# SUMMARY TECHNICAL REPORT

# PRIMARY CONTAINMENT INTEGRATED

# LEAK RATE TEST

APRIL 1982

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## INTRODUCTION

The Primary Containment Integrated Leak Rate Test (PCILRT) was conducted on April 2-3, 1982. The 24 hr. pressure test was performed in accordance with 10CFR50, Appendix J, the Oyster Creek Technical Specifications, and Station Procedure No. 666.5.007, "Primary Containment Leak Rate Test". Specific deviations from Appendix J testing requirements are listed in the "Oyster Creek Appendix J Exemption Requests", dated November 22, 1978 and approved on March 4, 1982. Guidance in conducting the test was provided by ANS N274-1978, ANSI N45-2-1972 and ANS/ANSI 56.8-1981.

Included herein, in accordance with 10CFR50, Appendix J is a summary of pertinent data, Type B and C test results, an analysis and interpretation of test results, and a test chronology. A description of the leak detection system, calculation methods, and supporting test data are provided as attachments. Additional test supporting data is available for review at the station site in accordance with ANS/ANSI 56.8-1981.

## GENERAL DATA

| | |
|---|---|
| Owner | Jersey Central Power & Light Co./General Public Utilities |
| Docket No. | 50-219 |
| Location | Route #9, Forked River, New Jersey |
| Containment Design | Mark I, General Electric Co. |
| Test Completion Date | April 3, 1982 |

## TECHNICAL DATA

| | |
|---|---|
| Containment Net Free Volume, cu. ft. | 300,000 |
| Design Pressure, psig | 62 (35) |
| Design Temperature, $^{o}F$ | 175 (281) |
| Design Accident Peak Pressure, Pac, psig | 38 psig |
| Calculated Accident Peak Temperature, $^{o}F$ | 285 |

## TEST DATA

| | |
|---|---|
| Test Method | Absolute |
| Data Analysis | Mass Plot |
| Test Pressure | 37.142 psia |
| Maximum Allowable Leak Rate | .567 wt %/day |
| Calculated Leakage Rate at upper confidence level (UCL) | .273 wt %/day (uncorrected, unadjusted)<br>.291 wt %/day (corrected, adjusted) |
| Measured Leak Rate, Lam | .225 wt %/day (uncorrected, unadjusted)<br>.244 wt %/day (corrected, adjusted) |

## VERIFICATION TEST

| | |
|---|---|
| Calibrated Leak Superimposed (%/24 hrs) | .7619 wt %/day |
| Mass step change | N/A |
| Mass step change measured by type A Instrumentation | N/A |

## ANALYSIS AND INTERPRETATION

Definitions:

Pa(psig): Calculated peak containment internal pressure related to the design basis accident

Pt(psig): Containment vessel reduced test pressure selected to measure the integrated leakage rate during type A testing

La(%/day): Maximum allowable leakage rate at pressure Pa, as specified in technical specification

Lt(%/day): Maximum allowable leakage rate at pressure Pt

Ltm(%/day): Total measured containment leakage rate at pressures Pa and Pt respectively, obtained from testing the containment with components and systems as close as practical to that which would exist under design basis accident conditions.

Acceptance Criteria

10CFR50, Appendix J requires that the leakage rate, LTM, at the 95% confidence level shall be less than .75 Lt. Therefore,

$$Lt = La\ (Pt/Pa)^{1/2}$$

$$Lt = 1 \text{ wt } \%/\text{day } (20\text{psig}/35\text{psig})^{1/2}$$

$$Lt = .75593$$

$$Ltm = .75\ Lt = .75\ (.75593)$$

$$Ltm = .567 \text{ wt } \%/\text{day}$$

Test Methods and Test Results

Containment leakage rate was determined by the absolute system analysis method and mass plot calculational technique. The Reference Vessel method was utilized for data comparison to insure confidence in test results.

The results of the absolute and mass plot analyses were corrected to account for changes in containment free volume due to water accumulation in the containment sump. (Reactor vessel level changes were automatically corrected for in the test method computerized program). These results were further adjusted to incorporate the results of Local Leak Rate Testing (LLRT). The level correction calculation and LLRT adjustment are given below.

The test results at the measured and 95% UCL for both the Absolute and Reference Vessel test methods are given in Table I. Both the level corrected and LLRT adjusted values at the 95% UCL for the Absolute Test Method are also provided.

TABLE 1

TEST RESULTS SUMMARY

| Calculation Technique | | Absolute Method | | Reference Vessel Method | |
|---|---|---|---|---|---|
| | | Measured | Calculated 95% UCL | Measured | Calculated 95% UC |
| Mass Plot | Uncorrected | .2253 | .2732 | N/A | N/A |
| | Level Corrected | .2313 | .2792 | N/A | N/A |
| | Total Adjusted | .2440 | .2919 | N/A | N/A |
| Mass Point | Uncorrected | N/A | N/A | .3017 | N/A |
| Total Time | Uncorrected | N/A | N/A | .3672 | .4244 |

Level Correction

The measured leakage rate was corrected to account for water leakage into the containment as determined by the following equation:

$$Lw = \frac{2400\ [0.1337\ (S_F - S_I)]}{(300{,}000)\ (DT)}$$

Where Lw = water leakage into containment free volume, wt %/day

DT = time interval between initial and final sump integrator readings, hrs.

$S_I$ = initial sump integrator reading, gallons

$S_F$ = Final sump integrator reading, gallons

2400 = 24 hrs/day x 100%

300,000 - containment net free air volume, $ft^3$

.1337 - conversion factor, gallons to $ft^3$

Substituting values:

$$Lw = \frac{2400\ [0.1337\ (166632-166496)]}{(300,000)\ (24)} = .0060 \text{ wt \%/day}$$

Local Leak Rate Test Adjustment

The level corrected leakage rate is further adjusted to include total leakage from those values and penetrations isolated during the type A test.

The following penetration was isolated during the type A test:

Instrument air and nitrogen system, V-6-393 & V-6-395

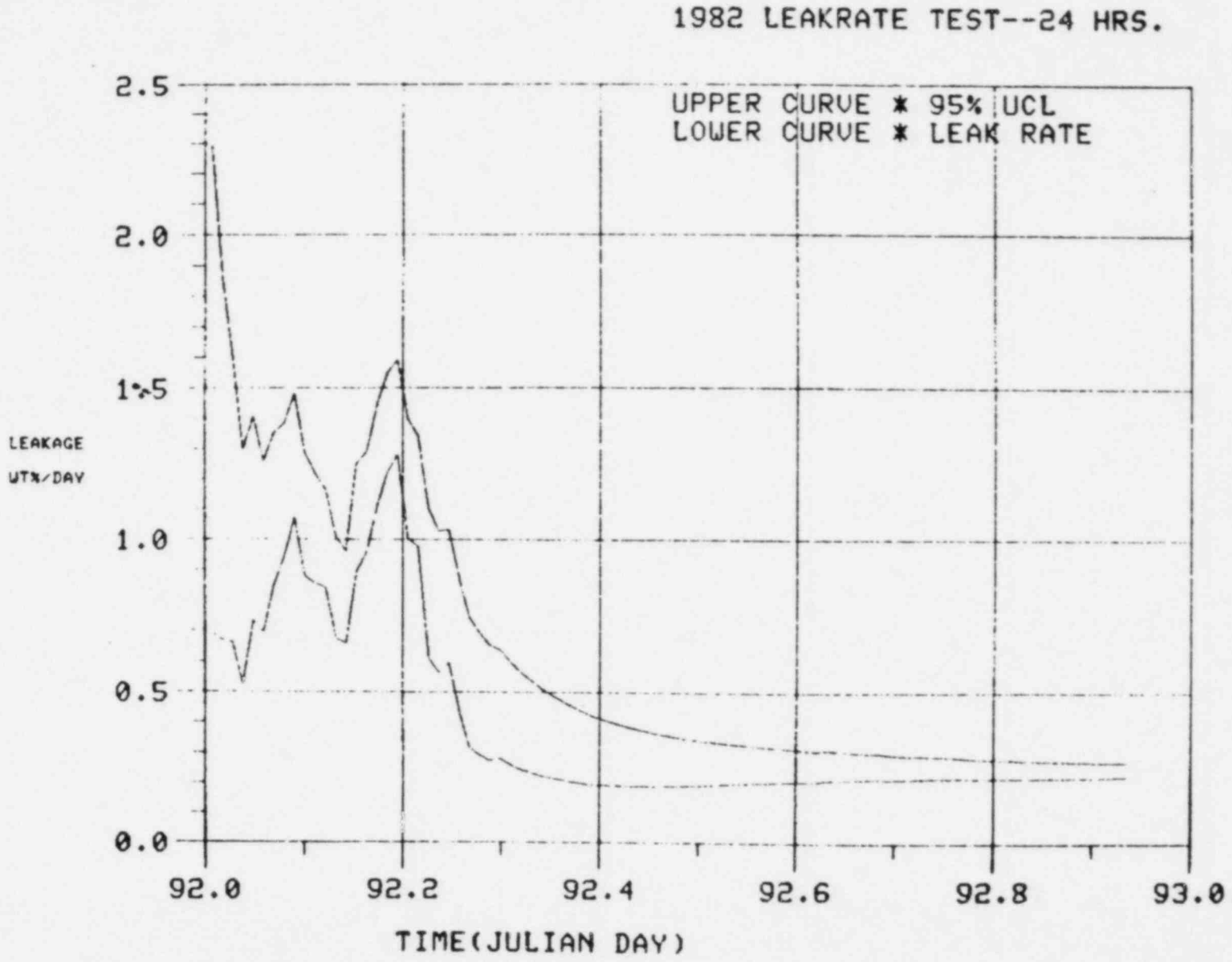
MSIV Drain Valves - V-1-106, 107, 110 & 111

Post type A local leak rate test results: 3.97SCFH = .012 wt %/day

Overall Test Performance

Figure I is a graphical description of the test performance as determined by the absolute and mass plot test method. The irregular test data results during the early test period is attributed to dewcell instrumentation instability. Following this unstable period, the data converges to the true leak rate in a smooth, continuous fashion. During the last hours of the test the measured leakage rate value begins to converge to the 95% UCL leakage value as expected.

FIGURE I


1982 LEAKRATE TEST--24 HRS.
UPPER CURVE * 95% UCL
LOWER CURVE * LEAK RATE
2.5
2.0
1.5
1.0
0.5
0.0
LEAKAGE
WT%/DAY
92.0
92.2
92.4
92.6
92.8
93.0
TIME(JULIAN DAY)

Verification Test

In accordance with 10CFR50, Appendix J, a verification test was performed following the type A test to provide a method for assuring the systematic error or bias was given adequate consideration.

