NRC FORM 366
(7-77)

U. S. NUCLEAR REGULATORY COMMISSION

CAR #1434

LICENSEE EVENT REPORT

CONTROL BLOCK: | | | | | | | (1) (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

0 1	N Y R E G 1 (2) LICENSEE CODE	0 0 - 0 0 0 0 0 - 0 0 (3) LICENSE NUMBER	4 1 1 1 1 (4) LICENSE TYPE	CAT (5)

CON'T

0 1	REPORT SOURCE L (6)	0 5 0 0 0 2 4 4 (7) DOCKET NUMBER	0 3 2 3 8 3 (8) EVENT DATE	0 5 0 6 8 3 (9) REPORT DATE

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)

0 2 While at 100% steady state operation, local leak testing of the containment personnel
0 3 hatch was being performed within the 6 month frequency required by Tech Specs. Based
0 4 on review of the test data, the personnel hatch met the allowable leakage requirements,
0 5 however, the individual doors, when used as a single barrier for containment integrity,
0 6 had a higher leak rate than allowed for the containment hatch (Tech Specs section
0 7 4.4.2.2). This would have allowed excessive leakage through this penetration for the
0 8 estimated 6 hours the hatch was in use above cold shutdown conditions with one door open. (con't)

	SYSTEM CODE	CAUSE CODE	CAUSE SUBCODE	COMPONENT CODE	COMP. SUBCODE	VALVE SUBCODE
0 9	S A (11)	D (12)	Z (13)	P E N E T R (14)	A (15)	Z (16)

(17) LER/RO REPORT NUMBER	EVENT YEAR		SEQUENTIAL REPORT NO.		OCCURRENCE CODE	REPORT TYPE		REVISION NO.
	8 3	—	0 1 2	/	0 3	L	—	1

ACTION TAKEN	FUTURE ACTION	EFFECT ON PLANT	SHUTDOWN METHOD	HOURS (22)	ATTACHMENT SUBMITTED	NPRD-4 FORM SUB.	PRIME COMP. SUPPLIER	COMPONENT MANUFACTURER
B (18)	G (19)	Z (20)	Z (21)	0 0 0 0	Y (23)	N (24)	A (25)	C 3 1 0 (26)

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)

1 0 During the Plant Operations Review Committee review of the test results, it was
1 1 identified that maintenance completed on 10/07/82 had included repacking of the
1 2 shaft area. The maintenance procedure had incorrectly, for this instance, required
1 3 only door seal leak testing. This procedure has been revised to assure the proper
1 4 post maintenance testing is completed. All other maintenance procedures are being (con't)

	FACILITY STATUS	% POWER	OTHER STATUS (30)	METHOD OF DISCOVERY	DISCOVERY DESCRIPTION (32)
1 5	E (28)	1 0 0 (29)	NA	B (31)	Local Leak Rate Test

	ACTIVITY RELEASED	CONTENT OF RELEASE	AMOUNT OF ACTIVITY (35)	LOCATION OF RELEASE (36)
1 6	2 (33)	2 (34)	NA	NA

PERSONNEL EXPOSURES

	NUMBER	TYPE	DESCRIPTION (39)
1 7	0 0 0 (37)	2 (38)	NA

PERSONNEL INJURIES

	NUMBER	DESCRIPTION (41)
1 8	0 0 0 (40)	NA

LOSS OF OR DAMAGE TO FACILITY (43)

	TYPE	DESCRIPTION
1 9	2 (42)	NA

PUBLICITY

	ISSUED	DESCRIPTION (45)	NRC USE ONLY
2 0	N (44)	NA	

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PDR ADOCK 05000244
S PDR

NAME OF PREPARER Stanley M. Spector PHONE: 315-524-4446

Event Description and Probable Consequences Continued

Based on conditions explained under the cause investigation, this is being reported under 6.9.2a (6) of our Tech Specs as a procedural inadequacy that could have rendered this containment boundary inoperable.

Cause Description and Corrective Actions Continued

reviewed and revised, if necessary, to assure proper post maintenance testing will be performed.

Attachment to LER 83-Ø12/Ø3L-Containment Equipment Hatch Leak Test
Rochester Gas and Electric Corporation
R. E. Ginna Nuclear Power Plant, Unit No. 1
Docket No. 5Ø-244

During the period 3-21-83 through 3-22-83, three attempts were made to perform local leak test on the personnel hatch.

Test 1: During initial pressurization an audible leak was detected when pressure had only reached approximately 15 psig. Pressurization was stopped while identification of the leaking area was made. The leak was identified to be on the shaft packing area. During this hold time sufficient pressure had decayed, that according to procedure guidance, the test was terminated and repairs on the outer door initiated.

Test 2: This test was initiated after repairs were made to the outer door. Full pressurization was made of the hatch (61 psig) with no noticeable leakage on the outer door. Pressure decay, during a short period (48 minutes), warranted, according to the procedure, termination of the test for repairs, however, data continued to be recorded for 1Ø5 minutes. While still partially pressurized adjustments were made on the shaft packing of the inner door.

Test 3: After this maintenance, an acceptable test was performed.

Through subsequent review of test data and error analysis, we have concluded that the hatch, as a unit, acted as an acceptable containment boundary. The outer door, at the upper limit of the error band had an unacceptable leak rate. The inner door had a unacceptable leak rate. This information is contained in the attached Leak Rate Analysis.

We have reviewed the security access logs on this door, when above cold shutdown conditions. Using the estimated number of entries and a conservative estimate of time for door opening for entries, based on field observations, we have estimated that we were dependent on one door as our sole boundary for 6 hours when above cold shutdown conditions.

