THREE MILE ISLAND NUCLEAR STATION

UNIT 1

GPU Nuclear

REACTOR CONTAINMENT BUILDING

INTEGRATED LEAK RATE TEST

APRIL 1984

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1.0 INTRODUCTION

The Three Mile Island Nuclear Station Unit 1 reactor containment building was subjected to a periodic integrated leak rate test during the period from April 15, 1984 to April 19, 1984. The purpose of this test was to demonstrate the acceptability of the building leakage rate at the calculated design basis accident pressure of 50.6 psig (P_{ac}). The allowable leakage is defined by the design basis accident, applied in the safety analysis, in accordance with site exposure guidelines specified by 10 CFR 100. For Three Mile Island Nuclear Station Unit 1, the maximum allowable integrated leakage rate at the design basis accident pressure is 0.10 percent by weight per day (L_a).

Testing was performed in accordance with the requirements of 10 CRF 50, Appendix J, ANSI N45.4 1972, ANSI/ANS-56.8-1981 and the procedural requirements as stated in GPU Nuclear Corporation Three Mile Island Nuclear Station Unit 1 Surveillance Procedure 1303-6.1. This procedure was recommended for approval by the Three Mile Island Nuclear Station Unit 1 Plant Review Group and approved by the Operations and Maintenance Director TMI 1 prior to the commencement of the test. All testing was performed by GPU Nuclear Corporation with the technical assistance of Volumetrics, Inc. Procedural and calculational methods were witnessed by Nuclear Regulatory Commission personnel and audited by the GPU Nuclear Corporation site Quality Control staff.

The combined local leakage rate from the reactor containment building isolation valves and penetrations, required to be tested by 10 CFR 50 Appendix J, was less than 40 percent of the maximum allowable leakage rate (L_a), well below the allowable value of 60 percent, at 50.6 psig prior to the commencement of the integrated leak rate test.

The 1984 "As Found" leakage through containment isolation valve IC-V3 was about 24,000 sccm. Subsequent repair prior to the ILRT failed to correct the leakage. The leakage actually increased to about 70,000 sccm. During the ILRT IC-V3 was maintained shut with its inboard isolation valve IC-V2 also shut in accordance with the normal ILRT valve lineup requirements. No special consideration or valve lineup was performed on the affected penetration during the ILRT. Repair was accomplished after the ILRT and the "As Left" leakage through IC-V3 was 7813 sccm, which was acceptable.

The calculated leakage rate based on the mass point method of analysis, for a period of 24 hours was found to be 0.0374 percent by weight per day at 50.6 psig. The leakage rate at the upper bound of the 95 percent confidence interval was 0.0405 percent by weight per day which is well below the allowable leakage rate of 0.075 percent by weight per day at 50.6 psig. The low integrated leakage rate from the reactor containment building, approximately one-half of the allowable

leakage rate, provides assurance that the reactor containment building is capable to perform its intended safety function.

Since the Industrial Cooler System was in operation during the integrated leak rate test, addition of the local leakage rate of the system isolation valves, RB-V2A and RB-V7, (1321 sccm and 1201 sccm respectively) to the measured integrated leakage rate must be considered. The combined local leakage rate of these isolation valves is 0.0015 percent by weight per day. The addition of these values changes the calculated leak rate at the upper bound of the 95% confidence level to 0.0420.

The supplemental instrumentation verification at P_{ac} was 15.8% which is within the 25 percent of L_a requirement of 10 CFR 50, Appendix J, Section III A.3(b)

2.0 GENERAL AND TECHNICAL DATA

2.1 GENERAL DATA

Owner:	General Public Utilities Nuclear Corporation
Docket No.:	50-289
Location:	Three Mile Island near the East Shore of the Susquehanna River in Dauphin County, Pennsylvania.
Containment Description:	Reinforced concrete structure composed of cylindrical walls (prestressed with a post-tensioning tendon system in vertical and horizontal directions), with a flat foundation mat (conventional reinforcing) and a shallow dome roof (prestressed utilizing a three-way post tensioning tendon system). The inside surface is lined with a 3/8" thick carbon steel liner.
Date Test Completed:	April 19, 1984

2.2 TECHNICAL DATA

Containment Net Free Volume:	2×10^6 cubic feet
Design Pressure:	55 psig
Design Temperature:	281°F
Calculated Accident Peak Pressure:	50.6 psig
Calculated Accident Peak Temperature:	281°F

3.0 ACCEPTANCE CRITERIA

Acceptance criteria established prior to the test and as specified by 10 CFR 50, Appendix J, ANSI N45.4-1972 and ANSI N56.8-1981 are as follows:

a. The measured leakage rate (L_{am}) at the calculated design basis accident pressure of 50.6 psig (P_{ac}) shall be less than 75 percent of the maximum allowable leakage rate (L_a), specified as 0.10 percent by weight of the building atmosphere per day at the upper bound of the 95 percent confidence level. The acceptance criteria is determined as follows:

$$L_a = 0.10\%/\text{day}$$

$$0.75L_a = 0.075\%/\text{day}$$

b. The test instrumentation shall be verified by means of a supplemental test. Agreement between the containment leakage measured during the Type A test and the containment leakage determined during the supplemental test shall be within 25 percent of L_a.

4.0 TEST INSTRUMENTATION

4.1 SUMMARY OF INSTRUMENTS

Test instruments employed are described in the following subsections:

4.1.1 Temperature Indicating System

Resistance Temperature Detectors

Quantity	23
Manufacturer	Yellow Spring Instr.
Type	YSI Model, 4150-1/4-6-3-138-AW-G1/2-QR (platinum)
Range, °F	60-120
Accuracy, °F	±0.1
Sensitivity, °F	±0.01

4.1.2 Dewpoint Indicating System

Dewcell Elements

Quantity	10
Manufacturer	Foxboro
Type	BD154WB, Lithium Chloride
Range, °F	40-100
Accuracy, °F	±2.0
Sensitivity, °F	±0.1

4.1.3 Pressure Monitoring System

Precision Pressure Gauges

Quantity	2
Manufacturer	Texas Instruments (Modified by Volumetrics to interface with ILRT System)
Type	Model 145.02

Range, psia	0-100
Accuracy, psia	±0.015% of indicated pressure
Sensitivity, psi	±0.001

4.1.4 Supplemental Test Flow Monitoring System

Flowmeter

Quantity	2
Manufacturer	Sierra
Type	Model 14636
Range, scfm	0.0 - 20.0
Accuracy,	±2% reading
Sensitivity, scfm	±0.5% of full scale

4.1.5 Inputs from the aforementioned sensors (with the exception of the output from the mass flowmeters) is forwarded to the Data Acquisition System (DAS) for conversion, display and forwarding to the computer. The installed DAS unit was a Model A-100, manufactured by Volumetrics.

The DAS unit has the capability of monitoring over 100 channels. For the ILRT, the channels were utilized as follows:

a.) Precision Pressure Gauge - 2 channels

b.) RTDs - 24 channels (Channels 1 to 24, 1 installed RTD was not usable during the ILRT)

c.) Dewcells - 10 channels (Channels 30 to 39)

Output from the DAS went to both a hardcopy printer and to a computer.

4.1.6 Sensor input conditioning cards, precision pressure gauges, DAS unit, etc., were purchased as a rack mounted unit from Volumetrics by GPUN in March, 1984. Details of the unit and equipment specifications are available onsite for review.

4.1.7 After the DAS unit converted the signal input into the desired parameter of temperature, pressure, etc., these values were printed out on a hardcopy printer and forwarded to the onsite computer for processing. The computer used averaging and weighting factors as delineated below:

a.) Pressure - average of the two inputs

b.) Temperature - an equal weighting factor of about 4.35% was assigned to each of the 23 operable RTDs. TMI-1 has 24 installed RTDs but one of these (TE-655V) could not be used due to a ground somewhere in one of the leads. This RTD was assigned a weighting factor of zero (0.0%) which effectively removed the signal input from the average temperature determination.

c.) Dewcells - each of the 10 dewcells was assigned a weighting factor of 10%, which effectively resulted in a straight average of the 10 values.

4.1.8 The accuracy of the DAS unit with respect to the different monitored parameters is given below:

a.) Pressure - direct transfer of the number of counts from the precision pressure gauges to the computer.

b.) Dewpoint accuracy: $\pm$ 2.0%°F.

c.) Temperature: $\pm$ 0.1°F. (60°F. to 120°F. range)

4.1.9 All operable RTDs and dewcells were assigned equal weighting factors. This is because:

a.) There are very few cubicles inside the Reactor Building,

b.) There is free communication between all levels of the building and also between the cubicles and the Reactor Building.

c.) The air inside the Reactor Building is continually recirculated by the installed ventilation system.

d.) Almost all of the equipment in the Reactor Building, with the exception of the aforementioned recirculating fans and required instrumentation, was deenergized during the test. This eliminated any heat producing equipment in the building which could cause local hot spots.

e.) No stratification has ever been observed during an ILRT.

4.1.10 See Appendix A for an instrumentation layout followed by a listing of the computer weighting factors.

4.2 SCHEMATIC ARRANGEMENT

The arrangment of the four measuring systems summarized in Section 4.1 is depicted in Appendix A.

The arrangment of temperature sensors can be grouped into five levels as follows:

Level	Elevation	Sensors
1	287 feet	TE-655R TE-655S TE-655T TE-655U
2	314 feet	TE-655M TE-655N TE-655O TE-655P TE-655Q
3	346 feet	TE-655A TE-655G TE-655I TE-655K
4	365 feet to 405 feet	TE-655D TE-655J TE-655L TE-655W TE-655X TE-655B
5	437 feet	TE-655C TE-655E TE-655H TE-655F

The average Reactor Building temperature varied by only .20°F during the 24 hour test. Of the 23 RTDs utilized, TE-655X (365' Elev.) indicated consistently low and TE-655N (314' Elev.) indicated consistently high. The average difference was 2.02°F. These results are summarized in Appendix B.

This analysis demonstrates that there was no large regional temperature variation in the Reactor Building and also that no large temperature fluctuations occurred during this ILRT. Small fluctuations, as discussed in section 5.2.2, were noted. Operation of the three Reactor Building recirculation units provided satisfactory temperature equalization throughout the building.

4.3 CALIBRATION CHECKS

Temperature, dewpoint, pressure and flow measuring systems were checked for calibration before the test in accordance with GPU Nuclear Corporation Procedure 1430-Y-23, as recommended by ANSI N56.8-1981. The results of the calibration checks are on file at Three Mile Island Nuclear Station Unit 1. The supplemental test at 50.6 psig confirmed the instrumentation acceptability.

4.4 INSTRUMENTATION PERFORMANCE

The twenty-three temperature sensors, ten dewcells, two precision pressure gauges, flowmeters, and readout equipment performed satisfactorily throughout the integrated leakage rate test. No sensor or readout equipment malfunctions occurred during performance of the test.

4.5 INSTRUMENTATION SELECTION GUIDE VALUE

Justification of instrumentation selection was accomplished, using manufacturer's sensitivity and repeatability tolerances stated in Section 5.1, by computing the instrumentation selection guide (ISG) value. Utilizing the methods, techniques and assumptions in Appendix G to ANSI N56.8-1981, the ISG was computed for the absolute method as follows:

a. Conditions

$L_a = 0.1\%/\text{day}$

$P = 65$ psia

$T = 72.30\ ^{o}R = 531.99^{o}R$ dry bulb (typical)

$Tdp = 67.2^{o}F$ dewpoint (typical)

$t = 24$ hours

b. Total Absolute Pressure: e_p

Sensor sensitivity error (E): $\pm 0.001\%$ of full scale

Measurement system error (ε): $\pm 0.002\%$ of full scale

$$e_p = \pm \left[(E_p)^2 + (\varepsilon_p)^2 \right]^{1/2} \Big/ \left[\text{no. of sensors} \right]^{1/2}$$

$$e_p = \pm \left[(0.001)^2 + (0.002)^2 \right]^{1/2} \Big/ \left[2 \right]^{1/2}$$

$$e_p = \pm\ 0.0016 \text{ psia}$$

c. Water Vapor Pressure: e_{pv}

Sensor sensitivity error (E): $\pm 0.1^{\circ}F$

Measurement system error (ε), excluding sensor: $\pm 0.1^{\circ}F$

At a dewpoint temperature of $67.2^{\circ}F$, the equivalent water vapor pressure change (as determined from the steam tables) is 0.01149 psia/°F.

$E_{pv} = \pm 0.1^{\circ}F\ (0.01149\ psia/^{\circ}F)$

$E_{pv} = \pm 0.001149$ psia

$\varepsilon_{pv} = \pm 0.1^{\circ}F\ (0.01149\ psia/^{\circ}F)$

$\varepsilon_{pv} = \pm 0.001149$ psia

$$e_{pv} = \pm \left[(E_{pv})^2 + (\varepsilon_{pv})^2 \right]^{1/2} \Big/ \left[\text{no. of sensors} \right]^{1/2}$$

$$e_{pv} = \pm \left[(0.001149)^2 + (0.001149)^2 \right]^{1/2} \Big/ \left[10 \right]^{1/2}$$

$e_{pv} = \pm 0.0005138$ psia

d. Temperature: e_T

No. of Sensors: 23

Sensor sensitivity error (E_T): $\pm 0.01^{\circ}F = \pm 0.01^{\circ}R$

System Error (ε_T): $\pm 0.02^{\circ}F = \pm 0.02^{\circ}R$

$$e_T = \pm \left[(E_T^2) + (\varepsilon_T)^2 \right]^{1/2} \Big/ \left[\text{no. of sensors} \right]^{1/2}$$

$$e_T = \pm \left[(.01)^2 + (0.02)^2 \right]^{1/2} \Big/ \left[23 \right]^{1/2}$$

$e_T = \pm 0.004662^{\circ}R$

e. Instrumentation Selection Guide (ISG)

$$ISG = \pm \frac{2400}{t} \left[2\left(\frac{e_P}{P}\right) + 2\left(\frac{e_{Pv}}{P}\right) + 2\left(\frac{e_T}{T}\right)^2 \right]^{1/2}$$

$$ISG = \pm \frac{2400}{24} \left[2\left(\frac{0.0016}{65}\right)^2 + 2\left(\frac{0.000514}{65}\right)^2 + 2\left(\frac{0.00466}{531.99}\right)^2 \right]^{1/2}$$

ISG = $\pm$ 0.00386

The ISG does not exceed 0.25 L_a (0.025%/day) and it is

therefore concluded that the instrumentation selected was acceptable for use in determining the reactor containment integrated leakage rate.

4.6 SUPPLEMENTAL VERIFICATION

4.6.1 8 Hour Superimposed Test

In addition to the calibration checks described in Section 4.3, test instrumentation operation was verified by a supplemental 8 hour flow test subsequent to the completion of the 24 hour leakage rate test. This test consisted of imposing a known calibrated leakage rate on the reactor containment building. After the flow rate was established, it was not altered for the duration of the test.

During the supplemental test, the calculated leakage rate was

$$L_c = L_{v'} + L_o$$

where,

L_c = calculated composite leakage rate consisting of the reactor building leakage rate plus the imposed leakage rate

L_o = imposed leakage rate

$L_{v'}$ = leakage rate of the reactor building during the supplemental test phase

Rearranging the above equation,

$$L_{v'} = L_c - L_o$$

The reactor containment building leakage during the supplemental test can be calculated by subtracting the known superimposed leakage rate from the calculated composite leakage rate.

The containment building leakage rate during the supplemental test ($L_{v'}$) was then compared to the calculated reactor containment building leakage rate during the preceding 24 hour test (L_{am}) to determine instrumentation acceptability. Instrumentation is considered acceptable if the agreement between the two building leakage rates is within 25 percent of the maximum allowable leakage rate (L_a).

5.0 TEST PROCEDURE

5.1 PREREQUISITES

Prior to commencement of reactor containment building pressurization, the following basic prerequisites were satisfied.

a. Proper operation of all test instrumentation was verified. As noted, one RTD was declared inoperable prior to the start of the test.

b. All reactor containment building isolation valves, with the exception of those within the R. B. Cooling System and Decay Heat System, were closed using the normal mode of operation. All associated system valves were placed in post-accident positions. The Reactor Building Cooling System was in service for temperature control during the test and the Decay Heat System was in service to maintain the plant in a safe condition during the test.

c. Equipment within the reactor containment building, subject to damage, was protected from external differential pressures.

d. Portions of fluid systems which, under post-accident conditions become extensions of the containment boundary, were drained and vented.

e. The Penetration Pressurization and Fluid Block Systems were depressurized. Manometers were installed at penetration pressurization manifolds to provide means for detection of leakage into the system.

f. Manometers or pressure gauges were installed on the purge valve interspaces, and access hatch interspaces to provide means for detection of leakage into such systems.

g. Local leakage rate testing of containment isolation valves and penetrations was concluded except that one containment isolation valve (IC-V3) had high local leakage prior to the ILRT and was repaired and retested after the ILRT.

h. Potential pressure sources were removed or isolated from the containment.

i. All accessible liner weld channels were vented to the containment atmosphere.

j. A general inspection of the accessible interior and exterior areas of the containment was completed.

5.2 TEST PERFORMANCE

5.2.1 Pressurization Phase

Pressurization of the reactor containment was started on April 16, 1984, at 1700. The pressurization rate was approximately 1.9 psi per hour rather than the desired 2.5 psi per hour due to low compressor sizing. Building pressure and temperature were monitored hourly and the amperage required by the recirculation unit fans (AH-E-1A, 1B, 1C) was monitored about every 2 hours. When containment internal pressure reached 12 psig on April 17, 1984, pressurization was secured. Subsequently at 0830, an inspection team entered containment to perform the 12 psig inspection. During the 12 psig inspection, one dewcell and two RTDs were found in their storage position. They were relocated to their proper test position. The 12 psig internal inspection was completely satisfactorily and pressurization was restarted at about 1000 on April 17, 1984.

