REACTOR CONTAINMENT BUILDING
INTEGRATED LEAK RATE TEST
TYPES A, B, AND C

SURVEILLANCE TEST

VIRGINIA ELECTRIC AND POWER COMPANY

SURRY NUCLEAR POWER STATION
UNIT NO. 2

DECEMBER 1981

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REFERENCES

1. 10CFR50 Appendix J, Primary Reactor Containment Leakage Testing for Water Cooled Power Reactors, April 19, 1976

2. Bechtel Topical Report BN-TOP-1, Rev. 1, Testing Criteria for Integrated Leak Rate Testing of Primary Containment Structures for Nuclear Power Plants, November 1, 1972

3. 2-PT-16.3, Reactor Containment Building Integrated Leak Rate Test, May 14, 1980

4. ANSI 56.8, Containment System Leakage Testing Requirements, February 19, 1981

SECTION 1

PURPOSE

The purpose of this report is to present a description and analyses of the Surveillance Types A, B, and C Containment Integrated Leak Rate Test (CILRT) results conducted on the Virginia Electric and Power Company's Surry Nuclear Power Station, Unit No. 2.

This report is submitted as required by 10CFR50 Appendix J, paragraph V.B (Reference 1).

SECTION 2

SUMMARY

2.1 TYPE A TEST

Pressurization for the CILRT was initiated at 2350 hours on December 15, 1981. At approximately 0150 hours on December 16, 1981, it was noted that the pressurization was approximately 3.2 psi/hr. The anticipated pressurization rate, with the combined compressor capacity rated at 9,900 scfm, had been 4.8 to 5 psi/hr. Leakage investigation revealed that MOV-VS-200B was leaking. At 0334 hours, pressurization was secured and MOV-VS-200B was cycled. Pressurization resumed at 0336 hours. Subsequently, the pressurization rate was 4.8 psi/hr. The leakage past MOV-VS-200B was calculated to be 3,000 scfm and it was determined the valve had been partially open.

Test pressure was reached at approximately 1111 hours and pressurization was secured. The containment temperature stabilization criteria were met at approximately 1720 hours. From 1720 hours on December 16, 1981 to 0950 hours on December 18, 1981, the mass trends indicated an unacceptable leakage rate of approximately 1.5 La. During this period, an extensive leakage investigation was conducted. The only major leakage path was identified at electrical penetration A-18. The leakage rate was quantified to be a minimum of 3.5 scfm. At approximately 0950 hours on December 18, 1981, the collar bushing nut on "B" phase wire in penetration A-18 was found to be loose and was tightened. From 1030 hours on December 18, 1981 to 0210 hours on December 19, 1981, the calculated leak rate was acceptable and the requirements of the procedure were satisfied.

At 0440 hours on December 19, 1981, the superimposed leak rate test commenced. At 0840 hours, the calculated containment leak rate satisfied the requirements of the procedure.

Depressurization of the containment started at 1150 hours on December 19, 1981. At 2138 hours, on December 19, 1981, the containment was at atmospheric pressure.

2.2 LOCAL LEAK RATE TESTS (TYPES B AND C)

The local leak rate testing of containment isolation valves and primary containment penetrations was conducted as required by station procedures since the last Type A Test*. The penetrations tested and their associated leak rates are listed in Section 4 of this report.

* The leakage past electrical penetration A-18 initiated a review of the Type B test procedures upon completion of the

Integegrated Leak Rate Test (ILRT). It was determined that the test pressure utilized for testing the electrical penetration cannisters was below Pa. A procedure was developed to require testing of the electrical penetration cannisters to Pa. All cannisters were tested prior to plant operations.

SECTION 3

TYPE A TEST

3.1 EDITED LOG OF EVENTS

December 15, 1981

2350 - Initiated containment pressurization

December 16, 1981

0334 - Secured containment pressurization and cycled MOV-VS-200B

0336 - Restarted pressurization

1102 - Identified leakage path at electrical penetration A-18

1111 - Secured containment pressurization

1720 - Completed stabilization

December 17, 1981

1700 - Quantified leakage at electrical penetration A-18 to be a minimum of 3.75 scfm

December 18, 1981

0800 - Only major leakage path identified - electrical penetration A-18

0950 - Tightened collar bushing nut on A-18 "B" Phase wire - leakage stopped

1030 - Started taking data for ILRT

December 19, 1981

0215 - Completed ILRT

0435 - Started superimposed verification test

0835 - Completed superimposed verification test

1150 - Commenced containment depressurization

2138 - Completed containment depressurization

3.2 GENERAL TEST DESCRIPTION

3.2.1 Prerequisites

In accordance with the Surry Unit No. 2 CILRT procedures, 2-PT-16.3 (Reference 3), the following is a partial listing of the prerequisites that were completed and documented prior to containment pressurization.

1. General inspection of the accessible interior and exterior surfaces of the containment structure was performed.

2. All equipment and instrumentation that could be damaged or destroyed by test pressure was removed or protected.

3. All instrumentation used for test was calibrated within 6 months of the test.

4. Valve line-ups, as required, were completed, including closure of the containment isolation valves.

5. Component cooling and chilled water systems were operable.

6. Plant computers were operational and programmed for the CILRT.

7. The Official Log of Events book was established and available prior to commencement of the test.

8. Site meteorology data was taken for 7 days prior to and throughout the performance of the CILRT.

3.2.2 Equipment and Instrumentation

Pressurization of the containment was achieved by utilization of nine air compressors. Air was piped through two aftercoolers in parallel and a refrigerated air dryer. Instrumentation and valving were installed to maintain proper monitoring and control during pressurization. The total capacity of the pressurization system, as installed, was rated at 9,990 scfm.

During the test, the necessary variables used to determine containment leakage were continually monitored using instrumentation which consisted of multiple resistance temperature detectors (RTDs), chilled mirror dew point indicators, and two absolute pressure quartz manometers (see Appendix 3D).

A mass flowmeter in the service air systems was used during the superimposed verification test. All test instrumentation readings are input into the plant computer for data acquisition and averaging.

3.2.3 Data Acquisition System

The Surry Unit No. 2 utilized a Westinghouse Prodac P250 to scan, log, average, and analyze data received from the containment instrumentation.

The P250 analog scan package reads all the analog inputs in a preestablished manner, converts these readings into engineering units, and then stores these values for use by the plant operators and by the plant application programs. For the CILRT, the P250 plant computer monitored the following instrumentation:

Type	Scan Rate (Sec)
22 RTDs	20
5 chilled mirrors	20
2 quartz manometers	2

Instantaneous values of the CILRT instruments were recorded every 5 minutes during the test period, using the P250 digital trend function on the operator's console.

A 10-minute time average of the readings, calculated by the P250 Average and Integrate (A&I) package, was used as input in the plant computer CILRT programs.

The plant computer CILRT program consists of ILRTDATA, which runs every 10 minutes, collects A&I data for all the instrumentation, performs sensor validity checks, and calculates weighted average dew point temperature, vapor pressure, weighted average containment temperature, and containment air mass.

3.2.4 Data Resolution System

After the appropriate data have been acquired and averaged utilizing the plant computer system, the results are manually input to a remote computer system for leak rate calculations.

3.2.4.1 Absolute Method Mass Point Analysis

The Absolute Method of Mass Point Analysis consists of calculating air masses within the containment structure over a period of time from pressure, temperature, and dew point observations during the CILRT. The air masses are computed using the ideal gas law as follows:

$$M = \frac{(P-Pv)\ V\ (144)}{RT} \qquad \text{(Eq 1)}$$

where:

M = air mass, lb
P = total pressure, psia
Pv = average vapor pressure, psia
R = 53.35 ft lbf/lbm °R (for air)
T = average containment temperature, °R
V = containment free volume, 1.8×10^6 ft^3

The leakage rate is then determined by plotting the air mass as a function of time, using a least-squares fit to determine the slope, A - dM/dt. The leak rate is expressed as a percentage of air mass lost in 24 hours, or symbolically:

$$\text{Leak rate} = A/B\ (-2400) \qquad \text{(Eq 2)}$$

where A is the slope of the least-squares curve and B is the y-intercept. The sign convention is such that an outward leak is positive and the units are in percent/day. The air mass is computed separately, and the result is correlated as a function of time by means of a least-squares fit of the form:

$$m = At + B \qquad \text{(Eq 3)}$$

The slope A and the y-intercept B are then used in Equation 2 to determine the leak rate.

A 95 percent confidence interval is calculated using a T distribution.

The sum of the leakage rate and the 95 percent confidence interval is the Upper Confidence Level (UCL).

The leak rate is less than the UCL with the probability of 95 percent.

3.2.4.2 Absolute Method Total Time Analysis

The absolute method of total time analysis consists of calculating air lost from the containment pressure, temperature, and dew point observations during the CILRT.

The containment air mass is computed using Equation 1 (Section 3.2.4.1).

The measured leakage rate at any time (t) is then determined by subtracting the mass at the time (Mt) from the initial mass (Mi) and dividing by the initial mass. The measured leak rate is

expressed as a percentage of containment mass lost in 24 hours or symbolically:

$$\text{MEA Leak Rate} = \frac{Mi - Mt}{Mi} \frac{(2400)}{(\Delta t)}$$

The sign convention is such that an outward leak is positive and the units are in percent/day.

The estimated leakage rate is then determined by plotting the measured leak rate as a function of time and then performing a least-squares fit of the measured leak rate values as follows:

$$\text{EST Leak Rate} = At + B$$

where A is the slope and B is the y intercept of the least-squares curve.

