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March 9, 1990

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Reference: Beaver Valley Power Station, Unit No. 1
Docket No. 50-334, License No. DPR-66
Reactor Containment Building Integrated Leakage Rate Report

Gentlemen:

Enclosed is the Beaver Valley Unit No. 1 Reactor Containment Building Integrated Leakage Rate Report submitted in accordance with Appendix J of 10CFR Part 50. The report provides a summary of the results of all Local Leakage Rate Testing performed since the previous Integrated Leakage Rate Test.

Very truly yours,

J. D. Sieber
Vice President
Nuclear Group

Attachment

cc: Mr. J. Beall, Sr. Resident Inspector
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# REACTOR CONTAINMENT BUILDING
# INTEGRATED LEAKAGE RATE TEST

DUQUESNE LIGHT COMPANY
BEAVER VALLEY POWER STATION UNIT NO. 1

DECEMBER 1989

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LIST OF ATTACHMENTS

## REFERENCES


1. 10CFR50, Appendix J, Primary Reactor Containment Leakage Testing For Water-Cooled Power Reactors, January 1, 1989

2. 1BVT 1.47.2, Containment Integrated Leakage Rate Test, Beaver Valley Power Station Unit No. 1, Issue 2, Revision 3, September 8, 1989.

3. ANSI N45.4, American National Standard, Leakage - Rate Testing of Containment Structures for Nuclear Reactors, March 16, 1972.

4. ANSI/ANS-56.8, Containment System Leakage Testing Requirements, January 20, 1987.[1]


[1]This document used only as a guideline and any reference to said document in no way implies compliance.

# SECTION 1

## PURPOSE

The purpose of this report is to present a description and analysis of the December 1989 Type A Containment Integrated Leakage Rate Test (ILRT), and a summary of Type B and C Local Leakage Rate Tests (LLRT's) performed since the last periodic ILRT (August 1986) at Duquesne Light Company's Beaver Valley Power Station Unit No. 1 (BVPS 1).

Stone & Webster Engineering Corporation (SWEC) provided test engineering consultation services to Duquesne Light Company during the performance of the 1989 ILRT.

This report is submitted as required by 10CFR50, Appendix J, Paragraph V.B.

# SECTION 2

# SUMMARY

## 2.1 TYPE A ILRT

### 2.1.1 Test Summary

Upon completion of all ILRT prerequisites and initial conditions, containment pressurization started at 2246 hours on November 29, 1989 at a fairly constant pressurization rate of 3.8 psi per hour. The compressors were secured at 1010 hours on November 30, 1989 with a peak instantaneous pressure of 56.217 PSIA.

At 1430 hours on November 30, 1989, the temperature stabilization criteria (< 0.5 °R/Hr) was satisfied. The ILRT start time was declared to be 1500 hours on November 30, 1989. Initial mass trends indicated an unacceptable leakage rate of approximately 45 lbm/hr. Penetration area leakage investigations identified a seal leak on Outside Recirculation Spray Pump [RS-P-2B].

At 1742 hours on November 30, 1989 [RS-P-2B] was isolated by closing pump discharge and suction isolation valves [MOV-RS-155B] and [MOV-RS-156B]. The ILRT start time was moved to 1800 hours on November 30, 1989. The mass trend after isolation of [RS-P-2B] still indicated an unacceptable leakage rate of approximately 22 lbm/hr.

At 1015 hours on December 1, 1989 air was found bubbling from the Fuel Transfer Tube Gate Valve [FH-1] in the Fuel Building Upender Canal. The canal water level was approximately six feet above the gate valve, with the gate valve closed. Gate valve [FH-1] was opened to relieve accumulated pressure in the Fuel Transfer Tube at 1430 hours on December 1, 1989.

Air continued to bubble through the water, indicating a significant leakage path existed through the Fuel Transfer Tube. The mass trend after opening of gate valve [FH-1] indicated an unacceptable leakage rate of approximately 75 lbm/hr. Attachment 2.1A shows how the mass trend was affected by these two leakage paths.

At 1520 hours on December 1, 1989 preparations for containment depressurization were started, due to the magnitude of the Fuel Transfer Tube leakage rate, while extensive leakage investigations of all penetration areas found no other significant leakage paths. Containment depressurization was started at 1918 hours on December 1, 1989, and was completed at 0306 hours on December 2, 1989.

Determination of the Fuel Transfer Tube, and Outside Recirculation Spray Pump [RS-P-2B] shaft seal leakage paths were started after containment depressurization.

A Type B leak test of the Fuel Transfer Tube Blind Flange was performed prior to the ILRT, and agian when containment depressurization was completed to verify flange integrity. Both tests measured an acceptable leakage rate of 0.47 SCF/D.

Inspection and testing of the Fuel Transfer Tube found that one of the two concentric flexitallic gaskets used to seal the blind flange to the Fuel Transfer Tube had dislodged during installation. The gasket had dislodged preventing the flange from sealing completely, and blocked the Type B test port, preventing test gas from pressurizing between the gaskets.

The inner and outer flexitallic gaskets on the Fuel Transfer Tube Blind Flange were replaced, and the flange was reinstalled. The Type B test performed after flange reinstallation measured a leakage rate of 56.94 SCF/D. To ensure full thread engagement, and uniform flange compression each blind flange bolt was removed individually, and lubricated. The threads on one bolt were chased. The blind flange bolts were retorqued, and the Type B test was repeated with a measured leakage rate of 0.47 SCF/D.

The inner and outer mechanical pump seals for [RS-P-2B] were cleaned and rebuilt with the existing parts prior to the ILRT because of a slight seal leak found during pump performance testing. Repairs after the first ILRT found the outer mechanical pump seal had inadequate seal face preload. The inner and outer mechanical seals, and also the shaft sleeve shaft o-ring were replaced. The Seal Water Accumulator was refilled after repairs using a temporary standpipe.

Within approximately five minutes the high level alarm extinguished, while no visible change in the standpipe level could be observed. This condition was indicative of a defective Seal Water Accumulator diaphragm. Disassembly of the accumulator verified a defective diaphragm. The diaphragm was replaced.

After all maintenance on [RS-P-2B] was completed, the pump casing was pressurized to 42 PSIG to inspect for any seal leakage. No detectable seal leakage was observed.

Upon completion or reverification of all ILRT prerequisites and initial conditions, containment pressurization started at 0248 hours on December 5, 1989 with a fairly constant pressurization rate of 3.2 psi per hour. The compressors were secured at 1542 hours on December 5, 1989 with a peak instantaneous pressure of 56.520 PSIA.

During the second ILRT the Fuel Transfer Tube Gate Valve [FH-1] was open, with the canal water level just above the gate valve. The water in the canal provided visual indication of any leakage from the Fuel Transfer Tube. Outside Recirculation Spray Pump [RS-P-2B] was aligned with the pump isolation valves [MOV-RS-155B] and [MOV-RS-156B] open.

At 1945 hours on December 5, 1989, the temperature stabilization criteria was satisfied. Initial mass trends indicated an acceptable leakage rate of approximately 7 lbm/hr. Leakage inspections of all penetration areas found no significant leakage paths.

The ILRT start time was declared to be 1945 hours on December 5, 1989. Temperature, dewpoint, and pressure data was collected at 15 minute intervals throughout the test period.

The ILRT was successfully completed at 1945 hours on December 6, 1989 with a Mass Point Analysis Upper Confidence Limit of 0.031005 percent/day (See Section 3.3, Test Results). This leakage rate was well below the 0.75 La acceptance criteria of 0.075 percent/day.

