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WEDCO CORPORATION

PREOPERATIONAL INTEGRATED LEAK RATE TEST OF THE REACTOR CONTAINMENT BUILDING

CONSOLIDATED EDISON CORPORATION
INDIAN POINT UNIT 2

Prepared By

GILBERT ASSOCIATES, INC.

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INDIAN POINT
UNIT 2

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WEDCO CORPORATION

BUCHANAN, NEW YORK

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1.0 SYNOPSIS

The purpose of this test was to measure the reactor containment building leakage rate at 47 and 24.5 psig. The leakage rates were calculated by the method of least squares and found to be 0.0090 ±0.0207 percent per day at 47 psig and -0.0026 ±0.0217 percent per day at 24.5 psig. These rates compare favorably with the allowable rates of 0.0749 percent and 0.0542 percent per day respectively for the initial test limits.

The tests were performed for the Wedco Corporation under the technical supervision of Gilbert Associates, Inc. All test phases were performed by the Wedco Corporation and Consolidated Edison Corporation. All data was taken and reduced by Consolidated Edison. Calculations were checked by Gilbert Associates, Inc.

2.0 INTRODUCTION

The object of the initial preoperational integrated leakage rate test was to establish the degree of overall leak tightness of the reactor containment building, penetrations, and isolation valves at the design pressure of 47 psig and to establish a reference test for subsequent retests at 24.5 psig. The allowable leakage was defined by the design basis accident applied in the safety analysis in accordance with the site exposure guidelines set forth in 10-CFR-100.[1] For the Indian Point Unit 2 Station, the allowable integrated leakage rates are as follows:

Conditions	Allowable Integrated Leak Rate Percent Per Day
Accident (47 psig @ 271 F)	0.1000
Test (47 psig @ 75 F) L_P	0.0749
Test (24.5 psig @ 75 F) L_{TO}	0.0542

During the test period of seven and one-half days the structural integrity test on the reactor containment structure was also conducted. A maximum internal pressure of 54 psig (1.15 times 47 psig design pressure) was used for the structural integrity test.

The leakage rate data was gathered over a period of at least 24 consecutive hours after conditions were stabilized at each pressure. Following each 24 hour period, a controlled leakage rate was superimposed on the reactor containment building for 12 hours to verify and validate the test instrumentation and technique.

3.0 CONCLUSIONS

a. The reactor containment structure leakage rate at 47 psig and 75 F was 0.0090 ±0.0207 percent per day (3.04 ± 7 lb/hr).

b. The leakage rate at 24.5 psig and 75 F was -0.0026 ±0.0217 percent per day (0.56 ±4.68 lb/hr). The negative value indicates that the leakage rate was less than the instrumentation sensitivity. In addition, outgassing from concrete and a box girder, which was noticed in the post test investigation of the building, contributed to the negative indication. If only the final 12 hours of data are considered, a positive leakage rate of 0.0044 percent per day (0.95 lb/hr) is obtained. All outgassing from components and structures should have subsided by that time, and future tests on this plant should use the value of 0.0044 percent per day to compare results.

c. The Indian Point Unit 2 reactor building is an extremely tight containment. This is especially noteworthy since all containment piping and electrical penetrations and all weld channels were intentionally opened to the containment atmosphere during the test. This left only one leakage barrier between the reactor building atmosphere and the outside, rather than the two leakage barriers that will be in effect during normal plant operation.

d. The above leakage rates were verified by superimposing a known leakage rate at each pressure. At 47 psig the superimposed leakage rate was 25.53 lb/hr. The measured leakage rate was 24.11

lb/hr. At 24.5 psig the measured leakage rate was 11.63 lb/hr compared to a superimposed leakage rate of 11.94 lb/hr. This good correlation verifies that the measuring technique is valid.

e. Primary boundry leakage was measured at the ball valves of the inner doors for both airlocks. The combined leakage of both equalizing valves was approximately 0.10 lb/hr at 47 psig.

f. Comparison of test instrumentation calibration before and after the test were made and negligible differences were noted.

4.0 DESCRIPTION OF APPARATUS

The containment vessel was tested by the absolute pressure method using the following equipment:

Six - Chicago Pneumatic mobile diesel-driven compressors rated at 1200 scfm (each).

One - Aftercooler, Zurn Model 1800 ACD

One - Oil separator, Zurn Model S10A30

One - Deliquescent desiccant type air dryer, Zurn Model 1800 ACD

Two - Texas Instruments, Model 145-02 precision pressure gauges. Range 0 - 100 psia, accuracy ±0.015 percent of reading (PI-1, PI-2)

One - Foxboro, Model Y/ERB6 dew point recorder and six Dewcel elements, Model 2701RG, accuracy ±0.5% of full scale (150 F)

One - Wallace and Tiernan Model FA233120 pressure gauge. Range 0 - 100 psia, accuracy ±0.1 percent of full scale (PI-3)

One - Heise, Model CM-3703 pressure gauge. Range 0 - 60 psig, accuracy ±0.1 psig

Two - Wallace and Tiernan 1/2 in. flowmeters. Range 0 - 10.4 scfm at 0 psig and 90 F, accuracy ±1 percent of reading

Flowmeter Model WT-1/2-40-G-10

Float Model 1/2-G-8-VI-16

24 - Honeywell, Model HP6A2-11-1/2-2A, 200 ohm plain platinum RTD, accuracy ±0.6 F, repeatability ±0.1 F

One - Hewlett-Packard digital voltmeter Model HP3460B, accuracy ± (0.004% of reading + 0.002% of full scale) equipped with a volts to ohms converter for direct RTD readout of resistance, Model HP3461A, accuracy ± (0.008% of reading + 0.002% of full scale)

The relative positions of RTDs and Dewcels are shown in Figure 1.

5.0 TEST DESCRIPTION

The test may be divided into the following areas of activity:

a. Prerequisites to test[2]

b. Test performance

c. Data analysis

Significant points in each of these areas are discussed below.

5.1 PREREQUISITES

An extensive list of test prerequisites was compiled to enable pre-test planning. The major areas of concern were the following:

a. All penetrations and weld channels complete and tested for leak tightness

b. Air locks complete and tested for leak tightness

c. Containment recirculation fans functional

d. Pressurization system installed and leak tested

e. Test instrumentation installed, leak checked, and calibrated

f. Structural test instrumentation installed, checked, and calibrated

g. Containment isolation valves positioned and leak checked

h. Communications

i. Equipment protection

j. All non-essential loads inside containment de-energized

k. Systems lined up to simulate potential post accident state

l. Interferences between containment building and adjoining structures or equipment that could be damaged by or restrain building growth.

Since the test called for piping and electrical penetrations as well as weld channels to be exposed to containment atmosphere, extensive testing of these components was required. Tests were performed during construction and final leak checks were made prior to this test. These final tests revealed many small leaks that were repaired. Two major leaks could not be repaired before the test. These were in the penetration heat exchangers for one steam generator blowdown line and one feedwater line. These two penetrations were isolated. They will be repaired and tested for leakage individually before the plant is put into operation.

Air locks were tested for leakage at connections, gaskets, and equalization ball valves. Leakage was measured and decreased by repair. The ball valves for the inner doors leaked past the seats. This leakage was decreased but could not be eliminated.

Containment recirculation fans were operationally tested. Orifices were installed to prevent motor overload at the high test pressures, and the service water lines to the recirculation units were hydrostatically tested. A leak in one fan motor cooler was discovered. The cooler was removed and the service water line to that fan was fitted with a temporary jumper. Four of the five recirculation units were available for use during the test.

The reactor building pressurization system was constructed, pressure tested, leak checked, and functionally checked prior to the test. The instrumentation was installed, leak checked, and operationally checked. The precision pressure gauges did not read within specification and were returned to the manufacturer for re-calibration. At the start of the test they again were slightly out of specification. The possible affect of this is discussed further in Section 5.3.4 Error Analysis.

All containment isolation valves were positioned and leak checked prior to the test. Leakage testing was mostly performed using the pressure decay method. In some instances a flowmeter was used to determine seat leakage. All the leakage detected was assigned to the isolation valves. An arbitrary leakage limit of 20 scc per min per inch of nominal valve diameter was used as a guideline for valve repair.

Since this plant has an extensive isolation valve seal water system, the number of containment isolation valves that must be tested periodically for leakage is small. The so called Type C testing of Reference 3 applies to the following lines only. Sketches and measured leakages are shown in Appendix B.

a. Pressurizer Relief Tank Nitrogen Supply

b. Accumulator Nitrogen Supply

c. Reactor Coolant Drain Tank Nitrogen Supply

d. Instrument Air

e. Containment Sump Recirculation Line

f. Deadweight Tester Line

g. Hydrogen Recombiner Line (5 lines)

h. Post Accident Air Sampling (7 lines)

The pretest leak checking of all isolation valves contributed to a successful building test and gave a final grooming to this portion of the containment isolation system. It was necessary to clean and repair several valve seats, discs, and diaphragms. Also, the stem travel of certain automatic valves had to be adjusted. This testing also revealed a severe unbonding problem with the rubber lined butterfly valves in the purge and pressure relief lines. Subsequently these valves were removed and had the rubber linings replaced prior to the building test.

The extensive pretest leak checking that was performed was a major factor in the very low leakage rates that were obtained for the reactor building. Costly test delays would have certainly resulted if many of the items revealed during the pretesting were not uncovered until the building testing began.

Extensive valve line-up sheets were prepared for each system that penetrated containment. Systems which were not missile shielded or those which could be vented to the containment atmosphere following a major loss of coolant accident or seismic disturbance were vented to the containment atmosphere. Lines penetrating containment that were not connected to closed systems outside of containment were vented to the outside atmosphere.

Equipment that could be damaged by the building pressure was either removed or vented. Light bulbs were not removed, and no breakage was noticed. A survey was also made to remove interferences between the containment building and adjacent structures. Construction staging and formwork that were hard against the building were removed, and several welds that inadvertantly tied the containment liner to the interior structural columns were cut. No apparent damage from building growth was noted.

5.2 TEST PERFORMANCE

Pressurization of the reactor building was started on March 4, 1971 at 1830. Figure 2 shows the actual test sequence.

The pressurization rate was approximately 2 psi per hour. This was the maximum rate possible with the available compressors. Five compressors were used for most of the test, since one compressor failed shortly after the test began. At 14 psig, pressurization was halted and a thorough inspection of the containment interior and exterior was made. The inspection revealed the following:

a. No oil haze was seen in the containment indicating clean pressurization air.

b. The test pressurization system butterfly valves were leaking by.

c. Several small valve packing leaks were found and repaired.

d. One small pinhole leak was noted in a piping penetration. This was repaired after the test was completed.

e. Water was noted at the recirculation unit with the temporary jumper. The water lines to this unit were then isolated.

After completion of the 14 psig inspections, pressurization was continued to 36 psig. Structural test data was obtained, and an external inspection for leaks was made. Slight leakage was detected past the seat of the equipment hatch air lock inner door equalizing valve.

After completion of the 36 psig inspections pressurization was continued to 47 psig. Structural test data was obtained, and an external inspection for leaks was made. Slight leakage was detected past the seat of the personnel air lock inner door equalizing valve. After the leakage investigation, all the electrical and mechanical penetrations and weld channels were blown down to atmospheric pressure. This was done to determine whether any in-leakage to the components existed from the reactor building. Since the normal integrated leak rate test checks the tightness of the second leakage barriers only for all weld channels and penetrations, this was done to check the integrity of the first leakage barrier. All four zones of the weld channel and penetration pressurization system had pressure increase which indicated that air was leaking from the building into these zones. It was not possible to pinpoint or measure the sources of leakage because of the quantities involved. The primary purpose of this test was to verify that no major leaks from containment to the weld channels and penetrations existed, and this was accomplished. Previous testing had verified that leakage from the weld channels and penetrations was small.

After all checks had been completed at 47 psig, pressurization was continued to 54 psig. Weld channels and penetrations were again opened to the containment atmosphere. At 53.5 psig three compressors were secured to decrease the rate of pressure increase. Pressure was increased to 54 psig and structural test data was taken. 54 psig could not be held without the compressors, since the relief valve on the temporary containment vessel pressurization line was leaking badly. The depressurization line (through penetration UU) and the pressurization line and relief valve (through penetration VV) were removed after the test. Both lines were blanked and tested for zero leakage.

After holding 54 psig for one hour, depressurization was begun to 47 psig. At 48 psig depressurization was secured to install a blank flange upstream of the pressurization supply butterfly valve. This valve had leaked at each pressure plateau. Since it was no longer required and was not a permanent installation, the leakage path was eliminated. Depressurization was continued to 47.1 psig and secured. Leakage data was obtained and after a short period it was evident that water was leaking into containment. Indicated reactor building sump water level was increasing and the calculated mass of air was increasing. The leak was traced to the service water line serving the recirculation unit with the removed motor cooler. A broken jumper hose was postulated, and building pressure was decreased to 30 psig to enable an inspection and repair crew to enter the containment building. 30 psig was chosen because exposures to that pressure for 40 minutes are permitted without any special decompression procedures.

The inspection crew found that the jumper hose had parted and that one to four inches of water covered the entire floor of the containment building. The hose was repaired, and the crew left the containment building in the required time. The sumps were drained by using building pressure to blow out the water through the sump drain lines. It was not possible to remove the water from the cavity beneath the reactor vessel, and so a pool of water approximately 17 feet across and 13 feet deep remained in the building for the remainder of the test.