Definitions

Lo = The known leakage rate superimposed on the containment during the verification test

Lam = The measured containment leakage rate at the test pressure

La = The maximum allowable leakage rate at the test pressure

Lc = The composite leakage rate measured during the verification test

Acceptance Criteria

10CFR50, Appendix J requires that the verification test results must satisfy the following order relationship:

$$(Lo + Lam - 0.25\ La) \leq Lc \leq (Lo + Lam + .25\ La)$$

Verification Test Methods and Test Results

The verification test utilized the superimposed leak verification method in which a calibrated leak was superimposed on the existing leaks in the primary containment. A 3.95 SCFM leak was introduced into the leak detection system

and the corresponding composite leakage rate was determined by the absolute analysis method and mass plot calculational technique. The Reference Vessel analysis method and point-to-point calculational technique was also utilized to assure confidence in test results. The results of the testing at the 95% UCL are given in Table II.

VERIFICATION TEST RESULTS

TABLE II

| Lx | Absolute Method | Reference Vessel Method |
|---|---|---|
| Lo | 0.7619 | 0.7619 |
| Lam | 0.2732 | 0.4244 |
| La | 0.1890 | 0.1890 |
| Lc | 1.2169 | 1.2654 |

Substituting values for the acceptance criteria order relationship provides the following test results:

Absolute Method

$$(0.7619 + 0.2732 \leq 0.1890) \leq 1.2169 \leq (0.7619 + 0.2732 + 0.1890)$$

$$0.8461 \leq 1.2169 \leq 1.2241$$

Reference Vessel Method

$$(0.7619 + 0.4244 - 0.1890) \leq 1.2654 \leq (0.7619 + 0.4244 + 0.1890)\ 0.9973$$

$$0.9973 \leq 1.2654 \leq 1.3753$$

Figure II is a graphical illustration of the verification test performance as determined by the absolute and mass plot test methods. The irregular test data during the early stage of the test is attributed to unstable dewcell instrumentation. After the dewcell instrumentation stabilized, both the measured and 95% UCL leakage rates continuously decrease in a smooth, continuous fashion.

## Summary and Conclusion

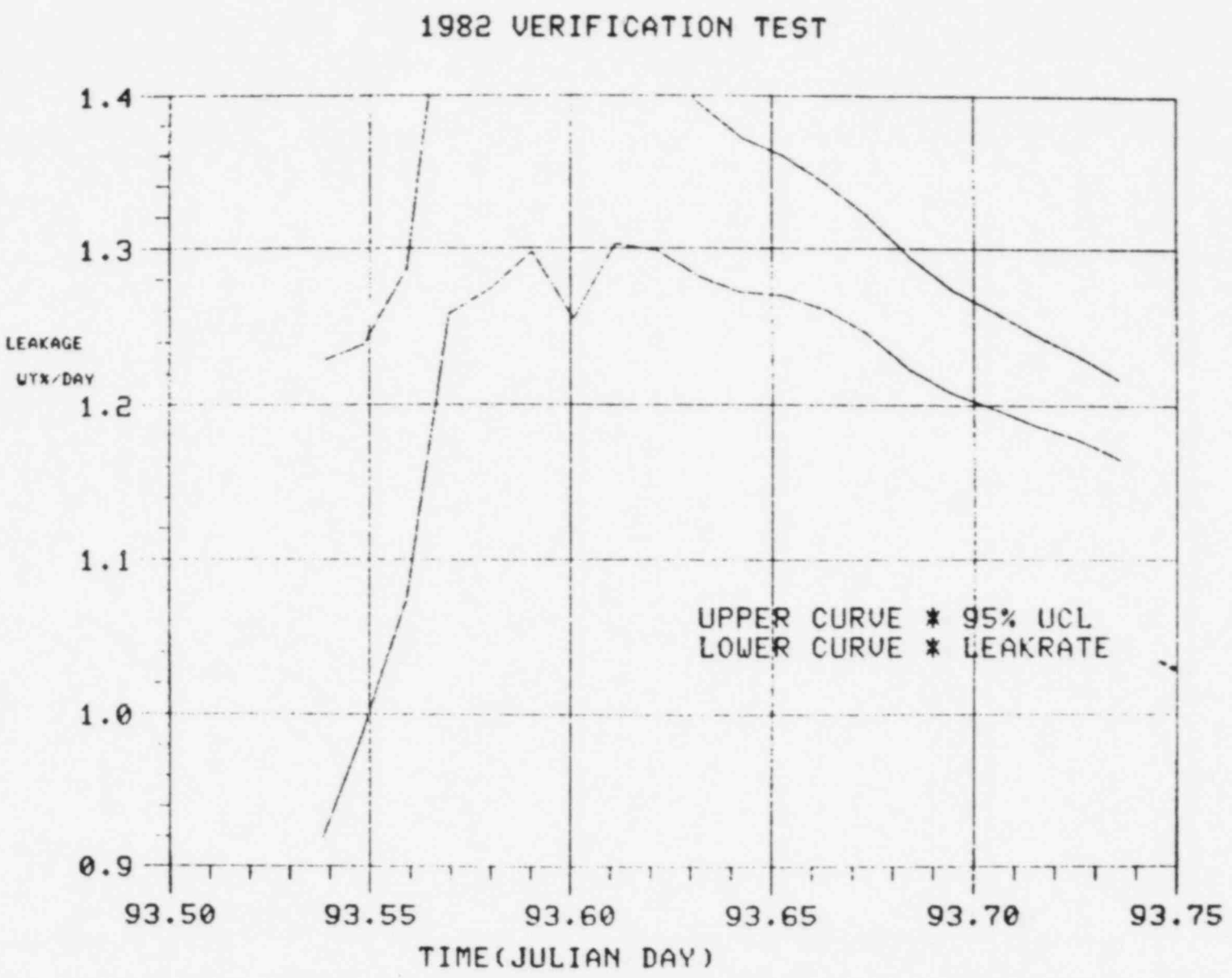
### Type A Test ("As-Left")

The results of the 24 hr. test determined a containment leakage rate well below that required in 10CFR50 Appendix J. The accuracy of the test data has been verified by the satisfactory performance of a verification test. It is therefore concluded that the validity of test data has been confirmed and that all type A testing requirements of 10CFR50, Appendix J has been demonstrated.

### Type A Test ("As-Found")

Due to excessive containment valve/penetration leakage determined by the "pre-repair" LLRT, the "as-found" containment leakage exceeded the acceptable containment leakage criteria. Valve repairs were completed and applicable valve "post-repair" leakage values were added to the Type A Test ("As-Left) results as required by 10CFR50, Appendix J. "Pre-repair" and "post-repair" valve leakage values are provided on pages 18 and 19. Appropriate instrument sensitivity is included in each test result value.

FIGURE II


1982 VERIFICATION TEST
1.4
1.3
LEAKAGE
WT%/DAY
1.2
1.1
1.0
0.9
UPPER CURVE * 95% UCL
LOWER CURVE * LEAKRATE
93.50
93.55
93.60
93.65
93.70
93.75
TIME(JULIAN DAY)

## TEST CHRONOLOGY AND HIGHLIGHTS

Type B and C local leak rate tests were performed on all testable penetrations prior to the initiation of the type A test. (The results of the local leak rate testing as required by 10CFR50, Appendix J, are provided in the following section).

The chronology of significant events prior to and during the performance of the type A test is as follows:

March 30, 1982

- An inspection of the drywell was completed. No structural deterioration was observed.

7:45 pm - Began containment pressurization

March 31, 1982

6:15 am - Commenced drywell depressurization due to inadequate drywell recirculation fan operation.

2:30 pm - Drywell depressurized. An investigation revealed a damaged fan speed control shim. The speed control shim was replaced.

April 1, 1982

2:20 am - Performed a drywell airlock leakrate test to insure the integrity of the drywell inner door seal.

3:14 am - Began drywell repressurization.

10:50 am- An air leak was discovered at valve N-19 which allowed a $N_2$ system leak into a predetermined type A test leakage path. A new leakage path was determined and utilized.

12:57 pm- Drywell pressurized to test pressure.

4:30 pm - Began pressure stablization period.

April 2, 1982

1:30 am - Dewcell instrumentation appeared to be unstable.

2:50 am - Service air vent was closed to investigate dewcell instability.

5:00 pm - Type A test was concluded with leakage rate of 0.273% at 95% UCL.

10:55 pm -Began verification test.

April 3, 1982

5:30 am - Determined that verification test period would be lengthened due to unstable dewcell instrumentation.

3:50 pm - Discovered that verification test rotameter was not properly connected to test cabinet. The rotameter was properly reconnected.

5:40 pm - Verification test was concluded with a leakage rate of 3.95 SCFM.

7:30 pm - Began drywell depressurization.

Type B and C Local Leak Rate Tests

Type B and C local leak rate tests were performed on all testable containment isolation valves, gaskets, and penetrations in accordance with 10CFR50, Appendix J and the Oyster Creek Technical Specifications.

Instrument Air and Nitrogen System Valves V-6-393 and V-6-395, and MSIV Drain Valves were isolated during the type A test. These valves were tested after the completion of the 24 hr. test and their test result values added to the type A test result value.

An attempt was made to test all four feedwater checkvalves although these valves are exempt from testing until piping modifications are completed in accordance with 10CFR50 Appendix J. However, due to the current piping configuration, it was determined that the test results were not representative of the valves leak tightness.

The "Pre-Repair" and "Post-Repair" results from the local leak rate testing are provided on the following pages and include all local leak rate testing conducted since the previous type A test. Leak rate test values listed indicate leakage through a penetration. Individual valves or seals which did not meet acceptable leakage criteria are as follows:

| Description | Valve/Gasket |
|---|---|
| Main Steam Isolation | NS03A, NS04A |
| Main Steam Drain | V-105, V-111 |
| 1-8 Sump Discharge | V-22-28, 29 |
| Drywell Purge | V-27-3 |
| Drywell Airlock | Outer Door Gasket |
| Torus to Reactor Bldg. Vac. Breaker | V-26-16 |
| Torus Vent Bypass | V-28-47 |

| Summary of Test Results | 20 psig (SCFH) | 35 psig (SCFH) |
|---|---|---|
| Total (Post-Repair Test Results) | 92.56 | 117.40 |

Combined leak rate @ 35 psig = 117.40 SCFH

= 0.279 La

where La = 419.88 SCFH

Total (Pre-Repair Test Results) - exceeded acceptance criteria.