During pressurization to the 50.6 psig pressure level, the following observations were made:

a. The water in several of the penetration pressurization manometers was blown out. This was apparently due to slight leakage past the fuel transfer tube flange gasket.

b. Manometers on the purge supply and exhaust interspaces were replaced with the original pressure gauges. The purge exhaust and supply interspace showed an increase in pressure indicating slight leakage from the inner valve.

c. A very gradual decrease in pressurizer level was noted as pressure was increased. Concurrently, a gradual increase was noted in Borated Water Storage Tank level. The allowed pressurizer level band was broadened as required to accomodate this level decrease. No makeup water was added to the RCS until after completion of the ILRT. No increase in Reactor Building sump level was observed. This loss of water from the reactor building would cause the leak rate to appear greater than actual.

Final pressurization was secured at 1119 on April 18, when Reactor Building pressure indicated between 50.7 and 50.8 psig. The stabilization period commenced at 1130 on April 18. The stabilization criteria was satisfied and the twenty-four (24) hour test began at 1600. Reactor Building pressure at that time was 50.727 psig with an average temperature of about 72.4°F.

5.2.2 Integrated Leak Rate Testing Phase

At 1600 on April 18, 1984, leakage rate testing was initiated. The following fifteen minute frequency test data was collected (See Appendix C).

a. Pressure indicated by the two precision gages was recorded.

b. The twenty-three RTD temperatures were recorded.

c. The ten dewpoint values were recorded. The average of the ten values was converted to vapor pressure by a computer. This permitted correction of the total pressure to the partial pressure of air by subtracting the vapor pressure.

The use of vapor pressure (P_{wv}), average temperature (T) and the total pressure (P_T) is described in more detail in Section 6.1. All original data is on file at Three Mile Island Nuclear Station Unit 1. The plot of average temperature and weight of air was maintained for each fifteen minute reading (See Appendix D).

At 0100, minor temperature fluctuations were noted due to cycling of the Industrial Cooler. Initially, the Shift Supervisor attempted to regulate air temperature by taking manual control of the system. Small perturbations resulted, however. At 0700, the Shift Supervisor was told to maintain the Industrial Cooler Fans in the existing configuration in manual control. No further temperature perturbations resulted.

The aforementioned temperature and pressure indications were monitored at fifteen minute intervals by the Volumetrics DAS. The data was then forwarded to a local mini-computer and also to a hard copy printer. The data was retained by the computer on a floppy disc. The computer also had a graphics display associated with it to allow the Shift Engineer to monitor and more easily trend ILRT parameters.

Periodically, the calculated and measured leak rate values were obtained. A graphic display of leak rate, temperature, pressure, etc., was also available. This graphics display was very useful in monitoring and trending the inputs into the computer.

At 1600 on April 19, 1984, the integrated leak rate test was concluded. A final computer run for 24 hours of data collection resulted in a calculated containment integrated leakage rate of 0.0374 percent per day. At the 95 percent UCL, the containment integrated leakage rate (corrected for RB-V2A/7) was 0.0420 percent per day. This confirmed the preliminary data and was significantly below the 0.075 percent per day limit at the 95 percent Upper Confidence Level.

5.2.3 <u>Supplemental Leakage Rate Test Phase</u>

8 Hour Superimposed Leak Rate

After the 24 hour integrated leak rate test data was obtained and evaluated, the leakage rate found to be acceptable, and a release permit had been obtained, a known leak rate was imposed at 2000 on

April 18, 1984, on the reactor containment building through a calibrated flowmeter for a period of 8 hours. During this time, temperature, pressure, and vapor pressure were monitored as described above. The average superimposed leak for the 8 hour period was 3.27 SCFM. This value equates to an integrated leak rate of 0.0538. w%/day. If this value is added to the calculated leak rate of 0.0374 w%day, the leak rate is 0.0912 w%/day. This is within 0.0158 w%/day of the 8 hr. leak rate of 0.0754 w%/day, and, therefore, meets the requirements to be within 25% of L_a (0.025) w%/day.

5.2.4 Depressurization Phase

After all required data was obtained and evaluated. The supplemental test results were found to be acceptable. Permission from the Rad Con Department and O&M Director was obtained, and depressurization of the reactor containment building was started. A post test inspection of the building revealed no unusual findings.

6.0 METHODS OF ANALYSIS

6.1 GENERAL DISCUSSION

The absolute method of leakage rate determination was employed during testing at the 50.6 psig pressure level. The Volumetrics computer program calculates the percent per day leakage rate using the mass point method of data analysis. The results presented are based on the mass point method.

The mass point method of computing leakage rates uses the following ideal gas law equation to calculate the weight of air inside containment for each quarter hour:

$$W = \frac{144\ PV}{RT} = \frac{KP}{T}$$

where,

W = mass of air inside containment, lbm

$K = 144\ V/R = 5.3983 \times 10^6 \ \frac{\text{lbm} - {}^{\circ}\text{R} - \text{in.}^2}{\text{lb}_f}$

P = partial pressure of air, psia

T = average internal containment temperature, $^{\circ}R$

$V = 2.0 \times 10^6\ ft^3$

The partial pressure of air, P, is calculated as follows:

$$P = \frac{P_{T1} + P_{T2}}{2} - P_{wv}$$

where,

P_{T1} = true corrected total pressure from PI-390, psia

P_{T2} = true corrected total pressure from PI-391, psia

P_{wv} = partial pressure of water vapor determined by averaging the ten dewpoint temperatures and converting to vapor pressure, psia.

The average internal containment temperature, (T), is calculated as follows:

$$T = \frac{\text{sum of 23 RTDs}}{23} + 459.69^{\circ}R$$

The weight of air is plotted versus time for the 24 hour test and for the 8 hour supplemental test. The Volumetrics computer program fits the locus of these points to a straight line using a linear least squares fit. The equation of the linear least squares fit line is of the form $W = W_o + W_1 t$ where W_1 is the slope in lbm per hour and W_o is the weight at time zero. The least squares parameters are calculated as follows:

$$W_o = \frac{\Sigma t_i^2 \ \Sigma W_i - \Sigma t_i \ \Sigma t_i W_i}{S_{xx}}$$

$$W_1 = \frac{N \ \Sigma t_i W_i - \Sigma t_i \ \Sigma W_i}{S_{xx}}$$

where,

$$S_{xx} = N \ \Sigma t_i^2 - (\Sigma t_i)^2$$

The weight percent leakage per day can then be determined from the following equation:

$$\text{wt. \%/day} = \frac{-2400 W_1}{W_o}$$

where the negative sign is used since W_1 is a negative slope to express the leakage rate as a positive quantity.

6.2 STATISTICAL EVALUATION

After performing the least squares fit, the following statistical parameters were calculated:

a. Standard error of confidence for the curve fit (S_e).

b. Limits of the 95 percent confidence interval for the curve fit.

The significance of the measured leakage rate can then be evaluated in view of the number of data points exceeding the limits of the 95 percent confidence interval and by the magnitude of the upper bound of the 95 percent confidence interval for the leakage rate.

Standard error of confidence is defined as follows:

$$S_e = \left[\frac{\Sigma \left[W_i - (W_o + W_i t_i) \right]^2}{N-2} \right]^{1/2}$$

where,

W_i = observed mass of air

$(W_0 + W_1 t_i)$ = least squares calculated mass of air

N = number of data points

This parameter is an expression of the difference between an observed and a calculated (least squares) mass point. The 95 percent confidence interval of the fit is twice the standard error of confidence ($2S_e$). The "degree-of-fit" is evaluated by determining the number of data points, W_i, not falling in the interval $(W_0 + W_1 t) \pm 2S_e$.

The 95 percent confidence limit for the mass leakage rate was calculated per the formulas in ANSI N56.8, N274. It is a measure of the uncertainty of the measured leakage rate.

7.0 DISCUSSION OF RESULTS

7.1 RESULTS AT P_a

The method used in calculating the mass point leakage rate is defined in Section 6.0. The result of this calculation is a mass point leakage rate using absolute values of 0.0374 %/day.

The 95 percent confidence limit associated with this leakage rate is 0.0031 percent per day. Thus, the leakage rate at the upper bound of the 95 percent confidence interval becomes

$$L_{am} = 0.0374\%/\text{day}$$

$$L_{am} \text{ (at 95\% Confidence Limit)} = L_{am} + 0.0031 = 0.0405\%/\text{day}$$

The measured leakage rate at the upper bound of the 95 percent confidence level is below the acceptance criteria of 0.075 percent per day (0.75 L_a). A comparison of each of the observed weights with the weights calculated using the least squares line reveals only four of the ninety-seven data points do not lie within the 95 percent confidence interval. Therefore, reactor containment building leakage at the calculated design basis accident pressure (P_a) of 50.6 psig is considered to be acceptable.

7.2 SUPPLEMENTAL TEST RESULTS

After conclusion of the 24 hour test at 50.6 psig, a mass flowmeter was placed in service and a flow rate, corrected for pressure and temperature conditions, of 3.27 SCFM was established. This flow rate is equivalent to a leakage rate of 0.0538 percent per day. After the flow was established, it was not altered for the duration of the supplemental test.

The measured leakage rate (L_c) using absolute values during the supplemental test was calculated to be 0.0754 percent per day using the mass point method of analysis. The 95 percent confidence interval associated with this leakage rate is 0.0150 percent per day. Only two of the 33 data points were outside of the 95 percent confidence interval.

The building leakage rate during the supplemental test is then determined as follows:

$$L_{v'} = L_c - L_o$$

$$L_{v'} = 0.0754 - 0.0538\ \%/\text{day}$$

$$L_{v'} = 0.0216\ \%/\text{day}$$

Comparing this leakage rate with the building leakage rate measured during the 24 hour test yields the following:

$$\left| \frac{L_{am} - L_{v'}}{L_a} \right| = \left| \frac{(0.0374-0.0216)}{0.1} \right| = 0.158$$

The building leakage rates agree within 15.8 percent of L_a which is below the acceptance criteria of 25 percent of L_a.

Therefore, the acceptability of the test instrumentation is considered to have been verified.

8.0 TYPE B AND C LEAKAGE RATE HISTORIES

Refer to Appendices G, H, and I for the report on Type B and C testing performed since the previous Type A test.

9.0 REFERENCES

1. SP 1303-6.1, "Reactor Building Integrated Leak Rate Test", Metropolitan Edison Company Surveillance Procedure.

2. ANSI N45.4-1972, "Leakage Rate Testing of Containment Structures for Nuclear Reactors", American Nuclear Society, (March 16, 1972).

3. Steam Tables, American Society of Mechanical Engineers, (1967).

4. 1430-Y-23, "Reactor Building Integrated Leak Rate Test Instrument Calibrations", Metropolitan Edison Company Procedure.

5. ANSI N56.8-1981, N274, "Containment System Leakage Testing Requirements", American Nuclear Society, (February 19, 1981).

6. Volumetrics Performance Test Reports. Document No. 83-02-7682. Dated 4/2/84.

7. 10CFR50 Appendix J.

APPENDICES

APPENDIX A

INSTRUMENTATION

SCHEMATIC

AND VOLUME WEIGHTING DATA

VOLUMETRICS

PASO ROBLES CALIFORNIA

ILRT SUB-VOLUME WEIGHTING PROGRAM

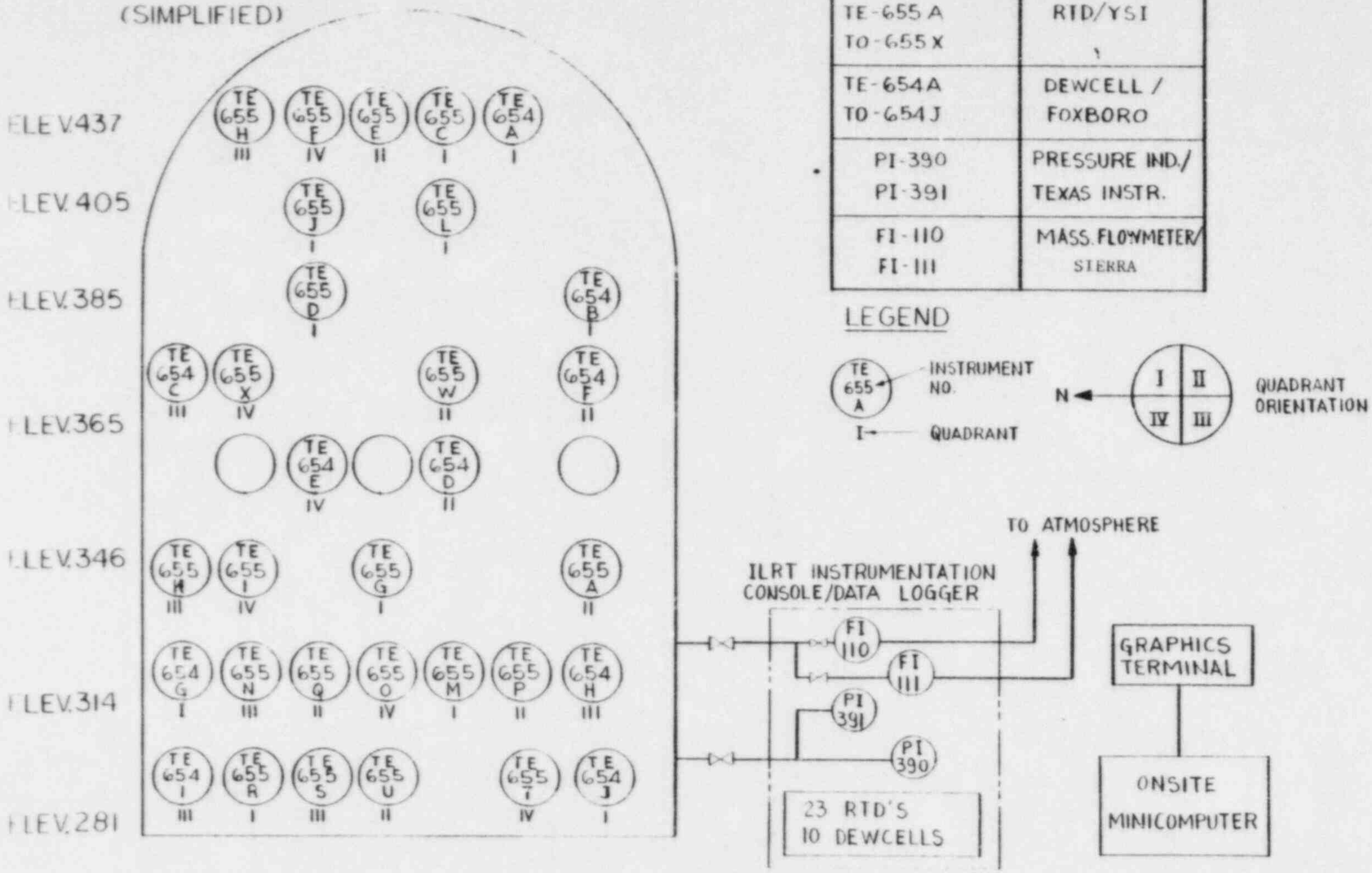
DAS CHANNEL NO.	TYPE OF SENSOR	CONTAINMENT WEIGHTING FACTOR(%)	DAS CHANNEL NO.	TYPE OF SENSOR	CONTAINMENT WEIGHTING FACTOR(%)
1	RTD# 1	4.35	2	RTD# 2	4.35
3	RTD# 3	4.35	4	RTD# 4	4.35
5	RTD# 5	4.35	6	RTD# 6	4.35
7	RTD# 7	4.35	8	RTD# 8	4.35
9	RTD# 9	4.35	10	RTD#10	4.35
11	RTD#11	4.35	12	RTD#12	4.35
13	RTD#13	4.35	14	RTD#14	4.35
15	RTD#15	4.35	16	RTD#16	4.35
17	RTD#17	4.35	18	RTD#18	4.35
19	RTD#19	4.35	20	RTD#20	4.35
21	RTD#21	4.35	22	RTD#22	00.00
23	RTD#23	4.35	24	RTD#24	4.35
25	DEW CELL# 1	10.00	26	DEW CELL# 2	10.00
27	DEW CELL# 3	10.00	28	DEW CELL# 4	10.00
29	DEW CELL# 5	10.00	30	DEW CELL# 6	10.00
31	DEW CELL# 7	10.00	32	DEW CELL# 8	10.00
33	DEW CELL# 9	10.00	34	DEW CELL#10	10.00

NO FAULTY PRESSURE GAGES
THE CONTAINMENT VOLUME IS 0.2000E+07 CUBIC FEET
THE NUMBER OF RTDS IN USE ARE 23.
* THE TOTAL PERCENT FOR RTDS IS 100.000 %
THE NUMBER OF DEW CELLS IN USE IS 10.
THE TOTAL PERCENT FOR DEW CELLS IS 100.000 %

* Individual RTD total greater than 100% due to computer rounding.

APPENDIX A
SCHEMATIC ARRANGEMENT OF TEST INSTRUMENTATION (SIMPLIFIED)

TEST INSTRUMENT	DEVICE / MANUFACTURER
TE-655 A TO-655 X	RTD/YSI
TE-654 A TO-654 J	DEWCELL / FOXBORO
PI-390 PI-391	PRESSURE IND./ TEXAS INSTR.
FI-110 FI-111	MASS. FLOWMETER/ SIERRA



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APPENDIX B

Average Temperature and Maximum Temperature Differential for the Reactor Building

APPENDIX B

Average Temperature and Maximum Temperature

Differential in the Reactor Building

DATE	TIME	AVG. TEMP.	TE655 N HI TEMP.	TE655 X LOW TEMP.	(Hi-Lo)
4/17/84	1600	72.37°	73.53°	71.64°	1.89°
	1700	72.35°	73.50°	71.60°	1.9°
	1800	72.32°	73.51°	71.37°	2.14°
	1900	72.31°	73.49°	71.59°	1.9°
	2000	72.33°	73.51°	71.52°	1.99°
	2100	72.31°	73.47°	71.40°	2.07°
	2200	72.32°	73.50°	71.41°	2.09°
	2300	72.30°	73.48°	71.34°	2.14°
4/18/84	2400/0000	72.36°	73.50°	71.68°	1.82°
	0100	72.37°	73.59°	71.71°(1)	1.88°
	0200	72.33°	73.53°	71.51°	2.02°
	0300	72.25°	73.43°	71.39°	2.04°
	0400	72.22°	73.38°	71.51°(2)	1.87°
	0500	72.23°	73.42°	71.31°	2.11°
	0600	72.42°	73.57°	71.58°	1.99°
	0700	72.27°	73.47°	71.42°	2.05°
	0800	72.26°	73.44°	71.29°	2.15°
	0900	72.31°	73.47°	71.45°	2.02°
	1000	72.28°	73.47°	71.35°	2.12°
	1100	72.32°	73.46°	71.40°	2.06°
	1200	72.28°	73.43°	71.39°	2.04°

1300	72.29°	73.49°	71.43°	2.06°
1400	72.32°	73.52°	71.49°	2.03°
1500	72.33°	73.50°	71.46°	2.04°
1600	72.32°	73.51°	71.42°	2.09°
Avg.:	72.31°	73.49°	71.48°	2.01°

(1) RTDs J and X both had the same reading.