The Superimposed Leakage Verification Test was started at 2045 hours on December 6, 1989 when the stability of all the containment parameter trends had recovered from the imposed leakage rate perturbation. The Superimposed Leakage Verification Test was successfully completed at 0045 hours on December 7, 1989. (See Section 3.3, Test Results)

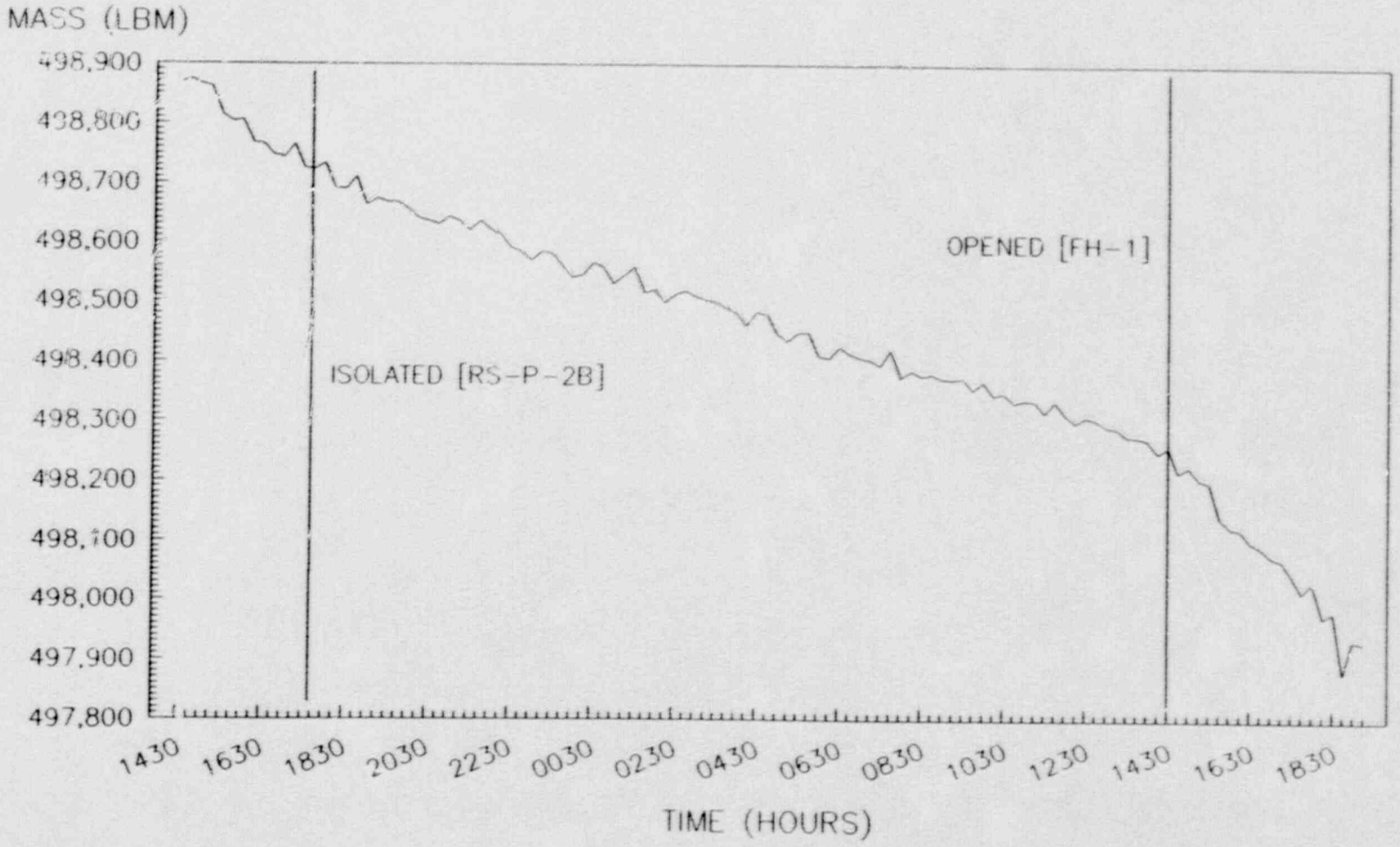
After review of all ILRT test data, containment depressurization started at 0158 hours and was completed at 1000 hours on December 7, 1989.

## 2.2 LOCAL LEAKAGE RATE TESTS (TYPES B AND C)

The Local Leakage Rate Tests (LLRT's) of the containment isolation valves and other containment penetrations were conducted as described in the Beaver Valley Power Station Unit No. 1 surveillance test procedures for Type B and C tests.

In accordance with Appendix J to 10CFR50, Paragraph V.B, data for the Local Leakage Rate Tests are summarized in Section 4 of this report.

BEAVER VALLEY POWER STATION UNIT NO. 1
DECEMBER 1989 CONTAINMENT ILRT
ATTACHMENT 2.1A – CNMT AIR MASS vs TIME




11/29/89 @ 1430 TO 12/1/89 @ 1915

SECTION 3

INTEGRATED LEAKAGE RATE TEST

3.1 EDITED LOG OF EVENTS

This log was edited from information contained in the ILRT test Log.

November 29, 1989

2109 - Secured the containment personnel airlock and successfully completed Type B test of door seals. Secured containment lighting.

2246 - Commenced ILRT pressurization. Initial containment pressure @ 14.42 PSIA.

2358 - Containment pressure @ 17.62 PSIA.

November 30, 1989

0245 - Completed walkdown of all penetration areas, no problems were detected. Containment pressure @ 28.04 PSIA.

0321 - Noted slight increase on pressure gauge installed at Penetration No. 90, Containment Purge Exhaust.

NOTE: Motor operated dampers inside containment for Penetration 90 and 91 were rotated 180° in response to NRC information Notice 88-73 during the refueling outage prior to the ILRT.

0345 - Received Low Level Seal Water Accumulator alarm for Outside Recirculation Spray Pump [RS-P-2B]. Containment pressure @ 31.87 PSIA.

0530 - Operations attempted to refill [RS-P-2B] accumulator, but where unable due to air pressure in the accumulator.

0547 - External leakage detected at [RS-P-2B] seal. Containment pressure @ 39.41 PSIA.

1010 - Secured containment pressurization with a peak instantaneous pressure of 56.217 PSIA.

1030 - Commenced ILRT stabilization period.

1105 - Noted pressure gauge installed at Penetration No. 91, Containment Purge Supply increased to 2 PSIG.

1430 - Satisfied temperature stabilization criteria (< 0.5 °R/Hr).

1500 - Declared start of ILRT.

1505 - Penetration No. 90 and 91 pressures are still increasing at a slow rate. Penetration No. 90 at 29.9 PSIG, and Penetration No. 91 at 34.6 PSIG.

1738 - Based on 2 1/2 hours of data analysis mass trend is approximately 45 lbm/hr with no signs of improvement. Decided to isolate [RS-P-2B] by closing [MOV-RS-155B] and [MOV-RS-156B] to assess impact of seal leak.

1742 - Closed [MOV-RS-155B] and [MOV-RS-156B].

1750 - Based on closing [MOV-RS-155B] and [MOV-RS-156B] the ILRT will be restarted at 1800.

December 1, 1989

0322 - Completed walkdown of penetration areas with only several minor packing leaks identified. Casing of [RS-P-2B] is pressurized to 22.4 PSIG.

0559 - Depressurized [RS-P-2B] casing, and verified isolation valves are leaking by at a rate of approximately 37 SCF/H (leakage measured by a rotameter on vent valve after depressurizing pump casing). Mass trend since isolating [RS-P-2B] is approximately 22 lbm/hr. Removed flexible ductwork outboard of outside containment isolation valves on Penetrations No. 90 and 91. Detected minimal leakage on both valve discs.

0800 - Isolated Recirculation Spray Heat Exchanger [RS-E-1A & 1B] river water inlet and outlet lines by closing [MOV-RW-104A & B] and [MOV-RW-105A & B] to assess the possibility of a leakage path through these heat exchangers.

0910 - Isolated Recirculation Spray Heat Exchanger [RS-E-1C & 1D] river water inlet and outlet lines by closing [MOV-RW-104C & D] and [MOV-RW-105C & D]. Very slight mass change observed since isolation of [RS-E-1A & 1B].

1006 - Unisolated [RS-E-1C & 1D] by opening [MOV-RW-104C & D] and [MOV-RW-105C & D]. [RS-E-1A & 1B] will remain isolated to monitor for any pressure increase on river water lines.

1015 - Operator inspecting for leakage from fuel pool weir gate to upender canal reported that water standing in upender canal is rippling.

1035 - Possible leakage path from Fuel Transfer Tube, air bubbling through water in canal. Need to get better lighting in canal to determine source of leakage.

1100 - Verified with Refueling Group that air line to fuel handling equipment in upender canal is isolated. Air appears to be bubbling from packing and valve disc of Fuel Transfer Tube Gate Valve [FH-1]. (canal water level approximately six feet above gate valve)

1250 - Partially open Fuel Transfer Tube Gate Valve [FH-1]; large rush of air was observed. Reclosed gate valve.

