DUKE POWER COMPANY

OCONEE NUCLEAR STATION

UNIT 2

REACTOR CONTAINMENT BUILDING

INTEGRATED LEAK RATE TEST

April 1988

A017

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DUKE POWER COMPANY

Oconee Nuclear Station

Unit 2

Reactor Containment Building

Integrated Leak Rate Test

Prepared by: Ken G. Rohde
Ken G. Rohde
Nuclear Production Engineer
ILRT Coordinator

Reviewed by: Khin Chea
Khin Chea
Test Engineer

Approved by: Dean M. Hubbard
Dean M. Hubbard
Performance Engineer

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1.0 Introduction

The periodic Containment Integrated Leak Rate Test (CILRT) of the Duke Power Company, Oconee Nuclear Station Unit 2 Containment Building was satisfactorily completed on March 28, 1988. The testing was conducted in accordance with the requirements of Technical specification 4.4, BN-TOP-1 (Bechtel Testing Criteria for ILRT), ANSI ANS 56.8-1982 and 10CFR50, Appendix J. The absolute method of testing was employed with the containment temperatures measured at 24 locations and containment dewpoint temperatures at six locations. Leakage was measured at half the design basis accident pressure of ~ 29.5 PSIG. A measured induced leakage was used to verify the results. Analysis of final test data shows the results to be well within the specified limits for this containment, which has a maximum allowable leak rate L_t = 0.176 wt.%/day and 75% L_t = 0.132 wt%/day. The leak rate for the Oconee Unit 2 containment was measured at 0.066047 wt%/day, and the 95% upper confidence limit (UCL) was determined to be 0.070276 wt%/day.

2.0 Summary and Conclusions

2.1 Synopsis

The Unit 2 Containment ILRT was performed in accordance with the Periodic Test Procedure PT/2/A/0150/03A as approved for use on March 26, 1988.

Pressurization for the ILRT began at 1700 hours on March 26, 1988, using the 2 permanently installed compressors and 2 rental diesel compressors. Pressurization was stopped at 0351 hours on March 27, 1988 when the containment pressure reached ~ 31 PSIG.

Stabilization began at 0440 hours on March 27, 1988, at which time a search for potential leaks began.

At ~ 1500 a leak was found on 2N-131, and a very small leak was found at 2BA-5.

At ~ 1010 on March 28, 1988, the final data analysis was completed. The test period was fixed from 1006 March 27, 1988, through 1006 March 28, 1988. The calculated leak rate was 0.066047 wt%/day and the 95% upper confidence limit (UCL) was 0.070276 wt%/day. These results were below the acceptance of .75 Lt. or 0.132 wt%/day.

An imposed leak rate of .1998 wt%/day or 7.0 SCFM with a back pressure of 4.9 psig was calculated for the verification leak rate test. This leak was imposed at 1045 hours on March 28, 1988.

At 1455 on March 28, 1988, the verification leak rate test was completed. The calculated leak rate was 0.2658 wt%/day. This result was within acceptable limits.

At ~ 1500 on March 28, 1988, depressurization of the containment began. Depressurization was completed at 2000 on March 28, 1988. An entry to the containment was made at 2030 on March 28, 1988, to inspect for damage caused by the ILRT. No significant damage due to the Leak Rate Test was observed.

2.2 Test Results

Tabulated below are the leak rates measured for the test. As can be seen, the acceptance criteria was met in both cases. All leak rates are reported in weight percent per day (Wt%/day) of containment mass at Post-Accident Conditions.

Test Pressure	Acceptance Criteria	Tech. Spec. Limit	Calculated Leak Rate	95% (UCL)
29.5 PSIG	0.132	0.176	0.066047	0.070276

The verification test consisted of imposing a known leak rate on the containment at the end of the CILRT. Results from this supplemental test is acceptable provided the difference between the Supplemental Test Data and the Type A Test Data is within 25% of L_t.

Test Leak Rate.	0.066047
Imposed Leak Rate	0.1998
Total	0.265847
Verification Leak Rate (Measured)	0.299366
Difference.	0.033529
Percent of L_t	19.05

This verification data demonstrates the accuracy of the CILRT Data and demonstrates the validity of the verification test.

2.3 Error Analysis

Three kinds of errors can be introduced into the leak rate test calculations. They are: 1) systematic measurement error due to instrumentation; 2) random measurement error due to instrumentation; and 3) inclusion of a bad data point into the calculation. Each of these types of errors is addressed below and is based on information in ANS-N274, work group 56.8, revision 3, Nov., 1978.

A) Systematic Measurement Errors

Systematic error is the error introduced by a difference between the measured parameter and the actual value of the parameter, produced by predictable or identifiable effects.

Instrument calibration traceable to the National Bureau of Standards is one method of holding this error to a minimum. However, since the mass-plot data analysis technique calculates the leakage based on a ratio of these measured parameters and not the actual value, the overall effect of these systematic instrumentation errors can be considered negligable, if the instrument drift over the test period is not significant.

The instrument calibration, and instrument drift, can be determined to be acceptable at the end of the test period by the Verification Test. This test imposes a known leakage on the containment structure through an indenpendently calibrated instrument which causes a known change in the leak rate. If the instrumentation has not experienced a calibration shift, and no other system change has occurred, the verification test measured leak rate would compare well with the sum of the test leak rate and the imposed leak rate. Therefore, a successful Verification Test confirms that the leak rate test instrumentation systematic error is within acceptable limits. Any other error associated with the measurement is due to random error.

B) Random Measurement Error

Random errors are those errors in the measured parameters whose sign and magnitude vary without pattern or discernable cause, such as instrument calibration.

For the leak rate test, the effect of random errors must be considered in the data analysis. This is accomplished by statistical techniques in which the deviation from a least square fit regression line of measured data is bounded such that a certain fraction of the data points lie within the bounds. These bounds define a region called the confidence interval. The probability that any measured data point will fall within the confidence interval is called the confidence level.

The confidence level set for this test is 95%, and from this, the limits or values of the confidence interval are calculated. The lower limit of this interval is of no significant consequence since the reported leak rate is higher. If the actual leakage is lower than the reported value, due to the inclusion of erroneously high values, then the reported value is of a conservative nature. If, on the other hand, random measurement errors has caused the inclusion of erroneously low values, then the actual leakage would be higher then the reported value. For this reason, the upper boundary (limit) to the 95% confidence interval is of significance to the test results and is included in the report.

C) Inclusion of Bad Data Points in the Calculations

Criteria exist in statistical analysis for the rejection of bad data points in the process of data analysis. This is not necessary in the mass-plot method for two reasons. First, since the mass-plot calculation is based on a regression fit of all the data points, a single erroneous value will have little effect on the calculated leak rate. Secondly, since the random error analysis clearly shows the need to calculate and report the upper limit of the 95% confidence interval, the inclusion of a bad data point in the calculation is already accounted for in the data analysis.

D) Analysis Conclusions

The information above, on each type of error, demonstrates that if the 95% upper confidence limit is less than 75% L_t and that the verification test results are acceptable, then the containment leakage rate accurately accounts for any instrument errors in the leak rate measurement system.

2.4 Test Organization

The Performance Section at the Oconee Nuclear Station has overall responsibility for the CILRT. The testing activities were supervised by the test coordinator. The organizational chart is presented in Figure 2.6.1. The test personnel were as follows:

A.	Test Coordinator responsible for all ILRT activities	K. G. Rohde
B.	Shift Coordinator (one per shift) responsible for testing activities on their assigned shifts	K. G. Rohde K. Chea
C.	Data Engineers (one per shift) responsible for Data Analysis	J. O. Lee L. S. Hawthorne
D.	Support Engineer (nuclear Performance evaluation, Duke Power) (one per shift)	B. W. Roberts M. A. Hutcheson
E.	Operators (normal shift)	

OCONEE ILRT ORGANIZATION

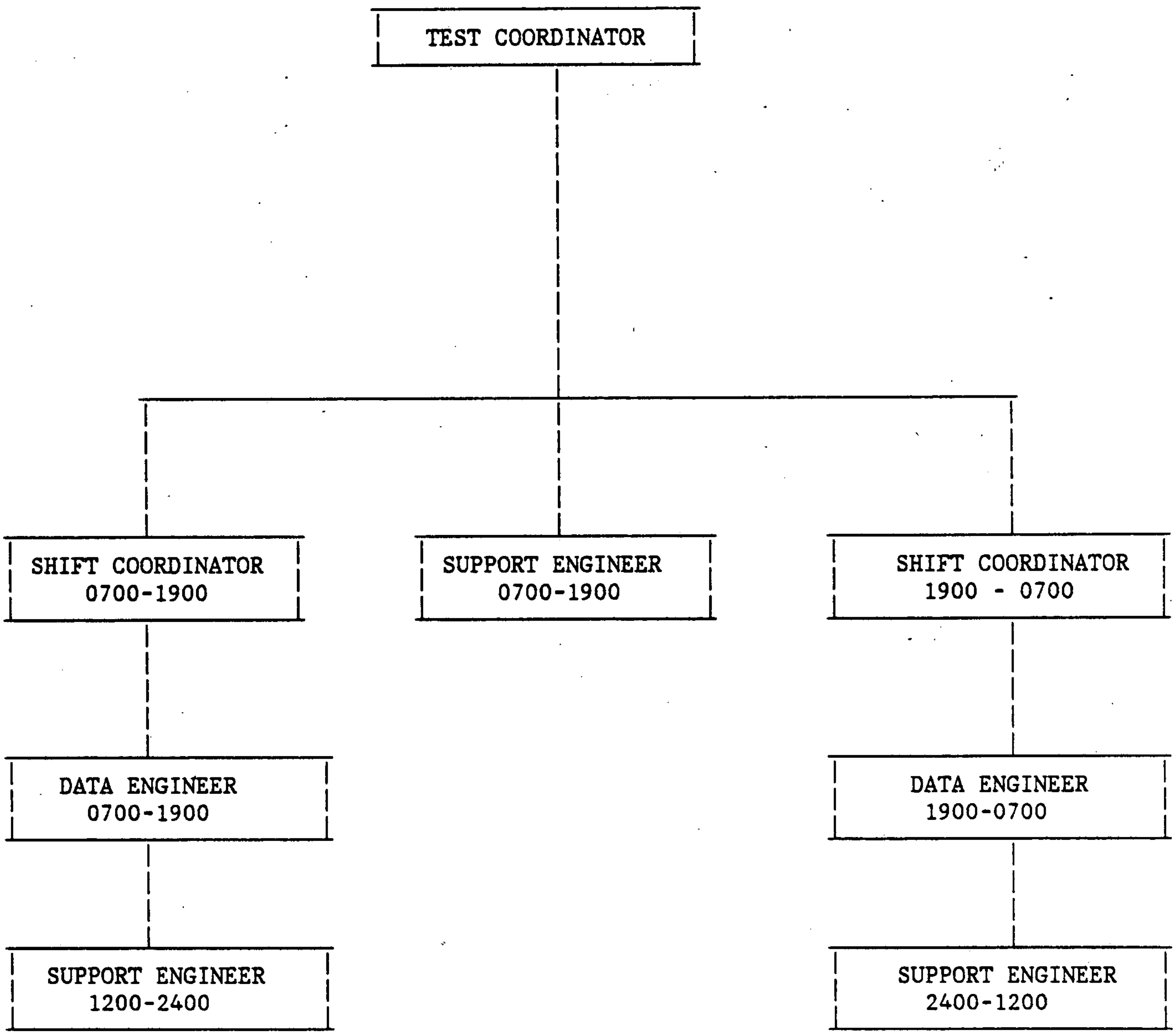


FIGURE 2.6-1

3.0 Design Information

3.1 Reactor Building

The Reactor Building is a reinforced and post-tensioned concrete structure designed to contain any accidental release of radioactivity from the reactor coolant system as defined in the Final Safety Analysis Report (Reference 1).

The structure consists of a post-tensioned reinforced concrete cylinder and dome connected to and supported by a massive reinforced concrete foundation slab as shown in Figure 3.1-1. The entire interior surface of the structure is lined with a ¼ inch thick welded ASTM A36 steel plate to assure a high degree of leak tightness. Numerous mechanical and electrical systems penetrate the Reactor Building wall through welded steel penetrations.

Principal dimensions are as follows:

Inside Diameter	116 ft.
Inside Height (including Dome)	208-1/2 ft.
Vertical Wall Thickness	3-3/4 ft.
Dome Thickness	3-1/4 ft.
Foundation Slab Thickness	8-1/2 ft.
Liner Plate Thickness	1/4 inch
Internal Free Volume	1,910,000 Cu. ft.

3.2 Measurement Systems

Instrumentation used for the Oconee Unit 2 ILRT is similar to that used on previous tests conducted by Bechtel. The leak rate test measurement system is shown schematically in Figure 3.2-1.

Reactor Building pressure was measured by two Ruska Instrument precision pressure gauges. The units were calibrated before the test.

Reactor Building temperature was measured by twenty-four (24) calibrated RTDs and read on a Acurex digital recorder. Each RTD was assumed to be representative of a fraction of the total containment volume.

Reactor Building dewpoint temperature was measured by six (6) EG&G Dewpoint Hygrometers.

The relative location of the humidity sensors is shown in Figure 3.4-1. A 0-10.45 SCFM Fisher Potor rotometer was used in establishing a known leak rate.

3.2.1 Instrument List

Specifications for the instrumentation used for the Oconee Unit 2 ILRT are listed in Table 3.2-1.

3.2.2 Temperature Sensor Locations

The locations of temperature sensors within the Reactor Building are shown in Figures 3.2-2 through 3.2-5.

3.2.3 RTD and Dewpoint Volume Fractions

Volume fractions were used for calculating the average temperature and the average dewpoint temperature in the containment. These fractions were determined using an equivalent volume for each sensor. The free volume of the containment was divided into "cells" with a sensor center in each. Volume fractions are given in Table 3.2-2.

3.3 Pressurization System

Reactor Building pressurization was accomplished by two (2) electric motor driven and two (2) diesel driven air compressors operating in parallel. These compressors also include aftercoolers as integral equipment. The discharge from the compressors passes through a air dryer which reduces the moisture content in the air prior to its entry into the Reactor Building. The specifications for these components are as follows:

A. Two (2) electric driven Joy Turbo-Air (20V2) centrifugal type air compressors with a capacity of 2300 SCFM @ 80 psig. Two (2) diesel driven Atlas Compco Oil Free Air Compressors with a capacity of 1500 SCFM @ 102 psig.

B. Two (2) Basco size 22048 aftercoolers (Integral to Compressors), type "ES" Fixed Tubesheet, with a capacity of 2100 SCFM @ 14.4 PSIA and with a design pressure of 150 PSIG. One (1) RP Adams Aftercoolers with a capacity of 5500 SCFM @ 80 PSIA and a design pressure of 150 PSIG.

C. Two (2) Arrow (Model 3519) refrigerator type air dryer with inertial impingement separator, and a capacity of 1600 SCFM (100°F Sat. inlet) @ 120 psig. Two (2) Arrow Air Refrigerator Aftercooler with a capacity of 1760 SCFM @ 125 psig, and a design pressure of 250 psig.

