculations was to construct a plot of point-to-point leakage rate (Figure A-1). This plot was useful in detecting trends or possible anomalies. The actual containment leakage rate, however, was taken as the average of data comparisons from six 24-hour intervals. The first six hours of data following stabilization of the containment atmosphere and the last six hours of data were used for this purpose. All data and calculations for the integrated containment leak rate test are tabulated in Appendix A.

4.3 Calculations for Verification of Type A Test Accuracy

Seven hrs of useful data were taken with a controlled leakage rate established in addition to the normal containment leakage rate. The integrated leakage rate test validity was established by comparing L_v' and L_v, where:

$$L_v' = L_c - L_o$$

L_v = Measured integrated leakage rate (wt %/day)

L_c = Leakage measured during controlled bleed (wt%/day)

L_o = Controlled bleed rate (wt%/day)

As described in 10 CFR 50, Appendix J, results from the controlled leak test are acceptable provided $L_v' - L_v$ is less than or equal to $0.25 L_t$. For Monticello with an allowable L_t of 1.2 wt %/day the requirement is that $L_v' - L_v \leq 0.3$ wt %/day.

Throttle valve R (Figure 1) was adjusted for approximately 0.28wt%/day through the controlled bleed rotameter. Rotameter indication and actual bleed rate were related in the following manner:

$$L_o \text{ (wt\%/day)} = \frac{F\, S_{cf}}{V_c} \cdot \frac{14.7}{P_c} \cdot \frac{1440 \text{ min}}{\text{day}} \cdot 100\%$$

F = [Rotameter indicated flowrate] = 1.0 scfm

S_{cf} = [Rotameter scale factor correction for air metered at P_c with 14.7 psia scale] = 1.86

P_c = Average containment absolute pressure during controlled bleed = 55.70 psia

V_c = Containment free air volume during testing = 247,353 ft^3

Data and calculations for the verification phase of the integrated leak rate test are tabulated in Appendix B.

5. Error Analysis

5.1 Type A Test Error Analysis

The assumptions for the type A test error analysis and the derivation of the type A test error relation are as reported in the summary technical report submitted May 1973 entitled REACTOR CONTAINMENT BUILDING INTEGRATED LEAK TEST MAY 1973. The estimated variance for each type A test measurement are as given below:

a) Estimate of σ^2 (T)

All temperature measurements were obtained with ALPHA-LINE RTD transmitters connected to the plant process computer. This system has an accuracy over the range of 60° F to 170°F of at least 0.10° F. Therefore:

$$\sigma^2(ti) = \left(\frac{0.10}{2}\right)^2 = 2.5 \times 10^{-3} \ {}^{o}R^2$$

Using the weighting factors from Tables 1 and 2.

$$T = \sum_{1}^{20} witi$$

$$\sigma^2(T) = \sum_{1}^{20'} wi^2 \ \sigma^2 (ti) = (6.7 \times 10^{-2}) \ (2.5 \times 10^{-3}) = 1.67 \times 10^{-4} \ {}^{o}R^2$$

b) Estimate of σ^2 (P)

The Wallace Tiernan gauge used to measure the containment pressure is readable to 0.012 PSIG and has a certified accuracy of 0.04 PSIG. The barometric pressure instrument is readable to 0.01 INCHES and has an equivalent accuracy when corrected for temperature effects on the density of mercury and on scale distortion. The combined error is given by:

$$\sigma^2 (P) = \left[\left(\frac{0.012}{2}\right)^2 + \left(\frac{0.04}{2}\right)^2 + \left(\frac{(0.01)\ (.491)}{2}\right)^2 + \left(\frac{(0.01)\ (.491)}{2}\right)^2\right]$$

$$\sigma^2 (P) = 44.86 \times 10^{-5} \quad Psi^2$$

$$\sigma^2 (P) = 0.3440 \quad in \ H_2O^2$$

c) Estimate of σ^2 (ΔP)

The water filled manometer is readable to within 0.02- inches water. Considering that left and right legs of the manometer had to be read gives:

$$\sigma^2 (\Delta P) = \sigma^2 (L_{LL}) + \sigma^2 (L_{RL})$$

$$= 2\ (0.02/2)^2 = 2x10^{-4} \ (\text{inches water})^2$$

d) Estimate of σ^2 (Pv)

All vapor pressure measurements were obtained with Foxboro type 2701 RPG DEWCELS connected through resistance-current converters and special RTD processing boards to the plant computer. The DEWCELS are certified to an accuracy of at least 0. 1% and the resulting system error will not exceed 0.2 - INCHES WATER vapor pressure. Therefore:

$$P_v = \sum_1^6 w_{vi} P_{vi}$$

$$\sigma^2(P_v) = \sum_1^6 w_{vi}^2 \sigma^2 (P_{vi})$$

$$= \sum_1^6 w_{vi}^2 \left(\frac{0.2}{2}\right)^2$$

Using the weighting factors from Tables 1 and 2

$$\sigma^2(P_v) = 1.86 \times 10^{-3} \quad (\text{INCH } H_2O)^2$$

5.2 Estimate of Type A Test Error

The overall measurement error is determined using the individual measurement variances in 5.1 and the following parameters obtained from the test data:

$\bar{L}_6$ = 0.25198 wt %/day

P_o = 1550.65 inches water

$\bar{P}_v$ = 7.56 inches water

$\Delta\bar{P}_2$ = 4.57 inches water

$\bar{T}$ = 527.43 ^oR

The standard deviation becomes

$$\sigma(L) = 0.00413 \text{ wt\%/day}$$

The estimated test error at the 95% confidence level is

$$\pm \frac{2\sigma(L)}{\sqrt{6}} = 0.00331 \text{ wt\%/day}$$

The validity of the error analysis can be verified by comparing each 24 hour data comparison with the interval:

$$\bar{L}_6 \pm 2\sigma(L)$$

All of the data points except one fall in this range. The one point outside the estimated interval is 0.00122 below the lower limit.