(2) RTD J was low reading.

APPENDIX C

Reduced Leakage Rate Data

(24 Hour Test)

TIME	AVG. TEMP.	AVG. PRESS. *	OBSERVED MASS	LOWER BOUND MASS	CALCULATED MASS **	UPPER BOUND MASS	DIFFERENCE (OBSERVED-CALCULATED)
0	532.06	64.729	656742.77	656666.33	656737.83	656809.34	[illegible].9398245
.25	532.03	64.728	656769.66	656663.78	656735.28	656806.78	34.382045
.5	532.04	64.724	656716.73	656661.22	656732.72	656804.22	-15.991442
.75	532.03	64.726	656749.37	656658.66	656730.17	656801.67	19.201928
1	532.04	64.724	656716.73	656656.11	656727.61	656799.11	-10.878342
1.25	532.03	64.725	656739.22	656653.55	656725.05	656796.55	14.168419
1.5	532.01	64.727	656784.2	656650.99	656722.5	656794	61.707929
1.75	532.01	64.725	656763.91	656648.44	656719.94	656791.44	43.970499
2	532.01	64.722	656733.47	656645.88	656717.38	656788.88	16.086079
2.25	532.04	64.724	656716.73	656643.32	656714.83	656786.33	1.9044065
2.5	532.01	64.721	656723.32	656640.77	656712.27	656783.77	11.052189
2.75	532.02	64.722	656721.12	656638.21	656709.71	656781.21	11.411579
3	532	64.719	656715.37	656635.66	656707.16	656778.66	8.2153513
3.25	532.05	64.717	656633.36	656633.1	656704.6	656776.1	-71.236122
3.5	532.01	64.719	656703.03	656630.54	656702.04	656773.54	.98440899
3.75	532.03	64.725	656739.22	656627.99	656699.49	656770.99	39.733917
4	532.02	64.72	656700.83	656625.43	656696.93	656768.43	3.9007297
4.25	532	64.724	656766.11	656622.87	656694.37	656765.87	71.734002
4.5	532	64.72	656725.52	656620.32	656691.82	656763.32	33.70183
4.75	532	64.723	656755.96	656617.76	656689.26	656760.76	66.699922
5	532	64.72	656725.52	656615.2	656686.7	656758.21	38.81493
5.25	532.01	64.717	656682.73	656612.65	656684.15	656755.65	-1.413722
5.5	531.99	64.717	656707.42	656610.09	656681.59	656753.09	25.830613
5.75	532	64.716	656684.93	656607.53	656679.03	656750.54	5.8958575
6	532.01	64.718	656692.88	656604.98	656676.48	656747.98	16.402917
6.25	532	64.71	656624.05	656602.42	656673.92	656745.42	-49.874126
6.5	532	64.708	656603.75	656599.86	656671.36	656742.87	-67.611937
6.75	531.97	64.711	656671.22	656597.31	656668.81	656740.31	2.4164865
7	531.99	64.707	656605.95	656594.75	656666.25	656737.75	-60.303801
7.25	531.97	64.71	656661.08	656592.19	656663.69	656735.2	-2.6181666
7.5	532.26	64.747	656678.56	656589.64	656661.14	656732.64	17.421169
7.75	532.1	64.727	656673.11	656587.08	656658.58	656730.08	14.532445
8	532.05	64.714	656602.92	656584.52	656656.03	656727.53	-53.100357

* Corrected for water vapor pressure
** Least squares fit

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TIME	AVG. TEMP.	AVG. PRESS.	OBSERVED MASS	LOWER BOUND MASS	CALCULATED MASS	UPPER BOUND MASS	DIFFERENCE (OBSERVED-CALCULATED)
8.25	532.01	64.711	656621.85	656581.97	656653.47	656724.97	-31.617063
8.5	532.09	64.719	656604.29	656579.41	656650.91	656722.41	-46.620227
8.75	532.22	64.736	656616.34	656576.85	656648.36	656719.86	-32.015009
9	532.06	64.718	656631.17	656574.3	656645.8	656717.3	-14.630781
9.25	532.05	64.715	656613.07	656571.74	656643.24	656714.74	-30.171381
9.5	532.03	64.712	656607.31	656569.18	656640.69	656712.19	-33.371346
9.75	532	64.707	656593.61	656566.63	656638.13	656709.63	-44.52397
10	532.02	64.71	656599.36	656564.07	656635.57	656707.07	-36.210066
10.25	531.96	64.707	656642.98	656561.52	656633.02	656704.52	9.9607818
10.5	531.97	64.704	656600.19	656558.96	656630.46	656701.96	-30.269536
10.75	531.96	64.704	656612.53	656556.4	656627.9	656699.4	-15.369949
11	531.94	64.704	656637.22	656553.85	656625.35	656696.85	11.874067
11.25	531.91	64.702	656653.96	656551.29	656622.79	656694.29	31.167502
11.5	531.92	64.701	656631.46	656548.73	656620.23	656691.73	11.230369
11.75	531.93	64.702	656629.27	656546.18	656617.68	656689.18	11.591114
12	531.91	64.699	656623.51	656543.62	656615.12	656686.62	8.390459
12.25	531.89	64.691	656567.01	656541.06	656612.56	656684.07	-45.557024
12.5	531.9	64.695	656595.26	656538.51	656610.01	656681.51	-14.747927
12.75	531.92	64.696	656580.72	656535.95	656607.45	656678.95	-26.730415
13	531.92	64.699	656611.17	656533.39	656604.89	656676.4	6.2722546
13.25	531.86	64.695	656644.64	656530.84	656602.34	656673.84	42.302782
13.5	531.9	64.696	656605.41	656528.28	656599.78	656671.28	5.6273608
13.75	532.02	64.706	656558.78	656525.72	656597.22	656668.73	-38.449015
14	532.11	64.71	656488.31	656523.17	656594.67	656666.17	-106.36115
14.25	532.09	64.717	656584	656520.61	656592.11	656663.61	-8.1105105
14.5	532.01	64.701	656520.38	656518.05	656589.55	656661.06	-69.173216
14.75	531.94	64.7	656596.63	656515.5	656587	656658.5	9.6290134
15	531.96	64.704	656612.53	656512.94	656584.44	656655.94	28.091397
15.25	531.96	64.699	656561.79	656510.38	656581.89	656653.39	-20.09177
15.5	531.95	64.701	656594.43	656507.83	656579.33	656650.83	15.103595
15.75	531.94	64.697	656566.18	656505.27	656576.77	656648.27	-10.589763
16	531.95	64.702	656604.58	656502.71	656574.22	656645.72	30.364829

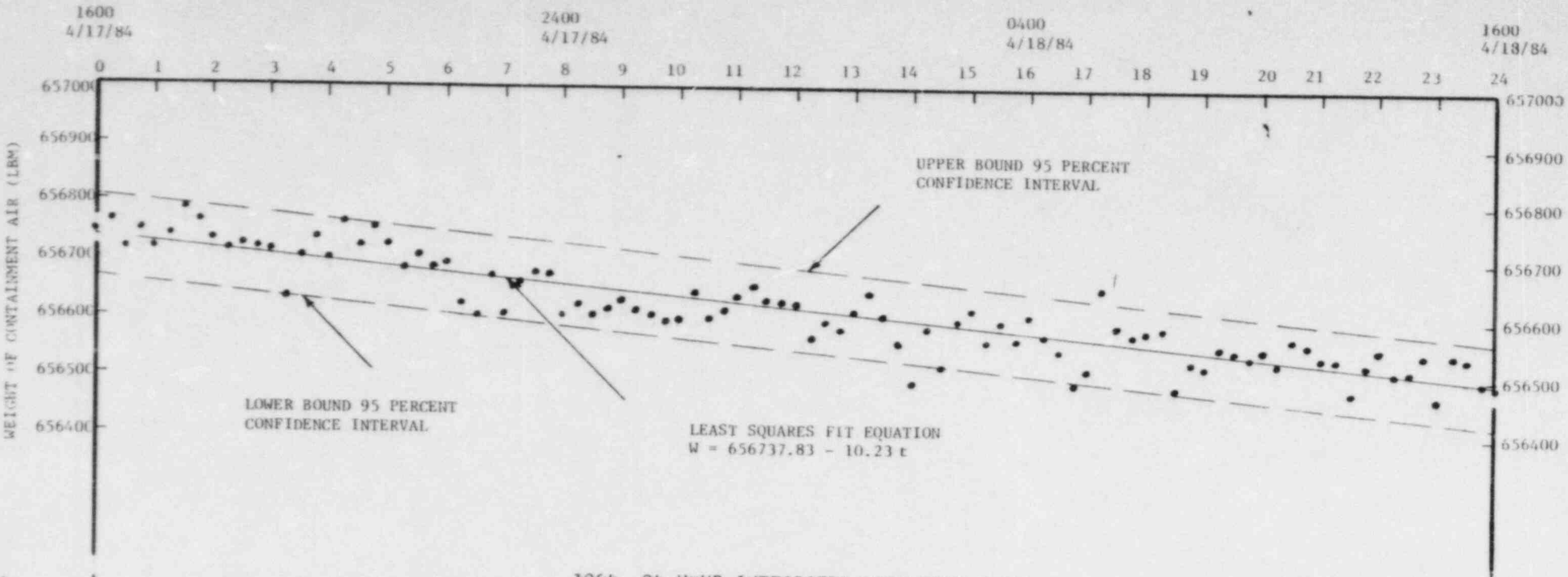
TIME	AVG. TEMP.	AVG. PRESS.	OBSERVED MASS	LOWER BOUND MASS	CALCULATED MASS	UPPER BOUND MASS	DIFFERENCE (OBSERVED-CALCULATED)
16.25	531.96	64.7	656571.94	656500.16	656571.66	656643.16	.28237221
16.5	531.94	64.695	656545.89	656497.6	656569.1	656640.6	-23.216763
16.75	531.97	64.693	656488.56	656495.04	656566.55	656638.05	-77.981071
17	532	64.699	656512.43	656492.49	656563.99	656635.49	-51.56147
17.25	531.92	64.704	656661.91	656489.93	656561.43	656632.93	100.47713
17.5	531.93	64.698	656588.67	656487.38	656558.88	656630.38	29.797695
17.75	531.95	64.699	656574.14	656484.82	656556.32	656627.82	17.816275
18	531.97	64.702	656579.89	656482.26	656553.76	656625.26	26.131452
18.25	531.94	64.699	656586.48	656479.71	656551.21	656622.71	35.272385
18.5	532	64.696	656481.99	656477.15	656548.65	656620.15	-66.663713
18.75	531.98	64.698	656526.96	656474.59	656546.09	656617.59	-19.131338
19	532.01	64.701	656520.38	656472.04	656543.54	656615.04	-23.15532
19.25	531.99	64.702	656555.21	656469.48	656540.98	656612.48	14.230282
19.5	531.97	64.699	656549.45	656466.92	656538.42	656609.93	11.027493
19.75	532.02	64.704	656538.48	656464.37	656535.87	656607.37	2.6145816
20	531.97	64.699	656549.45	656461.81	656533.31	656604.81	16.140592
20.25	532.02	64.703	656528.34	656459.25	656530.75	656602.26	-2.4191178
20.5	531.97	64.701	656569.75	656456.7	656528.2	656599.7	41.549197
20.75	532.07	64.712	656557.95	656454.14	656525.64	656597.14	32.310918
21	531.98	64.699	656537.11	656451.58	656523.08	656594.59	14.025172
21.25	532.03	64.705	656536.29	656449.03	656520.53	656592.03	15.760236
21.5	532.02	64.698	656477.6	656446.47	656517.97	656589.47	-40.370364
21.75	531.99	64.699	656524.77	656443.91	656515.42	656586.92	9.3536666
22	532.01	64.704	656550.82	656441.36	656512.86	656584.36	37.964247
22.25	532.05	64.705	656511.61	656438.8	656510.3	656581.8	1.3069388
22.5	531.99	64.698	656514.62	656436.24	656507.75	656579.25	6.8759447
22.75	531.99	64.701	656545.06	656433.69	656505.19	656576.69	39.874608
23	532.02	64.697	656467.45	656431.13	656502.63	656574.13	-35.177864
23.25	532.03	64.706	656546.43	656428.57	656500.08	656571.58	46.359242
23.5	532.02	64.704	656538.48	656426.02	656497.52	656569.02	40.962828
23.75	532.02	64.7	656497.89	656423.46	656494.96	656566.46	2.9321821
24	532.01	64.698	656489.94	656420.9	656492.41	656563.91	-2.4652935

```
W0 (THE LEAST SQUARES EQ. INTERCEPT POINT= W0 =  656737.83
W1 (THE LEAST SQUARES EQ. SLOPE           = W1 = -10.226199
SEOC (STANDARD ERROR OF CONFIDENCE)       = SEOC =  35.750628
95 PERCENT CONFIDENCE LEAK RATE           = LR95 =  .0031471543
LEAKAGE RATE                              = LR =  .037370891
```

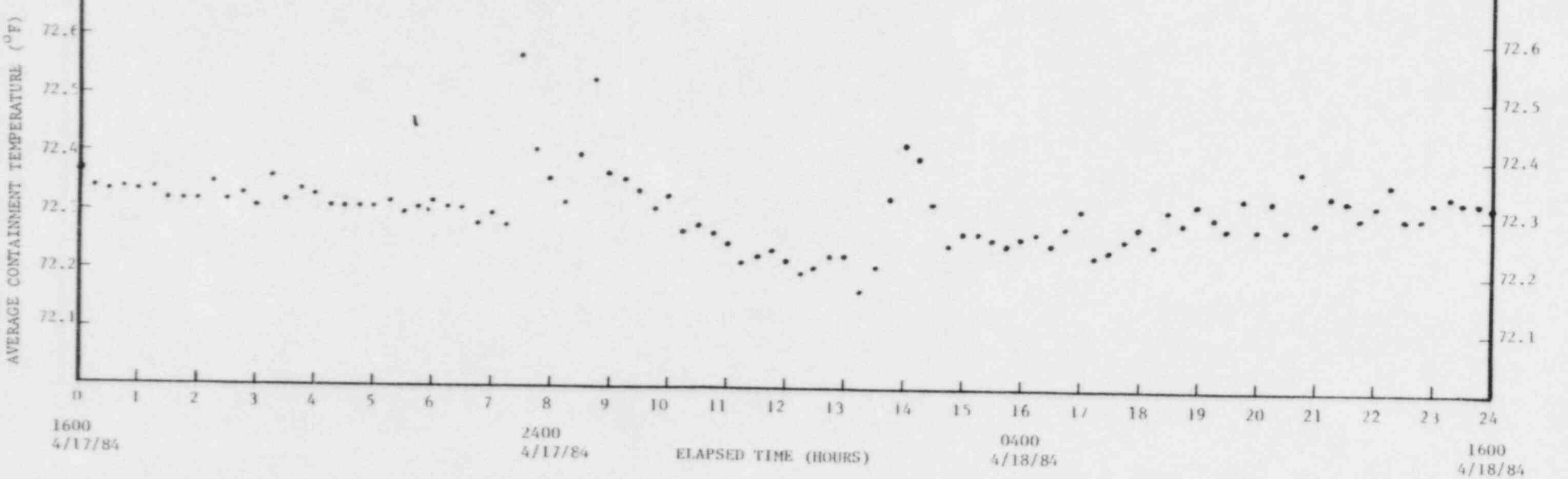
APPENDIX D

MASS/TEMPERATURE PLOT

(24 Hour Test)



1984 24 HOUR INTEGRATED LEAK RATE TEST
THREE MILE ISLAND UNIT 1



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APPENDIX E

Reduced Leakage Rate Data

(8 Hour Superimposed Leak Test)

TIME	AVG. TEMP.	AVG. PRESS. *	OBSERVED MASS	LOWER BOUND MASS	CALCULATED MASS **	UPPER BOUND MASS	DIFFERENCE (OBSERVED-CALCULATED)
0	532.01	64.699	656500.09	656395.89	656462.03	656528.17	38.058227
.25	532.03	64.696	656444.97	656390.73	656456.87	656523.01	-11.90328
.5	532.03	64.697	656455.12	656385.58	656451.71	656517.85	3.4007087
.75	532.01	64.693	656439.21	656380.42	656446.56	656512.7	-7.3515699
1	532.01	64.69	656408.76	656375.26	656441.4	656507.54	-32.635159
1.25	532	64.694	656461.69	656370.1	656436.24	656502.38	25.449454
1.5	532	64.691	656431.25	656364.95	656431.09	656497.22	.16529339
1.75	532.05	64.693	656389.85	656359.79	656425.93	656492.07	-36.073741
2	532.02	64.695	656447.16	656354.63	656420.77	656486.91	26.390311
2.25	532.04	64.695	656422.48	656349.47	656415.61	656481.75	6.8710826
2.5	532.02	64.695	656447.16	656344.32	656410.46	656476.59	36.705072
2.75	532.02	64.689	656386.28	656339.16	656405.3	656471.44	-19.018341
3	532.04	64.694	656412.34	656334	656400.14	656466.28	12.196806
3.25	531.99	64.688	656413.15	656328.84	656394.98	656461.12	18.164008
3.5	531.99	64.682	656352.26	656323.69	656389.83	656455.97	-37.562838
3.75	532	64.689	656410.96	656318.53	656384.67	656450.81	26.287357
4	532.01	64.685	656358.03	656313.37	656379.51	656445.65	-21.481542
4.25	532.01	64.688	656388.47	656308.22	656374.35	656440.49	14.116808
4.5	532	64.685	656370.37	656303.06	656369.2	656435.34	1.1707761
4.75	532.01	64.686	656368.18	656297.9	656364.04	656430.18	4.1375893
5	532.03	64.685	656333.36	656292.74	656358.88	656425.02	-25.525742
5.25	532.02	64.68	656294.96	656287.59	656353.72	656419.86	-56.765728
5.5	532	64.682	656339.93	656282.43	656348.57	656414.71	-8.6412434
5.75	532.01	64.684	656347.88	656277.27	656343.41	656409.55	4.4731317
6	532.02	64.685	656345.69	656272.11	656338.25	656404.39	7.4404087
6.25	532.02	64.68	656294.96	656266.96	656333.1	656399.23	-38.136206
6.5	532.04	64.679	656260.14	656261.8	656327.94	656394.08	-67.796131
6.75	532.01	64.685	656358.03	656256.64	656322.78	656388.92	35.249643
7	531.98	64.682	656364.6	656251.48	656317.62	656383.76	46.9784
7.25	531.95	64.681	656391.47	656246.33	656312.47	656378.6	79.004167
7.5	532	64.675	656268.9	656241.17	656307.31	656373.45	-38.412463
7.75	531.95	64.67	656279.84	656236.01	656302.15	656368.29	-22.310549
8	531.97	64.678	656336.35	656230.85	656296.99	656363.13	39.355288