The 95 percent confidence interval is determined with the T distribution.

This analysis method was used in conjunction with procedure 2-PT-16.3 (Reference 3).

3.3 TEST ANALYSIS

Test data acquired from the start of stabilization to the termination of the superimposed leak verification test are shown as a graph in Appendix 3J.

The graph is divided into the following zones:

Zone A - depicts temperature stabilization period from 1140 hours to 1710 hours on December 16, 1981.

Zone B - depicts unacceptable mass trend from 1710 hours on December 16, 1981 to 1030 hours on December 18, 1981 and also depicts the removal of an RTD from scan.

Zone C - depicts acceptable mass trend from 1030 hours on December 18, 1981 to 0200 hours on December 19, 1981.

Zone D - depicts superimposed verification test from 0440 hours to 0840 hours on December 19, 1981.

An RTD was removed from scan as it was reading below the maximum temperature span required by the procedure.

The unacceptable mass trend shown in Zone B was a result of excessive leakage past electrical penetration A18.

The correction of the leakage past electrical penetration A18 resulted in the acceptable mass trend shown in Zone C.

The leakage rate analysis was performed by Virginia Electric and Power Company's CILRT program (Section 3.2.4). The input data for the VEPCO CILRT program are shown in Appendix 3F.

The Absolute Method Mass Point Analysis (Section 3.4.2) represents the result of the containment leakage rate. The results given in Appendix 3G show that the UCL is 0.03837 percent/day which is within the acceptable limit of 0.073701 percent/day (0.075 less the Type C penalty for valves on systems not rented to the containment).

The Absolute Method Total Time Analysis (Section 3.4.1) is used to determine the acceptability of the CILRT if the test duration is less than 24 hours. The results of the total time analysis are shown in Appendix 3H. The results show the UCL to be 0.072185 percent/day, which is within the acceptable limit of 0.075 percent/day (La).

The following appendices contain the plots provided by this report:

Appendix	Description
3J	Containment air mass vs time (1230 hours on 12/16/81 to 0940 hours on 12/19/81)
3K	Containment leak rate and UCL vs time, mass point analysis (1030 hours on 12/18/81 to 0210 hours on 12/19/81)
3L	Containment leak rate vs time, total time analysis (1030 hours on 12/18/81 to 0210 hours on 12/19/81)

The leakage rate calculations were verified by the superimposed verification test. The test ran from 0440 hours to 0840 hours on December 19, 1981. The computer calculated air mass was within 0.25 La of the metered value and satisfied the procedures.

3.4 TEST RESULTS

3.4.1 CILRT Results - Total Time Method

1.	Leakage rate calculated, Lam	0.043258 percent/day
2.	95 percent upper confidence interval	0.028927 percent/day
3.	UCL, Lam leakage rate with 95 percent confidence interval (1 + 2)	0.072185 percent/day

3.4.2 CILRT Results-Mass Point Method

1.	Leakage rate calculated, Lam	0.037136 percent/day
2.	95 percent upper confidence interval	0.001238 percent/day
3.	UCL, Lam leakage rate with 95 percent confidence interval (1 + 2)	0.038374 percent/day
4.	Type C leakage penalty	0.001299 percent/day
5.	Total reportable Type A leak rate (3 + 4)	0.039673 percent/day

3.4.3 Superimposed Leakage Rate Test Results

1. The Superimposed Leak Rate Test is acceptable if Lc falls within the following range:

$$(Lo + Lam - 0.25\ La) \leq Lc \leq (Lo + Lam + 0.25\ La)$$

where:

Lc	= Containment leakage rate calculated during the verification test	0.122645 percent/day
Lo	= Leakage rate imposed on containment using flow measuring device	0.109090 percent/day

La =	Maximum allowable leakage rate	0.1 percent/day
Lam =	total measured containment leakage rate	0.037136 percent/day

$0.109090 + 0.037136 - 0.025 \leq 0.122645 \leq 0.109090 + 0.037136 + 0.025$

$0.121226 \leq 0.122645 \leq 0.171226$

3.4.4 Types C and B Penetration Leakage to be Added to Containment Calculated Leakage

Penetration No./Leakage (SCFH)

1/0.2 18/0.2
8/0.8 45/0.3
9/1.0
10/1.1

Total Type C leakage to be added	3.88 SCFH
Total Type B leakage to be added	0
Total Types B and C leakage to be added	0.00129 percent/day

NOTE: The above penetrations were in a nonvented valve lineup configuration for this test, with their respective leak rates taken from 2-PT-16.4.

APPENDIX 3A

SITE METEOROLOGY PRIOR TO CILRT

Date	Time	Barometric Pressure (in Hg)	Dew Point (°F)	Dry Bulb (°F)
12/8/81	0000	29.70	35	48
	0400	29.57	37	46
	0800	29.61	39	46
	1200	29.63	32	58
	1600	29.64	25	54
	2000	29.72	22	45
12/9/81	0000	29.75	21	40
	0400	29.75	22	35
	0800	29.82	19	36
	1200	29.80	17	39
	1600	29.80	12	38
	2000	29.86	10	32
12/10/81	0000	29.86	10	29
	0400	29.81	10	27
	0800	29.79	11	27
	1200	29.74	13	35
	1600	29.72	11	37
	2000	29.80	11	30

Date	Time	Barometric Pressure (in Hg)	Dew Point (°F)	Dry Bulb (°F)
12/11/81	0000	29.82	12	31
	0400	29.83	15	31
	0800	29.88	14	29
	1200	29.91	16	34
	1600	29.93	18	36
	2000	29.98	19	26
12/12/81	0000	30.03	20	31
	0400	30.36	20	31
	0800	30.12	20	29
	1200	30.16	24	40
	1600	30.18	20	41
	2000	30.24	18	28
12/13/81	0000	30.26	19	24
	0400	30.31	17	23
	0800	30.33	18	22
	1200	30.34	27	40
	1600	30.31	22	41
	2000	30.31	21	26

Date	Time	Barometric Pressure (in Hg)	Dew Point (°F)	Dry Bulb (°F)
12/14/81	0000	30.30	19	23
	0400	30.27	21	23
	0800	30.23	24	27
	1200	30.12	39	44
	1600	30.02	43	44
	2000	29.91	49	50
12/15/81	0000	29.87	45	45
	0400	29.89	37	37
	0800	29.87	36	36
	1200	29.75	37	37
	1600	29.53	37	37
	2000	29.55	36	37
12/16/81	0000	29.67	31	31

APPENDIX 3B

SITE METEOROLOGY DURING THE CILRT

Date	Time	Barometric Pressure (in Hg)	Dew Point (°F)	Dry Bulb (°F)
12/16/81	0100	29.87	37	38
	0200	29.87	37	38
	0300	29.87	37	38
	0400	29.89	37	38
	0500	29.89	37	38
	0600	30.03	35	39
	0700	30.03	36	40
	0800	30.03	36	40
	0900	30.11	36	48
	1000	30.17	33	45
	1100	30.17	32	45
	1200	30.17	33	44
	1300	30.16	27	50
	1400	30.16	29	46
	1500	30.16	30	47
	1600	30.16	27	48
	1700	30.16	28	47
	1800	30.70	31	37
	1900	30.80	30	36
	2000	30.70	35	41
	2100	30.80	28	31

APPENDIX 3B (CONT'D)

Date	Time	Barometric Pressure (in Hg)	Dew Point (°F)	Dry Bulb (°F)
	2200	30.8	28	33
	2300	30.38	27	27
12/17/81	0000	30.38	26	34
	0100	30.38	29	34
	0200	30.36	32	34
	1300	30.35	31	34
	1400	30.39	32	33
	0500	30.39	32	33
	0600	30.39	32	34
	0700	30.38	32	35
	0800	30.38	29	38
	0900	30.37	30	42
	1000	30.38	31	44
	1100	30.38	29	46
	1200	30.40	31	47
	1300	30.37	32	55
	1400	30.38	30	52
	1500	30.32	32	52
	1600	30.37	38	50
	1700	29.38	43	43
	1800	30.38	42	42
	1900	30.34	41	43

Date	Time	Barometric Pressure (in Hg)	Dew Point (°F)	Dry Bulb (°F)
	2000	30.35	37	50
	2100	30.34	39.5	46
	2200	30.37	39.5	46
	2300	**	**	**
12/18/81	0000	**	**	**
	0100	30.36	35	49
	0200	30.36	35	49
	0300	**	**	**
	0400	30.31	39	50
	0500	30.33	40	48
	0600	30.36	41	46
	0700	30.38	41	46
	0800	30.37	37	44
	0900	30.37	35	37
	1000	30.37	33	44
	1100	30.37	32	41
	1200	30.38	35	39
	1300	30.38	33	38
	1400	30.37	29	41
	1500	30.37	32	41
	1600	30.37	34	39
	1700	30.37	28	33

APPENDIX 3B (CONT'D)

Date	Time	Barometric Pressure (in Hg)	Dew Point (°F)	Dry Bulb (°F)
	1800	30.37	28	33
	1900	30.37	28	38
	2000	30.37	28	34
	2100	30.37	28	34
	2200	30.37	28	32
	2300	30.37	28	31
12/19/81	0000	30.37	28	31
	0100	**	**	**
	0200	30.38	21	34
	0300	**	**	**
	0400	**	**	**
	0500	30.38	21	34
	0600	30.37	24	33
	0700	30.37	18	22
	0800	30.37	18	32
	0900	30.38	18	