5.3 Estimate of Type A Test Verification Error

Measurement of the combined leakage rate during verification of the accuracy of the Type A test was based on the average of seven 1 - hour data comparisons. The expression for estimated standard deviation in this case becomes:

$$\sigma(L_v') = \sqrt{\sigma(L_c)^2 + \sigma(L_o)^2} \quad \text{for one measurement}$$

$$\sigma(L_c) = 24\,\sigma(L) = 24(0.0041) = 0.099 \text{ wt\%/day}$$

$$\sigma(L_o) = \text{variance in rotameter indication}$$

$$= (1\% \text{ of full scale})(4.6 \text{ SCFM}) \frac{S_{cf}\ (1440)(100)}{V_c\ P_c} (1/2)$$

$$= 0.00045 \text{ wt\%/day}$$

$$\sigma(L_v') = \sqrt{\frac{(0.099)^2 + (0.00045)^2}{7}} \quad \text{for average of 7} = 0.0374 \text{ wt\%/day}$$

$$2\sigma(L_v') = 0.0748 \text{ wt\%/day}$$

L_v' can therefore be expressed as:

$L_v' = 0.1774 \pm 0.0748$ at the 95% confidence level

This is in agreement with the test result of 0.25198. Therefore the accuracy of the leakage measuring system is verified and the controlled leakage result is validated.

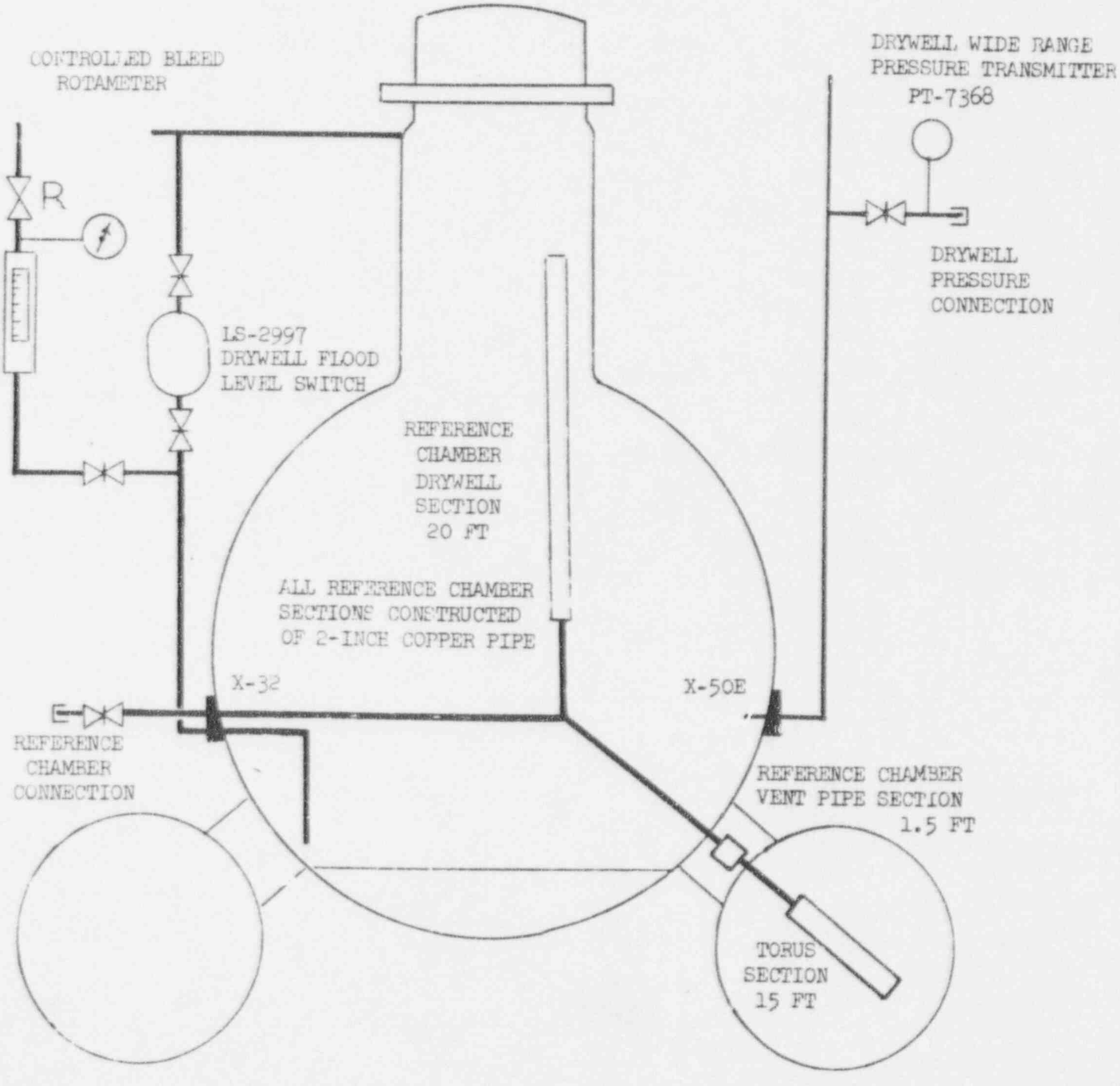

FIG. 1 Cross section of containment vessel showing location of reference chamber and controlled bleed rotometer connection.

