Commonwealth Edison
Dresden Nuclear Power Station
R.R. #1
Morris, Illinois 60450
Telephone 815/942-2920

October 6, 1986

EDE LTR: 86-088

Mr. Harold Denton
Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Reactor Containment Building Integrated Leak Rate Test, Dresden Nuclear Power Station Unit 3, Docket 050-249, DPR-25

Dear Mr. Denton:

Enclosed, please find the Reactor Containment Building Integrated Leak Rate Test (ILRT) report for Dresden Nuclear Power Station Unit 3, conducted July 24-26, 1986. This report is submitted to you in accordance with 10CFR 50, Appendix J, Section V.B.3.

Sincerely,

E. D. Eenigenburg
Station Manager
Dresden Nuclear Power Station

EDE:ML:hjb
Enclosure
cc: J. Keppler (U.S. NRC R III)
M. Ring (U.S. NRC R III)
L. McGregor (U.S. NRC R III)
L. Mariani (Am. Nuc. Ins.)
B. Stephenson
G. Diederich
N. Kalivianakis
P. LeBlond
J. Wojnarowski
R. Bax
J. Glover
J. Achterberg
M. Leahy
E. Mendenhall
File/NRC
File/T.S. File (1600)
File/Numerical

A017
1/1

8610280087

Dresden Unit 3

Reactor Containment Building
Integrated Leak Rate Test

July 24-26, 1986

A017
1/1

Abstract

The 1986 Dresden Unit 3 primary containment Integrated Leak Rate Rest (ILRT) was performed in accordance with the requirements of 10CFR 50, Appendix J, Section V.B.3, from July 24 to July 26, 1986. A "short duration" (less than 24 hours) test was conducted using the methods outlined in Bechtel Topical Report BN-TOP-1, Revision 1, dated November 1, 1972.

Total containment leakage upon successful completion of the ILRT was .5874 weight %/day, including local leak rate test results for several systems that were not vented or drained during the ILRT. The associated 95% upper confidence level leak rate was .7407 weight %/day. A supplemental induced phase verification test was performed in order to prove the accuracy of the computerized measurement system. The difference between the induced phase calculated leak rate and the sum of the measured phase calculated leak rate and the superimposed leak rate was 0.0785 weight %/day, which was well below the Technical Specification 4.7.A.2.d.(1). accuracy requirement of 0.4 weight %/day.

DRESDEN UNIT 3 1986 ILRT

Abstract

A. INTRODUCTION

A.1 Purpose of Test

The purpose of the Dresden Unit 3 primary containment Integrated Leak Rate Test was to measure the primary containment leak rate while at a test pressure equal to that postulated to occur during loss-of-coolant accident (LOCA) conditions. The system line-ups for the ILRT are intended to provide the normal isolations that are available under operation to prevent primary containment leakage should such conditions develop. This report is provided in order to give a detailed description of the test method and the final results. These results are reported in accordance with 10CFR 50, Appendix J, "Primary Containment Leakage Testing for Water Cooled Power Reactors".

A.2 Test Requirements

All leak rate tests performed during the recent refueling outage were done in accordance with schedules and acceptance criteria established by 10CFR 50, Appendix J, American National Standard ANSI N45.4 1972, and by the Dresden Unit 3 Technical Specifications. The maximum acceptable leak rates, as stated in the Technical Specifications are as follows:

Type "A" test (ILRT @ greater than 48 psig)

a. Measured Phase

1. 1.6 weight %/day (La) maximum allowable

2. 1.2 weight %/day (Lt) maximum operational

b. Supplemental Verification Phase

± 0.4 weight %/day (0.25 La)

Type "B" and "C" tests (Local Leak Rate Tests)

a. Testable penetrations and isolation valves must have a total combined leakage of less than or equal to 60 percent of La except for main steam isolation valves.

b. Any one air lock must have a leakage rate of less than or equal to 3.75 percent of La when pressurized to 10 psig.

c. Any one main steam isolation valve must have a leakage of less than or equal to 11.5 scfm when pressurized to 25 psig.

The Type "A" test was conducted in accordance with Technical Staff Surveillance Procedure DTS 1600-7, Rev. 8. This procedure incorporates all of the test requirements.

A.3 Summary of Results

The Dresden Unit 3 primary containment leak rate was found to be 0.5034 weight/%/day (or 337.3 scfh) at a test pressure of 48 psig minimum. This total calculated leak rate includes the 12-hour phase Type A calculated test result and several Type C test results for process lines not drained and vented as required by 10CFR 50, Appendix J. The associated upper 95% confidence limit was 0.6567 weight %/day.

The supplemental test result was 2.1849 weight %/day. This result was compared with the sum of the 12-hour phase result of 0.5034 weight %/day and an induced leakage of 1.76 weight %/day.

B. TEST METHOD

B.1 Basic Technique

The Absolute Method was used to perform the Type A test. The Absolute Method uses the ideal gas law to calculate changes in dry air mass as a function of pressure and temperature. Compensation for water vapor pressure is taken into account when the dry air mass within the containment is calculated. Leakage of mass (which is assumed to be constant) from the containment during the Type A test interval can be determined by establishing the rate of mass loss.

B.2 Supplemental Verification Test

The verification test (induced leakage) was performed by intentionally inducing a controlled leak of magnitude approximately equal to the maximum allowable leakage (110% of La). This induced leak was superimposed on the previously determined leak rate. The degree of detectability of the combined leakage provided a basis for resolving any uncertainties associated with the 12-hour phase of the test.

B.3 Linear Regression Analysis

Since it is assumed that the leak rate is constant during the testing period, a plot of the measured contained dry air mass versus time would ideally yield a straight line with a negative slope (assuming a non-zero leak rate). Obviously, sampling techniques and test conditions are not perfect and consequently the measured values will deviate from the ideal straight line situation.

A "least square" statistical analysis was performed to establish a regression line for the mass versus time parameters after each set of data was obtained. The slope of the regression line is called the statistically averaged leak rate. It was this quantity that was compared to the Technical Specification limit La.

Associated with the statistical leak rate is the upper 95% confidence leak rate. The calculation of this upper limit is based on the standard deviation of the regression lines and the one-sided Student's T-Distribution function. A procedural requirement specified that the 95% confidence limit was to be less than 75% of the Technical Specification limit La.

Both the regression line and the associated confidence limit were calculated after each set of data was obtained.

B.4 Short Duration Test

Although in the past it has been customary to conduct Primary Containment Leak Rate Tests for a duration of at least 24 hours at test pressure, this test was conducted for a shorter duration following the methods outlined in Bechtel Topical Report BN-TOP-1, Revision 1, November, 1972. The BN-TOP-1 method has been approved by the NRC.

A measured test phase of 12 hours was utilized. Also, the Supplemental Verification Test was conducted for a period of one-half that of the measured phase, or approximately 6 hours.

C. TEST INSTRUMENTATION AND CALIBRATION

C.1 Types of Sensors Used

Two types of sensors were placed inside of the primary containment during the test. The first type of sensor used was a resistance temperature device (RTD) designed to measure dry bulb temperature. The RTD detects a change in temperature through varying amounts of resistance within a platinum wire. The second type of sensor used was designed to measure dewpoint, using a Lithium chloride detector and heating element in conjunction with an internal RTD. There were 32 RTD's and 10 dewcells installed for the ILRT. At the start of the test, 28 RTD's and 9 dewcells were in use for the test. No instruments were deleted during the test.

C.2 ILRT Console

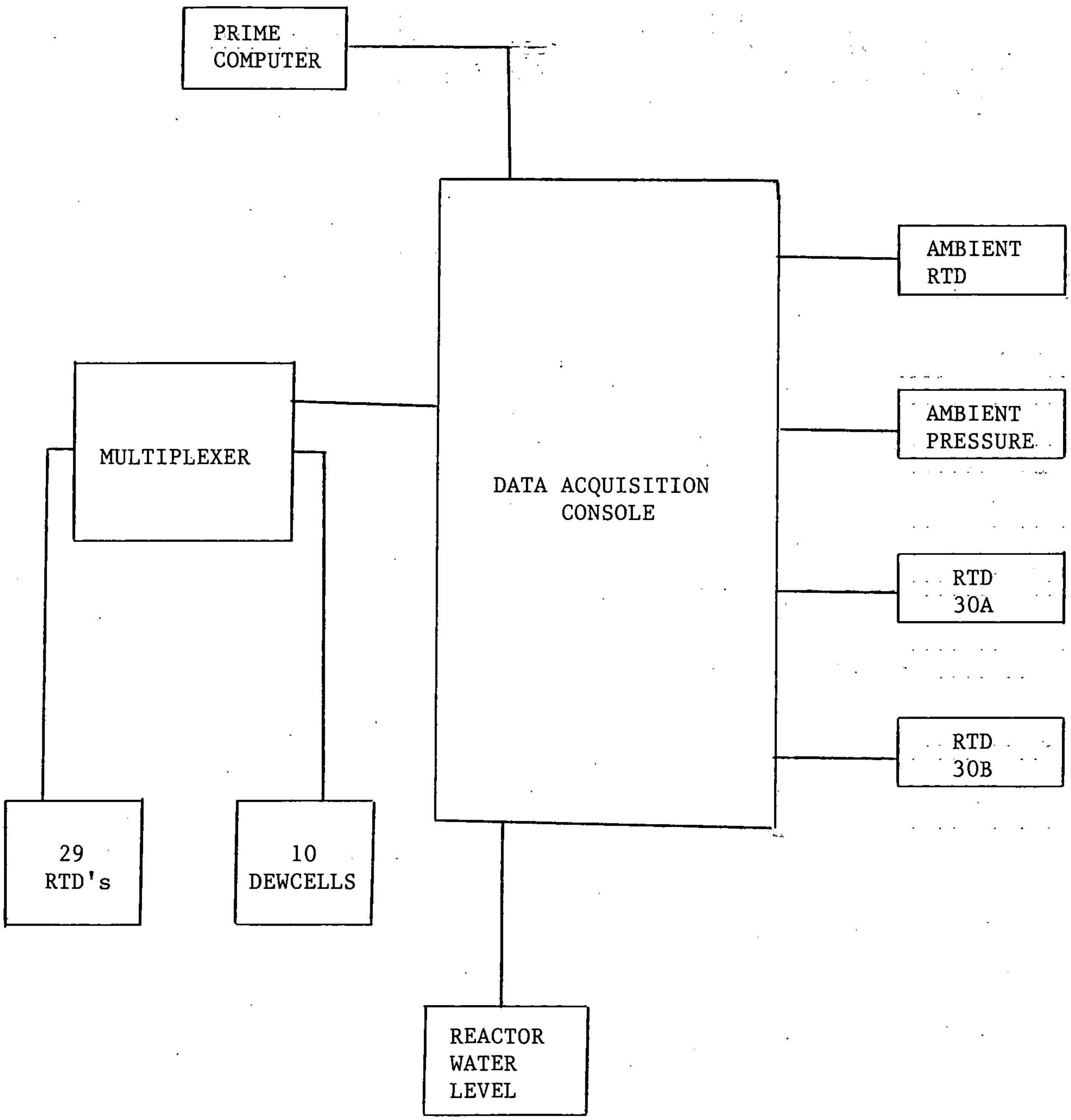
All the raw test data was digitally displayed on the Volumetrics Console 14627. LED displays enabled the console operator to visually monitor the raw data as it appeared at regular 10-minute intervals or manually select specific channels for specific data. This console also printed the data at each scan interval.

The test calculations were performed by an on-site Prime computer system, which received data from the Volumetrics console via permanent cables installed for this purpose. The data was manually verified on display terminals in the Technical Support Center before being released for calculations, disk storage and printing.

In addition to the display electronics enclosed in the console, there were 2 precision pressure gages and 2 clocks. The clocks and pressure gages were redundant features included within the console to insure reliability. A diagram of the ILRT console and related electronics is shown in Figure C.2.a.

C.3 Data Acquisition System

The ILRT Volumetric Console, sensors and multiplexer comprise the ILRT Data Acquisition System which was used to perform the Type A test at Dresden. A description of the ILRT console and sensors was given in Sections C.1 and C.2. The system also included a multiplexer, which was located within the containment throughout the test.



ILRT CONSOLE AND INPUT SYSTEMS

FIGURE C.2.a

In order to minimize the number of conductors penetrating the primary containment, the Data Acquisition System instrumentation was subdivided into two major parts. The multiplexer unit was the focal point for all the RTD's and the dewcells. This subsystem consisted of the solid state signal conditioning bridge circuit boards that are used to calibrate the system and the dual redundant electronic scanners which feed the sensor signal through the primary containment to the console outside.

These components, seen as a whole system, provide a full automatic multipoint data measuring and processing system capable of measuring absolute pressure, dewpoint temperature, dry bulb temperature and test duration. During the supplemental test, it also monitored the induced leak rate. (See Figure C.3.a for a block diagram of the system interconnections.)

C.4 Instrument Calibration

A major portion of the time spent in preparation for the Unit 2 ILRT was devoted to instrument calibration. All RTD's were calibrated to within ± 1.0°F of actual temperature by using a water bath and a RTD standard which is traceable to the National Bureau of Standards (NBS). The dewcells were calibrated to within ± 5.0°F of actual temperature by using a standard RTD (traceable to NBS) and a water bath which provided various dewpoints.

The precision pressure gages were calibrated to within ± 0.015 psig of actual pressure using a portable standard traceable to NBS.

The flowmeter used for the induced leakage portion of the ILRT was calibrated using a transfer standard which was traceable to NBS and accurate to within 1% of full scale.

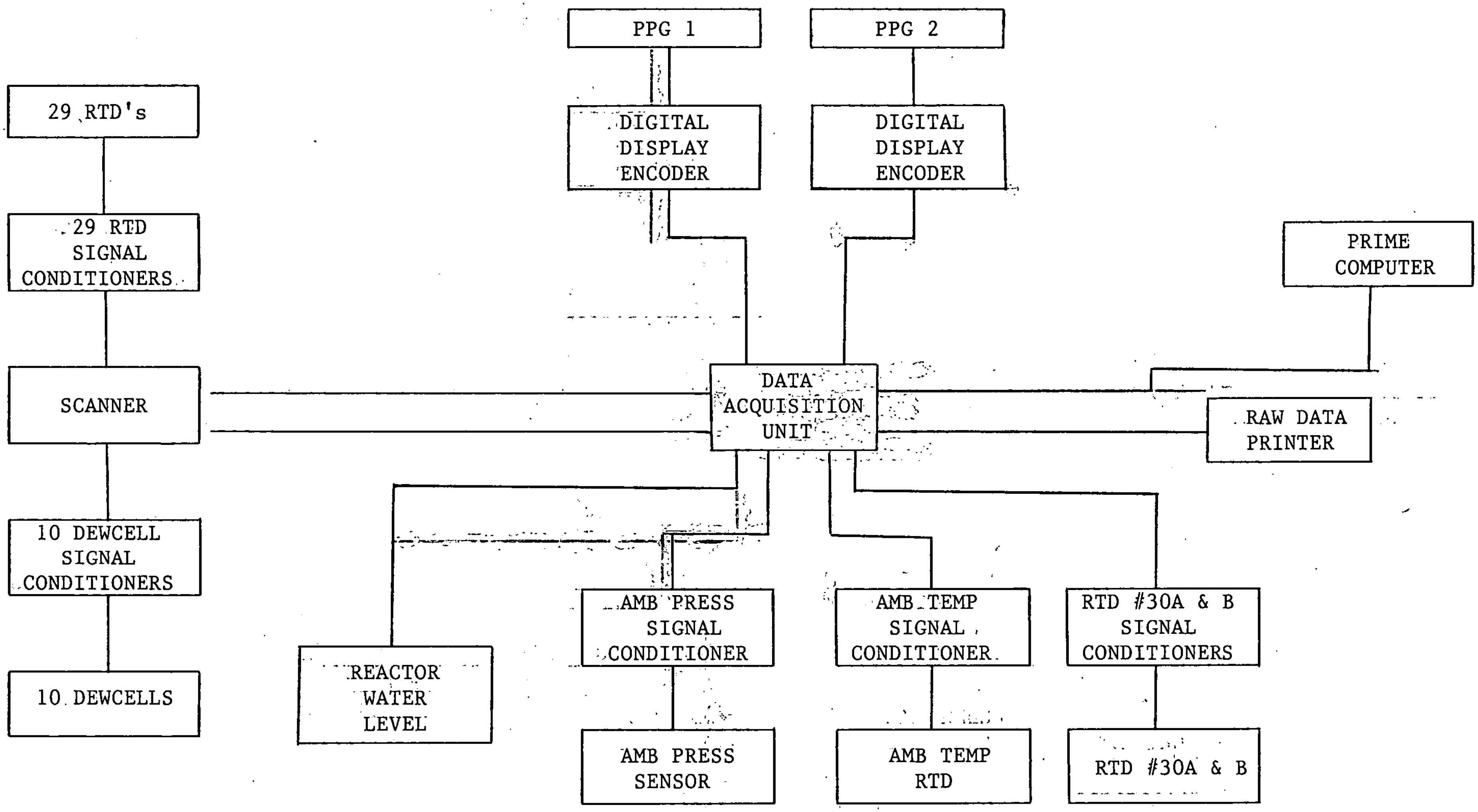
Table C.4.a shows the specifications for the instrumentation utilized in the Type A test. All of the instruments were calibrated prior to use, as required by ANSI/ANS-56.8-1981. The quantity of sensors used was based on the containment size and system error analysis.

Throughout the test, ambient atmospheric conditions were monitored. The instrumentation used for this monitoring was of sufficient accuracy to determine atmospheric changes for correlation with test data, had that been necessary.

C.5 Instrumentation Error Analysis - Application

To ensure that the instrumentation used during the ILRT was accurate enough to measure minute changes in containment mass, an instrumentation error analysis was performed prior to the test in accordance with BN-TOP-1. The instrumentation system error was calculated in two parts. The first, and most important calculation, was performed to determine the error due to system accuracy; the second, to determine the error due to system repeatability. The results were 0.1558 weight %/day and ± 0.03048 %/day, respectively. Combining these two errors yielded a total system error of 0.1863 weight %/day.

The instrumentation error is used only to illustrate the system's capability to measure the required parameters that are necessary for calculation of the primary containment leak rate. The instrumentation



ILRT SYSTEM BLOCK DIAGRAM

Figure C.3.a

Table C.4.a

INSTRUMENT	QUALITY/USAGE	RANGE	ACCURACY	REPEATABILITY
Precision Pressure Gage	2 - Containment Pressure	0-100 psia	± 0.015 psia	± 0.001 psia
RTD	28 - Containment Temp.	50-200°F	± 0.96°F	± 0.01°F
Dewcell	9 - Containment Dewpoint	-50-140°F	± 4.12°F	± 0.01°F
Flow Meter	1 - Induced Leak Rate	2-20 scfm	± 0.2 scfm	± 0.02 scfm
Ambient Temp. RTD	1 - Ambient Temp.	50-200°F	---	---
Ambient Pressure	1 - Ambient Pressure	0-20 psia	---	---
Humidigy	1 - Relative Humidity	0-100% R.H.	---	---

error is always present in the data and is incorporated in the 95% confidence limit in the form of data scatter. Procedures required that the error due to accuracy and repeatability be less than 0.25 La (0.4 weight %/day).

D. CONTAINMENT REPRESENTATION

D.1 Structural Data

The Unit 3 primary containment provides a multibarrier pressure suppression containment employing containment-in-depth principles in design. The containment systems are composed of a primary containment and the pressure suppression system, which when taken together enclosed a total free air space of 288966 ft^3. The primary containment consists of a drywell, which encloses a reactor vessel, a pressure suppression chamber which stores a large volume of water, a connecting vent system between the drywell and the water pool, isolation valves, containment cooling systems, and other service equipment. (See Figure D.2.a.)

The performance objectives of the primary containment system are: 1) to provide a barrier which in the unlikely event of a loss-of-coolant accident, which will control the release of fission products to the secondary containment, and 2) to rapidly reduce the pressure in the containment resulting from the loss-of-coolant accident. In order to meet these objectives, the containment was designed to withstand a design pressure of 62 psig with a leak rate of 0.5 weight %/day. To assure that the containment could structurally meet these criteria, the drywell was designed using a steel pressure vessel with a spherical lower portion and a cylindrical upper portion. (See Figure D.2.a.) The steel head and shell of the drywell are fabricated of SA-212 GRB plate manufactured to A-300 requirements. The top head closure is made with a double tongue and grove seal, which will permit periodic checks for tightness without pressurizing the entire vessel. The drywell is enclosed in reinforced concrete for shielding purposes and to provide additional resistance to deformation and buckling of the drywell over areas where concrete backs up the steel shell.

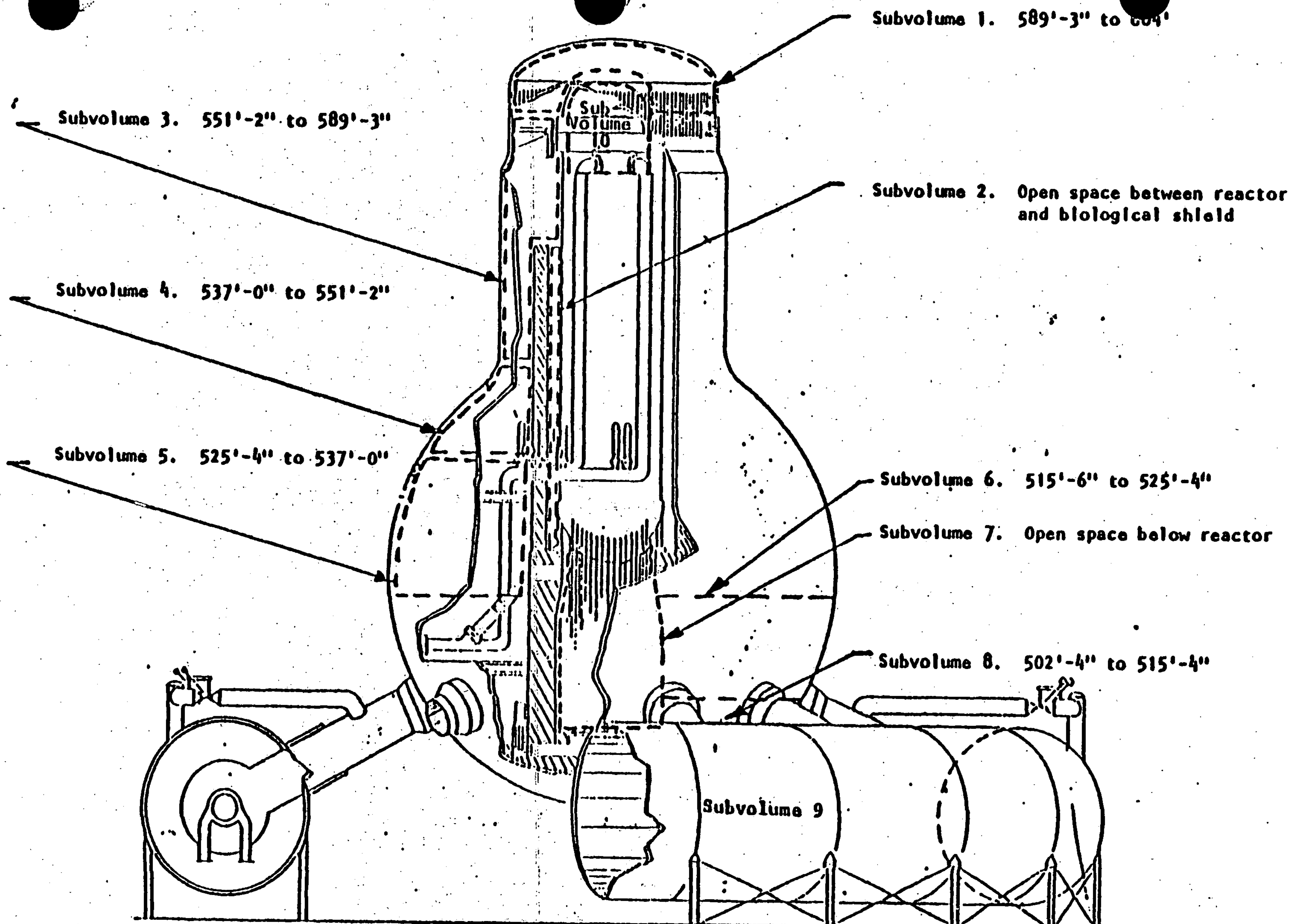
An integral part of the containment is the pressure suppression chamber, which is also pressurized during the ILRT. The pressure suppression chamber is a steel pressure vessel in the shape of a torus below and encircling the drywell which contains 112,203 ft^3 of water in its 109 ft. major diameter. The torus free air volume is 118529 ft^3.

D.2 Containment Survey

In order to establish the containment temperature tendencies for regional variations, an area temperature survey was performed. This survey complied with ANSI/ANS 56.8-1981 and was performed by Technical Staff personnel. The sensor locations are indicated in Table D.2.a (refer to Figure D.2.a for an idealized view of the containment structure and the zoning configuration used.)

D.3. Instrumentation Placement

Figures D.3.a through D.3.g indicate exactly where the RTD's and dewcells were placed within the primary containment. The dewcell placement is indi-



UNIT 3. PRESSURE SUPPRESSION CONTAINMENT SYSTEM

FIGURE D.2.a

TABLE D.2.a

DRESDEN U-3 ILRT SENSOR LOCATIONS

Sensor Type	I.D. Number	Subvolume Zone	Elevation	Azimuth
RTD	R1	1	595' 4"	60°
RTD	R2	1	592' 4"	240°
DEW CELL	D1	1	594'	225°
RTD	R3	2	554' 6"	340°
RTD	R4	2	561	160°
RTD	R5	3	573'	270°
RTD	R6	3	575	30°
RTD	R7	3	574	150°
DEW CELL	D2	3	571' 6"	80°
RTD	R8	4	545' 9"	320°
RTD	R9	4	546' 9"	90°
RTD	R10	4	544' 8"	220°
DEW CELL	D3	4	544'	220°
RTD	R11	5	533'	0°
RTD	R12	5	531'	180°
RTD	R13	5	531'	120°
RTD	R14	5	530'	270°
DEW CELL	D4	5	529'	270°
DEW CELL	D5	5	533'	90°
RTD	R15	6	521'	180°
RTD	R16	6	520'	60°
RTD	R17	6	520' 6"	300°
DEW CELL	D6	6	521' 10"	180°
RTD	R18	7	509' 4"	180°
RTD	R19	7	509' 4"	0°
RTD	120	8	509' 10"	230°
RTD	R21	8	509' 10"	140°
RTD	R22	8	510' 4"	50°
RTD	R23	8	510' 4"	320°
DEW CELL	D7	8	509' 4"	50°
DEW CELL	D8	8	509' 10"	230°
RTD	R24	9	503' 7"	300°
RTD	R25	9	503' 8"	240°
RTD	R26	9	503' 10"	120°
RTD	R27	9	503' 5"	60°
RTD	R28	9	503' 8"	180°
RTD	R29	9	503' 8"	0°
DEW CELL	D9	9	502' 1"	300°
DEW CELL	D10	9	502' 10"	120°
RTD	R30B	10	Located in Shutdown Cooling - Loop B.	