These valves, 2LRT-15, 2LRT-16 and 2LRT-17 are used to control pressurization of the Reactor Building. The controls for these valves are located in the test panel. The pressurization system is shown schematically in Figure 3.3-1. The valves used to control depressurization are as follows: 2LRT-15, 2LRT-16 and 2LRT-17 for minimum release, 1LRT-15, 1LRT-16, 3LRT-15 and 3LRT-16 for increased release, finally remove rental equipment, leaving flange open, remove flange to Unit 3 and open LRT-13, and LRT-10 for maximum release rate.

3.4 Recirculation System

During pressurization, all available fans were run to mix air. When stabalization began all fans were stopped, no fans were run during the test.

3.5 Computer Programs

The containment integrated leak rate test procedure specified that the test would utilize the IBM PC or equivalent program or the plant computer program in data analysis. Both programs calculate the mass-plot leak rate.

The off-line programs were written for and run on the IBM-9000 system. Two main subroutines were used, one to calculate the corrected values of building pressure and temperature, the second to calculate the leak rate. Tables of corrected temperature and pressure were stored in separate permanent files.

3.5.1 ILRT Program

3.5.1.1 Purpose

This program is used to process the raw data for use in leak rate calculations and print out these values.

3.5.1.2 Program Inputs

a) 24 RTD temperatures in °F

b) 6 Dewpoint temperatures in °F

c) Absolute pressure in PSIA

3.5.1.3 Calculations

Three calculations are performed with the input data. They are:

a) Volume-weighted average building temperature

b) Vapor pressure of water from volume-weighted dewpoint temperatures

c) Corrected building pressure

3.5.1.4 Temperature

a) Apply the instrument calibration correction factors for each RTD, loaded as part of the program.

b) Multiply each temperature by the volume fraction associated with each RTD.

c) Sum the volume weighted temperatures for building average.

3.5.1.5 Dewpoint Temperature

a) The values entered into this program have already been corrected for instrument calibration.

b) Multiply each temperature by the volume fraction associated with each Dewpoint.

c) From the dewpoint temperature (Saturation Temperature), the vapor pressure (Saturation Pressure) is determined from the steam tables. The program uses the ASME "K Function" for the saturation line and has been verified to be accurate to the least significant digit given in the 1967 ASME Steam Tables.

3.5.1.6 Pressure

a) Subtract vapor pressure from input absolute pressure.

3.5.1.7 Program Summary

This program will calculate the leak rate and 95% UCL from the input data, corrected pressure and temperature, based on the mass-plot method. The calculations are based on the formulas in Appendix B to ANS 56.8, 1981. As this work is readily available, it is not duplicated here.

TABLE 3.2-1

INSTRUMENT SPECIFICATIONS

Absolute Pressure Gauge

Mfg.	Ruska
Model	6000-151-100
Range	0-100 PSIA
Sensitivity	±0.002% of full scale
Accuracy	±0.011% of reading + 0.01% of full scale
Oconee I.D.	28024 and 28025

Pressure Gauge

Mfg.	Heise
Range	0-100 psig
Accuracy	0.1 psi
Repeatability	0.1 psi

Temperature Elements

Mfg.	Rosemount
Model	785
Type	RTD, Platinum, 100 ohms nominal at 32°F
Range	0-200°F
Sensitivity	±0.09°F
Accuracy	±0.45°F

Temperature, Pressure and Dewpoint Indication for Sensors

Mfg.	Acurex
Model	1050
Type	Controller
Range	0-10.000 V
Oconee I.D.	SNPRF-40075
Accuracy	±0.005% of full scale +0.015% reading +0.025 Ω @ 20 to 30°C high resolution (board 1061-59 RTD) (board 1061-31 DewPoint w/25 Ω Resistors attached) Resistor ±0.01%, voltage range ± 0.005% full scale +0.005% of reading + 25μF ±0.005% full scale +0.005% of reading +25 μVe 20-30°C high resolution (board 1061-31 Pressure)

TABLE 3.2-1 (Cont'd)

Dewpoint Temperature	
Mfg.	EG&G
Model	200
Range	-40°F to 140°F
Accuracy	1.0°F
Sensitivity	±0.20°C
Standard Lab I.D.	SNPRF 40460, SNPRF 40749, SNPRF 40458, SNPRF 40457, SNPRF 40456, and SNPRF 40455
Flow Indicator	
Mfg.	Fisher Porter
Type	Rotometer
Model	103555S
Range	0 to 10.2 SCFM
Accuracy	± 1% of maximum flow
Repeatability	±0.5% Full Scale
Serial No.	OCPRF 28202

TABLE 3.2-2

VOLUME FRACTIONS

Volume Fractions for RTDS

RTD #	Volume Fraction
1	.03
2	.02
3	.02
4	.05
5	.02
6	.03
7	.01
8	.08
9	.05
10	.05
11	.02
12	.02
13	.01
14	.02
15	.02
16	.01
17	.05
18	.09
19	.11
20	.01
21	.01
22	.09
23	.11
24	.07
Total	1.00

Dewpoint Sensors Volume Fraction

Dewpoint Sensor #	Volume Fraction
1 (Azimuth 100° Elevation 830')	0.15
2 (Azimuth 260° Elevation 830')	0.15
3 (Azimuth 100° Elevation 850')	0.15
4 (Aximuth 260° Elevation 850')	0.15
5 (Azimuth 100° Elevation 866')	0.20
6 (Azimuth 260° Elevation 866')	0.20
Total	1.0

REACTOR BUILDING

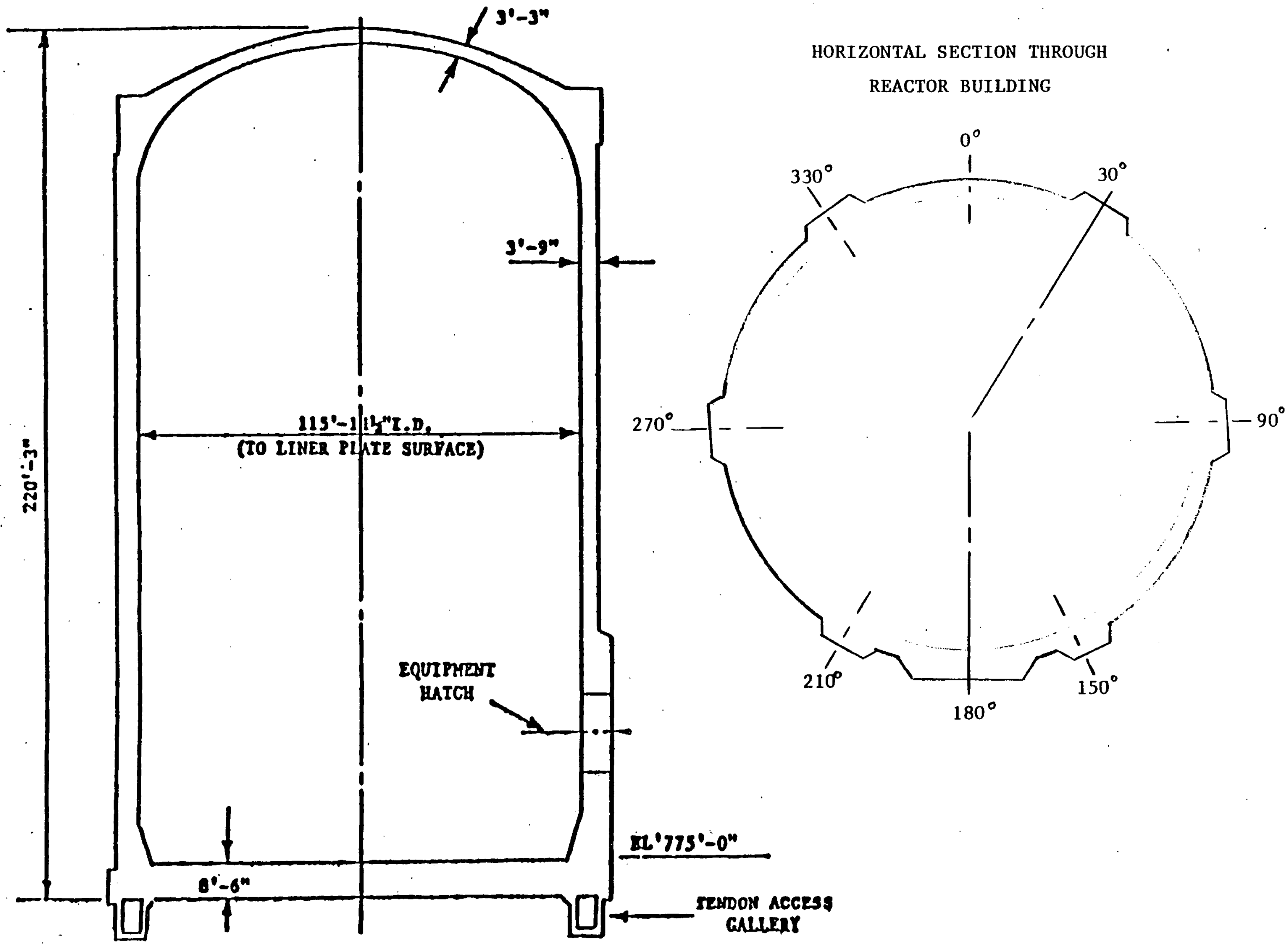


Figure 3.1-1

LEAK RATE MEASUREMENT SYSTEM

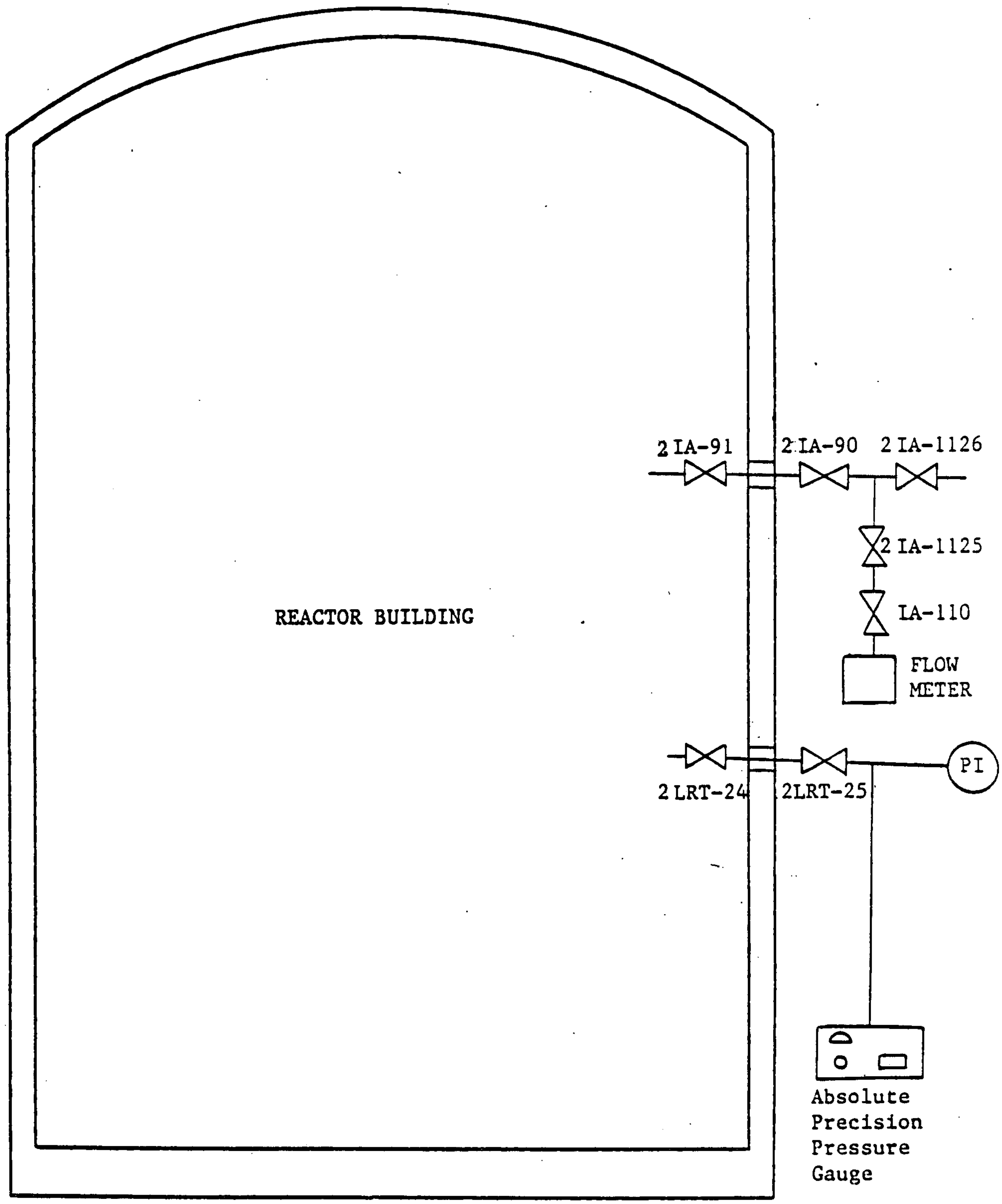


Figure 3.2-1 Test Measurement System Schematic.