LOCAL LEAK RATE TEST

| Double Gasketed Seals | Pre-Repair Test Results | | | Post-Repair Test Results | | |
|---|---|---|---|---|---|---|
| | Test Date | Leak Rates (SCFH) | | Test Date | Leak Rates (SCFH) | |
| | | 20 psig | 35 psig | | 20 psig | 35 psig |
| TIP Penetrations (4) | 2/15/82 | 0.04 | 0.05 | 2/15/82 | 0.04 | 0.05 |
| Torus Manhole Cover - North | 10/1/81 | .0122 | .0161 | | | |
| | 2/9/82 | .008 | .011 | 3/25/82 | 0.02 | 0.03 |
| - South | 10/1/81 | .48 | .642 | | | |
| | 2/10/82 | .496 | .66 | 3/25/82 | 5.54 | 7.33 |
| Drywell Head Seal | 6/12/80 | 0.016 | 0.02 | 6/12/80 | 0.016 | 0.02 |
| Drywell Head Manhole Cover | 6/4/80 | 0.016 | 0.02 | 6/4/80 | 0.016 | 0.02 |
| Steam Dryer Penetration | 5/10/82 | 0.0073 | 0.0096 | 5/10/82 | 0.0073 | 0.0096 |
| Torus to Drywell Vacuum Breakers (4) | 2/9/82 | 5.94 | 7.86 | 2/9/82 | 5.94 | 7.86 |
| Reactor Building to Torus Vacuum Breakers (2) Gaskets and O-rings | 2/7/82 | 0.043 | 0.057 | 2/7/82 + 3/2/82 | 0.041 | 0.055 |
| Biological Shield Stabilizer Manways (8) | 2/17/82 | 2.63 | 3.79 | 2/17/82 | 2.63 | 3.79 |
| Drywell Airlock Seal | 2/13/82 | 0.007 | 0.009 | 2/13/82 | 0.007 | 0.009 |
| Drywell Airlock | 7/19/80 | 4.21 | 5.486 | | | |
| | 7/19/80 | 4.09 | 5.49 | | | |
| | 3/9/81 | 7.78 | 10.29 | | | |
| | 4/1/81 | 4.667 | 6.17 | | | |
| | 5/29/81 | 11.63 | 15.43 | | | |
| | 10/18/81 | 4.633 | 6.129 | | | |
| | 11/4/81 | 3.114 | 4.116 | | | |
| | 4/1/82 | 4.67 | 6.17 | 4/1/82 | 4.67 | 6.17 |
| Penetrations and Isolation Valves | | | | | | |
| Electrical Penetrations (32) | 2/11/81 to 2/16/82 | 0.96 | 1.28 | 2/11/82 to 2/16/82 | 0.96 | 1.28 |
| Steam Dryer Penetrations (16) | 2/13/82 | 0.096 | 0.128 | 2/13/82 | 0.096 | 0.128 |
| Drywell Airlock Electrical Penetration | 2/10/82 | 0.008 | 0.011 | 2/10/82 | 0.008 | 0.011 |
| Demineralized Water System Penetration | 2/12/82 | 0.35 | 0.46 | 2/12/82 | 0.35 | 0.46 |
| Drywell Sump Discharge V-22-28 & 29 | 2/12/82 | 7.36 | 9.74 | 3/19/82 | 1.40 | 1.85 |

| Penetrations and Isolation Valves | Pre-Repair Test Results | | | Post-Repair Test Results | | |
|---|---|---|---|---|---|---|
| | Test Date | Leak Rates (SCFH) | | Test Date | Leak Rates (SCFH) | |
| | | 20 psig | 35 psig | | 20 psig | 35 psig |
| Drywell Equipment Drain Tank Discharge V-22-1 & 2 | 2/12/82 | 0.04 | 0.05 | 2/12/82 | 0.04 | 0.05 |
| MSIV's - NS03A & 4A | 02/08/82 | * | * | 04/05/82 | 1.43 | 1.89 |
| - NS03B & 4B | 02/08/82 | 11.49 | 15.2 | 02/08/82 | 11.49 | 15.20 |
| MSIV's Drain Valves V-1-106, 107, 110 & 111 | 03/17/82 | * | * | 04/09/82 | 1.17 | 1.54 |
| Isolation Condenser Vent Valves V-14-1 & 19 | 01/22/82 | 0.98 | 1.30 | 01/22/82 | 0.98 | 1.30 |
| V-14-5 & 20 | 01/22/82 | 3.53 | 4.67 | 01/22/82 | 3.53 | 4.67 |
| TIP Ball Valves (4) | 03/19/82 | 2.21 | 2.92 | 03/19/82 | 2.21 | 2.92 |
| Instrument Air & Nitrogen System V-6-393 & 395 | 02/14/82 | 2.33 | 3.08 | 04/09/82 | 1.84 | 2.43 |
| Drywell Vent V-27-1 & 2 | 02/09/82 | 5.11 | 6.76 | 02/09/82 | 5.11 | 6.76 |
| Drywell Purge V-27-3 & 4 | 03/03/82 | 10.73 | 14.20 | 03/03/82 | 10.73 | 14.20 |
| Drywell $N_2$ Purge V-23-13 & 14 | 02/06/82 | 0.10 | 0.13 | 02/06/82 | 0.10 | 0.13 |
| Drywell $N_2$ Makeup V-23-17 & 18 | 02/09/82 | 0.79 | 1.05 | 02/09/82 | 0.79 | 1.05 |
| Drywell Vent Bypass V-23-21 & 22 | 02/09/82 | 0.096 | 0.13 | 02/09/82 | 0.096 | 0.13 |
| Torus $N_2$ Purge V-23-15 & 16 | 02/08/82 | 3.14 | 4.16 | 02/08/82 | 3.14 | 4.16 |
| Torus $N_2$ Makeup V-23-19 & 20 | 02/09/82 | 0.07 | 0.09 | 02/09/82 | 0.07 | 0.09 |
| Torus Vent V-28-17, 18 & 47 | 05/13/81 | .03 | .03 | | | |
| | 02/15/82 | 4.32 | 5.71 | 02/15/82 | 4.32 | 5.71 |
| Reactor Building to Torus Vacuum Breakers V-26-15 & 16 | 02/07/82 | 10.89 | 14.74 | 03/02/82 | 1.297 | 1.72 |
| V-26-17 & 18 | 02/07/82 | 9.92 | 13.12 | 03/02/82 | 9.92 | 13.12 |
| Drywell $O_2$ Analyzer & Particulate Monitor V-38-9 & 10 | 02/11/82 | 1.14 | 1.51 | 02/11/82 | 1.14 | 1.51 |
| Torus Particulate Monitor V-38-16 & 17 | 02/11/82 | 0.75 | 0.91 | 02/11/82 | 0.75 | 0.91 |
| Torus $O_2$ Analyzer V-38-22 & 23 | 02/12/82 | 6.18 | 8.18 | 02/12/82 | 6.18 | 8.18 |

* Would not pressurize

# ATTACHMENT I

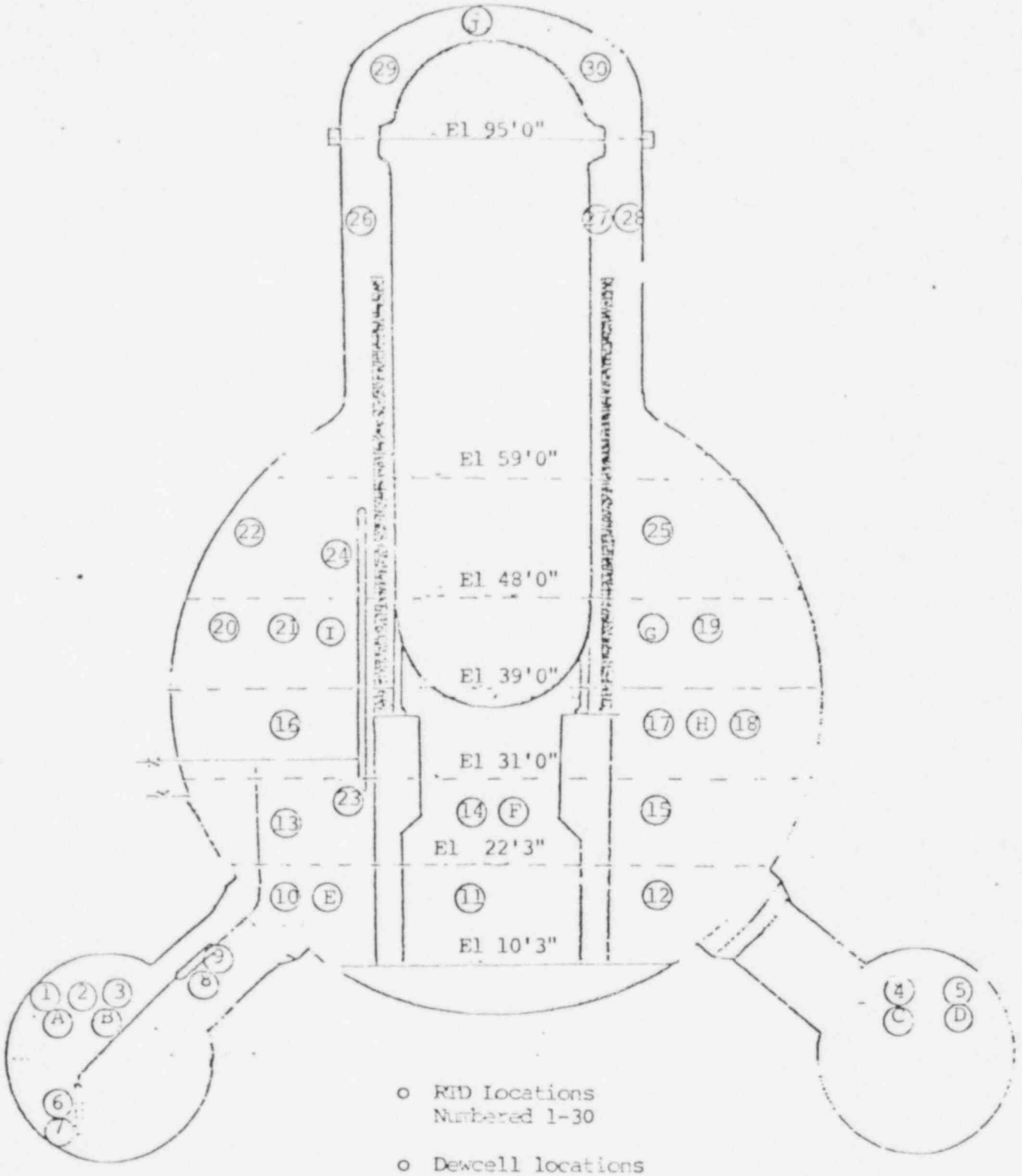
## LEAK RATE DETECTION SYSTEM

The leakage rate detection system consists of thirty (30) four-wire platinum (RTD's) and ten (10) lithium chloride dew cells positioned in the containment structure as illustrated in Figure I-1. The analog signals from these sensors are input to a multiplexer scanner also positioned inside the containment. A data acquisition system located external to the containment interrogates the scanner on demand for temperature and humidity information. Containment absolute pressure and reference vessel differential pressure information is input to the data acquisition system from a pair of fused quartz bourdon tube manometers which are externally connected to the containment and reference vessel. The analog signals are processed through an analog to digital converter and transmitter at present intervals to a PRIME 750 computer. A system sensitivity check is performed by introducing a calibrated leak through a mass flow transducer. The output from the transducer is also processed via the analog to digital converter and data acquisition system to the computer. In addition, the system reads and records the ambient temperature and pressure.