UNIT 3 DRYWELL
ELEVATION 573'

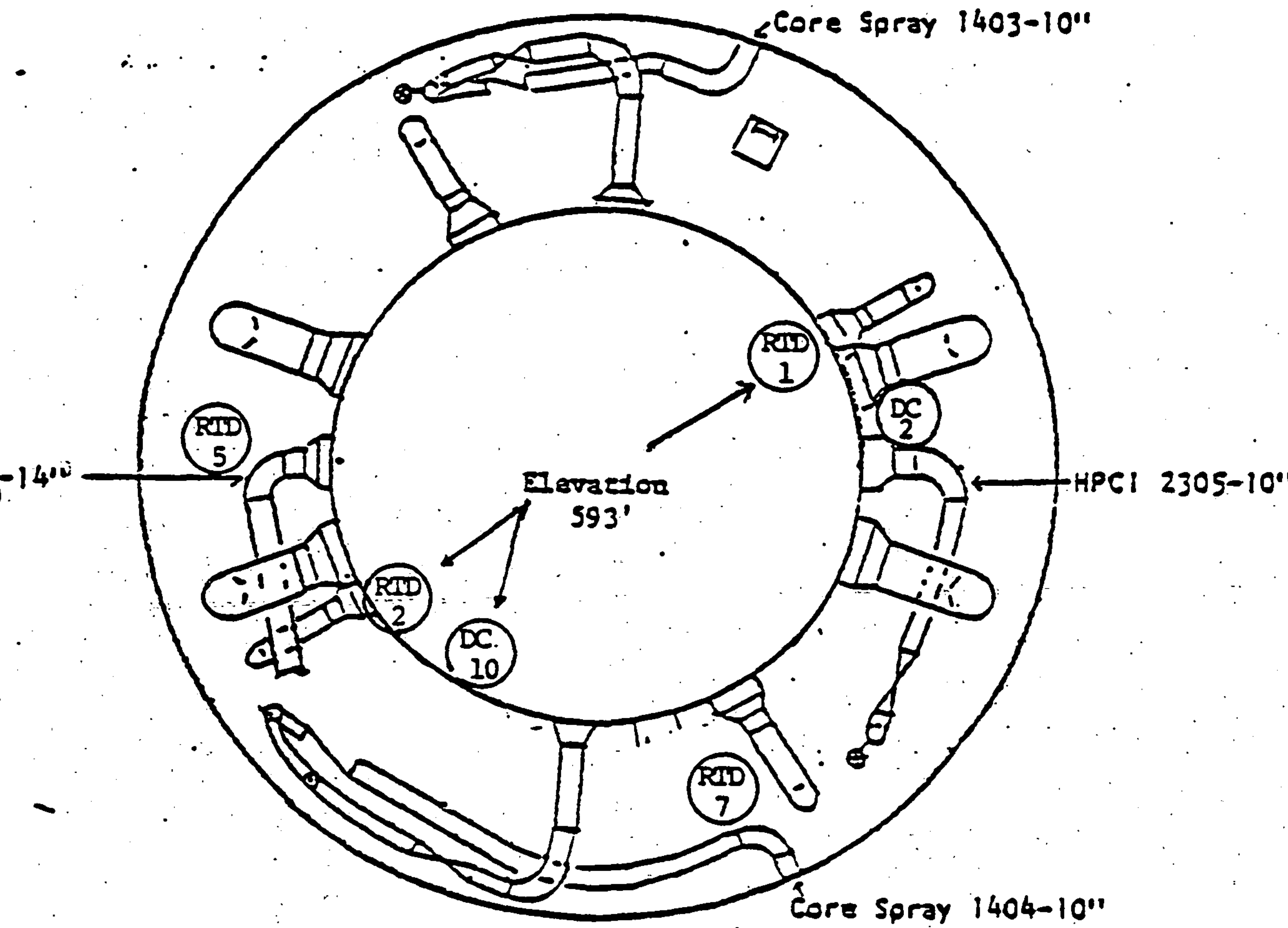


FIGURE D.3.a

UNIT 3 DRYWELL
ELEVATION 557'

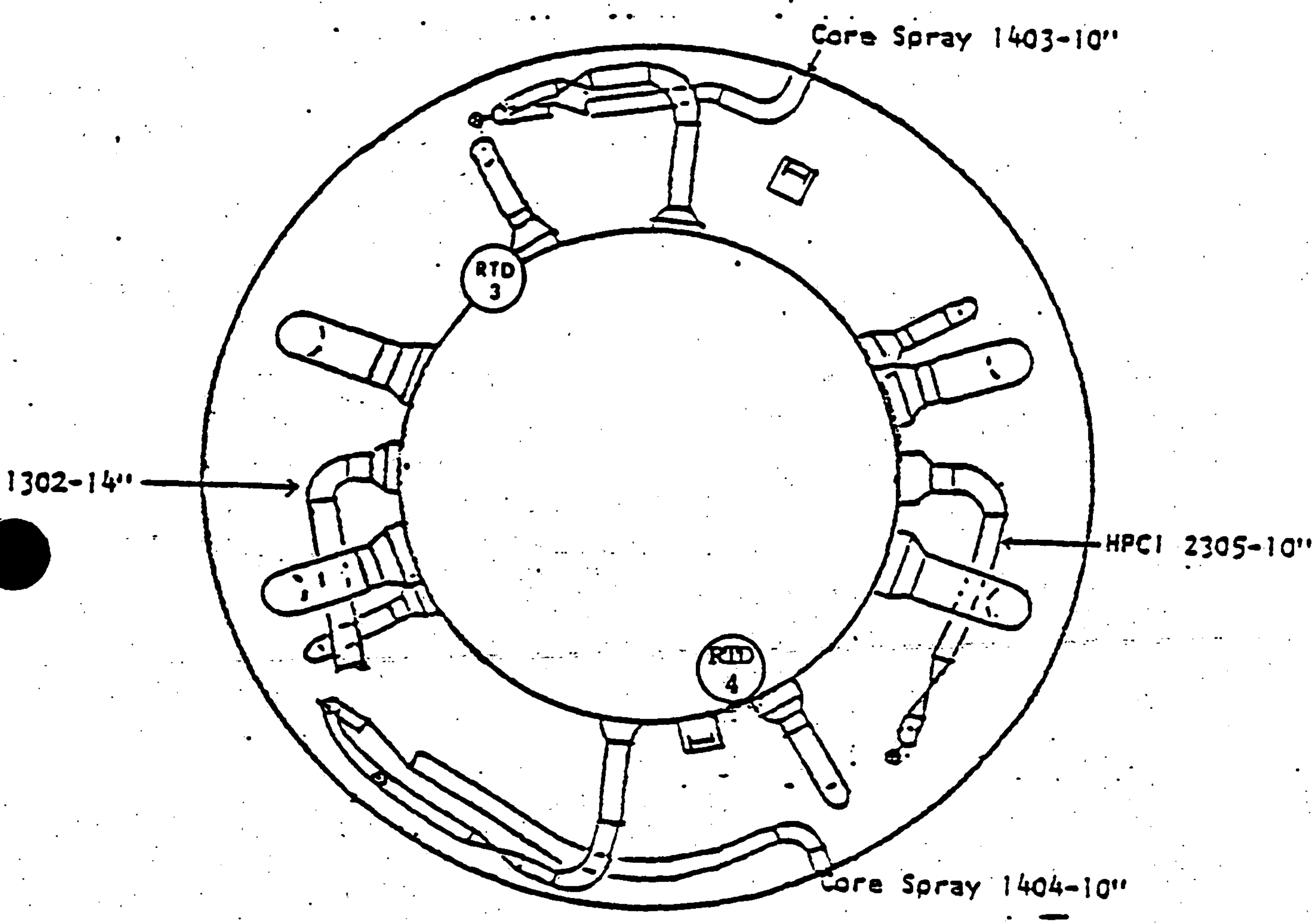


FIGURE D.3.b

UNIT 3 DRYWELL
ELEVATION 545'

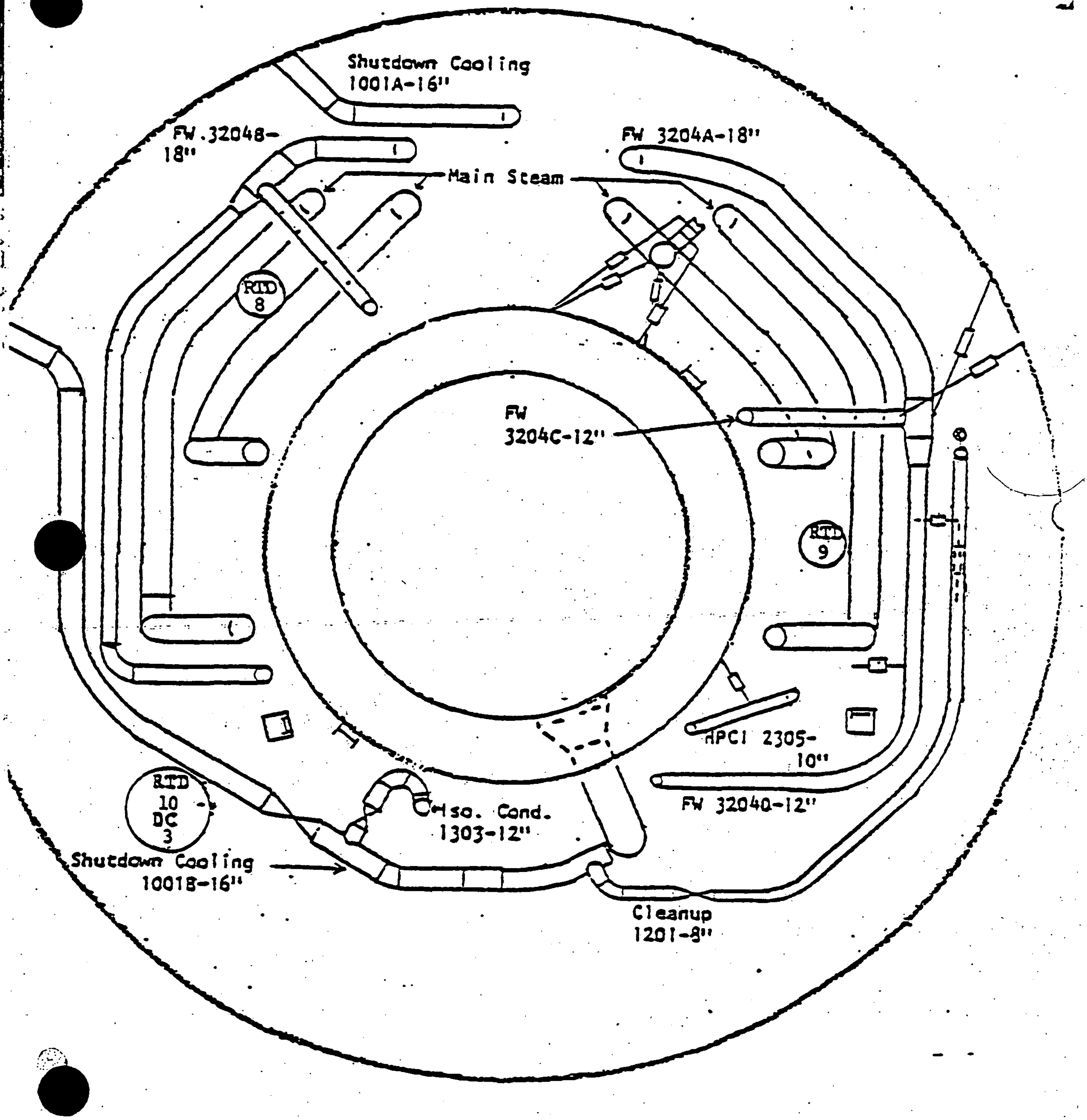


FIGURE D 3 d

UNIT 3 DRYWELL
ELEVATION 531'

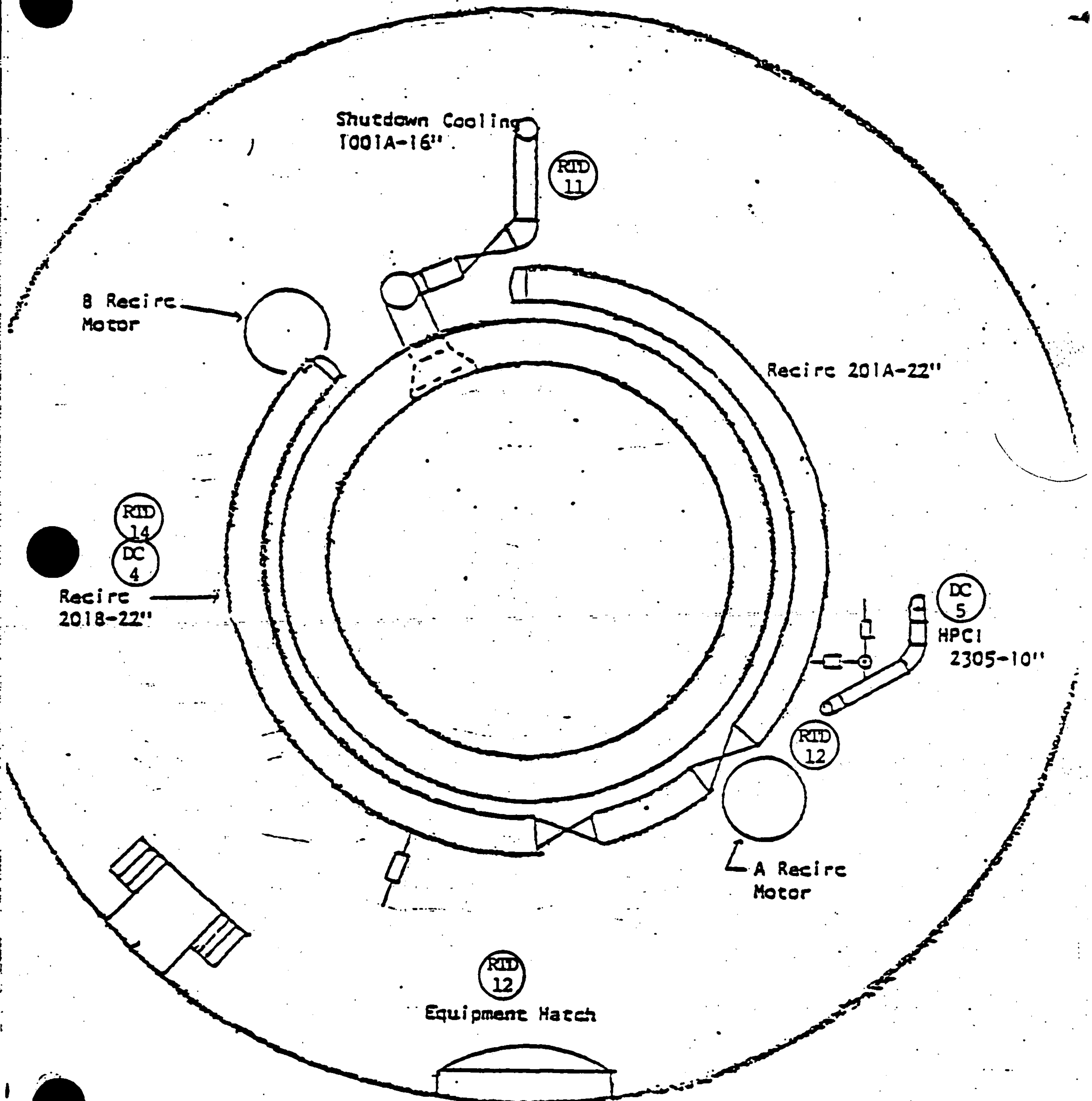


FIGURE D. 3.d.

UNIT 3 DRYWELL
ELEVATION 520'

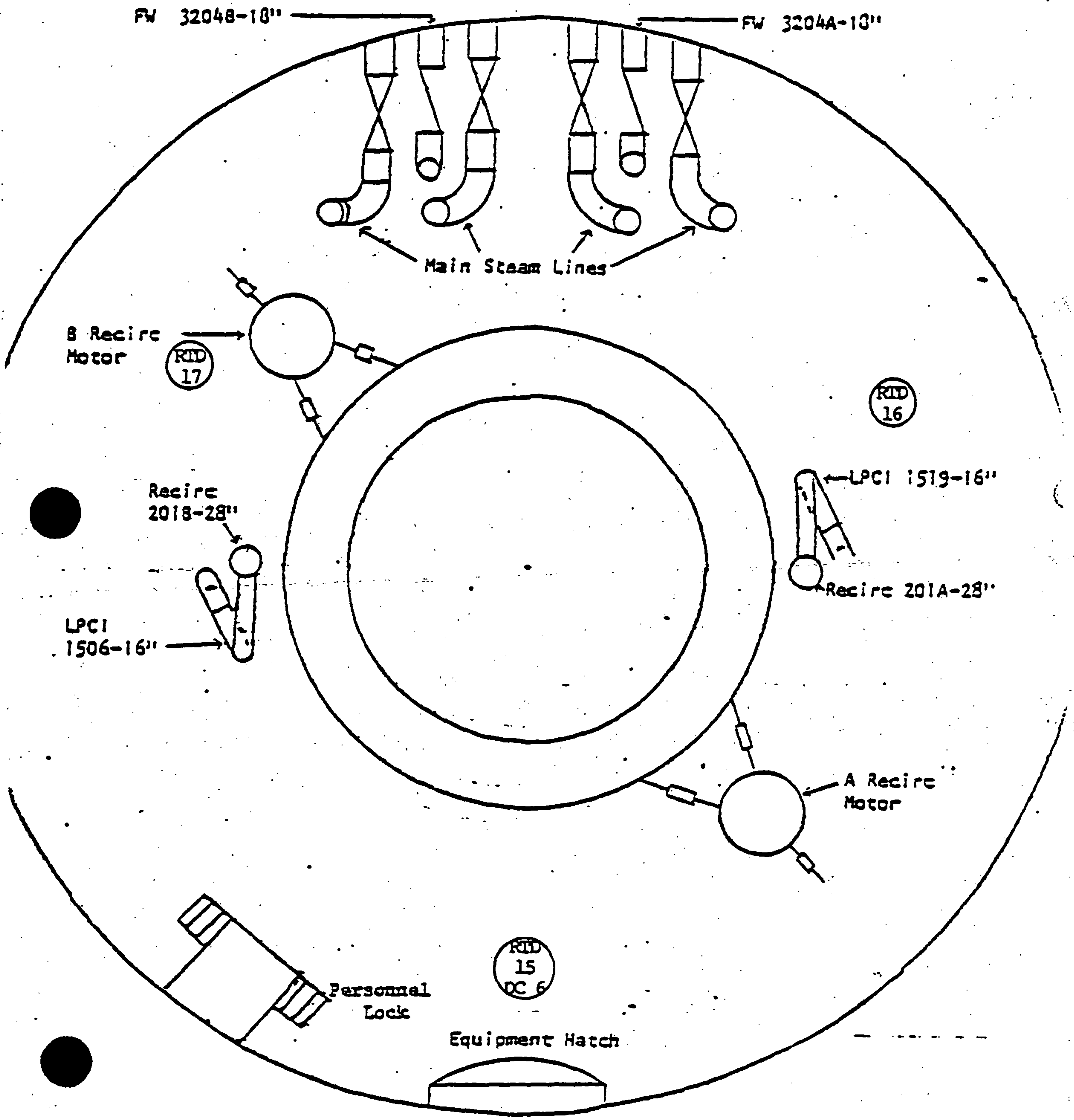


FIGURE D.3.e

UNIT 3 DRYWELL
ELEVATION 509'

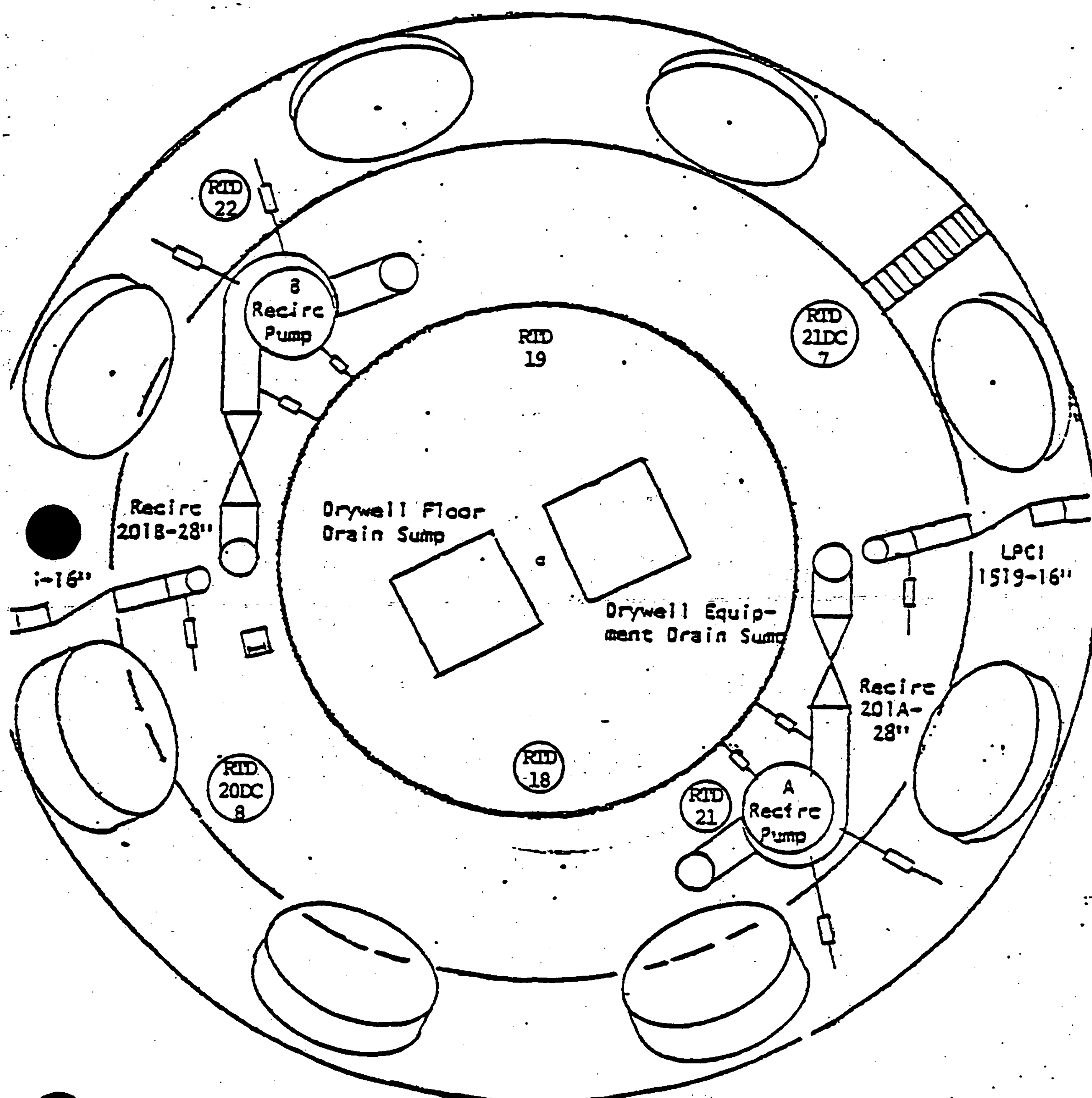


FIGURE D.3.f

UNIT 3 TORUS

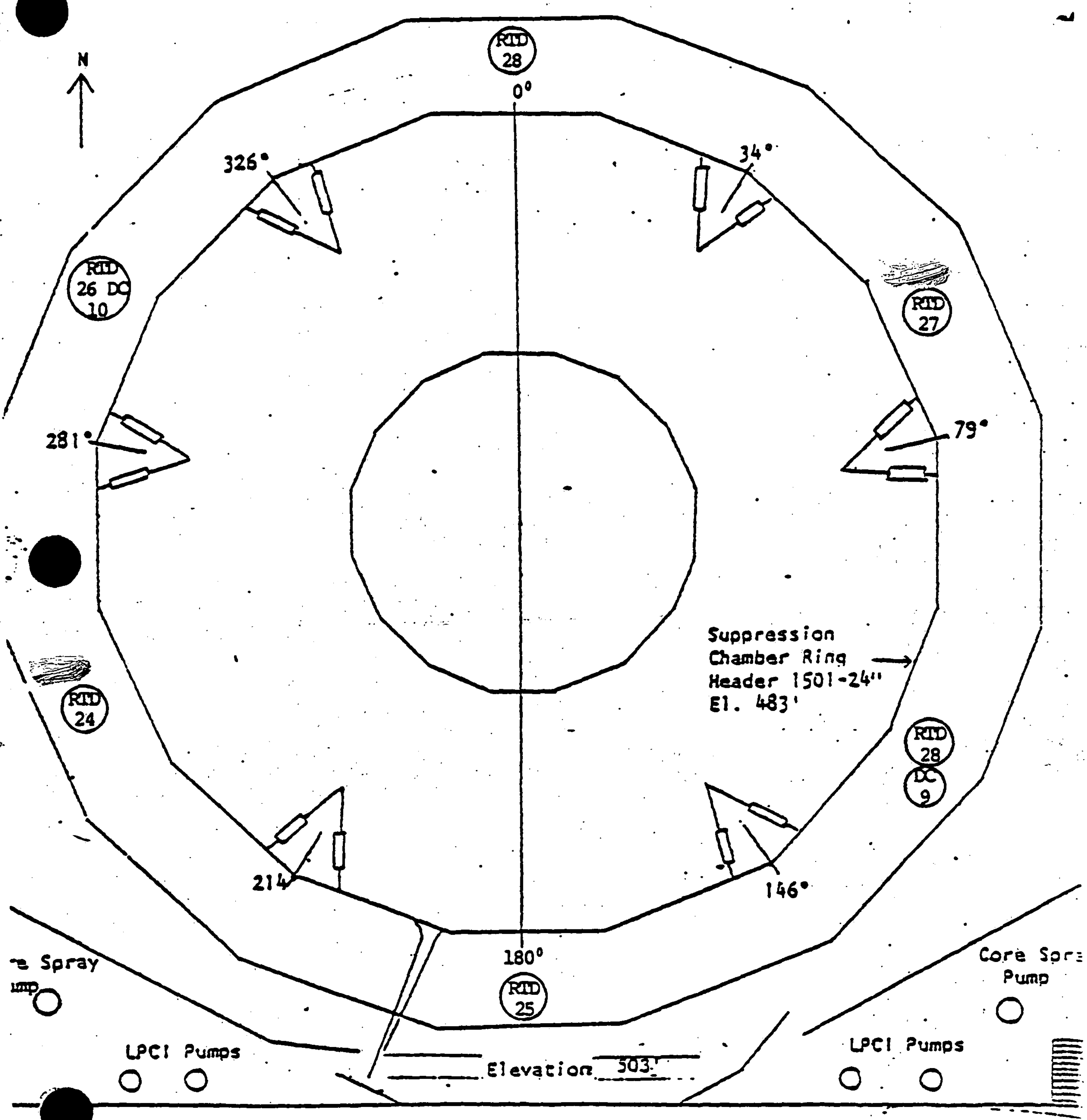


FIGURE D.3.g

cated by the initial D, and the RTD placement is indicated by the initial R.

To avoid local temperature variations, all RTD's and dewcells were placed at least three feet away from any pipe, wall, pump, motor, etc.

All sensors were placed in the containment immediately before the ILRT to minimize the possibility of sensor wire or sensor damage due to maintenance and cleanup work being performed while the containment was open.