1430 - Open gate valve [FH-1] to vent accumulated air pressure in Fuel Transfer Tube to verify continuing leakage. With [FH-1] fully open air continues to stream from Fuel Transfer Tube. Mass trend has increased to approximately 75 lbm/hr.

1520 - Based on the identified leakage paths and their magnitude, the General Manager Nuclear Operations has directed to terminate the ILRT and prepare for containment depressurization.

1638 - Unisolated [RS-E-1B] by opening [MOV-RW-104B] and [MOV-RW-105B].

1918 - Commenced containment depressurization.

December 2, 1989

0306 - Completed containment depressurization.

0500 - Containment open, performed fuel transfer blind flange Type B with a measured leakage of 0.47 SCF/D. Water was observed flowing from the Fuel Transfer Tube into refueling cavity.

0640 - Completed containment walkdown, no damage observed.

1330 - Setting up for freon leak check of [RS-E-1A & 1B].

1500 - Maintenance to remove blind flange from Fuel Transfer Tube.

1530 - Type B test line verified unobstructed by passing flow through line with blind flange removed.

December 3, 1989

0310 - Freon leak test of [RS-E-1A & 1B] satisfactorily completed, including all flanges and mechanical joints.

0420 - Maintenance working on placing a temporary flange on Fuel Transfer Tube in containment to support a pressure test of the tube.

0900 - Seals and shaft sleeve o-ring on [RS-P-2B] were replaced; however, Maintenance believes diaphragm in seal pot accumulator may be defective. Seal pot accumulator will be disassembled to inspect.

1730 - Completed pressure test of Fuel Transfer Tube. No leakage could be detected in containment.

1950 - Permanent blind flange will be reinstalled on Fuel Transfer Tube and Type B tested. If Type B test is satisfactory, then fuel building upender canal will be refilled with water above gate valve [FH-1] so Fuel Transfer Tube can be inspected for water leakage in containment.

2140 - Started reverification of containment penetration alignments for repeat of ILRT.

December 4, 1989

0610 - Performed Type B test on Fuel Transfer Tube Blind Flange after reinstallation. Measured a leakage rate of 56.94 SCF/D.

0800 - Maintenance will inspect blind flange bolt threads, and chase if necessary to ensure full bolt thread engagement, and uniform flange compression.

1245 - Performed Type B test on Fuel Transfer Tube Blind Flange after inspection of blind flange bolt threads, and retorquing. Measured leakage rate was 0.47 SCF/D.

1500 - Filled fuel building upender canal with water above gate valve [FH-1].

1705 - Completed visual inspection of Fuel Transfer Tube in containment for water leakage. No leakage detected.

1940 - Completed all containment penetration valve alignments and verifications.

2210 - Completed containment walkdown for ILRT. Secured containment personnel airlock, and successfully completed Type B of door seals.

December 5, 1989

0120 - Pressure test of [RS-P-2B] completed with no detectable seal leakage.

0248 - Commenced ILRT pressurization. Initial containment pressure @ 14.17 PSIA.

0725 - Completed walkdown of all penetration areas, no problems detected. [RS-P-2B] and Fuel Transfer Tube show no leakage indications. Fuel Transfer Tube Gate Valve [FH-1] is open with canal water just above valve. Containment pressure @ 26.98 PSIA.

1542 - Secured containment pressurization with a peak instantaneous pressure of 56.520 PSIA.

1545 - Commenced ILRT stabilization period.

1945 - Satisified temperature stabilization criteria. Declared start of ILRT at 1945.

2300 - Completed inspection of all penetration areas, only a few minor packing leaks identified. Penetrations 90 and 91 have pressurized to 32.5 and 38.6 PSIG respectively; detected minimal leakage on both valve discs for these penetrations.

December 6, 1989

0325 - Completed inspection of all penetration areas. Operations isolated ventilation in each area momentarily to permit audible leakage inspection. No significant leakage identified.

0500 - Mass trend is acceptable at approximately 7 lbm/hr. Mass Point Upper Confidence Level of 0.047 percent/day.

1300 - No leakage detected in penetration areas, staging test equipment for Superimposed Leakage Verification Test.

1700 - Containment leakage rate at Mass Point Upper Confidence Level of 0.032 percent/day.

1945 - Completed 24 hour ILRT test period.

1950 - Established a 4.6 SCF/M leakage flow for Superimposed Leakage Verification Test.

2045 - Commenced the Superimposed Leakage Verification Test.

December 7, 1989

0045 - Completed the Superimposed Leakage Verification Test.

0158 - Commenced containment depressurization.

1000 - Completed containment depressurization.

## 3.2 GENERAL TEST DESCRIPTION

### 3.2.1 Prerequisites

In accordance with Beaver Valley Power Station Unit 1 ILRT test procedure 1BVT 1.47.2, the following is a listing of the pertinent prerequisites completed and documented prior to containment pressurization:

a. All Type B and C Local Leakage Rate Testing completed.

b. All test instrumentation calibrated or functionally verified within 6 months of ILRT.

c. All penetration valve alignments completed.

d. All ILRT computer software used for data acquisition, and data analysis, tested and operational.

e. Temporary air compressors and auxiliary equipment checked out and available for pressurization.

f. All equipment that could be damaged by test pressure, removed or protected.

g. Portable pressure containing equipment removed from containment.

h. Depressurized and vented pressure vessels located inside containment.

i. Completed structural integrity inspection of containment.

### 3.2.2 Equipment and Instrumentation

Pressurization of the containment was achieved by the utilization of a temporary system consisting of eleven diesel driven oil free air compressors, a water cooled aftercooler, and a refrigerant air dryer. The system included adequate instrumentation and valving to maintain proper monitoring and control of the compressed air quality throughout the pressurization sequence. The total capacity of the pressurization system was 9900 SCFM. Air was supplied to containment through the Containment Purge System.

The various containment parameters required to calculate containment leakage were monitored using instrumentation which consisted of 16 resistance temperature detectors, 5 dewpoint detectors, and an absolute pressure quartz manometer. Pertinent data for the test instrumentation is listed in Attachment 3.2A.

A test panel consisting of a rotameter, pressure gauge, and a thermometer was used to perform the Superimposed Leakage Verification Test.

### 3.2.3 Data Acquisition System

The data acquisition system used for ILRT was the plant process P-250 computer.

For the ILRT, the plant process computer monitored the following instrumentation:

| Type | No. of Sensors |
|---|---|
| Temperature Detectors | 16 |
| Dewpoint Sensors | 5 |
| Quartz Manometer | 1 |

Instantaneous readings for each sensor were collected and printed at 15 minute intervals. Input to the data analysis program was based on these collections. Each data set was time stamped.

### 3.2.4 Data Resolution System

The recorded data was inputted to Stone & Webster Engineering Corporation's portable computer for data reduction and leakage rate calculations. The Mass Point Analysis Method was used to determine the containment leakage rate.

Absolute Method of Mass Point Analysis

The Absolute Method of Mass Point Analysis consists of calculating the air mass within the containment structure, over the test period, using pressure, temperature, and dewpoint data obtained during the ILRT. The air mass is computed using the ideal gas law as follows:

$$M = \frac{144V(P-Pv)}{RT}$$

Where:

M = air mass, lbm
P = total pressure, psia
Pv = average vapor pressure, psia
R = 53.35 ft-lbm/lbm °R (for air)
T = average containment temperature, °R
V = containment free volume, 1,760,000 cu. ft

The leakage rate is then determined by plotting air mass as a function of time, using a least-squares fit to determine the slope, A = dM/dT. The leakage rate is expressed as a percentage of the air mass lost in 24 hours or symbolically:

$$\text{Leakage Rate} = A/B(-2400)$$

Where A is the slope of the least-squares curve and B is the y-intercept. The sign convention is such that the leakage out of containment is positive, and the units are in percent/day.

The air mass is calculated and the result is correlated as a function of time by means of a least-squares curve fit of the form:

$$M = At + B$$

A confidence interval is calculated using a Student's T distribution. The sum of the leakage rate and confidence is the Upper Confidence Level.