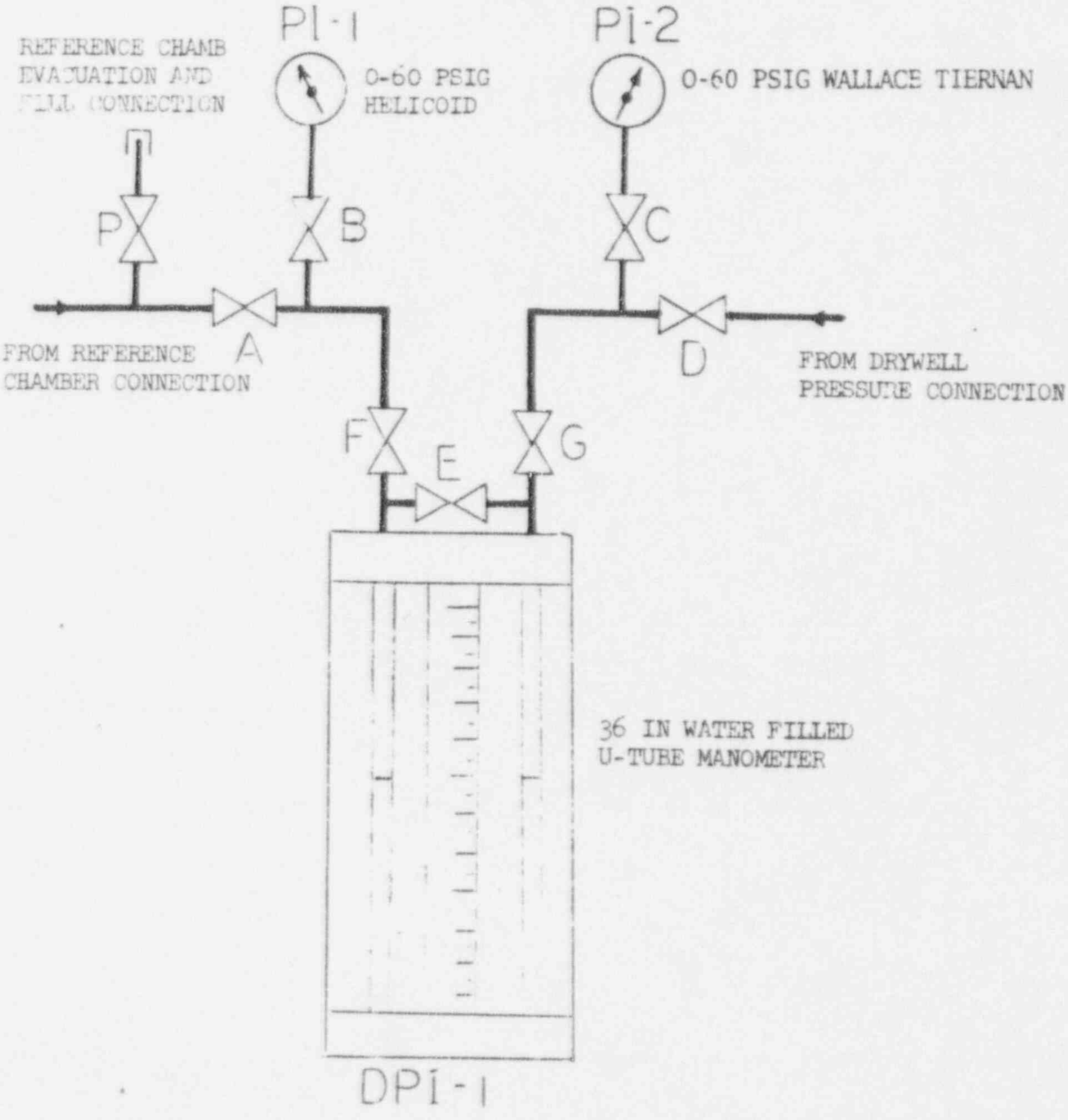

FIG. 2 Installation details of the test manometer and pressure gauges.