A special effort was made to place two RTD's in that subvolume between the reactor and the biological shield. See Figure D.3.b. This was done to minimize the transients in test data caused by ΔT change in that subvolume due to changes in reactor temperature.

Due to the impracticality of installing temperature and humidity sensors inside the vessel (Subvolume 10), several assumptions were made concerning the air space within. The reactor vessel air space was assumed to be saturated and at an equilibrium temperature with the water. To measure the reactor water temperature, an RTD was placed in the shutdown cooling loop between the shutdown cooling pump and the heat exchanger. This temperature was then used as the drybulb and dewpoint temperature for subvolume 10.

D.4 Pressurization System

Primary containment pressurization was accomplished with a 3000 scfm electric compressor connected to a 4" pressurization line.

The air compressor was located outside the Reactor Building. Refer to Figure D.4.a for a plan view.

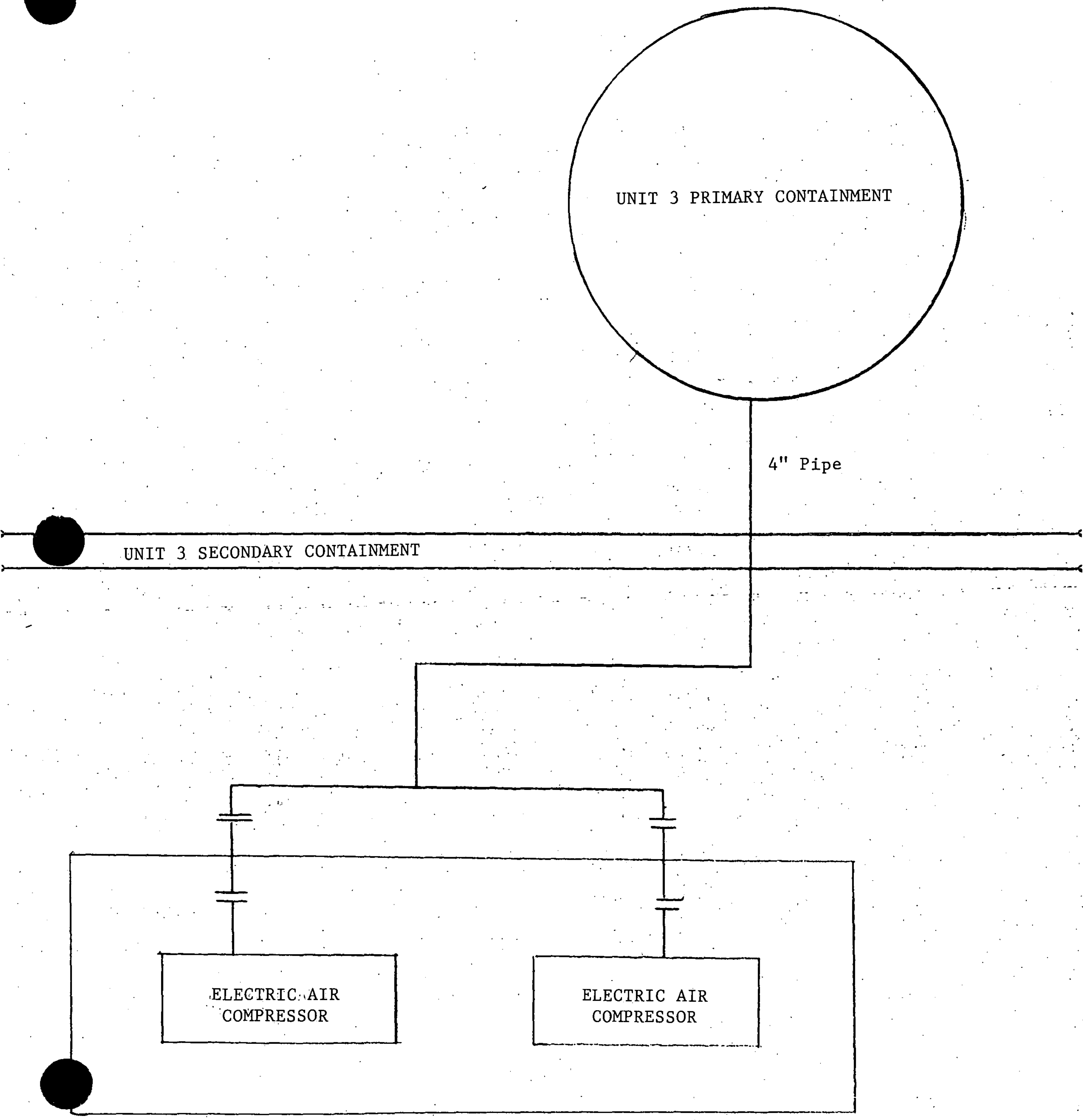
E. CALCULATIONS PERFORMED

E.1 Volume Weighting Factors

Due to the size and shape of the primary containment, a mathematical model was developed to account for the effects of temperature stratification and local temperature variations. The containment volume was theoretically divided into ten subvolumes with weighting factors assigned to each. (The value of the weighting factor is equivalent to the fractional part of the total containment volume occupied by the associated subvolume.) The volumes of the larger pieces of equipment were taken into account when calculating the subvolumes. (See Figure D.2.a for a diagram of the idealized containment and zoning configuration used.) Table E.1.a lists the subvolume weighting factors associated with each zone.

E.2. Data Reduction

Before the ideal gas law could be applied for obtaining the contained dry air mass, the raw data had to be reduced to a single dry air pressure and temperature. The total containment absolute pressure was determined by arithmetically averaging the two precision gauges. The average containment temperature and dewpoint were obtained by utilizing the same application of the volume weighting factors. Like sensors within a subvolume were arith-



CONTAINMENT PRESSURIZATION SYSTEM

FIGURE D.4.a

Table E.1.a

Temperature and Humidity Weighting Factors

SUB VOLUME	VOLUME (FT)	WEIGHTING FACTOR
1	11373	0.03936
2	3081	0.01066
3	20281	0.07018
4	23043	0.07974
5	30819	0.10665
6	26363	0.09123
7	7226	0.02501
8	41828	0.14475
9	118529	0.41018
10	6423	0.02223

metically averaged to determine the mean atmospheric conditions for the subvolume. Any subvolume void of a sensor type was assumed to have the same average value as the next subvolume in sequence. The sum of the products of the subvolume averages and respective weighting factors yielded the average containment temperature and dewpoint. The dewpoint was then converted to vapor pressure and subtracted from the average total containment pressure, yielding absolute dry air pressure. The following mathematical expressions summarize the data reduction process.

Average Subvolume Temperature and Dewpoint

$$Tj = \frac{\text{(All operable RTD's in jth subvolume)}}{\text{Number of operable RTD's in the jth subvolume}} \quad {}^\circ F$$

$$D.P.j = \frac{\text{(All operable dewcells in the jth subvolume)}}{\text{Number of operable dewcells in jth subvolume}} \quad {}^\circ F$$

where Tj = average temperature of the jth subvolume
D.P.j = average dewpoint of the jth subvolume

Primary Containment Temperature and Dry Air Pressure

$$T = \sum_{j=1}^{NVOL} (VFj)\ (Tj)\ {}^\circ F$$

if Tj = undefined, then
Tj = T(j + 1) for $1 \leq j \leq$ (NVOL-2)
Tj = T(j - 1) for j = NVOL - 1
Tj = estimate for j = NVOL

$$D.P. = \sum_{j=1}^{NVOL} (VFj)\ (D.P.j)\ {}^\circ F$$

if D.P.j = undefined, then
D.P.j = D.P(j + i) for $1 \leq j \leq$ (NVOL-2)
D.P.j = D.P(j - 1) for j = NVOL-1
D.P.j = estimate, for j = NVOL

$$D.P.({}^\circ K) = 273.16 + \frac{D.P.({}^\circ F) - 32}{1.8}$$

$$X = 647.27 - D.P\ ({}^\circ K)$$
$$A = 3.2437814$$
$$Z = 5.86826 \times 10^{-3}$$
$$C = 1.1702379 \times 10^{-8}$$
$$D = 2.1878462 \times 10^{-3}$$

$$EXPON = \frac{X(A + ZX + CX^3)}{(D.P.\ ({}^\circ K)\ \ (1 + DX)}$$

$$PV = \frac{(218.167)\ \ (14.696)}{(EXPON\ \ln 10)}\ PSI$$

$$Pt = \frac{P_1 + P_2}{2}\ PSIA$$

$$P = Pt - Pv\ PSIA$$

$$W = \frac{(28.97)\ \ (144)\ \ (P)\ \ ((\text{total volume} - (\text{level} -50)\ \ (28.635))}{1545.33\ (T + 459.69)}\ Lbs.$$

where NVOL = number of primary containment subvolumes
NFj = volume wrighting factor of the j^{th} subvolume
T = volume weighted containment temperature
D.P. = volume weighted containment dewpoint
X, A, Z, C, D, EXPON = dewpoint to vapor pressure conversion constants and coefficients

Pv = volume weighted containment vapor pressure
Pt = total absolute containment pressure
P = contained dry air absolute pressure
W = contained dry air mass
Level = reactor water level

NOTE: The subvolume numbering sequence is from the top to the bottom of the containment.

E.3 Measured Leak Rate (Total Time)

From BN-TOP-1 Rev. 1, Section 4.5, the following equation is given for the measured leak rate using the total time procedure:

$$M_i = \frac{2400}{H}\left(1 - \frac{T_o\overline{P}_i}{T_i\overline{P}_o}\right) \quad (\%\ \text{per day})$$

where M_i = measured leak rate in weight % per day for the i^{th} data point.

H = time interval, in hours, between measurements.

T_o, T_i = mean absolute temperature, °R, of the containment atmosphere at the beginning and the end of test interval (H), respectively.

P_o, P_i = mean total absolute pressure, psia, of the containment atmosphere at the beginning and end of the test interval (H), respectively.

Using the following relationship derived in ANSI N45.4 - 1972 Appendix B given below:

$$\frac{W_o - W_i}{W_o} = 1 - \frac{T_o\overline{P}_i}{T_i\overline{P}_o}$$

where W_o, W_i = dry air mass of the containment at the beginning of the test and data point i, respectively.

And substituting in the calculation of the containment dry air mass that corrects for a change in reactor water level gives the following expression for the measured leakage:

$$M_i = \frac{2400}{H}\left(1 - \frac{T_o\overline{P}_i\,(\text{volume} - \text{LEVEL}_i - 50)\,(28.635))}{T_i\overline{P}_o\,(\text{volume} - \text{LEVEL}_o - 50)\,(28.635))}\right)$$

where LEVEL_o, LEVEL_i = reactor water level in inches at beginning of the test and the data point i, respectively.

E.4 Calculated Leak Rate (Least Squares Fit)

The method of "Least Squares" is a statistical procedure for finding the best fitting regression line for a set of measured data. The criterion for the best fitting line to a set of data points is that the sum of the squares of the deviations of the observed points from the line must be a minimum. When this criterion is met, a unique best fitting line is obtained based on all of the data points in the ILRT. The value of the leak rate based on the regression is called the statistically average leak rate.

Since it is assumed that the leak rate is constant during the testing period, a plot of the measured contained dry air mass versus time would ideally yield a straight line with a negative slope (assuming a non-zero leak rate). Obviously, sampling techniques and test conditions are not perfect and consequently the measured values will deviate from the ideal straight line situation.

Based on this statistical process, the calculated leak rate is obtained from the equation:

$$L_i = A + B \times t_i$$

where t_i = time in hours since the beginning of the test to the i^{th} data setpoint.

The values of the constants A and B such that the regression line is best fitting to the ILRT data are

$$B = \frac{[n\Sigma(t_i)(M_i)] - [(\Sigma t_i)\ (\Sigma M_i)]}{[n\Sigma(t_i)^2 - (\Sigma t_i)^2]}$$

$$A = \frac{\Sigma M_i - B\Sigma_i ti}{n}$$

In order to reduce the round-off error in the above calculations, the equations are rearranged such that:

$$B\Sigma = \frac{n\Sigma t_i M_i - (\Sigma t_i)\ (\Sigma M_i)}{n\Sigma(t_i)^2 - (\Sigma t_i)^2}$$

$$A = \frac{(\Sigma M_i)\ (\Sigma t_i^2) - (\Sigma t_i)\ (\Sigma t_i M_i)}{n\Sigma t_i^2 - (\Sigma t_i)^2}$$

E.5 95% Confidence Limits

To determine the value of the confidence limits the following statistical information is required; the variance, standard deviation, and students' T-distribution.

$$S^2 = \frac{SSQ}{n-2}$$

where $SSQ = (M_i - L_i)^2$

S^2 = variance

S = standard deviation based (n-2) degrees of freedom.

The standard deviation has more practical significance since computing the standard deviation returns the measure of variability to the original units of measurement. Additionally, it can be shown that given a normal distribution of measurements, approximately 95% of the measurements will fall within two standard deviations of the mean.

The number of standard deviations either side of the regression line which establish a 95% confidence interval are more accurately determined using a statistical table called a "Table of Percentage Points of the T-Distribution" and provide increased confidence in outcomes for small and large sample sizes.

The table of T-Distribution has been formulized for use by the computer program as follows:

$$TD = 1.95996 + \frac{2.37226}{(n-2)} + \frac{2.8225}{(n-2)^2}$$

where TD = value of T-Distribution for the 95% confidence limit and (n-2) degrees of freedom.

n = number of data points including the i^{th} data point.

The application of the additional factor to the variance formula yields:

$$\sigma^2 = S^2 \left[1 + \frac{1}{n} + \frac{(t_p - \bar{t})^2}{\Sigma(t_i = \bar{t})^2}\right]$$

$$\sigma = S \left[1 + \frac{1}{n} + \frac{(t_p - \bar{t})^2}{\Sigma(t_i - \bar{t})^2}\right]^{1/2}$$

where t_p = time after start of test

$$\bar{t} = \frac{\Sigma t_i}{n}$$

$$UCL = L_i + TD \times o$$

E.6 Computer Program

In order to expedite the data reduction and statistical computations, the Station Prime computer system was used. A telephone connection to the Prime system at the Corporate Offices was also available had the Station computers become unavailable at any time during the test. Data was recorded and analyzed at 10 minute intervals.

The raw test data was printed by the Volumetrics Console, located just outside the drywell. Each data set was also automatically transferred over cables from the console to the Computer Room, where it was checked on a display terminal against the console printouts before being released for disk storage, calculations, and printing. Key test parameters were plotted on a color-graphics display screen as the test progressed. Hard copies of these graphs were also plotted by the computer system.

The computer program was written by off-site Commonwealth Edison Computer Systems personnel. Its logic was protected by codes intended to prevent unauthorized access. The program was reviewed and approved at the Station by the same process used for all test procedures and surveillances prior to their use.

E.7 Leak Rate Compensation for Non-Vented Penetrations

The actual calculated result of the Type "A" ILRT as performed was .5034 weight %/day. The test was performed with the following penetrations not drained and vented. Included with each penetration listed is the leakage as determined by Type C local leak rate testing.

		LEAK RATE	
SYSTEM DESCRIPTION	VALVE NUMBERS	SCFH	WT. %/DAY
"A" Rx Feedwater	220-57A & 220-58A	0.00	0.00
	220-57A & 220-62A	---	---
"B" Rx Feedwater	220-57B & 220-58B	0.7178	0.0014
	220-57B & 220-62B	---	---
Shutdown Cooling	1001-1A, 1B, 2A, 2B & 2C	3.3174	0.0006
Standby Liquid Control	1101-1 & 1101-15	6.01	0.0117
	1101-1 & 1101-16	---	---
Rx H_2O Cleanup	1201-1, 1A, 2, 3	-0-	-0-
Isolation Condenser	1301-3 & 1301-4	8.655	0.0168
"A" Core Spray Injection	1402-4A, 8A, 25A, & 36A	1.72	0.0033
	1402-24A & 25A	0.1078	0.0002
"B" Core Spray Injection	1402-4B, 8B, 25B, & 36B	0.911	0.0018
	1402-24B & 25B	0.310	0.0006
"A" LPCI	1501-18A & 19A	2.267	0.0044
"B" LPCI	1501-18B & 19B	0.296	0.0006
"A" LPCI	1501-20A & 1501-38A	0.970	0.00188
"B" LPCI	1501-20B & 1501-38B	0.647	0.00126
"A" LPCI	1501-22A, 26A, & 1001-5A	---	---
	1501-25A & 1501-26A	7.998	0.0156
"B" LPCI	1501-22B, 26B & 1001-5B	2.310	0.0045
	1501-25B & 1501-26B	---	---
"A" LPCI (Containment Spray)	1501-27A & 1501-28A	1.137	0.0022
"B" LPCI (Containment Spray)	1501-27B & 1501-28B	0.398	0.00077
HPCI Condensate Return	2301-45 & 2391-74	1.281	0.00249

SYSTEM DESCRIPTION	VALVE NUMBERS	LEAK RATE SCFH	LEAK RATE WT. %/DAY
Primary Sample	220-44 & 45	0.017	0.000033
Drywell CAM	9207A & 9207B*	1.65	0.0032
	9208A & 9208B*	2.306	0.0045
	Total	43.026	0.0837

*LLRT results for these lines are included because these lines were used during the ILRT for test instrumentation.

The total containment leak rate, including local leak rate test results for unvented systems as shown in the preceding list, is 0.5784 weight %/day. The associated 95% upper confidence limit is 0.7407 weight %/day. It should be noted that the CRD cooling water return penetration, which was previously reported in the above table, was removed from Unit 3 as a part of this outage.

F. CONTAINMENT PRESSURIZATION

F.1 Preparation

The following major events were completed prior to containment pressurization as required by 10CFR Part 50, Appendix J, and ANSI/ANS 56.8-1981.

1. Satisfactory completion of all Type B and C Leak Rate tests.
2. Primary containment temperature survey.
3. Calibration of all instrumentation.
4. Instrumentation error analysis calculation.
5. Visual containment inspection.
6. Venting of the reactor vessel to the primary containment atmosphere.

Training was provided to all technical personnel involved in the ILRT. The 2 hours of training was designed to familiarize personnel with the test instrumentation, computer program, and necessary scheduling for the successful completion of the 1986 ILRT.

Two 3000 scfm electric compressors were brought on site to supply clean air to the primary containment through a 4-inch pipe tied into the LPCI system. These compressors not only served as a source of oil free air but enabled Dresden personnel to realize 48 psig containment pressure in a minimal amount of time.

F.2 Containment Instrumentation

ILRT sensors were placed within the containment shortly before the test. All sensors were kept at a distance of three feet or farther from any pump, motor, or piece of piping. This was done so local temperature variations would not overly influence the real average subvolume temperature recorded by the sensor in that subvolume.

In preparation for the test, special care was taken to keep all sensors out of any airflow which might be caused by the compressor during pressurization.

F.3 ILRT Log Entries

The following is a list of significant events taken from the ILRT Log:

DATE	TIME	ILRT LOG
	1830	Log initiated per DTS 1600-7 Rev. 8, for 1986 Unit 3 ILRT.
	1920	Compressor started, not loaded.
	1930	Compressors aligned to MO3-1501-28B to pressurize it.
	1945	MO3-1501-28B opened and pressurizing drywell.
	1955	1.0 psi - 28B stopped.
	1955	Computer "Mover PH" stopped.
	2000	M. Moy to start night.
	2030	Equalized torus/drywell; Lizalek to secure open 2 sets of vacuum breakers.
	2050	McCabe/Sitts still on torus.
	2110	Two sets (4) of vacuum breakers gagged open.
	2115	LPCI 28B valved opened; commenced loading compressor.
	2207	Drywell pressure at 6 lbs.
	2250	Drywell pressure at 14 lbs.
	2255	Drywell pressure at 14 lbs.
	2300	Drywell pressure at 15 lbs.
	2301	Compressor unloaded; LPCI 28B closed.
	2317	B. McCabe found leaking LPCI line 7/25/86 downstream of 22B valve (3-1501-22B (#1500-16B) on torus.
	2329	U-3 foreman notified of air leak (Hussein Ata) and dispatched to torus. Awaiting status.
	2330	Drywell pressure holding at 15 lbs.
	2325	Drywell pressure holding at 15 lbs.
Late Entry 07-25-86	1700	On 7-24-86, at 2300 hours, Technical Staff personnel (B. McCabe) discovered leakage coming from a 1/4-inch diameter open threaded hole located on the sleeve of piping penetration X-116B. The leak was discovered during the pressurization phase of the test with the air compressor running and a drywell pressure of approximately 15 psig. The pipe plug was replaced. Pressurization continued and the test was started.

DATE	TIME	ILRT LOG
	1700 (Cont'd)	As part of the recirculation pipe replacement work performed during the refueling outage, the line running through penetration X-116B (3-1506-16A) was completely removed and replaced with new piping. During the installation of the new pipe, contractors performing the work needed to remove a pipe plug installed in the threaded hole that had been found leaking. The pipe plug had to be removed in order to install the new pipe. Station Construction Engineer, M. Hogan, gave permission to remove the plug provided the plug was re-installed after the pipe replacement was completed. The pipe replacement was completed but the plug was not replaced. The amount of leakage found could not be determined. The pipe penetration cannot be leak rate tested by Type B or Type C testing methods per 10CFR 50 Appendix J. The inside of the penetration is not sealed and is open directly to drywell atmosphere. Leakage of the penetration can only be verified by Type A testing. A meeting was held between J. Achterberg (Technical Staff Supervisor), J. Kotowski (Unit 3 Operating Engineer), R. Flessner (Superintendent Technical Services), J. Glover, M. Leahy (ILRT Coordinator) and P. LeBlond (Nuclear Licensing Administrator). As a result of the meeting, it was decided that the replacement of the plug should be considered a re-alignment (such as a valve re-alignment) and was <u>not</u> considered a repair or adjustment as described in 10CFR Appendix J. Therefore, the test was allowed to continue. (R. Stachniak, Technical Staff Group Leader).
07-24-86	2345	Drywell pressure at typer is 15 lbs.
07-25-86	0015	Instrument tap plugged; air leak stopped. (Ata/McCabe/Bandura).
	0030	Ata/McCabe to open LPCI isolation 43,45B and 80,79B to verify water in LPCI lines.
	0045	Water verified to be in LPCI lines. Air leak suspected to be in equalizing valves on upstream side of LPCI 3-1501-25B.
	0050	Drywell pressure still at 15 lbs.
	0105	Reviewed leak rate per procedure; no indication of pressure decay; will commence pressurization to 65.
	0120	Directed NSO to open LPCI 28B; loaded compressor.

DATE	TIME	ILRT LOG
	0132	Drywell pressure 18 lbs.
	0144	Drywell pressure 20 lbs.
	0235	Reactor water temperature 145°F.
	0235	RBCCW valved into a SDC Hx to control water temperature.
	0318	DN Pressure: 35lb Rx H_2O Level: 50.25 DN Temperature: 112.14 Torus Water Temperature: 87° Torus Water Level: 14"
07-25-86	0338	DAS #39 Drywell Pressure: 37 Rx Level: 49.91 (F 309) 53 (F 380) Drywell Temperature: 112.55 Torus Temperature: 87 Level: 13.6/14 Torus Level: 14
	0355	Rx Water Temperature: 140°F.
	0358	Drywell Pressure: 41# Rx Level: 49.63/53 Druwell Temperature: 112.55 Torus Temperature: 87 Torus Level: 14/13.6
	0410	Rx Water Temperature: 37°F. Secured a SDC.
	0420	Rx Water Temperature 35°F.
	0450 (4:48)	Drywell Pressure: 48# Drywell Temperature: 112.549 Rx H_2O Level: 49.48/52 - Stable Torus Water Level: 14 - Stable Torus Water Temperature: 87 - Stable
07/25/86	0450	Maintenance (Bandura/Shift [Ata]) notified of drywell pressure and preparation for drywell spray header installation of blind flange.
	0500	Compressor tripped on high temperature. Drywell pressure to 47#.
	0504	NSO directed to open 28B valve to continue pressurization.

DATE	TIME	ILRT LOG
	0518	Rx Water Temperature: Drywell Pressure: 49#
	0520	Compressor tripped on high H_2O temperature. LPCI 28B closed. Service H_2O discharge header pressure = 98#. Circulating water temperature 83.9/84.6.
	0530	2nd (Front) compressor started; continuing to pressurize; 28B valve opened.
	0540	Drywell Pressure: 51 Rx Water Level: 49.71/52 Rx Temperature: 112.023 28B valve closed: Stabilization commencing; data set 542.
	0550	2nd (Front) compressor unloaded.
	0554	H. Ata notified shift to hang outage fan 28B valve in preparation for installation of blind flange.
	0630	Breaker fan air compressors racked out.
	0640	Rx Pressure: 51 Rx Level: 49.19/52 Rx Temperature: 111.349 Torus Level: 14/13.6 Torus Temperature: 87 Maintenance not to install blind flange until after 0700. Rx Water Temperature: 137°F and steady.
	0650	J. Kotowski wants 24-hour watch on console due to station cleaning in the area. Ron Jackson sent to watch console. Phone extension at console is 732. Console must remain in attendance by T. S. Person.
07-25-86	0710	Shift turned over to Leahy. Temperature stabilization 7:42 to 9:42 = 0.226°F/hr, data set at 9:52 not significantly different from 9:42, so data set #87 at 10:02 (DAS time) will start test - Bechtel test will be performed.
	1130	Notified by NRC resident inspector that 3-2301-28 is out of position.
	1400	Found out that valve cannot be closed. Open is conservative position, so TPC 86-7-463 written to cover position change.