After repairs had been effected, pressurization of the building was restarted. Pressurization was secured at 47 psig and leakage data was obtained. Because of the large quantities of water present in the building, it took over 24 hours to reach an equilibrium condition of temperature and dewpoint when meaningful leakage data could be obtained. Also, the temperature control of the building was touchy because of the delicate equilibrium condition and lack of fine control of recirculation unit cooling water. It was decided to stop adjusting cooling water flow and permit the building to reach its own equilibrium condition. The test was originally intended to be run at approximately 90 F, but it was apparent that 90 F could not be reached. The temperature stabilized at approximately 75 F. Very good leakage data was finally obtained. Graph 1 shows the average reactor building temperature, dew point, and air mass throughout the integrated leak rate test period. The twenty-four hours of data, when analyzed by the method of least squares, indicated a measured leakage rate of 0.009 ±0.0207 percent per day. The allowable leakage rate was 0.0749 percent per day. A known leak rate was imposed on the building through a calibrated flowmeter for a period of 12 hours. Agreement between the calculated leakage rate and the measured leakage rate was excellent, thus showing the validity of the test technique. Section 5.3 discusses the data analysis in more detail.

After the 47 psig data was obtained, depressurization was begun to 24.5 psig. The test was originally planned to be run at 23.5 psig, but it was decided to test at 24.5 psig to be sure of meeting the Reference 3 requirement of testing at greater than 23.5 psig. When conditions stabilized leakage data was obtained. The twenty four hours of data, when analyzed by the method of least squares indicated a measured leakage of -0.00261 ±0.0217 percent per day. The allowable leakage rate was 0.0542 percent per day. A known leakage rate was imposed as before and good agreement between the measured and calculated values again verified the test technique.

After the 24.5 psig data was obtained depressurization was begun to atmospheric pressure. A post test inspection of the building revealed the following:

a. One main support box girder for the polar crane had buckled due to the pressure differential across the beam. The beam was not vented.

b. Another box girder was expelling air and air was also bubbling up through water puddles on the concrete floor. This undoubtedly contributed to the negative leakage rate at 24.5 psig.

c. The floors were mostly dry which was the main reason for the long stabilization time required at 47 psig. These floors had been thoroughly soaked.

d. Liner insulation at a few isolated locations had buckled slightly.

e. No light bulbs were broken and no other damage was noticed.

f. The containment atmosphere was clean, dry, and odorless.

5.3 DATA ANALYSIS

The discussion of the test data may be divided into four major areas.

a. Raw Data

b. Reduced Data

c. Leakage Determination

d. Error Analysis

Significant points in each of these areas are discussed below.

5.3.1 Raw Data

The raw test data that was obtained is listed in Appendix A. Data is shown for only the 36 hours pertaining to the tests at 47 psig and 24.5 psig. Data taken during the stabilization periods is not shown.

The precision pressure gauges (PI-1 and PI-2) were digital readout absolute pressure measuring devices which read directly in counts. The easy readout eliminated differences in data taking between individuals and left nothing to interpretation. Since absolute pressure is the most important parameter, it was important that the data be consistent.

The other absolute pressure gauge (PI-3) and the gauge pressure device (DPI-1) were used for test control only. They were standard dial gauges.

The dewpoint measuring device was a six channel strip chart recorder which read each dewcel in sequence. The tabulated data was read from the recorder face because the various readings were often so close together that printouts were not legible. This reading was the most subjective of those taken, but dewpoint is not as an important measurement as pressure or temperature as indicated in 5.3.4.2.

The temperature measuring device was a digital voltmeter equipped with a volts to ohms converter for direct readout of RTD resistance. A barrel switch was used to manually read the RTDs in sequence. The digital readout again eliminated any possibility of data interpretation by different individuals.

Atmospheric pressure was measured by an aneroid barometer that read in inches of mercury. It was used periodically to check the gauge pressure device (DPI-1) that was used for control of pressurization and depressurization.

The controlled leakage flow measurement device was a rotameter that read out in standard cubic feet per minute at 0 psig and 90 F. A bulb type temperature measurement device was used to determine the temperature of the air passing though the flowmeter. It had a dial type readout in ^{o}F.

Other data was taken periodically to monitor test performance such as air dryer temperature and pressure, recirculation unit motor current, and reactor building sump level. Test control data was taken by Wedco Corporation personnel and leakage data was taken by Consolidated Edison personnel.

5.3.2 Reduced Data

The reduced data that was obtained is listed in Appendix A. Data is shown for only the 36 hours pertaining to the tests at 47 psig and 24.5 psig. Data reduced during the stabilization periods is not shown. All data was reduced on prepared format sheets to ensure that all personnel handled the data in the same manner, that the same number of significant figures were used, and to simplify checking of results.

The absolute pressure was determined by converting counts to psia for each precision pressure gauge. Each gauge had computer printout calibration tables in ten count increments which made pressure determination easy. After absolute pressure was determined for each gauge, the average of the two readings was taken. This was called P_T (containment total pressure).

The average dewpoint was determined by taking the average of the six dewcel readings. The partial pressure of water vapor (P_{WV}) was determine from the steam tables which were available in 0.1 F increments.

The average dry bulb temperature was determined by taking the average of the 24 RTD readings. After the average ohmic value had been determined, a curve of the temperature-resistance relationship for the RTDs was used to find the average temperature in $^{\circ}$F. The curve was easily readable to 0.1 F and visual interpolation was used to read to 0.01 F. The absolute temperature was calculated by adding

459.69 to the Fahrenheit reading. This was called T. RTD #21 went bad between the 47 and 24.5 psig tests. Therefore the temperature at 24.5 psig is the average of 23 values.

The partial pressure of the containment air was calculated by subtracting the partial pressure of water vapor from the total pressure of the containment. This was called P_a

$$P_a = P_T - P_{wv} \tag{1}$$

The mass of air in containment was calculated from the perfect gas law as follows:

$$M = \frac{P_a V}{RT} \quad \text{where} \tag{2}$$

M = Air mass, lbm

P_a = Partial pressure of air, lbf/in^2

V = Containment free volume, 2.61×10^6 ft^3

R = Gas constant, 53.35 $\frac{ft\text{-}lbf}{lbm - R}$

T = Absolute temperature, R

When the values are substituted into Equation (2) above and the units are made consistent, the following expression results:

$$M = 7.0448 \times 10^6 \frac{P_a}{T} \tag{3}$$

Average dewpoint temperature, average drybulb temperature, and containment air mass were plotted hourly to notice trends and determine when sufficient stabilization had occurred to begin the

24 hour test period. Data plotting also served to pinpoint calculational errors. Graphs 1 and 2 show the data plots for 47 psig and 24.5 psig respectively.

When the controlled leakage phase was begun, the actual flow through the flowmeter was determined from the following:

$$\dot{W} = \frac{4.50 \times FI}{\frac{(TI + 460)}{550}} \quad \text{where} \qquad (4)$$

$\dot{W}$ = mass flowrate, lbm/hr

FI = measured flowrate, scfm at 90 F, 0 psig

TI = measured flow temperature, F

Consolidated Edison personnel performed all data reduction and calculations. Calculations were checked by Gilbert Associates, Inc.

5.3.3 Leakage Determination

The leakage rate was determined by using the CLERCAL computer program developed by Gilbert Associates, Inc. Average temperature, total pressure, and water vapor pressure were telephoned as input data to the offices of Gilbert Associates, Inc. As a check, the computer performed the same calculations as done in the field. The computer program then fit the data with a least squares fit and calculated the leakage rate in both percent per day and pounds per hour. Graphs 1 and 2 show the calculated data fits for the 47 and 24.5 psig runs respectively.

At 47 psig the calculated leakage rate based on 24 hours of consecutive data was 0.0090 percent per day (3.04 lb/hr). For information only, the leakage rate based on the final 12 hours of data resulted in a calculated leakage rate of 0.0079 per cent per day (2.66 lb/hr). The allowable leakage rate at the test pressure (47 psig) and temperature (75 F) was 0.0749 percent per day (25.2 lb/hr). Hence the measured leakage was approximately eight times smaller than the maximum allowable limit. It should be noted that a measurement of 3 pounds per hour in 800,000 pounds is a difficult quantity to measure with certainty. The method used to verify the calculational and measurement technique was to superimpose a known leak through a calibrated flowmeter and calculate the amount of additional leakage. The imposed leak rate was set at approximately the allowable level. From Graph 1 it is seen that the calculated total leakage between the 24th and 36th hour was 0.08057 percent per day (27.15 lb/hr). When compared to the base building leakage rate of 3.04 lb/hr, the imposed leakage rate was 27.15 - 3.04 = 24.11 lb/hr. The actual average flow through the flowmeter was 25.53 lb/hr. This is excellent agreement.

At 24.5 psig, the same procedures were followed as before. The calculated leakage rate was -0.00261 percent per day (-0.56 lb/hr). The allowable leakage rate at 24.5 psig and 75 F was 0.0542 percent per day (11.68 lb/hr). This allowable leakage rate is actually the operational leakage rate (L_{TO}) referred to in Reference 3. Anytime measured leakage rate is less than L_{TO} power operation of the plant is permitted. The imposed leakage rate was set at approximately the allowable level. From Graph 2 it is seen that the calculated total leakage between the 24th and 36th hour was 0.0514 percent per day (11.07 lb/hr). When compared to the base building leakage rate of -0.56 lb/hr, the imposed leakage rate was 11.07 - (-0.56) = 11.63 lb/hr. The actual average flow through the flowmeter was 11.94 lb/hr. This is outstanding agreement.

The slight negative leakage rate at 24.5 psig was due to outgassing from concrete and a box beam. Outgassing from both of these sources was noticed during the post test inspection of the building, and it is very likely that the same thing occured at 24.5 psig. When the second 12 hours of data are considered, the measured leakage rate was 0.0044 percent per day (0.94 lb/hr). Most of the outgasing should have subsided after 16 hours and all future comparisons should be based on the above leakage rate. Reference 3 requires that all tests must be run for a minimum of 24 hours to be valid, and the retest limit of 0.064 percent per day as calculated in 6.0.g was based on the 24 hour results. However should the final 12 hours of data be used, the retest limit would increase to 0.0723 percent per day. Consideration should be given to accepting this latter value as the retest limit, L_T since the difference between -0.56 and +0.94 lb/hr is negligible in 500,000 lb.

5.3.4 Error Analysis

5.3.4.1 General

The fundamental sources of error to be considered are both systematic and random. In a leakage rate test of this magnitude the main contributor is the systematic error inherent in the test instrumentation. Other factors include the following:

a. Temperature fluctuations and gradients within containment
b. Variation of water vapor pressure throughout the vessel
c. Change in free volume due to temperature changes
d. Certain errors inherent in the method of test
e. Error involved in the reading and reduction of data

In very large containment vessels, such as Indian Point Unit 2, the existence of finite temperature gradients are unavoidable, even though four recirculation units were run continuously for uniform mixing. Variation in average temperature and dewpoint temperature were minimal during the tests as seen on Graphs 1 and 2. Since changes from existing conditions are the important factors in a test such as this, the presence of local variations are not significant. It is expected that local variations will follow average variations and as long as enough measurements are made the affect of minor local changes has a negligible influence on the average.

The change in free volume is negligible because of the small temperature change experienced during the test periods.

Because the test was an around-the-clock operation, at least six data takers were involved which minimized any consistent errors in instrument reading, data reduction, or calculation. Also all calculations were checked independently.

All (weight) data points were within their expected error limits except one during the 47 psig controlled leakage phase. In addition, the controlled leakage phases showed close agreement with the least squares fit which verified the method and instrumentation.

Checks of the temperature and dewpoint instrumentation were performed before and after the test to ensure that no drift occurred over the test period. A comparison of the instrumentation checks revealed no descernible drift.

As stated in Section 5.1, the precision pressure gauges did not read within specification as revealed by comparing the readings on the two gauges when the test began. This was not considered to be a problem because the ability of the gauges to detect pressure change rather than absolute pressure is the important parameter. A comparison of the two precision gauge readings at both 47 and 24.5 psig reveals that the difference between readings is essentially constant throughout each pressure range. The variation in pressure difference falls easily within the stated accuracy of the instrument, and hence all uncertainty bands are reported based on the stated accuracy of ±0.015% of reading. If the most pesimistic approach were to be used for pressure error based on the observed difference between instruments, the pressure accuracy would be 0.045% of reading. This would result in a leakage rate at 47 psig of 0.009 ±.047 percent per day, still well below the allowable leakage of 0.0749 percent per day. Since the controlled leakage test results agree so closely with the measured values, it is clearly not justified to use the greater hypothetical pressure uncertainty stated above.

5.3.4.2 Test Instrumentation Error Analysis

The leakage rate in percent per day based on an interval of measurement of 24 hours duration is:

$$L = 100 \left[1 - \frac{P_{24} T_0}{P_0 T_{24}} \right] \text{percent per day} \qquad (5)$$

Where:

$P_0 = P_{T0} - P_{WV0}$, psia = Partial pressure of air-start

$P_{24} = P_{T24} - P_{WV24}$, psia - Partial pressure of air-finish

T_0 = Containment mean ambient temperature - start, R

T_{24} = Containment mean ambient temperature - finish, R

The change or uncertainity interval in L due to uncertainties in the measured variables is given by:

$$\sigma_L = 100 \left[\left(\frac{\partial L}{\partial P_{24}} \sigma_{P24}\right)^2 + \left(\frac{\partial L}{\partial P_0} \sigma_{P0}\right)^2 + \left(\frac{\partial L}{\partial T_0} \sigma_{T0}\right)^2 + \left(\frac{\partial L}{\partial T_{24}} \sigma_{T24}\right)^2 \right]^{\frac{1}{2}} \qquad (6)$$

Where σ is the standard error for each variable.