The computer operates in a real time mode to collect the transmitted information and calculate on demand the containment leakage rate. Figure I-2 is a detailed functional block diagram of the Leak Rate Detection System including individual appropriate component performance specifications.

FIGURE 1-1

(RTD and Dewcell Sensor Location)

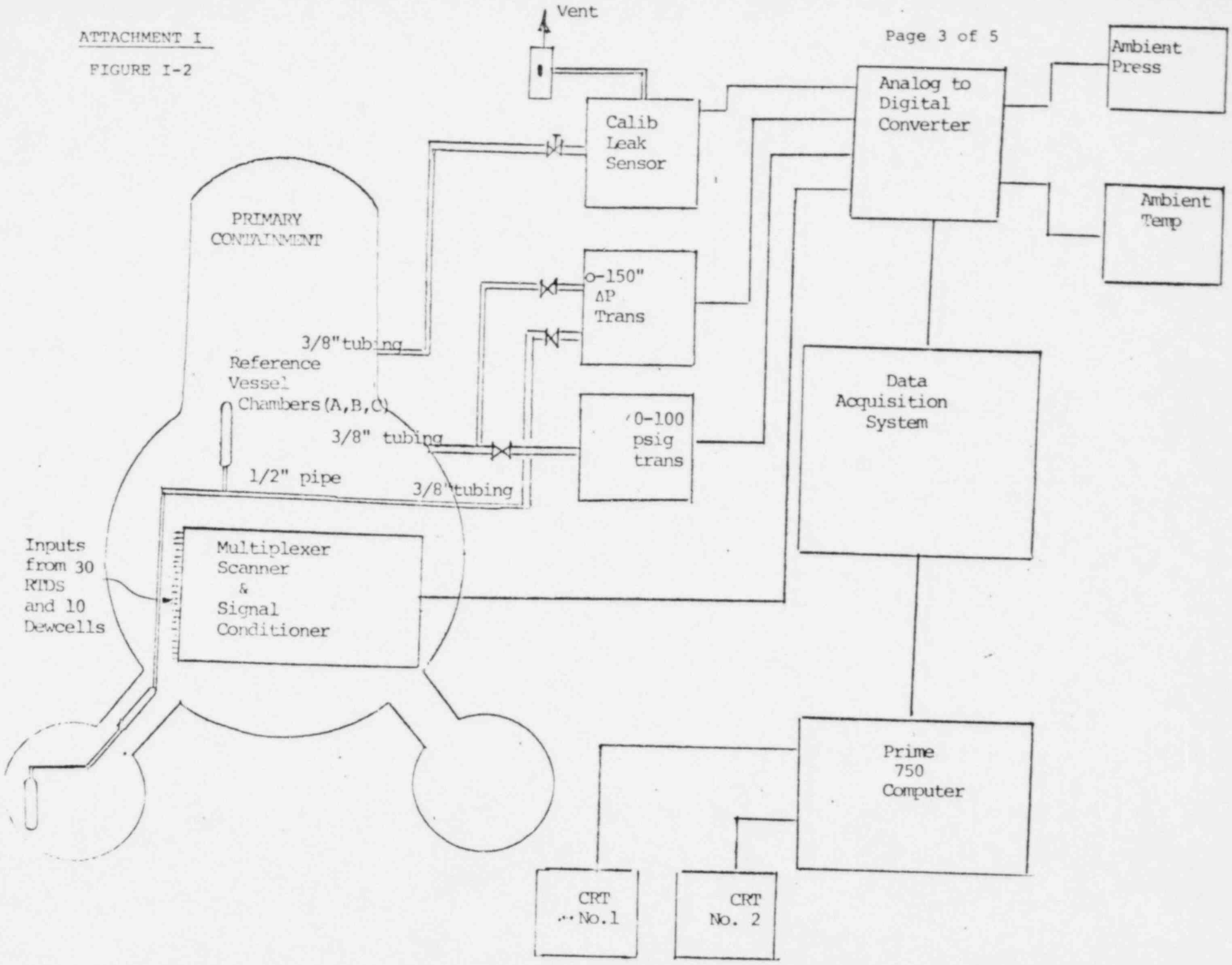



- RTD locations Numbered 1-30
- Dewcell locations lettered A-J

ATTACHMENT I

FIGURE I-2





# ATTACHMENT I

## INSTRUMENTATION

### Temperature

| | |
|---|---|
| Configuration: | 4 wire |
| Operating Range: | 32-250°F |
| Accuracy: | 60-120°F, ± 0.1°F<br>32-250°F, ± 0.15°F |
| Repeatability: | ± 0.1°F |
| Element: | Platinum |
| Quantity: | 30 |

### Dewpoint Temperature Measurement

| | |
|---|---|
| Dewpoint Range: | 0-200°F |
| Dewpoint Accuracy: | ± 1°F |
| Dewpoint Repeatability: | ± 0.5°F |
| Dewpoint Sensitivity: | ± 0.1°F |
| Type of Sensor: | Lithium Chloride |
| Quantity: | 10 |

ATTACHMENT I

## Pressure Measurement

| | |
|---|---|
| Operating Range: | 0-100 psia<br>0-150 in. H20 (differential) |
| Accuracy: | ± 0.02% of reading |
| Repeatability: | ± 0.001% of full scale |
| Stability: | Less than 0.001% F.S. degree<br>Fahrenheit ambient temperature range |
| Type of sensor: | Quartz Bourdon Tube |
| Quantity: | 1 each of the above |

## Data Acquisition System

| | |
|---|---|
| A/D | Dual slope integration<br>V → F, constant scan rate |
| Display: | 5 + digit, polarity, decimal and legend |
| Sampling Rate: | DC-180DB, 10000 ohm unbalance<br>AC-180DB at 50-60 HZ |
| Normal Mode Rejection: | 80DB |
| Input Impedance: | 1000 megohms/volt |
| Ambient Temp. Range: | 050°C |
| Zero Offset: | Recalibrate before each reading automatically |
| Voltage Temp: | ± 0.002% of reading (0.25 V/°C) |
| Accuracy: | ± 0.005: F.S., ± 0.005% of reading at 25°C<br>with ± 10% power variation at 67% F.S.:<br>0.012 F.S. |
| Repeatability: | ± 0.005% F.S. |

ATTACHMENT II

CALCULATIONAL METHODS

References

1. ANSI N454 - 1972, Leakage - Rate testing of Containment Structures for Nuclear Reactors.
2. ANS N274 - 1978 (W.G. 56.8 - Draft #2), Containment System Leakage Testing Requirements.

The containment leakage rate calculation was performed in accordance with the above standards and utilized the absolute system analysis method and mass plot calculational techniques. In addition, the reference vessel system analysis method was also performed for comparison to insure confidence in the test result. These analytical methods are described below.

ABSOLUTE METHOD

The absolute method of leakage rate determination consists of measuring the temperature and pressure of the containment atmosphere, with suitable correction for changes in humidity. This method assumes the temperature variations during the test will be insufficient to effect significant changes in the internal volume of the containment structure.

The percent leakage of air from the containment structure in terms of the original amount contained and that which escaped during each hourly test period is then calculated by the following formula:

$$\text{Leakage Rate (Wt \%/day)} = \left[1 - \frac{(T1)\ (P2)}{(T2)\ (P1)}\right]\ (100)\ \frac{(24)}{h}$$

where:

T1 = mean absolute temperature of the containment structure air, at the start of each data collection period (point-to-point method) or at the beginnning of the test (total time method).

T2 = mean absolute temperatue of the containment structure air at the end of each data collection period (point-to-point) method.

P1 = total aboslute pressure in the containment structure at the start of each data collection period (point-to-point method), or at the beginning of the test (total time method).

P2 = total absolute pressure in the containment structure at the end of each data collection period (point-to-point method).

h = total length of test period (hours)

An upper one-sided 95% confidence limit for the leakage rate (total time) is then calculated using the mass point calculational technique.

REFERENCE VESSEL METHOD

The reference vessel method of leakage rate determination compares changes in the pressure of the containment atmosphere with the pressure in a hermetically closed reference vessel system. Due to its geometry and location in the containment structure, the reference vessel assumes the temperature of the containment atmosphere with a time lag that is compatible with the frequency of the data collection.

The leakage rate of air from the containment structure in terms of the original amount contained and that which would escape during a 24 hour period is then calculated in accordance with the following formula:

$$\text{Leakage Rate (WT \%/day)} = \frac{(24)}{h} \quad (100) \quad \left[\frac{T1\ (PR2-P2+PV2)}{T2\ (P1-PV1)} - \frac{PR1-P1+PV1}{P1-PV1}\right]$$

Where T1, T2, P1, P2 and h are defined above and

PR1 = absolute pressure of the reference vessel at the start of each data collection period.

PR2 = absolute pressure of the reference vessel at the completion of each data collection period.

PV1 = the partial pressure of water vapor at the start of each data collection period.

PV2 = the partial pressure of water vapor at the completion of each data collection period.

MASS POINT METHOD

The mass point calculational method utilizing the ideal gas law, determines the mass of air in the containment, at each time point during the test and performs a straight line least squares analysis to estimate the leakage rate. An exact upper one-sided limit of 95% confidence level is then calculated on the leakage rate using the relationships identified below. The derivations and details for this calculational method can be found in reference 2.

The calculational methods employed in the computer code for mass point technique calculates a least squares analysis as follows:

NOTE: Symbols are defined at the end of this section.