DATE	TIME	ILRT LOG
Late Entry 07-25-86	1255	Valve AO-3-2301-28 was found open by Beth Hare (NRC) while performing an inspection of the Control Room panels. Attempts were made to close the valve from the control room and locally by the Unit 3 Operating Foreman, but all were unsuccessful. After preliminary review of the valve, it is believed that the solenoid to the air operator on the valve failed some time during the test. The valve had been verified closed by the Unit 3 NSO and the Technical Staff prior to conducting the test. The valve fails open on loss of air and could provide a leakage path from the torus if other valves in series with AS-23-1-28 were to leak. Leaving the valve open for the remainder of the test was considered conservative since leaving the valve open could only induce leakage. (R. Stachniak, Technical Staff Group Leader)
	2000	Shift turned over to M. Moy.
	2250	Completed leakage phase of test at data set #161. Calculated leak rate = 0.5034 %/day + 0.5874 %/day.
	2300	Notified J. Red for air sample.
07-26-86	0025	Rad/Chem took 8-minute air sample.
	0042	Rad/Chem takes 2nd sample; results ready 0200.
	0200	Rad/Chem air samples in. 0.0 Ioane $1.2E^{-11}$ B $5.2E^{-12}$ B. Causen ok to vent to Rx Bldg.
	0213	Flowmeter set at induced leak of 14.0 scfm. Data set #185 will be first data set @ 2:22.
Late Entry 07-26-86	1300	At approximately 2300 hours on 7-25-86, shortly <u>before</u> the end of the leakage phase of the test, the Unit 3 Operating Foreman discovered that valves MO-3-1501-32A and 3-1501-66A had <u>not</u> been opened during the test. The valves were to have been opened prior to starting the test, after Mechanical Maintenance had removed the temporary flange from the containment spray line. A review of the valves remaining closed shows that this did not jeopardize the test results. Closure of valve 1501-66A isolated any flow from the ECCS jockey pump and <u>could</u> <u>not</u> have isolated any leakage path. Valve MO-3-1501-32A is a crosstie isolation valve between the A and B LPCI loops. Closing this valve did not

DATE	TIME	ILRT LOG
		isolate any vent or leakage path. Closure of MO-3-1501-32A only affected LPCI system operability which was not required by the Technical Specifications. The unit was in cold shutdown with no maintenance ongoing that could drain the vessel.
	0720	Shift turned over to M. Leahy.
	0800	Looks like flow for verification about 1/2 of what was believed, due to 48 psig outlet calibration.
	0832	1st Verification phase failed, (data set #222) [(1.2099 + 0.084)-[(0.5034 + 1.74 + 0.084)] = 1.109 wt. %/day from 14 scfm flow. The cause of the failure was determined to be improper operation of the flow meter.
	0850	Installing flowmeter outlet passage and throttle valve.
	0902	Start stabilization of 2nd verification phase.
	1002	Start 2nd verification phase (data set #231).
Late Entry	0955	Temperature stable for 2nd verification phase.
Late Entry	1245	A review of the results from the first verification test had shown that the test had failed. The cause of failure has been attributed to improper operation of the flow meter used to measure the induced leakage. In a telephone conversation held between J. Glover (CECo) and H. Jacobine (Fischer Porter) on 7-26-86, at 0845 hrs, it was realized that the flow meter had been calibrated by Fischer Porter such that the discharge pressure of the flow meter outlet was 48 psig. The flow meter had been installed and operated by CECo such that the discharge pressure of the outlet of the flow meter was (approximately 14.7 psia) Reactor Building pressure. Under this condition, a flow rate of 14.0 scfm as measured on the flow meter was actually 6.78 scfm. Using an induced leakage rate of 6.78 scfm, the difference between the calculated induced leak rate and the actual induced leak rate (equation - page 15 of DTS 1600-7) was .2118 wt. %/day. This was less than the .4 wt. %/day (.25 La) limit necessary to pass the verification test. Although the verification test was successful, a flow rate of 6.78 scfm did not meet the minimum induced flow requirement of Technical Specification 4.7.A.2. For this reason a second flow verification test was performed.
		Prior to starting the second flow verification test, a calibrated pressure gauge (DTS-31) and throttle valve were placed on the discharge of the flow meter.

DATE	TIME	ILRT LOG
		Valves on the inlet and outlet of the flow meter were throttled until a discharge pressure of 48.0 psig and a flow rate of 14.0 scfm were established. Drywell pressure was approximately 50 psig at the time that the second verification test began and was monitored throughout the test to ensure that the pressure did not fall below 48 psig. The flow and discharge pressure on the flow meter were monitored throughout the test to ensure that a 14.0 scfm flow and a 48 psig discharge pressure were kept constant at all times.
		A review of the first verification test was held on 7-26-86 at 0910 hours between J. Achterberg (Technical Staff Supervisor), J. Kotowski (Unit 3 Operating Engineer), and M. Leahy (ILRT Coordinator). It was concluded that the cause of failure had been identified and corrected as required by 10CFR 50 Appendix J. A second flow verification test was approved. (R. Stachniak, Technical Staff Group Leader)
	1325	Drywell pressure 48.7 psig. Calculated induced leakage 2.1532 wt. %/day. Must fall within 2.25 + 4 wt. %/day.
	1510	Data scan received (Leahy and Blauw). Going to DAS to investigate why data received at this time (not 15:12)
	1530	Cause of $15{:}10^{+}$ scan determined to be console watcher (Technical Staff) inadvertently pressing the DAS power switch to "off" - he then re-energized the DAS using the power switch. The DAS has a memory feature which enables the DAS to maintain all input levels (100mV, °F, etc.). When the DAS was re-energized, a scan was transmitted since the 10-minute interval clock reset to zero. The subsequent data set was transmitted at 1520, verifying the retention of the interval set, and all input levels were retained. The final verification phase data set is now scheduled to be at 1620, 6:18 after the verification phase start.
	1630	Final Rad sample taken to be analyzed.
	1630	Final (1620) data set accepted. Difference = 0.0185. (1620 data set required since test phase was 12:333 hrs long).
	1645	Air sample being taken.
	1400	Air sample results - 0.0 Iodine 2.3E-11 Beta/Gamma 1.7E-11 Alpha
		Ok to depressurize via Rx Building vents per Art Tucker, Rad Protection Foreman.

DATE	TIME	ILRT LOG
08-19-86	1330	Procedure sign-off's completed - Log closed.

F.4 Final Calculated Leak Rate

The final calculated leak rate was found to be 0.5034 weight %/day. The upper 95% confidence limit was 0.6567 weight %/day. Including compensation for non-vented systems, these results are 0.5874 weight %/day and 0.7407 weight %/day, respectively. (Refer to Section E.7.) Since these values are well within the Technical Specification Limit of 1.2 weight %/day for reactor startup, the Unit 3 primary containment integrity remains intact.

G. SUPPLEMENTAL VERIFICATION TEST (INDUCED PHASE)

The purpose of the induced portion of the ILRT is to verify that the results of the 12-hour measured phase are valid. The supplemental test portion of the ILRT procedure involves inducing a leak from the primary containment through a separate calibrated flow meter. Concurrently, readings from the computerized ILRT data acquisition system are analyzed to determine the magnitude of the total containment leakage. If the criteria established by the following equation is satisfied, the ILRT calculated leakage is considered acceptable and the test is terminated.

$$L\ (\text{Induced Phase Total Containment Calculated Leak Rate}) - [L\ (\text{12-hour phase calculated leak rate}) + (\text{Superimposed leak rate})] \quad 0.25L_a$$

G.2 Magnitude of Induced Leakage

The induced leakage test was begun at 0222 hours on 7-26-86. A flow believed to be 14 scfm was induced from the primary containment. Because of a misunderstanding in the calibration conditions of the flowmeter, however, the actual flow rate was approximately 7 scfm (see ILRT Log entries, Section F.3). This induced test passed, but the flow rate was not sufficient to meet Technical Specification requirements. A flow of 14 scfm was then induced, and the induced test re-performed, starting at 1002 on 7-26-86. This flow was converted to weight %/day as follows:

$$14.0\ \text{scfm}\ \frac{1440\ \text{Min}}{\text{Day}}\ \frac{\bar{T} + 459.69°R}{519.69°R}\ \frac{14.696\ \text{psia}}{\bar{P}}\ \frac{100\%}{\text{Vol}} = \underline{1.718\ \text{weight}\ \%/\text{Day}}$$

where: $\bar{T}$ = Induced phase average containment temperature, 105°F

$\bar{P}$ = Induced phase average containment pressure, 63.3 psia. (Includes dry air and vapor)

VOL = Free volume of the containment, 288966 Ft^3.

The induced phase calculated leak rate, as shown by the computerized data acquisition system, was 2.1849 weight %/day. The resulting difference, following the equation of Section G.1, is:

$$\left| 2.1849 - (0.5034 + 1.76) \right| \leq 0.25 \, L_a$$

Since L_a, the maximum allowable containment leak rate is 1.6 weight %/day,

$$\left| 2.1849 - (0.5034 + 1.76) \right| \leq 0.4$$

$$0.0785 \leq 0.4$$

Since the difference, as shown above, was well below the 0.4 weight %/day accuracy requirement the ILRT values are considered valid.

H. TEST EVALUATION

Both the statistical leak rate and the upper confidence limit, corrected for process lines not vented or drained, were well within all Technical Specification limits.

Reactor vessel temperature transients were minimized by leaving the shutdown cooling system (B heat exchanger) in steady-state operation throughout the test. Reactor water temperature was controlled by varying the reactor building closed cooling water (RRCCW) supply flow rate to the heat exchanger. Remote throttling of the RBCCW discharge valve provided this method for stabilizing reactor water temperature.

APPENDIX A

TYPE A TEST INSTRUMENT ACCURACY ERROR ANALYSIS

APPENDIX A

INSTRUMENT ACCURACY ERROR ANALYSIS

A.1 Development of Equations

Per Topical Report BN-TOP-1 the measured total time leak rate (M) in weight percent per day is computed using the Absolute Method by the formula

$$M = (100)\,\frac{24}{H}\left[1 - \frac{T_1\,\bar{P}_n}{T_n\,\bar{P}_1}\right] \qquad (1)$$

where:

$\bar{P}_1 = P_1 - PV_1$ = total containment atmosphere absolute pressure, in psia, at the start of test, corrected for water vapor pressure.

$\bar{P}_n = P_n - PV_n$ = Total containment atmosphere absolute pressure, in psia, at data point n after start of the test, corrected for water vapor pressure.

T_1, T_n = containment mean atmospheric temperature in or at the start and at data point n, respectively.

H = test interval in hours between time 1 and time n.

R = gas constant.

The change or uncertainty interval in M due to uncertainties in the measured variables is given by:

$$M = \frac{2400}{H}\left[\left(\frac{dM}{dP_2}\cdot\delta_{P_2}\right)^2 + \left(\frac{dM}{dP_1}\cdot\delta_{P_1}\right)^2 + \left(\frac{dM}{dT_1}\cdot\delta_{T_1}\right)^2 + \left(\frac{dM}{dT_2}\cdot\delta_{T_2}\right)^2\right]^{\frac{1}{2}} \qquad (2)$$

where δ is the standard error for each variable. This formula assumes that all errors are systematic rather than random in character. Even though the formula is deterministic it does, however, allow assessment of figure of merit for various equipment to be used in the measuring system without the need for assembling and calibrating the system as an entity.

The error in M after differentiating is:

$$e_M = \frac{2400}{H} \left[\left(-\frac{T_1}{\bar{P}_1 T_2} \cdot e_{\bar{P}_2} \right)^2 + \left(\frac{\bar{P}_2 T_1}{\bar{P}_1{}^2 T_2} \cdot e_{\bar{P}_1} \right)^2 \right. \tag{3}$$

$$\left. + \left(-\frac{\bar{P}_2}{\bar{P}_1 T_2} \; e_T \right)^2 + \left(\frac{\bar{P}_2 T_1}{\bar{P}_1 T_2{}^2} \; e_T \right)^2 \right]^{\frac{1}{2}}$$

where:

$$e_{\bar{P}_1} = \delta_{P_1}$$

$$e_{\bar{P}_2} = \delta_{P_2}$$

$$e_T = e_{T_1} = e_{T_2}$$

For the purpose of developing a finite number for e_M using equation (3), it is necessary to assume certain containment conditions made.

1. For purposes of comparison to other tests H = 24 hours.

2. Containment leak rate is essentially zero, that is:

$T_1 = T_2 = \bar{T}$ where $\bar{T}$ is the average volume weighted primary containment air temperature (R) during the test;

$P_1 = P_2$ where P is the total containment atmospheric pressure (psia);

$PV_1 = PV_2$ where PV is the partial pressure of water vapor in the primary containment;

Equation (3) becomes:

$$e_M = \frac{2400}{H} \left[2 \left(\frac{e_P}{\bar{P}} \right)^2 + 2 \left(\frac{e_T}{\bar{T}} \right)^2 \right]$$

where:

e_P = the error in pressure which accounts for the error in the total pressure measurement system; both total absolute pressure and water vapor pressure.

$$e_P = \left[(e_{P_T})^2 + (e_{P_V})^2 \right]^{\frac{1}{2}}$$

e_{P_T} = inst. accuracy error/ $\sqrt{\text{no. inst.}}$ = error in total absolute pressure in psia.

e_{P_V} = inst. accuracy error/ $\sqrt{\text{no. inst.}}$ = error in water vapor pressure (dewpoint) indicator in psia at 80°F.

e_T = inst. accuracy error/ $\sqrt{\text{no. inst.}}$ = error in temperature, °R.

A.2 Calculations

Instrument	RTD (°F)	PPG (PSIA)	DEWCELL (°F)	FLOWMETER (SCFM)
Range	50-200	0-100	-50 - 140	2-20
Accuracy	± 0.96	0.015	± 4.12	1% (Full Scale)
Repeatability	± 0.01	0.001	± 0.01°F	0.02

BN-TOP

Computation of Instrument Accuracy Uncertainty.

1. e_T "Error in temperature"

$$e_T = \pm \frac{0.96}{\sqrt{28}} = 0.1814°F$$

2. "Error in total absolute pressure in psia"

$$e_{PT} = \pm\ (0.015\%)\quad (100)\quad \sqrt{2}$$

$$= 0.0106 \text{ psia}$$

3. Computing "e_p"

Error in water vapor pressure (dewpoint) indicator in psia at a dewpoint of between 85°F and 90°F (assumed), results in an interpolated conversion factor of 0.02046 psi/°F.

$$e_{pv} = \frac{4.12}{\sqrt{10^*}} \left(0.02046 \frac{\text{psi}}{°F}\right) = 0.0266 \text{ psia}$$

*9 Dewcells + 1 RTD as a dewcell in the reactor.

4. Computing "e_p"

$$e_p = \pm\ [(e_{pT})^2 + (e_{pv})^2]^{1/2}$$

$$= \pm\ [(0.0106) + (0.02666)^2]^{1/2}$$

$= 0.02869$ psia

5. Computing total instrument accuracy uncertainty "em".

$$em = \pm \frac{2400}{12} \left[2 \times \left(\frac{ep}{65.0}\right)^2 + 2 \times \left(\frac{e_T}{550}\right)^2\right]^{\frac{1}{2}}$$

$$= \pm 200 \left[2 \times \left(\frac{0.02869}{65.0}\right)^2 + 2 \times \frac{0.1814}{550})^2\right]^{\frac{1}{2}}$$

$$= \pm 0.1558 \text{ wt. \%/day}$$

Computation of Instrument Repeatibility.

1. "e_T"

$$e_T = \pm \frac{0.01}{\sqrt{28}}$$

$$= 0.00189°R$$

2. "e_{PT}"

$$e_{PT} = \frac{0.001}{\sqrt{2}}$$

$$= \pm 0.0007 \text{ psia.}$$

3. "e_{pv}"

$$e_{pv} = \pm \frac{0.01}{\sqrt{10}*} (0.02046 \frac{psi}{°F}$$

* 9 Dewcells + 1 RTD.

$$= \pm 0.0001 \text{ psia}$$

4. "e_p"

$$e_p = \pm [(0.0007)^2 + 0.0001)^2]^{\frac{1}{2}}$$

$$= 0.0007 \text{ psia}$$

5. "e_m"

$$e_m = \pm \frac{2400}{12} \left[2 \times \left(\frac{0.0007}{65}\right)^2 + 2\left(\frac{0.00189}{550}\right)^2\right]^{\frac{1}{2}}$$

$$= \pm 0.03048 \text{ \%/day}$$

APPENDIX B

TYPE A TEST DATA

12-HOUR TEST PHASE

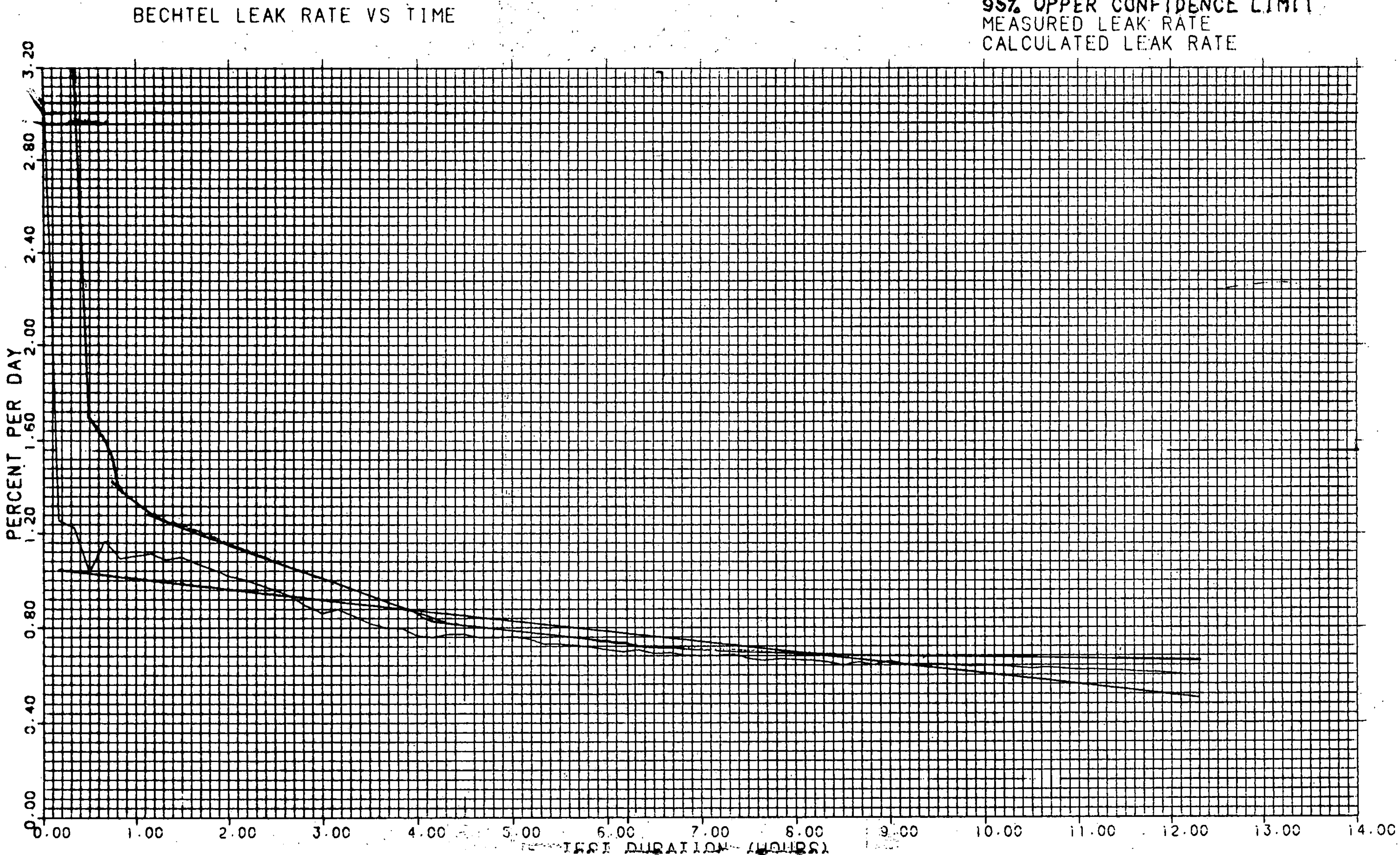
DRESDEN UNIT 3 13:21:04 WED, 20 AUG 1986

**** BECHTEL CALCULATIONS FOR DATA SETS 87 THRU 161 ****

DATA SET	TEST DURATION (HRS)	TAPE TIME	TEMP (R)	DRY AIR PRESSURE (PSIA)	WATER LEVEL (IN)	MEAS LEAK RATE % / DAY	CALC LEAK RATE % / DAY	95% UPPER CONFIDENCE LIMIT
87	0.000000	10:02:14	565.89087	63.54987	52.57000	0.0000	0.0000	0.0000
88	0.166016	10:12:12	565.85144	63.53759	52.20000	1.2568	1.0459	0.0000
89	0.333008	10:22:13	565.80432	63.52508	51.89000	1.2248	1.0385	0.0000
90	0.500000	10:32:14	565.76477	63.51613	51.63000	1.0316	1.0310	1.6961
91	0.666016	10:42:12	565.71619	63.50240	51.41000	1.1660	1.0236	1.5873
92	0.833008	10:52:13	565.66931	63.49256	51.24001	1.0915	1.0162	1.3881
93	1.000000	11:02:14	565.62158	63.48088	51.04999	1.1029	1.0087	1.3185
94	1.166016	11:12:12	565.59143	63.47242	51.06001	1.1119	1.0013	1.2884
95	1.333008	11:22:13	565.54431	63.46334	51.08999	1.0860	0.9939	1.2524
96	1.500000	11:32:14	565.50952	63.45395	51.06001	1.0983	0.9864	1.2363
97	1.666016	11:42:12	565.48743	63.44778	51.04001	1.0699	0.9790	1.2113
98	1.833008	11:52:13	565.44849	63.43967	51.02001	1.0472	0.9716	1.1850
99	2.000000	12:02:14	565.42102	63.43367	51.06001	1.0194	0.9642	1.1573
100	2.166016	12:12:12	565.40283	63.42761	50.99000	1.0039	0.9567	1.1318
101	2.333008	12:22:13	565.38733	63.42310	51.02999	0.9807	0.9493	1.1062
102	2.500000	12:32:14	565.36780	63.41817	51.04999	0.9586	0.9419	1.0809
103	2.666016	12:42:12	565.35242	63.41405	51.04001	0.9320	0.9345	1.0551
104	2.833008	12:52:13	565.32764	63.40986	50.99998	0.8925	0.9270	1.0274
105	3.000000	13:02:14	565.31103	63.40656	51.00999	0.8619	0.9196	0.9993
106	3.166016	13:12:12	565.29724	63.40025	51.06001	0.8773	0.9122	0.9769
107	3.333008	13:22:13	565.28430	63.39705	50.99998	0.8489	0.9047	0.9531
108	3.500000	13:32:14	565.27600	63.39536	51.02001	0.8179	0.8973	0.9281
109	3.666016	13:42:12	565.26233	63.39185	50.99998	0.8000	0.8899	0.9040
110	3.833008	13:52:13	565.26587	63.38924	51.02999	0.7966	0.8824	0.8826
111	4.000000	14:02:14	565.24951	63.38712	51.02001	0.7656	0.8750	0.8596
112	4.166016	14:12:12	565.24451	63.38367	50.99000	0.7595	0.8676	0.8389
113	4.333008	14:22:13	565.24414	63.37885	50.99000	0.7720	0.8601	0.8240
114	4.500000	14:32:14	565.23779	63.37452	50.93999	0.7712	0.8527	0.8122
115	4.666016	14:42:12	565.23352	63.37241	50.93999	0.7570	0.8453	0.8001
116	4.833008	14:52:13	565.23645	63.36967	50.99000	0.7573	0.8378	0.7907
117	5.000000	15:02:14	565.23584	63.36564	50.99000	0.7619	0.8304	0.7850
118	5.166016	15:12:12	565.23584	63.36338	50.93999	0.7516	0.8230	0.7786
119	5.333008	15:22:13	565.22754	63.36237	50.97999	0.7304	0.8155	0.7693
120	5.500000	15:32:14	565.22912	63.35935	50.97000	0.7298	0.8081	0.7620
121	5.666016	15:42:12	565.23254	63.35718	50.91999	0.7234	0.8007	0.7552
122	5.833008	15:52:13	565.22876	63.35496	50.95998	0.7160	0.7932	0.7484
123	6.000000	16:02:14	565.23157	63.35349	50.91999	0.7057	0.7858	0.7412
124	6.166016	16:12:12	565.22876	63.35139	50.89999	0.6968	0.7784	0.7340
125	6.333008	16:22:13	565.23401	63.34745	50.86999	0.7044	0.7709	0.7296
126	6.500000	16:32:14	565.23535	63.34762	50.91999	0.6880	0.7635	0.7233
127	6.666016	16:42:12	565.24170	63.34455	50.89999	0.6916	0.7561	0.7191
128	6.833008	16:52:13	565.23364	63.34224	50.88000	0.6818	0.7486	0.7140
129	7.000000	17:02:14	565.24939	63.34131	50.86999	0.6797	0.7412	0.7097
130	7.166016	17:12:12	565.25366	63.33906	50.88998	0.6791	0.7338	0.7063
131	7.333008	17:22:13	565.25732	63.33504	50.88000	0.6861	0.7263	0.7049
132	7.500000	17:32:14	565.26221	63.33500	50.67999	0.6674	0.7189	0.7010
133	7.666016	17:42:12	565.26221	63.33317	50.58001	0.6590	0.7115	0.6967
134	7.833008	17:52:13	565.27124	63.32838	50.34999	0.6660	0.7040	0.6942