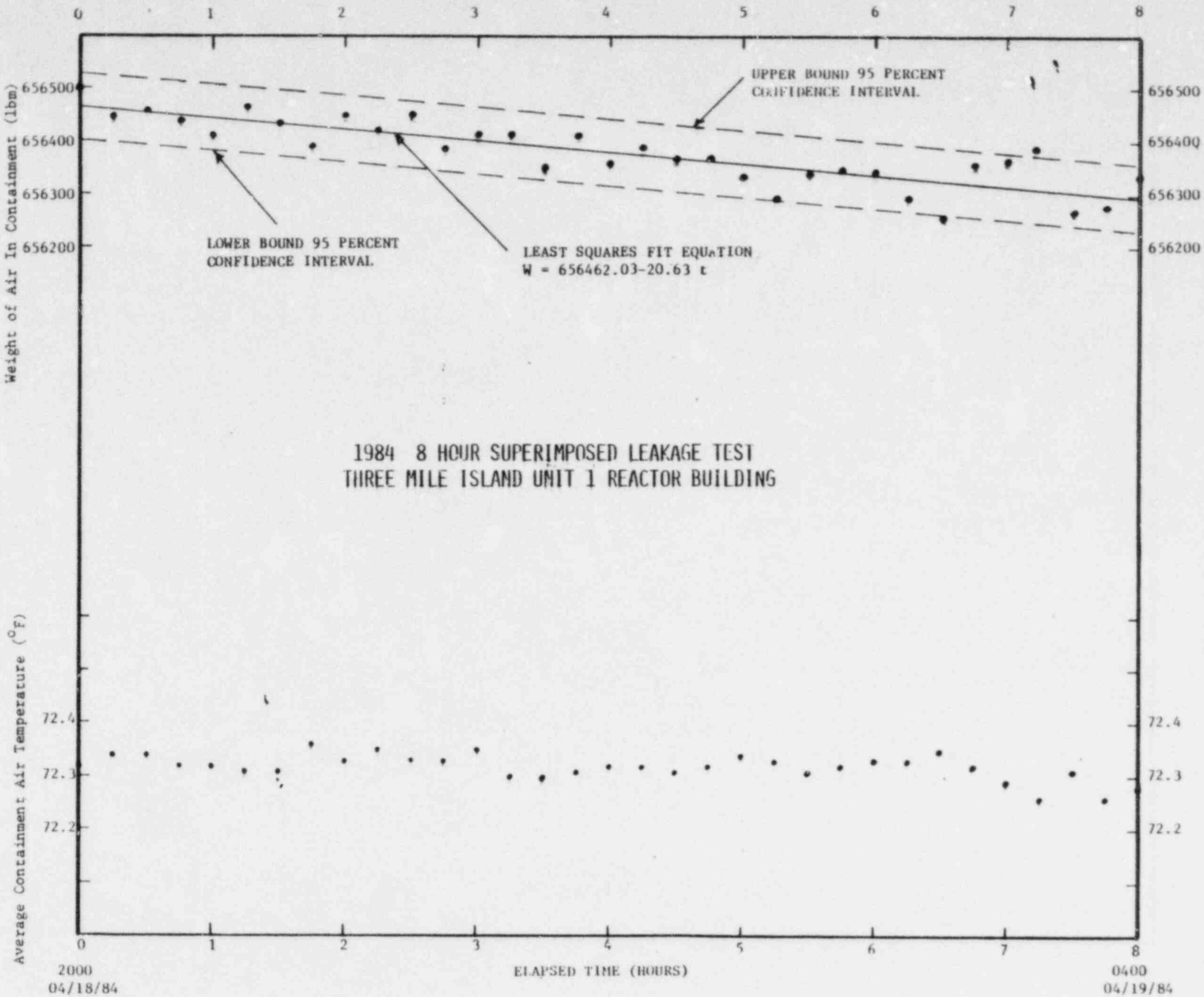
W0 (THE LEAST SQUARES EQ. INTERCEPT POINT= W0 = 656462.03
W1 (THE LEAST SQUARES EQ. SLOPE = W1 = -20.629522
SEOC (STANDARD ERROR OF CONFIDENCE) = SEOC = 33.069485
95 PERCENT CONFIDENCE LEAK RATE = LR95 = .014987951
LEAKAGE RATE = LR = .07542074

* Corrected for water vapor
** Least squares fit

APPENDIX F

MASS/TEMPERATURE PLOT

(8 Hour Superimposed Test)



1984 8 HOUR SUPERIMPOSED LEAKAGE TEST
THREE MILE ISLAND UNIT 1 REACTOR BUILDING
UPPER BOUND 95 PERCENT CONFIDENCE INTERVAL
LOWER BOUND 95 PERCENT CONFIDENCE INTERVAL
LEAST SQUARES FIT EQUATION
W = 656462.03-20.63 t
Weight of Air In Containment (lbm)
656500
656400
656300
656200
Average Containment Air Temperature (°F)
72.4
72.3
72.2
0
1
2
3
4
5
6
7
8
ELAPSED TIME (HOURS)
2000
04/18/84
0400
04/19/84

Π9000

APPENDIX G

THREE MILE ISLAND UNIT 1

1982 REACTOR BUILDING LOCAL LEAK RATE TESTING REPORT

SP 1303-11.18

08/09/81 - 10/12/82

<u>INDEX - 1982 R. B. LOCAL LEAK RATE TESTING REPORT</u>

REACTOR BUILDING LOCAL LEAK RATE TESTING REPORT

1982 REFUELING FREQUENCY

1. PURPOSE

1.1 To provide analysis to the Nuclear Regulatory Commission on the type B and type C leakage tests performed on the Three Mile Island Unit 1 Reactor Building in the interval between the sixth and seventh periodic refueling frequency leak tests.

This is in accordance with "Reactor Containment Leakage Testing for Water Cooled Power Reactors". Appendix J, Part 50, Title 10 Code of Federal Regulations which required the contents of this summary report to become part of the Type A test report along with the details of any other type B and type C testing performed since the previous type A test (also required per technical specification 4.4.1.1.8).

The unit has been in cold shutdown since the March 28, 1979 Unit II accident.

2. SUMMARY OF WORK ACCOMPLISHED

2.1 Valve Testing/Repairs

During the time period covered by this report Appendix J Type B and C leak tests were performed on the components as listed below.

1. AH-V1A/1B/1C/1D

2. Personnel Access Hatch.

3. Emergency Access Hatch.

Monthly leak checks were done when convenient starting in May 1982 in addition to annual tests of R. B. Purge valves AH-V1A/B/C/D due to recurring seat leakage. Results on these leak checks were used to expedite timely adjustments/repairs.

2.2 Access Hatch Testing/Repairs

2.2.1 Door Seals SP 1303-11.25 - Several door seal tests were performed though not required in the cold shutdown plant conditions by Technical Specifications. No repairs were required.

2.2.2 Overall Hatch Test

Semi-annual integrated type leak tests were performed on each access hatch in 1982 as required by Technical Specification 4.4.1.2.5. Due to higher than desirable leakage on the personnel access hatch for the beginning of year test some tubing fittings were tightened and a satisfactory retest was performed. Also it was suspected that the strongbacks for the doors had been tightened unevenly.

2.3 <u>Penetration Pressurization SP 1303-11.24</u>

Quarterly readings were recorded from the flow rotameters which supply air pressure or nitrogen pressure to reactor building mechanical and electrical penetrations as required by Technical Specification 4.4.1.2.5. No penetration leakage problems were noted although flow meter malfunctions required meter repair, and occasional tubing leaks in the air supply system were found and eliminated.

3. METHODS OF TESTING

3.1 Valve Test Methods

Testing was performed by use of TMI Unit 1 surveillance procedure SP 1303-11.18 Reactor Building Local Leak Rate Testing. This procedure gives detailed guidance on the test equipment and methods to be used for each penetration/valve. The following general philosophy is contained in the surveillance procedure.

3.1.1 Use air or nitrogen at a pressure differential across the valve greater than P_a (calculated accident pressure). 55 psig was normally used.

3.1.2 Assure that the pressure is exerted in the accident test direction unless it can be demonstrated that pressurizing in the opposite direction is as conservative. Butterfly valves AH-V1A/1B/1C/1D, and globe valves WDG-V14, SA-V3, and IA-V20 were tested in the reverse direction.

3.1.3 Assure that the test volume is drained of liquid so that air or nitrogen test pressure is against valve seats.

3.1.4 Assure that the test verifies valve packing integrity in those cases where the packing would be an R. B. leakage boundary.

3.1.5 Assure adequate time period for stabilization of test conditions.

3.1.6 Assure test equipment is calibrated and used in a manner consistent with the data accuracy desired (weekly meter standardization was performed to verify meters accurate within ± 4% full scale. -- MP 1430-Y-22).

3.1.7 Assure that the fluid blocking system is drained and vented during tests on the associated containment isolation valves to prevent any effects it might have on the test results (most of the F. B. system piping is seismic 3).

3.1.8 Assure valves to be tested are closed by the normal method prior to testing.

3.1.9 Document as-found conditions (prior to adjustments/repairs) and as-left conditions.

3.1.10 Record test instrument <u>scale</u> readings prior to doing any data corrections.

3.1.11 Assure that system drains and vents which could serve as containment isolation valves, are closed and capped and tagged after completion of the test program.

A training program prior to the refueling outage was performed to help assure that the above philosophy was understood by the personnel involved in the testing.

3.2 Access Hatch Test Methods

3.2.1 Door Seal Leak Tests-Method

Door seal leak tests were performed by use of SP 1303-11.25. This procedure gives detailed guidance on the test equipment and methods to be used.

The door seal tests are performed by pressurizing the interspace between the double seals on each door with metered air at the manufacturers recommended test pressure of 10 psig. After stabilization the air rotameter indicates the rate of air input required to maintain the test pressure.

3.2.2 Overall Hatch Leak Test -- Semi-annual overall hatch leak testing was performed by use of TMI Unit 1 Surveillance Procedure SP 1303-11.18 Reactor Building Local Leak Rate Testing. This procedure gives detailed guidance on the test equipment and methods to be used. The overall integrated leak test verifies the integrity of all of the following barriers:

a. Hatch shell/welds,

b. Rubber door seals,

c. Teflon operating shaft packing,

d. Bulkhead electrical penetrations,

e. Penetration pressurization check valves,

f. Emergency air flange and associated "O" rings on outer bulkhead,

g. Bulkhead equalizing ball valves and associated mounting flanges/"O" rings.

The overall leak test is performed by pressurizing the hatch to greater than calculated accident pressure and observing the rate of pressure drop on a high accuracy (Heise) pressure gage.

Pressure corrections are made by reference to a barometer. Minimum test duration is 4 hours after a 1 hour stabilization period.

3.3 Penetration Pressurization - Method

Quarterly readings were taken on the flow rotameters which are permanently installed in the penetration pressurization system. These readings represent the air/nitrogen makeup rate required to maintain approximately 60 psig in mechanical penetrations and 30 psig in electrical penetrations. High meter readings have occasionally occurred but these have been attributed to leaks in the compression fittings in the penetration pressurization system or to malfunctioning (stuck) rotameters. Testing was per plant surveillance procedure SP 1303-11.24.

4. TEST EQUIPMENT USED

4.1 Valve Test Equipment (See Figure 1)

a. Rotameters - Sets of 3

Mfgr. - Brooks Inst. Co.

Model - 1114 Full View

Ranges:

Float Mat'l.	Tube No.	Range
Pyrex	R-2-15D	8-1,120 SCCM
Saphire	R-2-15C	100-12,000 SCCM
Carboloy	R-6-15B	1,000-142,000 SCCM

Accuracy ± 2% full scale industrial accuracy

b. Temperature Indicators (as follows or similar)

Mfgr. - Ashcroft

Model - EH or AH / 3" or 5" Dial

Range - 30°-130°F

Accuracy - ± 2°F

c. Pressure Indicators (as follows or similar)

Mfgr. - Ashcroft

Model - 1279 - 4-1/2" Dial

Range - 0-60 or 0-100 psig

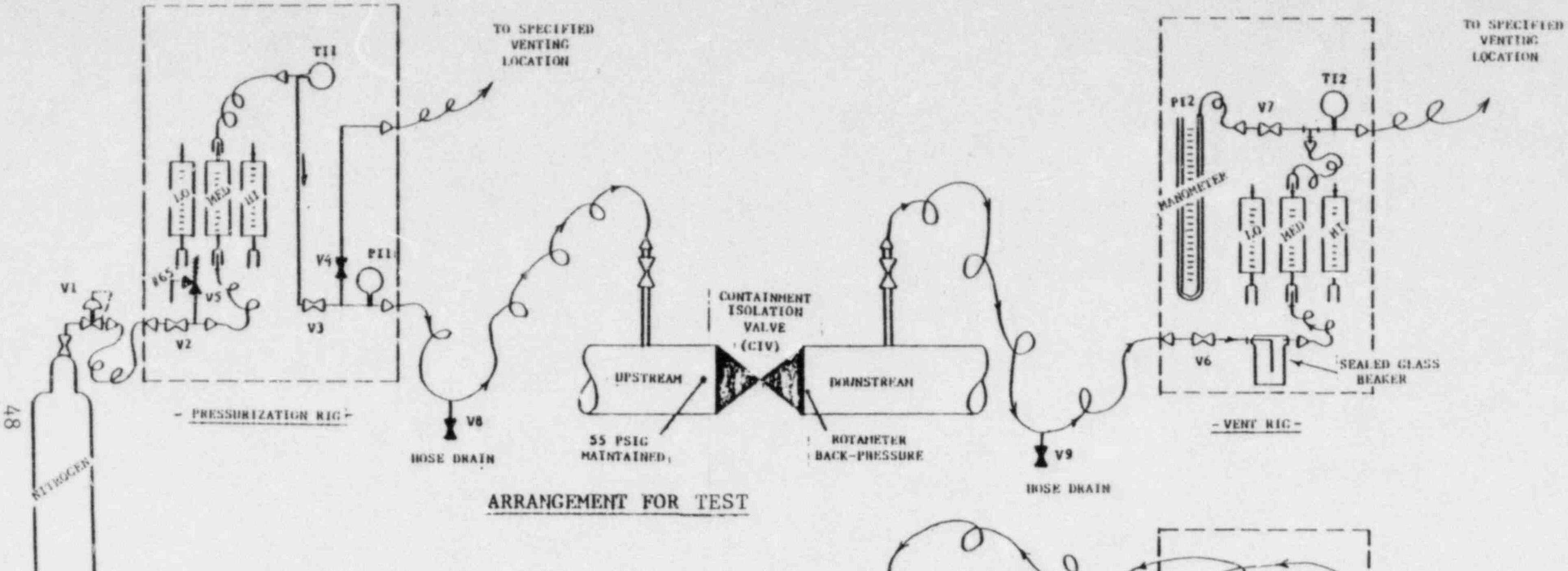
Accuracy - ± 2 psig

d. Pressure Regulator (as follows or similar)

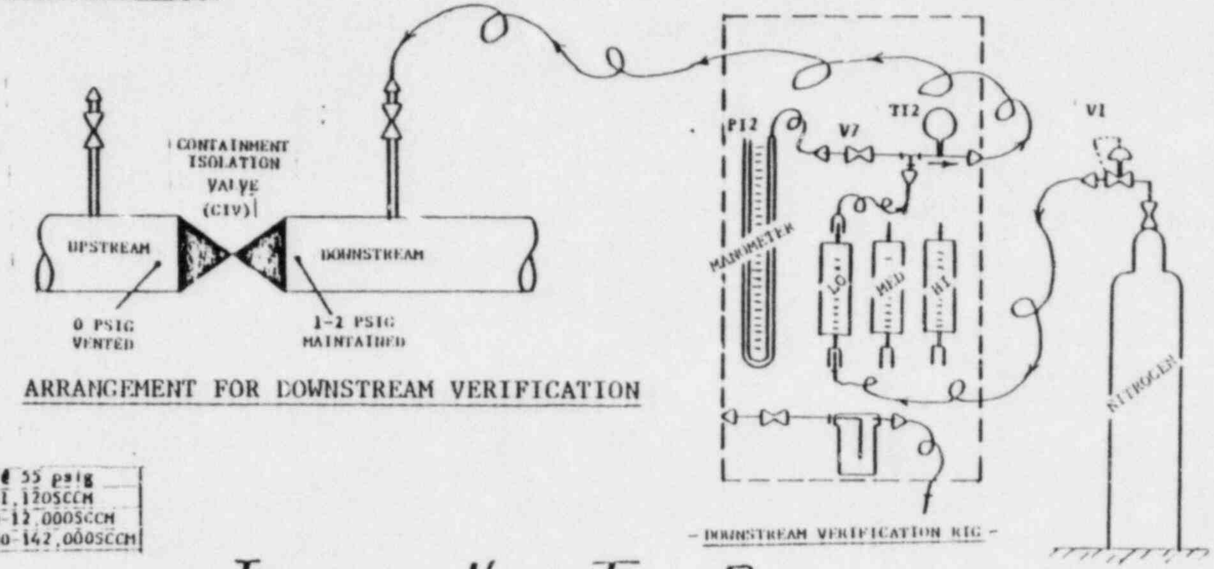
Mfgr. - Union Carbide Corp.