ATTACHMENT 3.2A

INSTRUMENTATION LIST

| Instrument | Weight Factor | Computer Address | Range | Zone | Elevation |
|---|---|---|---|---|---|
| A. Temperature | | | | | |
| TRB-LM100-01 | 0.039104 | Y0756A | 60-100 °F | A | 739' |
| TRB-LM100-02 | 0.043137 | Y1000A | 60-100 °F | B | 739' |
| TRB-LM100-03 | 0.038487 | T1000A | 60-100 °F | A | 739' |
| TRB-LM100-04 | 0.041176 | T1001A | 60-100 °F | B | 744' |
| TRB-LM100-05 | 0.076695 | T1002A | 60-100 °F | C | 799' |
| TRB-LM100-06 | 0.076246 | T1003A | 60-100 °F | C | 799' |
| TRB-LM100-07 | 0.076695 | T1004A | 60-100 °F | C | 799' |
| TRB-LM100-08 | 0.000000 | T1005A | 0-300 °F | | 799' |
| TRB-LM100-09 | 0.090756 | T1006A | 60-100 °F | D | 850' |
| TRB-LM100-10 | 0.090756 | T1007A | 60-100 °F | D | 850' |
| TRB-LM100-11 | 0.090756 | T1008A | 60-100 °F | D | 850' |
| TRB-LM100-12 | 0.038207 | T1009A | 60-100 °F | F | 799' |
| TRB-LM100-13 | 0.094846 | T1010A | 60-100 °F | E | 797' |
| TRB-LM100-14 | 0.000000 | T1011A | 0-300 °F | | 799' 6" |
| TRB-LM100-15 | 0.000000 | T1012A | 0-300 °F | E | 799' |
| TRB-LM100-16 | 0.000000 | T1013A | 0-300 °F | G | 701' 6" |
| TRB-LM100-17 | 0.051746 | T2457A | 60-100 °F | G | 701' 6" |
| TRB-LM100-18 | 0.055108 | T2460A | 60-100 °F | G | 701' 6" |
| TRB-LM100-19 | 0.045490 | T2467A | 60-100 °F | F | 740' 10" |
| TRB-LM100-20 | 0.050794 | T2477A | 60-100 °F | G | 701' 6" |

INSTRUMENTATION LIST

| Instrument | Weight Factor | Computer Address | Range | Zone | Elevation |
|---|---|---|---|---|---|
| B. Dewpoint | | | | | |
| MA-LM100-01 | 0.125690 | T0457A | 15-85 °F | J | 825' |
| MA-LM100-02 | 0.125690 | T0635A | 15-85 °F | J | 825' |
| MA-LM100-03 | 0.249540 | T0655A | 15-85 °F | K | 701' |
| MA-LM100-04 | 0.249540 | T0661A | 15-85 °F | K | 701' |
| MA-LM100-05 | 0.249540 | T0675A | 15-85 °F | K | 701' |
| C. Pressure | | | | | |
| Q.M. PIT-LM-102 | 1.000000 | P1003A | 0-150 IN HG A | | |
| # I-II-2.1409-B | 0.000000 | - | 0-100 PSIA | | |
| D. Superimposed Leakage Verification Test Flow Instrument | | | | | |
| I-A-1.553.2 | 1.000000 | - | 0-8 SCFM | | |
| I-A-1.553.3 | 0.000000 | - | 0-8 SCFM | | |

# Backup quartz manometer, logged locally at same frequency as primary manometer.

## 3.3 TEST RESULTS

### 3.3.1 Presentation of Test Results

The initial ILRT was unable to meet the containment leakage rate acceptance criteria of < 0.75 La, requiring reperformance following equipment repairs. The second ILRT satisfactorily met the containment leakage rate acceptance criteria.

During the initial ILRT two significant leakage paths were identified which caused the unacceptably high containment leakage.

A shaft seal leak was identified on Outside Recirculation Spray Pump [RS-P-2B] prior to the completion of containment pressurization. The impact of this seal leak could not be assessed until containment conditions stabilized after pressurization. 2 1/2 hours of data analysis after stabilization indicated containment air mass was trending at approximately 45 lbm/hr which exceeded acceptable leakage rate limits (0.75 La = 15.32 lbm/hr). [RS-P-2B] was isolated from containment by closing the pump discharge and suction MOV's, so that the seal leakage could be quantified. The containment air mass trend improved to approximately 22 lbm/hr after isolating [RS-P-2B] which still exceeded acceptable leakage rate limits.

The [RS-P-2B] casing was vented, and a rotameter connected to the casing vent to quantify MOV leakage. MOV leakage measured was approximately 37 SCFH, or equivalent to 2.8 lbm/hr. [RS-P-2B] discharge and suction MOV's are ASME Section XI Category B valves, and are not subject to leakage testing. While the isolated [RS-P-2B] pump was still a substantial leakage path, it was evident an additional leakage path(s) existed in the containment pressure boundary.

Leakage investigations in the Fuel Building found air bubbling through standing water from the Fuel Transfer Tube Gate Valve [FH-1] in the Fuel Building.

The amount of leakage visible is was apparent this leakage path was not significant. Gate valve [FH-1] was opened to vent the Fuel Transfer Tube, and to verify continuing leakage. After [FH-1] was fully opened the containment air mass trend increased to approximately 75 lbm/hr.

The ILRT was terminated for repairs since no additional leakage paths were identified, and the containment leakage rate was unacceptable.

Following repairs to Outside Recirculation Spray Pump [RS-P-2B], and Fuel Transfer Tube a second ILRT was performed. The test data for the second ILRT is based on an 24 hour test period starting at 1945 hours on December 5, 1989. The final test results were determined using SWEC's ILRT computer analysis program. The Reduced Input Data, Mass Point Analysis Test Results, Superimposed Leakage Verification Test Results, and representative graphs are contained in Attachments 3.3A through 3.3F.

The Mass Point Analysis Test Results for the ILRT satisfied the procedural acceptance criteria. The ILRT instrumentation was verified by the Superimposed Leakage Verification Test Method. The Mass Point Results for the Superimposed Leakage Verification Test satisfied the procedural acceptance criteria.

3.3.2 54.7 PSIA ILRT Results

The ILRT was conducted in accordance with Beaver Valley Power Station Unit No. 1 test procedure 1BVT 1.47.2. The results for the ILRT and for the Supplemental Test are shown below:

3.3.2.1 ILRT Results - Mass Point Analysis

| Item | (Percent/Day) |
|---|---|
| 1. Lam, Leakage Rate Calculated | 0.029556 |
| 2. Confidence Level | 0.001449 |
| 3. UCL, Lam Leakage Rate plus Confidence Level | 0.031005 |
| 4. Corrections for: (See Section 3.3.2.4) | |
| i. Type B Penalties | 0.000157 |
| ii. Type C Penalties | 0.000510 |
| iii. Water Levels | 0.000000 |
| iv. Total Corrections | 0.000667 |
| 5. Total Reported ILRT Leakage Rate (Items 3 & 4) | 0.031672 |

Results were within the acceptable limits of < 0.75 La or < 0.075 Percent/Day

3.3.2.2 Supplemental Test Results

The Supplemental Verification Test was performed using the Superimposed Leakage Verification Test Method in accordance with test procedure 1BVT 1.47.2. The results for the Superimposed Leakage Verification Test are shown below.

1. The Superimposed Leakage Verification Test is acceptable provided Lc falls within the following range:

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

Where: Lam = Type A calculated leakage (computer)
= 0.029556 Percent/Day

Lo = Superimposed leakage rate developed from rotameter
= 0.100043 Percent/Day

Lc = Composite leakage (computer)
= 0.107675

a. Mass Point

$$(0.029556 + 0.100043 - 0.025) \leq 0.107675 \leq (0.029556 + 0.100043 + 0.025)$$
$$(0.104599) \leq 0.107675 \leq (0.154599)$$

The Superimposed Leakage Verification Test was within the allowable limits.