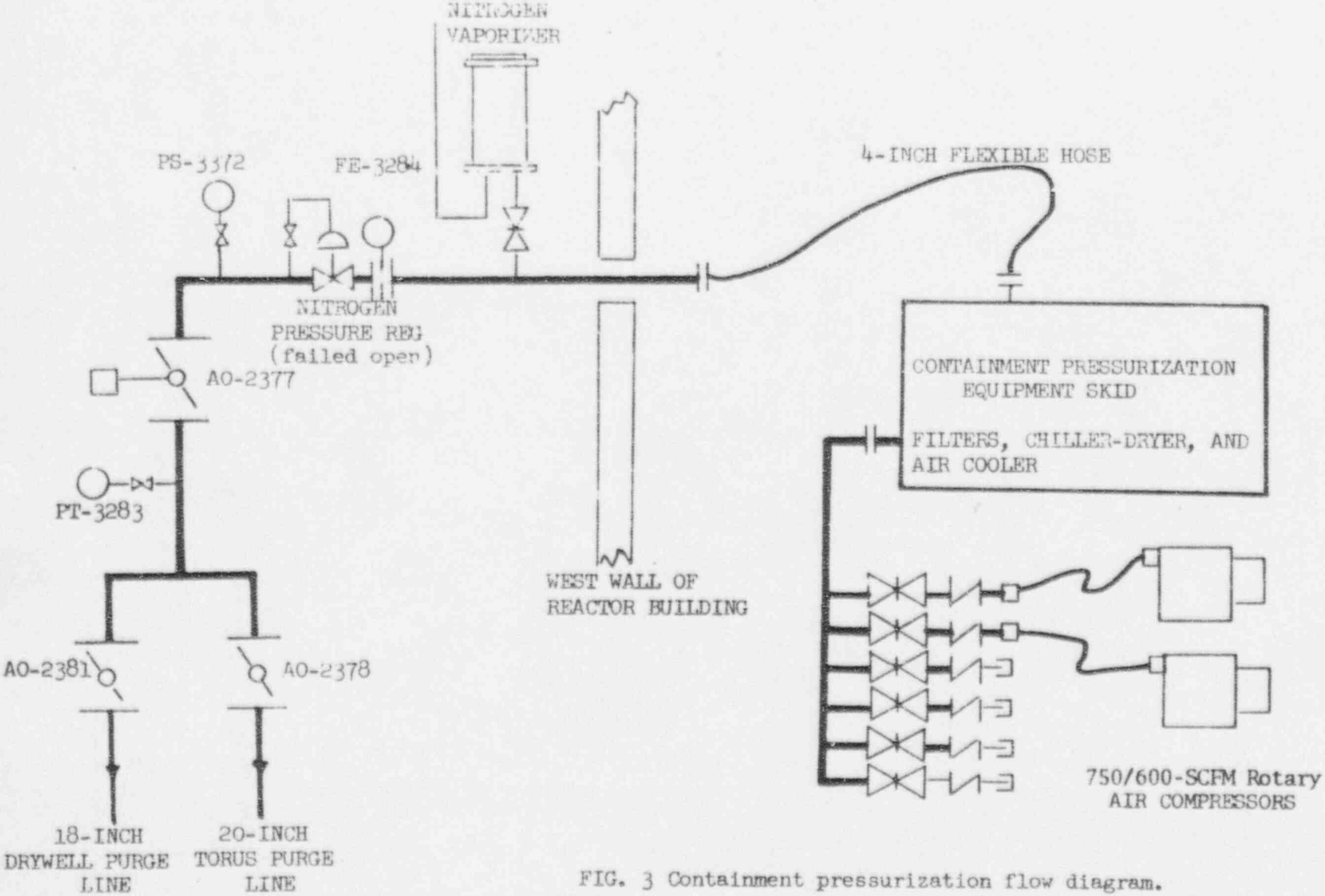

FIG. 3 Containment pressurization flow diagram.

TABLE 1. DRYWELL DEWCELS AND RTD's

Sensor Type	Sensor No.	Computer Point	Location *		Volume Weighting Factor
			Elevation	Azimuth	
Dewcel	3	D534	933	0	.2158
	4	D535	951	90	.2050
	5	D536	966	180	.0787
	6	D537	994	270	.0936
RTD	1	M523	933	0	.0537
	2	M524	933	90	.0537
	3	M525	933	180	.0537
	4	M526	933	270	.0537
	5	M527	951	0	.0513
	6	M528	951	90	.0513
	7	M529	951	180	.0513
	8	M530	951	270	.0513
	9	W564	966	0	.0198
	10	W565	966	90	.0198
	11	W566	966	180	.0198
	12	W567	966	270	.0198
	13	W568	994	0	.0235
	14	W569	994	90	.0235
	15	W570	994	180	.0235
	16	W571	994	270	.0235

TABLE 2. TORUS DEWCELS AND RTD's

Sensor Type	Sensor No.	Computer Point	Location *		Volume Weighting Factor
			Elevation	Azimuth	
Dewcel	1	D538	915	0	.2034
	2	D539	915	180	.2034
RTD	17	W572	915	0	.1017
	18	W573	915	90	.1017
	19	W574	915	180	.1017
	20	W575	915	270	.1017

*Referenced to the drywell floor at 920.5 ft, the torus center line at 912.5 ft, and the drywell airlock at 0 degrees.

TABLE 3 <u>TEST INSTRUMENT DATA</u>

Instrument	Range	Manufacturer	Serial	Certification
Dewcels	-50 to +142°F Dewpoint	FOXBORO 270 1 RG	6 7 DV 248 DV 255 DV 260 DV 316	Manufacturer's certification and comparison check with a certified decade resistance box.
RTD's	-15 to +185°F Ambient	ROSEMOUNT	Serial # 96673 thru 96693	Manufacturer's certification and comparison check with a certified decade resistance box.
Barometer	36" Mercury	MERIAM	G-75731	Manufacturer's certification.
PI-1	0-60 PSIG	Wallace Tiernan	UU-13922	Manufacturer's certification.
PI-2	0-60 PSIG	ACCO HELICOID	2719-0	Compared with certified test device.
DPI-1	36" H_2O	MERIAM	NONE	Manufacturer's certified scale.
Flow Rator	0-4.6 SCFM	FISCHER PORTER	7112 AO 997-A2	Scale verified by testing labratory.
Turbo Meter	1000 SCFM least counts	ROCKWELL T-140	1000056	Manufacturer's recalibration and certification.

APPENDIX A <u>TYPE A TEST DATA AND CALCULATIONS</u>

DATE	TIME	CONTAINMENT PRESS (PSIA)	(IN H_2O)	CONTAINMENT AVERAGE TEMP (^oR)	CONTAINMENT AVG VAPOR PRESS (in H_2O)	CONTAINMENT REF CHAMBER DP (in H_2O)	TEST INTERVAL (HOURS)	CALCULATED Leak RATE (WT % /24 HR)
5-13-74	0110	55.71	1543.72	528.71	7.81	1.71	0	----
	0210	55.60	1540.67	528.55	7.77	4.08	1	3.632
	0310	55.49	1537.62	528.41	7.76	6.22	1	3.341
	0410	55.41	1535.41	528.30	7.74	8.22	1	3.101
	0510	55.34	1534.50	528.21	7.71	10.22	1	3.084
	0610	55.24	1530.70	528.10	7.70	12.31	1	3.278
	0710	55.16	1528.50	528.01	7.66	14.23	1	2.9728
	0810	55.06	1527.80	527.92	7.66	16.22	1	3.14824
	0910	55.01	1524.40	527.82	7.64	17.93	1	2.6818
								↑ Period of Re-Pressurization and stabilization following isolation of leakage ↓
5-13-74	1520	55.98	1551.21	528.49	7.77	0	-	-----
	1620	55.96	1550.65	528.19	7.71	0.20	1	.2247
	1720	55.95	1550.37	528.11	7.71	0.54	1	.5308
	1820	55.94	1550.10	528.04	7.70	0.57	1	.0347
	1920	55.92	1549.49	527.98	7.68	0.70	1	.1726
	2020	55.91	1549.21	527.92	7.64	0.78	1	.06375
	2120	55.87	1548.27	527.86	7.64	0.99	1	.3285
	2220	55.87	1548.25	527.78	7.61	1.15	1	.2048
	2320	55.84	1547.29	527.70	7.60	1.42	1	.4069