DESIGN ANALYSIS

R. E. GINNA

LEAK RATE TEST ANALYSIS

Rochester Gas and Electric Corporation

89 East Avenue

Rochester, New York 14649

EWR: NA

REVISION 0

MAY 5, 1983

Prepared by:	Paul C Wilkens	5/6/83 DATE
Reviewed by:	John D Cook	5-6-83 DATE
Approved by:	R C Mecredy	5-6-83 DATE

42-92

Revision Status Sheet

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LEAK RATE TEST ANALYSIS

1.0 Objective

1.1 On March 21 and March 22, 1983, three separate pressure decay leak rate tests were performed on the Ginna containment personnel hatch. The test is performed by pressurizing between the doors, thus yielding the sum of door leakages. Conventional methods of calculating and reporting test results are very conservative as the result of simplifying assumptions. A more representative, but still conservative, test analysis is desirable to represent the actual accident configuration. The objectives of this analysis are:

1.2 Define the leak rate relationship for a pressure decay test in terms of known physical parameters and test data.

1.3 Define the pressure decay test leak rate result uncertainty arising from the uncertainty in the system physical parameters and uncertainty in the test data.

1.4 Define the through-penetration leakage, or leakage which will escape from containment under accident conditions through two series boundaries (the two closed doors), in terms of test results of two boundaries (doors) tested in a parallel configuration.

1.5 Evaluate numerically the March 21-22, 1983 personnel hatch leak rate test.

2.0 Design Inputs

Design Inputs are identified with their source where used in the analysis.

3.0 Referenced Documents

3.1 10 CFR 50, Appendix J.

3.2 Ginna Technical Specifications, Section 4.4.

3.3 ANSI/ANS 56.8-1981, Containment System Leakage Testing Requirements.

4.0 Assumptions

Analysis assumptions are defined in Section 6.0.

5.0 Computer Codes

Not Applicable.

6.0 Analysis

6.1 Leak Rate Analysis

The leak rate from closed containment penetration volumes is calculated based on the assumption that a compressed air test approximates an adiabatic process using an ideal gas which has no energy added or subtracted during the test. The leakage rate, expressed as a fraction of the containment mass which leaks out of the test volume per unit time, is:

$$L = \frac{\Delta n}{n_{cv}\,\Delta t} = \frac{n_2 - n_1}{n_{cv}(t_2 - t_1)}$$

where: n_{cv} = number of moles of gas within containment at test conditions

n = number of moles of gas which leaked from the test volume

n_1 and n_2 are the number of moles of gas in the test volume at the beginning and end of the test

t = the time duration of the test

t_1 and t_2 are the beginning and ending times of the test

6.2 Using the ideal gas law

PV = nRT

and the subscripts 1 and 2 to represent beginning and ending test data points respectively and cv to refer to containment, then

$$L = \frac{\frac{P_1 V_1}{RT_1} - \frac{P_2 V_2}{RT_2}}{\frac{P_{cv} V_{cv}}{R\,T_{cv}}(t_2 - t_1)}$$

Assuming the test volume does not change, then $V_1 = V_2 = V_H$, and

$$L = \frac{V_H}{V_{cv}} \frac{T_{cv}}{P_{cv}} \frac{1}{t_2 - t_1}\left(\frac{P_1}{T_1} - \frac{P_2}{T_2}\right)$$

6.3 For containment integrated leak rate tests, T_{cv} and P_{cv} are represented by test data. Integrated leak rate tests (Type A tests) use the time 0 intercept of the mass plot weights as the reference conditions of containment air mass for calculating the relative leak rate. For this calculation, the more conservative average weight calculated from the average temperature and pressure will be used for the reference conditions. Then L becomes

$$L = \frac{V_H}{V_{cv}} \frac{T_1 + T_2}{P_1 + P_2} \frac{1}{t_2 - t_1} \left(\frac{P_1}{T_1} - \frac{P_2}{T_2} \right) \qquad (1)$$

6.4 The standard error of the function $L = f(V_H, V_{cv}, T_1, T_2, t_1, t_2, P_1, P_2,)$ is given in ANS-58.6-1981, Containment System Leakage Requirements. Assuming covariance and higher order terms are negligible, the variance of L is:

$$Var(L) = \left(\frac{\partial L}{\partial V_H}\right)^2 (eV_H)^2 + \left(\frac{\partial L}{\partial V_{cv}}\right)^2 (eV_{cv})^2 + \left(\frac{\partial L}{\partial T_1}\right)^2 (eT_1)^2 + \left(\frac{\partial L}{\partial T_2}\right)^2 (eT_2)^2 + \left(\frac{\partial L}{\partial t_1}\right)^2 (et_1)^2 + \left(\frac{\partial L}{\partial t_2}\right)^2 (et_2)^2 + \left(\frac{\partial L}{\partial P_1}\right)^2 (eP_1)^2 + \left(\frac{\partial L}{\partial P_2}\right)^2 (eP_2)^2$$

and the standard deviation δL is:

$$\delta L = \left\{ \left(\frac{\partial L}{\partial V_H} eV_H\right)^2 + \left(\frac{\partial L}{\partial V_{cv}} eV_{cv}\right)^2 + \left(\frac{\partial L}{\partial T_1} eT_1\right)^2 + \left(\frac{\partial L}{\partial T_2} eT_2\right)^2 + \left(\frac{\partial L}{\partial t_1} et_1\right)^2 + \left(\frac{\partial L}{\partial t_2} et_2\right)^2 + \left(\frac{\partial L}{\partial P_1} eP_1\right)^2 + \left(\frac{\partial L}{\partial P_2} eP_2\right)^2 \right\}^{\frac{1}{2}} \qquad (2)$$