The error is L after differentiating is:

$$e_L = 100 \left[\left(\frac{T_0 e_P}{P_0 T_{24}}\right)^2 + \left(\frac{P_{24}\ T_0}{P_0{}^2 T_{24}} e_P\right)^2 + \left(\frac{P_{24} e_T}{P_0 T_{24}}\right)^2 + \left(\frac{P_{24} T_0}{P_0 T^2{}_{24}} e_T\right)^2 \right]^{\frac{1}{2}} \qquad (7)$$

Where: $e_P = \sigma_{P_0} = \sigma_{P_{24}}$

$e_T = \sigma_{T_0} = \sigma_{T_{24}}$

Equation (7) has been verified by K. Joroschek and E. Weipport, "Tightness Investigations on Reactor Safety Pressure Vessels" Vol. 13, No. 3, March 1961.

Since the values of T_0 and T_{24} are essentially the same and since P_0 and P_{24} are essentially the same, let $T_0 = T_{24}$ and $P_0 = P_{24}$ Equation 7 then becomes

$$e_L = 100\sqrt{2}\left[\left(\frac{e_P}{P_0}\right)^2 + \left(\frac{e_T}{T_0}\right)^2\right]^{\frac{1}{2}} \qquad (8)$$

The error in pressure, e_P may be expressed as,

$$e_P = \sqrt{e_{PA}^2 + e_{PB}^2}$$

Where:

e_{PA} = Error induced by the two (2) precision gages

or

$$e_{PA} = \frac{0.00015 \times 61.516}{\sqrt{2}}$$

e_{PA} = ±0.00652 psia

e_{PB} = Error induced by the Dewcels

$$e_{PB} = \frac{\pm 0.75\ F}{\sqrt{6}} = \pm 0.306\ F$$

and from the steam tables at a dewpoint of 50 F the pressure equivalent to ±0.306 F is

$$e_{PB} = \pm 0.0021 \text{ psia}$$

$$\therefore e_P = \sqrt{0.00652^2 + 0.0021^2} = \pm 0.00684 \text{ psia}$$

To determine temperature error it is necessary to sum the RTD repeatability and the readout circuitry accuracy. The RTD repeatability is ±0.1 F. The combined accuracy of the digital volt meter and the volts-to-ohms converter is ±(0.012% of reading + 0.004% of full scale). At 75 F this reduces to ±0.15 F. Hence the total temperature uncertainty is ±0.25 F.

The error in temperature e_T may be expressed as

$$\pm \frac{0.25}{\sqrt{24}} = \pm 0.0512 \text{ F at 47 psig and}$$

$$\pm \frac{0.25}{\sqrt{23}} = \pm .0523 \text{ F at 24.5 psig}$$

At 47 psig,

$$P_o = 61.516 \text{ psia } T_o = 534.13 \text{ R}$$

Substitution into Equation (8) yields

$$e_L = \pm 0.0207\% \text{ per day}$$

Similarly at 24.5 psig

$$P_o = 39.315 \text{ psia } T_o = 533.50 \text{ R}$$

$e_P = \pm 0.00465$ psia

$e_L = \pm 0.0217\%$ per day

One should keep in mind that the magnitude of the calculated error is inversly proportional to time and any reasonable error is not established until at least fifteen hours after the start of the test.

The error involved in the determination of the weight of air inside containment at any instant may be derived from:

$$W = \frac{KP}{T} \qquad (9)$$

Where W = Weight of air inside containment, LB

$K = \text{Constant} = V/R = 2.16 \times 10^6 \text{ ft}^3 \times 144 \frac{in^2}{ft^2} / 53.55 \frac{ft\text{-}lb}{lb\text{-} R}$

$= 7.0448 \times 10^6 \text{ in}^2 - R$

P = Partial pressure of air inside containment, psia

T = Mean containment air temperature, R

The error based on the second Law of Propagation on W is:

$$e_W = \left[\left(\frac{\partial W}{\partial P}\sigma_P\right)^2 + \left(\frac{\partial W}{\partial T}\sigma_T\right)^2\right]^{\frac{1}{2}}$$

$$= \left[\left(\frac{Ke_p}{T}\right)^2 + \left(\frac{-KP}{T^2}e_T\right)^2\right]^{\frac{1}{2}}$$

Where, e_p = Error induced by the pressure reading

= ±0.00684 psia (from previous page)

e_T = Error induced by the temperature reading

= ±0.0512 at 47 psig

= ±0.0522 F at 24.5 psig

Not taking into account the exact minute changes of temperature and pressure at each reading, one may use the values at time zero at 47 psig, P = 61.516 psia, T = 534.13 R, therefore:

$e_W = \pm 119$ lb

and for 24.5 psig, P = 39.315 psia and T = 533.50 R

$e_W = \pm 80$ lb

6.0 RECOMMENDATIONS AND GENERAL DISCUSSION

A review of the test results and procedures leads to the following observations:

a. Inspecting the building interior while it was pressurized at 14 psig was advantageous.

b. When there is excessive moisture in the building, it is best to permit the building to reach its own equilibrium condition rather than trying to control temperature within a certain band. The building time response is so slow and the equilibrium is so delicate that minor changes in cooling water flow have detrimental affects on stability.

c. Extensive local leak testing prior to the test is time well spent.

d. Future tests of this nature should do the low pressure leakage test first or decrease pressure below the test pressure for a period of time and then increase pressure to the test pressure. This will eliminate negative leakage indications caused by outgassing from components and structures. This will also more closely duplicate the method used for future periodic tests.

e. The Indian Point Unit 2 containment building system is extremely tight.

f. The air recirculation system was instrumental in maintaining the reactor building temperature essentially constant during test periods.

g. Per the plant Technical Specifications the maximum allowable leakage rate (L_T) for the next periodic integrated leak rate test at 24.5 psig shall be the lesser of

$$L_T = L_a \frac{L_{TM}}{L_{PM}} = 0.1 \left[\frac{-0.0026 + .0217}{0.0090 + .0207}\right] = .064$$

or

$$L_T = L_a \left(\frac{P_T}{P_P}\right)^{\frac{1}{2}} = 0.1\left(\frac{24.5}{47}\right)^{\frac{1}{2}}$$

$$L_T = .0723$$

Hence the limit for the next test is 0.064 percent per day. However consideration should we given to accepting 0.0723 per cent per day for the limit as discussed in 5.3.3.

This method for determining retest allowable leakage rates is unsatisfactory for buildings exhibiting <u>near zero</u> leak rates during initial tests. The current method actually presents an incentive to obtain a higher actual initial leakage rate yet less than the allowable to obtain a larger deterioration allowance. It also makes the future limits strictly dependant on the instrumentation error rather than measured building leakage.

h. Future tests of this nature should eliminate the absolute pressure dial gauge (PI-3), since it is not essential to test performance.

REFERENCES

1. Code of Federal Regulations, Title 49, January 1, 1967

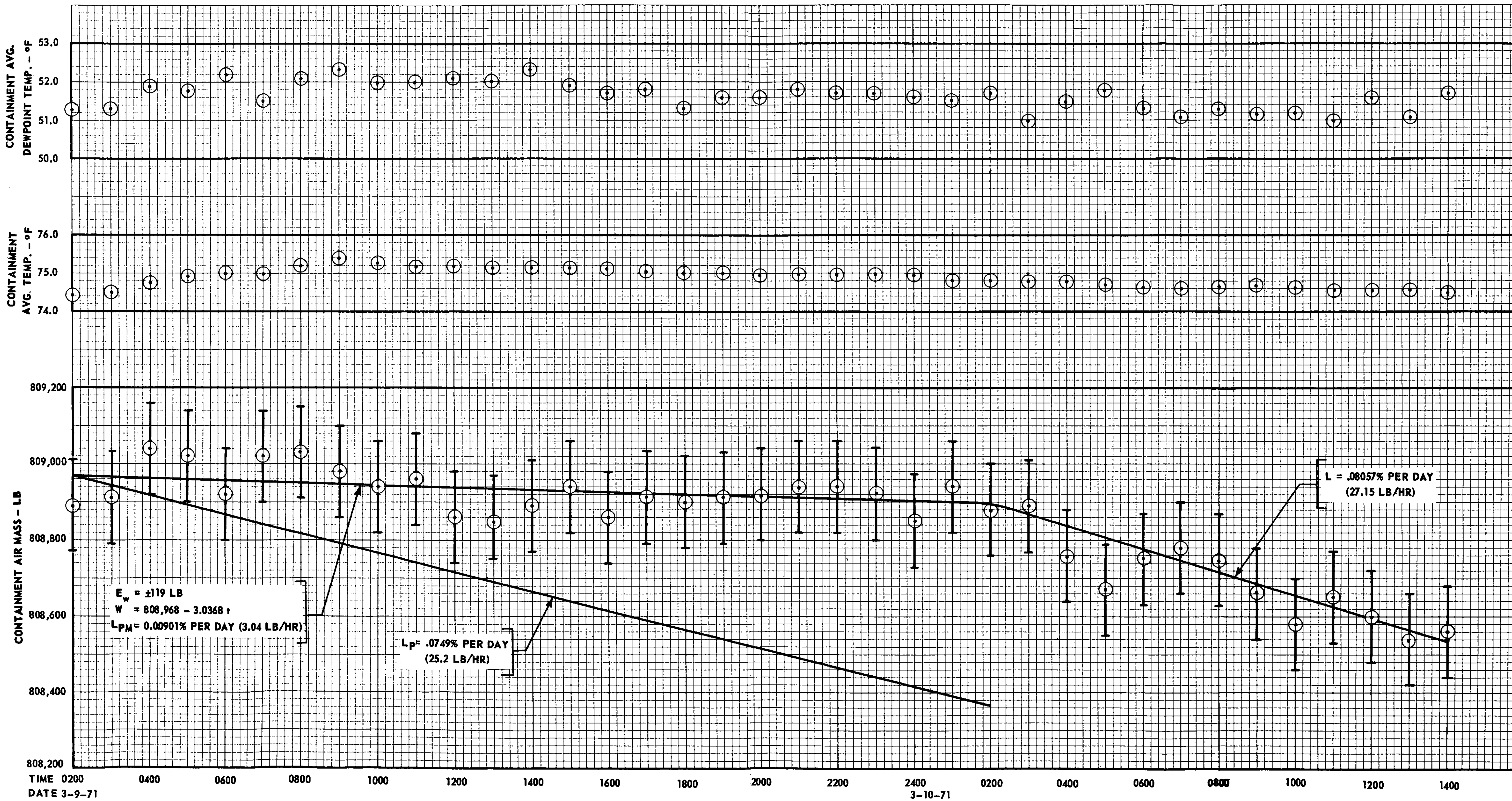
2. Prerequiste List for Vapor Containment Pressure Test, Revision 1

3. Appendix G, 10-CFR-50 Reactor Containment Leakage Testing for Water Cooled Power Reactors, May 1970 (Draft Form)

4. IPP-SU-4.39.1, Revision 1 - Vapor Containment Pressure Test

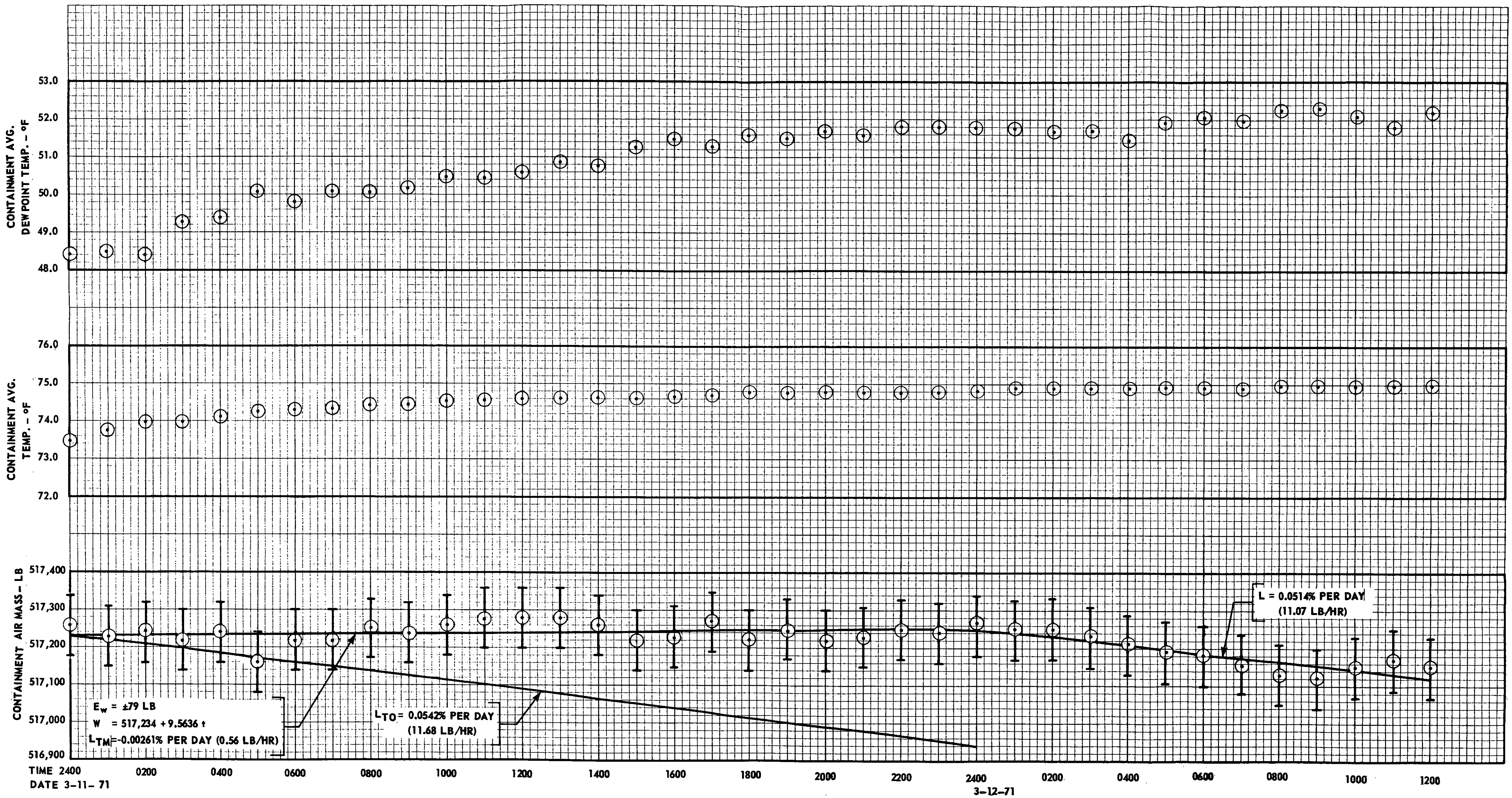
5. IPP-SU-4.39.2, Revision 1 - Isolation Valve Leakage Test

G R A P H S



GILBERT ASSOCIATES, INC.