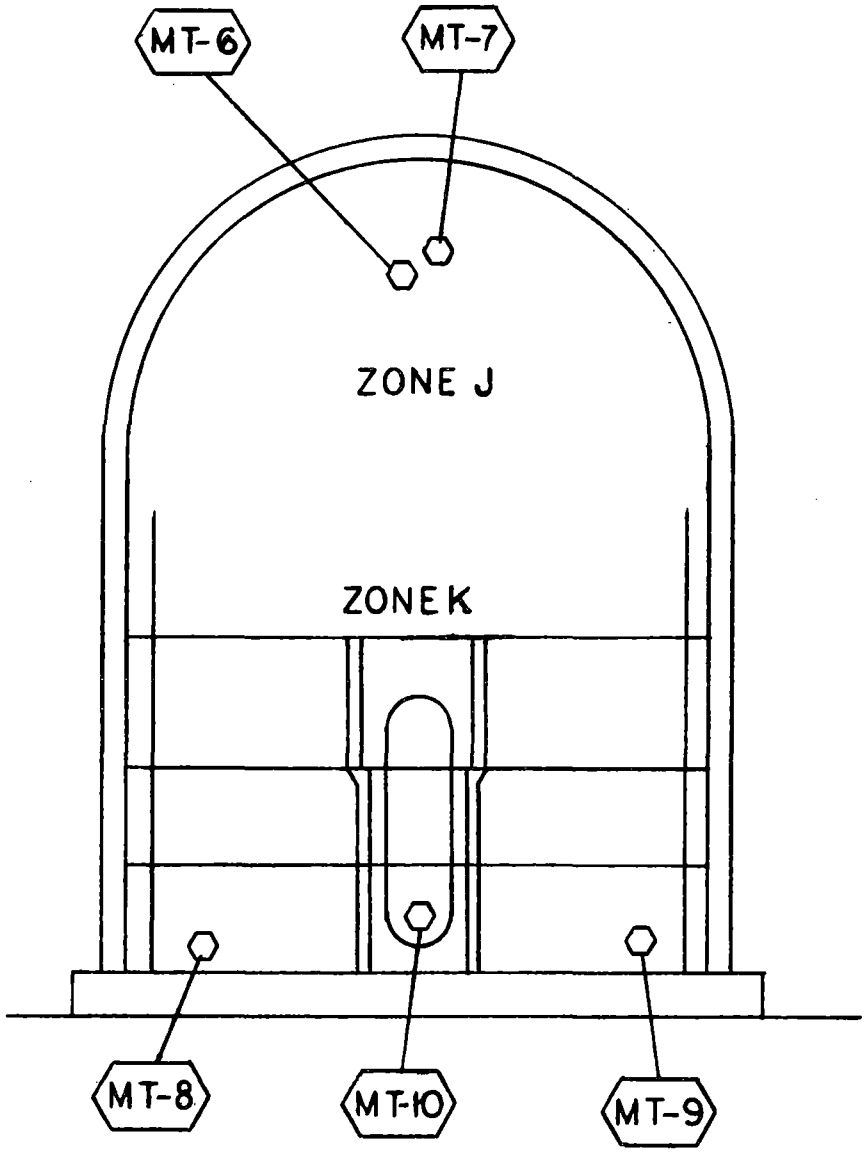
APPENDIX 3C

INSTRUMENTATION TABLE

The following instrumentation was calibrated and functionally tested no greater than 6 months prior to the performance of this test and in accordance with 10CFR50, Appendix J, and Field Calibration Procedures using instrumentation traceable to the National Bureau of Standards.

Instrument	Weight Factor	Computer Point	Range	Zone	Accuracy	Sensitivity
RTD-LM-200-1	0.02683	T1000A	55-105°F	F-1	±0.1°F	±0.09°F
RTD-LM-200-2	0.02322	T1001A	55-105°F	F-2	±0.1°F	±0.09°F
RTD-LM-200-3	0.02427	T1002A	55-105°F	F-3	±0.1°F	±0.09°F
RTD-LM-200-4	0.01820	T1003A	55-105°F	E-3	±0.1°F	±0.09°F
RTD-LM-200-5	0.08884	T1004A	55-105°F	B-1	±0.1°F	±0.09°F
RTD-LM-200-6	0.08884	T1005A	55-105°F	B-2	±0.1°F	±0.09°F
RTD-LM-200-7	0.08884	T1006A	55-105°F	C-1	±0.1°F	±0.09°F
RTD-LM-200-8	0.08884	T1007A	55-105°F	C-2	±0.1°F	±0.09°F
RTD-LM-200-9	0.04975	T1008A	55-105°F	A-1	±0.1°F	±0.09°F
RTD-LM-200-10	0.04975	T1009A	55-105°F	A-2	±0.1°F	±0.09°F
RTD-LM-200-11	0.04975	T1010A	55-105°F	A-3	±0.1°F	±0.09°F
RTD-LM-200-12	0.02460	T1011A	55-105°F	D-1	±0.1°F	±0.09°F
RTD-LM-200-13	0.02460	T1012A	55-105°F	D-2	±0.1°F	±0.09°F
RTD-LM-200-14	0.02460	T1013A	55-105°F	E-1	±0.1°F	±0.09°F
RTD-LM-200-15	0.02460	T4024A	55-105°F	E-2	±0.1°F	±0.09°F
RTD-LM-200-16	0.04766	T4025A	55-105°F	I-1	±0.1°F	±0.09°F
RTD-LM-200-17	0.04766	T4026A	55-105°F	I-2	±0.1°F	±0.09°F
RTD-LM-200-18	0.04766	T4027A	55-105°F	I-3	±0.1°F	±0.09°F

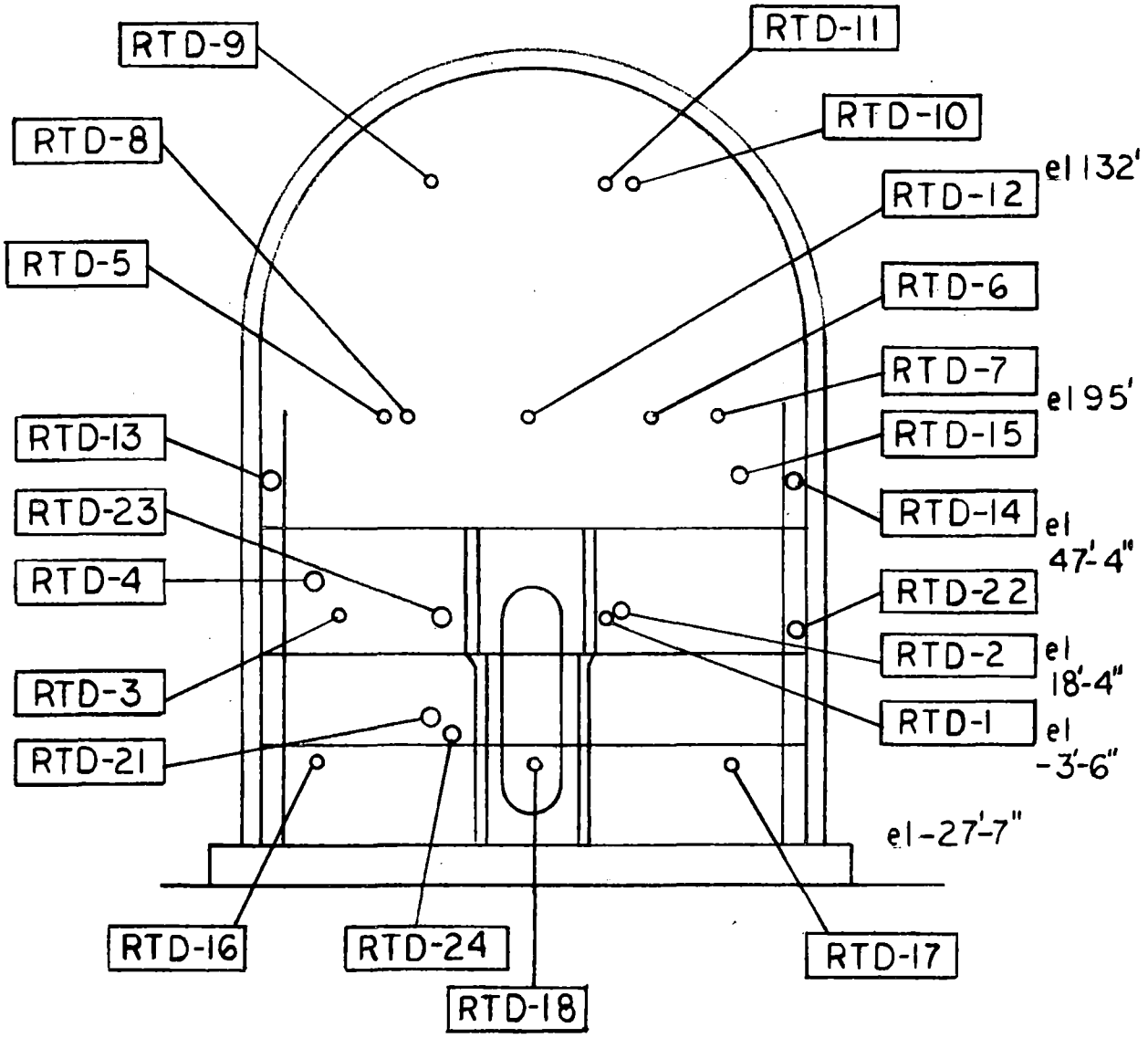
Instrument	Weight Factor	Computer Point	Range	Zone	Accuracy	Sensitivity
RTD-LM-200-21	0.03608	T4009A	55-105°F	H-1	±0.1°F	±0.09°F
RTD-LM-200-22	0.03961	T4020A	55-105°F	H-2	±0.1°F	±0.09°F
RTD-LM-200-23	0.01782	T4021A	55-105°F	G-1	±0.1°F	±0.09°F
RTD-LM-200-24	0.06800	T4022A	55-105°F	G-2	±0.1°F	±0.09°F
MT-LM-200-6	0.14064	T4039A	-40 to +200°F	J-1	±0.4°F	±0.05°F
MT-LM-200-7	0.14064	T4040A	-40 to +200°F	J-2	±0.4°F	±0.05°F
MT-LM-200-8	0.23959	T4041A	-40 to +200°F	K-1	±0.4°F	±0.05°F
MT-LM-200-9	0.23959	T4042A	-40 to +200°F	K-2	±0.4°F	±0.05°F
MT-LM-200-10	0.23959	T4043A	-40 to +200°F	K-3	±0.4°F	±0.05°F
PI-LM-206	0.5	U0960	0-100 psia		±0.068 psia	0.001% °FS
PI-LM-207	0.5	U0961	0-100 psia		±0.068 psia	0.001% °FS