The least squares line is given by

$$\overline{W} = At + B$$

where the slope (A) and intercept (B) are given, respectively by

$$A = \frac{N\left(\sum t_i W_i\right) - \left(\sum W_i\right)\left(\sum t_i\right)}{N\left(\sum t_i^{\,2}\right) - \left(\sum t_i\right)^2}$$

AND

$$B = \frac{\left(\sum W_i\right)\left(\sum t_i^{\,2}\right) - \left(\sum t_i W_i\right)\left(\sum t_i\right)}{N\left(\sum t_i^{\,2}\right) - \left(\sum t_i\right)^2}$$

Each $t_i$ is the elapsed time between a clock time for the initial reading and the clock time at which the ith reading is taken. The formulas for A and B do not require equal time intervals.

The leakage rate is expressed as the ratio of the rate of change of the mass and the mass in the containment at time $t_1 = 0$. The values of $t_i$ have units of hours and since the leakage rate is desired in Wt %/day the estimated mass point leakage rate, expressed as a positive number, is calculated as follows:

$$L = (-2400)\ (A/B)$$

The uncetainty in the estimated value of leakage rate is assessed in terms of the standard deviations of A and B and their covariance followed by the computation of an upper limit of the 95th confidence level for the leakage.

The estimate of the common standard deviation of the masses with respects to the line is given by:

$$S = \left[\frac{\sum(W - \bar{W})^2}{N-2}\right] 1/2$$

where

$W_i$ is the measured mass at time $t_i$ and

$\bar{W}_i$ is the estimated mass at time $t_i$ from $\bar{W}_i = At_i + B$

In order to determine the standard deviation of the slope ($S_a$) let

$$K = \frac{S}{[N(\sum t_i^2) - (\sum t_i)^2]^{1/2}}$$

then

$$S_a = K[N]^{1/2}$$

To determine the standard deviation of the intercept ($S_b$)

$$S_b = K[\sum t_i^{\ 2}]^{1/2}$$

and the covariance of the slope and intercept (SAB) is

$$S_{ab} = K^2 [-\sum t_i]$$

In order to calculate the exact upper one-sided limit of a 95% confidence level for the leakage rate, let

$$a = B^2 - t_{95}^2 (S_b 2)$$

$$b = AB - t_{95}^2 (S_{ab}) \text{ and}$$

$$c = A^2 - t_{95}^2 S_a^2$$

then the exact upper one-sided limit of a 95% confidence level for the leakage rate is determined as follows:

$$UCL (+95) = -2400 [b - (b^2 - ac)^{1/2}]/a$$

## SYMBOLS AND SUBSCRIPTS

### SYMBOLS

P - Total absolute pressure in the containment (psia)

T - Mean absolute temperature of the containment air (°R)

V - Internal free volume of the containment (assumed to remain constant for the duration of the test - $ft^3$)

R - Gas constant for air (53.35 ft-lbf/lbm-°R)

$P_V$ - Partial pressure for water vapor (PSIA)

N - Number of pairs of measurement

W - Measured mass of contained air (lbm)

T - Time interval of measurement after initial measurement (hr)

W - At & B - Lease squares line relating measured masses to corresponding times of measurement

A - Slope of least squares line

B - Intercept of least squares line

$S_a$ - Estimate of standard deivation of slope of least squares line

$S_b$ - Estimate of standard deviation of intercept of least squares line

$S_{ab}$ - Estimate of covariance between slope and intercept of least squares line

L - 2400A/B - Estimate of leakage rate, derived from least squares slope and intercept, expressed as a positive number (%/day)

$T_{95}$ - 95th percentile of student's distribution

UCL - Exact upper one-sided limit of a 95% confidence level for the leakage rate.

### SUBSCRIPTS

i - Indicates the ith data point.

For all analytical methods described above, constant containment volume is assumed. The leakage rate is later corrected for changes in containment volume due to water leakage into the containment. Changes in reactor vessel water level are automatically accounted for in the computer program.

Data for temperature and dewpoint input is corrected for instrument error using three point calibration data provided by the equipment supplier. In addition, the pressure sensor readings are corrected using a similar technique. Weighting factors are assigned to the temperature and dewpoint sensors thus providing a single ambient and dewpoint temperature reading indicative of containment conditions.

COMPUTER CODE QUALIFICATION:

An independent audit was performed on the computer code prior to utilizing it in the 1978 Primary Containment Leak Rate Test at Oyster Creek. The audit consisted of an in-depth check of the equations used to confirm agreement with those recommended by the governing standards. In addition, the code was run using data obtained by contractors who performed leakage rate tests on other containment structures. The results of this check agreed favorably with the values obtained using the cognizant contractor's code. The code was also utilized during the 1980 PCILRT at Oyster Creek.