Model - UPG 3-75-580

Range - 0-100 psi output / 0-3000 psi input



ARRANGEMENT FOR TEST



ARRANGEMENT FOR DOWNSTREAM VERIFICATION

48

VALVES

V1-Nitrogen Bottle Regulator
V2/V3/V6/V7-3/8 or 1/2" Ball Valve
V4-Toggle Type Globe Valve
V5-65# Safety Valve

PRESSURE INDICATORS

PI1-0 to 60 psig usage range with 2 psi increments
PI2-Manometer with 36 inch long scale

TEMPERATURE INDICATORS

TI1/TI2-0-100°F usage range with 2°F increments

ROTAMETERS

	Tube#	Float	Range @ 0 psig	Range @ 55 psig
Lo	R-2-150	Black Glass	8-380SCCM	45-1,120SCCM
Med	R-2-15-C	Syn. Saphire	100-5,300SCCM	200-12,000SCCM
High	R-6-15-B	Carboloy	1,000-61,000SCCM	2000-142,000SCCM

FIGURE 1

RLJ 1/13/83

0006U

- ISOLATION VALVE TEST RIG -

e. Calibration Rotameters (Set of 2)

Mfgr. - Brooks Inst. Co.

Models - 1110-05K2B1Z49, 1110-08K2B1Z06

Ranges - 20-16,000 SCCM, 3,600-234,000 SCCM

Repeatability - ± 1/4% of instantaneous

Accuracy - ± 1% instantaneous

f. Flow rate Calibrator

Mfgr. - Brooks Inst. Co.

Model - 1056A

Range 0 to 2,400 SCCM

Accuracy - ± 0.2% of indicated volume

4.2 <u>Access Hatch Test Equipment</u>

a. Precision Pressure Gage (as follows or similar)

Mfgr. - Heise

Model - CM

Range - 0.60 psig

Resolution - 0.25 psig

Accuracy - 0.1%

b. Barometer (as follows or similar)

Mfgr. - Pennwalt

Model - FA185260A

Range - 10.8 - 15.5 psia

Resolution - 0.005 psia

Accuracy - 0.1%

4.3 Penetration Pressurization Test Equipment

a. Flow Rotameters - (Permanent System Equipment)

Mfgr. - Brooks Inst. Co.

Model - 1114

Range - 0-10 SCFH at 60 psia air

Accuracy - ± 2% Industrial accuracy

5. SUMMARY AND INTERPRETATION OF DATA

5.1 Valve Test Results

There was no complete leak test program during the time period covered by this report. Following are the results for those few valves/penetrations which were tested:

1. AH-V1A/1B Not pressurizable to test pressure **

2. AH-V1C/1D Not pressurizable to test pressure **

5.2 Access Hatch Test Results

	SCCM	
	Personnel	Emergency
Beginning Year	6164/1205 1/30/82	2970/2970 11/27/81
Mid Year	1813/1813 5/29/82	1107/1107 5/21/82

5.2.1 Door Seal Leakage - SP 1303-11.25

None of the door seal leak tests exceeded the 3 SCFH administrative leakage limit. Typically, the leakage was less than 1 SCFH.

5.3 Penetration Pressurization Leakage - SP 1303-11.24

Leakage Rates

Date	Electrical	Mechanical
12/13/81	Data Missing *	Data Missing *
03/15/82	0.8	3.6
06/12/82	0.6	>10.7
08/26/82	0.9	1.92
09/11/82	0.5	2.7

* The data was missing but a surveillance record sheet was found indicating that results met the acceptance criteria.

** The purge valves were disassembled for repair the rest of the year thereby preventing retest in 1982.

Occasional meter problems were found and repaired and occasional leaks of tubing/pipe fittings in the PP system were located and eliminated. No penetration leakage problems were identified.

There is no technical specification limit on penetration pressurization system leakage.

6. ERROR ANALYSIS

6.1 Valve Testing Errors (For purge valves see Section 6.2)

The flow meters used in the field have normal industrial accuracies of ± 2% full scale in the 10-100% (15-150 mm) scale range. Prior to use mm versus sccm graphs were developed for each meter by 10 point calibrations using high accuracy (± 1% instantaneous) lab rotameters. During the leak test program weekly 3 point standardizations were performed on the field rotameters to verify continued accuracy. The acceptance criteria for these standardizations was a variance of no more than 4% from the calibration graphs. If meters were repaired or the 3 point standardization exceeded the inaccuracy limit a new 10 point calibration was performed. Scale readings on the leak rate procedure (SP 1303-11.18) data sheets were evaluated and corrected using the methods in Attachment 1. Conservative bias was introduced into the results by assuming 15 mm (10% of scale) as the minimum scale. Half of the test results actually showed a lower scale reading. More involved error corrections were not considered meaningful based on the very high total leakage as-found and the low total leakage as-left.

6.2 Access Hatch and Purge Valve Testing Errors

The measured pressure drops were corrected by adding the minimum scale increment of the gage used for both the heise gage and the barometer. This conservatively corrected for the resolution and repeatability errors. Gages used were recently calibrated. A minimum one hour temperature/pressure stabilization period was used prior to each pressure drop test. The access hatches and purge valves are not instrumented to allow temperature corrections.

6.3 Penetration Pressurization Testing Errors

These test results are used for information only and do not count toward the total leakage limit for Technical Specification conformance. The meters, installed permanently in the system, have ± 2% full scale industrial accuracy.

7. REFERENCES

7.1 1430-Y-22 Standardization of Flow Rotameters

7.2 SP 1303-11.18 Reactor Building Local Leak Rate Testing (Rev. 19)

7.3 Three Mile Island Unit 1 Technical Specification 4.4.1

7.4 TMI Surveillance File (for Data sheets)

7.5 SP 1303-11.24 R. B. Local Leakage Penetration Pressurization (Rev. 0)

7.6 SP 1303-11.25 R. B. Local Leakage Access Hatch Door Seals (Rev. 4).

ATTACHMENTS

ATTACHMENT 1

RESULTS EVALUATION PROCEDURE

(SP 1303-11.18 Enclosure 9)

Attachment 1

P. B. LOCAL LEAK RATE TESTING

RESULTS EVALUATION

The vent rotameter reading will be used if it can be demonstrated by the test data that all significant CIV leakage is being accounted for. If CIV packing, fluid block check valve, or gasket leakage was evident the supply rotameter results will be used unless this non-seat leakage was measured reliably and documented.

FOR USE OF SUPPLY ROTAMETER DATA:

Procedure:

a) Record supply meter reading in (1) below*. Also identify the meter used by tube # in (8) below and the metering pressure in (9).

b) Convert meter units in SCCM units using latest lab meter calibration curve. Enter in (3) below.

c) Correct results for temperature. Enter supply temperature in (4) below.

Calculate and enter in (7) below.

* If meter scale reading was less than 15 mm (minimum scale) use 15 mm in calculations.

FOR USE OF VENT ROTAMETER DATA:

Procedure:

a) Record vent meter reading in (1) below.*

b) Record downstream verification meter reading in (2) below. Also identify the respective meters used in (8) below and the metering pressure in (9).

c) Convert meter units to SCCM units using latest lab meter calibration curve. Enter in (3) below.

d) Correct results for temperature. Enter vent temperature (°F) in (4) below.

then

Calculate and enter in (5) below

e) If measurements of any other significant leakage paths (fluid block check valve, packing) are being claimed enter corrected flow (SCCM) in (6) below.

Attachment 1 (Continued)

(MM) (SCCM)

$$\left(\underset{(1)}{\_\_\_\_} + \underset{(2)}{\_\_\_\_}\right) \xrightarrow{\text{convert}} \left(\underset{(3)}{\_\_\_\_} + \_\_\_\_\right) \times \sqrt{\frac{530}{\underset{(4)}{\_\_\_\_} + 460}} = \underset{(5)}{\_\_\_\_}\ \text{SCCM}$$

____ ____
(8) (Identify meters used)

\+ ____ SCCM
(6)

@____ ____
(9) (Meter Pressures)

= CIV Leakage ____ SCCM
(7)

Attachment 1 (Continued)

APPENDIX H

THREE MILE ISLAND UNIT 1

1983 REACTOR BUILDING LOCAL LEAK RATE TESTING REPORT

SP 1303-11.18

10/12/82 - 12/31/83

INDEX - 1983 R. B. LOCAL LEAK RATE TESTING REPORT

REACTOR BUILDING LOCAL LEAK RATE TESTING REPORT

1983 REFUELING FREQUENCY

1. PURPOSE

1.1 To provide analysis to the Nuclear Regulatory Commission on the seventh periodic type B and type C leakage tests performed on the Three Mile Island Unit 1 Reactor Building.

This is in accordance with "Primary Reactor Containment Leakage Testing for Water Cooled Power Reactors". Appendix J, Part 50, Title 10 Code of Federal Regulations which required the contents of this summary report to become part of the Type A test report along with the details of any other type B and type C testing performed since the previous type A test (also required per technical specification 4.4.1.1.8).

The unit has been in cold shutdown since the March 28, 1979 Unit II accident except for periods of hot functional testing.

2. SUMMARY OF WORK ACCOMPLISHED

2.1 Valve Testing/Repairs

Appendix J Type B and C leak tests were performed on the components as listed in TMI Unit 1 Technical Specification 4.4.1. In addition the following components were leak tested though not yet listed in the Technical Specification.

1. HM-V1A/B, 2A/B, 3A/B, 4A/B - New System

2. IC-V16/18, NS-V11 - Check valves not previously tested. NRC request to add.

Monthly leak checks were done when convenient in addition to annual tests of R. B. Purge Valves AH-V1A/B/C/D due to recurring seat leakage. Results on these leak checks were used to expedite timely adjustments/repairs.

Repairs were initiated on the following components due to higher than desirable leakage.

1. CF-V12A - Seats lapped

*2. DH-V64 - Disc replaced

*3. DH-V69 - Disc replaced

4. HM-V4A - Manual opening device misadjusted

5. HP-V1 - Soft seats installed.

6. HP-V6 - Soft seats installed

*7. IC-V3 - Packing readjusted - Valve cycling/retest program run to verify consistent seating.

*8. IC-V4 - Nail under valve wedge prevented closing

9. LR-V49 - Soft seats installed

10. NI-V27 - Seats lapped

11. WDG-V4 - New type valve installed - Upgrade

* Repairs were mandatory due to gross leakage

During a November 1982 valve inspection the ethylene propylene rubber seats in AH-V1D were found to have cracked. The cracking did not affect leakage and was not judged to be a short term safety concern. It was evaluated by the valve vendor as excessive mold release agent. The vendor provided new seats for all four purge valves. The new seats were installed in AH-V1A/1B/1C/1D in March 1983.

In August 1983 the seats on AH-V1B were found to be cracked and a sample of the material was once again sent to the vendor for analysis. Once again the cracking did not affect valve leakage. The seats for AH-V1B were replaced with material from the same batch as that which failed. The vendor committed to replacing the seat material after development of a more suitable fabrication method. The new seat material was not received yet as of 12/31/83. The vendor, Pratt Valve Company, submitted a 10CFR21 type report to the NRC on the seat cracking problem. The cracking was now attributed to delamination between plies in the rubber and the promised new seats are to be one piece (no plies).

2.2 Access Hatch Testing/Repairs

2.2.1 Door Seals SP 1303-11.25

Door seal leak tests were performed at the 72 hour frequency as required by Technical Specification

4.4.1.2.5 while hot functional testing was being performed. All of the seal tests satisfied the surveillance procedure administrative acceptance criteria.

2.2.2 Overall Hatch Test

Semiannual integrated type leak tests were performed on each access hatch in 1983 as required by Technical Specification 4.4.1.2.5. Due to higher than desirable leakage on the emergency access hatch for the mid-year test some tubing fittings were tightened and a satisfactory retest was performed.

2.3 Penetration Pressurization SP 1303-11.24

Quarterly readings were recorded from the flow rotameters which supply air pressure or nitrogen pressure to reactor building mechanical and electrical penetrations as required by Technical Specification 4.4.1.2.5. No penetration leakage problems were noted although flow meter malfunctions required meter repair, and occasional tubing leaks in the air supply system were found and eliminated.

3. METHODS OF TESTING

3.1 Valve Test Methods

Testing was performed by use of TMI Unit 1 surveillance procedure SP 1303-11.18 Reactor Building Local Leak Rate Testing. This procedure gives detailed guidance on the test equipment and methods to be used for each penetration/valve. The following general philosophy is contained in the surveillance procedure.

3.1.1 Use air or nitrogen at a pressure differential across the valve greater than P_a (calculated accident pressure). 55 psig was normally used.

3.1.2 Assure that the pressure is exerted in the accident test direction unless it can be demonstrated that pressurizing in the opposite direction is as conservative. Butterfly valves AH-V1A/1B/1C/1D, and globe valves WDG-V4, SA-V3, and IA-V20 were tested in the reverse direction.

3.1.3 Assure that the test volume is drained of liquid so that air or nitrogen test pressure is against valve seats.

3.1.4 Assure that the test verifies valve packing integrity in those cases where the packing would be an R. B. leakage boundary.

3.1.5 Assure adequate time period for stabilization of test conditions.

3.1.6 Assure test equipment is calibrated and used in a manner consistent with the data accuracy desired (weekly meter standardization was performed to verify meters accurate within $\pm$ 4% full scale. -- MP 1430-Y-22).

3.1.7 Assure that the fluid blocking system is drained and vented during tests on the associated containment isolation valves to prevent any effects it might have on the test results (most of the F. B. system piping is seismic 3).

3.1.8 Assure valves to be tested are closed by the normal method prior to testing.

3.1.9 Document as-found conditions (prior to adjustments/repairs) and as-left conditions.

3.1.10 Record test instrument scale readings prior to doing any data corrections.

3.1.11 Assure that system drains and vents which could serve as containment isolation valves, are closed and capped and tagged after completion of the test program.

A training program prior to the refueling outage was performed to help assure that the above philosophy was understood by the personnel involved in the testing.

3.2 Access Hatch Test Methods

3.2.1 Door Seal Leak Tests-Method

Door seal leak tests were performed by use of SP 1303-11.25. This procedure gives detailed guidance on the test equipment and methods to be used.

The door seal tests are performed by pressurizing the interspace between the double seals on each door with metered air at the manufacturers recommended test pressure of 10 psig. After stabilization the air rotameter indicates the rate of air input required to maintain the test pressure.

3.2.2 Overall Hatch Leak Test -- Semi-annual overall hatch leak testing was performed by use of TMI Unit 1 Surveillance Procedure SP 1303-11.18 Reactor Building Local Leak Rate Testing. This procedure gives detailed guidance on the test equipment and methods to be used. The overall integrated leak test verifies the integrity of all of the following barriers:

a. Hatch shell/welds,

b. Rubber door seals,

c. Teflon operating shaft packing,

d. Bulkhead electrical penetrations,

e. Penetration pressurization check valves,

f. Emergency air flange and associated "O" rings on outer bulkhead,

g. Bulkhead equalizing ball valves and associated mounting flanges/"O" rings.

The overall leak test is performed by pressurizing the hatch to greater than calculated accident pressure and observing the rate of pressure drop on a high accuracy (Heise) pressure gage.

Pressure corrections are made by reference to a barometer. Minimum test duration is 4 hours after a 1 hour stabilization period.

3.3 <u>Penetration Pressurization - Method</u>

Quarterly readings were taken on the flow rotameters which are permanently installed in the penetration pressurization system. These readings represent the air/nitrogen makeup rate required to maintain approximately 60 psig in mechanical penetrations and 30 psig in electrical penetrations. High meter readings have occasionally occurred but these have been attributed to leaks in the compression fittings in the penetration pressurization system or to malfunctioning (stuck) rotameters. Testing was per plant surveillance procedure SP 1303-11.24.

4. TEST EQUIPMENT USED

4.1 Valve Test Equipment (See Figure 1)

a. Rotameters - Sets of 3

Mfgr. - Brooks Inst. Co.

Model - 1114 Full View

Ranges:

Float Mat'l.	Tube No.	Range
Pyrex	R-2-15D	8-1,120 SCCM
Saphire	R-2-15C	100-12,000 SCCM
Carboloy	R-6-15B	1,000-142,000 SCCM

Accuracy ± 2% full scale industrial accuracy

b. Temperature Indicators (as follows or similar)

Mfgr. - Ashcroft

Model - EH or AH / 3" or 5" Dial

Range - 30°-130°F

Accuracy - ± 2°F

c. Pressure Indicators (as follows or similar)

Mfgr. - Ashcroft

Model - 1279 - 4-1/2" Dial

Range - 0-60 or 0-100 psig

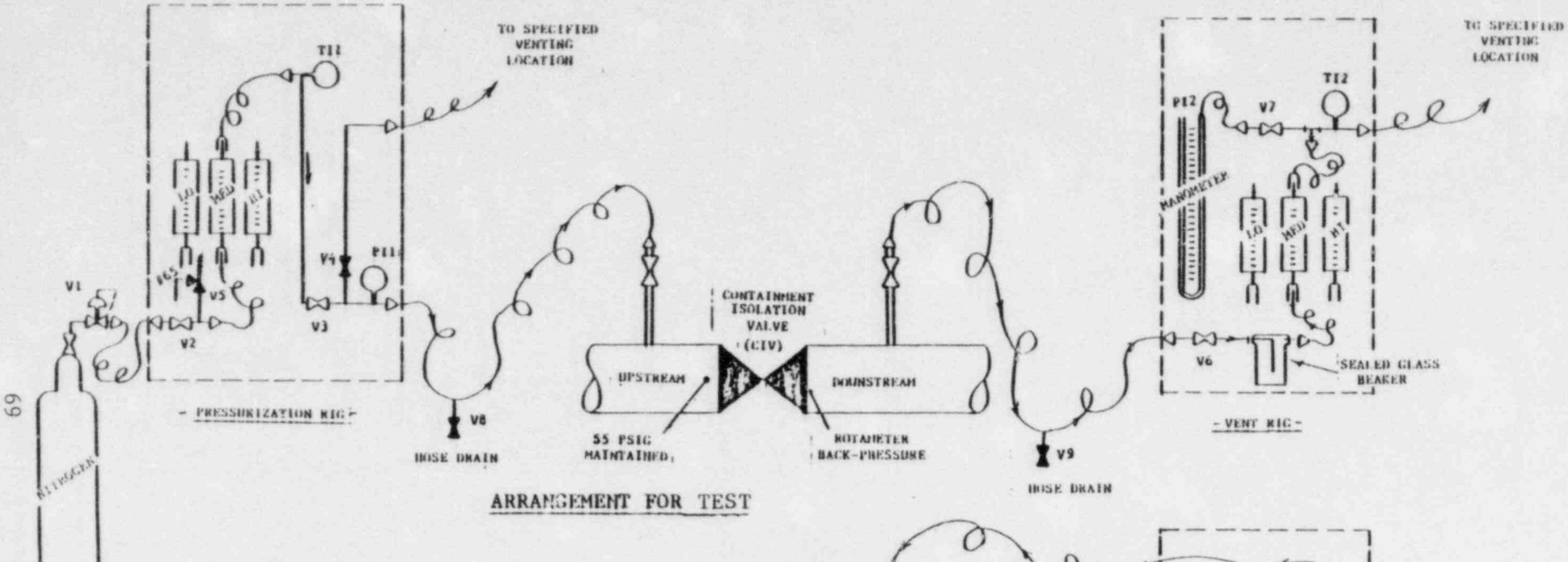
Accuracy - ± 2 psig

d. Pressure Regulator (as follows or similar)

Mfgr. - Union Carbide Corp.