REACTOR BUILDING PRESSURIZATION SYSTEM

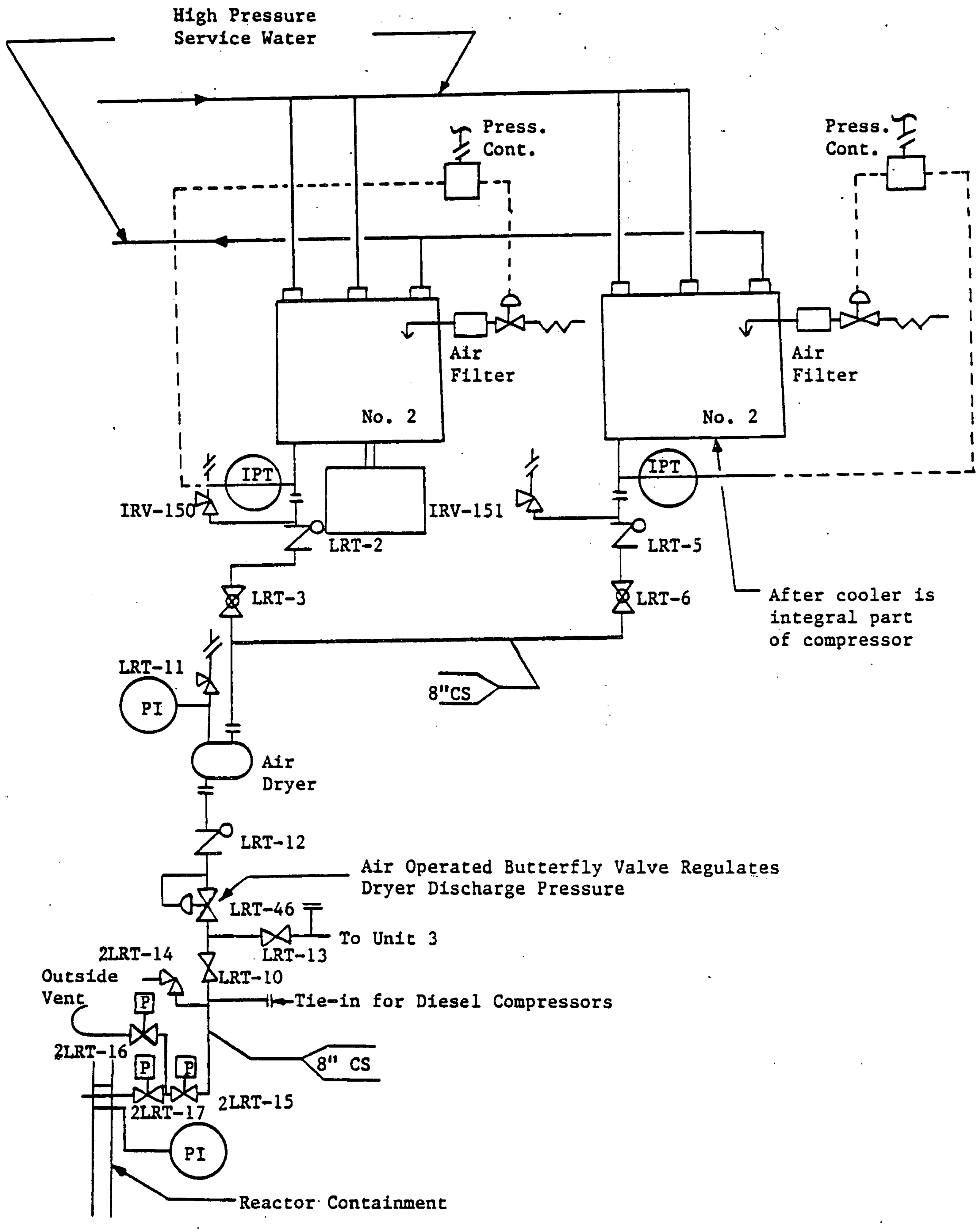


Fig. 3-3.1

REACTOR BUILDING

BASEMENT FLOOR

ELEVATION 787'

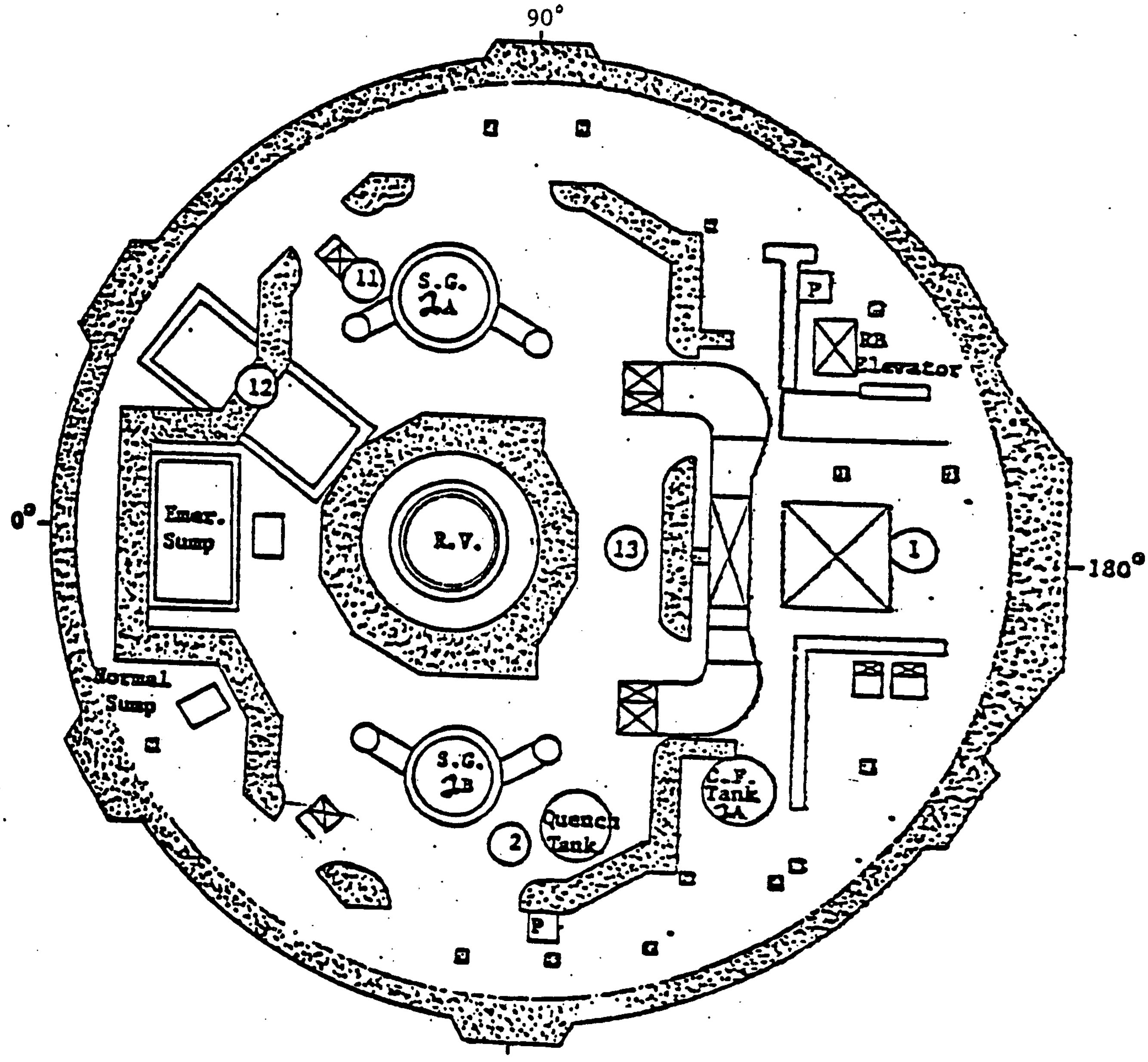


Figure 3.2-2

REACTOR BUILDING

INSTERMEDIATE FLOOR

ELEVATION 830'

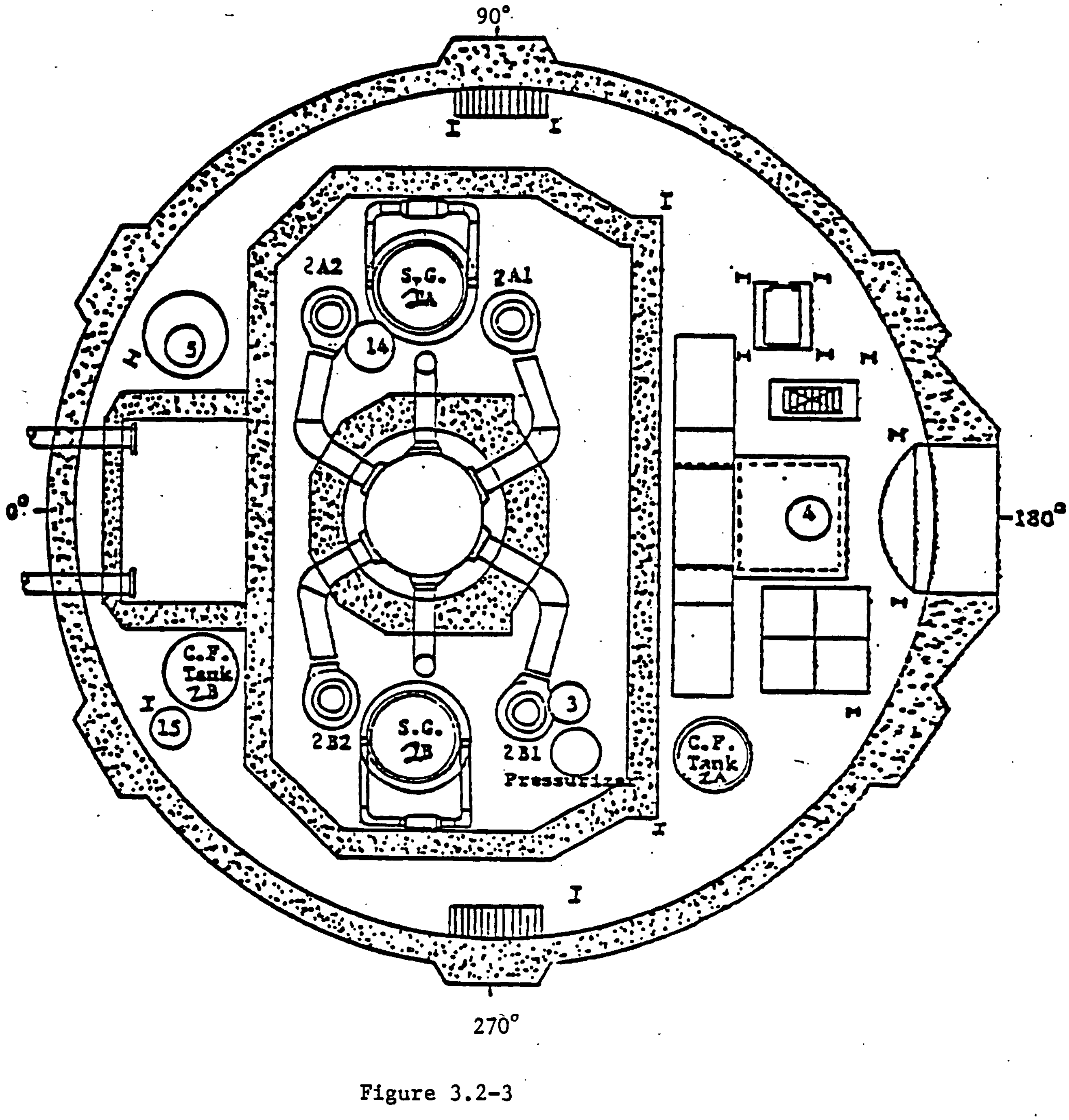


Figure 3.2-3

REACTOR BUILDING
OPERATING FLOOR
ELEVATION 850'

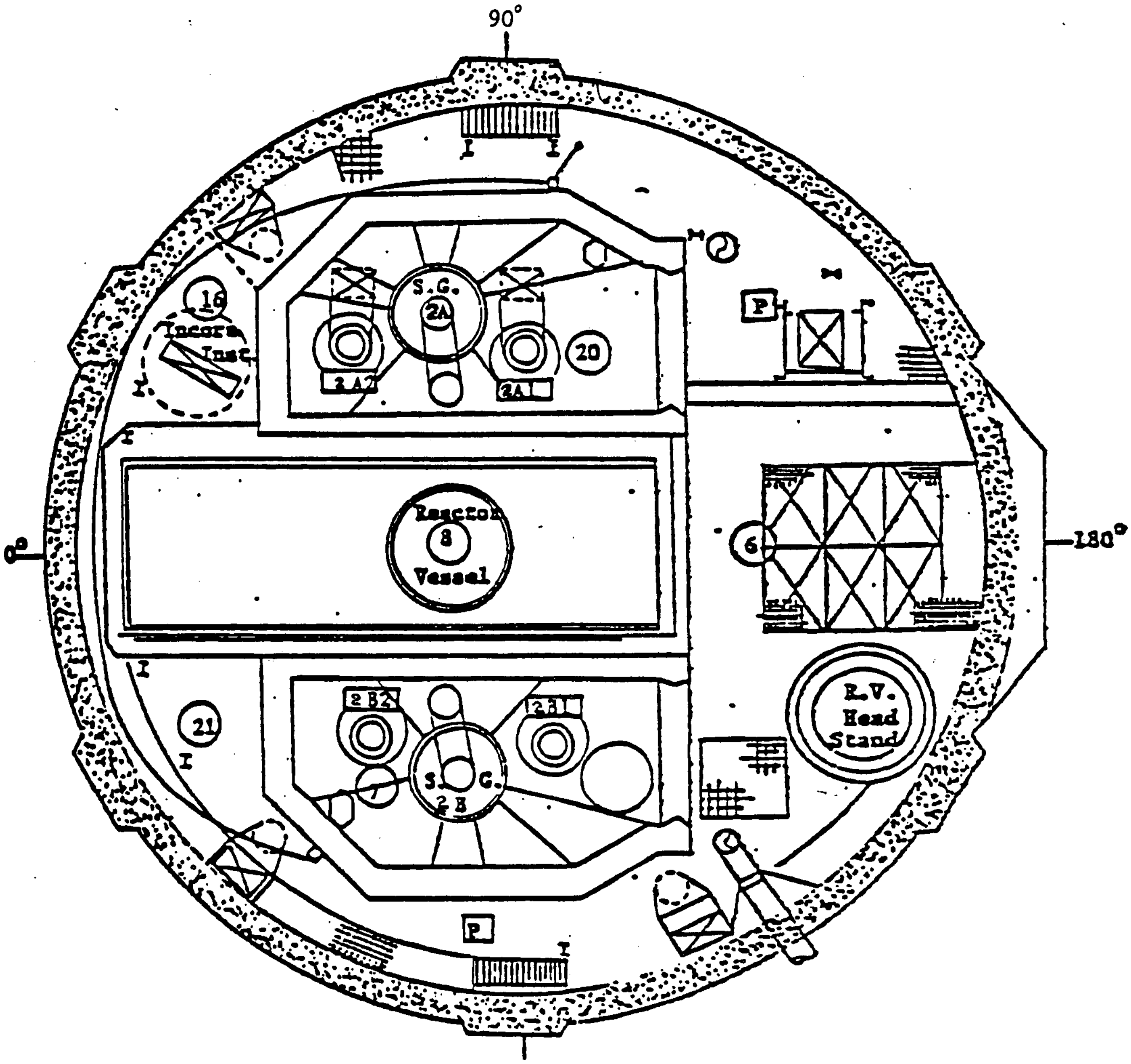


Figure 3.2-4

REACTOR BUILDING
SHIELDING FLOOR
ELEVATION 866'