# ATTACHMENT III

## SUPPORTING TEST DATA

24 hr. Test Data



Verification Test Data

JERSEY CENTRAL POWER & LIGHT CO.
OYSTER CREEK NUCLEAR GENERATING STATION

INTEGRATED CONTAINMENT LEAK RATE TEST *ABSOLUTE METHOD*

****MASS PLOT ANALYSIS****

REPORT PREPARED SAT, APR 03 1982 STARTING PRESSURE : 37.377 PSIA

| DAY | TIME | PRESSURE (PSIA) | TEMP. (F) | DEWPOINT (F) | VPRESS. (PSIA) | AIR MASS (MEAS ) | AIR MASS (CALC.) | LEAK RATE | LEAK RATE (UCL+95) |
|---|---|---|---|---|---|---|---|---|---|
| 91 | 22:25 | 37.377 | 79.060 | 71.902 | 0.3870 | 55391.3134 | 55350.5182 | | |
| 91 | 22:40 | 37.373 | 79.064 | 73.368 | 0.4066 | 55356.3267 | 55349.2189 | | |
| 91 | 22:55 | 37.373 | 79.071 | 70.936 | 0.3745 | 55404.1301 | 55347.9196 | | |
| 91 | 23:10 | 37.368 | 79.063 | 72.352 | 0.3929 | 55369.7891 | 55346.6203 | | |
| 91 | 23:25 | 37.368 | 79.039 | 74.057 | 0.4161 | 55336.6223 | 55345.3210 | | |
| 91 | 23:40 | 37.366 | 79.057 | 70.605 | 0.3703 | 55399.4646 | 55344.0217 | | |
| 91 | 23:55 | 37.364 | 79.018 | 74.589 | 0.4236 | 55319.6858 | 55342.7224 | | |
| 92 | 0:10 | 37.361 | 79.015 | 71.547 | 0.3824 | 55376.1595 | 55341.4231 | | |
| 92 | 0:25 | 37.360 | 78.985 | 72.757 | 0.3983 | 55353.4068 | 55340.1238 | | |
| 92 | 0:40 | 37.357 | 78.985 | 72.758 | 0.3983 | 55348.6344 | 55338.8245 | | |
| 92 | 0:55 | 37.354 | 78.988 | 71.862 | 0.3865 | 55362.0947 | 55337.5251 | | |
| 92 | 1:10 | 37.352 | 78.970 | 74.125 | 0.4171 | 55315.8957 | 55336.2258 | | |
| 92 | 1:25 | 37.349 | 78.974 | 72.723 | 0.3979 | 55340.2389 | 55334.9265 | | |
| 92 | 1:40 | 37.348 | 78.940 | 74.761 | 0.4260 | 55309.5571 | 55333.6272 | | |
| 92 | 1:55 | 37.344 | 78.942 | 74.630 | 0.4242 | 55297.2050 | 55332.3279 | | |
| 92 | 2:10 | 37.341 | 78.935 | 75.563 | 0.4376 | 55273.5562 | 55331.0286 | | |
| 92 | 2:25 | 37.339 | 78.911 | 71.792 | 0.3856 | 55351.1685 | 55329.7293 | | |
| 92 | 2:40 | 37.336 | 78.899 | 73.742 | 0.4117 | 55308.8652 | 55328.4300 | | |
| 92 | 2:55 | 37.334 | 78.896 | 73.830 | 0.4130 | 55303.3101 | 55327.1307 | | |
| 92 | 3:10 | 37.331 | 78.886 | 70.716 | 0.3718 | 55360.6228 | 55325.8314 | | |
| 92 | 3:25 | 37.329 | 78.886 | 73.129 | 0.4033 | 55309.3260 | 55324.5321 | | |
| 92 | 3:40 | 37.326 | 78.800 | 82.273 | 0.4871 | 55186.9398 | 55323.2328 | | |
| 92 | 3:55 | 37.323 | 78.821 | 76.130 | 0.4459 | 55240.6524 | 55321.9335 | | |
| 92 | 4:10 | 37.320 | 78.781 | 80.001 | 0.4868 | 55178.3126 | 55320.6342 | | |
| 92 | 4:25 | 37.316 | 78.776 | 81.677 | 0.4867 | 55174.4823 | 55319.3349 | | |
| 92 | 4:40 | 37.313 | 78.753 | 78.330 | 0.4796 | 55184.7944 | 55318.0356 | | |
| 92 | 4:55 | 37.309 | 78.736 | 66.703 | 0.3240 | 55415.2899 | 55316.7363 | | |
| 92 | 5:10 | 37.299 | 78.660 | 74.738 | 0.4257 | 55257.0195 | 55315.4370 | | |
| 92 | 5:25 | 37.285 | 78.488 | 57.839 | 0.2371 | 55537.6636 | 55314.1377 | | |
| 92 | 5:40 | 37.274 | 78.394 | 71.593 | 0.3830 | 55313.1264 | 55312.8384 | | |
| 92 | 5:55 | 37.264 | 78.328 | 74.750 | 0.4259 | 55240.8140 | 55311.5391 | | |
| 92 | 6:10 | 37.253 | 78.201 | 64.555 | 0.3007 | 55425.5723 | 55310.2398 | | |
| 92 | 6:25 | 37.242 | 78.087 | 65.220 | 0.3077 | 55410.1034 | 55308.9405 | | |
| 92 | 6:40 | 37.230 | 77.976 | 69.927 | 0.3619 | 55322.3334 | 55307.6412 | | |
| 92 | 6:55 | 37.218 | 77.864 | 69.729 | 0.3595 | 55318.9232 | 55306.3419 | | |
| 92 | 7:10 | 37.217 | 77.848 | 71.356 | 0.3799 | 55287.7120 | 55305.0426 | | |
| 92 | 7:25 | 37.219 | 77.845 | 69.701 | 0.3591 | 55321.7105 | 55303.7433 | | |
| 92 | 7:40 | 37.220 | 77.845 | 69.961 | 0.3623 | 55317.9843 | 55302.4440 | | |
| 92 | 7:55 | 37.219 | 77.879 | 69.931 | 0.3619 | 55313.0124 | 55301.1447 | | |
| 92 | 8:10 | 37.217 | 77.853 | 69.834 | 0.3608 | 55313.9864 | 55299.8454 | | |
| 92 | 8:25 | 37.214 | 77.816 | 70.048 | 0.3634 | 55308.9327 | 55298.5461 | | |
| 92 | 8:40 | 37.209 | 77.766 | 69.969 | 0.3624 | 55307.4585 | 55297.2468 | | |
| 92 | 8:55 | 37.205 | 77.712 | 69.850 | 0.3610 | 55308.7141 | 55295.9475 | | |
| 92 | 9:10 | 37.201 | 77.655 | 69.939 | 0.3620 | 55306.4557 | 55294.6482 | | |
| 92 | 9:25 | 37.197 | 77.633 | 69.661 | 0.3586 | 55307.2613 | 55293.3489 | | |
| 92 | 9:40 | 37.191 | 77.591 | 69.928 | 0.3619 | 55297.1584 | 55292.0496 | | |
| 92 | 9:55 | 37.189 | 77.560 | 69.822 | 0.3614 | 55297.5780 | 55290.7503 | | |
| 92 | 10:10 | 37.186 | 77.526 | 69.876 | 0.3613 | 55295.9288 | 55289.4510 | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 92 | 10:25 | 37.182 | 77.485 | 69.732 | 0.3595 | 55296.2175 | 55288.1517 | | |
| 92 | 10:40 | 37.178 | 77.473 | 69.724 | 0.3594 | 55290.7777 | 55286.8524 | | |
| 92 | 10:55 | 37.177 | 77.425 | 69.790 | 0.3602 | 55292.5097 | 55285.5531 | | |
| 92 | 11:10 | 37.173 | 77.425 | 69.672 | 0.3588 | 55287.8983 | 55284.2588 | | |
| 92 | 11:25 | 37.172 | 77.379 | 69.766 | 0.3599 | 55283.6604 | 55282.9545 | | |
| 92 | 11:40 | 37.168 | 77.357 | 69.683 | 0.3589 | 55285.8406 | 55281.6552 | | |
| 92 | 11:55 | 37.165 | 77.321 | 69.797 | 0.3603 | 55282.3190 | 55280.3559 | | |
| 92 | 12:10 | 37.164 | 77.306 | 69.779 | 0.3601 | 55282.0864 | 55279.0566 | | |
| 92 | 12:25 | 37.161 | 77.302 | 69.836 | 0.3608 | 55276.4933 | 55277.7573 | | |
| 92 | 12:40 | 37.160 | 77.313 | 69.811 | 0.3605 | 55273.6821 | 55276.4580 | | |
| 92 | 12:55 | 37.160 | 77.270 | 69.783 | 0.3601 | 55278.1394 | 55275.1587 | | |
| 92 | 13:10 | 37.159 | 77.300 | 69.761 | 0.3599 | 55273.3360 | 55273.8594 | | |
| 92 | 13:25 | 37.157 | 77.301 | 69.741 | 0.3596 | 55272.8360 | 55272.5601 | | |
| 92 | 13:40 | 37.155 | 77.285 | 69.837 | 0.3608 | 55270.8939 | 55271.2608 | | |
| 92 | 13:55 | 37.155 | 77.302 | 69.832 | 0.3607 | 55270.4502 | 55269.9615 | | |
| 92 | 14:10 | 37.155 | 77.304 | 69.881 | 0.3613 | 55270.6491 | 55268.6622 | | |
| 92 | 14:25 | 37.155 | 77.326 | 69.902 | 0.3616 | 55269.4007 | 55267.3629 | | |
| 92 | 14:40 | 37.154 | 77.361 | 69.857 | 0.3610 | 55266.5471 | 55266.0636 | | |
| 92 | 14:55 | 37.153 | 77.357 | 69.880 | 0.3613 | 55266.5283 | 55264.7643 | | |
| 92 | 15:10 | 37.152 | 77.379 | 71.021 | 0.3756 | 55242.6501 | 55263.4650 | | |
| 92 | 15:25 | 37.152 | 77.385 | 69.851 | 0.3610 | 55265.5550 | 55262.1657 | | |
| 92 | 15:40 | 37.151 | 77.428 | 69.926 | 0.3619 | 55259.6267 | 55260.8664 | | |
| 92 | 15:55 | 37.151 | 77.407 | 69.988 | 0.3627 | 55260.9076 | 55259.5671 | | |
| 92 | 16:10 | 37.148 | 77.424 | 70.040 | 0.3633 | 55253.8442 | 55258.2678 | | |
| 92 | 16:25 | 37.148 | 77.440 | 69.945 | 0.3621 | 55253.8827 | 55256.9685 | | |
| 92 | 16:40 | 37.147 | 77.423 | 69.235 | 0.3535 | 55267.3145 | 55255.6692 | | |
| 92 | 16:55 | 37.147 | 77.425 | 69.900 | 0.3616 | 55255.0929 | 55254.3699 | | |
| 92 | 17:10 | 37.146 | 77.439 | 70.025 | 0.3631 | 55250.0054 | 55253.0706 | | |
| 92 | 17:25 | 37.144 | 77.481 | 69.821 | 0.3606 | 55246.6273 | 55251.7713 | | |
| 92 | 17:40 | 37.144 | 77.443 | 69.927 | 0.3619 | 55248.5253 | 55250.4720 | | |
| 92 | 17:55 | 37.144 | 77.463 | 69.982 | 0.3626 | 55245.6131 | 55249.1727 | | |
| 92 | 18:10 | 37.143 | 77.469 | 69.860 | 0.3611 | 55245.9408 | 55247.8734 | | |
| 92 | 18:25 | 37.143 | 77.448 | 69.983 | 0.3626 | 55245.8282 | 55246.5741 | | |
| 92 | 18:40 | 37.143 | 77.470 | 69.229 | 0.3534 | 55257.5826 | 55245.2748 | | |
| 92 | 18:55 | 37.143 | 77.470 | 69.949 | 0.3622 | 55244.2164 | 55243.9755 | | |
| 92 | 19:10 | 37.143 | 77.501 | 70.014 | 0.3630 | 55239.9695 | 55242.6762 | | |
| 92 | 19:25 | 37.148 | 77.535 | 70.211 | 0.3654 | 55240.3910 | 55241.3769 | | |
| 92 | 19:40 | 37.150 | 77.588 | 70.143 | 0.3646 | 55239.3660 | 55240.0776 | | |
| 92 | 19:55 | 37.149 | 77.561 | 70.123 | 0.3643 | 55240.8293 | 55238.7783 | | |
| 92 | 20:10 | 37.149 | 77.593 | 70.257 | 0.3660 | 55235.2275 | 55237.4790 | | |
| 92 | 20:25 | 37.148 | 77.597 | 70.138 | 0.3645 | 55235.6029 | 55236.1797 | | |
| 92 | 20:40 | 37.148 | 77.611 | 70.141 | 0.3646 | 55234.1811 | 55234.8804 | | |
| 92 | 20:55 | 37.147 | 77.623 | 70.204 | 0.3653 | 55230.4221 | 55233.5811 | | |
| 92 | 21:10 | 37.147 | 77.617 | 70.208 | 0.3654 | 55231.0123 | 55232.2818 | | |
| 92 | 21:25 | 37.144 | 77.639 | 70.181 | 0.3651 | 55224.9553 | 55230.9825 | | |
| 92 | 21:40 | 37.143 | 77.645 | 69.365 | 0.3550 | 55238.0729 | 55229.6832 | | |
| 92 | 21:55 | 37.143 | 77.643 | 70.564 | 0.3698 | 55216.1926 | 55228.3839 | | |
| 92 | 22:10 | 37.141 | 77.654 | 70.190 | 0.3652 | 55219.2453 | 55227.0846 | | |
| 92 | 22:25 | 37.142 | 77.639 | 70.393 | 0.3677 | 55218.5229 | 55225.7853 | 0.22535 | 0.27322 |