Model - UPG 3-75-580

Range - 0-100 psi output / 0-3000 psi input



VALVES

V1-Nitrogen Bottle Regulator
V2/V3/V6/V7-3/8 or 1/2" Ball Valve
V4-Toggle Type Globe Valve
V5-65# Safety Valve

PRESSURE INDICATORS

PI1-0 to 60 psig usage range with 2 psi increments
PI2-Manometer with 36 inch long scale

TEMPERATURE INDICATORS

TI1/TI2-0-100°F usage range with ... ents

ROTAMETERS

	Tube#	Float	Range @ 0 psig	Range @ 55 psig
Lo	R-2-15D	Black Glass	8-380SCCM	45-1,120SCCM
Med	R-2-15-C	Syn. Saphire	100-5,300SCCM	200-12,000SCCM
High	R-6-15-B	Carboloy	1,000-61,000SCCM	2000-142,000SCCM

FIGURE 1

- ISOLATION VALVE TEST RIG -

1/13/83

0111U

e. Calibration Rotameters (Set of 2)

Mfgr. - Brooks Inst. Co.

Models - 1110-05K2B1Z49, 1110-08K2B1Z06

Ranges - 20-16,000 SCCM, 3,600-234,000 SCCM

Repeatability - $\pm$ 1/4% of instantaneous

Accuracy - $\pm$ 1% instantaneous

f. Flow rate Calibrator

Mfgr. - Brooks Inst. Co.

Model - 1056A

Range 0 to 2,400 SCCM

Accuracy - $\pm$ 0.2% of indicated volume

4.2 Access Hatch Test Equipment

a. Precision Pressure Gage (as follows or similar)

Mfgr. - Heise

Model - CM

Range - 0.60 psig

Resolution - 0.25 psig

Accuracy - 0.1%

b. Barometer (as follows or similar)

Mfgr. - Pennwalt

Model - FA185260A

Range - 10.8 - 15.5 psia

Resolution - 0.005 psia

Accuracy - 0.1%

4.3 Penetration Pressurization Test Equipment

a. Flow Rotameters - (Permanent System Equipment)

Mfgr. - Brooks Inst. Co.

Model - 1114

Range - 0-10 SCFH at 60 psia air

Accuracy - ± 2% Industrial accuracy

5. SUMMARY AND INTERPRETATION OF DATA

5.1 Valve Test Results

As-Found/As-Left Leakage - Also see tabulation of individual results in Attachment #2. The as-found leakage greater than acceptance criteria was not considered to require a License Event Report due to the long term plant shutdown condition during which the leakage was found.

	Total leakage	Tech. Spec. Limit	% Tech. Spec. Limit
As-Found	>305,863 SCCM	104,846 SCCM	>100%
As-Left	32,716 SCCM	104,846 SCCM	30%

NOTE: The total shown above is cumulative by penetration and not the total of all valve leakages. i.e., Only the highest valve leakage on each penetration is counted. This number is labeled as "PENTOTAL" on the tabulation of results in Attachment 2.

EXAMPLE: Penetration XYZ has three containment isolation valves inside the reactor building in parallel and one outside. The leakage from the three inside totals 500 SCCM and the outside valve is 1000 SCCM. The penetration leakage is counted as 1,000 SCCM <u>not</u> 1,500 SCCM.

5.2 Access Hatch Test Results

5.2.1 Overall Hatch Leakage - SP 1303-11.18 - See the computer tabulation of 1983 leak rates in Attachment #2. The leakages were considered to be satisfactory except for the mid year test on the emergency access hatch. Fittings were tightened to reduce that leakage.

5.2.2 Door Seal Leakage - SP 1303-11.25

None of the door seal leak tests exceeded the 3 SCFH administrative leakage limit. Typically, the leakage was less than 1 SCFH.

5.3 Penetration Pressurization (PP) Leakage - SP 1303-11.24

Leakage Rates - SCFH

Date	Mechanical	Electrical
12/12/82	0	10.5
First Quarter 83	Not performed*	Not performed*
06/12/83	18.5	1.3
09/30/83	16 LR-V1/49 Seat Leakage	2.3
10/04/83	42.5 LR-V1/49 Seat Leakage	.8
12/12/83	3.9	1.5

* Not performed due to system condition.

LR-V49 seats were found to be damaged and were replaced in March 1984. Otherwise no penetration leakage problems were identified. Occasional meter problems were found and repaired and occasional leaks of tubing/pipe fittings in the PP system were located and eliminated.

There is no technical specification limit on penetration pressurization system leakage.

6. ERROR ANALYSIS

6.1 Valve Testing Errors (For purge valves see Section 6.2)

The flow meters used in the field have normal industrial accuracies of ± 2% full scale in the 10-100% (15-150 mm) scale range. Prior to use mm versus sccm graphs were developed for each meter by 10 point calibrations using high accuracy (± 1% instantaneous) lab rotameters. During the leak test program weekly 3 point standardizations were performed on the field rotameters to verify continued accuracy. The acceptance criteria for these standardizations was a variance of no more than 4% from the calibration graphs. If meters were repaired or the 3 point standardization exceeded the inaccuracy limit a new 10 point calibration was performed. Scale readings on the leak rate procedure (SP 1303-11.18) data sheets were evaluated and corrected using the methods in Attachment 1. Conservative bias was introduced into the results by assuming 15 mm (10% of scale) as the minimum scale. Half of the test results actually showed a lower scale reading. More involved error corrections were not considered meaningful based on the very high total leakage as-found and the low total leakage as-left.

6.2 Access Hatch and Purge Valve Testing Errors

The measured pressure drops were corrected by adding the minimum scale increment of the gage used for both the heise gage and the barometer. This conservatively corrected for the resolution and repeatability errors. Gages used were recently calibrated. A minimum one hour temperature/pressure stabilization period was used prior to each pressure drop test. The access hatches and purge valves are not instrumented to allow temperature corrections.

6.3 Penetration Pressurization Testing Errors

These test results are used for information only and do not count toward the total leakage limit for Technical Specification conformance. The meters, installed permanently in the system, have ± 2% full scale industrial accuracy.

7. REFERENCES

7.1 1430-22 Standardization of Flow Rotameters

7.2 SP 1303-11.18 Reactor Building Local Leak Rate Testing (Rev. 22)

7.3 Three Mile Island Unit 1 Technical Specification 4.4.1

7.4 TMI Surveillance File (for Data sheets)

7.5 SP 1303-11.24 R. B. Local Leakage Penetration Pressurization (Rev. 3)

7.6 SP 1303-11.25 R. B. Local Leakage Access Hatch Door Seals (Rev. 6).

ATTACHMENTS

ATTACHMENT 1

RESULTS EVALUATION PROCEDURE

(SP 1303-11.18 Enclosure 9)

Attachment 1

R. B. LOCAL LEAK RATE TESTING

RESULTS EVALUATION

The vent rotameter reading will be used if it can be demonstrated by the test data that all significant CIV leakage is being accounted for. If CIV packing, fluid block check valve, or gasket leakage was evident the supply rotameter results will be used unless this non-seat leakage was measured reliably and documented.

FOR USE OF SUPPLY ROTAMETER DATA:

Procedure:

a) Record supply meter reading in (1) below*. Also identify the meter used by tube # in (8) below and the metering pressure in (9).

b) Convert meter units in SCCM units using latest lab meter calibration curve. Enter in (3) below.

c) Correct results for temperature. Enter supply temperature in (4) below.

Calculate and enter in (7) below.

* If meter scale reading was less than 15 mm (minimum scale) use 15 mm in calculations.

FOR USE OF VENT ROTAMETER DATA:

Procedure:

a) Record vent meter reading in (1) below.*

b) Record downstream verification meter reading in (2) below. Also identify the respective meters used in (8) below and the metering pressure in (9).

c) Convert meter units to SCCM units using latest lab meter calibration curve. Enter in (3) below.

d) Correct results for temperature. Enter vent temperature (°F) in (4) below.

then

Calculate and enter in (5) below

e) If measurements of any other significant leakage paths (fluid block check valve, packing) are being claimed enter corrected flow (SCCM) in (6) below.

DRAFT

Attachment 1 (Continued)

$$\underset{(MM)}{\left(\underset{(1)}{\_\_\_\_\_} + \underset{(2)}{\_\_\_\_\_}\right)} \xrightarrow{convert} \underset{(SCCM)}{\left(\underset{(3)}{\_\_\_\_\_ + \_\_\_\_\_}\right)} \times \sqrt{\frac{530}{\underset{(4)}{\_\_\_\_\_} + 460}} = \underset{(5)}{\_\_\_\_\_} \text{ SCCM}$$

_____ _____________
(8) (Identify meters used)

\+ _____ SCCM
(6)

@_____ _____________
(9) (Meter Pressures)

= CIV Leakage _____ SCCM
(7)

Attachment 1 (Continued)

ATTACHMENT 2

DATA 1983 TYPE C

REACTOR BUILDING LEAK RATE TESTING

LOCAL LEAK RATE TEST RESULTS
THREE MILE ISLAND UNIT 1 REACTOR BUILDING
1983 1983 1983 1983 1983 1983 1983 1983

RESULTS GIVEN IN STD. CUBIC CENTIMETERS PER MINUTE (SCCM)

ITEMS	TAGS	DESCS	OPERS	SIZE	ASFOUND	COMMENTS	ASLEFT	DATES
1	AH-VIA/B	BFLY	P/MO	48	1413	NEWSEAT	741	6/4/83
2	AH-VIC/D	BFLY	MO/P	48	2360	NEWSEAT	1790	5/27/83
3	CA-V1	GLOBE	MO	1	76	OK	76	12/16/82
4	CA-V2	GATE	P	1	1930	HIGH	1930	12/9/82
5	CA-V3	GLOBE	MO	1	76	OK	76	12/14/82
6	CA-V4A	GLOBE	MO	1	76	OK	76	12/2/82
7	CA-V4B	GLOBE	MO	1	124	OK	124	12/3/82
8	CA-V5A	GATE	P	1	378	OK	378	12/2/82
9	CA-V5B	GATE	P	1	825	OK	825	12/3/82
10	CA-V13	GLOBE	MO	1	76	OK	76	12/14/82
11	CA-V189	GATE	P	2	1591	HIGH	1591	1/15/83
12	CA-V192	LFT CHK	N/A	2	109	LOW	109	1/15/83
13				0	0		0	
14				0	0		0	
15	CF-V2A	GLOBE	MO	1	119	OK	119	1/17/83
16	CF-V2B	GLOBE	MO	1	328	OK	328	1/18/83
17	CF-V12A	LFT CHK	N/A	1	5166	HIGH	750	2/2/83
18	CF-V12B	LFT CHK	N/A	1	382	OK	382	1/10/83
19	CF-V19A	GATE	P	1	1976	HIGH	1976	1/12/83
20	CF-V19B	GATE	P	1	253	OK	253	1/12/83
21	CF-V20A	GATE	P	1	1144	HIGH	1144	1/17/83
22	CF-V20B	GATE	P	1	849	HIGH	849	1/18/83
23	CM-V1	BALL	P	1	58	OK	58	12/29/82
24	CM-V2	BALL	P	1	323	HIGH	323	12/29/82
25	CM-V3	BALL	P	1	58	OK	58	12/29/82
26	CM-V4	BALL	P	1	75	OK	75	12/29/82
27	DH-V64	GLOBE	HW	2	39850	FAILED	70	6/22/83
28	DH=V69	STOP CHK	HW	2	97533	FAILED	209	6/24/83
29				0	0		0	
30	FTTEAST	FLANGE	N/A	30	162	HIGH	162	12/13/82
31	FTTWEST	FLANGE	N/A	30	152	HIGH	152	12/13/82
32	HM=V1A	GLOBE	S	.5	69	NEWVALV	69	3/3/83
33	HM=V1B	GLOBE	S	.5	69	NEWVALV	69	3/3/83
34	HM-V2A	GLOBE	S	.5	69	NEWVALV	69	3/2/83
35	HM-V2B	GLOBE	S	.5	69	NEWVALV	69	3/3/83
36	HM-V3A	GLOBE	S	.5	31	OK	31	6/30/83
37	HM-V3B	GLOBE	S	.5	31	OK	31	6/30/83
38	HM-V4A	GLOBE	S	.5	2692	HIGH	31	7/11/83
39	HM-V4B	GLOBE	S	.5	31	OK	31	6/30/83
40	HP-V1	GATE	HW	6	7273	NEWSEAT	50	2/17/83
41	HP-V6	GATE	HW	6	1345	NEWSEAT	50	2/16/83
42	HR-V2A/B	GLOBE	HW	2	58	OK	58	2/4/83
43	HR-V4A/B	GLOBE	HW	2	58	OK	58	2/4/83
44	HRV22A/B	GLOBE	S	2	58	OK	58	2/4/83
45	HR-V23A	GLOBE	S	2	58	OK	58	2/4/83

LOCAL LEAK RATE TEST RESULTS
THREE MILE ISLAND UNIT 1 REACTOR BUILDING
1983 1983 1983 1983 1983 1983 1983 1983

RESULTS GIVEN IN STD. CUBIC CENTIMETERS PER MINUTE (SCCM)

ITEMS	TAGS	DESCS	OPERS	SIZE	ASFOUND	COMMENTS	ASLEFT	DATES
46	HR-V239	GLOBE	S	2	58	OK	58	2/4/83
47	IA-V6/20	GLOBE	HW	2	150	OK	58	2/10/83
48	IC-V2	GATE	MO	6	894	OK	894	11/5/82
49	IC-V3	GATE	P	6	13500	FAILED	4764	12/7/82
50	IC-V4	GATE	P	6	144000	FAILED	3893	11/24/82
51	IC-V6	GATE	P	3	71	OK	71	11/2/82
52	IC=V16	CHECK	N/A	4	87	LOW	87	11/3/82
53	IC-V18	CHECK	N/A	6	71	LOW	71	10/29/82
54	LR-V1/10	GATE	HW	6	199	OK	199	2/3/83
55	LR-V4	GLOBE	HW	.75	70	OK	70	10/12/82
56	LR-V5	GLOBE	HW	2	70	OK	70	10/12/82
57	LR-V6	GLOBE	HW	2	70	OK	70	10/12/82
58	LR-V49	GATE	HW	6	3970	OK	418	7/12/83
59	MU-V2A	GLOBE	MO	2.5	36	OK	36	1/28/83
60	MU-V2B	GLOBE	MO	2.5	36	OK	36	1/28/83
61	MU-V3	GATE	P	2.5	36	OK	36	1/28/83
62	MU-V18	GATE	P	2.5	130	LOW	130	2/1/83
63	MU-V20	GATE	P	4	77	OK	77	12/7/82
64	MU-V25	GLOBE	MO	4	225	OK	225	1/6/83
65	MU-V26	GATE	P	6	28	LOW	28	1/6/83
66	MU-V116	PIST CHK	N/A	1.5	272	LOW	272	12/6/82
67	NI-V27	GLOBE	HW	1	572	HIGH	36	3/11/83
68	NS-V4	GATE	N/A	1.5	58	LOW	58	1/8/83
69	NS-V11	CHECK	N/A	8	581	LOW	581	1/9/83
70	NS-V15	GATE	MO	8	124	LOW	124	1/9/83
71	NS-V35	GATE	MO	8	58	LOW	58	1/8/83
72	PENET104	BLK FLG	N/A	2	70	OK	70	8/4/83
73	PENET105	BLK FLG	N/A	10	56	OK	58	2/9/83
74	PENET106	BLK FLG	N/A	4	58	OK	58	2/8/83
75	PENET210	BLK FLG	N/A	2	70	OK	70	8/4/83
76	PENET211	BLK FLG	N/A	2	70	OK	70	8/4/83
77	PENET241	BLK FLG	N/A	18	50	OK	50	8/8/83
78	RB-V2A	GATE	MO	8	926	OK	926	10/19/82
79	RB-V7	GATE	MO	8	71	OK	71	10/20/82
80	SA-V2/3	GLOBE	HW	2	50	OK	50	8/9/83
81	SF-V23	GATE	HW	8	36	OK	36	1/24/83
82	WDG-V3/4	GL/GA	MO/SOL	2	2835	HIGH	2184	3/24/83
83	WDL-V303	GLOBE	MO	4	84	OK	84	12/23/82
84	WDL-V304	GATE	D	4	497	OK	497	12/23/82
85	WDL-V534	GATE	P	8	58	LOW	58	1/16/83
86	WDL-V535	GATE	P	8	58	LOW	58	1/16/83
87	EQPFLG	FLANGE	N/A	216	52	OK	52	2/22/83
88	PERACCES	MISC.	N/A	96	991	OK	991	5/29/83
89	PERACCES	MISC	N/A	96	1813	OK	1813	11/26/83
90	EMEACCES	MISC	N/A	96	10693	HIGH	2622	5/21/83
91	EMEACCES	MISC	N/A	96	1107	OK	1107	11/24/83