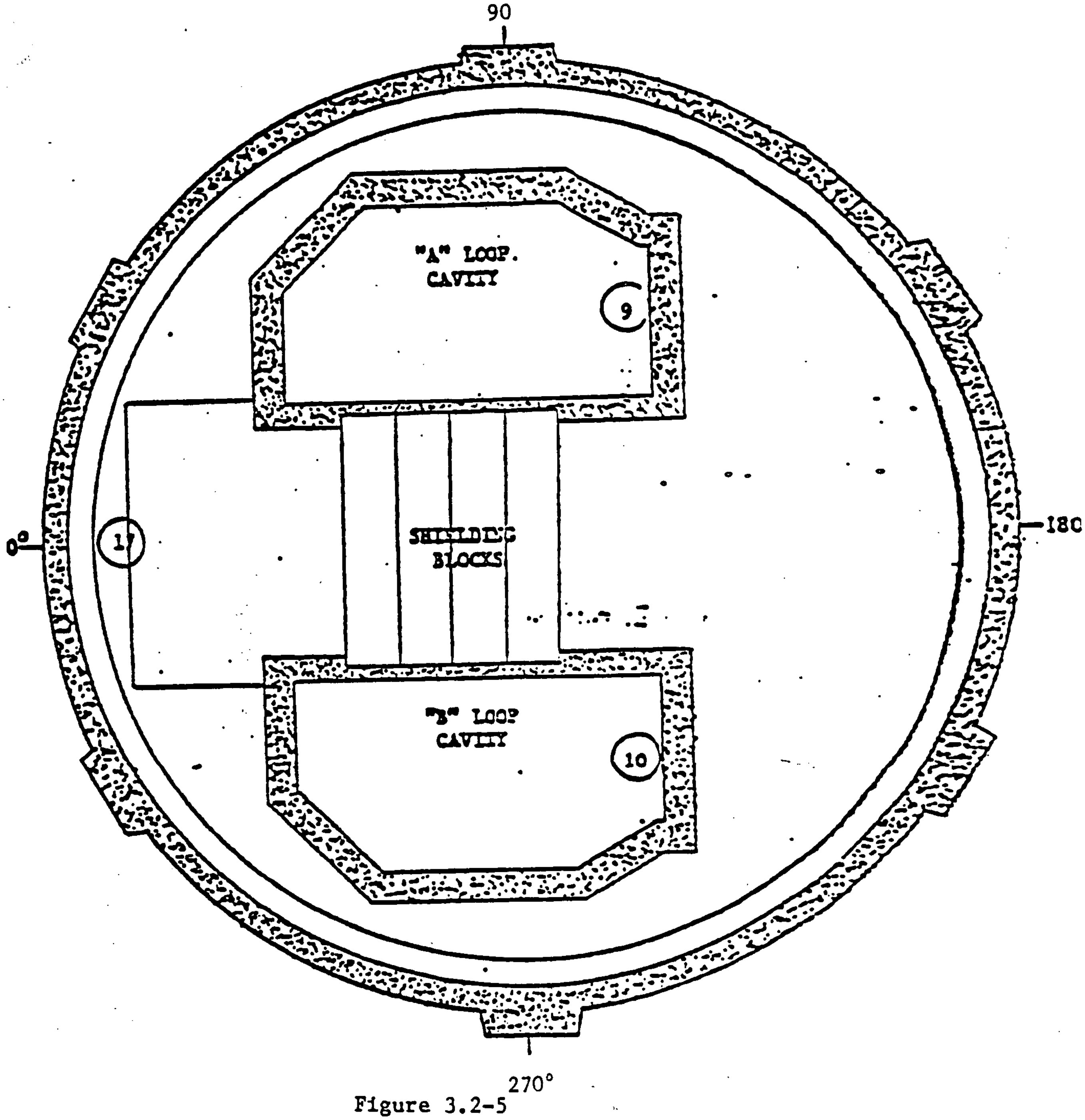


Figure 3.2-5

REACTOR BUILDING AIR RECIRCULATION SYSTEM

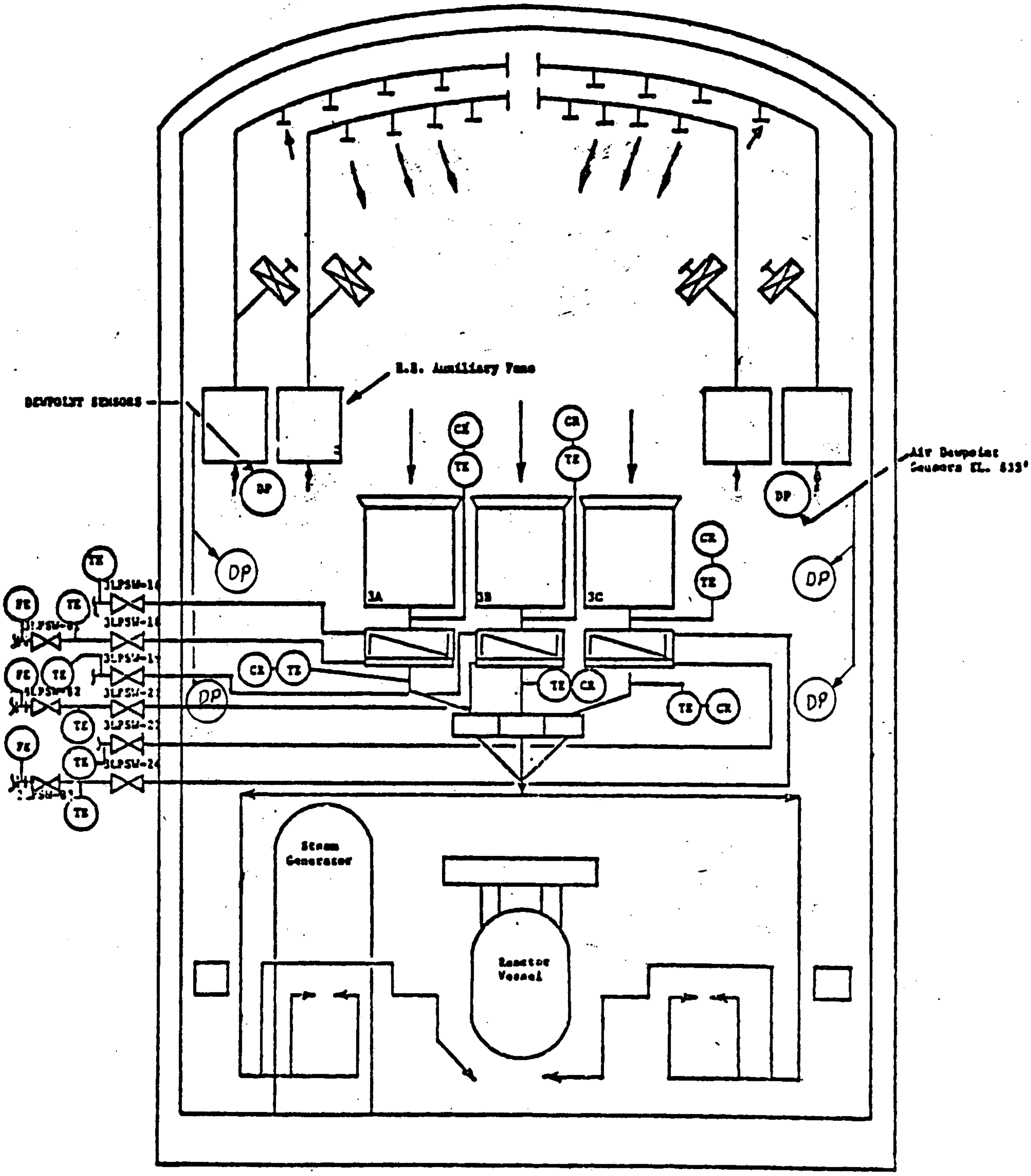


Figure 3.4-1

4.0 Conduct of Local Leak Tests

4.1 Local Leak Rate Test

The purpose of the Local Leak testing program was to systematically check the integrity of valves (seats and packing), flanges, pipe and electrical penetration welds, seals and compression fittings that are part of the boundaries of the containment system. These tests, specified by Section 4.4.1.2 of the Technical Specifications, have a combined Acceptance Criteria of less than or equal to 0.125% of the Reactor Building atmosphere per 24 hours. Final analysis of all penetration leakage rates show that the total penetration leakage rate was approximately 1.86 percent of the allowable.

4.1.1 Test Method

All electrical and mechanical penetration, including locks and hatches, were tested by pressurizing to ~ 59 PSIG. Two test methods are used. One is the mass make-up method using volumetric's test instruments. The other is mass difference method where the pressure, temperature and barometric pressure were recorded before and after the leak test (duration of test determined by penetration volume) and the leak rate determined.

4.1.2 Penetration Test Results

Per Technical Specification 4.4.1.2.3, the total leakage from all penetrations and isolation valves shall not exceed 0.125% of the Reactor Building atmosphere in 24 hours. The total measured minimum path as-found leak rate from all penetrations was 0.023005 wt% per 24 hours. Results of all individual as-found penetration tests are given in Table 4.1-1 and 4.1-2. The total measured as-left leak rate from all penetrations prior to this test was 0.036796 wt% per 24 hours. Results of all individual as-left penetration tests are given in Table 4.1-3 and 4.1-4. Results of all local penetration tests done since the last type A test are given in Tables 4.1-5 through 4.1-6.

4.2 Local Leak Test Failure Data

Per 10CFR50, Appendix J, V.B.3, a listing of all type "C" local leak tests that are failed to meet the acceptance criteria since the last ILRT are reported in Table 4.2.

TABLE 4.1-1 AS-FOUND MINIMUM PATH LEAK RATE

Penet.#	Valves(s)#	LR Limit in wt%/day	measured LR in wt%/day	
2	2FDW-105	1.1305×10^{-4}	2.6283×10^{-5}	$\pm 1.5014 \times 10^{-5}$
3	2CC-24	1.3471×10^{-3}	2.1243×10^{-4}	$\pm 1.5014 \times 10^{-5}$
5a	2LWD-1	2.2138×10^{-4}	1.5780×10^{-5}	$\pm 1.5780 \times 10^{-6}$
5b	2RC-165	1.1305×10^{-4}	7.5365×10^{-7}	$\pm 1.5014 \times 10^{-6}$
6	2HP-5,36,37,333	4.4748×10^{-4}	1.2011×10^{-4}	$\pm 1.5014 \times 10^{-5}$
7	2HP-21,68,69	4.4748×10^{-4}	3.0758×10^{-5}	$\pm 1.5014 \times 10^{-6}$
10a	2HP-146	1.1776×10^{-3}	4.8987×10^{-6}	$\pm 1.5014 \times 10^{-6}$
10b	2HP-147	1.1776×10^{-3}	1.1163×10^{-5}	$\pm 1.5014 \times 10^{-6}$
11a	Flange	4.7103×10^{-5}	0.0000	$\pm 1.5014 \times 10^{-6}$
11b	SSF-2SF-97	4.4748×10^{-4}	2.4023×10^{-5}	$\pm 1.5014 \times 10^{-6}$
11c	2SF-74	1.1305×10^{-4}	0.0000	$\pm 1.5014 \times 10^{-6}$
12a	Flange	4.7103×10^{-5}	0.0000	$\pm 1.5014 \times 10^{-6}$
12b	SSF-2HP-428	1.6486×10^{-4}	2.4965×10^{-5}	$\pm 1.5014 \times 10^{-6}$
18	2GWD-12	1.1305×10^{-4}	1.1305×10^{-6}	$\pm 1.5014 \times 10^{-6}$
19	2PR-6	2.7084×10^{-3}	1.1776×10^{-2}	$\pm 1.1776 \times 10^{-4}$
20	2PR-1	2.7084×10^{-3}	1.7840×10^{-3}	$\pm 1.7840 \times 10^{-5}$
22	2LPSW-15,144,145	1.2200×10^{-3}	9.9618×10^{-4}	$\pm 1.6515 \times 10^{-5}$
23a	2HP-145	6.4531×10^{-4}	7.3198×10^{-5}	$\pm 1.5014 \times 10^{-5}$
23b	2HP-144	6.4531×10^{-4}	4.6161×10^{-4}	$\pm 1.5014 \times 10^{-5}$
24	2PR-81	5.6523×10^{-5}	1.5073×10^{-6}	$\pm 1.5014 \times 10^{-6}$
24	2PR-84	5.6524×10^{-5}	2.2609×10^{-6}	$\pm 1.5014 \times 10^{-6}$
29	2CS-5,24	1.6957×10^{-4}	9.8445×10^{-6}	$\pm 9.8445 \times 10^{-7}$
38	2CS-12	2.2609×10^{-4}	1.0504×10^{-4}	$\pm 1.5014 \times 10^{-5}$
41	2IA-91	3.2972×10^{-4}	2.9728×10^{-3}	$\pm 1.5014 \times 10^{-4}$
42	2PR-87	5.6524×10^{-5}	3.5327×10^{-6}	$\pm 1.5014 \times 10^{-6}$

TABLE 4.1-1 AS-FOUND MINIMUM PATH LEAK RATE

Penet.#	Valves(s)#	LR Limit in wt%/day	measured LR in wt%/day	
42	2PR-90	5.6524×10^{-5}	0.0000	$\pm1.5014\times10^{-6}$
44	2CC-76	6.7357×10^{-4}	3.0028×10^{-4}	$\pm1.5014\times10^{-4}$
45a	2LRT-24	5.1813×10^{-5}	0.0000	$\pm1.5014\times10^{-6}$
45b	2LRT-39	5.1813×10^{-5}	1.3660×10^{-6}	$\pm1.5014\times10^{-6}$
45c	2LRT-36	5.1813×10^{-5}	0.0000	$\pm1.5014\times10^{-6}$
46	2FW-64	3.9095×10^{-4}	2.3835×10^{-3}	$\pm1.5014\times10^{-4}$
48	2BA-5	2.2609×10^{-4}	6.1611×10^{-5}	$\pm1.5914\times19^{-6}$
51	2LRT-17	8.8554×10^{-4}	0.0000	$\pm1.5014\times10^{-6}$
54	2CC-7	3.7682×10^{-3}	1.2049×10^{-3}	$\pm1.5014\times10^{-4}$
55	2DW-59	4.4748×10^{-4}	0.0000	$\pm1.5014\times10^{-6}$
58a	2RC-5,6	2.1667×10^{-4}	3.5327×10^{-6}	$\pm3.0028\times10^{-6}$
58b	2FDW-108,122,123, 124	1.0834×10^{-4}	4.8799×10^{-5}	$\pm1.5014\times10^{-5}$
60	2PR-7,59	1.6722×10^{-4}	3.7682×10^{-6}	$\pm1.5014\times10^{-6}$
61	2RP-9,60	1.6722×10^{-4}	6.9077×10^{-4}	$\pm1.5014\times10^{-4}$
TOTAL		2.1672×10^{-2}	2.2997×10^{-2}	$\pm1.3408\times10^{-3}$

TABLE 4.1-2 AS-FOUND MINIMUM PATH LEAK RATE

Penetration	LR Limit in wt%/day	measured LR in wt%/day
Electricals	1.2718×10^{-3}	7.3952×10^{-6}
Equipment Hatch	-----------	9.4206×10^{-7}
Emergency Hatch	-----------	0.0000
Personnel Hatch	-----------	0.0000
TOTAL		8.3373×10^{-6}