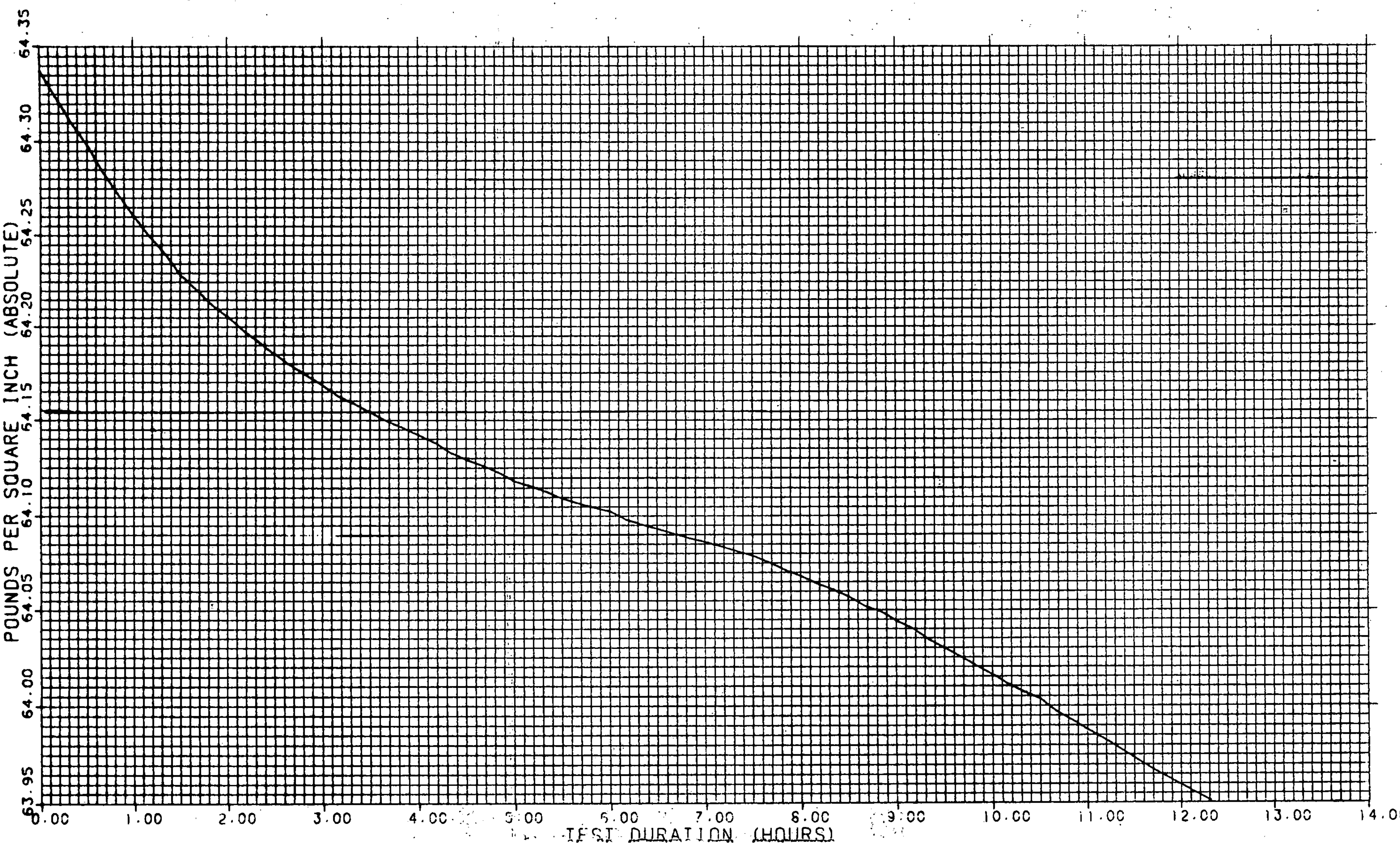
DATA SET	TEST DURATION (HRS)	TAPE TIME	TEMP (R)	DRY AIR PRESSURE (PSIA)	WATER LEVEL (IN)	MEAS LEAK RATE % / DAY	CALC LEAK RATE % / DAY	95% UPPER CONFIDENCE LIMIT
[illegible]5	8.000000	18:02:14	565.27173	63.32527	50.18000	0.6620	0.6966	0.6917
[illegible]6	8.166016	18:12:12	565.27258	63.32196	50.05999	0.6608	0.6892	0.6897
137	8.333008	18:22:13	565.26684	63.31924	49.90001	0.6524	0.6817	0.6870
138	8.500000	18:32:14	565.26050	63.31731	49.68001	0.6389	0.6743	0.6829
139	8.666016	18:42:12	565.25561	63.31029	49.57001	0.6519	0.6669	0.6814
140	8.833008	18:52:13	565.25586	63.30952	49.46999	0.6403	0.6594	0.6786
141	9.000000	19:02:14	565.25256	63.30133	49.30998	0.6570	0.6520	0.6787
142	9.166016	19:12:12	565.24805	63.30075	49.12000	0.6405	0.6446	0.6768
143	9.333008	19:22:13	565.24036	63.29526	48.95998	0.6438	0.6371	0.6757
144	9.500000	19:32:14	565.23682	63.29145	48.84000	0.6431	0.6297	0.6749
145	9.666016	19:42:12	565.22473	63.28669	48.66000	0.6409	0.6223	0.6741
146	9.833008	19:52:13	565.21570	63.28389	48.54001	0.6340	0.6148	0.6727
147	10.000000	20:02:14	565.20972	63.27858	48.36000	0.6367	0.6074	0.6720
148	10.166016	20:12:12	565.19922	63.27404	48.23999	0.6361	0.6000	0.6715
149	10.333008	20:22:13	565.19299	63.27070	48.07000	0.6316	0.5925	0.6706
150	10.500000	20:32:14	565.18750	63.26817	47.90999	0.6248	0.5851	0.6692
151	10.666016	20:42:12	565.17041	63.26138	47.81000	0.6302	0.5777	0.6688
152	10.833008	20:52:13	565.16052	63.25829	47.66999	0.6243	0.5703	0.6678
153	11.000000	21:02:14	565.14148	63.25376	47.52000	0.6198	0.5628	0.6666
154	11.166016	21:12:12	565.14014	63.24976	47.39000	0.6209	0.5554	0.6658
155	11.333008	21:22:13	565.12073	63.24503	47.28000	0.6180	0.5480	0.6648
156	11.500000	21:32:14	565.11011	63.24109	47.20000	0.6164	0.5405	0.6639
157	11.666016	21:42:12	565.09778	63.23765	47.02998	0.6109	0.5331	0.6627
158	11.833008	21:52:13	565.09228	63.23402	46.89999	0.6093	0.5257	0.6615
159	12.000000	22:02:14	565.06799	63.22980	46.82000	0.6039	0.5182	0.6600
[illegible]0	12.166016	22:12:12	565.04553	63.22501	46.67001	0.5999	0.5108	0.6584
[illegible]1	12.333008	22:22:13	565.03882	63.22223	46.63999	0.5974	0.5034	0.6567

DRESDEN UNIT 3



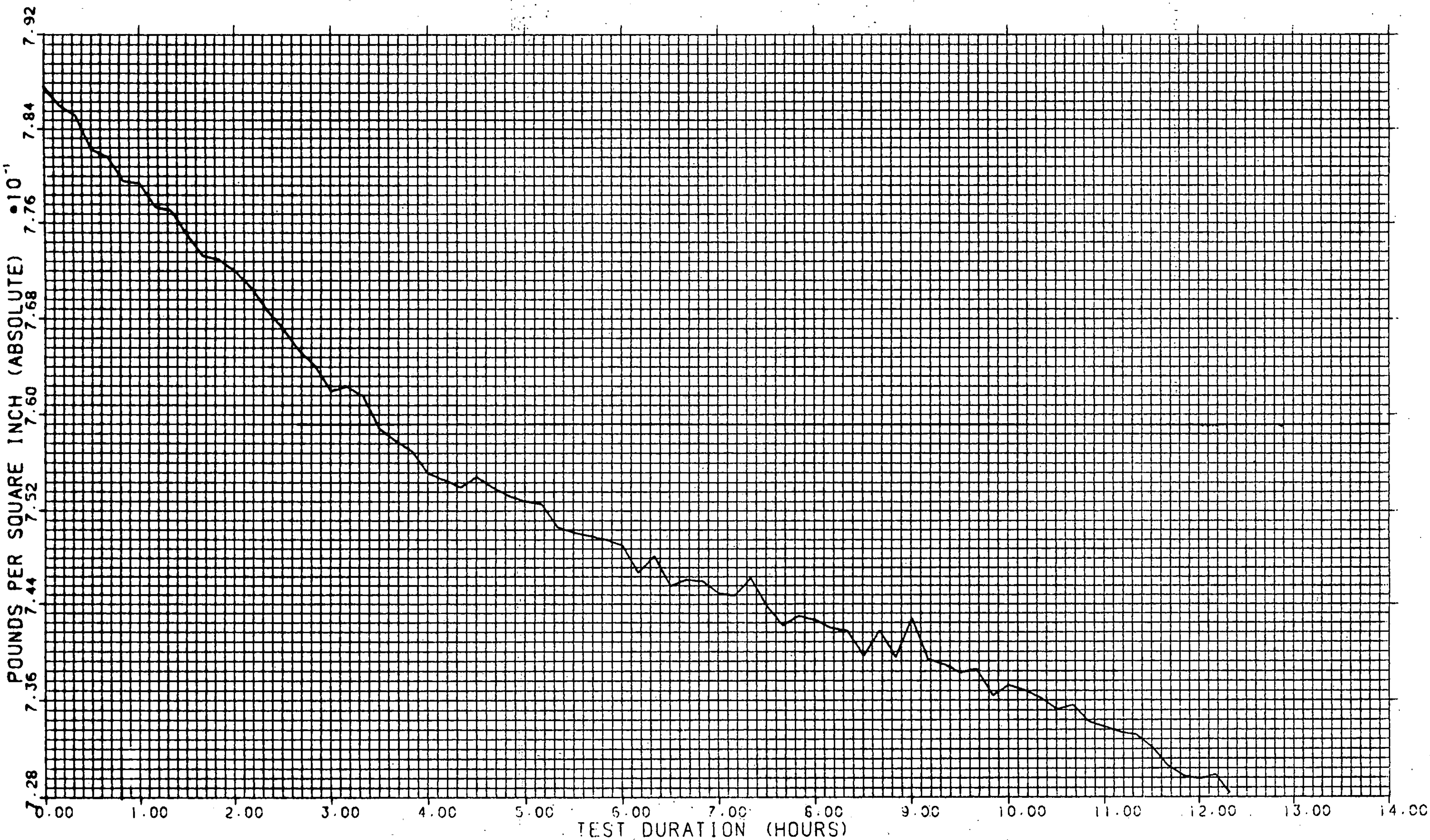
DRESDEN UNIT 3

TOTAL CONTAINMENT PRESSURE VS TIME

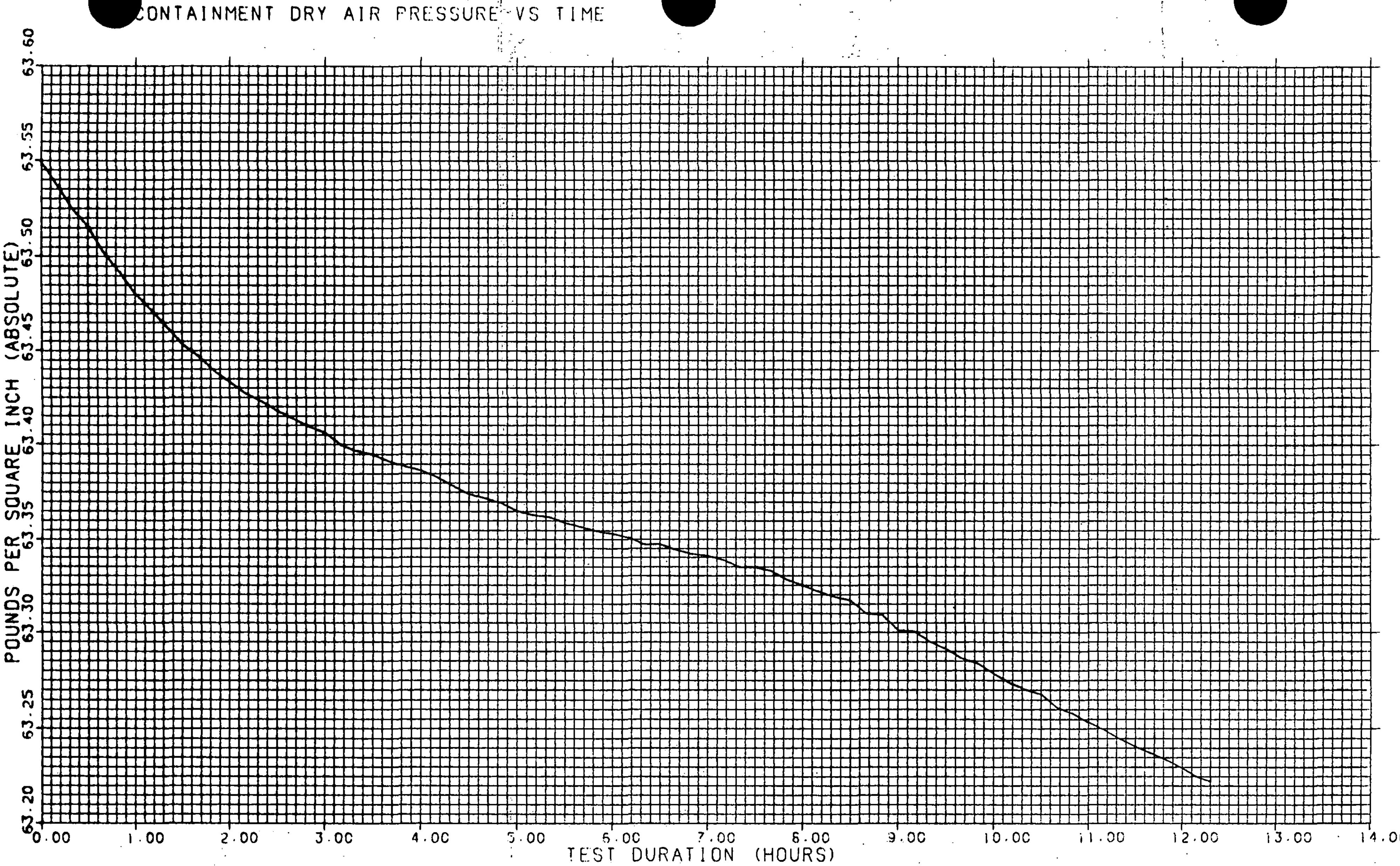


DRESDEN UNIT 3

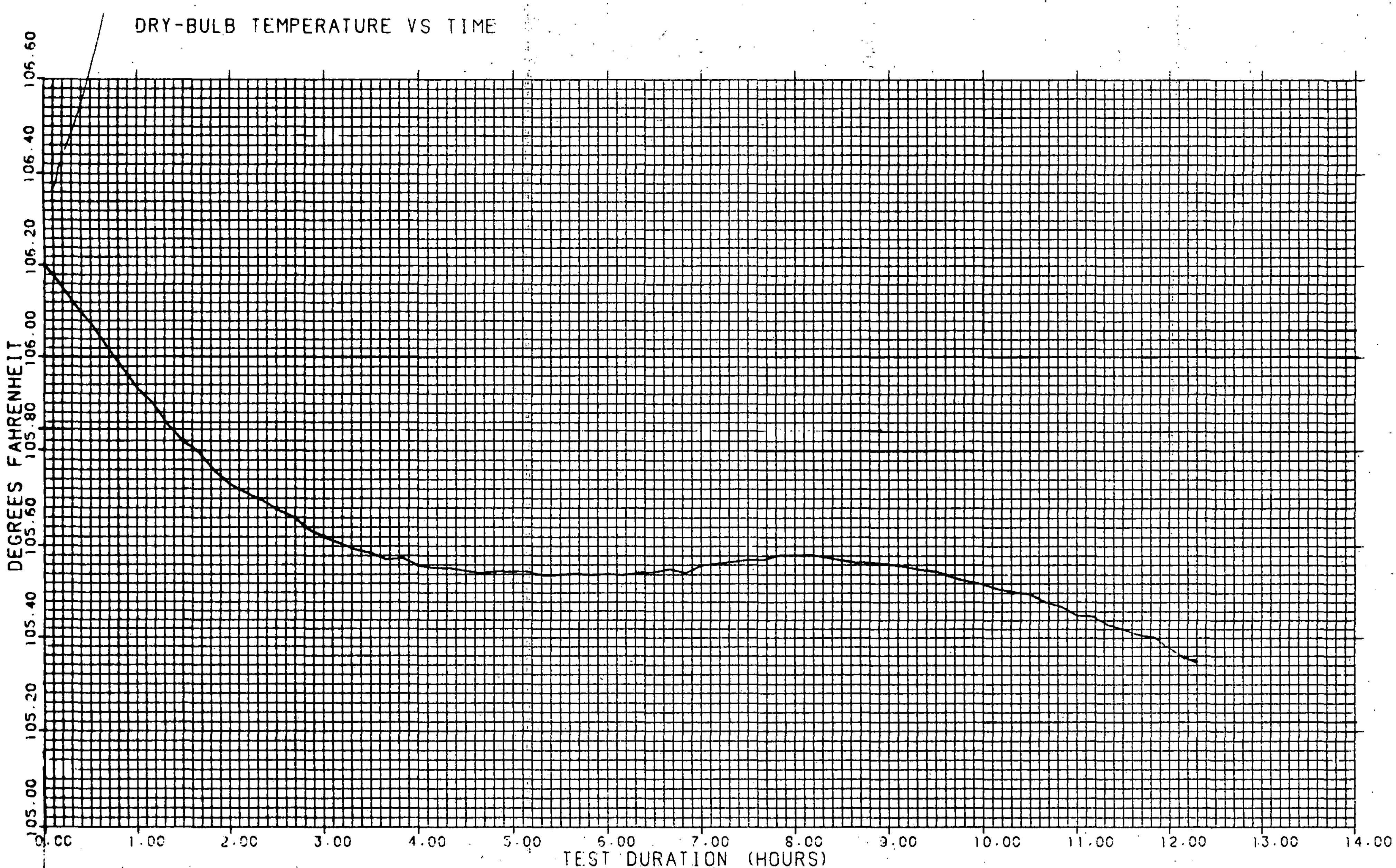
CONTAINMENT VAPOR PRESSURE VS TIME



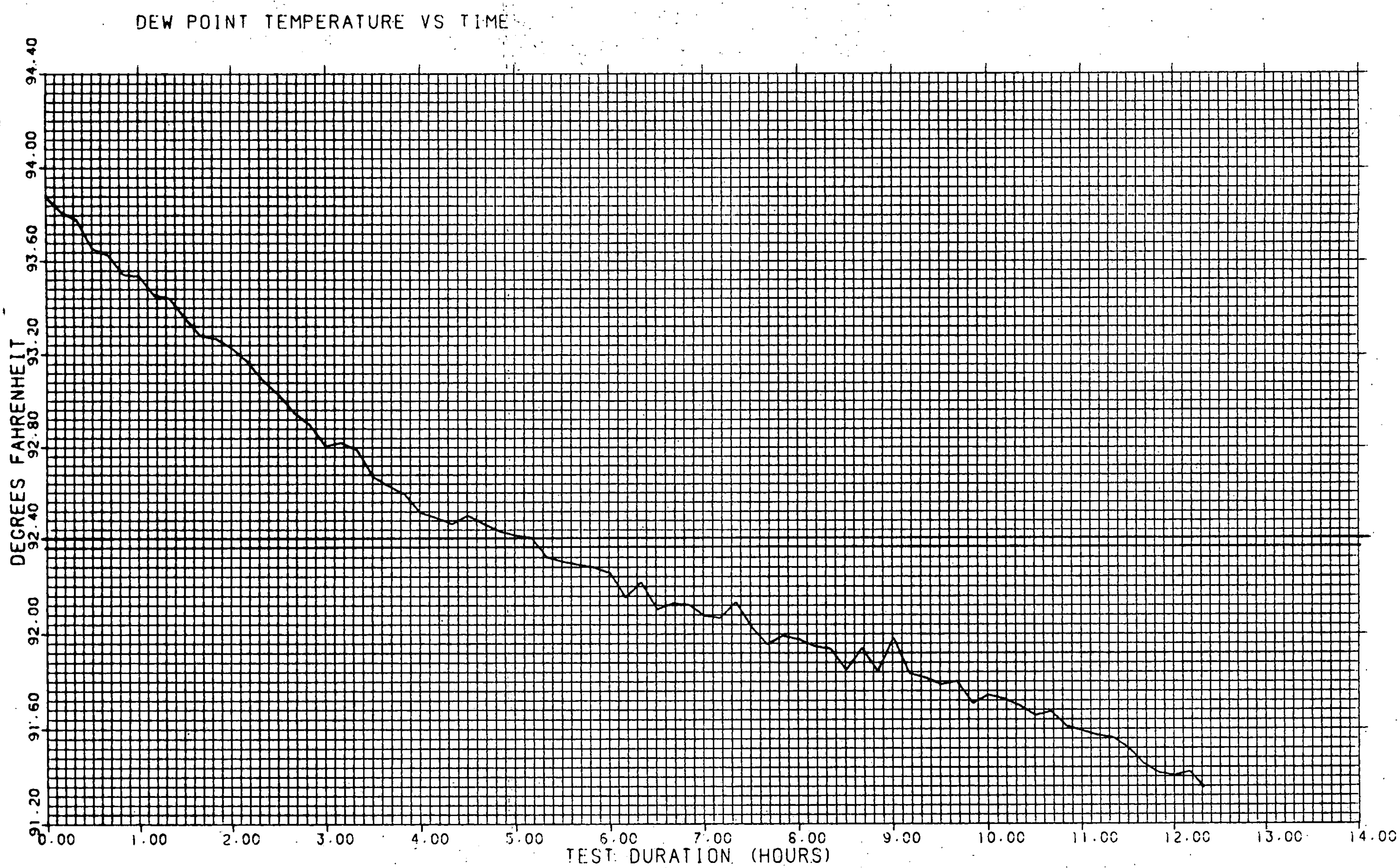
DRESDEN UNIT 3



DRESDEN UNIT 3



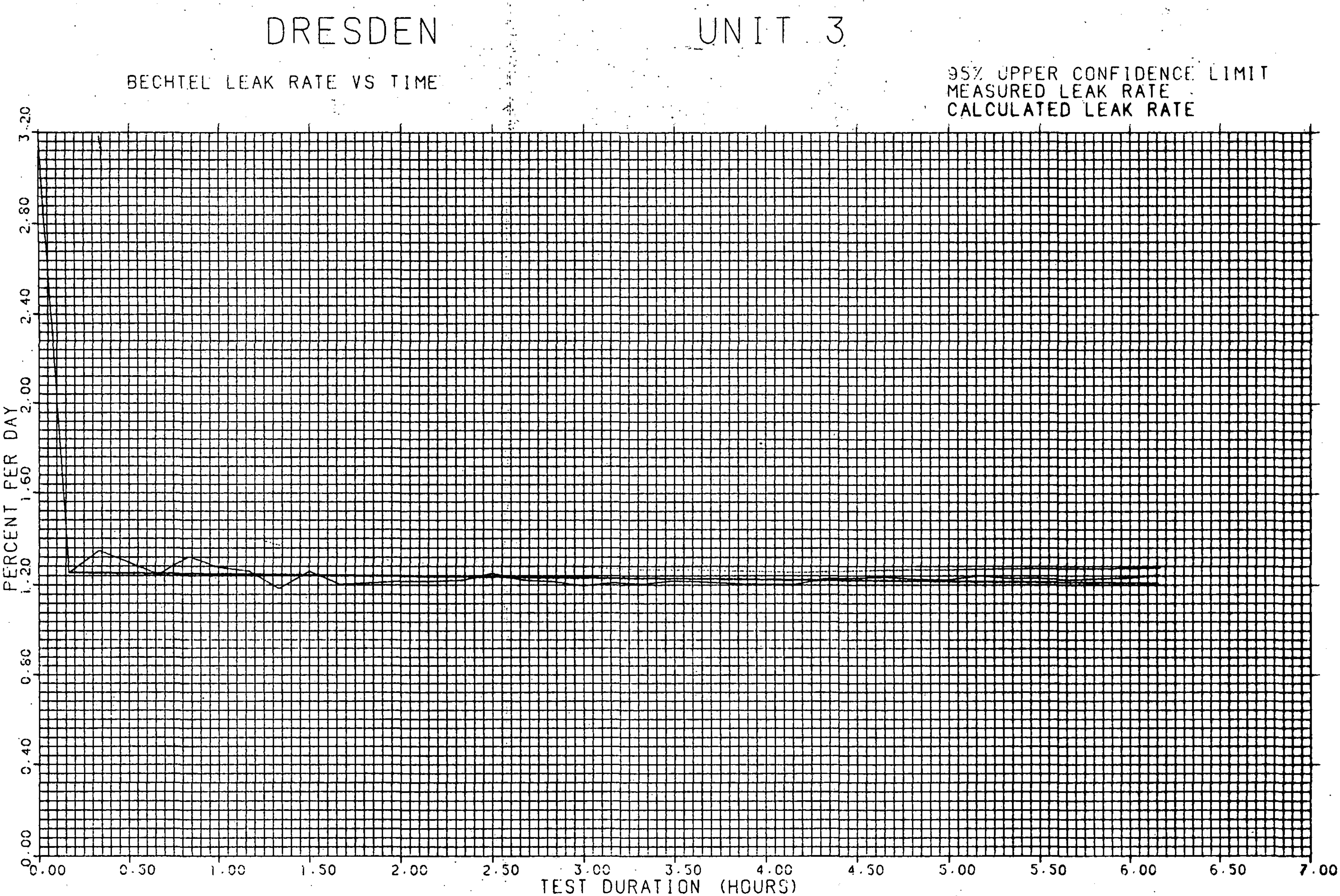
DRESDEN UNIT 3



VERIFICATION PHASE I

****** BECHTEL CALCULATIONS FOR DATA SETS 185 THRU 222 ******

DATA SET	TEST DURATION (HRS)	TAPE TIME	TEMP (R)	DRY AIR PRESSURE (PSIA)	WATER LEVEL (IN)	MEAS LEAK RATE % / DAY	CALC LEAK RATE % / DAY	95% UPPER CONFIDENCE LIMIT
185	0.000000	02:22:13	564.76111	63.12099	45.13000	0.0000	0.0000	0.0000
186	0.166992	02:32:14	564.75647	63.11516	45.16001	1.2509	1.2560	0.0000
187	0.333008	02:42:12	564.74438	63.10774	45.20000	1.3491	1.2547	0.0000
188	0.500000	02:52:13	564.72937	63.10061	45.16001	1.2954	1.2534	1.9224
189	0.666992	03:02:14	564.71374	63.09387	45.13000	1.2450	1.2521	1.5656
190	0.833008	03:12:12	564.70532	63.08637	45.22000	1.3215	1.2508	1.4988
191	1.000000	03:22:13	564.69690	63.08074	45.20998	1.2769	1.2496	1.4425
192	1.166992	03:32:14	564.68396	63.07425	45.22000	1.2601	1.2483	1.4044
193	1.333008	03:42:12	564.67200	63.07000	45.20998	1.1851	1.2470	1.3718
194	1.500000	03:52:13	564.67346	63.06207	45.20998	1.2583	1.2457	1.3609
195	1.666992	04:02:14	564.65967	63.05742	45.20998	1.2033	1.2444	1.3332
196	1.833008	04:12:12	564.66162	63.05206	45.20998	1.2096	1.2432	1.3136
197	2.000000	04:22:13	564.65832	63.04625	45.24000	1.2161	1.2419	1.3014
198	2.166992	04:32:14	564.65210	63.04047	45.27999	1.2155	1.2406	1.2921
199	2.333008	04:42:12	564.64868	63.03415	45.22999	1.2206	1.2393	1.2871
200	2.500000	04:52:13	564.64123	63.02647	45.29001	1.2494	1.2380	1.2950
201	2.666992	05:02:14	564.64831	63.02298	45.16999	1.2214	1.2368	1.2902
202	2.833008	05:12:12	564.64416	63.01745	45.13000	1.2147	1.2355	1.2844
203	3.000000	05:22:13	564.63476	63.01167	45.00999	1.1973	1.2342	1.2756
204	3.166992	05:32:14	564.63647	63.00504	44.92999	1.2103	1.2329	1.2713
205	3.333008	05:42:12	564.63220	62.99831	44.70001	1.2048	1.2316	1.2665
206	3.500000	05:52:13	564.62500	62.98997	44.54000	1.2185	1.2304	1.2660
207	3.666992	06:02:14	564.61572	62.98267	44.32000	1.2136	1.2291	1.2643
208	3.833008	06:12:12	564.60364	62.97575	44.17001	1.2071	1.2278	1.2614
209	4.000000	06:22:13	564.59289	62.96863	44.02001	1.2042	1.2265	1.2583
210	4.166992	06:32:14	564.58301	62.96211	43.97999	1.2032	1.2252	1.2555
211	4.333008	06:42:12	564.57361	62.95320	44.02999	1.2288	1.2240	1.2590
212	4.500000	06:52:13	564.57153	62.94795	44.10000	1.2292	1.2227	1.2618
213	4.666992	07:02:14	564.56128	62.94040	44.02999	1.2339	1.2214	1.2652
214	4.833008	07:12:12	564.55505	62.93561	44.04999	1.2249	1.2201	1.2661
215	5.000000	07:22:13	564.54700	62.92968	44.06999	1.2231	1.2188	1.2665
216	5.166992	07:32:14	564.54578	62.92191	44.08999	1.2406	1.2175	1.2703
217	5.333008	07:42:12	564.53943	62.91743	44.08999	1.2290	1.2163	1.2712
218	5.500000	07:52:13	564.53540	62.91122	44.08000	1.2310	1.2150	1.2723
219	5.666992	08:02:14	564.53809	62.90759	44.10000	1.2221	1.2137	1.2718
220	5.833008	08:12:12	564.54004	62.90173	44.10000	1.2269	1.2124	1.2720
221	6.000000	08:22:13	564.54407	62.89621	44.13001	1.2318	1.2111	1.2729
222	6.166992	08:32:14	564.54980	62.88943	44.13999	1.2445	1.2099	1.2757