LOCAL LEAK RATE TEST RESULTS
THREE MILE ISLAND UNIT 1 REACTOR BUILDING
1983 1983 1983 1983 1983 1983 1983 1983

RESULTS GIVEN IN STD. CUBIC CENTIMETERS PER MINUTE (SCCM)

TAGS	ASFOUND	COMMENTS	ASLEFT
********	*******	********	*******
TOTAL	352365		36879
PENTOTAL	305863	FAILED	32716
ACC CRIT	104846		104846

FOLLOWING IS THE TERMINOLOGY USED IN THE PREVIOUS COMPUTER DATA:

1) .1 - (ALONE) OR ANY OTHER NUMBER OTHER THAN ZERO IN THE FIRST DECIMAL PLACE MEANS TEST SCHEDULED.
.01- (ALONE) MEANS NO DATA AVAILABLE FOR THE YEAR OR THAT THE TEST WAS DELAYED. (E.G. VALVE NOT INSTALLED YET OR NOT IN PREVIOUS TESTING SCOPE.)
3) .001- (OR ANY NUMBER OTHER THAN ZERO IN THE THIRD DECIMAL PLACE) AFTER A LEAK RATE (I.E.59500.001) MEANS ACTUAL LEAK RATE WAS GREATER THAN MEASURED/RECORDED VALUE.
4) ASFOUND- LEAK RATE (SCCM) IN THE AS- FOUND CONDITION BEFORE ANY REPAIRS OR ADJUSTMENTS.
5) ASLEFT- THE LEAK RATE (SCCM) AFTER ANY ADJUSTMENTS/REPAIRS.
6) DATES- DATE OF THE LAST ACCEPTABLE TEST RESULTS FOR THE ITEM
7) DESC- DESCRIPTION OF THE VALVE OR PENETRATION.
8) OPER- TYPE OF VALVE OPERATOR (ACTUATOR).
9) NOTEST- THE TECH SPEC SCOPE DID NOT REQUIRE THIS VALVE TO BE TESTED DURING THE RESPECTIVE YEAR.
10) NOVALVE- THIS VALVE WAS INSTALLED DURING A LATER REFUELING OUTAGE
11) COMMENTS- COGNIZANT ENGINEER COMMENTS ABOUT THE RESULTS:
    A) FAILED- EXCEEDED THE PLANT ESTABLISHED LEAKAGE RATE LIMIT FROM SP 1303-11.18 ENCLOSURE 10 WHICH MADE REPAIR/ADJUSTMENT NECESSARY.
    B) HIGH/LOW- SUBJECTIVE JUDGEMENT OF COGNIZANT ENGINEER. REPRESENTS THE RESULTS WITH RESPECT TO THE LEAKAGE WHICH THE TYPE OF LEAKAGE BARRIER (E.G GATE VALVE, GLOBE VALVE CHECK VALVE, FLANGE, ETC.) IS CONSIDERED TO BE CAPABLE OF WINTOUT EXTRAORDINARY REPAIR/ADJUSTMENT.
    C)OK- NO PROBLEMS WITH LEAKAGE
    D) OTHER- E.G. NEWVALVE, NOVALVE, NOTEST, REPACKED SEATWORK, STEMBENT, ETC. (SELF-EXPLANATORY)
12) SIZES- THE NOMINAL PIPE SIZE FOR THE LEAKAGE BARRIER.

APPENDIX I

THREE MILE ISLAND UNIT 1

1984 REACTOR BUILDING LOCAL LEAK RATE TESTING REPORT

SP 1303-11.18

01/01/84 - 07/18/84

INDEX - 1984 R. B. LOCAL LEAK RATE TESTING REPORT

REACTOR BUILDING LOCAL LEAK RATE TESTING REPORT

1984 REFUELING FREQUENCY

1. PURPOSE

1.1 To provide analysis to the Nuclear Regulatory Commission on the eighth periodic type B and type C leakage tests performed on the Three Mile Island Unit 1 Reactor Building.

This is in accordance with "Reactor Containment Leakage Testing for Water Cooled Power Reactors". Appendix J, Part 50, Title 10 Code of Federal Regulations which required the contents of this summary report to become part of the Type A test report along with the details of any other type B and type C testing performed since the previous type A test (also required per technical specification 4.4.1.1.8).

The unit has been in cold shutdown since the March 28, 1979 Unit II accident except for periods of hot functional testing.

2. SUMMARY OF WORK ACCOMPLISHED

2.1 Valve Testing/Repairs

Appendix J Type B and C leak tests were performed on the components as listed in TMI Unit 1 Technical Specification 4.4.1. In addition the following components were leak tested though not yet listed in the Technical Specification. A Tech. Spec. change was pending to add these:

1. HM-V1A/B, 2A/B, 3A/B, 4A/B - New System

2. IC-V16/18, NS-V11 - Check valves not previously tested. NRC request to add.

Monthly non-tech spec leak checks were done when convenient in addition to annual tests of R. B. Purge Valves AH-V1A/B/C/D due to recurring seat leakage. Results on these leak checks were used to expedite timely adjustments/repairs.

Repairs were initiated on the following components due to higher than desirable leakage.

1. AH-V1B & AH-V1D - Adjusted seats to regain acceptable leakage.

2. CA-V5A/5B - Hand wheel type override device was in a position that prevented full valve closure. Permanently removed override provision to prevent recurrence of problem.

3. IC-V3 - Extensive seat/wedge work.

4. LR-V49 - Mechanical damage to teflon seat inserts. Replaced seat rings.

During a November 1982 valve inspection the ethylene propylene rubber seats in AH-V1D were found to have cracked. The cracking did not affect leakage and was not judged to be a short term safety concern. It was evaluated by the valve vendor as excessive mold release agent. The vendor provided new seats for all four purge valves. The new seats were installed in AH-V1A/1B/1C/1D in March 1983.

In August 1983 the seats on AH-V1B were found to be cracked and a sample of the material was once again sent to the vendor for analysis. Once again the cracking did not affect valve leakage. The seats for AH-V1B were replaced with material from the same batch as that which failed. The vendor committed to replacing the seat material after development of a more suitable fabrication method. The vendor, Pratt Valve Company, submitted a 10CFR21 type report to the NRC on the seat cracking problem which was now attributed to delamination between plies in the rubber and the promised new seats are to be one piece (no plies). Testing of materials by the vendor has delayed the shipment of new type seats. They have not yet been received as of 07/18/84.

2.2 Access Hatch Testing/Repairs

2.2.1 Door Seals SP 1303-11.25

Door seal leak tests were performed at the 72 hour frequency as required by Technical Specification 4.4.1.2.5 while hot functional testing was being performed. All of the seal tests satisfied the surveillance procedure administrative acceptance criteria.

2.2.2 Overall Hatch Test

Semiannual integrated type leak tests were performed on each access hatch in 1984 as required by Technical Specification 4.4.1.2.5. There was

acceptable but higher than desirable leakage on the emergency access hatch and parts are on order to repair the bulkhead equalizing valve.

2.3 Penetration Pressurization SP 1303-11.24

Quarterly readings were recorded from the flow rotameters which supply air pressure or nitrogen pressure to reactor building mechanical and electrical penetrations as required by Technical Specification 4.4.1.2.5. No penetration leakage problems were noted although flow meter malfunctions required meter repair, and occasional tubing leaks in the air supply system were found and eliminated.

3. METHODS OF TESTING

3.1 Valve Test Methods

Testing was performed by use of TMI Unit 1 surveillance procedure SP 1303-11.18 Reactor Building Local Leak Rate Testing. This procedure gives detailed guidance on the test equipment and methods to be used for each penetration/valve. The following general philosophy is contained in the surveillance procedure.

3.1.1 Use air or nitrogen at a pressure differential across the valve greater than P_a (calculated accident pressure). 55 psig was normally used.

3.1.2 Assure that the pressure is exerted in the accident test direction unless it can be demonstrated that pressurizing in the opposite direction is as conservative. Butterfly valves AH-V1A/1B/1C/1D, and globe valves WDG-V4, SA-V3, and IA-V20 were tested in the reverse direction.

3.1.3 Assure that the test volume is drained of liquid so that air or nitrogen test pressure is against valve seats.

3.1.4 Assure that the test verifies valve packing integrity in those cases where the packing would be an R. B. leakage boundary.

3.1.5 Assure adequate time period for stabilization of test conditions.

3.1.6 Assure test equipment is calibrated and used in a manner consistent with the data accuracy desired (weekly meter standardization was performed to verify meters accurate within $\pm$ 4% full scale. -- MP 1430-Y-22).

3.1.7 Assure that the fluid blocking system is drained and vented during tests on the associated containment isolation valves to prevent any effects it might have on the test results (most of the F. B. system piping is seismic 3).

3.1.8 Assure valves to be tested are closed by the normal method prior to testing.

3.1.9 Document as-found conditions (prior to adjustments/repairs) and as-left conditions.

3.1.10 Record test instrument <u>scale</u> readings prior to doing any data corrections.

3.1.11 Assure that system drains and vents which could serve as containment isolation valves, are closed, capped, and tagged after completion of the test program.

A training program prior to the refueling outage was performed to help assure that the above philosophy was understood by the personnel involved in the testing.

3.2 Access Hatch Test Methods

3.2.1 Door Seal Leak Tests-Method

Door seal leak tests were performed by use of SP 1303-11.25. This procedure gives detailed guidance on the test equipment and methods to be used.

The door seal tests are performed by pressurizing the interspace between the double seals on each door with metered air at the manufacturers recommended test pressure of 10 psig. After stabilization the air rotameter indicates the rate of air input required to maintain the test pressure.

3.2.2 Overall Hatch Leak Test -- Semi-annual overall hatch leak testing was performed by use of TMI Unit 1 Surveillance Procedure SP 1303-11.18 Reactor Building Local Leak Rate Testing. This procedure gives detailed guidance on the test equipment and methods to be used. The overall integrated leak test verifies the integrity of all of the following barriers:

a. Hatch shell/welds,

b. Rubber door seals,

c. Teflon operating shaft packing,

d. Bulkhead electrical penetrations,

e. Penetration pressurization check valves,

f. Emergency air flange and associated "O" rings on outer bulkhead,

g. Bulkhead equalizing ball valves and associated mounting flanges/"O" rings.

The overall leak test is performed by pressurizing the hatch to greater than calculated accident pressure and observing the rate of pressure drop on a high accuracy (Heise) pressure gage.

Pressure corrections are made by reference to a barometer. Minimum test duration is 4 hours after a 1 hour stabilization period.

3.3 Penetration Pressurization - Method

Quarterly readings were taken on the flow rotameters which are permanently installed in the penetration pressurization system. These readings represent the air/nitrogen makeup rate required to maintain approximately 60 psig in mechanical penetrations and 30 psig in electrical penetrations. High meter readings have occasionally occurred but these have been attributed to leaks in the compression fittings in the penetration pressurization system or to malfunctioning (stuck) rotameters. Testing was per plant surveillance procedure SP 1303-11.24.

4. TEST EQUIPMENT USED

4.1 Valve Test Equipment (See Figure 1)

a. Rotameters - Sets of 3

Mfgr. - Brooks Inst. Co.

Model - 1114 Full View

Ranges:

Float Mat'l.	Tube No.	Range
Pyrex	R-2-15D	8-1,120 SCCM
Saphire	R-2-15C	100-12,000 SCCM
Carboloy	R-6-15B	1,000-142,000 SCCM

Accuracy ± 2% full scale industrial accuracy

b. Temperature Indicators (as follows or similar)

Mfgr. - Ashcroft

Model - EH or AH / 3" or 5" Dial

Range - 30°-130°F

Accuracy - ± 2°F

c. Pressure Indicators (as follows or similar)

Mfgr. - Ashcroft

Model - 1279 - 4-1/2" Dial

Range - 0-60 or 0-100 psig

Accuracy - ± 2 psig

d. Pressure Regulator (as follows or similar)

Mfgr. - Union Carbide Corp.

Model - UPG 3-75-580

Range - 0-100 psi output / 0-3000 psi input

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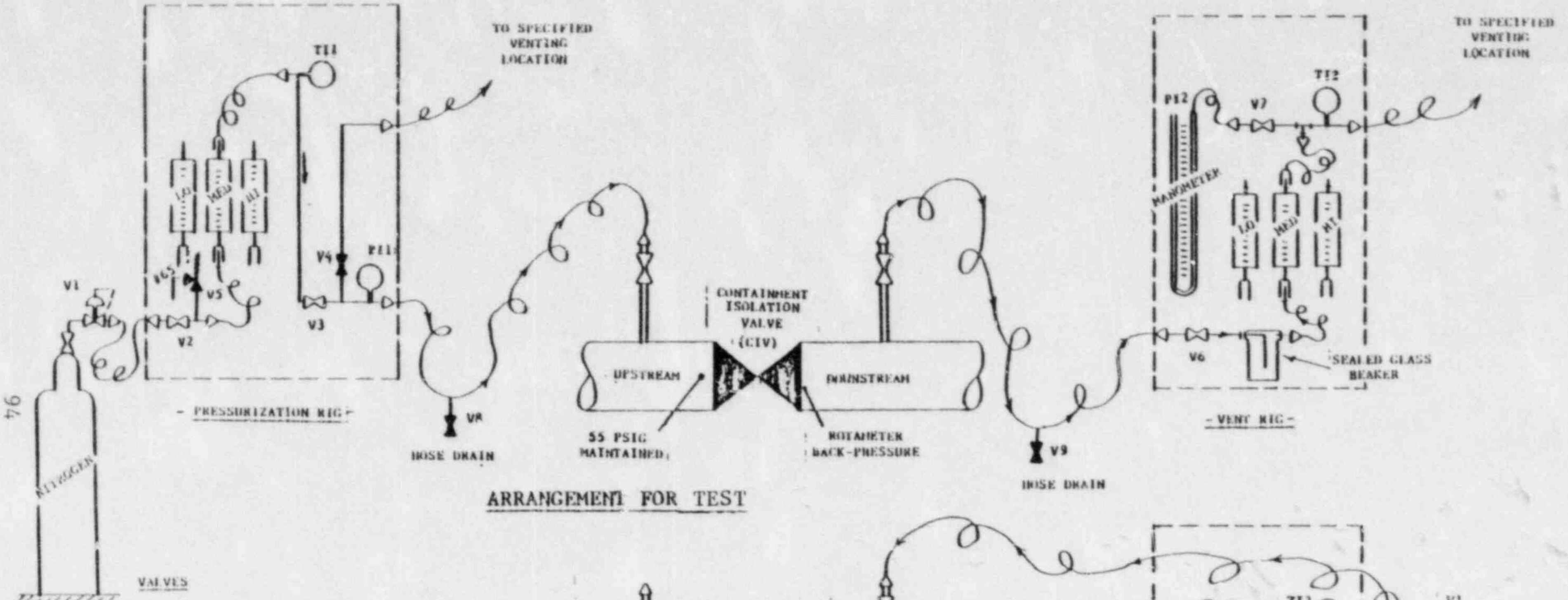

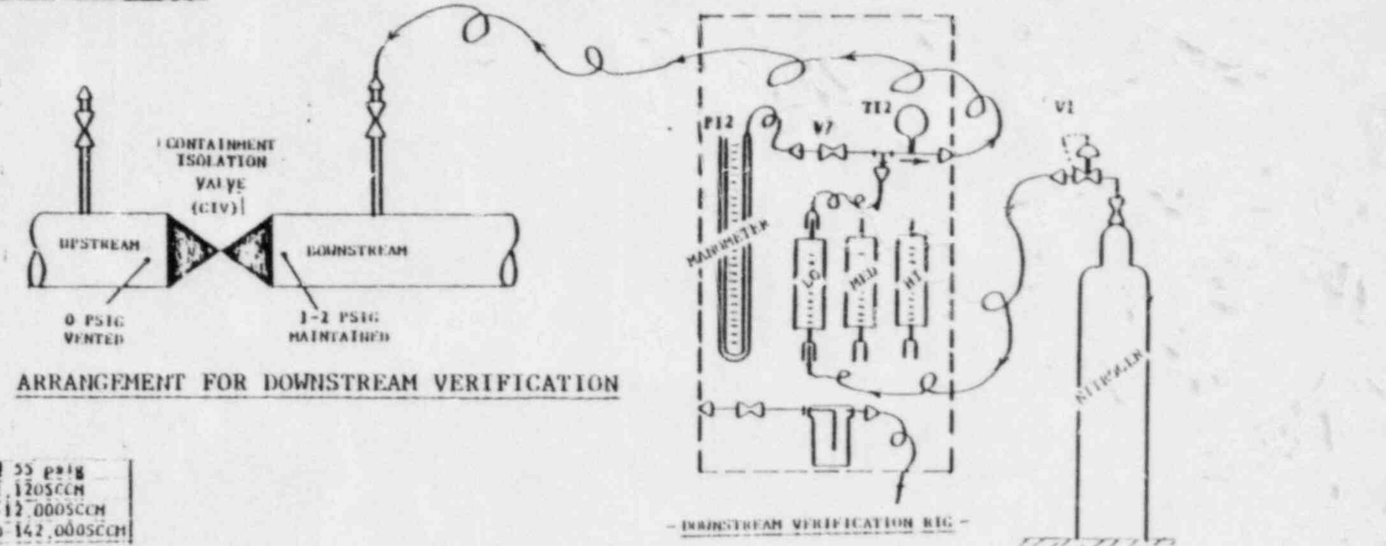

VALVES

V1-Nitrogen Bottle Regulator
V2/V3/V6/V7 3/8 or 1/2" Ball Valve
V4-Toggle Type Globe Valve
V5-65# Safety Valve

PRESSURE INDICATORS

PI1-0 to 60 psig usage range with 2 psi increments
PI2-Manometer with 36 inch long scale

TEMPERATURE INDICATORS

TI1/TI2-0-100°F usage range with 2°F increments

ROTAMETERS

	Tube#	Float	- Range - @ 0 psig	@ 55 psig
Lo	R-2-15D	Black Glass	8-380SCCM	45-1,120SCCM
Med	R-2-15-C	Syn. Saphire	100-5,300SCCM	200-12,000SCCM
High	R-6-15-B	Carboloy	1,000-61,000SCCM	2000-142,000SCCM

FIGURE 1

- ISOLATION VALVE TEST RIG -

0111U

e. Calibration Rotameters (Set of 2)

Mfgr. - Brooks Inst. Co.