### 3.3.2.3 Leakage Penalties Added to ILRT Leakage

Penetration leakage to be added since these penetrations were isolated or could not be vented and drained during the ILRT. The leakage assigned is the recorded value for minimum pathway leakage.

i. Type B Penalties

| Description | Leakage (SCF/D) |
|---|---|
| Electrical Penetrations — Canisters | 10.30 |

Total Type B Leakage = 10.30 SCF/D
Total Type B Leakage = 0.000157 Percent/Day

ii. Type C Penalties

| | Description | Leakage (SCF/D) |
|---|---|---|
| Pent #1 | Component Cooling Water System | 0.47 |
| Pent #2 | Component Cooling Water System | 0.47 |
| Pent #4 | Component Cooling Water System | 1.18 |
| Pent #5 | Component Cooling Water System | 0.47 |
| Pent #8 | Component Cooling Water System | 0.47 |
| Pent #9 | Component Cooling Water System | 4.69 |
| Pent #11 | Chilled Water System | 0.49 |
| Pent #13 | Fire Protection System | 0.47 |
| Pent #14 | Chilled Water System | 0.47 |
| Pent #16 | Component Cooling Water System | 0.47 |
| Pent #17 | Component Cooling Water System | 1.88 |
| Pent #18 | Component Cooling Water System | 2.59 |
| Pent #24 | RHR System to RWST | 0.47 |
| Pent #25 | Component Cooling Water System | 2.08 |
| Pent #26 | Component Cooling Water System | 3.84 |
| Pent #27 | Component Cooling Water System | 9.61 |
| Pent #28 | RCS Letdown | 0.47 |

ii. Type C Penalties (continued)

| | | |
|---|---|---|
| Pent #31 | Fire Protection System | 0.47 |
| Pent #32 | Fire Protection System | 0.47 |
| Pent #55-2 | Leakage Monitoring System | 0.47 |
| Pent #58 | Component Cooling System | 0.47 |
| Pent #97-1 | Reactor Plant Sample System | 0.47 |
| Pent #110-1 | Pressurizer Dead Weight Tester | 0.47 |

Total Type C Leakage = 33.41 SCF/D

Total Type C Leakage = 0.000510 Percent/Day

iii. Water Level Corrections

| Description | Leakage (SCF/D) |
|---|---|
| Rx Vessel | 0.0 |
| Cnmt Sump | 0.0 |

Total Water Level Corrections = 0.0 SCF/D

Total Water Level Corrections = 0.0 Percent/Day

3.3.2.4 As Found Containment Condition - LLRT Improvements

In order to account for the affect of Local Leakage Rate Test (LLRT) repairs (made prior to the ILRT) on the "as found" condition of containment, an analysis of LLRT results was performed.

The "as found" minimum pathway leakage rate is reviewed against the "as left" minimum pathway leakage rate for each LLRT penetration. If the penetration minimum pathway leakage rate is reduced because of repairs, maintenance, design changes, etc., then the leakage rate improvement is noted. The total of all these leakage rate improvements is the adjustment to the "as found" containment condition.

The minimum pathway leakage rate for the following LLRT penetrations was reduced as a result of repairs:

| PENT NO. | AS FOUND MINIMUM PATHWAY LEAKAGE (SCF/D) | AS LEFT MINIMUM PATHWAY LEAKAGE (SCF/D) | LEAKAGE DIFFERENCE (SCF/D) |
|---|---|---|---|
| 4 | 2.44 | 1.18 | 1.26 |
| 25 | 5.16 | 2.08 | 3.08 |
| 38 | 51.70 | 0.47 | 51.23 |
| 56-2 | 0.48 | 0.47 | 0.01 |
| 64 | 35.91 | 0.47 | 35.44 |
| 90 | 18.15 | 14.60 | 3.55 |
| 94 | 25.78 | 16.89 | 8.89 |
| 10-A | 0.46 | 0.10 | 0.36 |
| 11-A | 0.32 | 0.10 | 0.21 |
| 15-B | 0.20 | 0.10 | 0.10 |

Total Minimum Pathway Leakage Rate Improvement = 104.13 SCF/D
Total Minimum Pathway Leakage Rate Improvement = 0.001589 Percent/Day

Adding this "as found" containment adjustment to the reported ILRT results yields the following results:

| Item | (Percent/Day) |
|---|---|
| 1. Total Reported ILRT Leakage Rate (See Section 3.3.2.1) | 0.031672 |
| 2. As Found Containment Adjustment | 0.001589 |
| 3. Total Containment Leakage Rate | 0.033261 |

3.3.3 Conclusion

The Fuel Transfer Tube leakage path was caused by improper gasket compression of the blind flange after the completion of refueling. The design of the Fuel Transfer Tube Blind Flange incorporates two concentric flexitallic gaskets to form the seal on the Fuel Transfer Tube. These gaskets are held in place during installation by flange compression, and grooves machined into the blind flange. The area between the gaskets is machined slightly below the flange surface to provide a means of leak testing (Type B) by pressurizing between the gaskets after installation.

It is speculated that while lowering the blind flange into position that one of the flexitallic gaskets was struck by the Fuel Transfer Tube mating flange and dislodged from its recessed groove. Compression of the other flexitallic gasket was not achieved due to the dislodged gasket interference. The Type B test port which pressurizes the annulus area between the gaskets was blocked by the dislodged gasket. This blockage prohibited the test from identifying the improper gasket position, and provided satisfactory test results.

The Fuel Transfer Tube Blind Flange is located in a confined area. Access around the blind flange is very limited due to the proximity of the refueling cavity liner fuel transfer cart drive mechanism, and cart rails. These tight quarters make visual inspection of the entire flange very difficult, if not impossible. Additionally, radiological conditions in this area require extensive personnel protective equipment, and limit stay time.

A redesign of the Fuel Transfer Tube Blind Flange will be considered to reduce the probability of dislodging the flexitallic gaskets(s). Possibly a temporary installation clip, or a blind flange modification may be incorporated. Additional consideration will be given to the installation of a pressure port in the blind flange, offset from the existing test port.

During the Type B of the blind flange, a temporary pressure gauge would be installed at the offset pressure port. This gauge would provide positive indication that the annulus area between the gaskets is pressurized.

The BVPS No. 1 containment is designed to normally operate at a subatmospheric pressure of approximately 9.5 PSIA. Due to the magnitude of the Fuel Transfer Tube leakage path, and the subatmospheric containment design, it is highly improbable that the improperly installed blind flange would not have been detected. Air inleakage would increase the containment pressure indicating a leakage path in the containment pressure boundary.

The Outside Recirculation Spray Pump [RS-P-2B] leakage path was caused by inadequate seal face preload on the outer pump seal, and a leaking shaft sleeve o-ring. The pump is designed with a tandem mechanical seal arrangement as shown on Attachment 3.3G. The tandem mechanical seal arrangement provides a positive seal against pump leakage, with adequate lubrication and cooling for the seals. Seal water accumulator level alarms provide control room annunciation that adequate seal water is available, and indicate failure of either seal.

The seal arrangement consists of two mechanical face seals (#2 & #7), arranged to enclose demineralized seal water. When the pump is operating, the pressure between the seals is maintained higher than the pressure outside either seal by the seal water accumulator (#5) with a weight loaded diaphragm. The seal water accumulator is equipped with high and low level alarms (#9), which annunciate in the control room. The seal water is cooled by being pumped by the pumping ring (#6) through the air cooler (#4).

During pump performance testing a slight seal leak was identified at the outer pump seal. The rotating seal face bellows for the outer seal had taken a set, which caused the seal faces to be slightly misaligned.

The inner and outer mechanical pump seals were cleaned, and rebuilt with the existing parts prior to the first ILRT.

Seal water accumulator level was lost during containment pressurization for the first ILRT. Air leakage from the [RS-P-2B] outside pump seal was identified shortly after the seal water accumulator level went low. [RS-P-2B] was isolated from containment in an attempt to reduce containment leakage to an acceptable rate. After pump isolation the resulting change in containment air mass loss was significantly reduced. If [RS-P-2B] was the only major leakage path in the containment pressure boundary, it is very probable that the ILRT leakage rate would have been within acceptable limits with [RS-P-2B] isolated.

After containment depressurization from the first ILRT, both inner and outer mechanical seals were replaced. The outer seal preload was determined to have been inadequate to maintain proper seal face contact. The preload was inadvertently altered when a stripped preload adjustment set screw was replaced during reassembly prior to the first ILRT. Also the shaft sleeve o-ring was replaced. While refilling the seal water accumulator using a standpipe, accumulator level was lost, with no corresponding loss of standpipe level. A ruptured diaphragm was suspected, and confirmed by accumulator disassembly. After completion of all [RS-P-2B] maintenance, the pump casing was pressurized to 42 PSIG with no external leakage detected, or lost of seal water accumulator level.