APPENDIX A (cont) TYPE A TEST DATA AND CALCULATIONS

DATE	TIME	CONTAINMENT PRESS (PSIA)	CONTAINMENT PRESS (IN H_2O)	CONTAINMENT AVERAGE TEMP (°R)	CONTAINMENT AVG VAPOR PRESS. (IN H_2O)	CONTAINMENT REF CHAMBER DP (IN H_2O)	TEST INTERVAL (HOURS)	CALCULATED LEAK RATE (WT %/24 HR)
5-14-74	0020	55.82	1546.91	527.61	7.58	1.59	1	.2362
	0120	55.82	1546.88	527.52	7.57	1.88	1	.4388
	0220	55.80	1546.40	527.44	7.54	2.04	1	.2049
	0320	55.78	1545.86	527.35	7.52	2.25	1	.2989
	0420	55.78	1545.58	527.29	7.52	2.39	1	.21842
	0520	55.77	1545.30	527.26	7.53	2.58	1	.3129
	0620	55.74	1544.48	527.20	7.50	2.79	1	.2827
	0720	55.71	1543.78	527.14	7.51	2.99	1	.3299
	0820	55.72	1543.91	527.09	7.50	3.10	1	.1578
	0920	55.70	1543.45	527.08	7.50	3.28	1	.2815
	1020	55.71	1543.63	527.06	7.50	3.40	1	.1880
	1120	55.70	1543.45	527.06	7.50	3.60	1	.3125
	1220	55.71	1543.63	527.09	7.52	3.75	1	.2646
	1320	55.71	1543.63	527.10	7.50	3.85	1	.1250
	1420	55.70	1543.45	527.11	7.52	4.05	1	.3434
	1520	55.70	1543.45	527.12	7.52	4.15	1	.1559
	1620	55.70	1543.45	527.13	7.54	4.25	1	.3434
	1720	55.68	1542.76	527.13	7.53	4.49	1	.2813
	1820	55.66	1542.47	527.12	7.54	4.59	1	.2505
	1920	55.65	1542.19	527.09	7.53	4.72	1	.1887
	2020	55.65	1542.05	527.07	7.52	4.89	1	.2509
	2120	55.63	1541.50	527.05	7.52	4.98	1	.1415