6.5 Using equation (1) and taking partial derivatives, the terms of the equation for the standard deviation become:

$$\frac{\partial L}{\partial V_H} = \frac{1}{V_{cv}} \frac{T_1 + T_2}{P_1 + P_2} \frac{1}{t_2 - t_1} \left(\frac{P_1}{T_1} - \frac{P_2}{T_2} \right)$$

$$\frac{\partial L}{\partial V_{cv}} = -\frac{V_H}{V_{cv}^2} \frac{T_1 + T_2}{P_1 + P_2} \frac{1}{t_2 - t_1} \left(\frac{P_1}{T_1} - \frac{P_2}{T_2} \right)$$

$$\frac{\partial L}{\partial t_1} = \frac{1}{(t_2 - t_1)^2} \frac{V_H}{V_{cv}} \frac{T_1 + T_2}{P_1 + P_2} \left(\frac{P_1}{T_1} - \frac{P_2}{T_2} \right)$$

$$\frac{\partial L}{\partial t_2} = -\frac{\partial L}{\partial t_1}$$

$$\frac{\partial L}{\partial T_1} = \frac{V_H}{V_{CV}} \frac{T_1+T_2}{P_1+P_2} \frac{(-1)}{t_2-t_1} \frac{P_1}{T_1^2} + \left(\frac{P_1}{T_1} - \frac{P_2}{T_2}\right) \frac{V_H}{V_{CV}} \frac{1}{P_1+P_2} \frac{1}{t_2-t_1}$$

$$\frac{\partial L}{\partial T_2} = \frac{V_H}{V_{CV}} \frac{T_1+T_2}{P_1+P_2} \frac{1}{t_2-t_1} \frac{P_2}{T_2^2} + \left(\frac{P_1}{T_1} - \frac{P_2}{T_2}\right) \frac{V_H}{V_{CV}} \frac{1}{P_1+P_2} \frac{1}{t_2-t_1}$$

$$\frac{\partial L}{\partial P_1} = \frac{V_H}{V_{CV}} \frac{T_1+T_2}{P_1+P_2} \frac{1}{t_2-t_1} \frac{1}{T_1} + \left(\frac{P_1}{T_1} - \frac{P_2}{T_2}\right) \frac{V_H}{V_{CV}} \frac{(-1)}{t_2-t_1} \frac{T_1+T_2}{(P_1+P_2)^2}$$

$$\frac{\partial L}{\partial P_2} = \frac{V_H}{V_{CV}} \frac{T_1+T_2}{P_1+P_2} \frac{1}{t_2-t_1} \frac{(-1)}{T_2} + \left(\frac{P_1}{T_1} - \frac{P_2}{T_2}\right) \frac{V_H}{V_{CV}} \frac{(-1)}{t_2-t_1} \frac{T_1+T_2}{(P_1+P_2)^2}$$

6.6 Equations (1) and (2) can be evaluated for the leak rate and the standard deviation using test data and uncertainties in the data for terms eV_H, eV_{CV}, et_1, et_2, eT_1, eT_2, eP_1, and eP_2. Test data for the March 21 to March 22, 1983 personnel hatch test are shown on the instrument recorder chart reproduced as Figure 1. Three tests were run in that twenty-four hour period. The first test began at approximately 11 a.m. and was terminated less than one-half hour later because Test and Result technicians recognized that the hatch leak rate was much greater than normal and should be repaired. The handwheel shaft packing was tightened on the outer door and a second test was begun at approximately 3:20 p.m. It was also terminated early, this time to tighten the inner door handwheel shaft packing. A third test was begun by pressurizing the hatch shortly after 5 p.m. The hatch remained pressurized until after 8 a.m. the following morning. A customary four hour test period was chosen to begin after a period of stabilization and to extend from 10 p.m. to 2 a.m. Note that the recorder traces are not synchronous with time to allow full span movement of both pens. The pressure span is 0 to 100 psia. The temperature span is 30°F to 130°F.

6.7 A pressure gauge is mounted outside the hatch to also read the test pressure. A thermometer is also located outside the hatch although it measures ambient

conditions outside the hatch rather than test air conditions.

6.8 The recorder trace data and the pressure gauge and thermometer readings have been put in tabular form and appear on the Data Table. On the same Data Table are estimates of the parameter uncertainties and the basis for those uncertainties.

6.9 Parameter values from the Data Table are used to evaluate the leak rate for the three tests using equation (1). The Test 1 leak rate is 14,800 cc/min. This test was conducted at a reduced pressure, however, and the leak rate is extrapolated to accident pressure using the ANS 56.8 and Technical Specification 4.4 formulation, square root of the ratio of accident pressure to test pressure, or $\sqrt{\frac{Pa}{P_T}}$. The extrapolation of the leak rate gives a leakage of 23,900 cc/min. The Test 2 leak rate is 25,000 cc/min after tightening the outer door packing and the Test 3 leak rate is 299 cc/min after tightening the inner door packing.

6.10 After completion of the test series, the pressure temperature recorder was recalibrated because the recorded pressures were lower than those observed on the gauge outside the hatch even though the recorder had been calibrated within one month of the test, well within the specified time of one year. The recalibration established that the temperature indication was within the calibration limits; the pressure indication was in error and low by less than 3 psi. The pressure change response was correct during the recalibration and thus is presumed to have been correct during the test. An indicated pressure lower than the actual pressure during the test will result in conservatively high calculated leak rates. This is because the change in pressure during the test is then greater relative to the indicated pressure. An indicated pressure which is 3 psi low during a 60 psig test will yield a leak rate which is approximately 4 1/2% too high.

6.11 Parameter values and uncertainties from the Data Table are also used with equation (2) to evaluate the standard deviation of each of the Tests. Each term of equation (2) has been evaluated and is tabulated as shown on Table 1.