Most probably the seal water accumulator diaphragm ruptured after water level was lost due the higher than normal differential pressure across the diaphragm. The leakage path would have developed when the diaphragm ruptured, providing a path from containment through the pump casing, accumulator, and passed the outer seal. An additional leakage path existed because of the leaking shaft sleeve o-ring, allowing leakage between the shaft and shaft sleeve.

The leakage of [RS-P-2B] mechanical seal, shaft sleeve o-ring, and the ruptured seal water accumulator diaphragm would not have gone undetected. The seal water accumulator would have continued to give a control room low level alarm annunciation due to loss of level, or sinking of the diaphragm. Air inleakge would have detected the defective shaft sleeve o-ring, since the pump casing is exposed to containment subatmospheric conditions.

To ensure integrity of the external loop for Outside Recirculation Spray Pumps [RS-P-2A & B] a periodic surveillance test will be developed to pressurize each pump casing for leakage inspection. This test would be performed on a refueling frequency.

ATTACHMENT 3.3A

INTEGRATED LEAKAGE RATE TEST

FROM 19:45 HOURS ON 12/5/89 TO 19:45 HOURS ON 12/6/89

REDUCED INPUT VARIABLES

| TIME (HR) | ABS. PRES (PSIA) | VAP. PRES (PSI) | ABS. TEMP (°R) | DEWPOINT (°F) | MASS (LBM) |
|---|---|---|---|---|---|
| 0.000 | 56.165 | 0.1965 | 526.484 | 52.678 | 505007.13 |
| 0.250 | 56.160 | 0.1974 | 526.471 | 52.798 | 504971.83 |
| 0.500 | 56.157 | 0.1964 | 526.434 | 52.660 | 504985.35 |
| 0.750 | 56.153 | 0.1974 | 526.389 | 52.809 | 504983.83 |
| 1.000 | 56.149 | 0.1958 | 526.364 | 52.586 | 504986.51 |
| 1.250 | 56.146 | 0.1964 | 526.340 | 52.659 | 504973.63 |
| 1.500 | 56.143 | 0.1954 | 526.298 | 52.526 | 504996.37 |
| 1.750 | 56.140 | 0.1952 | 526.266 | 52.504 | 505001.93 |
| 2.000 | 56.137 | 0.1954 | 526.253 | 52.528 | 504985.85 |
| 2.250 | 56.134 | 0.1965 | 526.240 | 52.677 | 504962.55 |
| 2.500 | 56.131 | 0.1967 | 526.228 | 52.701 | 504949.92 |
| 2.750 | 56.129 | 0.1957 | 526.202 | 52.572 | 504961.22 |
| 3.000 | 56.126 | 0.1954 | 526.171 | 52.527 | 504971.56 |
| 3.250 | 56.125 | 0.1955 | 526.168 | 52.535 | 504956.19 |
| 3.500 | 56.122 | 0.1964 | 526.156 | 52.661 | 504933.44 |
| 3.750 | 56.120 | 0.1950 | 526.144 | 52.469 | 504938.86 |
| 4.000 | 56.118 | 0.1949 | 526.109 | 52.454 | 504955.68 |
| 4.250 | 56.116 | 0.1947 | 526.090 | 52.424 | 504958.78 |
| 4.500 | 56.114 | 0.1944 | 526.084 | 52.393 | 504948.89 |
| 4.750 | 56.113 | 0.1950 | 526.067 | 52.474 | 504950.54 |
| 5.000 | 56.110 | 0.1948 | 526.049 | 52.448 | 504943.55 |
| 5.250 | 56.108 | 0.1931 | 526.035 | 52.208 | 504954.17 |
| 5.500 | 56.106 | 0.1942 | 526.036 | 52.353 | 504931.21 |
| 5.750 | 56.104 | 0.1937 | 526.022 | 52.286 | 504925.95 |
| 6.000 | 56.103 | 0.1942 | 526.020 | 52.361 | 504914.61 |
| 6.250 | 56.102 | 0.1946 | 525.997 | 52.408 | 504925.08 |

ATTACHMENT 3.3A (continued)

INTEGRATED LEAKAGE RATE TEST

FROM 19:45 HOURS ON 12/5/89 TO 19:45 HOURS ON 12/6/89

REDUCED INPUT VARIABLES

| TIME (HR) | ABS. PRES (PSIA) | VAP. PRES (PSI) | ABS. TEMP (°R) | DEWPOINT (°F) | MASS (LBM) |
|---|---|---|---|---|---|
| 6.500 | 56.100 | 0.1944 | 525.976 | 52.389 | 504932.93 |
| 6.750 | 56.099 | 0.1940 | 525.986 | 52.335 | 504913.07 |
| 7.000 | 56.098 | 0.1942 | 525.956 | 52.359 | 504926.99 |
| 7.250 | 56.097 | 0.1938 | 525.956 | 52.296 | 504922.78 |
| 7.500 | 56.096 | 0.1948 | 525.928 | 52.439 | 504931.26 |
| 7.750 | 56.094 | 0.1945 | 525.925 | 52.396 | 504923.84 |
| 8.000 | 56.093 | 0.1932 | 525.925 | 52.219 | 504922.18 |
| 8.250 | 56.091 | 0.1924 | 525.897 | 52.099 | 504942.94 |
| 8.500 | 56.091 | 0.1923 | 525.890 | 52.090 | 504945.49 |
| 8.750 | 56.090 | 0.1935 | 525.895 | 52.261 | 504921.07 |
| 9.000 | 56.089 | 0.1928 | 525.909 | 52.162 | 504909.57 |
| 9.250 | 56.088 | 0.1926 | 525.891 | 52.132 | 504919.91 |
| 9.500 | 56.088 | 0.1925 | 525.898 | 52.116 | 504909.64 |
| 9.750 | 56.087 | 0.1939 | 525.884 | 52.317 | 504901.70 |
| 10.000 | 56.086 | 0.1935 | 525.857 | 52.266 | 504921.66 |
| 10.250 | 56.084 | 0.1937 | 525.868 | 52.289 | 504896.36 |
| 10.500 | 56.083 | 0.1933 | 525.845 | 52.239 | 504912.82 |
| 10.750 | 56.083 | 0.1943 | 525.864 | 52.380 | 504881.15 |
| 11.000 | 56.081 | 0.1929 | 525.840 | 52.170 | 504904.72 |
| 11.250 | 56.080 | 0.1930 | 525.842 | 52.188 | 504892.66 |
| 11.500 | 56.079 | 0.1929 | 525.827 | 52.180 | 504894.10 |
| 11.750 | 56.078 | 0.1921 | 525.820 | 52.060 | 504899.89 |
| 12.000 | 56.077 | 0.1921 | 525.806 | 52.057 | 504904.42 |
| 12.250 | 56.076 | 0.1928 | 525.802 | 52.158 | 504892.82 |
| 12.500 | 56.075 | 0.1923 | 525.797 | 52.090 | 504893.41 |
| 12.750 | 56.073 | 0.1931 | 525.788 | 52.206 | 504880.85 |

ATTACHMENT 3.3A (continued)