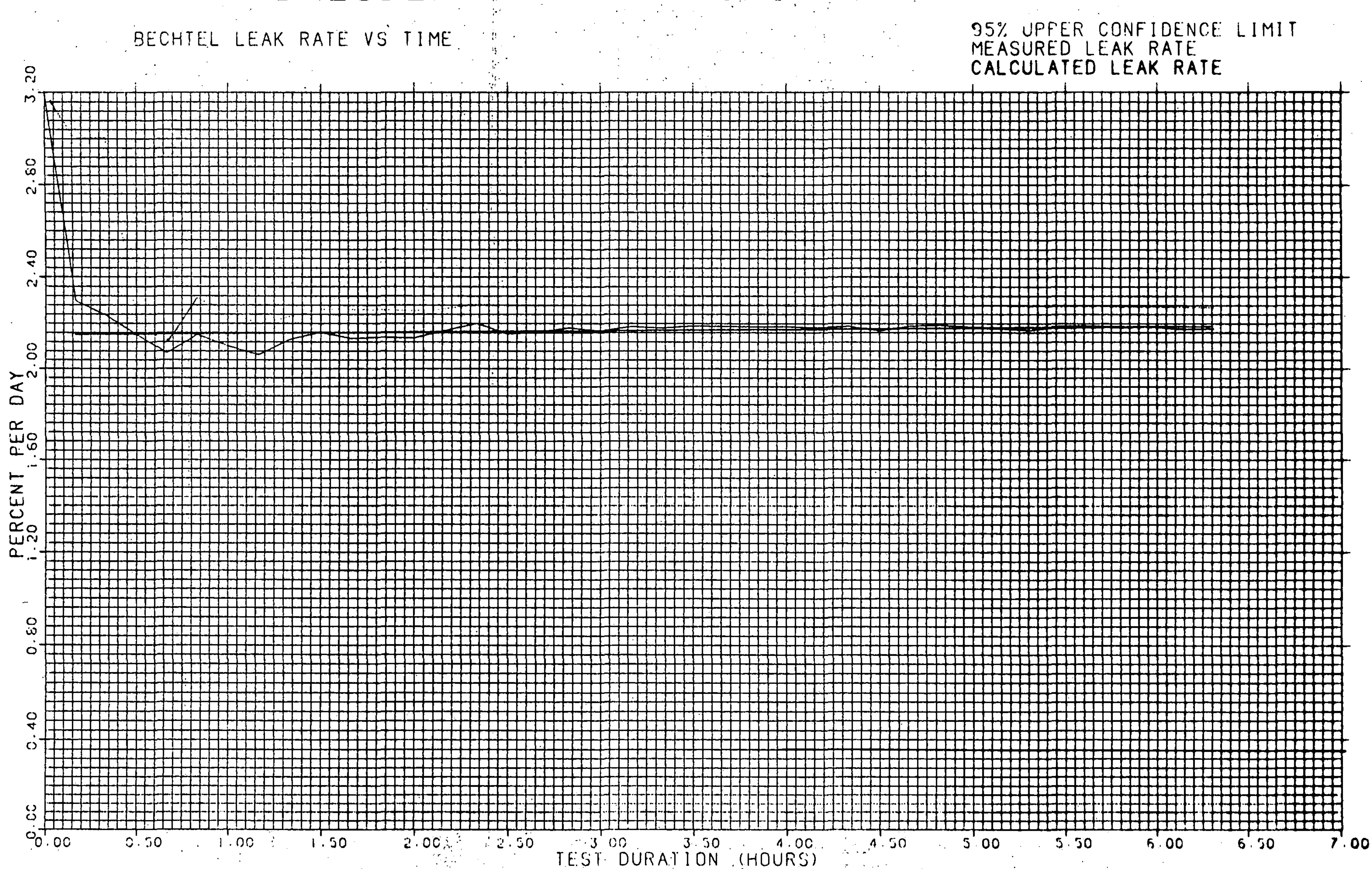
DRESDEN
UNIT 3
BECHTEL LEAK RATE VS TIME
95% UPPER CONFIDENCE LIMIT
MEASURED LEAK RATE
CALCULATED LEAK RATE
PERCENT PER DAY
3.20
2.80
2.40
2.00
1.60
1.20
0.80
0.40
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
5.50
6.00
6.50
7.00
TEST DURATION (HOURS)

VERIFICATION PHASE II

**** BECHTEL CALCULATIONS FOR DATA SETS 231 THRU 269 ****

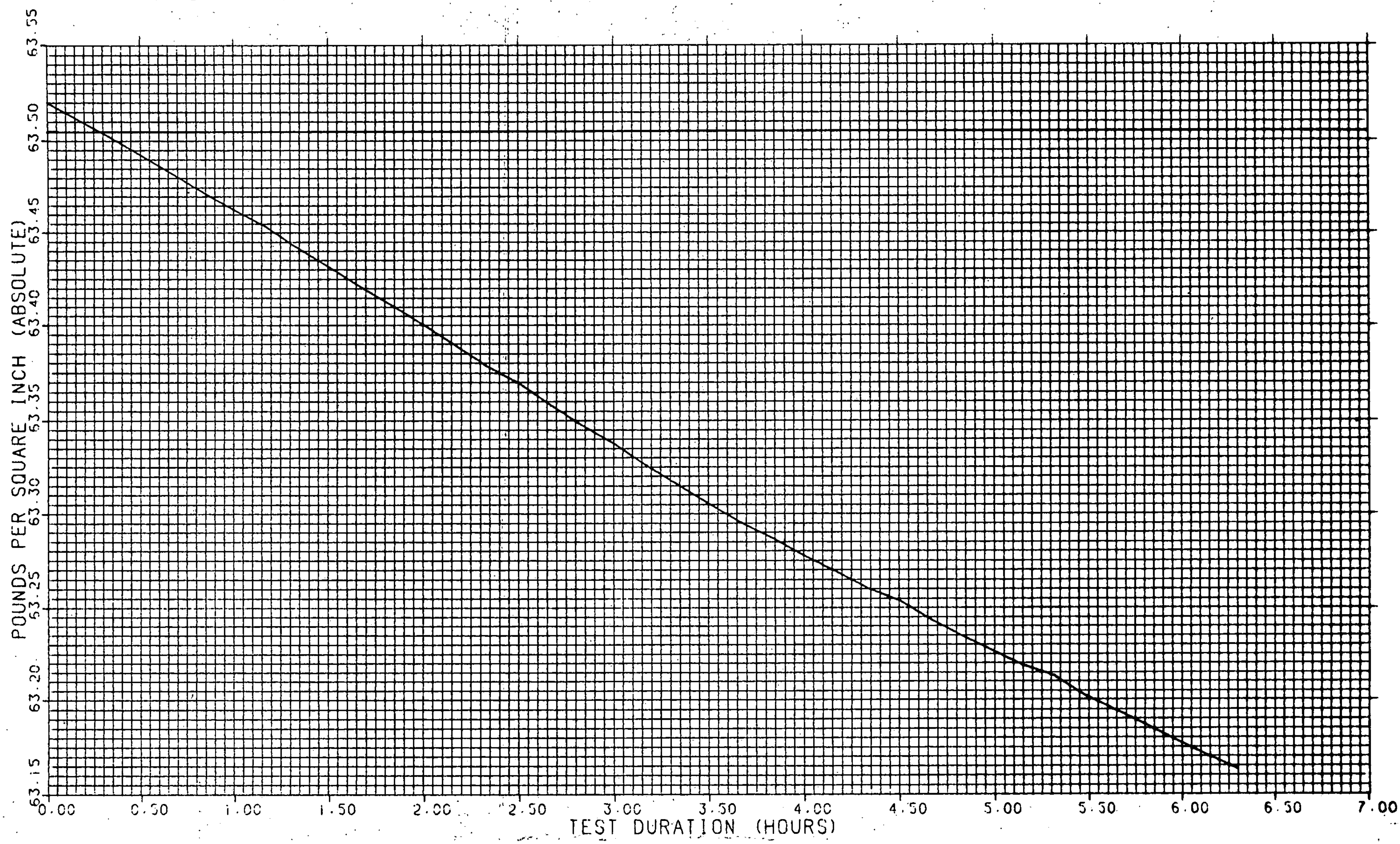
DATA SET	TEST DURATION (HRS)	TAPE TIME	TEMP (R)	DRY AIR PRESSURE (PSIA)	WATER LEVEL (IN)	MEAS LEAK RATE % / DAY	CALC LEAK RATE % / DAY	95% UPPER CONFIDENCE LIMIT
231	0.000000	10:02:14	564.59570	62.82247	44.21000	0.0000	0.0000	0.0000
232	0.166016	10:12:12	564.60779	62.81403	44.24001	2.2951	2.1493	3.0000
233	0.333008	10:22:13	564.62158	62.80503	44.06999	2.2307	2.1503	3.0000
234	0.500000	10:32:14	564.62610	62.79601	43.93001	2.1471	2.1513	2.2267
235	0.666016	10:42:12	564.62537	62.78667	43.71999	2.0681	2.1522	2.1033
236	0.833008	10:52:13	564.63379	62.77564	43.53000	2.1483	2.1532	2.3058
237	1.000000	11:02:14	564.64209	62.76752	43.38000	2.0991	2.1542	2.2497
238	1.166016	11:12:12	564.63782	62.75829	43.25001	2.0604	2.1551	2.1946
239	1.333008	11:22:13	564.63721	62.74601	43.10999	2.1273	2.1561	2.2244
240	1.500000	11:32:14	564.64294	62.73582	43.05999	2.1582	2.1571	2.2590
241	1.666016	11:42:12	564.63769	62.72626	42.94000	2.1321	2.1580	2.2563
242	1.833008	11:52:13	564.63696	62.71612	42.85999	2.1371	2.1590	2.2551
243	2.000000	12:02:14	564.63330	62.70591	42.75999	2.1343	2.1600	2.2515
244	2.166016	12:12:12	564.63904	62.69520	42.70999	2.1654	2.1609	2.2614
245	2.333008	12:22:13	564.63672	62.68302	42.61999	2.1964	2.1619	2.2805
246	2.500000	12:32:14	564.63721	62.67564	42.50000	2.1516	2.1628	2.2763
247	2.666016	12:42:12	564.63318	62.66508	42.45000	2.1582	2.1638	2.2742
248	2.833008	12:52:13	564.62976	62.65337	42.37999	2.1780	2.1648	2.2777
249	3.000000	13:02:14	564.62805	62.64412	42.26000	2.1630	2.1657	2.2757
250	3.166016	13:12:12	564.62305	62.63173	42.13999	2.1832	2.1667	2.2787
251	3.333008	13:22:13	564.62341	62.62231	42.06000	2.1764	2.1677	2.2789
252	3.500000	13:32:14	564.61706	62.61157	42.10000	2.1850	2.1686	2.2806
253	3.666016	13:42:12	564.61670	62.60186	42.06998	2.1849	2.1696	2.2816
254	3.833008	13:52:13	564.62830	62.59404	42.10000	2.1825	2.1706	2.2816
255	4.000000	14:02:14	564.63196	62.58494	42.12000	2.1834	2.1715	2.2815
256	4.166016	14:12:12	564.63757	62.57658	42.11001	2.1781	2.1725	2.2803
257	4.333008	14:22:13	564.64319	62.56697	42.12000	2.1849	2.1734	2.2801
258	4.500000	14:32:14	564.64783	62.56046	42.13999	2.1645	2.1744	2.2770
259	4.666016	14:42:12	564.65552	62.54952	42.15999	2.1851	2.1754	2.2769
260	4.833008	14:52:13	564.67517	62.54172	42.15999	2.1885	2.1763	2.2770
261	5.000000	15:02:14	564.67981	62.53369	42.15000	2.1802	2.1773	2.2760
262	5.144531	15:10:54	564.69311	62.52751	42.13999	2.1754	2.1781	2.2742
263	5.311523	15:20:56	564.70508	62.52096	42.19998	2.1661	2.1791	2.2717
264	5.478516	15:30:57	564.71667	62.50980	42.18999	2.1865	2.1801	2.2716
265	5.644531	15:40:54	564.72803	62.50138	42.17999	2.1872	2.1810	2.2714
266	5.811523	15:50:56	564.74060	62.49419	42.15000	2.1796	2.1820	2.2704
267	5.978516	16:00:57	564.75305	62.48560	42.18999	2.1840	2.1830	2.2698
268	6.144531	16:10:54	564.75378	62.47789	42.15000	2.1720	2.1839	2.2681
269	6.311523	16:20:56	564.78210	62.47124	42.15999	2.1739	2.1849	2.2667

DRESDEN UNIT 3



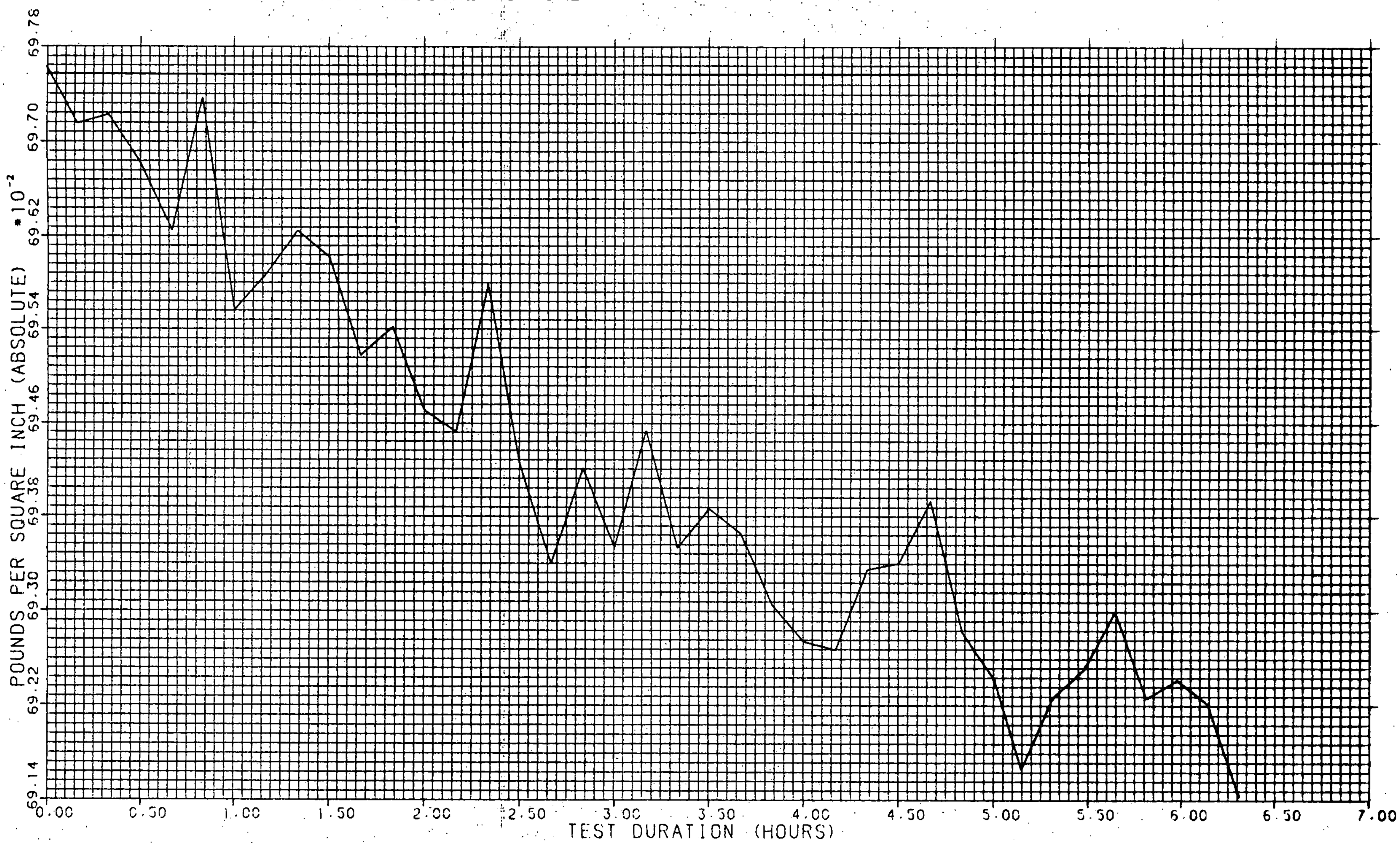
DRESDEN UNIT 3

TOTAL CONTAINMENT PRESSURE VS TIME



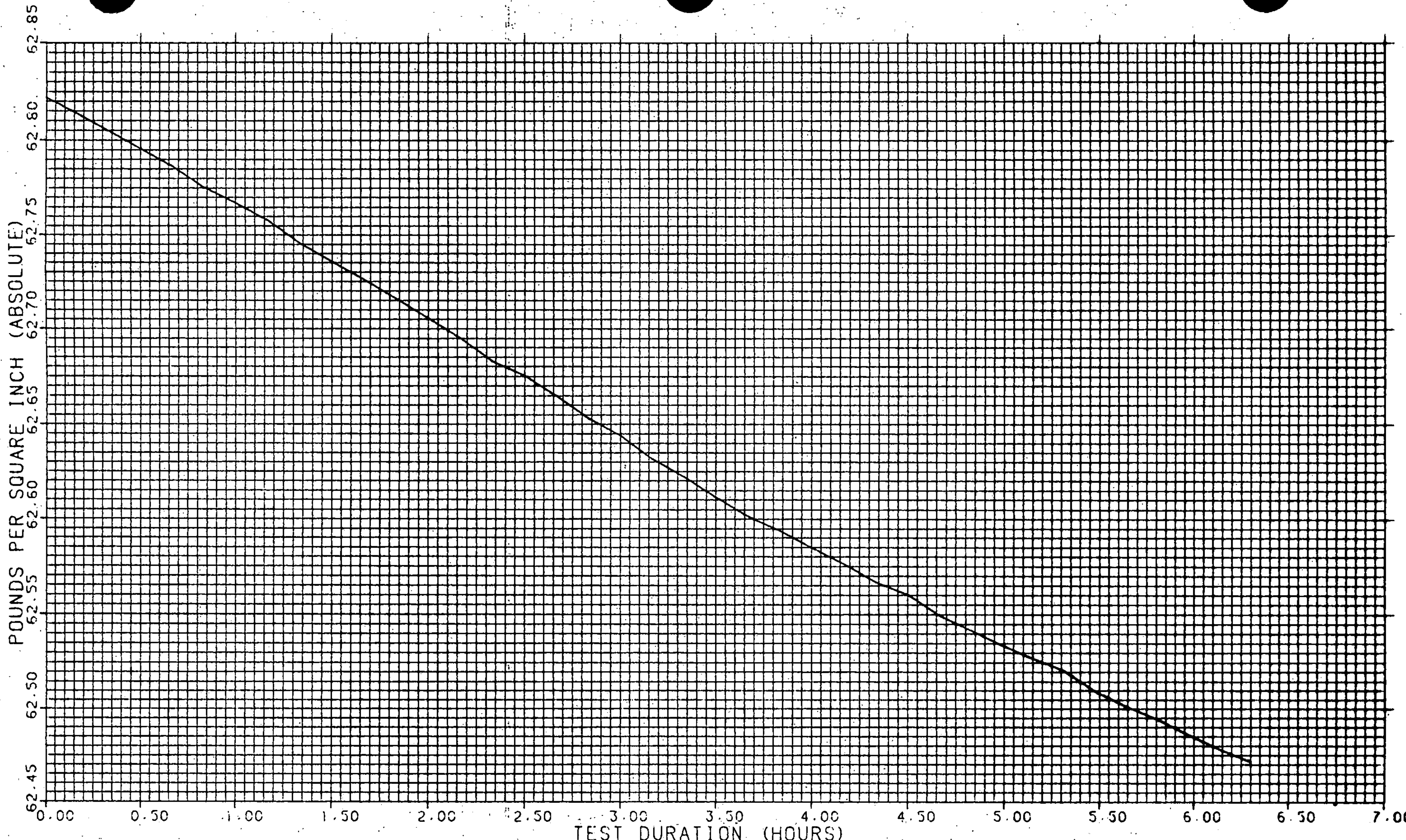
DRESDEN UNIT 3

CONTAINMENT VAPOR PRESSURE VS TIME

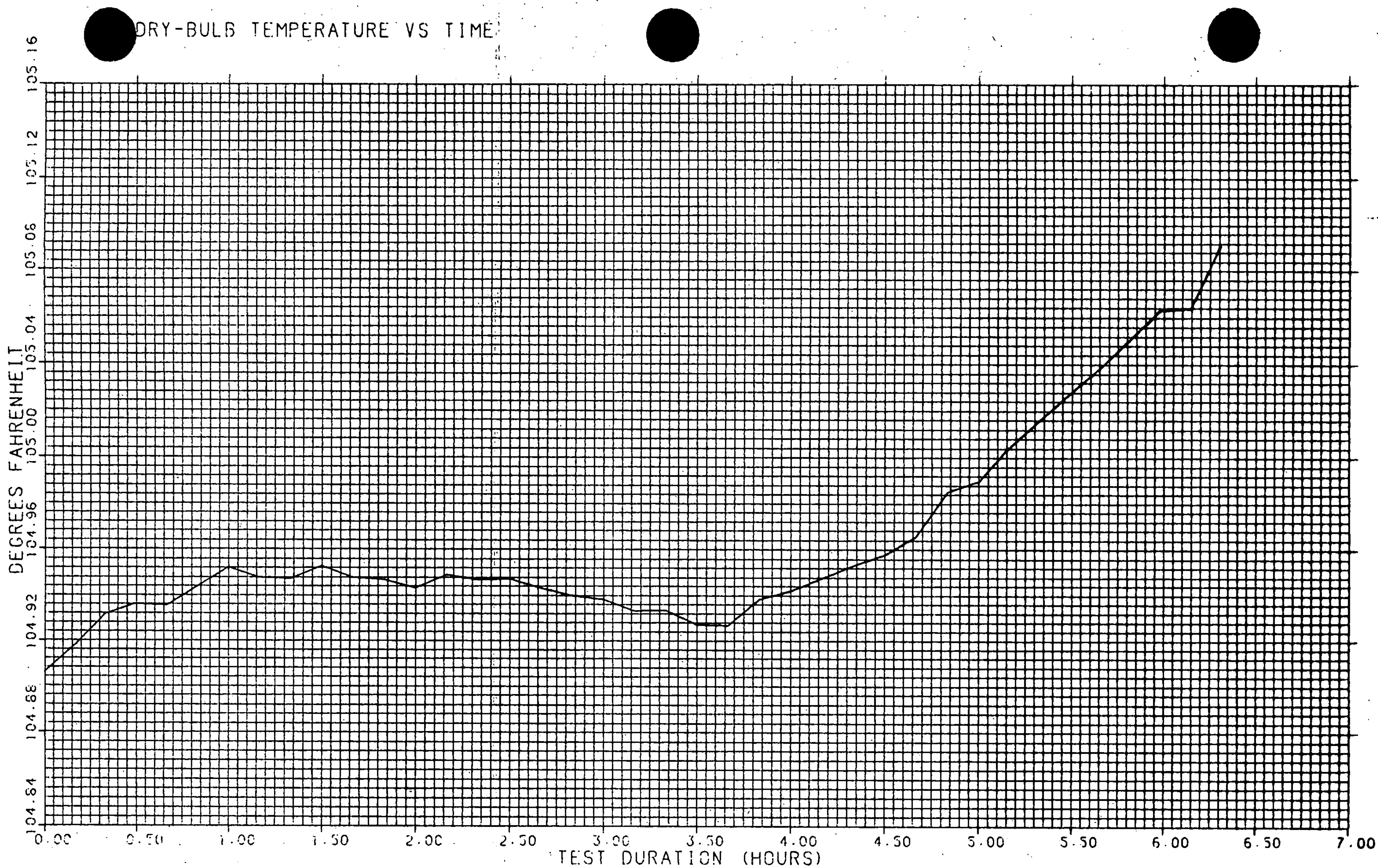


DRESDEN UNIT 3

CONTAINMENT DRY AIR PRESSURE VS TIME

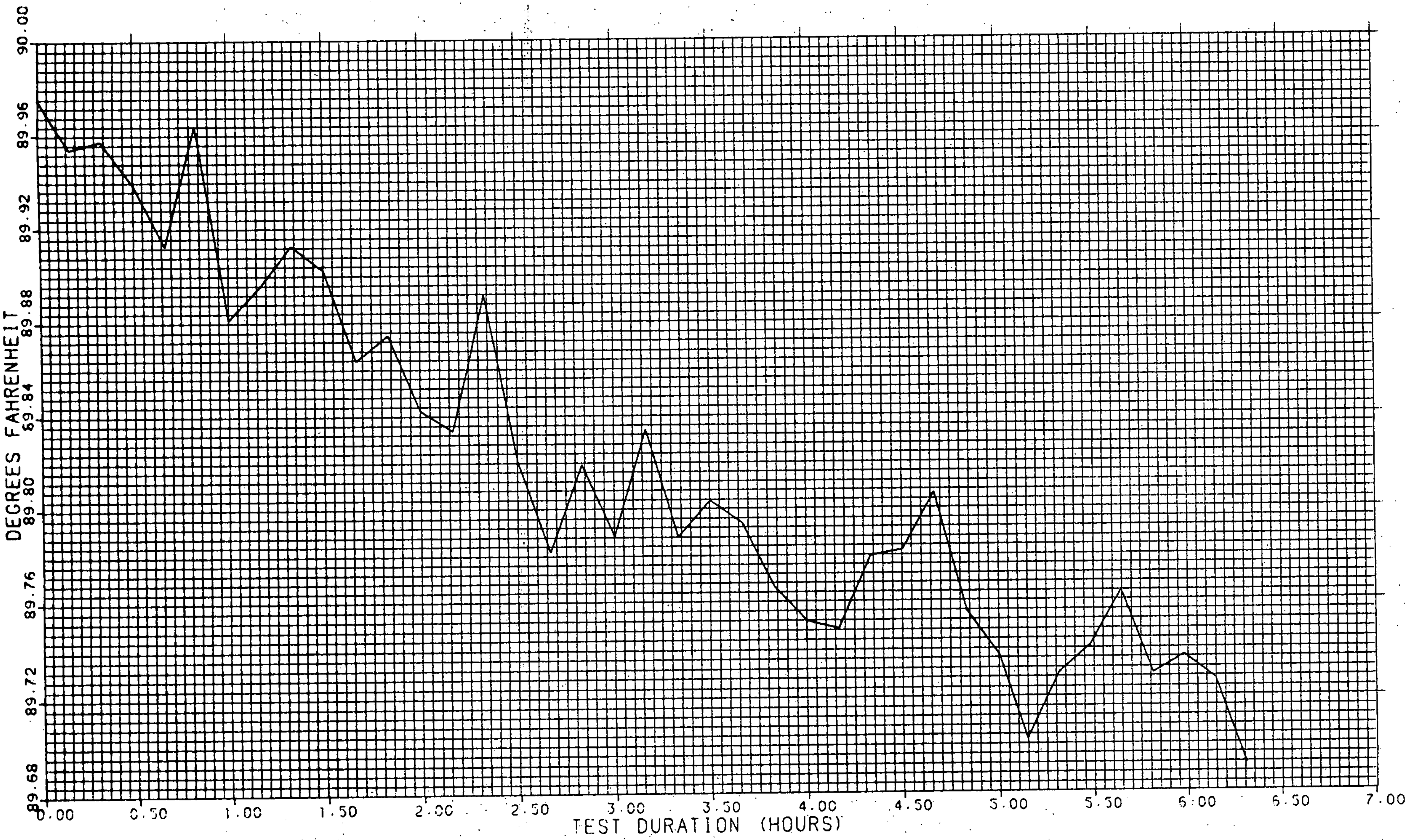


DRESDEN UNIT 3



DRESDEN UNIT 3

DEW POINT TEMPERATURE VS TIME



APPENDIX C

TYPE "B" AND "C" TEST RESULTS
UNIT 3 1986 REFUELING OUTAGE

1985-1986 UNIT 3 OUTAGE

TO: D. J. Scott

Jesw 9/1/86

SUBJECT: Unit 3 Primary Containment Local Leak Rate Testing During the 1985-1986 Refueling Outage

Unit 3 entered its 1985-1986 refueling outage with a total initial or "as found" leak rate from the primary containment of 3878.590 SCFH for Type B and C testing which exceeds the Technical Specification limit of 493.116 SCFH (493.116 SCFH = 60% La). The final or "as left" leak rate from all the Type B and C testable penetrations, isolation valves, and double gasketed seals is 408.549 SCFH, which is 82.85% of the Technical Specification limit. The Type A containment leak prior to startup is 60.24% of the Technical Specification allowable operational containment leak rate, Lam (616.39 SCFH = .75 La). The Type A "as found" containment leak rate, prior to shutdown, was 454.655 SCFH which is 73.76% of the Technical Specification limit for Lam. Reportable through leakage for Type B and C testing is calculated using Maximum Pathway methods. Correcting for Type A "as found" and "as left" leakage, the Minimum Pathway method is used. Maximum Pathway method entails reporting leakage assuming a complete failure of the best valve in the test volume. Minimum Pathway method entails reporting leakage assuming the leakage is equal to that past the best valve in the test volume.