APPENDIX A (cont) TYPE A TEST DATA AND CALCULATIONS

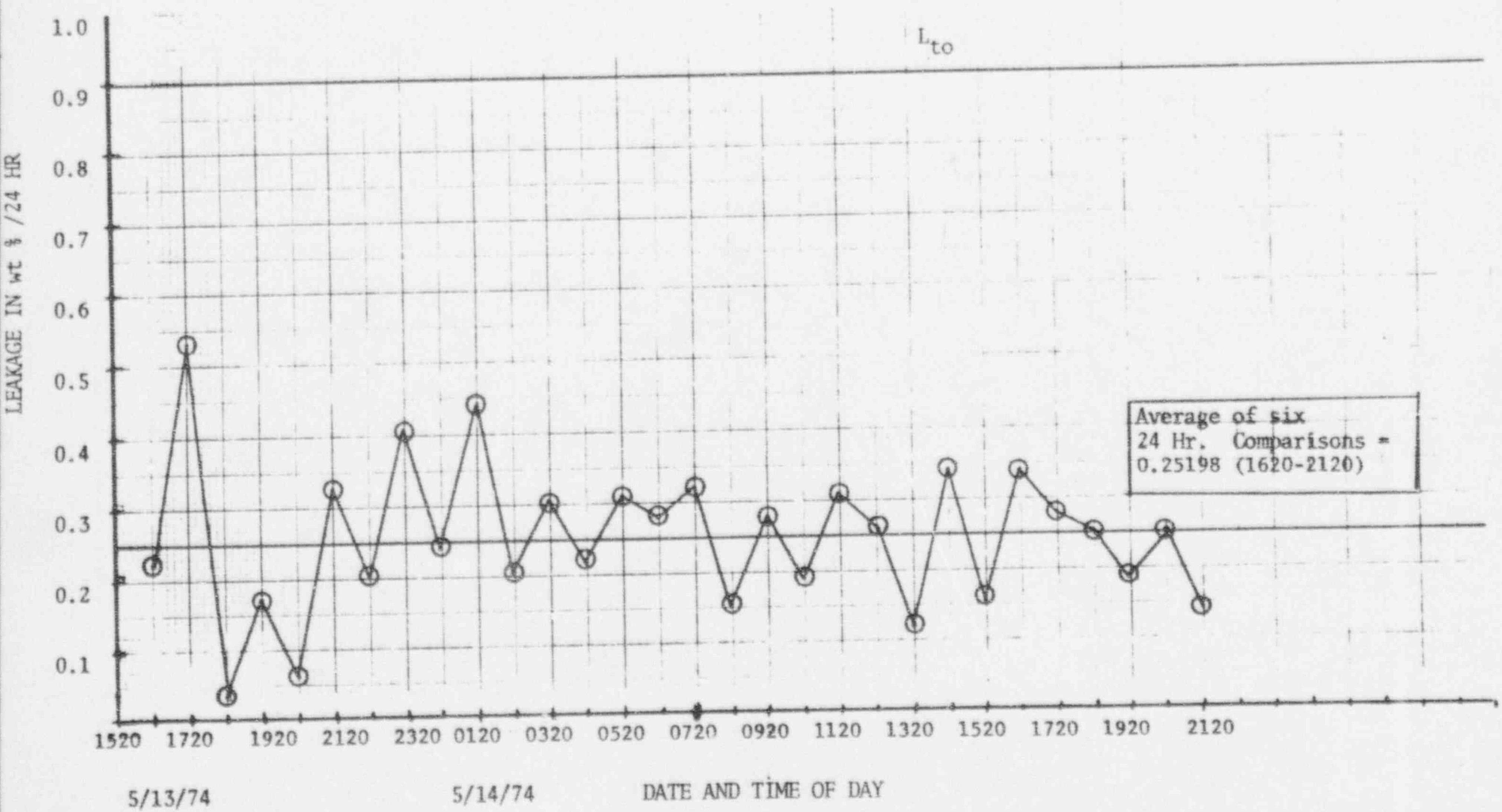

FIG. A-1. Point tc point plot of hourly leak rate calculations

APPENDIX B TYPE A TEST VERIFICATION DATA AND CALCULATIONS

DATE	TIME	CONTAINMENT PRESS (PSIA)	CONTAINMENT PRESS (IN H_2O)	CONTAINMENT AVERAGE TEMP (^oR)	CONTAINMENT AVG VAPOR PRESS. (IN H_2O)	CONTAINMENT REF CHAMBER DP (IN H_2O)	TEST INTERVAL (HOURS)	CALCULATED LEAK RATE (WT % /24 HR)
5-14-74	2125	55.63	1541.50	527.05	7.52	4.98	0	-
	2225	55.62	1541.23	527.02	7.51	5.36	1	.58003
	2325	55.59	1540.36	526.98	7.48	5.58	1	.30197
5-15-74	0025	55.58	1540.12	526.95	7.46	5.90	1	.4709
	0125	55.59	1540.40	526.91	7.46	6.24	1	.5340
	0225	55.58	1540.12	526.87	7.46	6.51	1	.4244
	0325	55.55	1539.29	526.83	7.45	6.85	1	.5184
	0425	55.51	1538.18	526.79	7.45	7.10	1	.3934
								0.4604
								avg of 7

$L_c = 0.4604$ wt%/day

$L_o = 0.2858$

$L_v' = 0.4604 - 0.2858$
$= 0.1746$

$L_v - L_v' = 0.0774$
≤ 0.3

APPENDIX B (cont) TYPE A TEST VERIFICATION DAT' AND CALCULATIONS

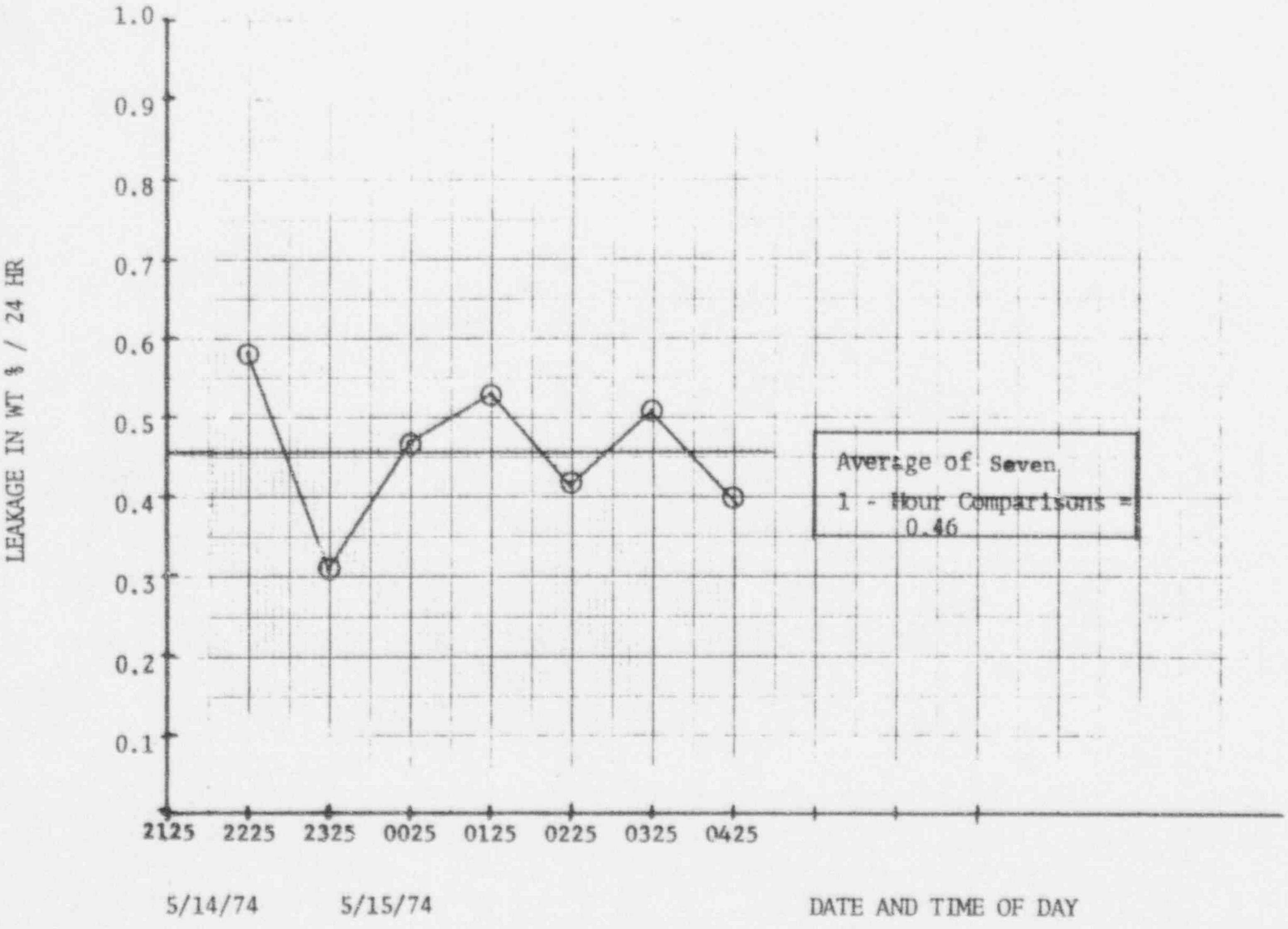

FIG. B-1 Point to point plot of hourly leak rate calculations during controlled bleed test