PROFILE VIEW

NOTE:
MT-6 MT-LM-200-6(TYP)

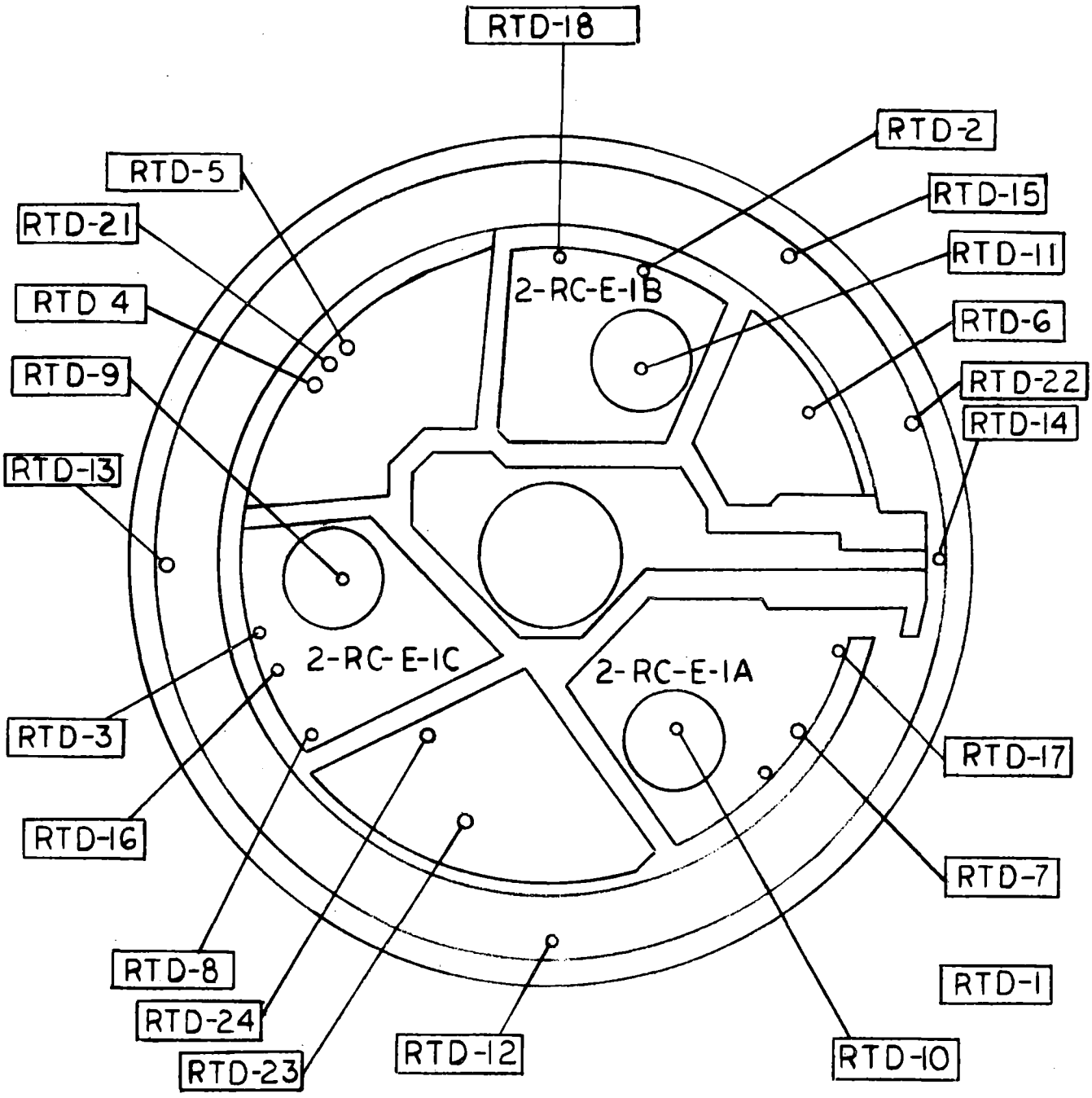
APPENDIX 3D
INSTRUMENTATION LOCATION
DEW POINT SENSORS
SURRY POWER STATION-UNIT 2
INTEGRATED LEAK RATE TEST



PROFILE VIEW

NOTES:
1. RTD-1=RTD-LM-200-1 (TYP)
2. RTD-19, 20 NOT USED

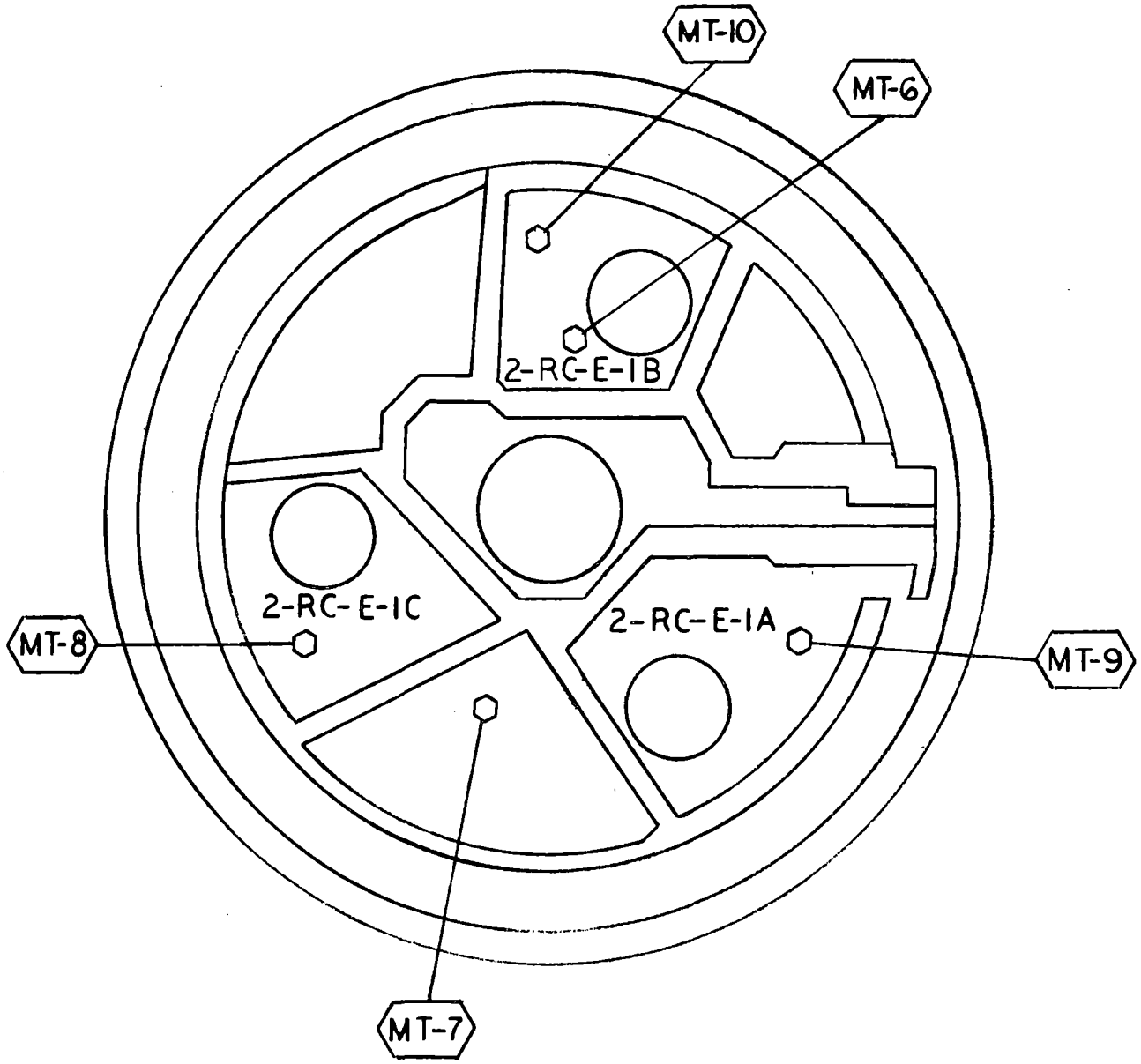
APPENDIX 3D
INSTRUMENTATION LOCATION
RESISTANCE TEMPERATURE
DETECTORS (RTD)
SURRY POWER STATION-UNIT 2
INTEGRATED LEAK RATE TEST