CALCULATED LEAK RATE PERCENT/DAY= 0.22535
UPPER CONFIDENCE LEVEL AT 95 PERCENT= 0.27322

**THE ZERO TIME INTERCEPT IS 55350.5 LBS AND THE SLOPE -5.197 LBM/HR**

JERSEY CENTRAL POWER & LIGHT CO.
OYSTER CREEK NUCLEAR GENERATING STATION

INTEGRATED CONTAINMENT LEAK RATE TEST *REFERENCE VESSEL METHOD*

REPORT PREPARED SAT, APR 03 1982 STARTING PRESSURE : 37.377 PSIA

| DAY | TIME | PRESSURE (PSIA) | DPRESS. (PSID) | TEMP. (F) | DEWPOINT (F) | POINT-TO-POINT PPLR (MEAS.) | TTLR (MEAS.) | TOTAL TIME TTLR (CALC.) | TTLR (UCL+95) |
|---|---|---|---|---|---|---|---|---|---|
| 91 | 22:40 | 37.373 | 3.152 | 79.064 | 73.368 | 0.28051 | 0.28051 | 0.42660 | |
| 91 | 22:55 | 37.373 | 3.150 | 79.071 | 70.936 | 0.41355 | 0.34687 | 0.42596 | |
| 91 | 23:10 | 37.368 | 3.148 | 79.063 | 72.352 | 0.39126 | 0.36169 | 0.42532 | |
| 91 | 23:25 | 37.368 | 3.147 | 79.039 | 74.057 | 0.47071 | 0.38891 | 0.42468 | |
| 91 | 23:40 | 37.366 | 3.146 | 79.057 | 70.605 | 0.48306 | 0.40867 | 0.42404 | |
| 91 | 23:55 | 37.364 | 3.144 | 79.018 | 74.589 | 0.51316 | 0.42609 | 0.42341 | |
| 92 | 0:10 | 37.361 | 3.143 | 79.015 | 71.547 | 0.49417 | 0.43575 | 0.42404 | |
| 92 | 0:25 | 37.360 | 3.142 | 78.985 | 72.757 | 0.26222 | 0.41405 | 0.42341 | |
| 92 | 0:40 | 37.357 | 3.141 | 78.985 | 72.758 | 0.39773 | 0.41221 | 0.42277 | |
| 92 | 0:55 | 37.354 | 3.139 | 78.988 | 71.862 | 0.34872 | 0.40583 | 0.42213 | |
| 92 | 1:10 | 37.352 | 3.138 | 78.970 | 74.125 | 0.30629 | 0.39676 | 0.42149 | |
| 92 | 1:25 | 37.349 | 3.136 | 78.974 | 72.723 | 0.28627 | 0.38752 | 0.42085 | |
| 92 | 1:40 | 37.348 | 3.134 | 78.940 | 74.761 | 0.41400 | 0.38952 | 0.42022 | |
| 92 | 1:55 | 37.344 | 3.132 | 78.942 | 74.630 | 0.40742 | 0.39075 | 0.41958 | |
| 92 | 2:10 | 37.341 | 3.131 | 78.935 | 75.563 | 0.27141 | 0.38276 | 0.41894 | |
| 92 | 2:25 | 37.339 | 3.129 | 78.911 | 71.792 | 0.45119 | 0.38697 | 0.41830 | |
| 92 | 2:40 | 37.336 | 3.128 | 78.899 | 73.742 | 0.34089 | 0.38425 | 0.41766 | |
| 92 | 2:55 | 37.334 | 3.127 | 78.896 | 73.830 | 0.47869 | 0.38946 | 0.41703 | |
| 92 | 3:10 | 37.331 | 3.125 | 78.886 | 70.716 | 0.45569 | 0.39292 | 0.41639 | |
| 92 | 3:25 | 37.329 | 3.124 | 78.886 | 73.129 | 0.45735 | 0.39613 | 0.41575 | |
| 92 | 3:40 | 37.326 | 3.123 | 78.800 | 82.273 | 0.48165 | 0.40017 | 0.41511 | |
| 92 | 3:55 | 37.323 | 3.121 | 78.821 | 76.130 | 0.66515 | 0.41213 | 0.41447 | |
| 92 | 4:10 | 37.320 | 3.120 | 78.781 | 80.001 | 0.22736 | 0.40408 | 0.41383 | |
| 92 | 4:25 | 37.316 | 3.118 | 78.776 | 81.677 | 0.34549 | 0.40155 | 0.41320 | |
| 92 | 4:40 | 37.313 | 3.116 | 78.753 | 78.330 | 0.24838 | 0.39535 | 0.41256 | |
| 92 | 4:55 | 37.309 | 3.113 | 78.736 | 66.703 | 0.31535 | 0.39220 | 0.41192 | |
| 92 | 5:10 | 37.299 | 3.106 | 78.660 | 74.738 | 1.47061 | 0.43218 | 0.41128 | |
| 92 | 5:25 | 37.285 | 3.101 | 78.488 | 57.839 | 0.95137 | 0.45063 | 0.41064 | |
| 92 | 5:40 | 37.274 | 3.098 | 78.394 | 71.593 | 0.47247 | 0.45145 | 0.41001 | |
| 92 | 5:55 | 37.264 | 3.095 | 78.328 | 74.750 | 0.58191 | 0.45577 | 0.40937 | |
| 92 | 6:10 | 37.253 | 3.091 | 78.201 | 64.555 | 0.71456 | 0.46405 | 0.40873 | |
| 92 | 6:25 | 37.242 | 3.088 | 78.087 | 65.220 | 0.72200 | 0.47213 | 0.40809 | |
| 92 | 6:40 | 37.230 | 3.084 | 77.976 | 69.927 | 0.78051 | 0.48148 | 0.40745 | |
| 92 | 6:55 | 37.218 | 3.081 | 77.864 | 69.729 | 0.78221 | 0.48883 | 0.40682 | |
| 92 | 7:10 | 37.217 | 3.085 | 77.848 | 71.356 | -0.90026 | 0.44917 | 0.40618 | |
| 92 | 7:25 | 37.219 | 3.086 | 77.845 | 69.701 | -0.12752 | 0.43316 | 0.40554 | |
| 92 | 7:40 | 37.220 | 3.086 | 77.845 | 69.961 | 0.06273 | 0.42314 | 0.40490 | |
| 92 | 7:55 | 37.219 | 3.084 | 77.879 | 69.931 | 0.54561 | 0.42635 | 0.40426 | |
| 92 | 8:10 | 37.217 | 3.083 | 77.853 | 69.834 | 0.37353 | 0.42498 | 0.40363 | |
| 92 | 8:25 | 37.214 | 3.081 | 77.816 | 70.043 | 0.47567 | 0.42623 | 0.40299 | |
| 92 | 8:40 | 37.209 | 3.079 | 77.766 | 69.969 | 0.57746 | 0.42990 | 0.40235 | |
| 92 | 8:55 | 37.205 | 3.078 | 77.712 | 69.850 | 0.39363 | 0.42902 | 0.40171 | |
| 92 | 9:10 | 37.201 | 3.076 | 77.655 | 69.939 | 0.55991 | 0.43204 | 0.40107 | |
| 92 | 9:25 | 37.197 | 3.074 | 77.633 | 69.661 | 0.44680 | 0.43236 | 0.40044 | |
| 92 | 9:40 | 37.191 | 3.073 | 77.591 | 69.928 | 0.40494 | 0.43174 | 0.39980 | |
| 92 | 9:55 | 37.189 | 3.071 | 77.560 | 69.882 | 0.37478 | 0.43048 | 0.39916 | |
| 92 | 10:10 | 37.186 | 3.070 | 77.526 | 69.876 | 0.51689 | 0.43230 | 0.39852 | |
| 92 | 10:25 | 37.182 | 3.069 | 77.485 | 69.732 | 0.23266 | 0.42813 | 0.39788 | |
| 92 | 10:40 | 37.178 | 3.068 | 77.473 | 69.724 | 0.50303 | 0.42964 | 0.39725 | |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 92 | 10:55 | 37.177 | 3.066 | 77.425 | 69.799 | 0.30938 | 0.42723 | 0.39661 | |
| 92 | 11:10 | 37.173 | 3.065 | 77.425 | 69.672 | 0.42732 | 0.42721 | 0.39597 | |
| 92 | 11:25 | 37.172 | 3.064 | 77.379 | 69.766 | 0.41249 | 0.42691 | 0.39533 | |
| 92 | 11:40 | 37.168 | 3.063 | 77.357 | 69.683 | 0.42265 | 0.42682 | 0.39469 | |
| 92 | 11:55 | 37.165 | 3.061 | 77.321 | 69.797 | 0.35511 | 0.42548 | 0.39406 | |
| 92 | 12:10 | 37.164 | 3.060 | 77.306 | 69.779 | 0.37446 | 0.42453 | 0.39342 | |
| 92 | 12:25 | 37.161 | 3.059 | 77.302 | 69.836 | 0.33986 | 0.42301 | 0.39278 | |
| 92 | 12:40 | 37.160 | 3.058 | 77.313 | 69.811 | 0.35139 | 0.42174 | 0.39214 | |
| 92 | 12:55 | 37.160 | 3.057 | 77.270 | 69.783 | 0.28268 | 0.41933 | 0.39150 | |
| 92 | 13:10 | 37.159 | 3.056 | 77.300 | 69.761 | 0.44092 | 0.41968 | 0.39087 | |
| 92 | 13:25 | 37.157 | 3.055 | 77.301 | 69.741 | 0.29322 | 0.41756 | 0.39023 | |
| 92 | 13:40 | 37.155 | 3.053 | 77.285 | 69.837 | 0.09409 | 0.41226 | 0.38959 | |
| 92 | 13:55 | 37.155 | 3.052 | 77.302 | 69.832 | 0.18246 | 0.40855 | 0.38895 | |
| 92 | 14:10 | 37.155 | 3.050 | 77.304 | 69.881 | 0.21664 | 0.40550 | 0.38831 | |
| 92 | 14:25 | 37.155 | 3.049 | 77.326 | 69.902 | 0.08342 | 0.40046 | 0.38768 | |
| 92 | 14:40 | 37.154 | 3.048 | 77.361 | 69.857 | 0.21308 | 0.39757 | 0.38704 | |
| 92 | 14:55 | 37.153 | 3.046 | 77.357 | 69.880 | 0.20347 | 0.39463 | 0.38640 | |
| 92 | 15:10 | 37.152 | 3.045 | 77.379 | 71.021 | 0.09066 | 0.39009 | 0.38576 | |
| 92 | 15:25 | 37.152 | 3.044 | 77.385 | 69.851 | 0.01692 | 0.38460 | 0.38512 | |
| 92 | 15:40 | 37.151 | 3.042 | 77.428 | 69.926 | 0.22387 | 0.38227 | 0.38449 | |
| 92 | 15:55 | 37.151 | 3.041 | 77.497 | 69.988 | 0.22659 | 0.38003 | 0.38385 | |
| 92 | 16:10 | 37.148 | 3.040 | 77.424 | 70.040 | 0.20662 | 0.37759 | 0.38321 | |
| 92 | 16:25 | 37.148 | 3.040 | 77.440 | 69.945 | 0.12315 | 0.37405 | 0.38257 | |
| 92 | 16:40 | 37.147 | 3.038 | 77.423 | 69.235 | 0.34273 | 0.37361 | 0.38193 | |
| 92 | 16:55 | 37.147 | 3.037 | 77.425 | 69.900 | 0.21134 | 0.37141 | 0.38130 | |
| 92 | 17:10 | 37.146 | 3.037 | 77.439 | 70.025 | 0.21372 | 0.36930 | 0.38066 | |
| 92 | 17:25 | 37.144 | 3.036 | 77.481 | 69.821 | 0.27119 | 0.36800 | 0.38002 | |
| 92 | 17:40 | 37.144 | 3.035 | 77.443 | 69.927 | 0.13699 | 0.36499 | 0.37938 | |
| 92 | 17:55 | 37.144 | 3.034 | 77.463 | 69.982 | 0.16640 | 0.36244 | 0.37874 | |
| 92 | 18:10 | 37.143 | 3.033 | 77.469 | 69.860 | 0.34171 | 0.36217 | 0.37811 | |
| 92 | 18:25 | 37.143 | 3.032 | 77.448 | 69.983 | 0.14788 | 0.35949 | 0.37747 | |
| 92 | 18:40 | 37.143 | 3.031 | 77.470 | 69.229 | 0.22107 | 0.35777 | 0.37683 | |
| 92 | 18:55 | 37.143 | 3.031 | 77.470 | 69.949 | 0.22610 | 0.35616 | 0.37619 | |
| 92 | 19:10 | 37.143 | 3.031 | 77.501 | 70.014 | -0.02638 | 0.35155 | 0.37555 | |
| 92 | 19:25 | 37.148 | 3.032 | 77.535 | 70.211 | -0.39322 | 0.34270 | 0.37492 | |
| 92 | 19:40 | 37.150 | 3.030 | 77.588 | 70.143 | 0.70724 | 0.34696 | 0.37428 | |
| 92 | 19:55 | 37.149 | 3.028 | 77.561 | 70.123 | 0.39735 | 0.34753 | 0.37364 | |
| 92 | 20:10 | 37.149 | 3.028 | 77.593 | 70.257 | 0.20599 | 0.34590 | 0.37300 | |
| 92 | 20:25 | 37.148 | 3.027 | 77.597 | 70.138 | 0.22648 | 0.34454 | 0.37236 | |
| 92 | 20:40 | 37.148 | 3.026 | 77.611 | 70.141 | 0.26440 | 0.34363 | 0.37173 | |
| 92 | 20:55 | 37.147 | 3.025 | 77.623 | 70.204 | 0.30050 | 0.34314 | 0.37109 | |
| 92 | 21:10 | 37.147 | 3.023 | 77.617 | 70.208 | 0.30724 | 0.34274 | 0.37045 | |
| 92 | 21:25 | 37.144 | 3.022 | 77.639 | 70.181 | 0.29254 | 0.34218 | 0.36981 | |
| 92 | 21:40 | 37.143 | 3.021 | 77.645 | 69.365 | 0.19350 | 0.34058 | 0.36917 | |
| 92 | 21:55 | 37.143 | 3.020 | 77.643 | 70.564 | 0.32690 | 0.34042 | 0.36854 | |
| 92 | 22:10 | 37.141 | 3.019 | 77.654 | 70.190 | 0.13151 | 0.33822 | 0.36790 | |
| 92 | 22:25 | 37.142 | 3.018 | 77.639 | 70.393 | 0.30171 | 0.33783 | 0.36726 | **0.42444** |