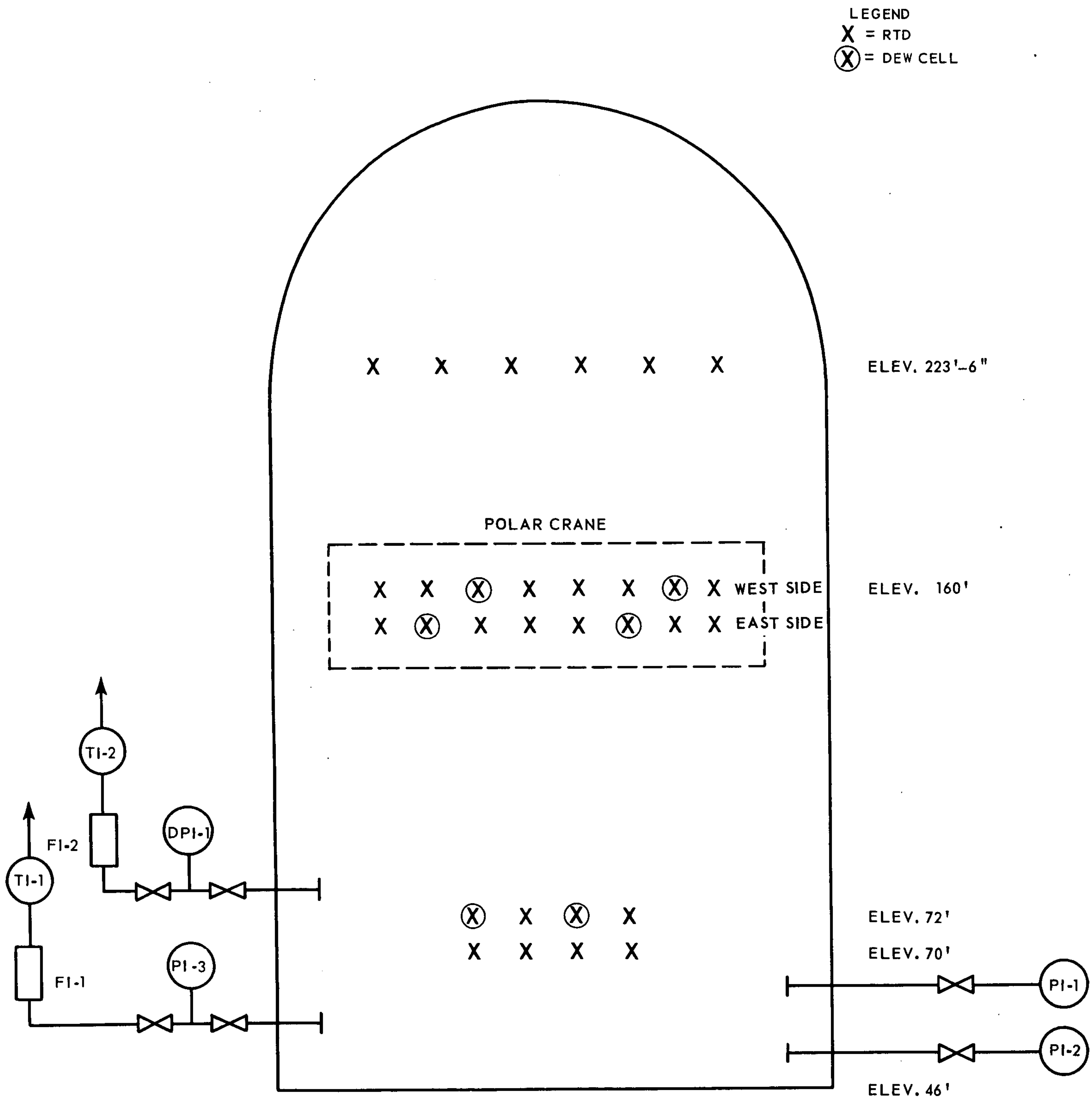
GRAPH 1
CONTAINMENT AVERAGE DEWPOINT, AVERAGE TEMPERATURE AND AIR MASS AT 47 PSIG VERSUS TIME



GILBERT ASSOCIATES, INC.

GRAPH 2
CONTAINMENT AVERAGE DEWPOINT, AVERAGE TEMPERATURE AND AIR MASS AT 24.5 PSIG VERSUS TIME

F I G U R E S



GILBERT ASSOCIATES, INC.

FIGURE 1
RELATIVE LOCATION OF RESISTANCE TEMPERATURE DETECTORS AND DEWCELS

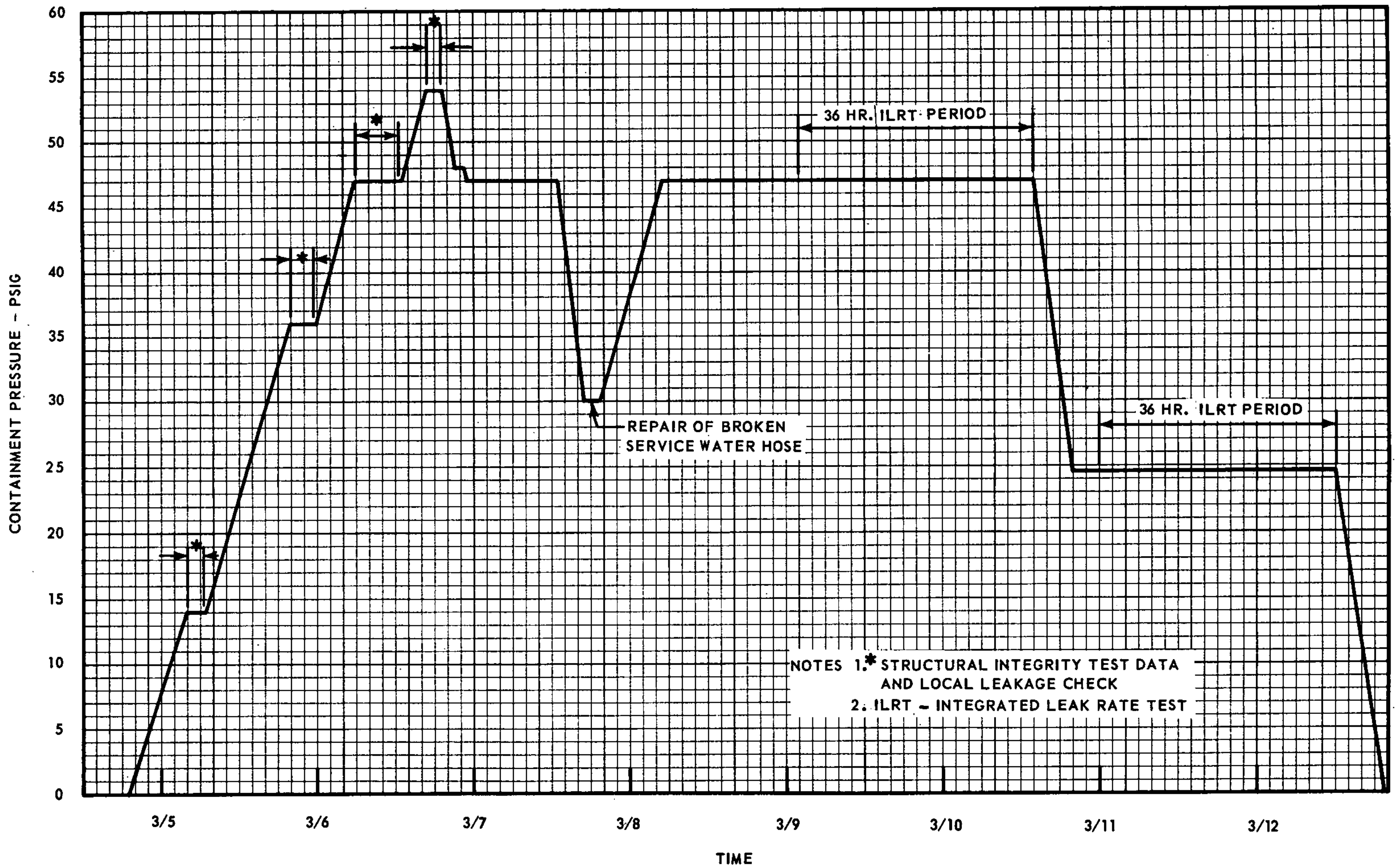
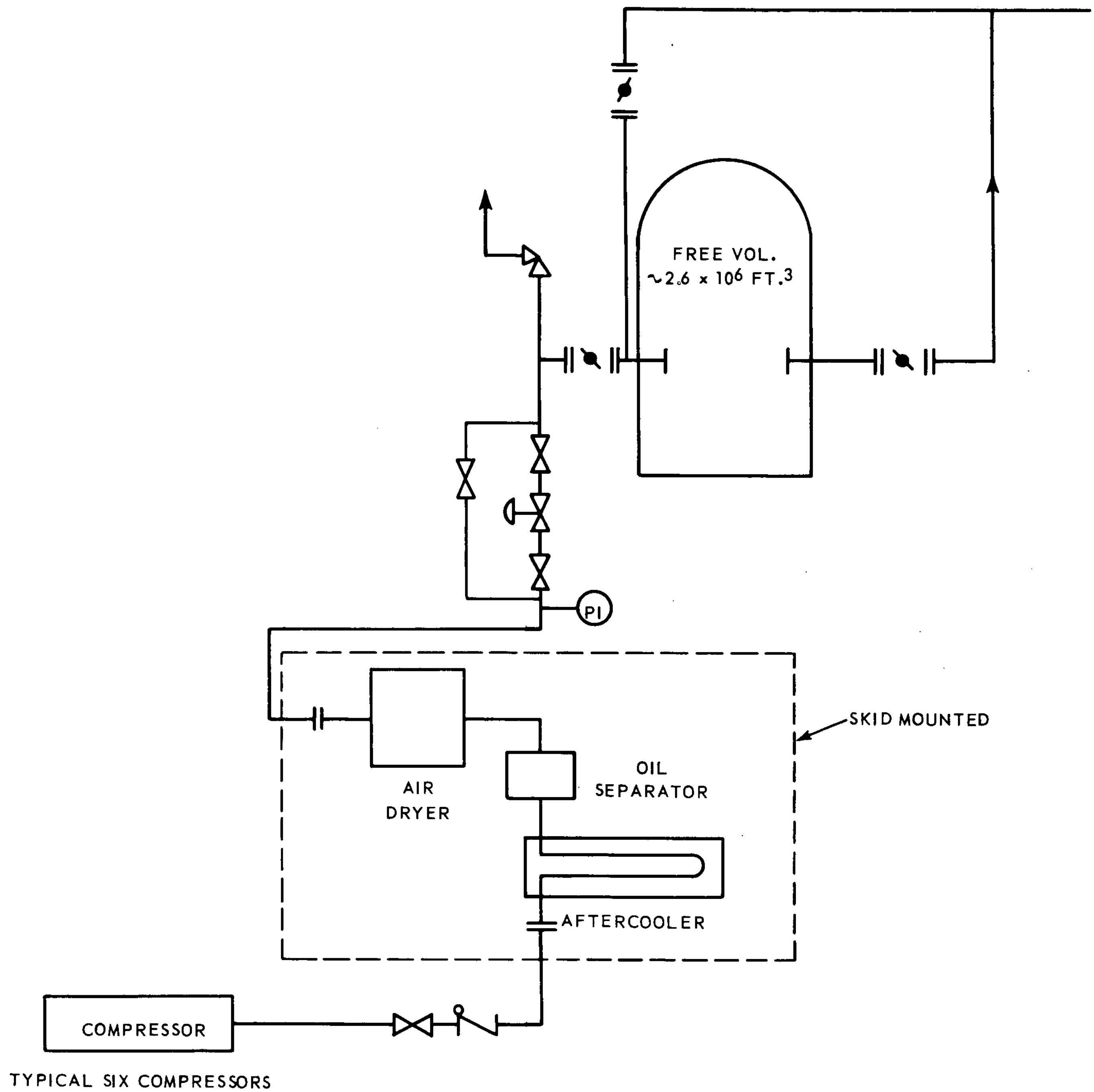


FIGURE 2
TIME – PRESSURE HISTORY

GILBERT ASSOCIATES, INC.



GILBERT ASSOCIATES, INC.