Type of Test	Minimum-Maximum Pathway (SCFH)
B&C As Found	3878.590
B&C As Left	408.549
Nonvented Add-Ons	35.724
Type A As Found	454.655
Type A As Left	371.300

TEST RESULTS

Seven initial local leak rate test results were greater than or equal to the recommended limit of 30.82 SCFH (3.75% of La). Only one of the seven initial test failures exceeded the Technical Specification limit of 493.116 SCFH for type "B" and "C" testing of all testable penetrations combined. This test failure was caused by excessive leakage (3026.35 SCFH) past RV-3-8526 in the Nitrogen Makeup line. Investigation found that teflon tape, used on the threads of the pipe connected to RV-3-8526 had become unwrapped and lodged on the seat of the valve preventing RV-3-8526 from seating properly. Safety significance was minimal because RV-3-8526 is bounded by primary containment isolation valves A03-1601-57,58 and 59. These other in-line isolation valves showed no significant leakage during the test. Therefore, the "through" leakage past these valves was minimal. The leakage past RV-3-8526 accounted for 78% of the total type "B" and "C" "as found" leakage. This test failure is documented in Reportable Occurrence 85-021 on Docket #050-249.

Maintenance was performed on the equipment involved in these test failures and the final test results for each individual local leak rate test failure and the cause of the failure are shown in Table 2.

TEST PROCEDURE

The drywell bellows seals were tested using the permanently installed flow make-up stations. The electrical penetrations were tested using a flow make-up leak rate monitor. The remainder of all tests were performed using the pressure decay method. The local leak rate equipment, including the permanently installed bellow seals flow make-up stations, were calibrated throughout the outage.

LLRT TEST VOLUME CHANGE ASSOCIATED WITH RPR ACTIVITIES

During the Unit 3 Pipe Replacement Project, several local leak rate test lines were removed and replaced with new piping. This resulted in changes to the calculated test volume of these lines. The table below outlines the extent of the changes made to the calculated volume of the local leak rate test lines replaced during the pipe replacement project.

SYSTEM	Volume Tested	Previous Test Volume	New As-Built Test Volume
		(All units in Ft^3)	
Cleanup (1200)	3-1201-1,1A,2&3	37.19	24.75
Isolation Condenser (1300)	3-1301-3&4	20.30	29.47
LPCI (A) (1500)	3-1501-25A&26A	33.50	23.62
LPCI (A) (1500)	3-1501-22A,26A, 1001-5A	41.866	46.00
LPCI (B) (1500)	3-1501-25B&26B	25.133	24.05
LPCI (B) (1500)	3-1501-22B,26B & 1001-5B	41.866	47.20

Also, during the pipe replacement project, the control rod drive (CRD) return line (including inboard check valve 3-0301-98) to the reactor vessel was permanently removed from inside primary containment. The reactor vessel nozzle was capped at the safe-end and the containment penetration was capped on the inboard side. Outside primary containment, the pipe was cut and caps were installed on the segment protruding from the containment penetration and on the line downstream of the outboard check valve 3-0301-95. This deleted CRD valve 3-0301-98, and isolated CRD valve 3-0301-95 from primary containment. Therefore, these valves no longer serve as primary containment isolation valves and will no longer be leak tested per Appendix J.

Prepared by (signature) (F.r)
B. McCabe
Technical Staff Engineer

Approved by (signature)
J. Achterberg
Technical Staff Supervisor

cc: J. Brunner
J. Achterberg
J. Kotowski
R. Stachniak
B. McCabe
File/T.S. File,LLRT

Appendix A

Dreden Unit 3 LLRT Summary (all units in SCFH)

As Found	3878.590
As Left	408.549
Back Correction for ILRT	83.355

Maximum Allowable Leak Rate (La)

1.6 wt.%/Day = 821.857 SCFH

Allowable Operational Containment Leak Rate (.75La)

1.2 Wt.%/Day - 616.392 SCFH

Type B and C Containment Leak Rate (.6 La)

.96 Wt.%/Day = 493.116 SCFH

Percent of Limit for Type B and C Testing Prior to Shutdown:

$$\frac{3878.590}{493.116} = 786.5\%$$

Percent of Limit for Type B and C Testing Prior to Startup:

$$\frac{408.549}{493.116} = 82.85\%$$

LLRT Not Drained and Vented During ILRT (all units in SCFH)

'A' Feedwater	0.0
'B' Feedwater	0.7178
Shutdown Cooling	3.3174
SBLC	6.01
Cleanup	0.0
Isolation Condenser	1.353
'A' Core Spray	1.828
'B' Core Spray	1.221
'A' LPCI	12.372
'B' LPCI	3.651
Primary Sample	0.017
Drywell Cam	3.956
HPCI Suction	1.281
TOTAL	35.724

			SCFH
ILRT Result (1986)	0.6533 Wt.%/Day	=	335.576
LLRT Not Drained or Vented during ILRT		=	35.724
Total Containment Leak Rate Prior to Startup		=	371.300
LLRT Back Correction		=	83.355
Total Containment Leak Rate Prior to Shutdown		=	454.655

Percent of Limit for Type A Testing Prior to Shutdown:

$$\frac{454.655}{616.392} = 73.76\%$$

Percent of Limit for Type A Testing Prior to Startup:

$$\frac{371.300}{616.392} = 60.24\%$$

Table 1

Dresden Unit 3 Local Leak Rate Test Summary

	INITIAL	FINAL
MSIV's	6.672	9.654
Isolation Valves	3727.932	305.868
Electrical Pen.	96.704	73.160
Bellows Seals	42.238	10.022
Double Gask.	5.044	9.845
TOTAL	3878.590	408.549

Table 2

Dresden Unit 3 Local Leak Rate Test Failures

Valves or Penetration	Initial Leakage (SCFH)	Final Leakage (SCFH)	Cause of Failure	Corrective Action
MO 3-220-2	54.328	1.736	Packing Leak	Replaced Packing
3-220-58A	250.570	0.0	Worn Seat	Replaced Valve
AO 3-1601-21	55.287	27.601	Worn Seat to Disc.Clearance	Replaced Valve
RV 3-8526	3026.35	1.239	Teflon Tape on Valve Seat	Cleaned Seat
3-2599-23B	38.8	0.0	Check Valve Hung up - Open	Lubricated Shaft and Cleaned Valve
Electrical Penetration X-204L	31.83	8.286	Inner Drywell Seal Leak	Applied Sealant
CRD Return Bellows X-109B	32.0	0.0	Outer Bellows Seal Leak	Cut Line out and capped inside Drywell

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3
REFUELING OUTAGE OF 1985-1986

TYPE OF PENETRATION: MSIVs

Test Number	Penetration Number	Volume Being Tested	Type B and Type C Testing				Type A Testing			
			Initial Measured Leak Rate	Valve(s) Repaired	Initial Reported Leakage	Final Measured Leak Rate	Final Reported Leakage	As Found Leakage	As Left Leakage	Back Correction
1	105A	203-1A&203-2A	2.66	Repacked Both	2.66	5.566	5.566	1.33	2.783	0
2	105B	203-1B&203-2B	2.72	Repacked Both	2.72	2.747	2.747	1.36	1.374	0
3	105C	203-1C&203-2C	1.292	Repacked Both	1.292	0.0	0.0	0.646	0.0	0.646
4	105D	203-1D&203-2D	0.0	Repacked Both	0.0	1.341	1.341	0.0	0.671	0
	TOTALS				6.672		9.654	3.336	4.828	0.646

LOCAL LEAK RATE TESTS P[illegible]ORMED DURING THE UNIT 3 REFUELING OU[illegible] OF 1985-1986

TYPE OF PENETRATION: Primary Containment Isolation Valves

Test Number	Penetration Number	Volume Being Tested	Type B and Type C Testing: Initial Measured Leak Rate	Valve(s) Repaired	Initial Reported Leakage	Final Measured Leak Rate	Final Reported Leakage	Type A Testing: As Found Leakage	As Left Leakage	Back Correctio
5	X-147	205-2-4&flange	17.916	NA	17.916	17.916	17.916	-	-	-
6	X-147	205-2-7& flange	1.2424	NA	-	-	-	1.2424	1.2424	0
7	X-106	220-1&2	54.328	220-2	54.328	1.736	1.736	1.736	0.868	0.868
8	X-122	220-44&45	.033	NA	.033	.033	.033	0.017	0.017	0
9	X-107A	220-57A&58A	250.57	220-58A	250.57	0.0	0.0	-	0.0	-
10	X-107A	220-57A&62A	10.85	NA	-	10.85	10.85	10.85	-	10.85
11	X-107B	220-57B&58B	0.7178	NA	-	-	-	0.7178	0.7178	0
12	X-107B	220-57B&62B	4.577	NA	4.577	4.577	4.577	-	-	-
13	NA	302-156A&157A	3.822	NA	3.822	3.822	3.822	1.911	1.911	0
14	NA	301-160A&161A	0.1929	NA	0.1929	0.1929	0.1929	0.096	0.096	0
15	NA	301-156B&157B	3.58	NA	3.58	3.58	3.58	1.790	1.790	0
16	NA	301-160B&161B	5.368	NA	5.368	5.368	5.368	2.684	2.684	0
17	X-109B	301-95&99	0.8449	Line Removed RPR	–	0*	0*	0.8449	0	0.8449
18	X-109B	301-98&99	1.714	Line Removed RPR	1.714	0*	0*	-	-	-
19	X-111A,111B	1001-1A,1B,2A,2B&2C	17.676	RPR Work 1001-1A-1B	17.676	6.347	6.347	8.838	3.174	5.664
20	X-138	1101-1&15	6.01	NA	-	-	-	6.01	6.01	0
21	X-138	1101-1&16	11.81	NA	11.81	11.81	11.81	-	-	-
22	X-113	1201-1,1A,2&3	4.207	RPR	4.207	0.0	0.0	2.104	0	2.104
23	X-108A	1301-1&2	0.9365	NA	0.9365	0.9365	0.9365	0.4683	0.4683	0
24	X-109A	1301-3&4	17.311	RPR 1301-3,4	17.311	2.706	2.706	8.655	1.353	7.302
25	X-108A,109A	1301-17&20	1.742	NA	1.742	1.742	1.742	0.871	0.871	0
26	X-310A	1402-4A,8A,25A,36A	3.44	NA	3.44	3.44	3.44	1.72	1.72	0
27	X-149A	1402-24A&25A	0.2156	NA	0.2156	0.2156	0.2156	0.1078	0.1078	0
		*Line Removed								
		PAGE TOTALS			399.439		75.272	50.663	23.030	27.633

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1985-1986

TYPE OF PENETRATION: Primary Containment Isolation Valves

Test Number	Penetration Number	Volume Being Tested	Type B and Type C Testing					Type A Testing		
			Initial Measured Leak Rate	Valve(s) Repaired	Initial Reported Leakage	Final Measured Leak Rate	Final Reported Leakage	As Found Leakage	As Left Leakage	Back Correction
28	X-310B	1402-4B,8B,25B,36B	1.821	NA	1.821	1.821	1.821	0.911	0.911	0
29	X-149B	1402-24B&25B	0.6193	NA	0.6193	0.6193	0.6193	0.310	0.310	0
30	X-311A	1501-18A&19A	4.534	NA	4.534	4.534	4.534	2.267	2.267	0
31	X-311B	1501-18B&19B	0.5917	NA	0.5917	0.5917	0.5917	0.296	0.296	0
32	X-310B	1501-20B&38B	1.294	NA	1.294	1.294	1.294	0.647	0.647	0
33	X-310A	1501-20A&38A	1.94	NA	1.94	1.94	1.94	0.970	0.970	0
34	X-116A	1501-22A,26A,1001-5A	4.824	RPR 1501-22A	-	10.699	10.699	4.824	-	-
35	X-116A	1501-25A&26A	8.722	RPR 1501-25A	8.722	7.998	-	-	7.998	0
36	X-116B	1501-25B&26B	12.06	RPR 1501-25B	12.06	21.973	21.973	-	-	-
37	X-116B	1501-22B,26B,1001-5B	2.049	RPR 1501-22B	-	2.310	-	2.049	2.310	0
38	X-145	1501-27A&28A	2.273	NA	2.273	2.273	2.273	1.137	1.137	0
39	X-150A	1501-27B&28B	0.7959	NA	0.7959	0.7959	0.7959	0.398	0.398	0
40	NA	1599-61&62	2.762	NA	2.762	2.762	2.762	1.381	1.381	0
41	X-304	1601-20A&31A	GRIT 4.323	NA	4.323	3.394	3.394	2.162	1.697	.465
42	X-304	1601-20B&31B	GRIT 11.28	NA	11.28	15.951	15.951	5.64	7.975	0
43	X-126,304	1601-21,22,55,56 8502-500	55.287	GRIT-1601-56 1601-21 Replaced	55.287	27.601	27.601	27.643	13.80	13.842
44	X-125,318	1601-23,24,60,61,62,63	29.827	GRIT Removed NA	29.827	12.583	12.583	14.914	6.292	8.622
45	X-126,304	1601-57,58,59	3026.35	RV3-8526	3026.35	1.239	1.239	1.239	0.6195	0.6195
46	X-313A	1699-63A& Flange	0.044	NA	0.044	0.044	0.044	0.022	0.022	0
47	X-313B	1699-63B & Flange	0.928	NA	0.928	0.928	0.928	0.464	0.464	0
48	X-316A	1699-73A & Flange	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
49	X-304	1699-73B & Flange	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
50	X-118	2001-5&6	1.482	NA	1.482	1.482	1.482	0.741	0.741	0
		PAGE TOTALS			3166.934		112.525	68.015	50.236	23.549

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3
REFUELING OUTAGE OF 1985-1986

TYPE OF PENETRATION: Primary Containment Isolation Valves

Test Number	Penetration Number	Volume Being Tested	Type B and Type C Testing					Type A Testing		
			Initial Measured Leak Rate	Valve(s) Repaired	Initial Reported Leakage	Final Measured Leak Rate	Final Reported Leakage	As Found Leakage	As Left Leakage	Back Correction
51	X-117	2001-105&106	0.203	NA	0.203	0.203	0.203	0.102	0.102	0
52	X-128	2301-4&5	3.44	NA	3.44	3.44	3.44	1.72	1.72	0
53	X-312	2301-34&71	0.9925	NA	0.9925	0.9925	0.9925	0.4963	0.4963	0
54	NA	2301-35&36	1.437	NA	1.437	1.437	1.437	0.7185	0.7185	0
55	X-317	2301-45&74	2.562	NA	2.562	2.562	2.562	1.281	1.281	0
56	X-202V	2499-1A&2A	1.903	NA	1.903	1.903	1.903	0.9515	0.9515	0
57	X-204B	2499-1B&2B	0.3278	NA	0.3278	0.3278	0.3278	0.1639	0.1639	0
58	X-316A	2499-3A&4A	0.6078	NA	0.6078	0.6078	0.6078	0.3039	0.3039	0
59	X-316B	2499-3B&4B	0.545	NA	0.545	0.545	0.545	0.2725	0.2725	0
60	X-202V	2599-2A&23A	1.62	NA	1.62	1.62	1.62	0.81	0.81	0
61	X-204B	2599-2B&23B	38.80	2599-23B	38.80	0.0	0.0	0.0	0.0	0
62	X-316A	2599-3A&24A	3.207	NA	3.207	3.207	3.207	1.604	1.604	0
63	X-316B	2599-3B&24B	5.92	NA	5.92	5.92	5.92	2.96	2.96	0
64	X125,318	2599-4A&5A	14.01	NA	14.01	14.01	14.01	7.005	7.005	0
65	X-125,318	2599-4B&5B	4.02	NA	4.02	4.02	4.02	2.01	2.01	0
66	X-123	3702&3799-126	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
67	X-124	3703&3706	22.265	Repacked 3703	22.265	17.637	17.637	11.133	8.819	2.314
68	X-139D	4720&4721	2.62	NA	2.62	2.62	2.62	1.31	1.31	0
69	X-121	4722 & Check	1.949	NA	1.949	1.949	1.949	0.975	0.975	0
70	X-101	9207A & End	3.146	NA	3.146	3.146	4.146	-	-	-
71	X-101	9207B & End	1.65	NA	-	-	-	1.65	1.65	0
72	X-101	9208A & End	2.306	NA	-	-	-	2.306	2.306	0
73	X-101	9208B & End	4.345	NA	4.345	4.345	4.345	-	-	-
		PAGE TOTALS			113.980		70.492	37.773	35.459	2.314

LOCAL LEAK RATE TESTS P[illegible]ORMED DURING THE UNIT 3
REFUELING O[illegible] OF 1985-1986

TYPE OF PENETRATION: Primary Containment Isolation Valves

			Type B and Type C Testing					Type A Testing		
Test Number	Penetration Number	Volume Being Tested	Initial Measured Leak Rate	Valve(s) Repaired	Initial Reported Leakage	Final Measured Leak Rate	Final Reported Leakage	As Found Leakage	As Left Leakage	Back Correctio
74	X-313A	E.Torus Drain Vlvs	0.1991	NA	0.1991	0.1991	0.1991	0.996	0.0996	0
75	X-313B	W.Torus Drain Vlvs	0.2109	NA	0.2109	0.2109	0.2109	0.1055	0.1055	0
76	X-136J	Tip Valve A	1.20	NA	1.20	1.20	1.20	1.20	1.20	0
77	X-136F	Tip Valve B	2.535	NA	2.535	2.535	2.535	2.535	2.535	0
78	X-136E	Tip Valve C	0.599	NA	0.599	0.599	0.599	0.599	0.599	0
79	X-136H	Tip Valve D	0.627	NA	0.627	0.627	0.627	0.627	0.627	0
80	X-136E	Tip Valve E	0.214	NA	0.214	0.214	0.214	0.214	0.214	0
81	X-309A	8501-1A & End	0.199	NA	-	-	-	0.199	0.199	0
82	X-309A	8501-1B & End	0.206	NA	0.206	0.206	0.206	-	-	-
83	X-204	8501-3A & 3B	9.213	NA	9.213	9.213	9.213	4.607	4.607	0
84	X-143	8501-5A & End	0.212	NA	-	-	-	0.212	0.212	0
85	X-143	8501-5B & End	0.244	NA	0.244	0.244	0.244	-	-	-
86	X-143	9205A & End	1.615	NA	1.615	1.615	1.615	-	-	-
87	X-143	9205B & End	0.581	NA	-	-	-	0.581	0.581	0
88	X-143	9206A & End	1.122	NA	-	-	-	1.122	1.122	0
89	X-143	9206B & End	1.454	NA	1.454	1.454	1.454	-	-	-
90	X-101	Personnel Airlock	25.117	NA	25.117	25.117	25.117	12.559	12.559	0
91	X-136E	Purge Chk Valve(Tip)	4.145	NA	4.145	4.145	4.145	4.145	4.145	0
		PAGE TOTALS			47.579		47.579	28.805	28.805	0

LOCAL LEAK RATE TESTS PE[illegible]RMED DURING THE UNIT 3
REFUELING OUT[illegible]F 1985-1986

TYPE OF PENETRATION: Electrical Penetrations

Test Number	Penetration Number	Volume Being Tested	Type B and Type C Testing: Initial Measured Leak Rate	Valve(s) Repaired	Initial Reported Leakage	Final Measured Leak Rate	Final Reported Leakage	Type A Testing: As Found Leakage	As Left Leakage	Back Correction
92	X-200C	LV Power & Control	10.105	NA	10.105	10.105	10.105	5.053	5.053	0
93	X-201B	HV Power	6.063	NA	6.063	6.063	6.063	3.032	3.032	0
94	X-202B	CRD Indication	0	NA	0	0	0	0	0	0
95	X-202BB	CRD Indicator	2.627	NA	2.627	2.627	2.627	1.314	1.314	0
96	X-202D	HV Power	0	NA	0	0	0	0	0	0
97	X-202F	Thermocouples	10.105	NA	10.105	10.105	10.105	5.053	5.053	0
98	X-202J	Neutron Monitor	0	NA	0	0	0	0	0	0
99	X-202N	Neutron Monitor	0	NA	0	0	0	0	0	0
100	X-202Q	Instrumentation	2.021	NA	2.021	2.021	2.021	1.0105	1.0105	0
101	X-202S	CRD Indicators	0	NA	0	0	0	0	0	0
102	X-202W	CRD Indicators	5.053	NA	5.053	5.053	5.053	2.527	2.527	0
103	X-203B	HV Power	3.234	NA	3.234	3.234	3.234	1.617	1.617	0
104	X-204A	HV Power	1.516	NA	1.516	1.516	1.516	0.758	0.758	0
105	X-204E	Newtron Monitor	0	NA	0	0	0	0	0	0
106	X-204H	Neutron Monitor	2.627	NA	2.627	2.627	2.627	1.314	1.314	0
107	X-204L	Power & Ground	31.83	Inner Boundary	31.83	8.286	8.286	15.92	4.143	11.78
108	X-204M	LV Power	2.526	NA	2.526	2.526	2.526	1.263	1.263	0
109	X-204N	CRD Indicator	2.021	NA	2.021	2.021	2.021	1.011	1.011	0
110	X-204Q	CRD Indicator	2.627	NA	2.627	2.627	2.627	1.314	1.314	0
111	X-204S	LV Power & Control	12.126	NA	12.126	12.126	12.126	6.063	6.063	0
112	X-205B	CRD Indicator	2.223	NA	2.223	2.223	2.223	1.112	1.112	0
		TOTAL			96.704		73.160	48.362	36.585	11.78

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1985-1986

TYPE OF PENETRATION: Drywell Bellow Seals

			Type B and Type C Testing					Type A Testing		
Test Number	Penetration Number	Volume Being Tested	Initial Measured Leak Rate	Valve(s) Repaired	Initial Reported Leakage	Final Measured Leak Rate	Final Reported Leakage	As Found Leakage	As Left Leakage	Back Correctio
113	X-105A	Main Steam	3.974	NA	3.974	3.974	3.974	1.987	1.987	0
114	X-105B	Main Steam	0.0	NA	0.0	0.0	0.0	0.0	0.0	-
115	X-105C	Main Steam	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
116	X-105D	Main Steam	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
117	X-106	Main Steam Drain	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
118	X-107A	Feedwater	0.864	NA	0.864	0.864	0.864	0.432	0.432	0
119	X-107B	Feedwater	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
120	X-108A	Iso.Cond. Steam	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
121	X-109A	Iso.Cond. Condensate	0.0	RPR Removal & Replace	0.0	0.0	0.0	0.0	0.0	0
122	X-111A	Shutdown Cooling	3.024	NA	3.024	3.024	3.024	1.512	1.512	0
123	X-111B	Shutdown Cooling	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
124	X-113	Cleanups	0.648	RPR Removal & Replace	0.648	0.432	0.432	0.324	0.216	0.108
125	X-128	HPCI Steam	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
126	X-116A	LPCI Injection	0.0	RPR Removal & Replace	0.0	0.0	0.0	0.0	0.0	0
127	X -116B	LPCI Injection	0.0	RPR Removal & Replace	0.0	0.0	0.0	0.0	0.0	0
128	X-123	RBCCW Inlet	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
129	X-124	RBCCW Outlet	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
130	X-125	Vent From DW	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
131	X-126	Vent to DW	0.o	NA	0.0	0.0	0.0	0.0	0.0	0
132	X-138	SBLC	0.432	NA	0.432	0.432	0.432	0.216	0.216	0
133	X-109B	CRD Return	32.0	Cut out & Capped	32.0	0.0	0.0	16.0	0.0	16.0
134	X-147	Rx Head Spray	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
135	X-149A	Core Spray	0.216	NA	0.216	0.216	0.216	0.108	0.108	0
136	X-149B	Core Spray	1.08	NA	1.08	1.08	1.08	0.54	0.54	0
		Totals			42.238		10.022	21.119	5.011	16.108

LOCAL LEAK RATE TESTS P[illegible]ORMED DURING THE UNIT 3
REFUELING OU[illegible] OF 1985-1986

TYPE OF PENETRATION: Double Gasketed Seals

Test Number	Penetration Number	Volume Being Tested	Type B and Type C Testing: Initial Measured Leak Rate	Valve(s) Repaired	Initial Reported Leakage	Final Measured Leak Rate	Final Reported Leakage	Type A Testing: As Found Leakage	As Left Leakage	Back Correctio
137	X-100	DW Equip Hatch	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
138	X-102	CRD Hatch	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
139	X-136A	Tip Flange	0.0779	NA	0.0779	0.0779	0.0779	0.0390	0.0390	0
140	X-136B	Tip Flange	0.0783	NA	0.0783	0.0783	0.0783	0.0392	0.0392	0
141	X-136C	Tip Flange	0.1093	NA	0.1093	0.1093	0.1093	0.0547	0.0547	0
142	X-136D	Tip Flange	0.125	NA	0.125	0.125	0.125	0.0625	0.0625	0
143	X-136E	Tip Flange	0.5933	NA	0.5933	0.5933	0.5933	0.2967	0.2967	0
144	X-136F	Tip Flange	0.0694	NA	0.0694	0.0694	0.0694	0.0347	0.0347	0
145	NA	DW Head	0.6909	NA	0.6909	0.163	0.163	0.3454	0.0815	.264
146	X-137	DW Head Manway	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
147	X-301F	Tor.Vac. Bkr 32A	0.072	NA	0.072	0.015	0.015	0.036	0.0075	0.029
148	X-301F	Tor.Vac. Bkr 32B	0.2249	NA	0.2249	0.0	0.0	0.1125	0.0	0.1125
149	X-301E	Tor.Vac. Bkr 32C	0.1272	NA	0.1272	0.064	0.064	0.064	0.032	0.032
150	X-301E	Tor.Vac. Bkr 32D	0.0474	NA	0.0474	2.729	2.729	0.024	1.365	0
151	X-301D	Tor.Vac. Bkr 32E	0.0	NA	0.0	0.036	0.036	0.0	0.018	0
152	X-301D	Tor.Vac. Bkr 32F	0.0992	NA	0.0992	0.015	0.015	0.0496	0.008	0.042
153	X-301A	Tor.Vac. Bkr 33A	0.2465	NA	0.2465	0.348	0.348	0.123	0.174	0
154	X-301A	Tor.Vac. Bkr 33B	0.0972	NA	0.0972	0.048	0.048	0.049	0.024	0.025
155	X-301B	Tor.Vac. Bkr 33C	0.1444	NA	0.1444	0.031	0.031	0.072	0.016	0.056
156	X-301B	Tor.Vac. Bkr 33D	0.6806	NA	0.6806	0.032	0.032	0.340	0.016	0.324
157	X-301C	Tor.Vac. Bkr 33E	0.577	NA	0.577	0.0	0.0	0.289	0.0	0.289
158	X-301C	Tor.Vac. Bkr 33F	0.4389	NA	0.4389	0.137	0.137	0.2195	0.0685	0.151
159	X-306A	E. Torus Hatch	0.0	NA	0.0	1.621	1.621	0.0	0.811	0
160	X-306B	W. Torus Hatch	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
161	X-313A	E. Torus Drain	0.0	NA	0.0	1.335	1.335	0.0	0.6675	0

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1985-1986

TYPE OF PENETRATION: Double Gasketed Seals

Test Number	Penetration Number	Volume Being Tested	Type B and Type C Testing					Type A Testing		
			Initial Measured Leak Rate	Valve(s) Repaired	Initial Reported Leakage	Final Measured Leak Rate	Final Reported Leakage	As Found Leakage	As Left Leakage	Back Correction
162	X-313B	W. Torus Drain	0.0	NA	0.0	1.675	1.675	0.0	0.8375	0
163	NA	Shear Hatch 1	0.0613	NA	0.0613	0.0613	0.0613	0.0307	0.0307	0
164	NA	Shear Hatch 2	0.1143	NA	0.1143	0.1143	0.1143	0.0572	0.0572	0
165	NA	Shear Hatch 3	0.0511	NA	0.0511	0.0511	0.0511	0.0256	0.0256	0
166	NA	Shear Hatch 4	0.1594	NA	0.1594	0.1594	0.1594	0.0797	0.0797	0
167	NA	Shear Hatch 5	0.0932	NA	0.0932	0.0932	0.0932	0.0466	0.0466	0
168	NA	Shear Hatch 6	0.0631	NA	0.0631	0.0631	0.0631	0.0316	0.0316	0
169	NA	Shear Hatch 7	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
170	NA	Shear Hatch 8	0.0	NA	0.0	0.0	0.0	0.0	0.0	0
		TOTALS			5.044		9.845	2.522	4.925	1.325

1983-1984 UNIT 3 OUTAGE

April 16, 1984

TO: D. J. Scott

SUBJECT: Unit 3 Primary Containment Local Leak Rate Testing During The 1983-1984 Refueling Outage

498.5 SCFH 2.c. 10/25/84 101.1%

Unit 3 entered its eighth refueling outage with a total initial or "as found" local leak rate from the primary containment of 596.33 SCFH, which is 72.6% of La, the maximum allowable leak rate (821.86 SCFH). See Appendix A. The initial leak rate from all testable penetrations, isolation valves, and double-gasketed seals was 449.2 SCFH, which is 91.1% of the Technical Specification limit (493.116 SCFH = 60% of La). The containment leak prior to startup was 323.48 SCFH, which is 52.5% of the Technical Specification allowable operational containment leak rate, Lam (616.39 SCFH = 75% of La).