ATTACHMENT III

JERSEY CENTRAL POWER & LIGHT CO.
OYSTER CREEK NUCLEAR GENERATING STATION

INTEGRATED CONTAINMENT LEAK RATE TEST *ABSOLUTE METHOD*

****MASS PLOT ANALYSIS****

REPORT PREPARED SAT, APR 03 1982 STARTING PRESSURE : 36.948 PSIA

| DAY | TIME | PRESSURE (PSIA) | TEMP. (F) | DEWPOINT (F) | VPRESS. (PSIA) | AIR MASS (MEAS.) | AIR MASS (CALC.) | LEAK RATE | LEAK RATE (UCL+95) |
|---|---|---|---|---|---|---|---|---|---|
| 93 | 11:10 | 36.948 | 78.111 | 71.594 | 0.3830 | 54856.5442 | 54867.9420 | | |
| 93 | 11:25 | 36.946 | 78.140 | 70.894 | 0.3740 | 54864.4009 | 54861.2809 | | |
| 93 | 11:40 | 36.942 | 78.150 | 70.600 | 0.3703 | 54863.2394 | 54854.6199 | | |
| 93 | 11:55 | 36.938 | 78.170 | 70.657 | 0.3710 | 54854.4163 | 54847.9588 | | |
| 93 | 12:10 | 36.935 | 78.185 | 70.733 | 0.3720 | 54847.1849 | 54841.2977 | | |
| 93 | 12:25 | 36.932 | 78.189 | 70.849 | 0.3734 | 54840.6072 | 54834.6366 | | |
| 93 | 12:40 | 36.929 | 78.218 | 70.690 | 0.3714 | 54836.4638 | 54827.9755 | | |
| 93 | 12:55 | 36.926 | 78.237 | 70.957 | 0.3748 | 54824.2551 | 54821.3145 | | |
| 93 | 13:10 | 36.924 | 78.258 | 70.825 | 0.3731 | 54818.4738 | 54814.6534 | | |
| 93 | 13:25 | 36.918 | 78.260 | 70.607 | 0.3704 | 54808.0461 | 54807.9923 | | |
| 93 | 13:40 | 36.915 | 78.249 | 71.393 | 0.3804 | 54784.4973 | 54801.3312 | | |
| 93 | 13:55 | 36.913 | 78.234 | 70.744 | 0.3721 | 54790.6332 | 54794.6701 | | |
| 93 | 14:10 | 36.910 | 78.265 | 70.785 | 0.3726 | 54780.8085 | 54788.0091 | | |
| 93 | 14:25 | 36.909 | 78.279 | 70.508 | 0.3691 | 54785.1069 | 54781.3480 | | |
| 93 | 14:40 | 36.907 | 78.338 | 71.429 | 0.3809 | 54760.4475 | 54774.6869 | | |
| 93 | 14:55 | 36.905 | 78.355 | 71.154 | 0.3773 | 54762.6316 | 54768.0258 | | |
| 93 | 15:10 | 36.901 | 78.403 | 70.841 | 0.3733 | 54759.2087 | 54761.3648 | | |
| 93 | 15:25 | 36.899 | 78.413 | 71.132 | 0.3770 | 54751.2726 | 54754.7037 | | |
| 93 | 15:40 | 36.896 | 78.443 | 71.320 | 0.3795 | 54741.9270 | 54748.0426 | | |
| 93 | 15:55 | 36.894 | 78.492 | 71.209 | 0.3780 | 54737.9161 | 54741.3815 | | |
| 93 | 16:10 | 36.891 | 78.489 | 71.289 | 0.3791 | 54734.0148 | 54734.7204 | | |
| 93 | 16:25 | 36.888 | 78.506 | 71.124 | 0.3769 | 54732.8790 | 54728.0594 | | |
| 93 | 16:40 | 36.885 | 78.523 | 71.323 | 0.3795 | 54724.7482 | 54721.3983 | | |
| 93 | 16:55 | 36.881 | 78.556 | 71.360 | 0.3800 | 54716.7204 | 54714.7372 | | |
| 93 | 17:10 | 36.878 | 78.584 | 71.254 | 0.3786 | 54711.7149 | 54708.0761 | | |
| 93 | 17:25 | 36.876 | 78.598 | 71.315 | 0.3794 | 54705.3306 | 54701.4150 | | |
| 93 | 17:40 | 36.872 | 78.582 | 71.167 | 0.3775 | 54702.9068 | 54694.7540 | 1.16546 | 1.21693 |

CALCULATED LEAK RATE PERCENT/DAY= 1.16546
UPPER CONFIDENCE LEVEL AT 95 PERCENT= 1.21693

THE ZERO TIME INTERCEPT IS 54867.9 LBS AND THE SLOPE -26.644 LBM/HR

JERSEY CENTRAL POWER & LIGHT CO.
OYSTER CREEK NUCLEAR GENERATING STATION

INTEGRATED CONTAINMENT LEAK RATE TEST *REFERENCE VESSEL METHOD*

REPORT PREPARED SAT, APR 03 1982 STARTING PRESSURE : 36.948 PSIA

| DAY | TIME | PRESSURE (PSIA) | DPRESS. (PSID) | TEMP. (F) | DEWPOINT (F) | POINT-TO-POINT PPLR (MEAS.) | TOTAL TIME TTLR (MEAS.) | TTLR (CALC.) | TTLR (UCL+95) |
|---|---|---|---|---|---|---|---|---|---|
| 93 | 11:25 | 36.946 | 2.790 | 78.140 | 70.894 | 1.14732 | 1.14732 | 1.14482 | |
| 93 | 11:40 | 36.942 | 2.785 | 78.150 | 70.600 | 1.15262 | 1.15006 | 1.14430 | |
| 93 | 11:55 | 36.938 | 2.782 | 78.170 | 70.657 | 0.80644 | 1.03556 | 1.14378 | |
| 93 | 12:10 | 36.935 | 2.778 | 78.185 | 70.733 | 1.09649 | 1.05078 | 1.14327 | |
| 93 | 12:25 | 36.932 | 2.774 | 78.189 | 70.849 | 1.07856 | 1.05631 | 1.14275 | |
| 93 | 12:40 | 36.929 | 2.769 | 78.218 | 70.690 | 1.09007 | 1.06188 | 1.14223 | |
| 93 | 12:55 | 36.926 | 2.766 | 78.237 | 70.957 | 1.14304 | 1.07341 | 1.14172 | |
| 93 | 13:10 | 36.924 | 2.763 | 78.258 | 70.825 | 1.35907 | 1.10901 | 1.14120 | |
| 93 | 13:25 | 36.918 | 2.757 | 78.260 | 70.607 | 2.32003 | 1.24336 | 1.14069 | |
| 93 | 13:40 | 36.915 | 2.755 | 78.249 | 71.393 | 1.44092 | 1.26296 | 1.14017 | |
| 93 | 13:55 | 36.913 | 2.752 | 78.234 | 70.744 | 1.58041 | 1.29164 | 1.13965 | |
| 93 | 14:10 | 36.910 | 2.750 | 78.265 | 70.785 | 1.01273 | 1.26829 | 1.13914 | |
| 93 | 14:25 | 36.909 | 2.746 | 78.279 | 70.508 | 0.51015 | 1.20992 | 1.13862 | |
| 93 | 14:40 | 36.907 | 2.741 | 78.338 | 71.429 | 1.05644 | 1.19958 | 1.13810 | |
| 93 | 14:55 | 36.905 | 2.737 | 78.355 | 71.154 | 0.84047 | 1.17554 | 1.13759 | |
| 93 | 15:10 | 36.901 | 2.732 | 78.403 | 70.841 | 1.08633 | 1.16985 | 1.13707 | |
| 93 | 15:25 | 36.899 | 2.728 | 78.413 | 71.132 | 0.85484 | 1.15123 | 1.13656 | |
| 93 | 15:40 | 36.896 | 2.723 | 78.443 | 71.320 | 1.03991 | 1.14494 | 1.13604 | |
| 93 | 15:55 | 36.894 | 2.719 | 78.492 | 71.209 | 0.81328 | 1.12740 | 1.13552 | |
| 93 | 16:10 | 36.891 | 2.714 | 78.489 | 71.289 | 0.83261 | 1.11257 | 1.13501 | |
| 93 | 16:25 | 36.888 | 2.710 | 78.506 | 71.124 | 0.90998 | 1.10283 | 1.13449 | |
| 93 | 16:40 | 36.885 | 2.705 | 78.523 | 71.323 | 0.85941 | 1.09168 | 1.13398 | |
| 93 | 16:55 | 36.881 | 2.700 | 78.556 | 71.360 | 1.02204 | 1.08854 | 1.13346 | |
| 93 | 17:10 | 36.878 | 2.696 | 78.584 | 71.254 | 1.01131 | 1.08522 | 1.13294 | |
| 93 | 17:25 | 36.876 | 2.692 | 78.598 | 71.315 | 1.29070 | 1.09330 | 1.13243 | |
| 93 | 17:40 | 36.872 | 2.688 | 78.582 | 71.167 | 1.12172 | 1.09427 | 1.13191 | 1.26541 |