FIGURE 3
LEAK RATE TEST
PRESSURIZATION SYSTEM

APPENDIX A

ORIGINAL TEST DATA

APPENDIX A

ORIGINAL TEST DATA - SHEET 1 of 10
LEAKAGE RATE DATA AT 47 PSIG

Time	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300
Containment Pressure												
PI-1 (Counts)	61,503	61,515	61,555	61,573	61,580	61,580	61,610	61,630	61,608	61,598	61,593	61,590
PI-2 (Counts)	61,614	61,620	61,660	61,675	61,680	61,684	61,715	61,735	61,713	61,704	61,700	61,695
PI-3 (psia)	61.52	61.50	61.60	61.70	61.65	61.65	61.7	61.7	61.7	61.7	61.6	61.7
DPI-1 (psig)	46.7	46.7	46.7	46.7	46.7	46.7	46.7	46.7	46.7	46.7	46.7	46.7
Containment Dew Point (°F)												
DP-1	49.0	50.0	50.0	50.0	49.0	49.0	49.5	49.5	50.0	50.0	50.5	50.5
DP-2	50.0	48.0	50.0	50.0	50.0	50.0	49.5	50.0	50.0	50.0	49.0	49.0
DP-3	51.0	52.0	54.0	53.0	53.0	52.0	54.5	55.0	53.5	53.0	54.0	53.0
DP-4	53.8	52.0	53.0	52.0	55.0	53.0	53.0	53.5	54.0	53.5	54.0	55.0
DP-5	52.0	54.0	52.5	54.0	53.0	53.0	54.5	53.5	53.0	53.5	53.0	53.5
DP-6	52.0	52.0	52.0	52.0	53.0	52.0	51.5	52.0	51.5	52.0	52.0	51.0
Containment RTD Reading (ohms)												
TE-1	218.38	218.37	218.55	218.61	218.64	218.66	218.76	218.87	218.76	218.73	218.73	218.72
TE-2	218.47	218.47	218.64	218.73	218.74	218.77	218.86	218.96	218.85	218.80	218.80	218.77
TE-3	218.54	218.55	218.72	218.79	218.82	218.83	218.93	219.03	218.93	218.89	218.87	218.86
TE-4	218.44	218.43	218.63	218.68	218.72	218.70	218.83	218.86	218.78	218.74	218.72	218.71
TE-5	218.34	218.41	218.54	218.64	218.67	218.66	218.76	218.82	218.73	218.68	218.70	218.66
TE-6	218.40	218.46	218.56	218.63	218.67	218.68	218.77	218.96	218.86	218.79	218.82	218.80
TE-7	218.53	218.51	218.62	218.69	218.71	218.71	218.80	218.98	218.94	218.90	218.88	218.87
TE-8	218.65	218.75	218.86	218.95	219.00	218.97	219.09	219.16	219.10	219.08	219.05	219.06
TE-9	218.69	218.68	218.81	218.87	218.92	218.90	219.00	219.11	219.04	219.01	219.00	219.01
TE-10	218.71	218.84	218.96	219.04	219.09	219.07	219.21	219.22	219.16	219.11	219.13	219.11
TE-11	218.64	218.65	218.76	218.81	218.86	218.87	218.96	219.02	218.97	218.95	218.94	218.92
TE-12	218.80	218.80	218.97	219.03	219.06	219.07	219.17	219.19	219.11	219.08	219.06	219.05
TE-13	218.59	218.58	218.71	218.80	218.82	218.83	218.90	218.98	218.85	218.83	218.82	218.80
TE-14	218.82	218.84	218.98	219.00	219.08	219.06	219.20	219.26	219.16	219.12	219.12	219.09
TE-15	218.56	218.56	218.69	218.75	218.78	218.77	218.85	218.92	218.87	218.84	218.81	218.81
TE-16	218.78	218.80	218.92	218.93	219.01	218.99	219.10	219.16	219.03	219.01	219.01	218.97
TE-17	218.65	218.66	218.81	218.82	218.87	218.86	218.92	219.04	219.00	218.96	218.93	218.95
TE-18	218.70	218.68	218.78	218.81	218.86	218.85	218.93	219.03	218.94	218.92	218.91	218.90
TE-19	218.16	218.25	218.37	218.43	218.47	218.48	218.58	218.62	218.53	218.52	218.50	218.47
TE-20	219.21	219.25	219.23	219.33	219.34	219.35	218.69	219.16	219.39	219.42	219.27	219.41
TE-21	218.88	219.54	219.81	219.96	219.83	219.82	220.84	220.21	219.96	219.91	219.89	219.90
TE-22	218.05	218.16	218.24	218.30	218.33	218.33	218.41	218.74	218.70	218.66	218.65	218.64
TE-23	218.85	218.44	218.44	218.49	218.51	218.53	218.50	218.72	218.80	218.74	218.99	218.79
TE-24	218.89	218.44	218.41	218.50	218.49	218.51	218.38	218.74	218.81	218.71	218.79	218.73
Barometric Pressure (in. Hg)	29.61	29.60	29.61	29.64	29.68	29.74	29.77	29.79	29.80	29.81	29.81	29.82
Controlled Leak Rate, FI-2 (scfm)												
Controlled Leak Temperature, TI-2 (°F)												

APPENDIX A

ORIGINAL TEST DATA - SHEET 2 of 10
LEAKAGE RATE DATA AT 47 PSIG

												3-10-71
Time	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100
Containment Pressure												
PI-1 (counts)	61,589	61,587	61,584	61,582	61,578	61,574	61,570	61,573	61,573	61,570	61,565	61,555
PI-2 (counts)	61,694	61,691	61,687	61,685	61,682	61,677	61,672	61,675	61,676	61,673	61,665	61,660
PI-3 (psia)	61.6	61.6	61.6	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5
DPI-1 (psig)	46.7	46.6	46.6	46.6	46.6	46.6	46.5	46.6	46.5	46.6	46.5	46.5
Containment Dew Point (^oF)												
DP-1	50.0	50.0	50.0	50.0	49.5	50.0	50.0	51.0	49.5	50.0	50.0	50.0
DP-2	50.0	49.5	49.5	50.0	48.5	49.5	49.0	50.0	50.0	50.0	49.5	49.0
DP-3	53.5	52.5	51.5	53.5	51.0	52.5	53.0	52.0	52.0	52.5	51.5	52.0
DP-4	54.5	54.0	54.5	53.0	54.0	53.0	53.0	53.5	53.5	53.5	53.5	53.0
DP-5	53.5	53.5	52.5	53.0	53.0	52.5	53.5	52.5	53.5	53.0	53.0	53.0
DP-6	52.0	52.0	52.0	51.5	52.0	52.0	51.0	51.5	51.5	51.0	52.0	52.0
Containment RTD Reading (ohms)												
TE-1	218.70	218.68	218.70	218.68	218.65	218.65	218.64	218.65	218.63	218.61	218.62	218.59
TE-2	218.77	218.78	218.75	218.72	218.72	218.71	218.70	218.69	218.69	218.71	218.68	218.64
TE-3	218.86	218.85	218.85	218.83	218.82	218.79	218.79	218.79	218.78	218.71	218.77	218.74
TE-4	218.72	218.70	218.67	218.65	218.69	218.66	218.63	218.63	218.63	218.64	218.62	218.59
TE-5	218.66	218.65	218.62	218.60	218.63	218.60	218.60	218.58	218.60	218.59	218.56	218.54
TE-6	218.78	218.78	218.78	218.77	218.73	218.75	218.72	218.74	218.72	218.70	218.71	218.68
TE-7	218.86	218.85	218.85	218.83	218.84	218.81	218.80	218.80	218.79	218.78	218.77	218.73
TE-8	219.04	219.03	218.99	219.00	218.99	218.97	218.95	218.94	218.98	218.99	218.93	218.90
TE-9	218.99	218.99	218.95	218.95	218.94	218.91	218.90	218.90	218.90	218.91	218.88	218.85
TE-10	219.12	219.08	219.05	219.06	219.06	219.03	219.00	219.03	219.01	219.03	219.00	218.97
TE-11	218.92	218.90	218.90	218.88	218.88	218.85	218.84	218.84	218.85	218.83	218.82	218.80
TE-12	219.05	219.05	219.02	219.01	219.00	219.00	218.97	218.99	218.98	218.97	218.98	218.94
TE-13	218.81	218.79	218.79	218.77	218.75	218.74	218.72	218.73	218.72	218.72	218.71	218.67
TE-14	219.09	219.09	219.07	219.05	219.05	219.02	219.00	219.03	219.02	218.97	219.00	218.96
TE-15	218.80	218.81	218.78	218.76	218.76	218.75	218.73	218.72	218.73	218.75	218.72	218.70
TE-16	218.96	218.97	218.97	218.93	218.94	218.90	218.89	218.88	218.90	218.88	218.88	218.84
TE-17	218.93	218.93	218.90	218.89	218.88	218.87	218.84	218.86	218.88	218.86	218.84	218.82
TE-18	218.88	218.88	218.87	218.82	218.83	218.81	218.80	218.81	218.80	218.78	218.78	218.75
TE-19	218.47	218.46	218.45	218.44	218.43	218.41	218.38	218.41	218.41	218.42	218.39	218.35
TE-20	219.29	219.30	219.35	219.23	219.34	219.27	219.28	219.17	219.18	219.20	219.20	219.23
TE-21	219.91	219.91	219.93	219.87	219.92	219.87	219.84	219.96	219.97	219.91	219.86	219.78
TE-22	218.63	218.64	218.63	218.62	218.61	218.59	218.58	218.58	218.57	218.56	218.55	218.53
TE-23	218.77	218.79	218.88	218.86	218.75	218.80	218.78	218.75	218.72	218.70	218.84	218.76
TE-24	218.76	218.81	218.84	218.80	218.72	218.74	218.81	218.68	218.80	218.68	218.73	218.69
Barometric Pressure (in. Hg)	29.74	29.80	29.87	29.78	29.90	29.93	29.94	29.98	30.02	30.03	30.04	30.06
Controlled Leak Rate, FI-2 (scfm)												
Controlled Leak Temperature, TI-2 (^oF)												

APPENDIX A

ORIGINAL TEST DATA - SHEET 3 of 10
LEAKAGE RATE DATA AT 47 PSIG

Time	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400
Containment Pressure													
PI-1 (counts)	61,550	61,540	61,534	61,525	61,520	61,514	61,514	61,513	61,506	61,500	61,498	61,495	61,493
PI-2 (counts)	61,654	61,645	61,637	61,630	61,625	61,618	61,617	61,616	61,610	61,605	61,601	61,597	61,595
PI-3 (psia)	61.5	50.6	50.6	50.6	50.6	50.8	50.8	50.8	50.8	50.8	50.8	50.85	50.80
DPI-1 (psig)	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.4	46.4	46.4	46.4	46.4	46.4
Containment Dew Point (°F)													
DP-1	50.0	49.0	49.0	50.0	50.0	49.0	49.0	49.0	50.0	49.0	50.0	49.0	50.5
DP-2	50.0	49.0	50.0	50.0	49.0	49.0	49.0	49.0	49.0	49.5	50.0	48.0	49.5
DP-3	54.0	52.0	52.0	52.5	52.0	51.5	52.0	53.0	50.5	52.0	51.5	52.5	53.0
DP-4	52.0	53.0	53.0	54.0	52.5	52.5	53.5	53.0	53.5	52.5	53.5	52.5	52.5
DP-5	52.0	52.0	53.0	53.0	52.5	52.5	53.0	52.0	52.5	52.0	53.0	53.0	53.0
DP-6	52.0	51.0	52.0	51.0	51.5	52.0	51.0	51.0	51.5	51.0	51.5	51.5	51.5
Containment RTD Reading (ohms)													
TE-1	218.54	218.53	218.52	218.52	218.49	218.45	218.47	218.49	218.45	218.43	218.45	218.45	218.45
TE-2	218.62	218.62	218.58	218.58	218.56	218.54	218.56	218.55	218.54	218.52	218.53	218.53	218.48
TE-3	218.72	218.71	218.68	218.66	218.64	218.63	218.63	218.64	218.61	218.60	218.59	218.59	218.59
TE-4	218.55	218.54	218.52	218.48	218.48	218.49	218.48	218.47	218.47	218.45	218.47	218.45	218.44
TE-5	218.52	218.52	218.50	218.46	218.45	218.44	218.45	218.46	218.43	218.42	218.41	218.44	218.40
TE-6	218.64	218.64	218.62	218.60	218.58	218.55	218.55	218.58	218.55	218.54	218.53	218.53	218.53
TE-7	218.72	218.69	218.68	218.70	218.66	218.63	218.64	218.65	218.64	218.62	218.62	218.62	218.61
TE-8	218.92	218.88	218.85	218.84	218.82	218.83	218.83	218.82	218.80	218.80	218.78	218.79	218.76
TE-9	218.84	218.81	218.79	218.79	218.79	218.77	218.77	218.77	218.75	218.73	218.72	218.72	218.70
TE-10	218.97	218.94	218.92	218.90	218.87	218.87	218.88	218.89	218.86	218.85	218.85	218.84	218.84
TE-11	218.78	218.75	218.74	218.72	218.72	218.70	218.69	218.68	218.68	218.67	218.65	218.65	218.64
TE-12	218.90	218.90	218.86	218.86	218.84	218.82	218.83	218.81	218.82	218.81	218.79	218.80	218.79
TE-13	218.68	218.63	218.62	218.60	218.60	218.59	218.58	218.56	218.57	218.55	218.53	218.52	218.52
TE-14	218.92	218.93	218.90	218.87	218.87	218.83	218.86	218.87	218.84	218.82	218.82	218.83	218.83
TE-15	218.68	218.65	218.62	218.62	218.59	218.59	218.58	218.59	218.57	218.57	218.54	218.55	218.54
TE-16	218.82	218.79	218.78	218.76	218.75	218.72	218.74	218.74	218.72	218.71	218.69	218.70	218.69
TE-17	218.80	218.78	218.75	218.74	218.73	218.72	218.70	218.71	218.70	218.71	218.67	218.69	218.66
TE-18	218.72	218.71	218.68	218.70	218.66	218.63	218.65	218.65	218.65	218.60	218.61	218.61	218.59
TE-19	218.35	218.32	218.30	218.28	218.28	218.28	218.28	218.28	218.26	218.23	218.23	218.24	218.24
TE-20	219.30	219.16	219.21	219.20	219.19	219.21	219.07	219.05	219.10	219.09	219.01	219.03	218.95
TE-21	219.79	219.72	219.72	219.70	219.67	219.67	219.82	219.79	219.75	219.72	219.74	219.79	219.80
TE-22	218.52	218.49	218.49	218.46	218.46	218.42	218.43	218.44	218.43	218.41	218.41	218.40	218.40
TE-23	218.68	218.89	218.91	219.00	218.72	218.68	218.64	218.58	218.69	218.64	218.72	218.61	218.63
TE-24	218.68	218.75	218.70	218.70	218.64	218.63	218.55	218.61	218.70	218.52	218.59	218.61	218.53
Barometric Pressure (in. Hg)	30.05	30.03	30.05	30.07	30.08	30.10	30.12	30.12	30.11	30.11	30.09	30.06	30.03
Controlled Leak Rate, FI-2 (scfm)	5.6	5.58	5.58	5.55	5.50	5.50	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Controlled Leak Temperature, TI-2 (°F)	64.0	59.0	59.0	58.5	58.5	60.0	60.0	62.0	62.0	64.0	64.0	64.0	65.0