6.12 The standard deviations and leak rates calculated above yield test results which, reported in the normal fashion, are:

Test 1: 23,900 cc/min ± 20,300 cc/min
Test 2: 25,000 cc/min ± 2,870 cc/min
Test 3: 299 cc/min ± 820 cc/min

6.13 These leak rates are the sum of the leak rates through both hatch doors because the test is conducted by pressurizing between the doors (see Figure 2). These leak rates, in effect, represent the total leakage that might occur if a containment was designed with two separate hatches which have only a single boundary each.

6.14 The actual containment hatch has these two boundaries in series so that the accident environment would have to leak through both boundaries before being released. The maximum leak rate from the series combination of the two doors is the smaller of the two door test leak rates. And this leak rate would be valid only if the accident pressure is applied to each door, a situation which does not exist since the pressure drop from the containment to the environment will be split across the two boundaries.

6.15 Following an accident the containment will be at accident pressure and the inner door will leak initially at the same rate as during the test because the differential pressure across the door will be accident pressure minus atmospheric pressure. The inner door leak rate will decrease as the pressure between the doors builds up. The outer door leak rate after the accident will initially be zero because the volume between the hatch doors will be at atmospheric pressure. As the hatch pressure increases, the outer door leak rate will increase. The maximum leak rate that will exist through both doors at equilibrium pressure will be less than half the measured test leak rate for the following reasons:

a) The through-penetration leakage, or leakage which can escape from the containment through both doors of the hatch to the atmosphere, is limited by the smaller of the two test leaks. The test measures the sum of the leak rates from the two doors. The smaller leak rate may be as large as 1/2 of the total test leak rate.

b) The pressure drop across each door during a test is accident pressure. Following an accident, the sum of the pressure drops across both doors is equal to accident pressure. The reduced pressure drop across each door will reduce each door's leak rate.

Quantitatively, the leak rate through a series combination of doors compared to the parallel combination leak rate found in the test can be determined using the formulation below.

6.16 Let the variables shown pictorially on Figure 2 be defined as:

- L_T = total test leakage, or sum of leakage for both doors during test
- L_1 = inner door test leakage
- L_2 = outer door test leakage
- P_a = containment accident pressure and pressure between doors during tests
- P_H = hatch pressure at equilibrium conditions when containment is pressurized to Pa
- L_x = leak rate through inner door at equilibrium conditions with containment pressurized to Pa
- L_y = leak rate through outer door at equilibrium conditions with containment pressurized to Pa

$$L_T = L_1 + L_2$$

If the containment is pressurized to P_a, instead of the space between the doors, and equilibrium conditions are reached for the leaking hatch, then,

$$L_x = L_1 \sqrt{\frac{P_a - P_H}{P_a}} \quad (3)$$

and

$$L_y = L_2 \sqrt{\frac{P_H}{P_a}}$$

(Because of the way P_a and P_H are used here to give boundary differential pressures, P_a and P_H are gauge pressures.)

but at equilibrium

$$L_x = L_y$$

therefore

$$L_1 \sqrt{\frac{P_a - P_H}{P_a}} = L_2 \sqrt{\frac{P_H}{P_a}}$$

or

$$L_2 = L_1 \sqrt{\frac{P_a - P_H}{P_a}} \sqrt{\frac{P_a}{P_H}} = L_1 \sqrt{\frac{P_a - P_H}{P_H}}$$

or

$$\left(\frac{L_2}{L_1}\right)^2 = \frac{P_a - P_H}{P_H}$$

or

$$P_a - P_H = P_H \left(\frac{L_2}{L_1}\right)^2$$

or

$$P_a = P_H \left[1 + \left(\frac{L_2}{L_1}\right)^2\right]$$

or

$$P_a = P_H \left[\frac{L_1^2 + L_2^2}{L_1^2}\right]$$

or

$$P_H = P_a \left(\frac{L_1^2}{L_1^2 + L_2^2}\right) \qquad (4)$$

substituting (4) into (3)

$$L_x = L_1 \left[\frac{P_a - P_a\left(\frac{L_1^2}{L_1^2 + L_2^2}\right)}{P_a}\right]^{\frac{1}{2}}$$

or

$$L_x = L_1 \left[1 - \frac{L_1^2}{L_1^2 + L_2^2}\right]^{\frac{1}{2}}$$

or

$$L_x = L_1 \left[\frac{L_2^2}{L_1^2 + L_2^2}\right]^{\frac{1}{2}} \qquad (5)$$

but $L_1 = L_T - L_2$

therefore

$$L_x = (L_T - L_2)\left[\frac{L_2^2}{(L_T - L_2)^2 + L_2^2}\right]^{\frac{1}{2}}$$

or

$$L_x = (L_T - L_2)\left[\frac{L_2^2}{L_T^2 - 2L_TL_2 + 2L_2^2}\right]^{\frac{1}{2}}$$

or

$$L_x = L_T\left(1 - \frac{L_2}{L_T}\right)\left[\frac{(L_2/L_T)^2}{1 - 2(L_2/L_T) + 2(L_2/L_T)^2}\right]^{\frac{1}{2}}$$

and from (4) and (5)

$$P_H = P_a\left[\frac{(L_T - L_2)^2}{(L_T - L_2)^2 + L_2^2}\right]$$

or

$$\frac{P_H}{P_a} = \frac{L_T^2 - 2L_TL_2 + L_2^2}{L_T^2 - 2L_TL_2 + 2L_2^2}$$

or

$$\frac{P_H}{P_a} = \frac{1 - 2(L_2/L_T) + (L_2/L_T)^2}{1 - 2(L_2/L_T) + 2(L_2/L_T)^2}$$

6.17 These relationships can be evaluated for various L_2/L_T and curves prepared for L_x/L_T vs. L_2/L_T and P_H/P_a vs. L_2/L_T to describe the relationships. The numerical evaluation of L_x as a fraction of L_T for varying L_2/L_T is given in Table 2 and the results are plotted on Figure 3. P_H/P_a vs. L_2/L_T is also given on Table 2 and is plotted on Figure 4.