TABLE 4.1-3 AS-LEFT MAXIMUM PATH LEAK RATE

Penet.#	Valves(s)#	LR Limit in wt%/day	measured LR in wt%/day
2	2FDW-106,117,118,119	$1.1305x10^{-4}$	$4.1309x10^{-5}$ ±$1.5014x10^{-5}$
3	2CC-24,20,21,22,23	$1.6580x10^{-3}$	$5.2605x10^{-4}$ ±$1.5464x10^{-4}$
5a	2LWD-1,2,27,29	$3.3443x10^{-4}$	$2.0396x10^{-5}$ ±$1.7054x10^{-6}$
5b	2RC-164	$1.1305x10^{-4}$	$1.8841x10^{-5}$ ±$1.5014x10^{-5}$
6	2HP-5,36,37,333	$4.4748x10^{-4}$	$1.2011x10^{-4}$ ±$1.5014x10^{-5}$
7	2HP-20,420	$5.6053x10^{-4}$	$2.8380x10^{-4}$ ±$1.6515x10^{-5}$
10a	2HP-286,216,218	$1.2906x10^{-3}$	$9.5195x10^{-4}$ ±$3.0028x10^{-6}$
10b	2HP-389,223,225	$1.2906x10^{-3}$	$1.6943x10^{-4}$ ±$1.6515x10^{-5}$
11a	Flange	$4.7103x10^{-5}$	$1.6486x10^{-5}$ ±$1.5014x10^{-6}$
11b	SSF-2SF-97	$4.4748x10^{-4}$	$5.4168x10^{-6}$ ±$1.5014x10^{-6}$
11c	2SF-72,73	$1.1305x10^{-4}$	$3.3914x10^{-6}$ ±$1.5014x10^{-6}$
12a	Flange	$4.7103x10^{-5}$	$4.2393x10^{-6}$ ±$1.5014x10^{-6}$
12b	SSF-2HP-405,417,423, 425,426	$6.1705x10^{-4}$	$4.7951x10^{-5}$ ±$7.5070x10^{-6}$
18	2GWD-10,11,12,13	$3.3914x10^{-4}$	$7.5365x10^{-6}$ ±$3.0028x10^{-6}$
19	2PR-5,6	$2.7084x10^{-3}$	$2.7644x10^{-3}$ ±$2.7644x10^{-5}$
20	2PR-1,2	$2.7084x10^{-3}$	$1.6145x10^{-2}$ ±$1.6145x10^{-4}$
22	2LPSW-15,144,145, 2PG-190	$1.2200x10^{-3}$	$1.2986x10^{-3}$ ±$1.4488x10^{-5}$
23a	2HP-390,145,211,209	$1.2906x10^{-3}$	$2.8262x10^{-7}$ ±$3.0028x10^{-6}$
23b	2HP-144,202,204,284	$1.2906x10^{-3}$	$8.1064x10^{-5}$ ±$3.0028x10^{-6}$
24a	2PR-81	$5.6524x10^{-5}$	$1.5073x10^{-6}$ ±$1.5014x10^{-6}$
24b	2PR-84	$5.6524x10^{-5}$	$2.2609x10^{-6}$ ±$1.5014x10^{-6}$
29	2CS-5,6,23,24,25	$7.0183x10^{-4}$	$4.5045x10^{-4}$ ±$1.6515x10^{-5}$
38	2CS-11,17,18	$3.3914x10^{-4}$	$1.6156x10^{-4}$ ±$1.6515x10^{-5}$

TABLE 4.1-3 AS-LEFT MAXIMUM PATH LEAK RATE

Penet.#	Valves(s)#	LR Limit in wt%/day	measured LR in wt%/day	
41	2IA-91	$3.2972x10^{-4}$	$2.9355x10^{-4}$	$\pm1.5014x10^{-5}$
42a	2PR-87	$5.6524x10^{-5}$	$3.5327x10^{-6}$	$\pm1.5014x10^{-6}$
42b	2PR-90	$5.6524x10^{-5}$	0.0000	$\pm1.5014x10^{-6}$
44	2CC-77,80,81,82	$6.7357x10^{-4}$	$3.0028x10^{-4}$	$\pm1.5014x10^{-4}$
45a	2LRT-24	$5.1813x10^{-5}$	0.0000	$\pm1.5014x10^{-5}$
45b	2LRT-39	$5.1813x10^{-5}$	$5.1813x10^{-7}$	$\pm1.5014x10^{-6}$
45c	2LRT-36	$5.1813x10^{-5}$	$1.2718x10^{-6}$	$\pm1.5014x10^{-6}$
46	2FW-64,65,66	$7.8191x10^{-4}$	$1.8841x10^{-6}$	$\pm3.0028x10^{-6}$
48	2BA-33	$2.2609x10^{-4}$	$1.0509x10^{-4}$	$\pm1.5014x10^{-5}$
51	2LRT-17	$8.8554x10^{-4}$	0.0000	$\pm1.5014x10^{-6}$
53	2N-263	$1.1305x10^{-4}$	$7.2586x10^{-5}$	$\pm1.5014x10^{-6}$
54	2CC-7,8,54,55,56	$3.8766x10^{-3}$	$4.7296x10^{-3}$	$\pm1.6515x10^{-5}$
55	2DW-60	$4.4748x10^{-4}$	$1.5780x10^{-5}$	$\pm1.5014x10^{-5}$
58a	2RC-7,49,50,51	$1.0834x10^{-4}$	$1.0749x10^{-4}$	$\pm1.5014x10^{-6}$
58b	2FDW-107	$1.0834x10^{-4}$	$8.1064x10^{-5}$	$\pm1.5014x10^{-5}$
60	2PR-7,8,24,59,68	$3.3443x10^{-4}$	$6.1234x10^{-7}$	$\pm3.0028x10^{-6}$
61	2RP-10,25	$3.3443x10^{-4}$	$9.4206x10^{-6}$	$\pm3.0028x10^{-6}$
TOTAL		$2.6278x10^{-2}$	$2.8891x10^{-2}$	$\pm7.5929x10^{-4}$

TABLE 4.1-4 AS-LEFT MAXIMUM PATH LEAK RATE

Penetration	LR Limit in wt%/day	measured LR in wt%/day	
Electricals	1.2718×10^{-3}	7.3952×10^{-6}	$\pm 1.6215 \times 10^{-4}$
Equipment Hatch	-----------	1.3198×10^{-6}	$\pm 1.3198 \times 10^{-8}$
Emergency Hatch	-----------	0.0000	$\pm 1.3198 \times 10^{-8}$
Personnel Hatch	-----------	7.8796×10^{-3}	$\pm 7.8796 \times 10^{-5}$
TOTAL		7.9047×10^{-3}	$\pm 2.4097 \times 10^{-4}$

TABLE 4.1-5

TYPE "B" TESTS

PENETRATION	DATE	WT%/DAY LEAKAGE
Electrical Penetrations	09/03/86	1.3990×10^{-5}
	02/08/88	7.3952×10^{-6}
Equipment Hatch	04/15/85	1.0834×10^{-6}
	06/24/85	0.0000
	07/06/85	1.4131×10^{-6}
	08/16/86	1.3660×10^{-6}
	10/07/86	7.5365×10^{-7}
	10/18/86	9.8916×10^{-7}
	02/03/88	9.4206×10^{-7}
	03/25/88	1.3189×10^{-6}
Personnel Hatch	09/19/84	1.3801×10^{-4}
	12/06/84	1.1616×10^{-3}
	04/17/85	2.0480×10^{-3}
	06/27/85	0.0000
	07/07/85	0.0000
	11/26/85	0.0000
	05/06/86	3.9331×10^{-4}
	10/13/86	9.8375×10^{-4}
	03/17/87	8.0075×10^{-3}
	04/10/87	0.0000
	09/09/87	0.0000
	03/26/88	7.8796×10^{-3}
	04/03/88	0.0000
Personnel Hatch O'Rings	04/02/85	4.5219×10^{-4}
	04/20/85	3.7682×10^{-6}
	04/22/85	1.8841×10^{-5}
	04/23/85	1.1305×10^{-5}
	05/01/85	1.8841×10^{-6}
	06/28/85	6.2176×10^{-6}
	07/09/85	3.7682×10^{-6}
	09/05/85	4.2393×10^{-6}
	09/13/85	4.7103×10^{-6}
	09/19/85	3.9567×10^{-6}
	11/21/85	5.6524×10^{-6}
	12/05/85	5.6524×10^{-6}
	12/05/85	3.7682×10^{-6}
	12/27/85	3.7682×10^{-6}
	01/23/86	1.8841×10^{-6}
	10/14/86	1.1305×10^{-6}

TABLE 4.1-5 (Cont'd)

PENETRATION	DATE	WT%/DAY LEAKAGE
Personnel Hatch O'Rings (Cont'd)	10/16/86	2.8267×10^{-6}
	10/22/86	3.5798×10^{-6}
	11/05/86	4.5219×10^{-6}
	11/14/86	6.7640×10^{-5}
	11/20/86	9.6561×10^{-6}
	12/03/86	4.0038×10^{-6}
	01/02/87	1.5544×10^{-4}
	01/03/87	7.5365×10^{-6}
	01/19/87	3.6740×10^{-4}
	08/14/87	5.6524×10^{-6}
	08/21/87	7.1597×10^{-6}
	09/04/87	8.0075×10^{-6}
	09/13/87	4.8045×10^{-6}
	09/22/87	6.0292×10^{-6}
	09/24/87	8.6670×10^{-6}
	12/22/87	3.6552×10^{-5}
	04/06/88	6.5473×10^{-6}
	04/09/88	2.9675×10^{-5}
Emergency Hatch	12/03/84	1.6486×10^{-4}
	04/13/85	0.0000
	04/17/85	5.0165×10^{-4}
	09/17/85	2.4823×10^{-4}
	02/13/86	0.0000
	07/15/86	3.0146×10^{-5}
	10/03/86	1.2445×10^{-4}
	10/13/86	0.0000
	08/17/87	6.6076×10^{-4}
	01/13/88	0.0000
	04/09/88	2.9675×10^{-5}
Emergency Hatch O'Rings	10/14/86	1.1305×10^{-6}
Purge Valves	04/16/85	1.9513×10^{-3}
	04/17/85	4.9932×10^{-3}
	06/25/85	4.4286×10^{-3}
	07/06/85	3.9133×10^{-3}
	08/16/86	6.8848×10^{-3}
	10/10/86	6.3646×10^{-3}
	02/03/86	6.5743×10^{-2}
	03/26/88	1.8910×10^{-2}

TABLE 4.1-6

TYPE "C" TESTS

PENETRATION	DATE	WT%/DAY LEAKAGE
Mechanical Penetrations	04/17/85	7.6121×10^{-3}
	09/01/86	9.6168×10^{-2}
	10/11/86	1.9470×10^{-2}
	02/12/88	2.2997×10^{-2}
	03/25/88	5.5801×10^{-3}

TABLE 4.2

LOCAL TEST FAILURE DATA

	DATE	REASON FOR FAILURE	CORRECTIVE ACTION
Type C			
2FW-66	02/28/85	Leaking Past Seat	Replaced Diaphragm & Adjusted Stops
2FW-65	02/28/85	Body to Bonnet Leak	Replaced Diaphragm & Adjusted Stops
2FW-64	02/28/85	Leaking Past Seat	Replaced Diaphragm & Adjusted Stops
2HP-284	03/08/85	Leaking Past Seat	Cleaned & Lapped Seat
2HP-146	03/08/85	Leaking Past Seat	Lapped Seat & Replaced Internals
2FDW-107	03/11/85	Leaking Past Seat	Replaced Valve
2FDW-108	03/12/85	Leaking Past Seat	Replaced Valve
2CS-12	03/13/85	Leaking Past Seat	Cleaned & Lapped Seat
2FDW-105	03/13/85	Leaking Past Seat	Replaced Valve
2FDW-106	03/13/85	Leaking Past Seat	Replaced Diaphragm
2RC-5	03/17/85	Leaking Past Seat	Cleaned & Lapped Seat
2RC-6	03/17/85	Leaking Past Seat	Cleaned & Lapped Seat
2HP-329	03/17/85	Leaking Past Seat	Cleaned Seat
2[illegible]-7	03/19/85	Leaking Past Seat	Lapped Seat & Set Limit Switch
[illegible]24	08/21/86	Leaking Past Seat	Repaired Seat
2CS-25	08/21/86	Leaking Past Seat	Repaired Seat
SSF-2HP-417	08/23/86	Leaking Past Seat	Adjusted Torque Switch
2HP-3	08/23/86	Packing leak	Replaced Packing
2FDW-147	08/23/86	Leaking Past Seat	Repaired Seat
2FDW-149	08/23/86	Leaking Past Seat	Repaired Seat
2FDW-108	08/24/86	Leaking Past Seat	Repaired Seat
2CC-7	08/25/86	Leaking Past Seat	Replaced Valve Seat & Guides
2FW-66	08/27/86	Leaking Past Seat	Replaced Seat
2HP-146	08/27/86	Leaking Past Seat	Replaced Valve
2FDW-108	08/29/86	Leaking Past Seat	Repaired Seat
2FDW-122	08/29/86	Leaking Past Seat	Repaired Seat
2FDW-123	08/29/86	Leaking Past Seat	Repaired Seat
2FDW-124	08/29/86	Leaking Past Seat	Repaired Seat
2FDW-117	08/29/86	Leaking Past Seat	Repaired Seat
2FDW-118	08/29/86	Leaking Past Seat	Repaired Seat
2FDW-119	08/29/86	Leaking Past Seat	Repaired Seat
[illegible]-24	09/02/86	Packing Leak	Repacked Valve

TABLE 4.2
(Continued)
LOCAL TEST FAILURE DATA

	DATE	REASON FOR FAILURE	CORRECTIVE ACTION
Type C (Cont'd)			
2LRT-25	09/02/86	Packing Leak	Repacked Valve
2FW-65	09/17/86	Leaking Past Seat	Repaired Seat
2FW-64	09/17/86	Leaking Past Seat	Repaired Seat
2CC-8	09/29/86	Leaking Past Seat	Replaced Valve
2LPSW-15	09/30/86	Leaking Past Seat	Replaced Valve
2CS-5	10/03/86	Leaking Past Seat	Replaced Valve Diaphragm
2IA-90	02/07/88	Leaking Past Seat	Repaired Seat
2IA-91	02/07/88	Leaking Past Seat	Replaced Valve
2N-246	02/11/88	Leaking Past Seat	Cleaned & Lapped Disc & Seat
Type B			
Hatch Inner Electrical Penetrations			
WD-2	02/25/85	Leaking Past Flange	Retorqued Flange Bolts
WA-11	02/25/85	Leaking Past Flange	Retorqued Flange Bolts
WA-10	02/25/85	Leaking Past Flange	Retorqued Flange Bolts
WMV-2	02/26/85	Leaking Past Flange	Retorqued Flange Bolts
[illegible]	03/08/85	Leaking Past Flange	Retorqued Flange Bolts