INTEGRATED LEAKAGE RATE TEST

FROM 19:45 HOURS ON 12/5/89 TO 19:45 HOURS ON 12/6/89

REDUCED INPUT VARIABLES

| TIME (HR) | ABS. PRES (PSIA) | VAP. PRES (PSI) | ABS. TEMP (°R) | DEWPOINT (°F) | MASS (LBM) |
|---|---|---|---|---|---|
| 13.000 | 56.073 | 0.1910 | 525.771 | 51.903 | 504912.41 |
| 13.250 | 56.072 | 0.1914 | 525.770 | 51.968 | 504900.46 |
| 13.500 | 56.071 | 0.1916 | 525.767 | 51.988 | 504892.62 |
| 13.750 | 56.070 | 0.1916 | 525.748 | 51.987 | 504907.23 |
| 14.000 | 56.070 | 0.1931 | 525.754 | 52.206 | 504878.66 |
| 14.250 | 56.069 | 0.1914 | 525.742 | 51.970 | 504896.01 |
| 14.500 | 56.068 | 0.1920 | 525.730 | 52.054 | 504893.32 |
| 14.750 | 56.067 | 0.1925 | 525.728 | 52.118 | 504882.35 |
| 15.000 | 56.066 | 0.1925 | 525.737 | 52.115 | 504864.63 |
| 15.250 | 56.065 | 0.1917 | 525.723 | 52.007 | 504880.56 |
| 15.500 | 56.064 | 0.1919 | 525.718 | 52.032 | 504875.54 |
| 15.750 | 56.063 | 0.1925 | 525.701 | 52.117 | 504873.12 |
| 16.000 | 56.062 | 0.1915 | 525.692 | 51.976 | 504886.07 |
| 16.250 | 56.062 | 0.1928 | 525.692 | 52.156 | 504869.66 |
| 16.500 | 56.061 | 0.1923 | 525.682 | 52.087 | 504874.81 |
| 16.750 | 56.060 | 0.1920 | 525.690 | 52.055 | 504860.56 |
| 17.000 | 56.059 | 0.1922 | 525.679 | 52.083 | 504864.97 |
| 17.250 | 56.059 | 0.1919 | 525.686 | 52.042 | 504856.39 |
| 17.500 | 56.058 | 0.1918 | 525.661 | 52.024 | 504872.35 |
| 17.750 | 56.057 | 0.1910 | 525.663 | 51.911 | 504873.80 |
| 18.000 | 56.057 | 0.1923 | 525.659 | 52.098 | 504860.72 |
| 18.250 | 56.056 | 0.1920 | 525.660 | 52.047 | 504854.11 |
| 18.500 | 56.055 | 0.1908 | 525.644 | 51.877 | 504876.53 |
| 18.750 | 56.055 | 0.1910 | 525.647 | 51.907 | 504867.34 |
| 19.000 | 56.054 | 0.1906 | 525.633 | 51.848 | 504875.60 |
| 19.250 | 56.053 | 0.1914 | 525.637 | 51.965 | 504840.34 |

ATTACHMENT 3.3A (continued)

INTEGRATED LEAKAGE RATE TEST

FROM 19:45 HOURS ON 12/5/89 TO 19:45 HOURS ON 12/6/89

REDUCED INPUT VARIABLES

| TIME (HR) | ABS. PRES (PSIA) | VAP. PRES (PSI) | ABS. TEMP (°R) | DEWPOINT (°F) | MASS (LBM) |
|---|---|---|---|---|---|
| 19.500 | 56.053 | 0.1918 | 525.634 | 52.028 | 504854.25 |
| 19.750 | 56.052 | 0.1904 | 525.620 | 51.828 | 504871.36 |
| 20.000 | 56.051 | 0.1911 | 525.623 | 51.921 | 504857.92 |
| 20.250 | 56.051 | 0.1900 | 525.631 | 51.764 | 504855.75 |
| 20.500 | 56.050 | 0.1910 | 525.617 | 51.910 | 504851.04 |
| 20.750 | 56.049 | 0.1913 | 525.604 | 51.947 | 504856.72 |
| 21.000 | 56.049 | 0.1920 | 525.596 | 52.048 | 504853.43 |
| 21.250 | 56.048 | 0.1925 | 525.600 | 52.118 | 504840.63 |
| 21.500 | 56.048 | 0.1920 | 525.592 | 52.048 | 504848.76 |
| 22.750 | 56.047 | 0.1906 | 525.606 | 51.852 | 504843.15 |
| 22.000 | 56.046 | 0.1909 | 525.603 | 51.897 | 504834.01 |
| 22.250 | 56.046 | 0.1922 | 525.584 | 52.083 | 504840.61 |
| 22.500 | 56.046 | 0.1915 | 525.597 | 51.978 | 504834.70 |
| 22.750 | 56.046 | 0.1926 | 525.598 | 52.130 | 504819.97 |
| 23.000 | 56.045 | 0.1907 | 525.570 | 51.865 | 504854.74 |
| 23.250 | 56.045 | 0.1912 | 525.576 | 51.934 | 504844.93 |
| 23.500 | 56.044 | 0.1905 | 525.570 | 51.837 | 5048[illegible].25 |
| 23.750 | 56.044 | 0.1909 | 525.558 | 51.891 | 504855.43 |
| 24.000 | 56.043 | 0.1923 | 525.567 | 52.095 | 504825.07 |

ATTACHMENT 3.3B

INTEGRATED LEAKAGE RATE TEST

FROM 19:45 HOURS ON 12/05/89 TO 19:45 HOURS ON 12/06/89

ABSOLUTE TEST METHOD, MASS POINT ANALYSIS TEST RESULTS

| TIME (HR) | MASS (LBM) | LEAKAGE (PCT/DAY) | CONFIDENCE (PCT/DAY) | UCL (PCT/DAY) |
|---|---|---|---|---|
| 0.000 | 505007.13 | 0.000000 | 0.000000 | 0.000000 |
| 0.250 | 504971.83 | 0.000000 | 0.000000 | 0.000000 |
| 0.500 | 504985.35 | 0.206992 | 2.292464 | 2.499456 |
| 0.750 | 504983.83 | 0.107199 | 0.391202 | 0.498401 |
| 1.000 | 504986.51 | 0.055601 | 0.193882 | 0.249483 |
| 1.250 | 504973.63 | 0.067888 | 0.115909 | 0.183797 |
| 1.500 | 504996.37 | 0.018689 | 0.096320 | 0.115009 |
| 1.750 | 505001.93 | -0.012178 | 0.077412 | 0.065233 |
| 2.000 | 504985.85 | -0.005392 | 0.058933 | 0.053541 |
| 2.250 | 504962.55 | 0.022522 | 0.055021 | 0.077543 |
| 2.500 | 504949.92 | 0.047631 | 0.051647 | 0.099278 |
| 2.750 | 504961.22 | 0.052028 | 0.042737 | 0.094766 |
| 3.000 | 504971.56 | 0.046490 | 0.036247 | 0.082737 |
| 3.250 | 504956.19 | 0.050028 | 0.031019 | 0.081047 |
| 3.500 | 504933.44 | 0.061889 | 0.029318 | 0.091207 |
| 3.750 | 504938.86 | 0.066186 | 0.025870 | 0.092056 |
| 4.000 | 504955.68 | 0.061570 | 0.023184 | 0.084754 |
| 4.250 | 504958.78 | 0.056216 | 0.021213 | 0.077429 |
| 4.500 | 504948.89 | 0.054464 | 0.018987 | 0.073451 |
| 4.750 | 504950.54 | 0.051961 | 0.017213 | 0.069173 |
| 5.000 | 504943.55 | 0.051158 | 0.015546 | 0.066704 |
| 5.250 | 504954.17 | 0.047555 | 0.014543 | 0.062097 |
| 5.500 | 504931.21 | 0.049041 | 0.013327 | 0.062369 |
| 5.750 | 504925.95 | 0.050696 | 0.012299 | 0.062995 |
| 6.000 | 504914.61 | 0.053506 | 0.011629 | 0.065135 |
| 6.250 | 504925.08 | 0.053556 | 0.010715 | 0.064270 |
| 6.500 | 504932.93 | 0.051986 | 0.010024 | 0.062010 |

ATTACHMENT 3.3B (continued)

INTEGRATED LEAKAGE RATE TEST

FROM 19:45 HOURS ON 12/05/89 TO 19:45 HOURS ON 12/06/89

ABSOLUTE TEST METHOD - MASS POINT ANALYSIS TEST RESULTS

| TIME (HR) | MASS (LBM) | LEAKAGE (PCT/DAY) | CONFIDENCE (PCT/DAY) | UCL (PCT/DAY) |
|---|---|---|---|---|
| 6.750 | 504913.07 | 0.053136 | 0.009362 | 0.062498 |
| 7.000 | 504926.99 | 0.051872 | 0.008792 | 0.060664 |
| 7.250 | 504922.78 | 0.051026 | 0.008237 | 0.059263 |
| 7.500 | 504931.26 | 0.049050 | 0.007936 | 0.056986 |
| 7.750 | 504923.84 | 0.047945 | 0.007510 | 0.055455 |
| 8.000 | 504922.18 | 0.046942 | 0.007115 | 0.054057 |
| 8.250 | 504942.94 | 0.043878 | 0.007330 | 0.051209 |
| 8.500 | 504945.49 | 0.040871 | 0.007504 | 0.048375 |
| 8.750 | 504921.07 | 0.040246 | 0.007107 | 0.047353 |
| 9.000 | 504909.57 | 0.040477 | 0.006721 | 0.047198 |
| 9.250 | 504919.91 | 0.039714 | 0.006406 | 0.046120 |
| 9.500 | 504909.64 | 0.039661 | 0.006073 | 0.045733 |
| 9.750 | 504901.70 | 0.040022 | 0.005776 | 0.045798 |
| 10.000 | 504921.66 | 0.038871 | 0.005603 | 0.044475 |
| 10.250 | 504896.36 | 0.039347 | 0.005353 | 0.044700 |
| 10.500 | 504912.82 | 0.038642 | 0.005147 | 0.043788 |
| 10.750 | 504881.15 | 0.039735 | 0.005024 | 0.044759 |
| 11.000 | 504904.72 | 0.039276 | 0.004818 | 0.044094 |
| 11.250 | 504892.66 | 0.039401 | 0.004608 | 0.044009 |
| 11.500 | 504894.10 | 0.039333 | 0.004410 | 0.043743 |
| 11.750 | 504899.89 | 0.038892 | 0.004246 | 0.043138 |
| 12.000 | 504904.42 | 0.038197 | 0.004126 | 0.042323 |
| 12.250 | 504892.82 | 0.038011 | 0.003964 | 0.041975 |
| 12.500 | 504893.41 | 0.037735 | 0.003816 | 0.041551 |
| 12.750 | 504880.85 | 0.037927 | 0.003672 | 0.041599 |
| 13.000 | 504912.41 | 0.036761 | 0.003708 | 0.040469 |