6.18 Table 2 and Figure 3 show that the maximum hatch leakage following an accident is less than 36% of the total measured test leakage. For test 1, which was performed prior to any repairs, the maximum through-penetration leakage is .36 x (23,900 cc/min) or 8,600 cc/min. Even if the standard deviation δL is added to the test result for conservatism, the maximum through-penetration leakage is 15,900 cc/min.

6.19 Other penetration leakages (those other than the personnel hatch) which existed at the time of the hatch test totaled less than 3000 cc/min. Therefore, the total containment penetration leak rate at the time of the March 21, 1983 hatch test can be stated to be less than 12,000 cc/min, or, with the conservatism of δL added to the test result, less than 19,000 cc/min.

6.20 The technical specification limit for penetration leakage is .6 La or .6 (.2%/day). Converting to cc/min the limit is

$$0.6(.002/\text{day})(9.72\times10^{5}\,ft^{3})\left(\frac{\text{day}}{24\,\text{hr}}\right)\left(\frac{\text{hr}}{60\,\text{min}}\right)(2.832\times10^{4}\,cc/ft^{3}) = 22{,}900\ cc/min$$

DATA TABLE

	GAGE READINGS: Test 1	GAGE READINGS: Test 2	GAGE READINGS: Test 3	GAGE READINGS: Uncertainty	GAGE READINGS: Basis for Uncertainty	RECORDER CHART READINGS: Test 1	RECORDER CHART READINGS: Test 2	RECORDER CHART READINGS: Test 3	RECORDER CHART READINGS: Uncertainty	RECORDER CHART READINGS: Reason for Uncertainty
P1		75.7	75.8	0.5 PSI	STANDARD ENGINEERING PRACTICE 1/2 SMALLEST DIVISION	29.1 PSIA	72.3 PSIA	72.1 PSIA	0.5 PSI	1/2 SMALLEST DIVISION. STANDARD ENGINEERING PRACTICE SUPPORTED BY I&C MINI TEST AND INSTRUMENT MANUFACTURER'S SPECIFICATIONS.
P2		73.7	74.9	0.5 PSI	SAME AS P1	28.2 PSIA	63.0 PSIA	71.8 PSIA	0.5° PSI	SAME AS P1
T1		72		20° F	TEMPERATURE MEASURED IS FOR ROOM NEXT TO HATCH. MAY VARY SIGNIFICANTLY FROM HATCH	93.0° F =553°R	87.0° F =547°R	84.3° F =544.3°R	0.5° F	STANDARD ENGINEERING PRACTICE MANUFACTURER'S SPECIFICATION INDICATES ACCURACY OF 0.75% OF SPAN
T2		72		20° F	SAME AS T1	86.0° F =546°R	84.3° F =544.3°R	84.0° F =544°R	0.5° F	SAME AS T1
t1		1517	3/21 1900	1 MIN.	CLOCK OR WATCH READING NOTED TO CLOSEST MINUTE	11:00	1520	2200	3 MIN.	READABILITY OF CHART. SMALLEST DIVISION IS 15 MINUTES.
t2		1537	3/22 0830	1 MIN.	SAME AS t1	11:25	1705	0200	3 MIN.	SAME AS t1
T_{cv}					$T_{cv} = \frac{T_1 + T_2}{2}$ →					CONTAINMENT PRESSURE AND TEMPERATURE ARE USED WITH CONTAINMENT VOLUME TO CALCULATE AIR MASS IN CONTAINMENT TO DETERMINE RELATIVE LEAK RATE. USE AVERAGE TEST CONDITIONS TO REPRESENT CONTAINMENT.
P_{cv}					$P_{cv}\ \frac{P_1 + P_2}{2}$ →					
V_{cv}	972.000 ft^3 FSAR SECT. 14.3.4			+50.000 ft^3 -0	5% OF VOLUME - ASSUMED CALCULATION ERROR					
V_H	700 ft^3 CAL. FROM DWG 9-6159 PLANT MEAS.			35 ft^3	5% OF VOLUME - ASSUMED CALCULATION ERROR					

TABLE 1

Standard Deviation of Test Results

Equation (2) term	Test 1 (min^{-2})	Test 2 (min^{-2})	Test 3 (min^{-2})
$\left(\frac{\partial L}{\partial V_H} eV_H\right)^2$	7.23×10^{-16}	2.06×10^{-15}	2.95×10^{-19}
$\left(\frac{\partial L}{\partial V_{CV}} eV_{CV}\right)^2$	7.66×10^{-16}	2.19×10^{-15}	3.12×10^{-19}
$\left(\frac{\partial L}{\partial T_1} eT_1\right)^2$	6.78×10^{-16}	3.93×10^{-17}	7.60×10^{-18}
$\left(\frac{\partial L}{\partial T_2} eT_2\right)^2$	6.96×10^{-16}	3.97×10^{-17}	7.61×10^{-18}
$\left(\frac{\partial L}{\partial t_1} et_1\right)^2$	4.17×10^{-15}	1.35×10^{-15}	3.68×10^{-20}
$\left(\frac{\partial L}{\partial t_2} et_2\right)^2$	4.17×10^{-15}	1.35×10^{-15}	3.68×10^{-20}
$\left(\frac{\partial L}{\partial P_1} eP_1\right)^2$	1.46×10^{-13}	2.23×10^{-15}	4.33×10^{-16}
$\left(\frac{\partial L}{\partial P_2} eP_2\right)^2$	3.88×10^{-13}	2.94×10^{-15}	4.37×10^{-16}
sum of terms	5.46×10^{-13}	1.08×10^{-14}	8.86×10^{-16}
δL (min^{-1})	7.39×10^{-7}	1.04×10^{-7}	2.98×10^{-8}
(cc/min)	20,300	2,870	820