APPENDIX A
ORIGINAL TEST DATA - SHEET 4 of 10
LEAKAGE RATE DATA AT 24.5 PSIG

Time	2400	3-11-71 0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
Containment Pressure												
PI-1 (counts)	39,206	39,225	39,238	39,248	39,258	39,266	39,273	39,320	39,287	39,288	39,297	39,300
PI-2 (counts)	39,287	39,307	39,319	39,329	39,339	39,348	39,354	39,402	39,370	39,370	39,380	39,385
PI-3 (psia)	39.18	39.20	39.20	39.23	39.25	39.25	39.55		39.2	39.2	39.3	39.3
DPI-1 (psig)	24.40	24.44	24.45	24.50	24.50	24.50	24.50		24.6	24.6	24.6	24.6
Containment Dew Point (°F)												
DP-1	46.5	47.0	47.0	48.0	47.5	48.5	49.0	47.5	48.0	48.5	49.0	50.0
DP-2	47.0	46.5	44.5	47.0	47.0	48.0	47.0	49.5	47.5	48.0	48.0	49.0
DP-3	49.5	49.0	49.5	50.0	50.5	52.0	50.0	50.0	51.0	50.5	51.0	50.0
DP-4	49.0	49.5	50.0	50.5	51.0	51.0	51.0	51.5	51.0	52.0	51.5	51.5
DP-5	50.0	50.0	50.5	51.0	51.0	51.5	51.5	52.0	52.0	52.0	52.5	52.0
DP-6	48.5	49.0	49.0	49.5	49.5	49.5	50.0	50.0	51.0	50.0	51.0	50.5
Containment RTD Reading (ohms)												
TE-1	218.19	218.29	218.36	218.39	218.43	218.49	218.51	518.52	218.57	218.58	218.64	218.64
TE-2	218.25	218.35	218.38	218.44	218.47	218.53	218.54	218.54	218.60	218.64	218.65	218.69
TE-3	218.37	218.47	218.54	218.58	218.62	218.68	218.67	218.69	218.74	218.75	218.82	218.82
TE-4	218.22	218.32	218.41	218.43	218.47	218.55	218.54	218.57	218.61	218.62	218.64	218.67
TE-5	218.10	218.19	218.26	218.30	218.33	218.39	218.40	218.44	218.49	218.48	218.53	218.53
TE-6	218.22	218.34	218.40	218.45	218.48	218.54	218.54	218.58	218.61	218.62	218.67	218.69
TE-7	218.05	218.15	218.22	218.26	218.32	218.37	218.40	218.43	218.47	218.49	218.52	218.55
TE-8	218.20	218.33	218.43	218.50	218.55	218.60	218.63	218.65	218.72	218.71	218.74	218.79
TE-9	218.40	218.47	218.55	218.58	218.64	218.68	218.70	218.71	218.76	218.82	218.83	218.87
TE-10	218.35	218.50	218.56	218.63	218.66	218.70	218.75	218.76	218.81	218.79	218.85	218.85
TE-11	218.31	218.43	218.50	218.56	218.60	218.64	218.68	218.72	218.74	218.75	218.81	218.81
TE-12	218.49	218.61	218.69	218.72	218.78	218.83	218.86	218.89	218.95	218.94	218.99	218.99
TE-13	218.30	218.41	218.50	218.50	218.60	218.65	218.65	218.69	218.72	218.73	218.78	218.78
TE-14	218.60	218.70	218.78	218.83	218.87	218.92	218.94	218.96	219.03	219.02	219.05	219.07
TE-15	218.22	218.31	218.38	218.45	218.49	218.55	218.65	218.61	218.71	218.66	218.71	218.76
TE-16	218.56	218.65	218.74	218.80	218.84	218.90	218.93	218.94	219.00	219.00	219.04	219.05
TE-17	218.52	218.41	218.51	218.55	218.61	218.68	218.72	218.73	218.80	218.79	218.83	218.84
TE-18	218.10	218.62	218.70	218.76	218.82	218.88	218.91	218.93	218.98	218.97	219.01	219.00
TE-19	218.35	218.20	218.27	218.34	218.29	218.39	218.42	218.41	218.43	218.42	218.50	218.47
TE-20	217.64	218.44	218.45	218.52	218.52	218.55	218.59	218.59	218.59	218.63	218.66	218.70
TE-21	-	-	-	-	-	-	-	-	-	-	-	-
TE-22	217.63	217.72	217.77	217.80	217.83	217.87	217.89	217.90	217.93	217.93	217.96	217.98
TE-23	217.63	217.70	217.73	217.77	217.79	217.85	217.86	217.86	217.87	217.92	217.93	217.94
TE-24	217.64	217.71	217.76	217.80	217.85	217.87	217.89	217.92	217.93	217.96	217.98	218.00
Barometric Pressure (in. Hg)	29.92	29.90	29.88	29.85	29.83	29.82	29.81	29.80	29.80	29.80	29.79	29.79
Controlled Leak Rate, FI-2 (scfm)												
Controlled Leak Temperature, TI-2 (°F)												

APPENDIX A

ORIGINAL TEST DATA - SHEET 5 of 10

LEAKAGE RATE DATA AT 24.5 PSIG

Time	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
Containment Pressure												
PI-1 (counts)	39,305	39,307	39,307	39,307	39,311	39,318	39,320	39,320	39,321	39,320	39,323	39,324
PI-2 (counts)	39,388	39,393	39,390	39,392	39,394	39,400	39,402	39,402	39,404	39,403	39,404	39,406
PI-3 (psia)	39.3	39.3	39.3	39.2	39.25	39.25	39.30	39.2	39.20	39.20	39.25	39.20
DPI-1 (psig)	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.5
Containment Dew Point (^oF)												
DP-1	49.0	50.0	49.0	49.0	49.5	49.0	49.5	50.0	50.0	50.0	50.0	50.5
DP-2	49.0	48.5	49.0	49.5	50.0	49.5	50.5	49.0	49.5	48.5	49.5	49.0
DP-3	51.0	51.0	51.0	52.0	52.0	52.0	51.0	52.0	52.0	53.0	52.5	52.0
DP-4	51.5	52.0	51.5	52.5	52.5	52.5	53.0	53.0	53.0	52.5	53.5	53.5
DP-5	52.0	53.0	52.5	53.0	53.0	53.5	53.5	53.5	53.5	53.5	53.5	53.5
DP-6	51.0	51.0	51.5	52.0	52.0	51.5	52.0	51.5	52.0	52.0	51.5	52.0
Containment RTD Reading (ohms)												
TE-1	218.65	218.64	218.65	218.65	218.68	218.70	218.70	218.71	218.71	218.70	218.71	218.72
TE-2	218.70	218.68	218.69	218.70	218.72	218.72	218.73	218.76	218.73	218.75	218.73	218.75
TE-3	218.81	218.80	218.82	218.84	218.84	218.85	218.88	218.88	218.86	218.88	218.85	218.89
TE-4	218.09	218.70	218.69	218.69	218.73	218.74	218.75	218.75	218.74	218.77	218.75	218.77
TE-5	218.69	218.56	218.57	218.56	218.58	218.61	218.61	218.61	218.75	218.62	218.00	218.63
TE-6	218.68	218.70	218.69	218.70	218.70	218.75	218.77	218.75	218.76	218.75	218.75	218.76
TE-7	218.56	218.58	218.58	218.58	218.57	218.62	218.63	218.64	218.62	218.64	218.65	218.66
TE-8	218.80	218.79	218.82	218.83	218.83	218.85	218.86	218.85	218.85	218.86	218.87	218.88
TE-9	218.87	218.87	218.87	218.88	218.88	218.91	218.93	218.91	218.91	218.92	218.91	218.93
TE-10	218.88	218.90	218.90	218.90	218.88	218.94	218.96	218.93	218.96	218.94	218.95	218.96
TE-11	218.83	218.85	218.85	218.85	218.86	218.88	218.89	218.91	218.91	218.91	218.90	218.91
TE-12	219.01	219.02	219.02	219.03	219.02	219.07	219.07	219.06	219.06	219.06	219.07	219.07
TE-13	218.82	218.82	218.80	218.81	218.82	218.85	218.86	218.86	218.87	218.87	218.88	218.89
TE-14	219.09	219.11	219.11	219.10	219.11	219.14	219.16	219.14	219.14	219.15	219.15	219.17
TE-15	218.76	218.77	218.78	218.76	218.77	218.85	218.85	218.86	218.84	218.86	218.83	218.84
TE-16	219.06	219.08	219.10	219.08	219.09	219.14	219.15	219.15	219.15	219.14	219.17	219.16
TE-17	218.87	218.87	218.90	218.88	218.89	218.94	218.95	218.92	218.95	218.94	218.95	218.95
TE-18	219.04	219.07	219.05	219.05	219.06	219.11	219.12	219.10	219.13	219.11	219.15	219.15
TE-19	218.51	218.55	218.56	218.55	218.55	218.56	218.59	218.52	218.56	218.52	218.56	218.59
TE-20	218.76	218.72	218.73	218.73	218.77	218.72	218.78	218.78	218.80	218.83	218.88	218.88
TE-21	-	-	-	-	-	-	-	-	-	-	-	-
TE-22	217.98	218.00	218.01	218.00	218.00	218.03	218.04	218.03	218.05	218.06	218.06	218.07
TE-23	217.95	217.99	218.00	217.99	218.01	218.01	218.01	218.04	218.02	218.05	218.04	218.07
TE-24	218.01	218.02	218.03	218.05	218.04	218.05	218.07	218.07	218.07	218.08	218.10	218.09
Barometric Pressure (in. Hg)	29.77	29.76	29.76	29.76	29.76	29.76	29.78	29.80	29.82	29.84	29.86	29.86
Controlled Leak Rate, FI-2 (scfm)												
Controlled Leak Temperature, TE-2 (^oF)												

APPENDIX A

ORIGINAL TEST DATA - SHEET 6 of 10
LEAKAGE RATE DATA AT 24.5 PSIG

Time	2400	3-12-71 0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200
Containment Pressure													
PI-1 (counts)	39,329	39,330	39,328	39,329	39,327	39,328	39,328	39,327	39,328	39,330	39,330	39,327	39,333
PI-2 (counts)	39,411	39,413	39,413	39,414	39,412	39,413	39,413	39,413	39,413	39,414	39,414	39,411	39,418
PI-3 (psia)	39.25	35.60	35.60	35.6	35.65	35.65	35.60	35.60	35.60	35.60	35.60	35.65	35.60
DPI-1 (psig)	24.55	24.50	24.55	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.40	24.5
Containment Dew Point (°F)													
DP-1	50.0	49.5	49.5	50.0	49.5	50.5	50.5	50.5	51.5	51.0	51.0	50.0	50.5
DP-2	50.5	49.5	49.5	50.0	49.5	50.0	50.0	50.0	50.5	50.0	50.0	50.0	50.0
DP-3	52.0	52.5	52.5	52.0	52.0	52.0	52.0	53.0	53.0	53.0	52.5	52.5	52.0
DP-4	53.0	53.0	53.0	52.5	52.5	53.5	53.5	53.0	53.5	53.5	53.0	52.5	54.0
DP-5	53.5	54.0	53.5	53.5	53.0	53.5	54.0	53.5	53.5	54.0	54.0	53.5	54.0
DP-6	52.0	52.0	52.0	52.0	52.5	52.0	52.5	52.0	52.0	52.5	52.0	52.5	52.5
Containment RTD Reading (ohms)													
TE-1	218.76	218.76	218.75	218.76	218.78	218.79	218.79	218.77	218.80	218.80	218.80	218.78	218.84
TE-2	218.80	218.78	218.77	218.80	218.80	218.81	218.81	218.79	218.83	218.82	218.83	218.83	218.85
TE-3	218.94	218.93	218.90	218.93	218.95	218.93	218.96	218.92	218.96	218.95	218.98	218.96	219.01
TE-4	218.76	218.80	218.81	218.80	218.81	218.80	218.81	218.81	218.81	218.83	218.84	218.82	218.86
TE-5	218.63	218.67	218.67	218.68	218.67	218.68	218.67	218.67	218.68	218.69	218.69	218.69	218.73
TE-6	218.80	218.79	218.79	218.82	218.81	218.82	218.82	218.80	218.83	218.85	218.85	218.84	218.86
TE-7	218.67	218.68	218.70	218.71	218.70	218.71	218.70	218.70	218.72	218.72	218.72	218.70	218.74
TE-8	218.91	218.90	218.92	218.94	218.92	218.94	218.93	218.95	218.94	218.95	218.94	218.95	218.97
TE-9	218.94	218.97	218.96	218.99	218.98	218.96	218.98	218.97	219.00	219.02	219.04	219.00	219.05
TE-10	218.99	218.99	219.02	219.00	219.01	219.01	219.00	219.02	219.02	219.02	219.03	219.03	219.06
TE-11	218.94	218.92	218.97	218.97	218.96	218.97	218.99	218.97	218.98	218.97	218.99	218.98	219.01
TE-12	219.10	219.11	219.12	219.12	219.12	219.12	219.12	219.15	219.14	219.14	219.16	219.14	219.17
TE-13	218.91	218.90	218.91	218.94	218.92	218.92	218.95	218.94	218.96	218.97	218.95	218.94	218.97
TE-14	219.18	219.20	219.20	219.18	219.19	219.20	219.21	219.21	219.23	219.24	219.23	219.22	219.24
TE-15	218.85	218.90	218.91	218.90	218.90	218.90	218.90	218.91	218.90	218.90	218.92	218.90	218.95
TE-16	219.17	219.20	219.20	219.20	219.20	219.22	219.22	219.22	219.20	219.22	219.23	219.22	219.26
TE-17	218.96	219.00	219.00	219.00	219.00	219.02	219.00	219.00	219.02	219.03	219.04	219.02	219.06
TE-18	219.13	219.18	219.18	219.19	219.19	219.19	219.18	219.19	219.18	219.21	219.20	219.19	219.23
TE-19	218.62	218.60	218.61	218.60	218.64	218.60	218.64	218.63	218.60	218.65	218.62	218.66	218.68
TE-20	218.83	218.85	218.67	218.92	218.94	218.88	218.87	218.81	218.93	218.88	218.89	218.92	218.91
TE-21	-	-	-	-	-	-	-	-	-	-	-	-	-
TE-22	218.07	218.09	218.10	218.10	218.10	218.07	218.09	218.10	218.11	218.10	218.12	218.10	218.14
TE-23	218.06	218.05	218.07	218.08	218.08	218.08	218.12	218.11	218.10	218.11	218.10	218.12	218.11
TE-24	218.10	218.11	218.11	218.12	218.13	218.14	218.15	218.14	218.14	218.15	218.16	218.15	218.16
Barometric Pressure (in. Hg)	29.88	29.89	29.85	29.90	29.92	29.94	29.60	29.98	30.00	30.02	30.02	30.00	29.97
Controlled Leak Rate, FI-2 (scfm)	2.61	2.60	2.60	2.59	2.60	2.60	2.60	2.61	2.60	2.60	2.60	2.60	2.60
Controlled Leak Temperature, TI-2 (°F)	71.5	69.0	67.0	65.0	64.0	64.0	64.0	65.0	65.0	66.0	65.0	65.0	65.0