PLAN VIEW

NOTES:
1. RTD-1=RTD-LM-200-1 (TYP)
2. RTD-19,20 NOT USED

APPENDIX 3 E
INSTRUMENTATION LOCATION
RESISTANCE TEMPERATURE
DETECTORS (RTD)
SURRY POWER STATION-UNIT 2
INTEGRATED LEAK RATE TEST



PLAN VIEW

NOTE:
MT-6 MT-LM-200-6 (TYP)

APPENDIX 3E
INSTRUMENTATION LOCATION
DEW POINT SENSORS
SURRY POWER STATION-UNIT 2
INTEGRATED LEAK RATE TEST

APPENDIX 3F

VEPCO SURRY POWER STATION UNIT NO. 2
CONTAINMENT INPUT VARIABLES
1030 HOURS ON 12/18/81 TO 0210 HOURS ON 12/19/81

Time (Hours)	ABS Pressure (Psia)	DEWPT (°F)	Vap Pressure (Psia)	Dry Bulb Temperature (°R)
0.0	60.949	66.42	0.3209	534.33
0.333	60.950	66.43	0.3210	534.34
0.667	60.950	66.45	0.3212	534.33
1.000	60.949	66.46	0.3213	534.32
1.333	60.950	66.47	0.3215	534.34
1.667	60.951	66.50	0.3218	534.34
2.000	60.951	66.50	0.3218	534.35
2.333	60.951	66.52	0.3220	534.36
2.667	60.951	66.52	0.3220	534.35
3.000	60.950	66.53	0.3221	534.34
3.333	60.950	66.56	0.3225	534.35
3.667	60.951	66.56	0.3225	534.36
4.000	60.951	66.57	0.3226	534.37
4.333	60.951	66.58	0.3227	534.37
4.667	60.952	66.57	0.3226	534.38
5.000	60.952	66.60	0.3229	534.38
5.333	60.952	66.60	0.3229	534.38
5.667	60.952	66.60	0.3229	534.38
6.000	60.952	66.61	0.3230	534.38
6.333	60.952	66.62	0.3231	534.39
6.667	60.952	66.62	0.3231	534.40

Time (Hours)	ABS Pressure (Psia)	DEWPT (°F)	Vap Pressure (Psia)	Dry Bulb Temperature (°R)
7.000	60.952	66.62	0.3231	534.39
7.333	60.951	66.63	0.3232	534.39
7.667	60.951	66.64	0.3234	534.39
8.000	60.951	66.63	0.3232	534.39
8.333	60.951	66.64	0.3234	534.39
8.667	60.951	66.63	0.3232	534.40
9.000	60.951	66.64	0.3234	534.40
9.333	60.951	66.65	0.3235	534.40
9.667	60.951	66.64	0.3234	534.40
10.000	60.950	66.62	0.3231	534.40
10.333	60.950	66.65	0.3235	534.40
10.667	60.950	66.64	0.3234	534.40
11.000	60.950	66.64	0.3234	534.40
11.333	60.949	66.65	0.3235	534.40
11.667	60.949	66.67	0.3237	534.40
12.000	60.949	66.65	0.3235	534.41
12.333	60.949	66.64	0.3234	534.41
12.667	60.948	66.64	0.3234	534.40
13.000	60.948	66.65	0.3235	534.40
13.333	60.948	66.64	0.3234	534.41
13.667	60.948	66.64	0.3234	534.41
14.000	60.948	66.64	0.3234	534.40
14.333	60.947	66.63	0.3232	534.41

Time (Hours)	ABS Pressure (Psia)	DEWPT (°F)	Vap Pressure (Psia)	Dry Bulb Temperature (°R)
14.667	60.947	66.63	0.3232	534.40
15.000	60.947	66.62	0.3231	534.41
15.333	60.946	66.63	0.3232	534.40
15.667	60.945	66.63	0.3232	534.40

APPENDIX 3G (CONT'D)

Time (Hours)	Mass (LBM)	Leakage (%/day)	Conf (%/day)	UCL (%/day)
6.333	551221.60	0.041207	0.005040	0.046247
6.667	551211.28	0.042827	0.004825	0.047651
7.000	551221.60	0.041938	0.004463	0.046401
7.333	551211.49	0.042241	0.004076	0.046317
7.667	551210.47	0.042185	0.003728	0.045913
8.000	551211.49	0.041629	0.003467	0.045096
8.333	551210.47	0.040950	0.003264	0.044214
8.667	551201.17	0.041049	0.003018	0.044068
9.000	551200.16	0.040924	0.002801	0.043725
9.333	551199.14	0.040633	0.002620	0.043252
9.667	551200.16	0.040047	0.002509	0.042556
10.000	551193.10	0.039884	0.002349	0.042233
10.333	551190.05	0.039749	0.002204	0.041953
10.667	551191.06	0.039353	0.002104	0.041457
11.000	551191.06	0.038825	0.002045	0.040870
11.333	551180.96	0.038826	0.001926	0.040752
11.667	551178.92	0.038772	0.001818	0.040590
12.000	551170.64	0.039022	0.001736	0.040758
12.333	551171.66	0.039023	0.001643	0.040666
12.667	551172.88	0.038812	0.001571	0.040383
13.000	551171.86	0.038538	0.001515	0.040053
13.333	551162.57	0.038591	0.001441	0.040033
13.667	551162.57	0.038509	0.001374	0.039883

Time (Hours)	Mass (LBM)	Leakage (%/day)	Conf (%/day)	UCL (%/day)
14.000	551172.88	0.037888	0.001442	0.039330
14.333	551154.49	0.037961	0.001377	0.039338
14.667	551164.81	0.037524	0.001382	0.038906
15.000	551155.51	0.037375	0.001329	0.038704
15.333	551155.72	0.037137	0.001292	0.038430
15.667	551146.62	0.037136	0.001238	0.038374

APPENDIX 3G

VEPCO SURRY POWER STATION UNIT NO. 2
LEAK RATE DATA
INTEGRATED LEAK RATE TEST FROM
1030 HOURS ON 12/18/81 TO 0210 HOURS ON 12/19/81

49 DATA SETS

ABSOLUTE TEST METHOD - MASS POINT ANALYSIS

Time (Hours)	Mass (LBM)	Leakage (%/day)	Conf (%/day)	UCL (%/day)
0.0	551276.49	0.0	0.0	0.0
0.333	551274.26	0.0	0.0	0.0
0.667	551282.55	-0.039582	0.339245	0.299663
1.000	551282.76	-0.035414	0.052661	0.017247
1.333	551270.21	0.005280	0.060467	0.065747
1.667	551276.26	0.004864	0.035836	0.040700
2.000	551265.95	0.018629	0.028814	0.047443
2.333	551253.60	0.036246	0.028634	0.064881
2.667	551263.92	0.033067	0.021901	0.054968
3.000	551264.13	0.029497	0.017572	0.047069
3.333	551250.77	0.034141	0.014974	0.049115
3.667	551249.55	0.036121	0.012491	0.048612
4.000	551238.22	0.041005	0.011622	0.052628
4.333	551237.20	0.043284	0.010152	0.053436
4.667	551236.99	0.043750	0.08749	0.052498
5.000	551233.94	0.043975	0.007612	0.051587
5.333	551233.94	0.043268	0.006720	0.049988
5.667	551233.94	0.042011	0.006080	0.048091
6.000	551232.93	0.040659	0.005586	0.046245

APPENDIX 3H

VEPCO SURRY POWER STATION UNIT NO. 2
LEAK RATE DATA
INTEGRATED LEAK RATE TEST FROM
1030 HOURS ON 12/18/81 TO 0210 HOURS ON 12/19/81

49 DATA SETS

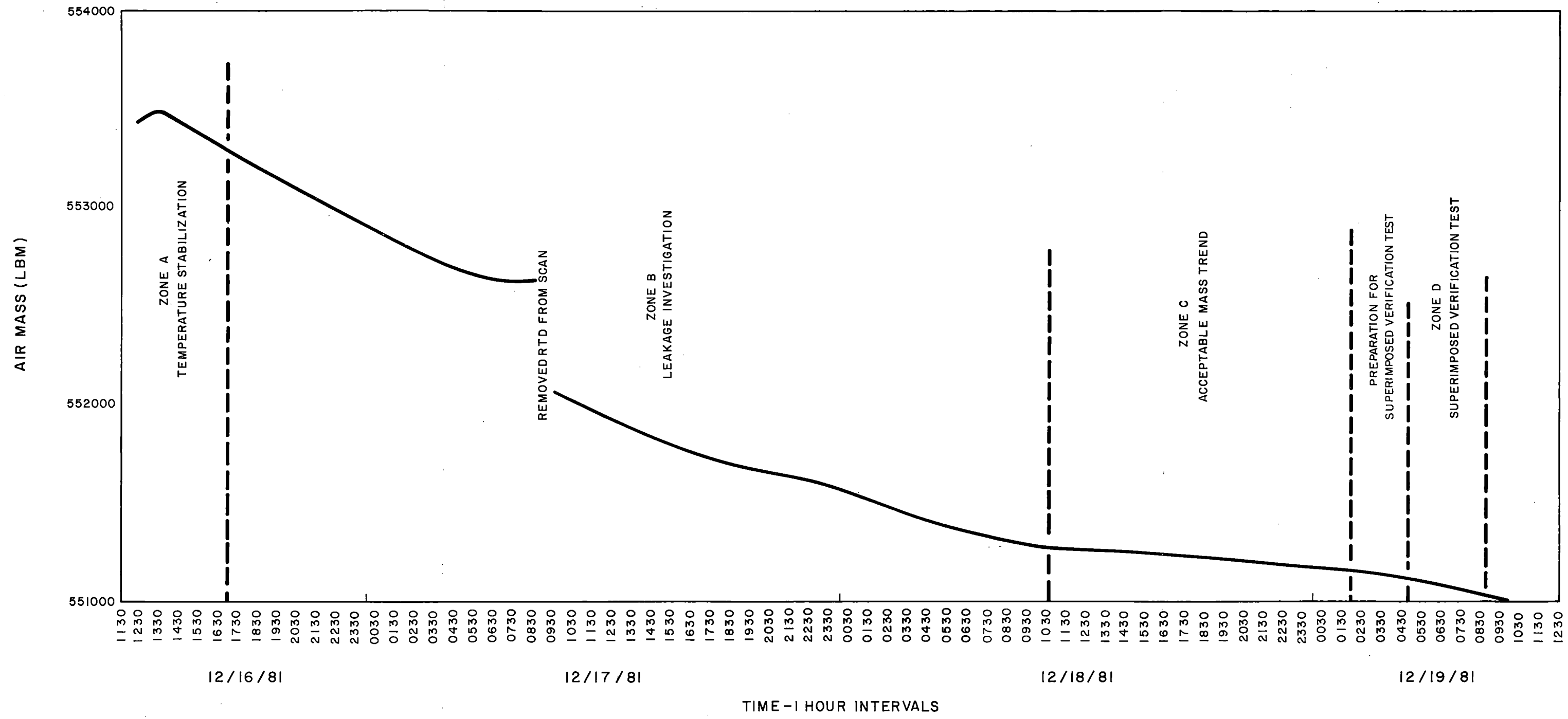
ABSOLUTE TEST METHOD - TOTAL TIME ANALYSIS