TABLE 2

Through-Penetration Leakage and Hatch Pressure Relative to Total Test Leakage and Pressure

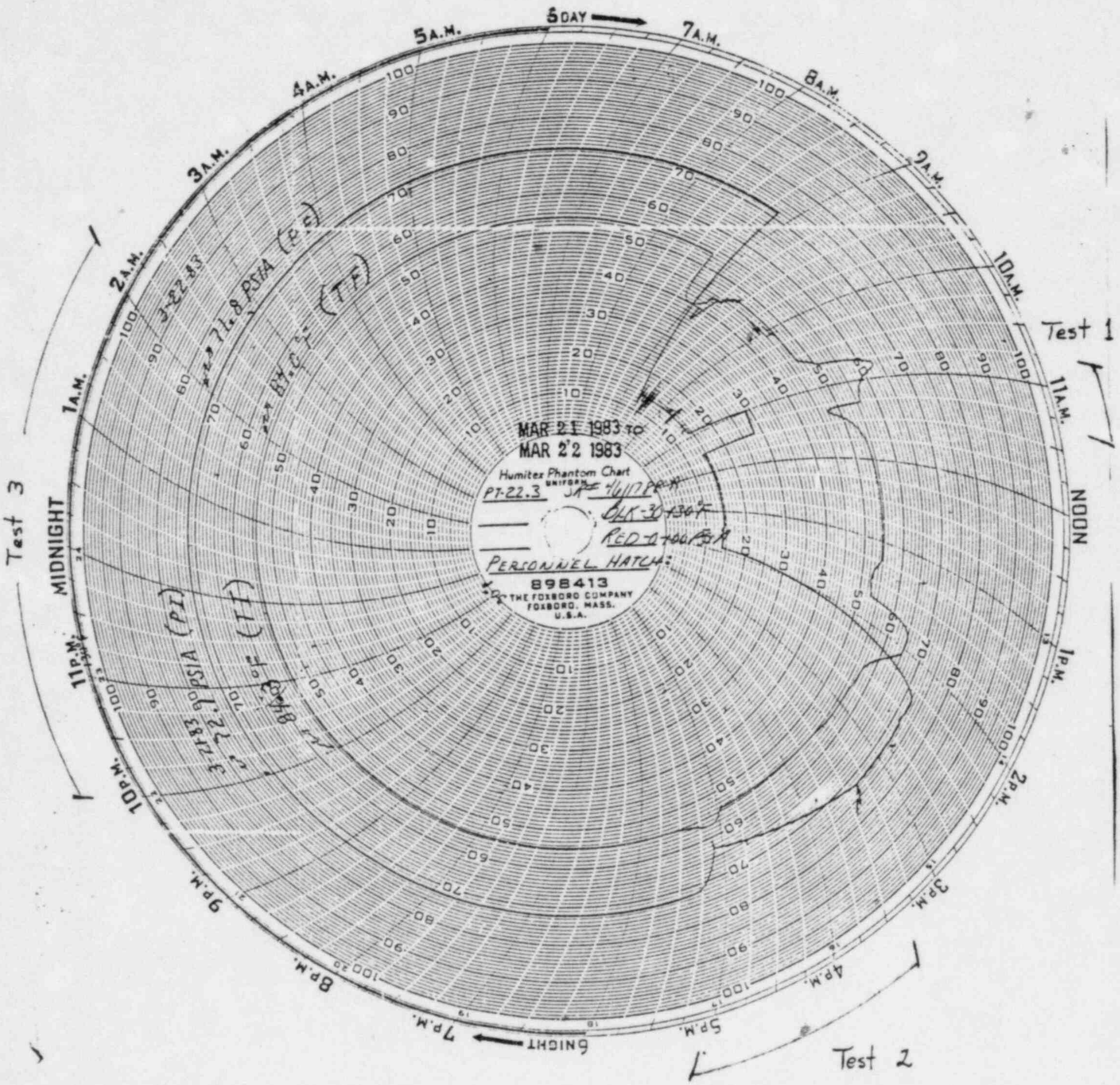
Given

$$L_x = L_T\left(1-\frac{L_2}{L_T}\right)\left[\frac{(L_2/L_T)^2}{1-2(L_2/L_T)+2(L_2/L_T)^2}\right]^{\frac{1}{2}}$$

$$P_H = P_a\left[\frac{1-2(L_2/L_T)+(L_2/L_T)^2}{1-2(L_2/L_T)+2(L_2/L_T)^2}\right]$$