A total of approximately 400 local leak rate tests were performed during the course of the Unit 3 outage. A summary sheet listing all test results for equipment failures is shown on Table 2.

Test Procedure

The drywell bellow seals were tested using the permanently installed flow make-up stations. The electrical penetrations were tested using a flow make-up leak rate monitor. The remainder of all tests were performed using the pressure decay method. The local leak rate equipment, including the permanently installed bellow seals flow make-up stations, were calibrated throughout the outage.

Test Results

Six initial local leak rate test results were greater than the recommended limit of 30.82 SCFH (3.75% of La). None of the six initial test failures exceeded the Technical Specification limit (493.116 SCFH) for thru leakage for all testable penetrations combined. Two of the initial failures did not merit maintenance and repair; the RBCCW discharge from drywell coolers and the electrical penetration to CRD indicators. Consequently, the initial leakage was left as the final leakage for the two test failures. The reasons for this were the difficulty involved in performing maintenance on the test volume and also the relatively low leakage rate; i.e. close to the recommended limit of 30.82 SCFH. Maintenance was performed on the equipment involved in the four other initial test failures and also on two initial leak tests which showed higher than average leakage. The results for each individual local leak rate test and a summary table of all the tests are shown on Tables 3 and 1, respectively.

It should be noted that the method used to determine thru leakage for penetration boundaries has changed. Starting with the Dresden Unit 2 1983 refueling outage, thru leakage is one-half the total volume leakage measured on any penetration. This method of calculating thru leakage is conservative and yields large leak rates when compared to previous outage test results.

Prepared by *Lawrence Coyle*
L. Coyle
Technical Staff

Approved by *[signature] for*
J. D. Brunner
Technical Staff Supervisor
Dresden Nuclear Power Station

JDB:LC:hjb

cc: R. Coen
L. Coyle
T. Ciesla
J. Brunner
File/T.S. File, LLRT

DRESDEN UNIT 3 LOCAL LEAK RATE TEST SUMMARY

Penetration Thru Leakage In SCFH (At 48 PSIG)

	1978		1980		1982		1983-1984	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
MSIVs	1.12	1.31	4.1	4.1	19.22	3.82	1.314	1.314
Isolation Valves	459.823	104.479	76.73	70.37	57.13	55.58	407.8	135.82
Electrical Pen.	12.324	11.662	11.683	11.683	129.16	32.07	30.6	30.6
Bellows Seals	.972	.972	3.49	3.49	4.8	4.8	8.33	8.33
Double Gasketed Seals	30.397	14.476	5.53	0.0	17.97	4.0	1.137	.303
Total	504.636	132.899	105.53	89.64	288.28	100.27	449.2	176.35

Table 1

DRESDEN UNIT 3 INITIAL OUTAGE LOCAL LEAK RATE TEST FAILURES

Valves or Pen.	System	Initial Leakage (SCFH)	Final Leakage (SCFH)	Cause of Leakage	Corrective Action
3-220-62A	220	87.9	9.33	Worn "O" Ring	Replaced "O" Ring
3-1301-3	1300	12.27	1.415	Worn Valve Seat	Lapped Disc to Seat
3-1601-21	1600	285.55	17.5	Worn Valve Seat	Replaced Valve
3-2301-35	2300	79.82	19.73	Worn Valve Seat	Lapped Disc to Seat
3-301-156B	300	116.23	.864	Improper Valve Adjustment	Valve Adjusted
3-1599-62	1500	28.58	1.49	Improper Valve Adjustment	Valve Adjusted
X-124	3700	40.29	40.29	---	---
X-202W	300	45	45	---	---

Table 2

APPENDIX A

Dresden Unit 3 LLRT Summary (All Units in SCFH)

As Found	~~449.2~~ 498.5 L.C. 10/25/84
As Left	~~176.35~~ 225.7
LLRT Improvement	272.85

LLRT Not Drained and Vented During ILRT

Feedwater Check Valves	6.06
Core Spray	.459
LPCI	18.63
Shutdown Cooling	1.29
SBLC	5.56
Isolation Condenser	.708
CRD Return	11.8
Rx. Clean-up	1.64
Primary Sample	0
Total	46.15

Dresden Unit 3 Containment Leakage Summary

ILRT Result (1982) 0.54 Wt.%/Day	277.33
LLRT Not Drained or Vented During ILRT	46.15
Total Containment Leak Rate Prior to Startup	323.48
LLRT Improvement	272.85
Total Containment Leak Prior to Shutdown	596.33

Maximum Allowable Leak Rate (La)

1.6 Wt.%/Day 821.857 SCFH

Allowable Operational Containment Leak Rate (.75 La)

1.2 Wt.%/Day 616.392 SCFH

Percent of Limit for Total Containment Leak Rate Prior to Startup:

$$\frac{323.48}{616.392} \times 100 = 52.5\%$$

Percent of Limit for Total Containment Leak Rate Prior to Shutdown:

$$\frac{596.33}{821.857} \times 100 = 72.6\%$$

Total Containment Leak Rate	323.48	L.C.
LLRT	~~176.35~~ 225.7	10/25/84
Untestable Containment Penetrations: (Using 1982 ILRT Results)	~~147.13~~ 97.78	

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

TYPE OF PENETRATION: MAIN STEAM ISOLATION VALVES
TESTED AT 25 PSIG

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	1982 FINAL THRU LEAKAGE SCFH	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL THR LEAKAGE SCFH
1	X-105A	203-1A* & 203-2A					
2	X-105A	203-1A & 203-2A	0	2.627	1.314	--	1.314
3	X-105B	203-1B* & 203-2B					
4	X-105B	203-1B & 203-2B	0	0	0	--	0
5	X-105C	203-1C* & 203-2C					
6	X-105C	203-1C & 203-2C	3.82	0	0	--	0
7	X-105D	203-1D* & 203-2D					
8	X-105D	203-1D & 203-2D	0	0	0	--	0
			TOTAL THRU LEAKAGE FOR PAGE		1.314		1.314

*Indicates waterhead present on one side of valve.

Table 3

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

TYPE OF PENETRATION: ISOLATION VALVES

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	1982 FINAL THRU LEAKAGE SCFH	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL THRU LEAKAGE SCFH
9	X-147	205-2-4 & Blind Flange	.09	0	0	--	0
10	X-147	205-2-7 & Blind Flange	--	0	0	--	0
11	X-106	220-1 & 220-2	1.42	7.67	3.84	--	3.84
12	X-122	220-44* & 220-45	0	0	0	--	0
13	X-107A	220-57A* & 220-58A	0	0	44.0	--	4.67
14	X-107A	220-57A* & 220-62A	--	87.9	--	9.33	--
15	X-107B	220-57B* & 220-58B	0	2.77	1.39	--	1.39
16	X-107B	220-57B* & 220-62B	--	0	--	--	--
17	X-109B	301-95 & 301-99*	0	5.16	11.8	--	11.8
18	X-109B	301-98 & 301-99*	--	18.37	--	--	--
19	X-111A, 111B	1001-1A*, 1B*, 2A, 2B & 2C	1.30	2.576	1.29	--	1.29
20	X-138	1101-1* & 1101-15	.96	11.115	5.56	--	5.56
21	X-138	1101-1* & 1101-16	--	0	--	--	--
22	X-113	1201-1*, 2 & 3	2.73	6.51	3.26	3.28	1.64
23	X-108A	1301-1* & 1301-2	0	2.15	1.08	--	1.08
24	X-109A	1301-3 & 1301-4*	0	12.27	6.14	1.415	.708
25	X-108A, 109A	1301-17 & 1301-20	.54	.649	.325	--	.325
26	X-310A	1402-4A, 8A*, 25A & 36A*	.56	0	0	--	0
27	X-149A	1402-24A & 1402-25A	.4	.832	.416	--	.416
28	X-310B	1402-4B, 8B*, 25B & 36B*	0	.918	.459	--	.459
29	X-149B	1402-24B & 1402-25B	0	0	0	--	0
			TOTAL THRU LEAKAGE FOR PAGE		79.6		33.18

*Indicates waterhead present on one side of valve.

Table 3

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

TYPE OF PENETRATION: ISOLATION VALVES

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	1982 FINAL THRU LEAKAGE SCFH	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL T[illegible] LEAKAGE SCFH
30	X-311A	1501-18A & 1501-19A	0	1.185	.593	1.36	.68
31	X-311B	1501-18B & 1501-19B	.19	0	0	.783	.391
32	X-310A	1501-20A & 1501-38A	3.92	4.05	2.03	--	2.03
33	X-310B	1501-20B & 1501-38B	1.24	0	0	--	0
34	X-116A	1501-22A, 26A* & 1001-5A	.4	0	2.86	5.69	12.43
35	X-116A	1501-25A & 1501-26A*	--	5.72	--	19.16	--
36	X-116B	1501-22B, 26B* & 1101-5B	4.625	11.22	6.2	--	6.2
37	X-116B	1501-25B & 1501-26B*	--	1.17	--	--	--
38	X-145	1501-27A & 1501-28A	0	0	0	--	0
39	X-150A	1501-27B & 1501-28B	3.45	.198	.1	--	--
40	X-304	1601-20A & 1601-31A	3.27	4.29	2.14	4.55	2.77
41	X-304	1601-20B & 1601-31B	3.29	8.72	4.36	7.32	3.66
42	X-126, 304	1601-21, 22, 55 & 56	.81	285.55	143.0	17.5	8.75
43	X-125, 318	1601-23, 24, 60, 61, 62 & 63	6.03	10.237	5.12	--	5.12
44	X-126, 304	1601-57, 58 & 59	.47	.308	.154	--	.154
45	X-118	2001-5 & 2001-6	.09	.029	.015	--	.015
46	X-117	2001-105 & 2001-106	.59	.710	.355	--	.355
47	X-128	2301-4* & 2301-5	.51	2.12	1.06	--	1.06
48	X-312	2301-34 & 2301-71	.19	0	0	--	0
49	---	2301-35 & 2301-36	0	79.82	39.9	19.73	9.87
50	X-317	2301-45 & 2301-74	1.45	0	0	--	0
		TOTAL THRU LEAKAGE FOR PAGE			207.9		53.59

*Indicates waterhead present on one side of valve.

Table 3

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

TYPE OF PENETRATION: ISOLATION VALVES

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	1982 FINAL THRU LEAKAGE SCFH	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL THR LEAKAGE SCFH
51	X-202V	2499-1A & 2499-2A	.19	.592	.296	--	.296
52	X-204B	2499-1B & 2499-2B	0	.344	.172	--	.172
53	X-316A	2499-3A & 2499-4A	0	0	0	--	0
54	X-316B	2499-3B & 2499-4B	0	0	0	--	0
55	X-202V	2599-2A & 2599-23A	.11	1.84	.92	--	.92
56	X-204B	2599-2B & 2599-23B	0	.781	.391	--	.391
57	X-316A	2599-3A & 2599-24A	0	0	0	--	0
58	X-316B	2599-3B & 2599-24B	0	.991	.496	--	.496
59	X-125, 318	2599-4A & 2599-5A	4.09	7.63	3.82	--	3.82
60	X-125, 318	2599-4B & 2599-5B	.28	1.59	.795	--	.795
61	X-139D	4720 & 4721	0	4.14	2.07	--	2.07
62	X-121	4722 & Check Valve	.12	3.92	1.96	--	1.96
63	X-309A	8501-1A & End of Line	.08	.89	.445	--	.445
64	X-309A	8501-1B & End of Line	.16	.60	.30	--	.30
65	X-204	8501-3A & 8501-3B	3.38	7.75	3.88	--	3.88
66	X-143	8501-5A & End of Line	.25	.594	.297	--	.297
67	X-143	8501-5B & End of Line	.31	0	0	--	0
68	X-143	9205A & End of Line	.26	2.21	1.1	--	1.1
69	X-143	9205B & End of Line	.10	.317	.159	--	1.59
70	X-143	9206A & End of Line	4.58	0	0	--	0
71	X-143	9206B & End of Line	0	0	0	--	0
		TOTAL THRU LEAKAGE FOR PAGE			17.1	--	17.1

*Indicates waterhead present on one side of valve.

Table 3

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

TYPE OF PENETRATION: ISOLATION VALVES

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	1982 FINAL THRU LEAKAGE SCFH	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL THRU LEAKAGE SCFH
72	X-101	9207A & End of Line	.94	.158	.079	--	.079
73	X-101	9207B & End of Line	.695	.019	.01	--	.07
74	X-101	9208A & End of Line	.26	.045	.023	--	.023
75	X-101	9208B & End of Line	.53	.077	.038	--	.038
76	X-136F	TIP Purge Check Valve	.37	6.87	3.44	--	3.44
77	X-136C	TIP Ball Valve A	.18	.383	.192	--	.192
78	X-136B	TIP Ball Valve B	3.21	5.01	2.51	--	2.51
79	X-136D	TIP Ball Valce C	.28	.67	.335	--	.335
80	X-136F	TIP Ball Valve D	.43	.755	.378	--	.378
81	X-136E	TIP Ball Valve E	.11	.344	.172	--	.172
82	X-313A	East Torus Drain Valves	0	0	0	--	0
83	X-313B	West Torus Drain Valves	0	0	0	--	0
84	X-101	Personnel Air Lock	0	0	0	--	0
84a	N/A	301-157A & 301-156A	.12	1.67	.835	--	.835
84b	N/A	301-160A & 301-161A	.44	.529	.265	--	.265
84c	N/A	301-157B & 301-156B	.01	116.23	58.12	.864	.432
84d	N/A	301-160B & 301-161B	1.29	4.39	2.2	--	2.20
84e	N/A	1599-61 & 1599-62	N/A	28.58	14.29	1.49	.75
84f	X-124	3702 & 3799-126	N/A	.289	.145	--	.145
84g	X-124	3703 & 3706	N/A	40.29	20.15	--	20.15
			TOTAL THRU LEAKAGE FOR PAGE		103.2		31.95

*Indicates waterhead present on one side of valve.

Table 3

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

*TYPE OF PENETRATION: ELECTRICAL

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	1982 FINAL THRU LEAKAGE SCFH	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL THR LEAKAGE SCFH
85	X-200	LV Power & Control	3.55	~~2.5~~ 5.04	~~1.25~~ 2.52	--	2.52 ~~1.25~~
86	X-201B	HV Power	.32	0	0	--	0
87	X-202B	CRD Indicators	0	0	0	--	0
88	X-202BB	CRD Indicators	0	0	0	--	0
89	X-202D	HV Power	0	0	0	--	0
90	X-202F	Thermocouples	5.48	~~7~~ 17.47	3.5 8.735	--	8.735 ~~3.5~~
91	X-202J	Neutron Monitor	0	0	0	--	0
92	X-202N	Neutron Monitor	0	0	0	--	0
93	X-202Q	LV Power & Control	0	0	0	--	0
94	X-202S	CRD Indicators	0	.93 ~~.65~~	.465 ~~.33~~	--	.465 ~~.33~~
95	X-202W	CRD Indicators	4.85	107.33 ~~45~~	53.66 ~~22.5~~	--	53.66 ~~22.5~~
96	X-203B	HV Power	0	0	0	--	0
97	X-204A	HV Power	2.41	0	0	--	0
98	X-204E	Neutron Monitor	.33	0	0	--	0
99	X-204H	Neutron Monitor	.34	0	0	--	0
100	X-204L	Power & Ground	5.3	8.53 ~~4~~	4.265 ~~2~~	--	4.265 ~~2~~
101	X-204M	V Power	3.59	6.32 ~~3~~	3.16 ~~1.5~~	--	3.16 ~~1.5~~
102	X-204N	CRD Indicators	0	0	0	0	0
103	X-204Q	CRD Indicators	3.71	0	0	--	0
104	X-204S	LV Power & Control	2.19	6.32 ~~3~~	3.16 ~~1.5~~	--	3.16 1.5
105	X-205B	CRD Indicators	0	0	0	--	0
			TOTAL THRU LEAKAGE FOR PAGE		~~30.6~~ 75.96		~~30.6~~ 75.96

*Indicates waterhead present on one side of valve.

Table 3

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

TYPE OF PENETRATION: DRYWELL BELLOWS SEALS

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	1982 FINAL THRU LEAKAGE SCFH	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL THRU LEAKAGE SCFH
106	X-109A	Iso. Cond. Condensate Return	2.01	~~6.5~~ 21.42	~~3.25~~ 10.71	--	10.71 ~~3.25~~
107	X-149A	Core Spray					
108	X-149B	Core Spray					
109	X-1	CRD Return					
110	X-105A	Main Steam Line					
111	X-105B	Main Steam Line					
112	X-105C	Main Steam Line					
113	X-105D	Main Steam Line					
114	X-106	Main Steam Drain					
115	X-107A	Feedwater	2.79	9.33	4.665	--	4.665
116	X-107B	Feedwater					
117	X-111A	Shutdown Cooling					
118	X-111B	Shutdown Cooling					
119	X-128	HPCI Steam Line					
120	X-116A	LPCI Injection					
121	X-116B	LPCI Injection					
122	X-123	RBCCW Inlet					
123	X-124	RBCCW Outlet					
124	X-126	Vent to Drywell					
		TOTAL THRU LEAKAGE FOR PAGE			~~7.92~~ 15.375		~~7.92~~ 15.375

*Indicates waterhead present on one side of valve.

Table 3

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

TYPE OF PENETRATION: DRYWELL BELLOWS SEALS

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	1982 FINAL THRU LEAKAGE SCFH	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL T[illegible] LEAKAGE SCFH
125	X-108A	Iso. Cond. Steam Line					
126	X-113	Cleanup					
127	X-125	Vent from Drywell		.821	.411	--	.411
128	X-138	Standby Liquid Control					
129	X-147	Reactor Head Spray					
		TOTAL THRU LEAKAGE FOR PAGE			.411		.411

*Indicates waterhead present on one side of valve.

Table 3

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

TYPE OF PENETRATION: DOUBLE GASKETED SEALS

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	1982 FINAL THRU LEAKAGE SCFH	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL THRU LEAKAGE SCFH
130	X-100	Drywell Equipment Hatch	.13	.415	.208	0	0
131	X-102	CRD Hatch	0	0	0	0	0
132	X-135E	Spare	N/A	N/A	--	--	N/A
133	X-136A	TIP Monitor Flange (Spare)	0	0	0	--	0
134	X-136B	TIP Monitor Flange	0	0	0	--	0
135	X-136C	TIP Monitor Flange	0	0	0	--	0
136	X-136D	TIP Monitor Flange	0	0	0	--	0
137	X-136E	TIP Monitor Flange	0	.145	.073	--	.073
138	X-136F	TIP Monitor Flange	0	0	0	--	
139	X-136G	TIP Monitor Flange	N/A	N/A	--	--	--
140	X-136H	TIP Monitor Flange	N/A	N/A	--	--	--
141	X-136J	TIP Monitor Flange	N/A	N/A	--	--	--
142	X-137	Drywell Head Manhole	0	0	0	--	0
143	N/A	Drywell Head Flange	.21	0	0	.221	.111
144	X-301A	Torus Vacuum Breaker 1601-32A	.27	.054	.027	0	0
145	X-301A	Torus Vacuum Breaker 1601-32B	.91	.283	.142	0	0
146	X-301B	Torus Vacuum Breaker 1601-32C	.39	.036	.018	.238	.119
147	X-301B	Torus Vacuum Breaker 1601-32D	0	0	0	0	0
148	X-301C	Torus Vacuum Breaker 1601-32E	0	.352	.176	0	0
149	X-301C	Torus Vacuum Breaker 1601-32F	0	.09	.045	0	0
		TOTAL THRU LEAKAGE FOR PAGE			.689		.303

*Indicates waterhead present on one side of valve.

Table 3

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

TYPE OF PENETRATION: DOUBLE GASKETED SEALS

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	1982 FINAL THRU LEAKAGE SCFH	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL TH LEAKAGE SCFH
150	X-301F	Torus Vacuum Breaker 1601-33A	0	.0725	.036	0	0
151	X-301F	Torus Vacuum Breaker 1601-33B	0	.0542	.027	0	0
152	X-301E	Torus Vacuum Breaker 1601-33C	0	.539	.270	0	0
153	X-301E	Torus Vacuum Breaker 1601-33D	.47	.0716	.036	0	0
154	X-301D	Torus Vacuum Breaker 1601-33E	1.26	.11	.055	0	0
155	X-301D	Torus Vacuum Breaker 1601-33F	.34	.049	.024	0	0
156	X-306A	East Torus Access Hatch	0	0	0	0	0
157	X-306B	West Torus Access Hatch	0	0	0	0	0
158	X-313A	East Torus Drain	0	0	0	0	0
159	X-313B	West Torus Drain	0	0	0	0	0
160		Shear Lug Hatch #1	0	0	0	--	0
161		Shear Lug Hatch #2	0	0	0	--	0
162		Shear Lug Hatch #3	0	0	0	--	0
163		Shear Lug Hatch #4	0	0	0	--	0
164		Shear Lug Hatch #5	0	0	0	--	0
165		Shear Lug Hatch #6	0	0	0	--	0
166		Shear Lug Hatch #7	0	0	0	--	0
167		Shear Lug Hatch #8	0	0	0	--	0
		TOTAL THRU LEAKAGE FOR PAGE			.448		0

*Indicates waterhead present on one side of valve.

Table 3

LOCAL LEAK RATE TESTS PERFORMED DURING THE UNIT 3 REFUELING OUTAGE OF 1983-1984

TYPE OF PENETRATION: MISCELLANEOUS TESTS & AUGMENTED TESTS

TEST NUMBER	PENETRATION NUMBER	VOLUME BEING TESTED	INITIAL LEAK RATE SCFH	INITIAL THRU LEAKAGE SCFH	FINAL LEAK RATE SCFH	FINAL THRU LEAKAGE SCFH
		CCSW 3-1510-16"0	Passed	--	--	--
	CCSW	CCSW 3-1514-16"0	Passed	--	--	--
	Wall	CCSW 3-1510A-10"0	Passed	--	--	--
	Penetrations	CCSW 3-1505B-12"0	Passed	--	--	--
		CCSW 3-1512C-12"0	Passed	--	--	--
		Power Supply to "B" CCSW Pump	Passed	--	--	--
		Hypochlorite 3-4505-3"AS	Passed	--	--	--
		Hypochlorite 3-4506-3"AS	Passed	--	--	--
		Service Water to Hypochlorite	Passed	--	--	--
		CCSW Vault Door	.31 gal/hr	--	--	--
		Target Rock Pneumatic System	12.3 psig/hr	--	--	--
	X-312	Piping to Torus from HPCI Drain Pot	0			

NEW LLRT RESULTS FOR D3 1983 Refueling Outage due to ERRORS IN calibration of flow make-up boxes, usage of diff Pressures, and usage of N_2.

USING FORMULA

$$AF = MLR \sqrt{\left(\frac{AP}{CP}\right)\left(\frac{CT}{AT}\right)} \times 1.02$$

AF = Actual Flow Rate
MLR = Measured Leak Rate
AP = Actual Pressure
CP = Calibrated Pressure
CT = Calibrated Temperature
AT = Actual Pressure
Correction Factor of 1.02 for the usage of N_2 instead of Air

NEW RESULTS:

Electrical Penetrations	Original Leak Rate (SCFH)	New leak Rate (SCFH)
X 200 C	2.5	5.04
X 202 F	7	17.47
X 203 S	.65	.93
X 202 W	45	107.328
X 204 L	4	8.53
X 204 M	3	6.32
X 204 S	3	6.32
Bellows Seal		
Iso Condenser	6.5	21.42