Time (Hours)	Mass (LBM)	Meas Leakage (%/day)	Est Leakage (%/day)	Conf (%/day)	UCL (%/day)
0.0	551276.49	0.0	0.0	0.0	0.0
0.333	551274.26	0.029223	0.0	0.0	0.0
0.667	551282.55	-0.039548	0.0	0.0	0.0
1.000	551282.76	-0.027304	-0.040813	0.320027	0.279214
1.333	551270.21	0.020517	-0.006387	0.210105	0.203719
1.667	551276.26	0.000595	-0.002760	0.132961	0.130201
2.000	551265.95	0.022953	0.010836	0.104361	0.115196
2.333	551253.60	0.042710	0.027720	0.089938	0.117658
2.667	551263.92	0.020521	0.028753	0.078209	0.106962
3.000	551264.13	0.017938	0.028227	0.070467	0.098694
3.333	551250.77	0.033597	0.033105	0.063595	0.096700
3.667	551249.55	0.031990	0.035936	0.058408	0.094345
4.000	551238.22	0.041659	0.040724	0.054122	0.094847
4.333	551237.20	0.039478	0.043608	0.050721	0.094329
4.667	551236.99	0.036847	0.045043	0.048220	0.093263
5.000	551233.94	0.037046	0.046102	0.046182	0.092285
5.333	551233.94	0.034733	0.046327	0.044732	0.091059
5.667	551233.94	0.032686	0.045993	0.043698	0.089691

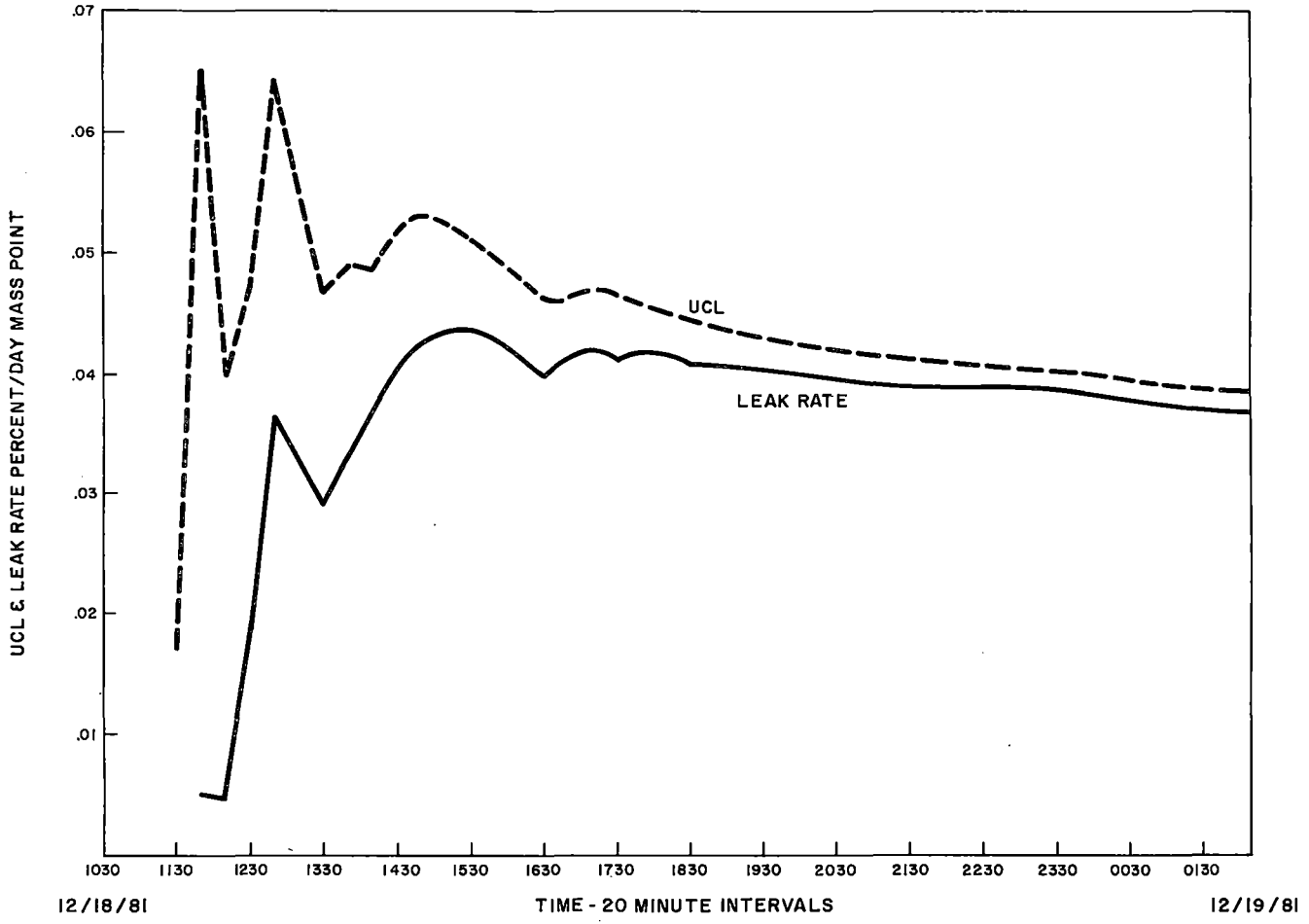
APPENDIX 3H (CONT'D)

Time (Hours)	Mass (LBM)	Meas Leakage (%/day)	Est Leakage (%/day)	Conf (%/day)	UCL (%/day)
6.000	551232.93	0.031609	0.045422	0.042849	0.088271
6.333	551221.60	0.037737	0.046083	0.041530	0.087613
6.667	551211.28	0.042582	0.047488	0.040147	0.087635
7.000	551221.60	0.034141	0.047117	0.039504	0.086622
7.333	551211.49	0.038592	0.047516	0.038570	0.086085
8.000	551211.49	0.035375	0.047378	0.037258	0.084636
8.333	551210.47	0.034493	0.046984	0.036793	0.083778
8.667	551201.17	0.037833	0.047102	0.036135	0.083237
9.000	551200.16	0.036926	0.047047	0.035577	0.082624
9.333	55119.14	0.036083	0.046861	0.035101	0.081962
9.667	551200.16	0.034378	0.046454	0.034745	0.081199
10.000	551193.10	0.036306	0.046314	0.034283	0.080597
10.333	551190.05	0.036421	0.046186	0.033837	0.080023
10.667	551191.06	0.034866	0.045871	0.033488	0.079359
11.000	551191.06	0.033810	0.045449	0.033195	0.078644
11.333	551180.96	0.036700	0.045380	0.032771	0.078150
11.667	551178.92	0.036409	0.045275	0.032378	0.077653
12.000	551170.64	0.038402	0.045378	0.031936	0.077314
12.333	551171.66	0.037006	0.045316	0.031563	0.076878
12.667	551172.88	0.035610	0.045109	0.031256	0.076366
13.000	551171.86	0.035039	0.044852	0.030978	0.075831
13.667	551162.57	0.036290	0.044692	0.030328	0.075020
14.000	551172.88	0.032219	0.044193	0.030186	0.074379