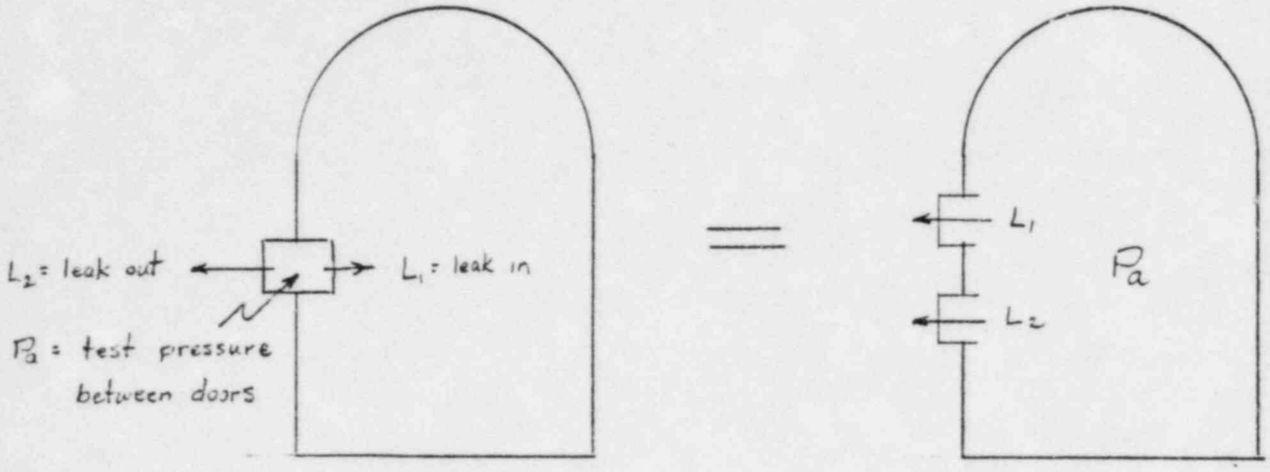
L_2/L_T	L_X/L_T	P_H/P_a
0.0	0.0	1.0
0.1	0.099	0.988
0.2	0.194	0.941
0.3	0.276	0.845
0.4	0.333	0.692
0.5	0.354	0.500
0.6	0.333	0.308
0.7	0.276	0.155
0.8	0.194	0.059
0.9	0.099	0.012
1.0	0.0	0.0
One Boundary Leakage Relative to Total Test Leakage	Through-Penetration Leakage Relative to Total Test Leakage	Relative Hatch pressure for series boundary leakage

FIGURE 1

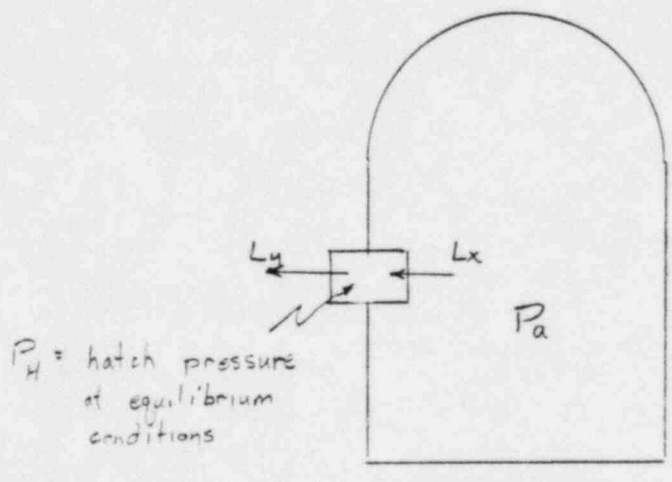


MAR 21 1983 TO
MAR 22 1983
Humitex Phantom Chart
PT-22.3
PERSONNEL HATCH
898413
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.
6 DAY
NOON
MIDNIGHT
6 NIGHT
Test 1
Test 2
Test 3
3-22-83
71.8 PSIA (PF)
83.6°F (TF)
3-21-83
72.1 PSIA (PI)
84.3°F (TI)

FIGURE 2



a) Pressurizing between the doors during testing is equivalent to finding the leak rate resulting from pressurizing the containment with the two doors in parallel.



b) The maximum leak rate from two doors in series is the smaller leak rate of the two doors assuming that the door with the lower leak rate is subject to full accident pressure. Any pressure drop across the door with the larger leak rate will decrease the pressure drop across the door with the lower leakage and reduce that door's leak rate.