RDG	TIME (MINUTES)	NORM. MASS	MEASURED LEAK (WT %/DAY)	UCL LEAK (WT %/DAY)
68	.00	1.000000	-	-
69	15.00	.999969	.301241	-
70	30.00	.999921	.379677	.767184
71	45.00	.999942	.211669	.503231
72	60.00	.999868	.279227	.442265
73	74.98	.999849	.283647	.380451
74	89.97	.999888	.215429	.317858
75	104.97	.999837	.209741	.283645
76	119.95	.999850	.184628	.246844
77	134.93	.999750	.214459	.272766
78	149.92	.999764	.214714	.261648
79	166.48	.999758	.207796	.246906
80	181.48	.999790	.186704	.225897
81	196.47	.999695	.194395	.228579
82	211.47	.999670	.200505	.230554
83	226.45	.999703	.193203	.220363
84	241.45	.999699	.185174	.210362
85	256.43	.999677	.180051	.202935
86	271.40	.999658	.176431	.197153
87	286.38	.999666	.170100	.189747
88	301.37	.999694	.159846	.180329
89	316.37	.999663	.153730	.173284
90	331.35	.999622	.151628	.169566
91	346.33	.999671	.143860	.161998
92	361.32	.999602	.142556	.159264
93	376.32	.999606	.139978	.155587
94	391.30	.999512	.143970	.158933
95	406.30	.999549	.143475	.157359
96	421.28	.999550	.142071	.155056
97	436.28	.999533	.141036	.153185
98	451.28	.999660	.132022	.146426
99	466.27	.999564	.129067	.142867
100	481.27	.999485	.129959	.142941
101	496.27	.999433	.132547	.145015
102	511.25	.999504	.130839	.142704
103	526.23	.999497	.129110	.140435
104	541.23	.999547	.125064	.136476
105	556.22	.999507	.122672	.133726
106	571.22	.999567	.117961	.129406
107	586.20	.999434	.118136	.129003

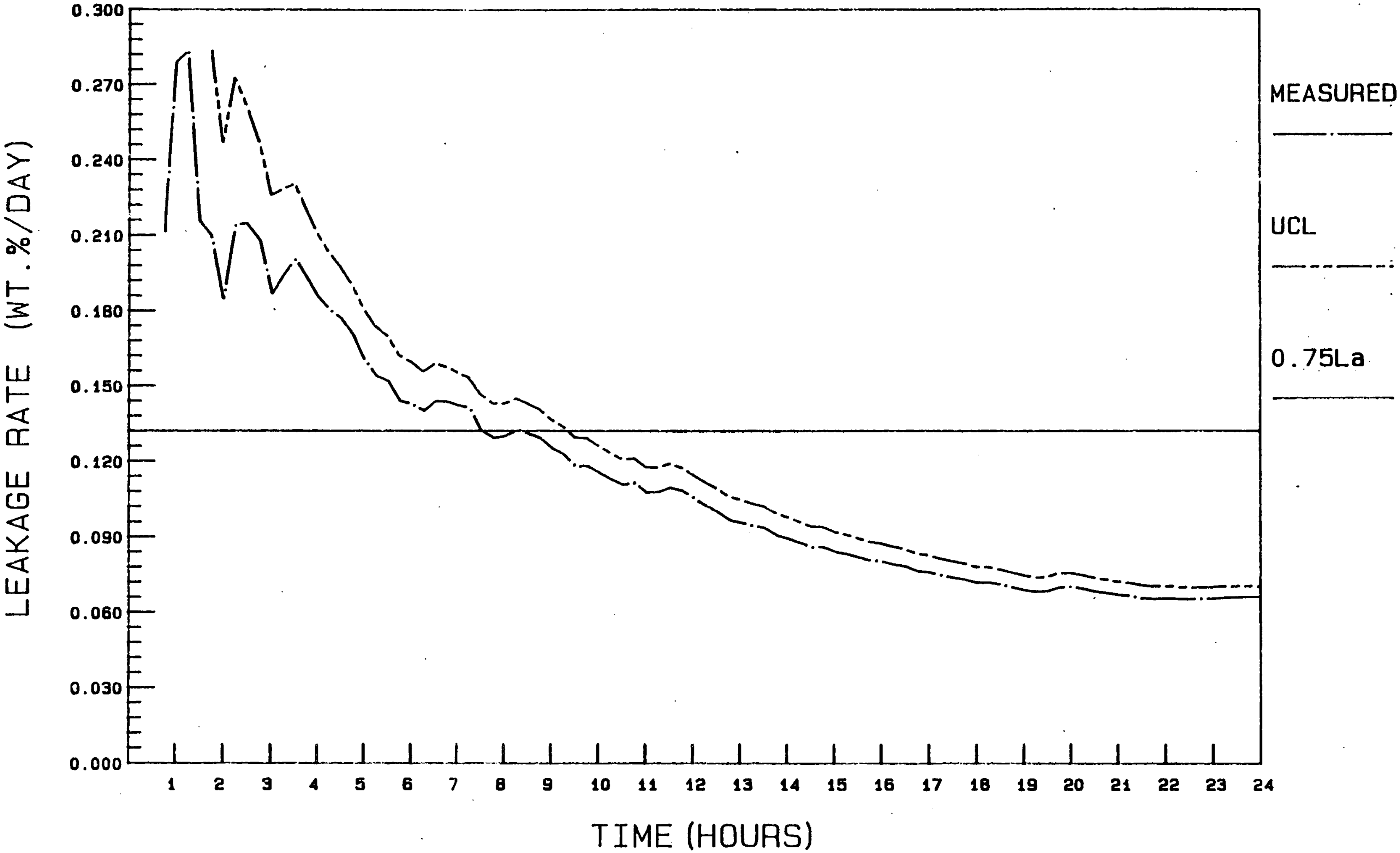
RDG	TIME (MINUTES)	NORM. MASS	MEASURED LEAK (WT %/DAY)	UCL LEAK (WT %/DAY)
108	601.20	.999510	.115336	.126022
109	616.18	.999503	.112769	.123243
110	631.18	.999488	.110630	.120827
111	646.17	.999380	.111573	.121345
112	661.17	.999545	.107498	.117638
113	676.17	.999386	.107854	.117555
114	691.17	.999316	.109681	.119133
115	706.17	.999427	.108294	.117448
116	721.15	.999490	.105330	.114567
117	736.15	.999500	.102232	.111591
118	751.15	.999475	.099801	.109094
119	766.15	.999511	.096668	.106101
120	781.15	.999420	.095498	.104643
121	796.13	.999413	.094394	.103263
122	811.13	.999399	.093493	.102081
123	826.13	.999501	.090667	.099386
124	841.13	.999428	.089235	.097759
125	856.13	.999442	.087547	.095935
126	871.13	.999454	.085685	.093983
127	886.13	.999331	.085795	.093815
128	901.13	.999453	.083906	.091873
129	916.13	.999386	.083047	.090800
130	931.13	.999413	.081766	.089372
131	945.00	.999410	.080528	.087992
132	960.00	.999356	.080014	.087265
133	975.00	.999397	.078901	.086013
134	989.98	.999367	.078160	.085096
135	1004.98	.999460	.076245	.083226
136	1019.98	.999345	.075770	.082563
137	1034.97	.999404	.074557	.081258
138	1049.97	.999378	.073645	.080216
139	1064.97	.999367	.072840	.079275
140	1079.97	.999406	.071610	.077979
141	1094.97	.999282	.071680	.077876
142	1109.97	.999357	.070916	.076990
143	1124.97	.999396	.069750	.075770
144	1139.97	.999386	.068703	.074652
145	1154.97	.999355	.067953	.073794
146	1169.97	.999218	.068448	.074160
147	1184.97	.999097	.069911	.075655

RDG	TIME (MINUTES)	NORM. MASS	MEASURED LEAK (WT %/DAY)	UCL LEAK (WT %/DAY)
148	1199.97	.999225	.070102	.075706
149	1214.97	.999345	.069200	.074735
150	1229.97	.999370	.068097	.073601
151	1244.97	.999314	.067464	.072871
152	1259.97	.999327	.066717	.072045
153	1274.97	.999278	.066341	.071557
154	1289.97	.999340	.065479	.070641
155	1304.97	.999277	.065088	.070146
156	1319.97	.999162	.065496	.070455
157	1334.98	.999268	.065085	.069950
158	1349.98	.999219	.064989	.069747
159	1364.98	.999129	.065460	.070136
160	1379.98	.999199	.065397	.069973
161	1394.98	.999115	.065839	.070337
162	1409.98	.999140	.066051	.070459
163	1424.98	.999145	.066175	.070491
164	1439.98	.999178	.066047	.070276

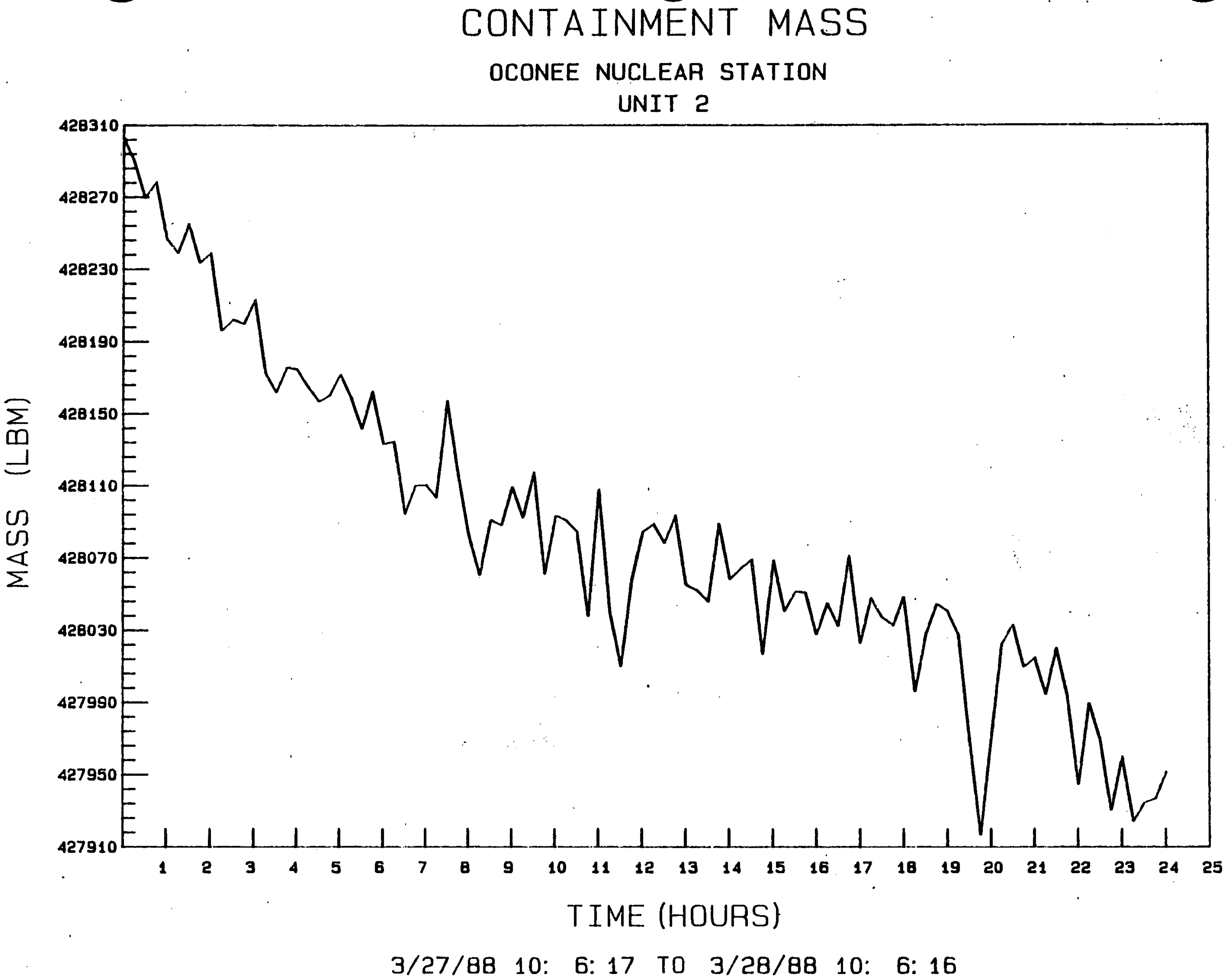
RDG	TIME (MINUTES)	NORM. MASS	MEASURED LEAK (WT %/DAY)	UCL LEAK (WT %/DAY)
168	.00	1.000000	-	-
169	10.00	1.000025	-.357107	-
170	20.02	.999954	.332125	3.733370
171	30.00	.999935	.383702	.914369
172	40.00	.999881	.473201	.746966
173	50.00	.999876	.440107	.607417
174	60.00	.999906	.335003	.500708
175	70.00	.999825	.361382	.484110
176	80.02	.999877	.298848	.414023
177	90.02	.999798	.312965	.404404
178	100.02	.999879	.253369	.350295
179	110.02	.999833	.234566	.316696
180	120.02	.999802	.230574	.299476
181	130.03	.999761	.238260	.297346
182	140.03	.999686	.264169	.321498
183	150.02	.999670	.280657	.333263
184	160.02	.999714	.274233	.320866
185	170.02	.999642	.283139	.325371
186	180.03	.999619	.290220	.328522
187	190.02	.999570	.301268	.337359
188	200.03	.999540	.311199	.345228
189	210.03	.999516	.319017	.350833
190	220.03	.999570	.313074	.342647
191	230.03	.999561	.306639	.334429
192	240.03	.999526	.303490	.329194
193	250.02	.999518	.299366	.323397