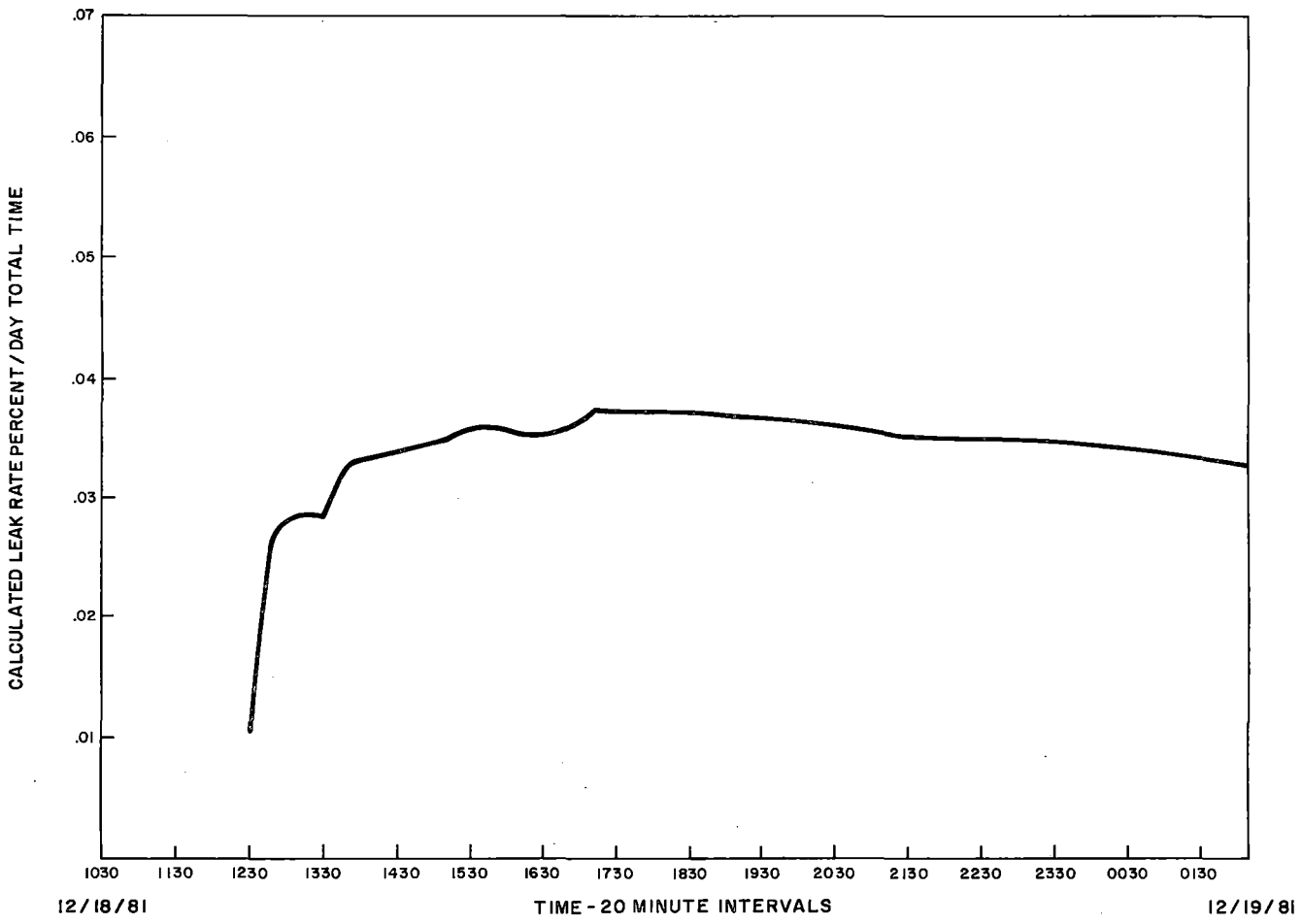
Time (Hours)	Mass (LBM)	Meas Leakage (%/day)	Est Leakage (%/day)	Conf (%/day)	UCL (%/day)
14.333	551154.49	0.037056	0.044161	0.029866	0.074027
14.667	551164.81	0.033151	0.043783	0.029681	0.073464
15.000	551155.51	0.035113	0.043595	0.029426	0.073021
15.333	551155.72	0.034292	0.043345	0.029200	0.072545
15.667	551146.62	0.036088	0.043258	0.028927	0.072185



APPENDIX 3J
STABILIZATION, CILRT + VERIFICATION CONTAINMENT AIR MASS VS TIME
SURRY POWER STATION - UNIT 2
INTEGRATED LEAK RATE TEST



APPENDIX 3K
CONTAINMENT LEAK RATE + UCL VS TIME
SURRY POWER STATION - UNIT 2
INTEGRATED LEAK RATE TEST



APPENDIX 3L
CALCULATED CONTAINMENT
LEAK RATE VS. TIME
SURRY POWER STATION - UNIT 2
INTEGRATED LEAK RATE TEST

SECTION 4

LOCAL LEAK RATE TESTS (TYPES B AND C)

Local leak rate tests were performed by pressurizing with air the penetrations listed in the following tables and either measuring leakage across containment isolation valves (Type C) or across resilient seals (Type B). The reported tests include the testing of all electrical penetration cannisters to Pa. This testing was done subsequent to the Type A test and prior to operations.

The total Types B and C leakage documented was verified to be in accordance with station procedures. The following pages list the penetrations tested and their documented leakage.

APPENDIX 4A

1980-1981 TYPE B DATA SUMMARY

Penetration	Equipment Tested	Prerepair Leakage (scfd)/Date	Post Repair Leakage (scfd/Date	Remarks
Personnel Air Lock	O-Ring	33.6/8-3-80	N/A	N/A
Personnel Air Lock	O-Ring	32.4/2-9-81	N/A	N/A
Personnel Air Lock	O-Ring	32.4/4-26-81	N/A	N/A
Personnel Air Lock	O-Ring	27.48/9-7-81	N/A	N/A
Personnel Air Lock	O-Ring	57.6/12-13-81	N/A	N/A
Fuel Transfer Tube	O-Ring	1.92/12-7-81	N/A	N/A
Equipment Hatch	O-Ring	0/12-12-81	N/A	N/A
Emergency Escape Air Lock	O-Ring	0/12-12-81	N/A	N/A

All electrical penetration O-Rings were tested with no excessive leakage noted or repairs required.

All electrical penetration cannisters were tested subsequent to this Type A test with no excessive leakage noted or repairs required, with two exceptions.

Electrical Penetration A-18 was found leaking 4,320 scfd and the collar bushing nut was tightened with "0" leakage noted.

Electrical Penetration A-17 was found to be leaking 912 scfd and the collar bushing nut was tightened with "0" leakage noted.

APPENDIX 4B

1980-1981 TYPE C DATA SUMMARY

Penetration	System	Valve(s) Tested	Leakage(scfd)/Date	Mr No/Date/Repair	Post Repair Leakage/Date
1	Comp Cool (CC)	TV-CC-209B	>1776/11-21-81	2111211600/11-24-81/Cleaned valve	4.8/11-29-81
2	Comp Cool (CC)	2-CC-177	>3240/11-20-81	2111200700/11-22-81 Lapped and cleaned valve	0/11-22-81
4	Comp Cool (CC)	2-CC-176	>3240/11-18-81	S211118153I/11-22-81 Lapped and cleaned valve	0/11-22-81
5	Comp Cool (CC)	TV-CC-209A	>3240/11-20-81	2109050700/11-21-81/Replaced rubber seat	0/11-22-81
7	Safety Injection (SI)	2-SI-150 MOV-2867C&D	0/11-09-81 360/11-08-81	N/A 2111082345/11-21-81/New gasket and packing	0/12-12-81 0/12-12-81
8	Comp Cool (CC)	TV-CC-207	19.2/11-11-81	N/A	N/A
9	Comp Cool (CC)	2-CC-224	204/11-13-81	2111131801/12-05-81/Machined disc & Lapped valve	24/12-05-81
10	Comp Cool (CC)	2-CC-242	432/11-13-81	2111130738/11-19-81/Lapped valve	26.4/11-19-81
11	Comp Cool (CC)	2-CC-233	6.72/11-13-81	N/A	N/A
12	Comp Cool (CC)	TV-CC-210B	0/11-13-81	N/A	N/A
13	Comp Cool (CC)	TV-CC-210C	>2400/11-06-81	2111131803/11-13-81/Replaced rubber seat	38.4/11-27-81
14	Comp Cool (CC)	TV-CC-210A	0/11-13-81	N/A	N/A
15	Charging (Ch)	2-CH-309 MOV-2289A	0/11-19-81	N/A	N/A
16	Comp Cool (CC)	2-CC-59	>432/11-11-81	2111110330/11-19-81/Lapped valve	0/11-20-81

APPENDIX 4B (CONT'D)

1980-1981 TYPE C DATA SUMMARY

Penetration	System	Valve(s) Tested	Leakage (scfd)/Date	Mr No/Date/Repair	Post Repair Leakage/Date
17	Comp Cool (CC)	2-CC-58	0/11-11/81	N/A	N/A
18	Comp Cool (CC)	2-CC-1	52.8/11-11-81	2111110300/11-13-81/Lapped valve	4.8/11-20-81
19	Charging (Cn)	MOV-2381	0/11-12-81	N/A	N/A
20	Safety Injection (SI)	2-SI-32	0/11-09-81	N/A	N/A
21	Safety Injection (SI)	MOV-2842	21.6/11-08-81	N/A	N/A
23	Safety Injection (SI)	MOV-2869B	0/11-09-81	N/A	N/A
24	Residual Heat Removal (RH)	MOV-RH-200	0/11-21-81	N/A	N/A
25	Comp Cool (CC)	TV-CC-205A	0/11-13-81	N/A	N/A
26	Comp Cool (CC)	TV-CC-205C	0/11-11-81	N/A	N/A
27	Comp Cool (CC)	TV-CC-205B	0/11-11-81	N/A	N/A
28	Chem and Volume (CV)	HCV-2200 A, B, C TV-2204	0/11-22-81 0/11-22-81	N/A N/A	N/A N/A
32	Gaseous Waste (GW)	TV-GW-202 TV-GW-203	0/12-3-81 0/12-03-81	N/A N/A	N/A N/A
33	Gaseous Drains (GS)	TV-DG-208A TV-DG-208B	228/11-13-81 19.2/11-15-81	2111132311/12-05-81/Overhauled N/A	0/12-11-81 N/A
38	Aerated Drains (DA)	TV-DA-200A TV-DA200B	>3240/12-9-81 480/12-09-81	S2112092201/12-12-81/Lapped valve S2112092241/12-12-81/Ground valve seat	456/12-12-81 0/12-12-81