Models - 1110-05K2B1Z49, 1110-08K2B1Z06

Ranges - 20-16,000 SCCM, 3,600-234,000 SCCM

Repeatability - ± 1/4% of instantaneous

Accuracy = ± 1% instantaneous

f. Flow rate Calibrator

Mfgr. - Brooks Inst. Co.

Model - 1056A

Range 0 to 2,400 SCCM

Accuracy - ± 0.2% of indicated volume

4.2 Access Hatch Test Equipment

a. Precision Pressure Gage (as follows or similar)

Mfgr. - Heise

Model - CM

Range - 0.60 psig

Resolution - 0.25 psig

Accuracy - 0.1%

b. Barometer (as follows or similar)

Mfgr. - Pennwalt

Model - FA185260A

Range - 10.8 - 15.5 psia

Resolution - 0.005 psia

Accuracy - 0.1%

4.3 Penetration Pressurization Test Equipment

a. Flow Rotameters - (Permanent System Equipment)

Mfgr. - Brooks Inst. Co.

Model - 1114

Range - 0-10 SCFH at 60 psia air

Accuracy - ± 2% Industrial accuracy

5. SUMMARY AND INTERPRETATION OF DATA

5.1 Valve Test Results

As-Found/As-Left Leakage - Also see tabulation of individual results in Attachment #2. The as-found leakage greater than acceptance criteria was not considered to require a License Event Report due to the long term plant shutdown condition during which the leakage was found.

	Total Leakage	Tech. Spec. Limit	% Tech. Spec. Limit
As-Found	>249,090 SCCM	104,846 SCCM	>100%
As-Left	39,783 SCCM	104,846 SCCM	38%

NOTE: The total shown above is cumulative by penetration and not the total of all valve leakages. i.e., Only the highest valve leakage on each penetration is counted. This number is labeled as "PENTOTAL" on the tabulation of results in Attachment 2.

EXAMPLE: Penetration XYZ has three containment isolation valves inside the reactor building in parallel and one outside. The leakage from the three valves inside totals 500 SCCM and the outside valve is 1000 SCCM. The penetration leakage is counted as 1,000 SCCM not 1,500 SCCM.

5.2 Access Hatch Test Results

5.2.1 Overall Hatch Leakage - SP 1303-11.18 - See the computer tabulation of 1984 leak rates in Attachment #2. The leakages were considered to be satisfactory though future repair/retest is planned on the emergency access hatch after the bulkhead equalizing valve seats are replaced.

5.2.2 Door Seal Leakage - SP 1303-11.25

None of the door seal leak tests exceeded the 3 SCFH administrative leakage limit. Typically, the leakage was less than 1 SCFH.

5.3 Penetration Pressurization (PP) Leakage - SP 1303-11.24

Leakage Rates - SCFH

Date	Mechanical	Electrical
03/14/84	0.5	6.1

No penetration leakage problems were identified.

Occasional meter problems were found and repaired and occasional leaks of tubing/pipe fittings in the PP system were located and eliminated.

There is no technical specification limit on penetration pressurization system leakage.

6. ERROR ANALYSIS

6.1 Valve Testing Errors (For purge valves see Section 6.2)

The flow meters used in the field have normal industrial accuracies of ± 2% full scale in the 10-100% (15-150 mm) scale range. Prior to use mm versus sccm graphs were developed for most of the meters by 10 point calibrations using high accuracy (± 1% instantaneous) lab rotameters. During the leak test program weekly 3 point standardizations were performed on the field rotameters to verify continued accuracy. The acceptance criteria for these standardizations was a variance of no more than 4% from the calibration graphs. If meters were repaired or the 3 point standardization exceeded the inaccuracy limit a new 10 point calibration was performed. Scale readings on the leak rate procedure (SP 1303-11.18) data sheets were evaluated and corrected using the methods in Attachment 1. Conservative bias was introduced into the results by assuming 15 mm (10% of scale) as the minimum scale. Half of the test results actually showed a lower scale reading. More involved error corrections were not considered meaningful based on the very high total leakage as-found and the low total leakage as-left.

Several of the meters, however, did not receive the above described calibration prior to use since the calibration standard had not been returned from the vendor until late in the test program. The affected field meters were calibrated after use and leak rate data was corrected accordingly.

6.2 Access Hatch and Purge Valve Testing Errors

The measured pressure drops were corrected by adding the minimum scale increment of the gage used for both the heise gage and the barometer. This conservatively corrected for the resolution and repeatability errors. Gages used were recently calibrated. A minimum one hour temperature/pressure stabilization period was used prior to each pressure drop test. The access hatches and purge valves are not instrumented to allow temperature corrections.

6.3 Penetration Pressurization Testing Errors

These test results are used for information only and do not count toward the total leakage limit for Technical Specification conformance. The meters, installed permanently in the system, have ± 2% full scale industrial accuracy.

7. REFERENCES

7.1 1430-22 Standardization of Flow Rotameters

7.2 SP 1303-11.18 Reactor Building Local Leak Rate Testing (Rev. 26)

7.3 Three Mile Island Unit 1 Technical Specification 4.4.1

7.4 TMI Surveillance File (for Data sheets)

7.5 SP 1303-11.24 R. B. Local Leakage Penetration Pressurization (Rev. 5)

7.6 SP 1303-11.25 R. B. Local Leakage Access Hatch Door Seals (Rev. 9).

ATTACHMENTS

ATTACHMENT 1

RESULTS EVALUATION PROCEDURE

(SP 1303-11.18 Enclosure 9)

Attachment 1

R. B. LOCAL LEAK RATE TESTING

RESULTS EVALUATION

The vent rotameter reading will be used if it can be demonstrated by the test data that all significant CIV leakage is being accounted for. If CIV packing, fluid block check valve, or gasket leakage was evident the supply rotameter results will be used unless this non-seat leakage was measured reliably and documented.

FOR USE OF SUPPLY ROTAMETER DATA:

Procedure:

a) Record supply meter reading in (1) below*. Also identify the meter used by tube # in (8) below and the metering pressure in (9).

b) Convert meter units in SCCM units using latest lab meter calibration curve. Enter in (3) below.

c) Correct results for temperature. Enter supply temperature in (4) below.

Calculate and enter in (7) below.

* If meter scale reading was less than 15 mm (minimum scale) use 15 mm in calculations.

FOR USE OF VENT ROTAMETER DATA:

Procedure:

a) Record vent meter reading in (1) below.*

b) Record downstream verification meter reading in (2) below. Also identify the respective meters used in (8) below and the metering pressure in (9).

c) Convert meter units to SCCM units using latest lab meter calibration curve. Enter in (3) below.

d) Correct results for temperature. Enter vent temperature (°F) in (4) below.

then

Calculate and enter in (5) below

e) If measurements of any other significant leakage paths (fluid block check valve, packing) are being claimed enter corrected flow (SCCM) in (6) below.

ATTACHMENT 2

DATA 1984 TYPE C

REACTOR BUILDING LEAK RATE TESTING

LOCAL LEAK RATE TEST RESULTS
THREE MILE ISLAND UNIT 1 REACTOR BUILDING
1984 1984 1984 1984 1984 1984 1984 1984

RESULTS GIVEN IN STD. CUBIC CENTIMETERS PER MINUTE (SCCM)

ITEMS	TAGS	DESCS	OPERS	SIZE	ASFOUND	COMMENTS	ASLEFT	DATES
1	AH-VIA/B	BFLY	P/MO	48	3583.001	HIGH	983	4/5/84
2	AH-V1C/D	BFLY	MO/P	48	51873.001	FAILED	1940	4/6/84
3	CA-V1	GLOBE	MO	1	60	OK	60	3/15/84
4	CA-V2	GATE	P	1	1636	HIGH	1636	3/15/84
5	CA-V3	GLOBE	MO	1	60	OK	60	3/15/84
6	CA-V4A	GLOBE	MO	1	50	OK	50	2/28/84
7	CA-V4B	GLOBE	MO	1	50	OK	50	2/27/84
8	CA-V5A	GATE	P	1	118040	FAILED	80	2/29/84
9	CA-V5B	GATE	P	1	11252	FAILED	50	3/1/84
10	CA-V13	GLOBE	MO	1	60	OK	60	3/15/84
11	CA-V189	GATE	P	2	2140	HIGH	2140	3/26/84
12	CA-V192	LFT CHK	N/A	2	69	LOW	69	3/26/84
13				0	0		0	
14				0	0		0	
15	CF-V2A	GLOBE	MO	1	61	OK	61	3/16/84
16	CF-V2B	GLOBE	MO	1	61	OK	61	3/15/84
17	CF-V12A	LFT CHK	N/A	1	737	OK	737	3/16/84
18	CF-V12B	LFT CHK	N/A	1	60	LOW	60	3/15/84
19	CF-V19A	GATE	P	1	761	OK	761	3/17/84
20	CF-V19B	GATE	P	1	52	OK	52	3/17/84
21	CF-V20A	GATE	P	1	197	OK	197	3/16/84
22	CF-V20B	GATE	P	1	368	OK	368	3/15/84
23	CM-V1	BALL	P	1	50	OK	50	2/23/84
24	CM-V2	BALL	P	1	238	HIGH	238	2/23/84
25	CM-V3	BALL	P	1	50	OK	50	2/23/84
26	CM-V4	BALL	P	1	50	OK	50	2/23/84
27	DH-V64	GLOBE	HW	2	587	HIGH	587	3/4/84
28	DH-V69	STOP CHK	HW	2	65	LOW	65	3/2/84
29				0	0		0	
30	FTTEAST	FLANGE	N/A	30	168	HIGH	168	3/17/84
31	FTTWEST	FLANGE	N/A	30	81	OK	81	3/17/84
32	HM-V1A	GLOBE	S	.5	72	OK	72	3/20/84
33	HM-V1B	GLOBE	S	.5	46	OK	46	3/18/84
34	HM-V2A	GLOBE	S	.5	68	OK	68	3/20/84
35	HM-V2B	GLOBE	S	.5	46	OK	46	3/18/84
36	HM-V3A	GLOBE	S	.5	69	OK	69	3/20/84
37	HM-V3B	GLOBE	S	.5	46	OK	46	3/18/84
38	HM-V4A	GLOBE	S	.5	69	OK	69	3/20/84
39	HM-V4B	GLOBE	S	.5	46	OK	46	3/18/84
40	HP-V1	GATE	HW	6	69	LOW	69	3/23/84
41	HP-V6	GATE	HW	6	69	LOW	69	3/23/84
42	HR-V2A/B	GLOBE	HW	2	309	OK	309	3/19/84
43	HR-V4A/B	GLOBE	HW	2	294	OK	294	3/19/84
44	HRV22A/B	GLOBE	S	2	279	OK	279	3/19/84
45	HR-V23A	GLOBE	S	2	69	OK	69	3/18/84

LOCAL LEAK RATE TEST RESULTS
THREE MILE ISLAND UNIT 1 REACTOR BUILDING
1984 1984 1984 1984 1984 1984 1984 1984

RESULTS GIVEN IN STD. CUBIC CENTIMETERS PER MINUTE (SCCM)

ITEMS	TAGS	DESCS	OPERS	SIZE	ASFOUND	COMMENTS	ASLEFT	DATES
46	HR-V23B	GLOBE	S	2	69	OK	69	3/18/84
47	IA-V6/20	GLOBE	HW	2	46	OK	46	3/22/84
48	IC-V2	GATE	MO	6	486	OK	486	3/9/84
49	IC-V3	GATE	P	6	24242	FAILED	7813	5/13/84
50	IC-V4	GATE	P	6	3438	HIGH	3438	3/10/84
51	IC-V6	GATE	P	3	172	OK	172	3/11/84
52	IC=V16	CHECK	N/A	4	134	LOW	134	3/11/84
53	IC-V18	CHECK	N/A	6	56	LOW	56	3/10/84
54	LR-V1/10	GATE	HW	6	69	HIGH	69	3/23/84
55	LR-V4	GLOBE	HW	.75	69	OK	69	3/18/84
56	LR-V5	GLOBE	HW	2	69	OK	69	3/18/84
57	LR-V6	GLOBE	HW	2	69	OK	69	3/18/84
58	LR-V49	GATE	HW	6	11252	FAILED	69	3/23/84
59	MU-V2A	GLOBE	MO	2.5	64	OK	64	4/7/84
60	MU-V2B	GLOBE	MO	2.5	64	OK	64	4/7/84
61	MU-V3	GATE	P	2.5	38	OK	38	4/7/84
62	MU-V18	GATE	P	2.5	247	OK	247	3/29/84
63	MU-V20	GATE	P	4	56	OK	56	3/13/84
64	MU-V25	GLOBE	MO	4	149	OK	149	3/14/84
65	MU-V26	GATE	P	6	60	OK	60	3/14/84
66	MU-V116	PIST CHK	N/A	1.5	382	LOW	382	3/13/84
67	NI-V27	GLOBE	HW	1	69	OK	69	3/25/84
68	NS-V4	GATE	N/A	1.5	107	LOW	107	3/13/84
69	NS-V11	CHECK	N/A	8	1007	OK	1007	3/12/84
70	NS-V15	GATE	MO	8	376	OK	376	3/12/84
71	NS-V35	GATE	MO	8	99	LOW	99	3/13/84
72	PENET104	BLK FLG	N/A	2	52	OK	52	4/12/84
73	PENET105	BLK FLG	N/A	10	46	OK	46	3/23/84
74	PENET106	BLK FLG	N/A	4	46	OK	46	3/23/84
75	PENET210	BLK FLG	N/A	2	52	OK	52	4/12/84
76	PENET211	BLK FLG	N/A	2	52	OK	52	4/12/84
77	PENET241	BLK FLG	N/A	18	46	OK	46	3/23/84
78	RB-V2A	GATE	MO	8	1321	OK	1321	3/27/84
79	RB-V7	GATE	MO	8	1201	HIGH	1201	3/22/84
80	SA-V2/3	GLOBE	HW	2	46	OK	46	3/23/84
81	SF-V23	GATE	HW	8	135	OK	135	3/25/84
82	WDG-V3/4	GL/GA	MO/SOL	2	922	HIGH	922	3/11/84
83	WDL-V303	GLOBE	MO	4	109	OK	109	3/17/84
84	WDL-V304	GATE	D	4	52	OK	52	3/17/84
85	WDL-V534	GATE	P	8	194	LOW	194	3/24/84
86	WDL-V535	GATE	P	8	259	LOW	259	3/24/84
87	EQPFLG	FLANGE	N/A	216	47	OK	47	3/19/84
88	PERACCES	MISC.	N/A	96	1123	OK	1123	6/2/84
89	PERACCES	MISC	N/A	96	.01		.01	
90	EMEACCES	MISC	N/A	96	10248	HIGH	10248	5/16/84
91	EMEACCES	MISC	N/A	96	.01		.01	

LOCAL LEAK RATE TEST RESULTS
THREE MILE ISLAND UNIT 1 REACTOR BUILDING
1984 1984 1984 1984 1984 1984 1984 1984

RESULTS GIVEN IN STD. CUBIC CENTIMETERS PER MINUTE (SCCM)

TAGS	ASFOUND	COMMENTS	ASLEFT
********	*******	********	*******
TOTAL	252850		43543
PENTOTAL	249090	FAILED	39783
ACC CRIT	104846		104846

FOLLOWING IS THE TERMINOLOGY USED IN THE PREVIOUS COMPUTER DATA:

1) .1 - (ALONE) OR ANY OTHER NUMBER OTHER THAN ZERO IN THE FIRST DECIMAL PLACE MEANS TEST SCHEDULED.
.01- (ALONE) MEANS NO DATA AVAILABLE FOR THE YEAR OR THAT THE TEST WAS DELAYED. (E.G. VALVE NOT INSTALLED YET OR NOT IN PREVIOUS TESTING SCOPE.)
3) .001- (OR ANY NUMBER OTHER THAN ZERO IN THE THIRD DECIMAL PLACE) AFTER A LEAK RATE (I.E.59500.001) MEANS ACTUAL LEAK RATE WAS GREATER THAN MEASURED/RECORDED VALUE.
4) ASFOUND- LEAK RATE (SCCM) IN THE AS- FOUND CONDITION BEFORE ANY REPAIRS OR ADJUSTMENTS.
5) ASLEFT- THE LEAK RATE (SCCM) AFTER ANY ADJUSTMENTS/REPAIRS.
6) DATES- DATE OF THE LAST ACCEPTABLE TEST RESULTS FOR THE ITEM
7) DESC- DESCRIPTION OF THE VALVE OR PENETRATION.
8) OPER- TYPE OF VALVE OPERATOR (ACTUATOR).
9) NOTEST- THE TECH SPEC SCOPE DID NOT REQUIRE THIS VALVE TO BE TESTED DURING THE RESPECTIVE YEAR.
10) NOVALVE- THIS VALVE WAS INSTALLED DURING A LATER REFUELING OUTAGE
11) COMMENTS- COGNIZANT ENGINEER COMMENTS ABOUT THE RESULTS:
    A) FAILED- EXCEEDED THE PLANT ESTABLISHED LEAKAGE RATE LIMIT FROM SP 1303-11.18 ENCLOSURE 10 WHICH MADE REPAIR/ADJUSTMENT NECESSARY.
    B) HIGH/LOW- SUBJECTIVE JUDGEMENT OF COGNIZANT ENGINEER. REPRESENTS THE RESULTS WITH RESPECT TO THE LEAKAGE WHICH THE TYPE OF LEAKAGE BARRIER (E.G GATE VALVE, GLOBE VALVE CHECK VALVE, FLANGE, ETC.) IS CONSIDERED TO BE CAPABLE OF WINTOUT EXTRAORDINARY REPAIR/ADJUSTMENT.
    C)OK- NO PROBLEMS WITH LEAKAGE
    D) OTHER- E.G. NEWVALVE, NOVALVE, NOTEST, REPACKED SEATWORK, STEMBENT, ETC. (SELF-EXPLANATORY)
12) SIZES- THE NOMINAL PIPE SIZE FOR THE LEAKAGE BARRIER.