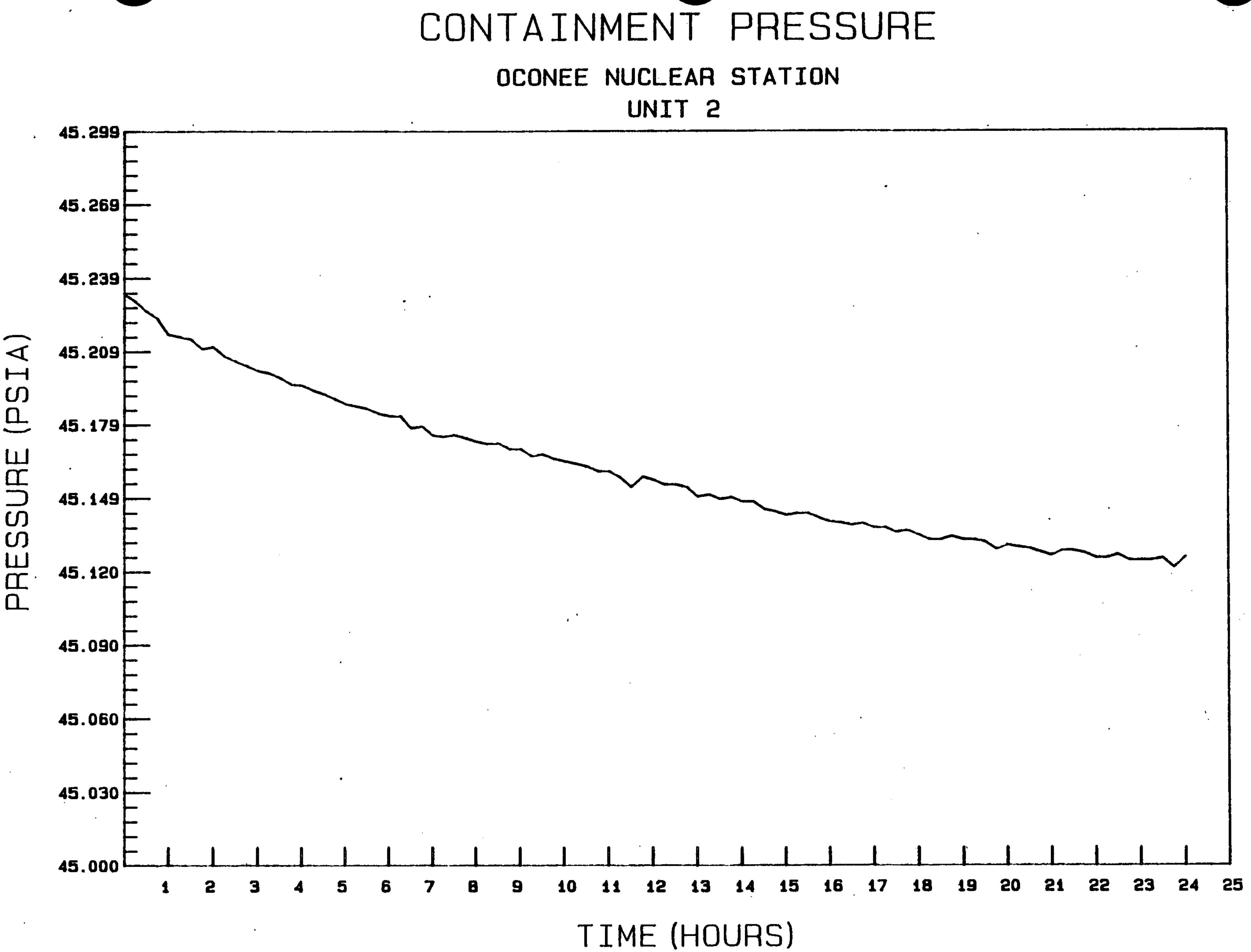
MASS POINT LEAKAGE RATE AND UCL

OCONEE NUCLEAR STATION
UNIT 2



3/27/88 10: 6: 17 TO 3/28/88 10: 6: 16

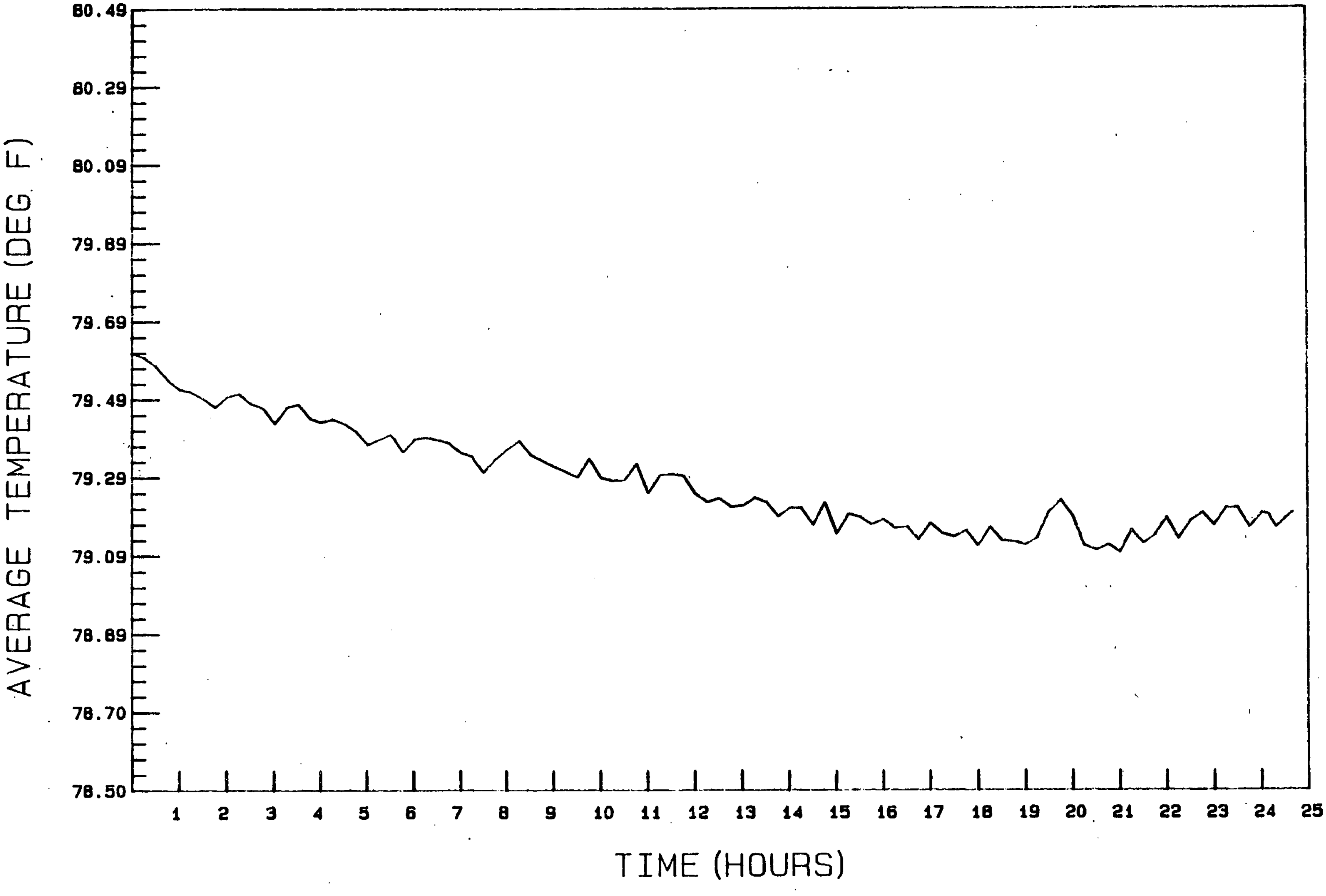

CONTAINMENT MASS
OCONEE NUCLEAR STATION
UNIT 2
MASS (LBM)
428310
428270
428230
428190
428150
428110
428070
428030
427990
427950
427910
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
TIME (HOURS)
3/27/88 10: 6: 17 TO 3/28/88 10: 6: 16



3/27/88 10: 6: 17 TO 3/28/88 10: 6: 16

CONTAINMENT AVG. TEMP.