APPENDIX A
REDUCED TEST DATA - SHEET 7 of 10
LEAKAGE RATE DATA AT 47 PSIG

Time	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100
Containment Pressure																				
PI-1 (psia)	61.492	61.504	61.544	61.562	61.569	61.569	61.598	61.619	61.596	61.586	61.582	61.579	61.578	61.576	61.573	61.571	61.566	61.563	61.559	61.562
PI-2 (psia)	61.540	61.547	61.586	61.601	61.606	61.610	61.641	61.661	61.639	61.630	61.626	61.621	61.620	61.617	61.613	61.611	61.609	61.603	61.598	61.601
Ave. P_T (psia)	61.516	61.525	61.565	61.582	61.588	61.589	61.619	61.640	61.618	61.608	61.604	61.600	61.599	61.600	61.593	61.591	61.588	61.583	61.579	61.582
Avg. Dew Point (F)	51.3	51.3	51.9	51.8	52.2	51.5	52.1	52.3	52.0	52.0	52.1	52.0	52.3	51.9	51.7	51.8	51.3	51.6	51.6	51.8
Avg. Containment Temp. (F)	74.44	74.50	74.73	74.90	74.99	74.98	75.20	75.40	75.25	75.15	75.17	75.15	75.10	75.10	75.10	75.05	75.0	74.99	74.95	74.95
Avg. Containment Temp. (R)	534.13	534.19	534.42	534.59	534.68	534.67	534.89	535.09	534.94	534.84	534.86	534.84	534.79	534.79	534.70	534.74	534.69	534.68	534.64	534.64
Partial Pressure of Containment Water Vapor - P_{wv} (psia)	.187	.187	.191	.190	.193	.188	.192	.194	.192	.192	.193	.192	.194	.191	.190	.190	.187	.189	.189	.190
Partial Pressure of Containment Air $P = P_T - P_{wv}$ (psia)	61.329	61.338	61.374	61.392	61.395	61.401	61.427	61.446	61.426	61.416	61.411	61.408	61.405	61.409	61.403	61.401	61.401	61.394	61.390	61.392
Weight of Containment Air $W = 7.0448 \times 10^6 \frac{P}{T}$ (lb)	808,890	808,910	809,040	809,020	808,920	809,020	809,030	808,980	808,940	808,960	808,860	808,850	808,890	808,940	808,860	808,910	808,990	808,910	808,920	808,940
Controlled Leakage Rate (lb/hr.)																				

APPENDIX A
REDUCED TEST DATA - SHEET 8 of 10
LEAKAGE RATE DATA AT 47 PSIG

Time	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400
Containment Pressure																	
PI-1 (psia)	61.562	61.559	61.554	61.554	61.539	61.529	61.523	61.514	61.509	61.503	61.503	61.502	61.495	61.489	61.489	61.484	61.482
PI-2 (psia)	61.602	61.599	61.591	61.586	61.580	61.571	61.563	61.556	61.552	61.544	61.544	61.542	61.542	61.532	61.528	61.524	61.522
Ave. P_T (psia)	61.582	61.579	61.573	61.565	61.560	61.550	61.543	61.535	61.530	61.524	61.524	61.522	61.516	61.511	61.509	61.504	61.502
Avg. Dew Point (F)	51.7	51.7	51.6	51.5	51.7	51.0	51.5	51.8	51.3	51.1	51.3	51.2	51.2	51.0	51.6	51.1	51.7
Avg. Containment Temp. (F)	74.95	74.94	74.94	74.82	74.80	74.75	74.75	74.72	74.65	74.60	74.60	74.65	74.65	74.57	74.55	74.58	74.51
Avg. Containment Temp. (R)	534.64	534.63	534.63	534.51	534.49	534.44	534.44	534.41	534.34	534.29	534.29	534.34	534.34	534.26	534.24	534.27	534.20
Partial Pressure of Containment Water Vapor - P_{wv} (psia)	.190	.190	.189	.188	.190	.185	.188	.190	.187	.185	.187	.186	.186	.185	.189	.185	.190
Partial Pressure of Containment Air $P = P_T - P_{wv}$ (psia)	61.392	61.389	61.384	61.377	61.370	61.365	61.355	61.345	61.343	61.339	61.337	61.336	61.330	61.326	61.320	61.319	61.312
Weight of Containment Air $W = 7.0448 \times 10^6 \frac{P}{T}$ (lb)	808,940	808,920	808,850	808,940	808,880	808,890	808,760	808,670	808,750	808,780	808,750	808,660	808,580	808,650	808,600	808,540	808,560
Controlled Leakage Rate (lb/hr.)					25.71	25.89	25.89	25.75	25.52	25.52	25.52	25.52	25.52	25.51	25.26	25.26	25.26

APPENDIX A
REDUCED TEST DATA - SHEET 9 of 10
LEAKAGE RATE DATA AT 24.5 PSIG

Time	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
Containment Pressure																				
PI-1 (psia)	39.297	39.316	39.329	39.339	39.349	39.357	39.364	39.369	39.377	39.379	39.388	39.390	39.396	39.397	39.397	39.397	39.402	39.409	39.411	39.411
PI-2 (psia)	39.333	39.353	39.365	39.375	39.385	39.394	39.400	39.404	39.415	39.415	39.425	39.430	39.433	39.438	39.435	39.437	39.439	39.445	39.447	39.447
Ave. P_T (psia)	39.315	39.335	39.347	39.357	39.367	39.376	39.382	39.387	39.396	39.397	39.407	39.410	39.415	39.418	39.416	39.417	39.421	39.427	39.429	39.469
Avg. Dew Point (F)	48.4	48.5	48.4	49.3	49.4	50.1	49.8	50.1	50.1	50.2	50.5	50.5	50.6	50.9	50.8	51.3	51.5	51.3	51.6	51.5
Avg. Containment Temp. (F)	73.47	73.77	73.93	74.02	74.12	74.25	74.30	74.34	74.43	74.46	74.55	74.57	74.62	74.64	74.64	74.64	74.67	74.73	74.78	74.75
Avg. Containment Temp. (R)	533.16	533.46	533.62	533.71	533.81	533.94	533.99	534.03	534.12	534.15	534.24	534.26	534.31	534.33	534.33	534.33	534.36	534.42	534.47	534.44
Partial Pressure of Containment Water Vapor - P_{wv} (psia)	.168	.168	.168	.173	.174	.179	.177	.179	.179	.179	.181	.181	.182	.184	.183	.187	.188	.187	.189	.189
Partial Pressure of Containment Air $P = P_T - P_{wv}$ (psia)	39.147	39.167	39.179	39.184	39.193	39.197	39.205	39.208	39.217	39.218	39.226	39.227	39.233	39.234	39.233	39.230	39.233	39.240	39.240	39.240
Weight of Containment Air $W = 7.0448 \times 10^6 \frac{P}{T}$ (lb)	517,260	517,140	517,240	517,220	517,240	517,160	517,220	517,220	517,250	517,240	517,260	517,280	517,280	517,280	517,260	517,220	517,230	517,270	517,220	517,250
Controlled Leakage Rate (lb/hr.)																				

APPENDIX A
REDUCED TEST DATA - SHEET 10 of 10
LEAKAGE RATE DATA AT 24.5 PSIG

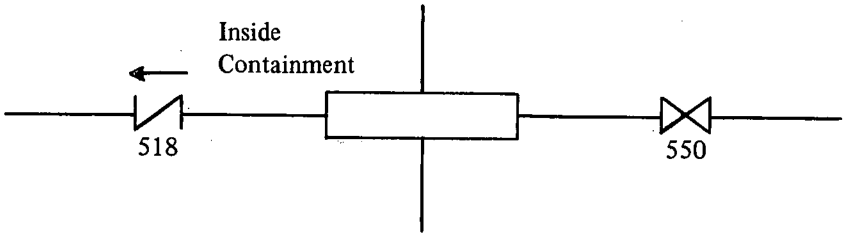
Time	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200
Containment Pressure																	
PI-1 (psia)	39.411	39.411	39.414	39.414	39.420	39.421	39.419	39.420	39.418	39.419	39.419	39.418	39.420	39.421	39.421	39.418	39.424
PI-2 (psia)	39.449	39.448	39.449	39.451	39.456	39.458	39.459	39.460	39.457	39.458	39.458	39.458	39.458	39.459	39.459	39.456	39.463
Ave. P_T (psia)	39.430	39.430	39.432	39.433	39.438	39.440	39.439	39.440	39.438	39.439	39.439	39.438	39.439	39.440	39.440	39.437	39.444
Avg. Dew Point (F)	51.7	51.6	51.8	51.8	51.8	51.8	51.7	51.7	51.5	51.9	52.1	52.0	52.3	52.3	52.1	51.8	52.2
Avg. Containment Temp. (F)	74.78	74.78	74.78	74.80	74.85	74.87	74.87	74.90	74.92	74.92	74.92	74.92	74.94	74.96	74.96	74.94	75.00
Avg. Containment Temp. (R)	534.47	534.47	534.47	534.49	534.54	534.56	534.56	534.59	534.61	534.61	534.61	534.61	534.63	534.65	534.65	534.63	535.69
Partial Pressure of Containment Water Vapor - P_{wv} (psia)	.190	.189	.190	.190	.190	.191	.190	.190	.188	.191	.192	.192	.194	.194	.192	.190	.193
Partial Pressure of Containment Air $P = P_T - P_{wv}$ (psia)	39.240	39.241	39.242	39.243	39.248	39.249	39.249	39.250	39.250	39.248	39.247	39.246	39.245	39.246	39.248	39.247	39.251
Weight of Containment Air $W = 7.0448 \times 10^6 \frac{P}{T}$ (lb)	517,220	517,230	517,250	517,240	517,260	517,250	517,250	517,230	517,210	517,190	517,180	517,160	517,130	517,120	517,150	517,160	517,150
Controlled Leakage Rate (lb/hr.)					11.98	11.94	11.94	11.89	11.94	11.94	11.94	11.98	11.94	11.94	11.94	11.94	11.94