Appendix C

TYPE B AND TYPE C TEST DATA AND RESULTS

Valve or Penetration	Test Volume (ft^3)	Technical Specification Leakage Limit	Measured Leak Rate (SCFH)	
			As Found *	As Left
X-100A	2.26	17.2 SCFH @ 41 psig	0.047	0.047
X-100B	2.31	17.2 SCFH @ 41 psig	0.048	0.048
X-100C	1.92	17.2 SCFH @ 41 psig	0.16	0.16
X-100D	2.05	17.2 SCFH @ 41 psig	0.043	0.043
X-101B	1.93	17.2 SCFH @ 41 psig	0.080	0.080
X-101D	1.97	17.2 SCFH @ 41 psig	0.00	0.00
X-103	2.05	17.2 SCFH @ 41 psig	0.00	0.00
X-104A	1.94	17.2 SCFH @ 41 psig	0.081	0.081
X-104B	2.06	17.2 SCFH @ 41 psig	0.0256	0.0256
X-104C	1.93	17.2 SCFH @ 41 psig	0.00	0.00
X-104D	2.05	17.2 SCFH @ 41 psig	0.00	0.00
X-105A	1.92	17.2 SCFH @ 41 psig	0.32	0.32
X-105C	2.05	17.2 SCFH @ 41 psig	0.00	0.00
X-105D	1.93	17.2 SCFH @ 41 psig	0.00	0.00
AO 2541A & AO 2541B	.044	17.2 SCFH @ 41 psig	5.80	5.80
AO 2561A & AO 2561B	.044	17.2 SCFH @ 41 psig	1.79	1.79
N_2 Control System Sample Valves (Note 1)	0.25	17.2 SCFH @ 41 psig	15.03	1.97
CV 3267				
CV 3268 & CV 3269	1.15	17.2 SCFH @ 41 psig	0.141	0.141
MO 2373 & MO 2374	0.973	17.2 SCFH @ 41 psig	487.4	1.53
AO 2-80A	40.74	11.5 SCFH @ 25 psig	73.4	3.35-
AO 2-86A	40.74	11.5 SCFH @ 25 psig	4.75	Combined Leakage
AO 2-80B	40.74	11.5 SCFH @ 25 psig	1.01	1.01
AO 2-86B	40.74	11.5 SCFH @ 25 psig	3.52	3.52
AO 2-80C	40.74	11.5 SCFH @ 25 psig	0.00	0.00
AO 2-86C	40.74	11.5 SCFH @ 25 psig	3.88	3.88

APPENDIX C (cont)

Valve or Penetration	Test Volume(ft³)	Technical Specification Leakage Limit	Measured Leak Rate(SCFH)	
			As Found *	As Left
AO 2-80D	40.74	11.5 SCFH @ 25 psig	4.62	4.62
AO 2-86D	40.74	11.5 SCFH @ 25 psig	5.08	5.08
AO 2379 & DWV 8-2	11.8	17.2 SCFH @ 41 psig	3.23	0.19
AO 2380 & DWV 8-1	11.8	17.2 SCFH @ 41 psig	5.06	4.76
AO 2377 AO 2378 & AO 2381	210	17.2 SCFH @ 41 psig	4.62	2.03
AO 2386 AO 2387 & CV 2385	3.7	17.2 SCFH @ 41 psig	0.56	0.56
AO 2896 AO 2383 & CV 2384	3.7	17.2 SCFH @ 41 psig	3.32	3.32
MO 2034 & MO 2035	10.4	17.2 SCFH @ 41 psig	0.31	0.31
HPC1-9	6.7	17.2 SCFH @ 41 psig	65.6	0.00
HPC1 - 14	0.05	17.2 SCFH @ 41 psig	0.00	0.00
RC1C - 9	1.1	17.2 SCFH @ 41 psig	12.57	9.88
RC1C - 16	0.06	17.2 SCFH @ 41 psig	5.71	5.71
CV 2790 & CV 2791	2.53	17.2 SCFH @ 41 psig	0.48	0.48
MO 2075 & MO 2076	1.46	17.2 SCFH @ 41 psig	0.39	0.39
XP - 6	0.14	17.2 SCFH @ 41 psig	2.08	0.00
MO 2397 & MO 2398	1.7	17.2 SCFH @ 41 psig	0.13	0.13
FW 94-1	19	17.2 SCFH @ 41 psig	1.38	1.38
FW 94-2	19	17.2 SCFH @ 41 psig	6.28	6.28
FW 97-1	6.9	17.2 SCFH @ 41 psig	0.56	0.56
FW 97-2	6.9	17.2 SCFH @ 41 psig	929	0.00
AO 10-46A	44	17.2 SCFH @ 41 psig	27.7	3.21
AO 10-46B	43	17.2 SCFH @ 41 psig	1.95	1.95
MO 2014	81	17.2 SCFH @ 41 psig	2.04	2.04
MO 2015	77	17.2 SCFH @ 41 psig	3.92	3.92

APPENDIX C (cont)

Valve or Penetration	Test Volume (ft^3)	Technical Specification Leakage Limit	Measured Leak Rate (SCFH) As Found *	Measured Leak Rate (SCFH) As Left
MO 2020 & MO 2022	5.9	17.2 SCFH @ 41 psig	0.41	0.41
MO 2021 & MO 2023	13.7	17.2 SCFH @ 41 psig	0.07	0.07
MO 2026 & MO 2027	1.23	17.2 SCFH @ 41 psig	0.00	0.00
MO 2029	20.8	17.2 SCFH @ 41 psig	0.34	0.34
MO 2030	83.7	17.2 SCFH @ 41 psig	10.2	10.2
MO 1753	8.3	17.2 SCFH @ 41 psig	0.02	0.02
MO 1754	7.13	17.2 SCFH @ 41 psig	1.96	1.96
AO 14-13A	2.5	17.2 SCFH @ 41 psig	331	15.82
AO 14-13B	1.7	17.2 SCFH @ 41 psig	396	2.62
CRD-31	1.2	17.2 SCFH @ 41 psig	4.7	4.7
Airlock	380	Ensure sealing @ 10 psig	0.00	0.00
Airlock Electrical Penetration	.042	17.2 SCFH @ 41 psig	0.09	0.09
Torus Manway Norhteast	Note 2	Note 3	0.00	0.07 Note 4
Torus Manway Southwest	Note 2	Note 3	0.00	0.07 Note 4
Drywell Head	Note 2	Note 3	0.00	0.00
Drywell Head Manway	Note 2	Note 3	0.52	0.52
CRD Manway	Note 2	Note 3	10.3	0.09
Drywell Equipment Hatch	Note 2	Note 3	0.82	1.51 Note 4
Seismic Pertraint Port A	Note 2	Note 3	0.18	0.18
Seismic Pertraint Port B	Note 2	Note 3	0.00	0.00