OCONEE NUCLEAR STATION
UNIT 2

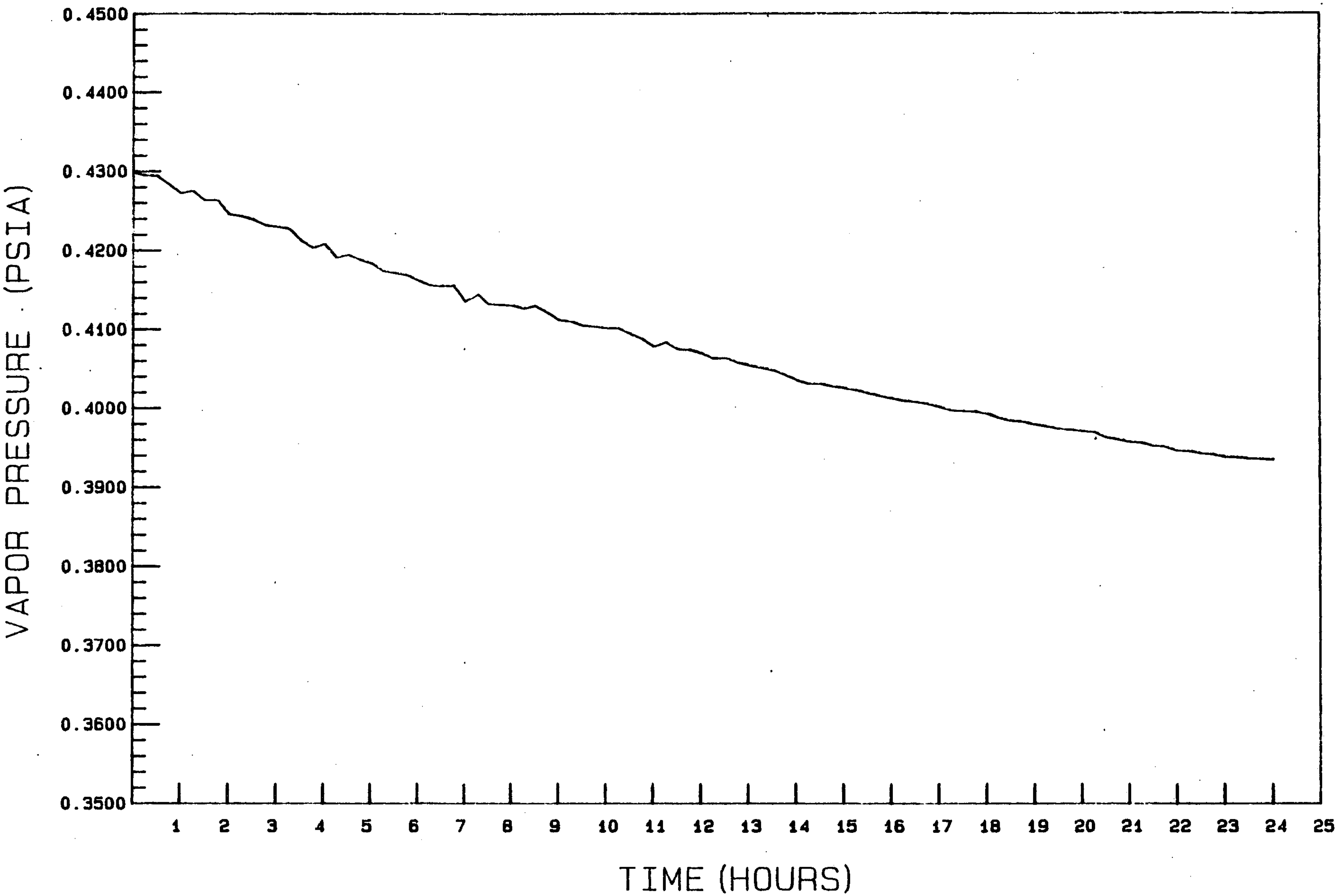


3/27/88 10: 6: 17 TO 3/28/88 10: 45: 16

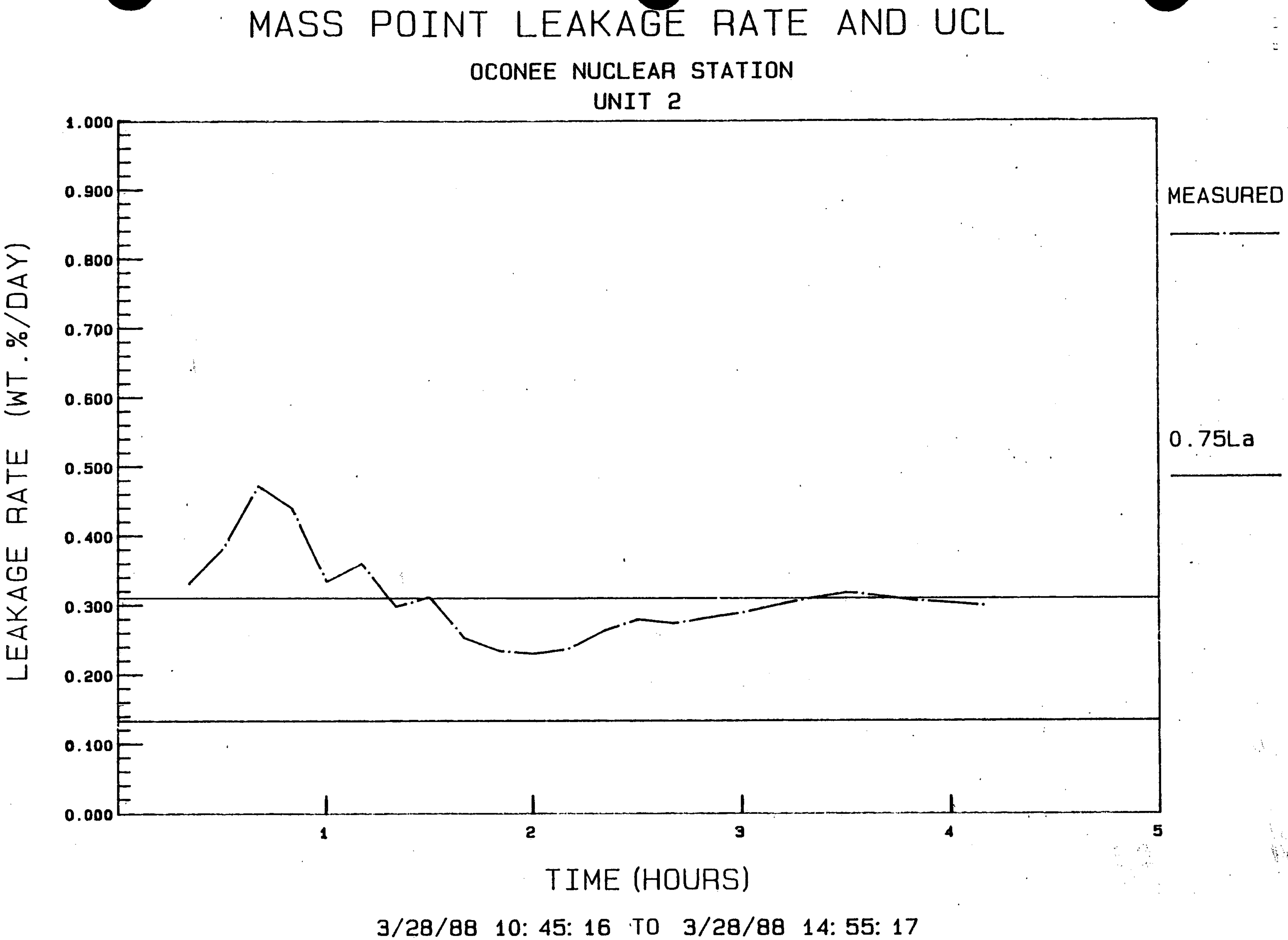
CONTAINMENT VAPOR PRESSURE

OCONEE NUCLEAR STATION

UNIT 2



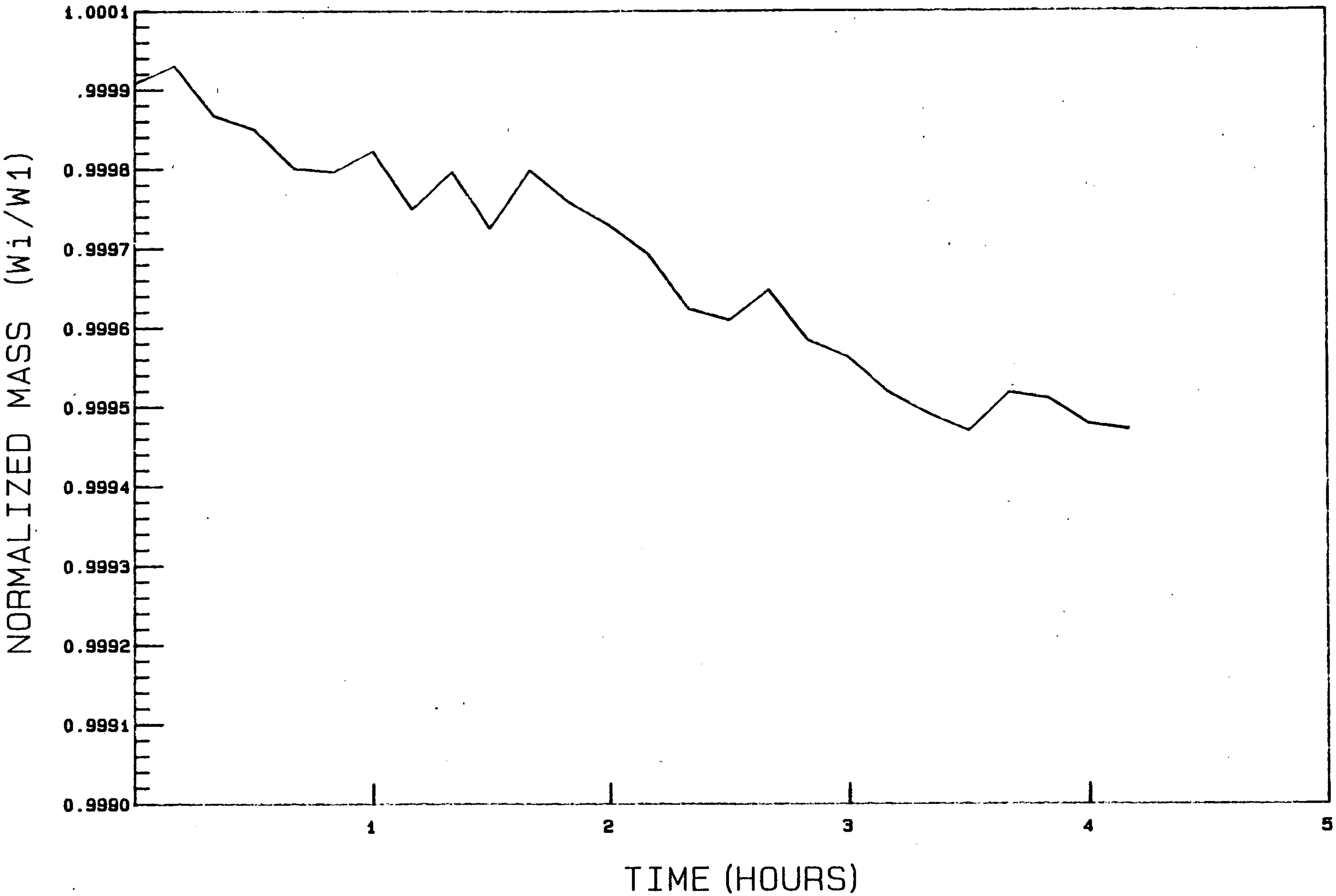
3/27/88 10: 6: 17 TO 3/28/88 10: 6: 16



MASS POINT LEAKAGE RATE AND UCL
OCONEE NUCLEAR STATION
UNIT 2
LEAKAGE RATE (WT.%/DAY)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
1
2
3
4
5
MEASURED
0.75La
TIME (HOURS)
3/28/88 10: 45: 16 TO 3/28/88 14: 55: 17

NORMALIZED CONTAINMENT MASS

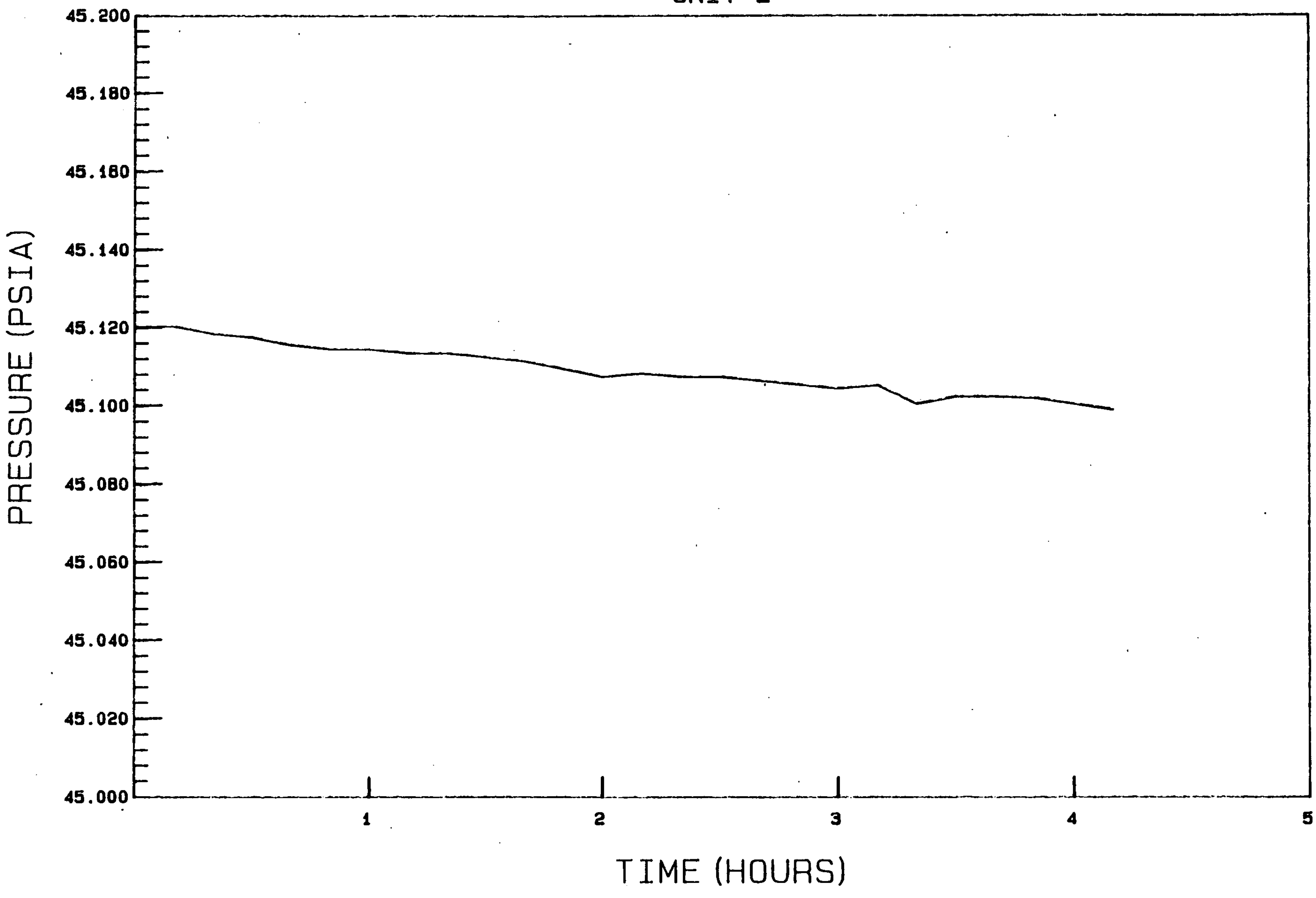
OCONEE NUCLEAR STATION
UNIT 2



3/28/88 10: 45: 16 TO 3/28/88 14: 55: 17

CONTAINMENT PRESSURE

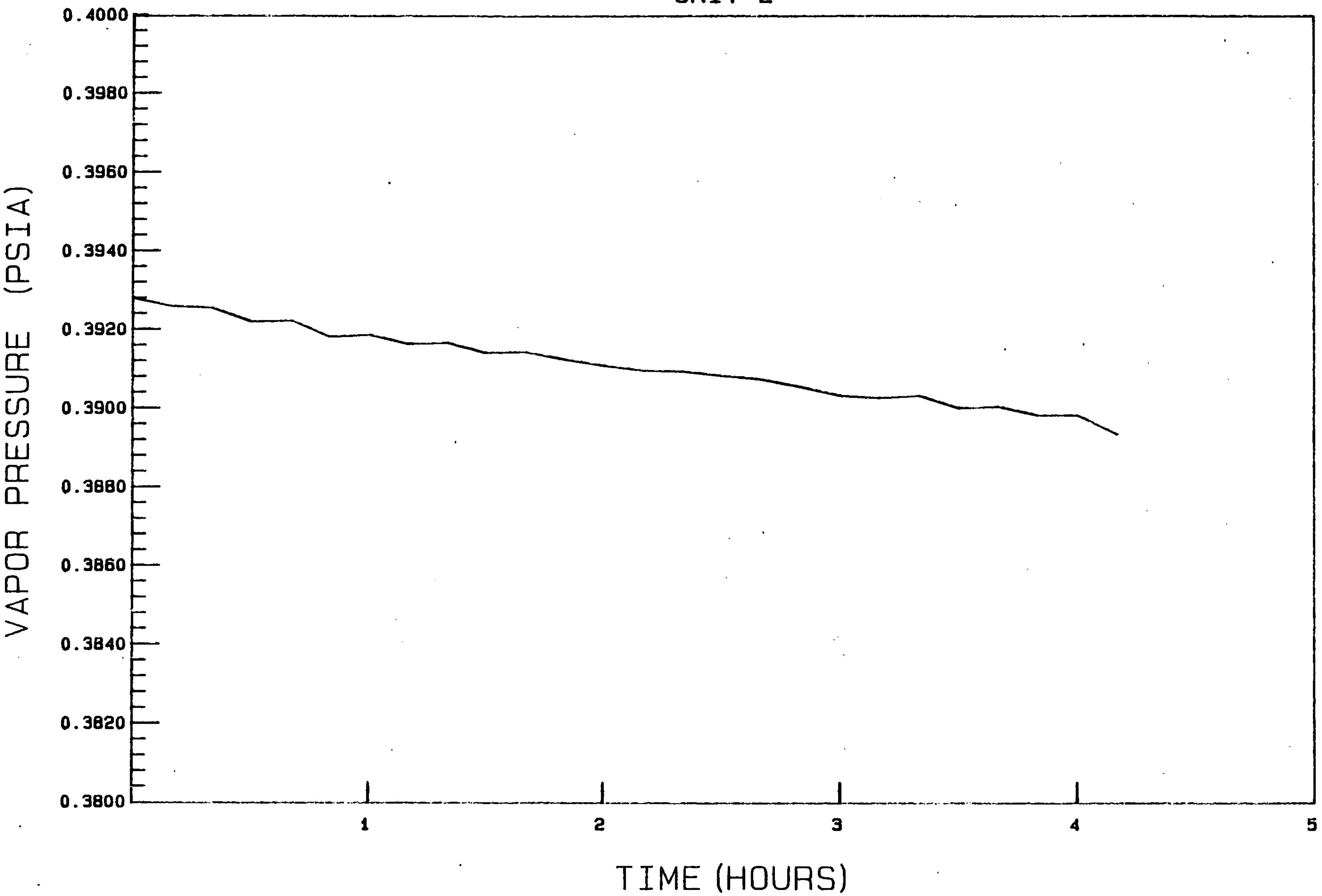
OCONEE NUCLEAR STATION
UNIT 2



3/28/88 10: 45: 16 TO 3/28/88 14: 55: 17

CONTAINMENT VAPOR PRESSURE

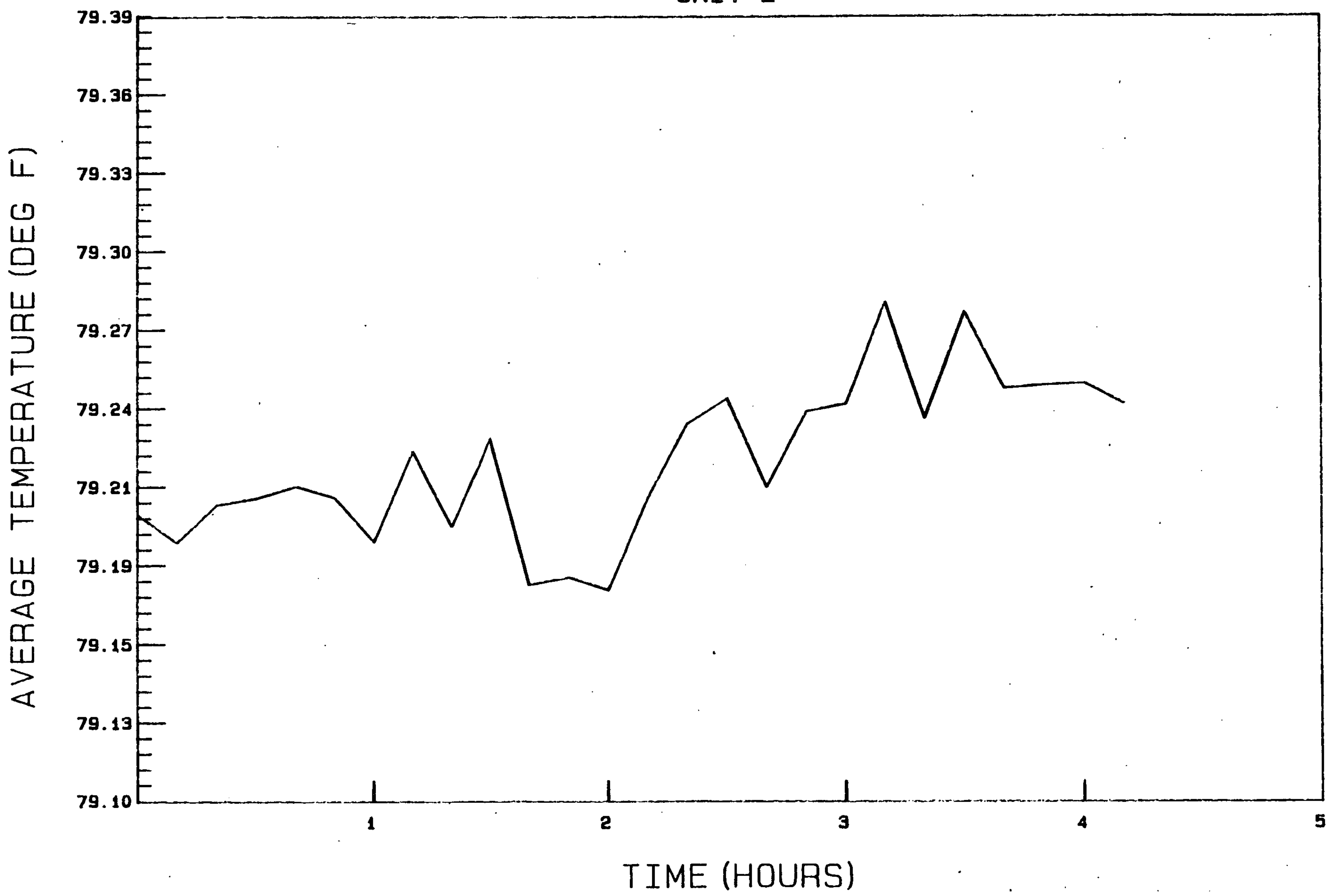
OCONEE NUCLEAR STATION
UNIT 2



3/28/88 10: 45: 16 TO 3/28/88 14: 55: 17

CONTAINMENT AVG. TEMP.

OCONEE NUCLEAR STATION
UNIT 2



3/28/88 10: 45: 16 TO 3/28/88 14: 55: 17