APPENDIX B

RESULTS OF TYPE C ISOLATION VALVE LEAKAGE TESTING

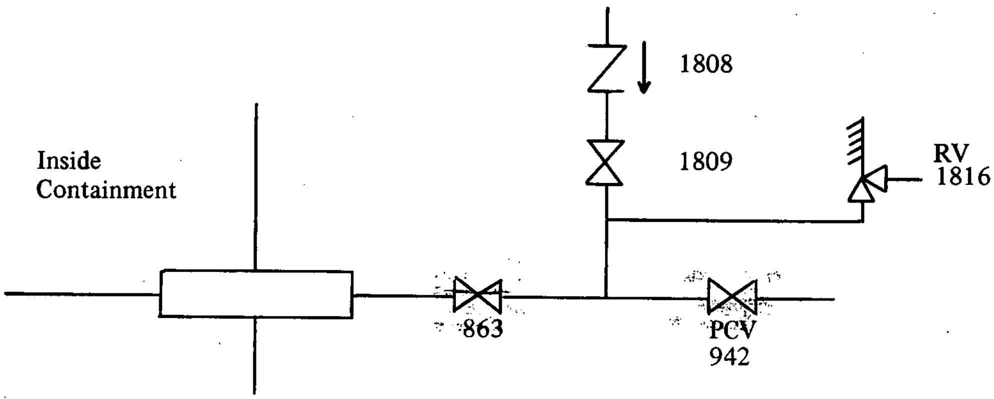
APPENDIX B
RESULTS OF TYPE C ISOLATION VALVE LEAKAGE TESTING

Line 32 - Pressurizer Relief Tank Nitrogen Supply



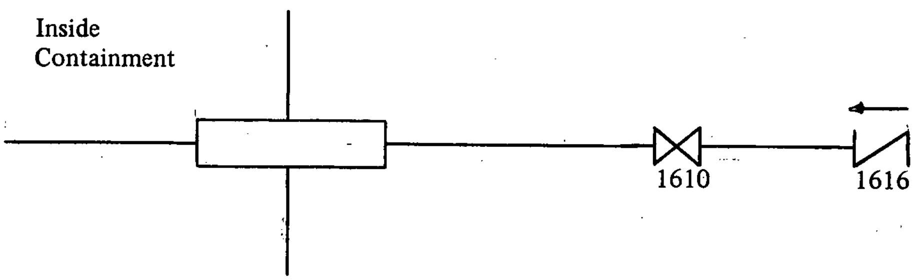
Leakage Past Valve 518 - 520 SCC/MIN
Leakage Past Valve 550 - Zero

Line 68 - Accumulator Nitrogen Supply



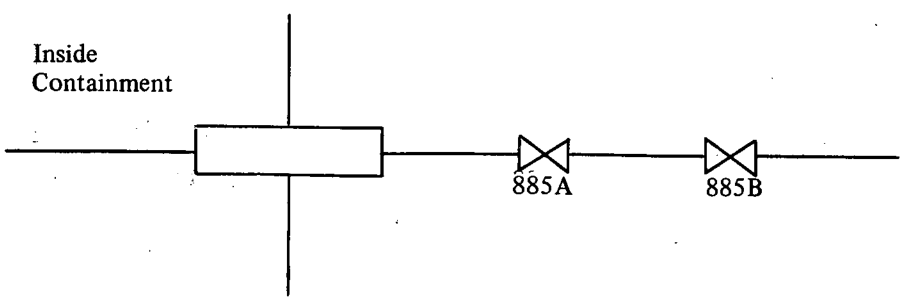
Zero Leakage Past Valves 863, PCV 942, RV-1816, 1809, 1808

Line 67 - Reactor Coolant Drain Tank Nitrogen Supply



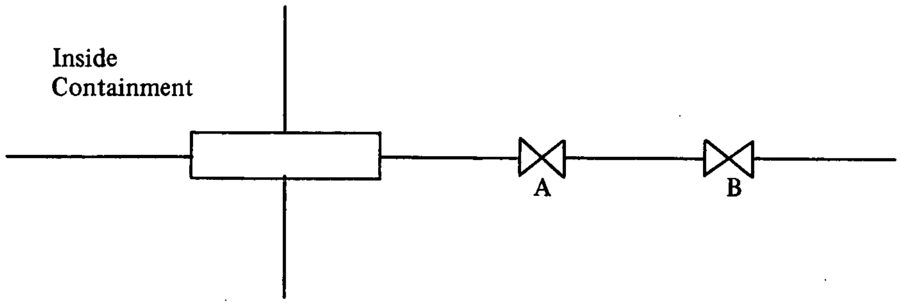
Leakage Past Valve 1610 - Zero
Leakage Past Valve 1616 - 95 SCC/MIN

Line 57 - Containment Sump Recirculation Line



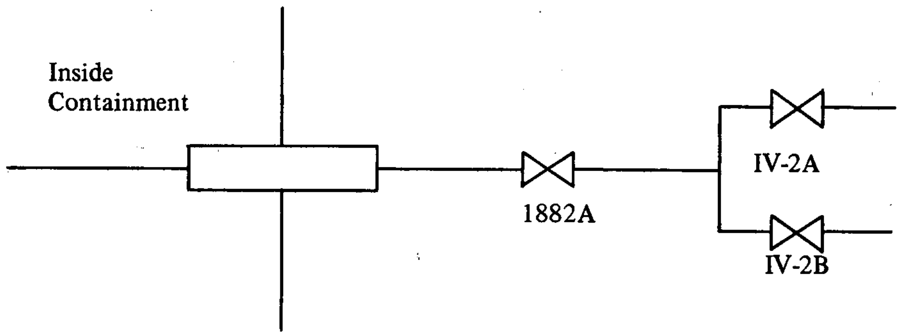
Zero Leakage Past Valves 885A and 885B

Line 574 - Deadweight Tester Line



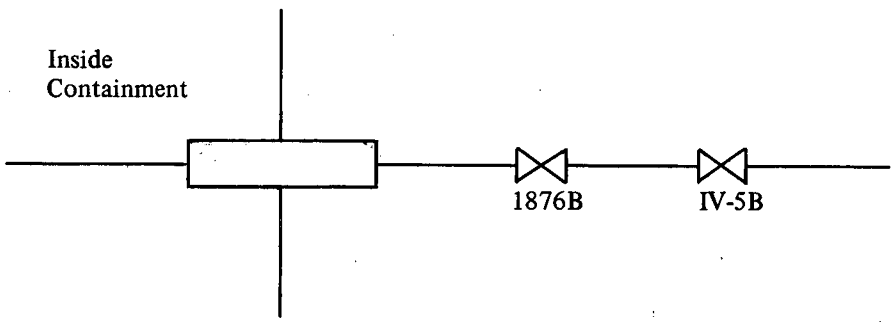
Zero Leakage Past Valves A and B

Line 571 - Hydrogen Recombiner - Oxygen Supply



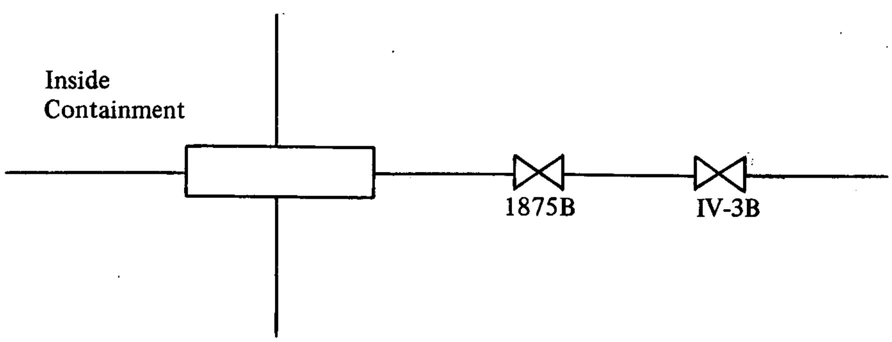
Zero Leakage Past Valves 1882A, IV-2A, IV-2B

Line 573 - Hydrogen Recombiner - Hydrogen Supply



Leakage Past 1876B and IV-5B - 3 SCC/MIN

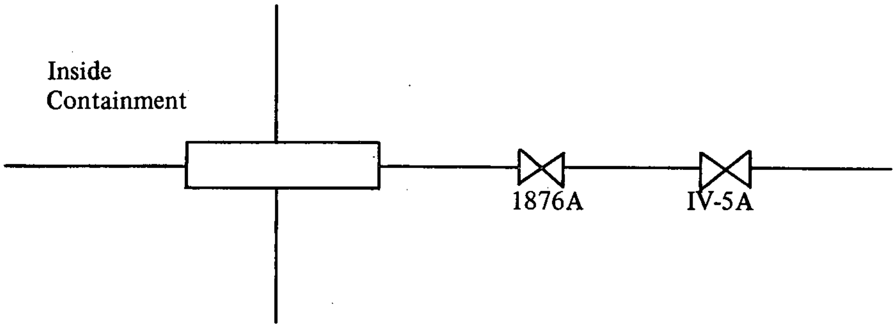
Line 574 - Hydrogen Recombiner - Hydrogen Supply



Zero Leakage Past Valves 1875B, IV-3B

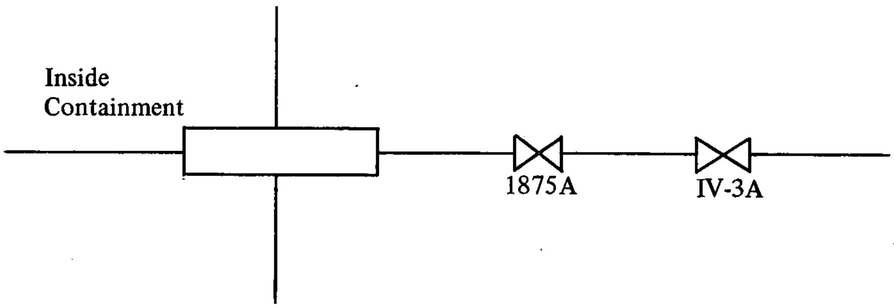
APPENDIX B
RESULTS OF TYPE C ISOLATION VALVE LEAKAGE TESTING

Line 575 - Hydrogen Recombiner - Hydrogen Supply



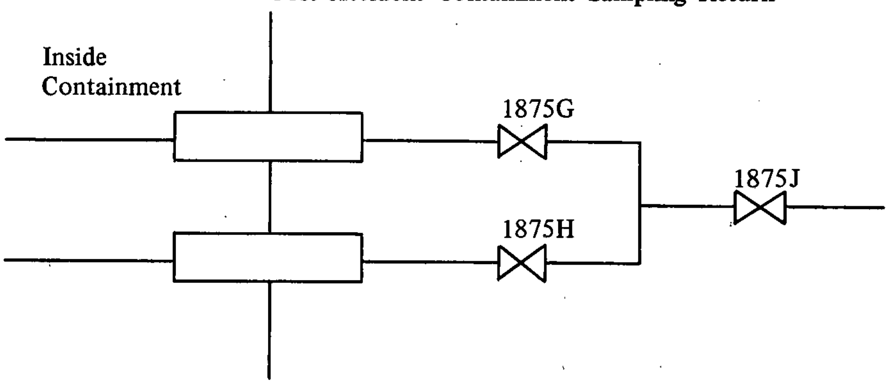
Leakage Past Valves 1876A and IV-5A - 3 SCC/MIN

Line 576 - Hydrogen Recombiner - Hydrogen Supply



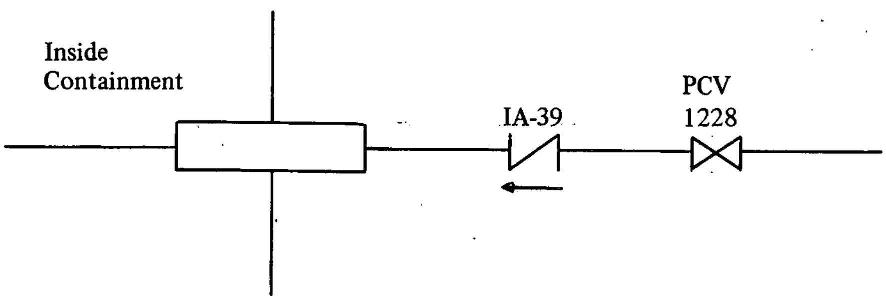
Zero Leakage Past Valves 1875A, IV-3A

Post Accident Containment Sampling Return



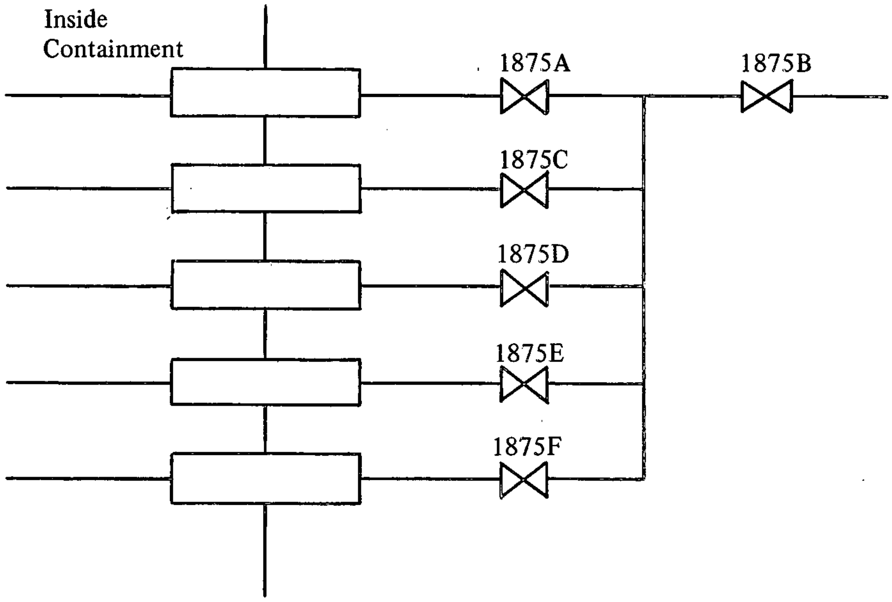
Zero Leakage Past Valves 1875G, 1875H, 1875J

Line 39 - Instrument Air



Zero Leakage Past Valves IA-39, PCV-1228

POST ACCIDENT CONTAINMENT SAMPLING SUPPLY



Zero Leakage Past Valves 1875A, 1875B, 1875C, 1875D, 1875E, 1875F

ILRT REPORT

ADDENDUM

In accordance with IPP-SU-4.39.1 (Vapor Containment Pressure Test) and PWR Engineering Letter EUP-7 Penetrations CC&F were leak tested after the completion of the ILRT. Both these penetrations exhibited "zero" leakage as measured on an in-line flow meter. Test was witnessed by Messrs. Zelkin of WEDCO and J. Dragosits of Con Edison on June 1, 1971.

[signature] WEDCO

John Dragosits Con Edison

This document will be an Addendum to ILRT Test Report.