APPENDIX C (cont)

Valve or Penetration	Test Volume(ft^3)	Technical Specification Leakage Limit	Measured Leak Rate(SCFH)	
			As Found *	As Left
Seismic Restraint Port C	Note 2	Note 3	0.00	0.00
Seismic Restraint Port D	Note 2	Note 3	2.66	2.66
Seismic Restraint Port E	Note 2	Note 3	0.02	0.02
Seismic Restraint Port F	Note 2	Note 3	0.02	0.02
Seismic Restraint Port G	Note 2	Note 3	0.02	0.02
Seismic Restraint Port H	Note 2	Note 3	1.67	1.67
X-7A Inboard	Note 2	17.2 SCFH @ 41 psig	0.03	0.03
X-7A Outboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00
X-7B Inboard	Note 2	17.2 SCFH @ 41 psig	1.13	1.13
X-7B Outboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00
X-7C Inboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00
X-7C Outboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00
X-7D Inboard	Note 2	17.2 SCFH @ 41 psig	0.87	0.87
X-7D Outboard	Note 2	17.2 SCFH @ 41 psig	0.22	0.22
X-8A Inboard	Note 2	17.2 SCFH @ 41 psig	0.12	0.12
X-8A outboard	Note 2	17.2 SCFH @ 41 psig	0.03	0.03
X-9A Inboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00

APPENDIX C (cont)

Valve or Penetration	Test Volume (ft^3)	Technical Specification Leakage Limit	Measured Leak Rate (SCFH)	
			As Found*	As Left
X-9A Outboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00
X-9B Inboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00
X-9B outboard	Note 2	17.2 SCFH @ 41 psig	1.28	1.28
X-10 inboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00
X-10 outboard	Note 2	17.2 SCFH @ 41 psig	0.03	0.03
X-11 inboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00
X-11 outboard	Note 2	17.2 SCFH @ 41 psig	0.07	0.07
X-12 inboard	Note 2	17.2 SCFH @ 41 psig	0.56	0.56
X-12 outboard	Note 2	17.2 SCFH @ 41 psig	0.32	0.32
X-13A inboard	Note 2	17.2 SCFH @ 41 psig	0.48	0.48
X-13A outboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00
X-13B inboard	Note 2	17.2 SCFH @ 41 psig	0.00	0.00
X-13B outboard	Note 2	17.2 SCFH @ 41 psig	0.17	0.17
X-14 Inboard	Note 2	17.2 SCFH @ 41 psig	0.01	0.01
X-14 outboard	Note 2	17.2 SCFH @ 41 psig	0.01	0.01
X-16A inboard	Note 2	17.2 SCFH @ 41 psig	0.57	0.57
X-16A outboard	Note 2	17.2 SCFH @ 41 psig	0.13	0.13
X-16B inboard	Note 2	17.2 SCFH @ 41 psig	1.17	1.17
X-16B outboard	Note 2	17.2 SCFH @ 41 psig	0.56	0.56
X-17 Inboard	Note 2	17.2 SCFH @ 41 psig	0.05	0.05

APPENDIX C (cont)

Valve or Penetration	Test Volume (ft^3)	Technical Specification Leakage Limit	Measured Leakage Rate (SCFH)	
			As Found*	As Left
X-17 outboard	Note 2	Note 3	0.04	0.04

NOTES: 1. The following valves were tested as a group by pressurizing a common drain line manifold

CV 3305 & CV 3306

CV 3307 & CV 3308

CV 3309 & CV 3310

CV 3311 & CV 3312

CV 3313 & CV 3314

2. The volumes of the toroidal spaces in the double-gasketed seals are uncertain due to the presence of flexible rubber, and in any case are quite small. For all seals except the drywell head, the volume of the test rig was used as the test volume. For the drywell head, twice the volume of the test rig was used as the test volume.

The expansion bellows penetration similarly have a small volume and the volume of the test rig was used as the test volume.

3. The Technical Specification for double-gasketed seals is that the total leakage not exceed 34.4 scfh/hr @ 41 psig. No specification is given for an individual double-gasketed seal.

4. The "as left" leak rate for these penetrations was the leak rate measured immediately prior to the integrated leakage rate test. All Type B penetrations opened for the outage were retested when closed.

* Refueling outage valve leakage problems and corrective measures are summarized in Mr. L.O. Mayer's letter to Mr. J.F.O'Leary dated May 20,1974.

APPENDIX D Containment Volume Data and Calculations

Date	Time	Flowmeter Reading ft^3	Containment Pressure psia	Containment Avg Temperature ^{o}R	Containment Avg Vapor Pres psia	Calculated Volume ft^3
5/12/74	1330	121704	18.56	528.45	0.284	-
	1430	121777	22.76	529.02	0.288	260753
	1530	121842	27.21	529.10	0.290	218881
	1630	121924	31.36	529.20	0.291	296023
	1730	122988	36.57	529.38	0.291	183776
	1830	122059	40.18	529.51	0.291	294949
	1930	122129	44.38	530.06	0.291	252314
	2030	122205	48.78	530.41	0.291	260778
	2130	122266	53.08	530.27	0.290	211355

Average of eight 247353 ft^3