APPENDIX 4B (CONT'D)

1980-1981 TYPE C DATA SUMMARY

Penetration	System	Valve(s) Tested	Leakage (scfd)/Date	Mr No/Date/Repair	Post Repair Leakage/Date
42	Service Air (SA)	2-SA-81	0/11-21-81	N/A	N/A
		2-SA-82	0/11-21-81	N/A	N/A
43	Air Monitoring (RM)	2-RM-3A, 3B	360/11-06-81	S2111201631/12-12-81/Cleaned seat	36/12-14-81
		TV-RM-200A	0/11-20-81	N/A	N/A
44	Air Monitoring (RM)	TV-RM-200B	2.4/11-20-81	N/A	N/A
		TV-RM-200C	0 /11-20-81	N/A	N/A
45	Primary Grade Water System (PG)	2-RC-160	7.2/11-09-81	N/A	N/A
		TV-2519A	0 /11-9-81	N/A	N/A
46	Charging (Ch)	FCV-2160	192/11-12-81	2A1121021/11-17-81/New plug and cage	0/12-13-81
47	Instrument Air (IA)	2-IA-864	43.2/11-15-81	2111150407/11-16-81/Cleaned valve	0/11-15-81
		TV-IA-200	0/11-15-81	N/A	N/A
		2-IA-704	528/11-15-81	2111/50408/11-15-81/Lapped valve	N/A
48	Vent & Drain System (DA)	TV-VG-209A	0/11-14-81	N/A	N/A
		TV-VG-209B	0/11-14-81	N/A	N/A
50	Safety Injection (SI)	TV-SI-201A	81.6/11-10-81	2111102038/11-19-81 Lapped valve	7.2/12-11-81
		TV-SI-201B	84 /11-10-81	2111102101/11-21-81 Replaced body seat	
51	Service Water (SW)	2-SW-206	>432/11-10-81	2111101508/11-24-81/Overhauled valve	0/12-08/81
		2-SW-208	0/11-24-81	N/A	N/A
53	Safety Injection (SI)	TV-SI-200	52.8/11-13-81	2111101200/11-16-81 Overhauled valve	0/12-08-81
		2-SI-234	26.4/11-13-81		N/A
54	Primary Vent (VA)	2-VA-1	0/11-12-81	N/A	N/A
		2-VA-9	9.6/11-12-81	N/A	N/A

APPENDIX 4B (CONT'D)

1980-1981 TYPE C DATA SUMMARY

Penetration	System	Valve(s) Tested	Leakage(scfd)/Date	Mr No/Date/Repair	Post Repair Leakage/Date
55,57 97,105	Leakage Monitoring (LM)	TV-LM-200E	0/11-14-81	N/A	N/A
		TV-LM-200G	0/11-14-81	N/A	N/A
		TV-LM-200A	0/11-14-81	N/A	N/A
		TV-LM-200C	0/11-14-81	N/A	N/A
		TV-LM-200F	0/11-14-81	N/A	N/A
		TV-LM-200H	0/11-14-81	N/A	N/A
		TV-LM-200B	0/11-14-81	N/A	N/A
		TV-LM-200D	0/11-14-81	N/A	N/A
56	Sample System (SS)	TV-SS-206A	1.6/12-06-81	N/A	N/A
		TV-SS-206B	0/12-06-81	N/A	N/A
56	Sample System (SS)	TV-SS-200A	0/12-09-81	N/A	N/A
		TV-SS-200B	0/12-09-81	N/A	N/A
56	Sample System (SS)	TV-SS-202A	1.52/12-06-81	N/A	N/A
		TV-SS-202B	.48/12-06-81	N/A	0/12-09-81
57	Sample System (SS)	TV-SS-201A	0/12-03-81	N/A	N/A
		TV-SS-201B	0/12-03-81	N/A	N/A
57	Sample System (SS)	TV-SS-204A	0/12-10-81	N/A	N/A
		TV-SS-204B	0/12-10-81	N/A	N/A
57	Aerated Drains (DA)	TV-DA-203A	0/11-27-81	N/A	N/A
		TV-DA-203B	0/11-27-81	N/A	N/A
58	Instrument Air (IA)	2-IA-868	0/11-14-81	N/A	N/A
		1-IA-704	0/11-14-81	N/A	N/A
60	Safety Injection (SI)	MOV-2890A	12/11-08-81	N/A	N/A
61	Safety Injection (SI)	MOV-2890C	0/11-08-81	N/A	N/A
62	Safety Injection (SI)	MOV-2890B	0/11-8-81	N/A	N/A
63	Containment Spray (CS)	2-CS-24	0/11-22-51	N/A	N/A/11-23-81
		MOV-CS-201C, D	50.4/11-23-81	N/A	N/A

APPENDIX 4B (CONT'D)

1980-1981 TYPE C DATA SUMMARY

Penetration	System	Valve(s) Tested	Leakage (scfd)/Date	Mr No/Date/Repair	Post Repair Leakage/Date
64	Containment Spray (CS)	2-CS-13	720/11-26-81	2111250737/11-28-81/Turned rubber disc insert	0/11/29/81
		MOV-CS-201A, B	12/11-29-81	N/A	N/A
66,69	Recirculation Spray (RS)	MOV-RS-255A,B	0/12-01-81	N/A	N/A
67,68	Safety Injection (SI)	MOV-2860A	0/11-24-81	N/A	N/A
		MOV-2860B	0/11-24-81	N/A	N/A
70	Recirc Spray (RS)	2-RS-11	216/11-26-81	2111260630/11-28-81/Turned rubber disc insert	0/11-29-81
		MOV-RS-256B	0/11-25-81	N/A	NA
71	Recirc Spray (RS)	2-RS-17	0/11-25-81	N/A	N/A
		MOV-RS-256A	0/11-25-81	N/A	NA
89	Air Ejector Discharge (VP)	2-VP-12	216/11-18-81	S2111180955/11-24-81/ Lapped valve	9.6/11-20-81
		TV-SV-202A	0/11-18-81	N/A	NA
90	Ventilation (VS)	MOV-VS-200C	38.4/12-12-81	N/A	N/A
		MOV-VS-200D & 201	>1776/12-12-81	2112130738/12-13-81/Cleaned seat and disc 2112140308/12-14-81/Replaced seat	16.8/12-15-81
91	Ventilation (VS)	MOV-VS-200A	912/12-08-81	2112081800/12-12-81 Lapped valve	12/12-9-81
		MOV-VS-200B&202	912/12-08-81	2112081801/12-11-81/Repaired valve seat	24/12-11-81
92	Cont Vacuum & Gaseous Waste (CV) (GW)	TV-GW-204	0/12-03-81	N/A	NA
		TV-GW-205	0/12-03-81	N/A	NA
		TV-CV-250C	240/11-14-81	2111140732/11-23-81/Overhauled Valve	0/11-24-81
		TV-CV-250D	0/11-14-81	N/A	NA
93	Containment Vac & Gaseous Waste (CV) (GW)	TV-GW-200	0/12-03-81	N/A	NA/11-24-81
		TV-GW-201	0/12-03-81		NA/11-24-81
		TV-CV-250A	>432/11-14-81	2111140832/11-19-81/Lapped valve	0/11-24-81
		TV-CV-250B	>432/11-14-81	2111140833/11-20-81/Lapped valve	16.8/11-24-81
94	Containment Vac (CV)	2-CV-2	0/11-11/81	N/A	N/A
		HCV-CV-200	0/11-11-81	N/A	N/A

APPENDIX 4B (CONT'D)

1980-1981 TYPE C DATA SUMMARY

Penetration	System	Valve(s) Tested	Leakage(scid)/Date	Mr No/Date/Repair	Post Repair Leakage/Date
97	Sample System (SS)	TV-SS-203A	0/12-10-81	N/A	N/A
		TV-SS-203B	0/12-10-81	N/A	N/A
100	Gaseous Waste (GW)	TV-GW-206	0/12-03-81	N/A	N/A
		TV-GW-207	0/12-03-81	N/A	N/A
101	Fire Protection (FP)	2-FP-151	0/12-02-81	N/A	N/A
		2-FP-152	0/12-02-81	N/A	N/A
103	Reactor Letdown (RL)	2-RL-3	0/11-12-81	N/A	N/A
		2-RL-5	0/11-12-81	N/A	N/A
104	Reactor Letdown (RL)	2-RL-13	0/11-12-81	N/A	N/A
		2-RL-15	0/11-12-81	N/A	N/A
106	Safety Injection (SI)	2-SI-73	0/11-10-81	N/A	N/A
112	Instrument Air (IA)	TV-IA-201A	0/11-18-81	N/A	NA
		TV-IA-201B	52.8/11-18-81	S2111182345/11-19-81/Repaired seat	28.8/12-02-81
113	Safety Injection (SI)	2-SI-174	9.6/11-08-81	N/A	N/A
		MOV-2869A	9.6/11-08-81	N/A	N/A