FIGURE 3

Through-Penetration Leakage Relative to Total Test Leakage

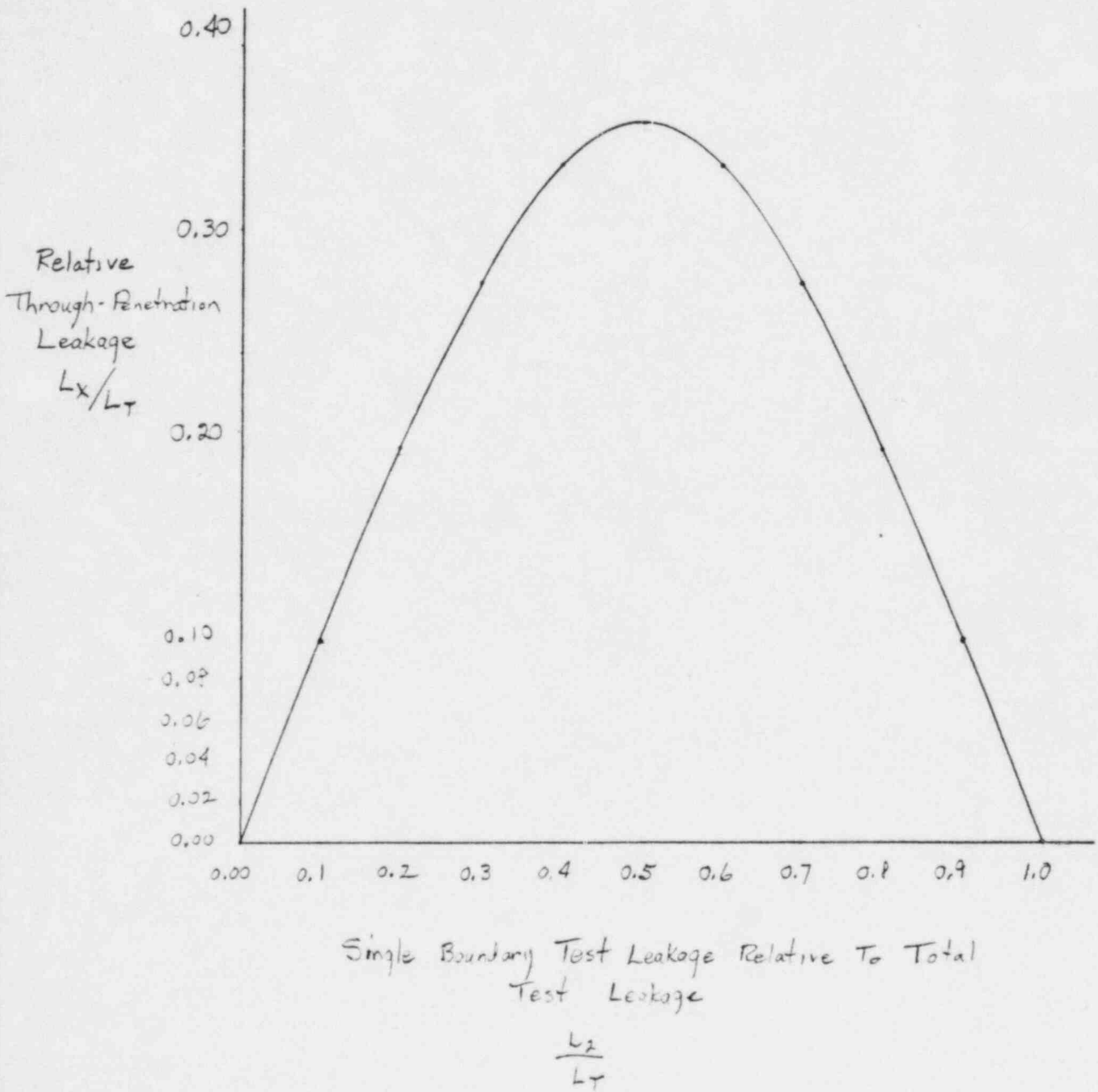
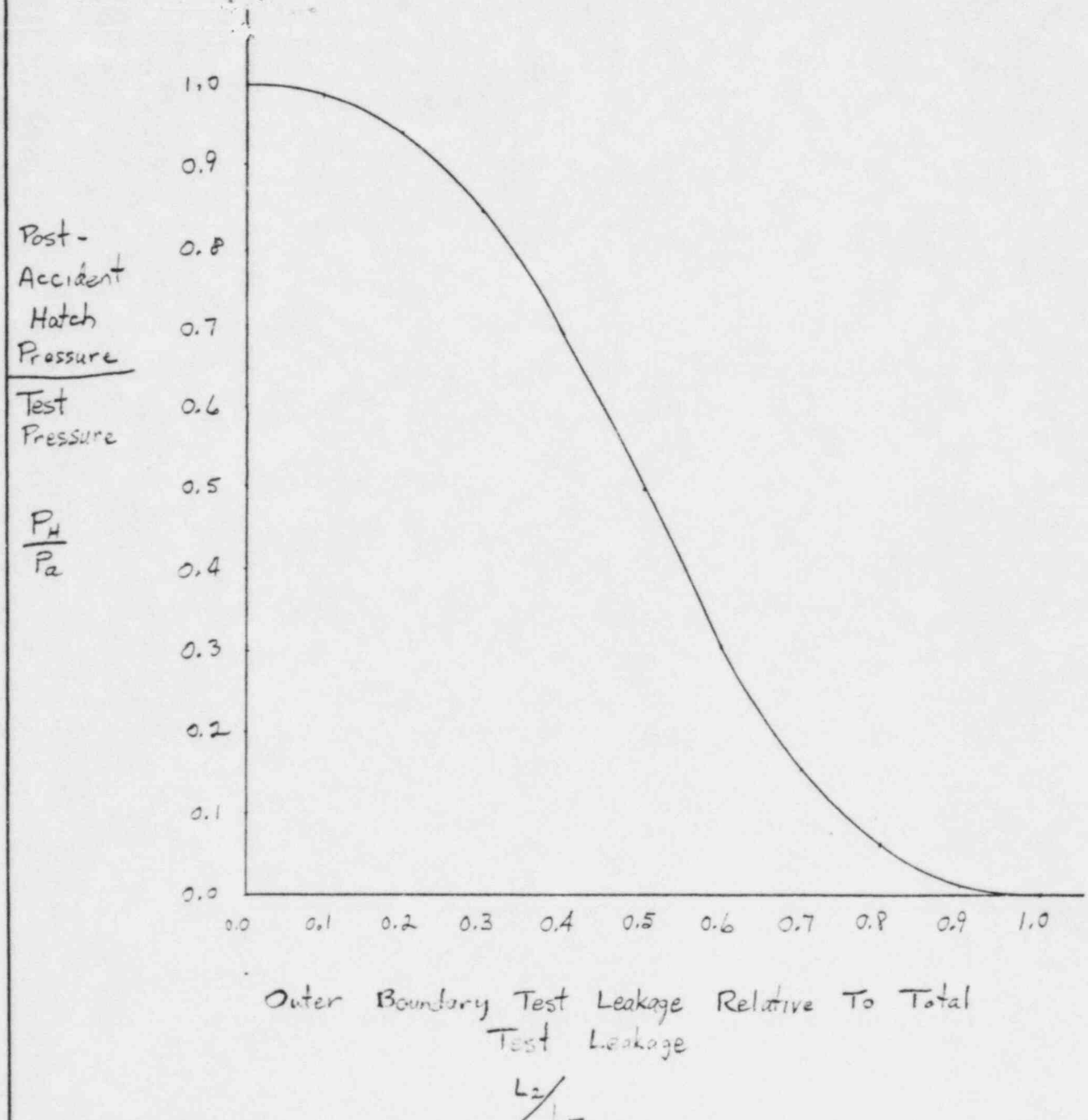


FIGURE 4

Relative Hatch Pressure Vs Outer Boundary Test Leakage Relative to Total Test Leakage



DESIGN ANALYSIS

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7.0 Results

See Section 6.0.