ATTACHMENT 3.3B (continued)

INTEGRATED LEAKAGE RATE TEST

FROM 19:45 HOURS ON 12/05/89 TO 19:45 HOURS ON 12/06/89

ABSOLUTE TEST METHOD - MASS POINT ANALYSIS TEST RESULTS

| TIME (HR) | MASS (LBM) | LEAKAGE (PCT/DAY) | CONFIDENCE (PCT/DAY) | UCL (PCT/DAY) |
|---|---|---|---|---|
| 13.250 | 504900.46 | 0.036104 | 0.003626 | 0.039729 |
| 13.500 | 504892.62 | 0.035736 | 0.003511 | 0.039247 |
| 13.750 | 504907.23 | 0.034818 | 0.003499 | 0.038316 |
| 14.000 | 504878.66 | 0.034915 | 0.003376 | 0.038290 |
| 14.250 | 504896.01 | 0.034362 | 0.003302 | 0.037664 |
| 14.500 | 504893.32 | 0.033893 | 0.003221 | 0.037114 |
| 14.750 | 504882.35 | 0.033755 | 0.003116 | 0.036871 |
| 15.000 | 504864.63 | 0.034112 | 0.003032 | 0.037144 |
| 15.250 | 504880.56 | 0.033917 | 0.002939 | 0.036856 |
| 15.500 | 504875.54 | 0.033832 | 0.002847 | 0.036678 |
| 15.750 | 504873.12 | 0.033772 | 0.002758 | 0.036529 |
| 16.000 | 504886.07 | 0.033326 | 0.002706 | 0.036032 |
| 16.250 | 504869.66 | 0.033297 | 0.002624 | 0.035921 |
| 16.500 | 504874.81 | 0.033098 | 0.002552 | 0.035650 |
| 16.750 | 504860.56 | 0.033220 | 0.002479 | 0.035699 |
| 17.000 | 504864.97 | 0.033187 | 0.002407 | 0.035594 |
| 17.250 | 504856.39 | 0.033313 | 0.002341 | 0.035654 |
| 17.500 | 504872.35 | 0.033033 | 0.002290 | 0.035324 |
| 17.750 | 504873.80 | 0.032707 | 0.002248 | 0.034956 |
| 18.000 | 504860.72 | 0.032647 | 0.002187 | 0.034834 |
| 18.250 | 504854.11 | 0.032693 | 0.002128 | 0.034821 |
| 18.500 | 504876.53 | 0.032251 | 0.002114 | 0.034365 |
| 18.750 | 504867.34 | 0.031990 | 0.002073 | 0.034063 |
| 19.000 | 504875.60 | 0.031559 | 0.002061 | 0.033621 |
| 19.250 | 504840.34 | 0.031783 | 0.002019 | 0.033803 |
| 19.500 | 504854.25 | 0.031709 | 0.001969 | 0.033679 |
| 19.750 | 504871.36 | 0.031310 | 0.001958 | 0.033268 |

ATTACHMENT 3.3B (continued)

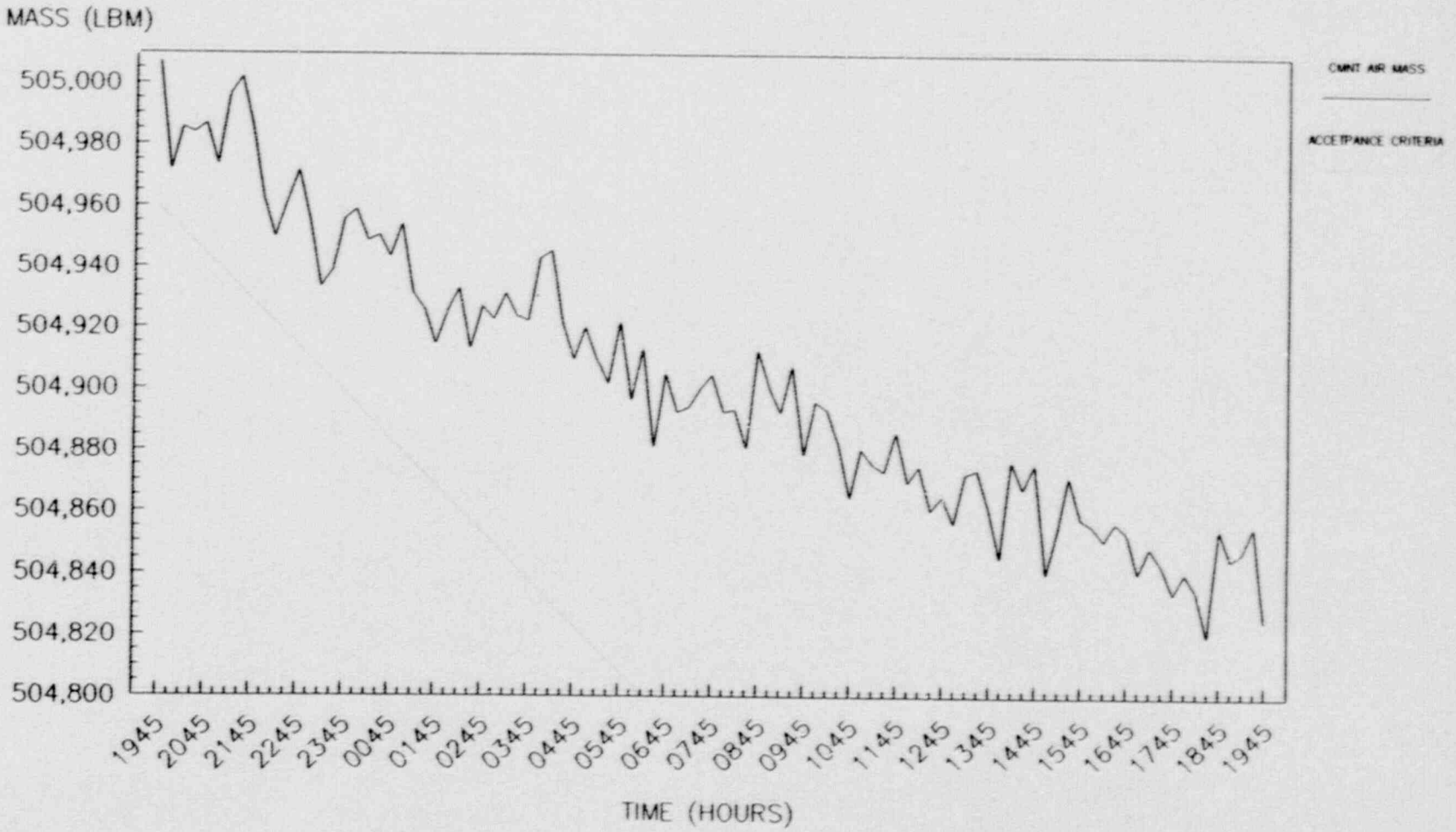
INTEGRATED LEAKAGE RATE TEST

FROM 19:45 HOURS ON 12/05/89 TO 19:45 HOURS ON 12/06/89

ABSOLUTE TEST METHOD - MASS POINT ANALYSIS TEST RESULTS

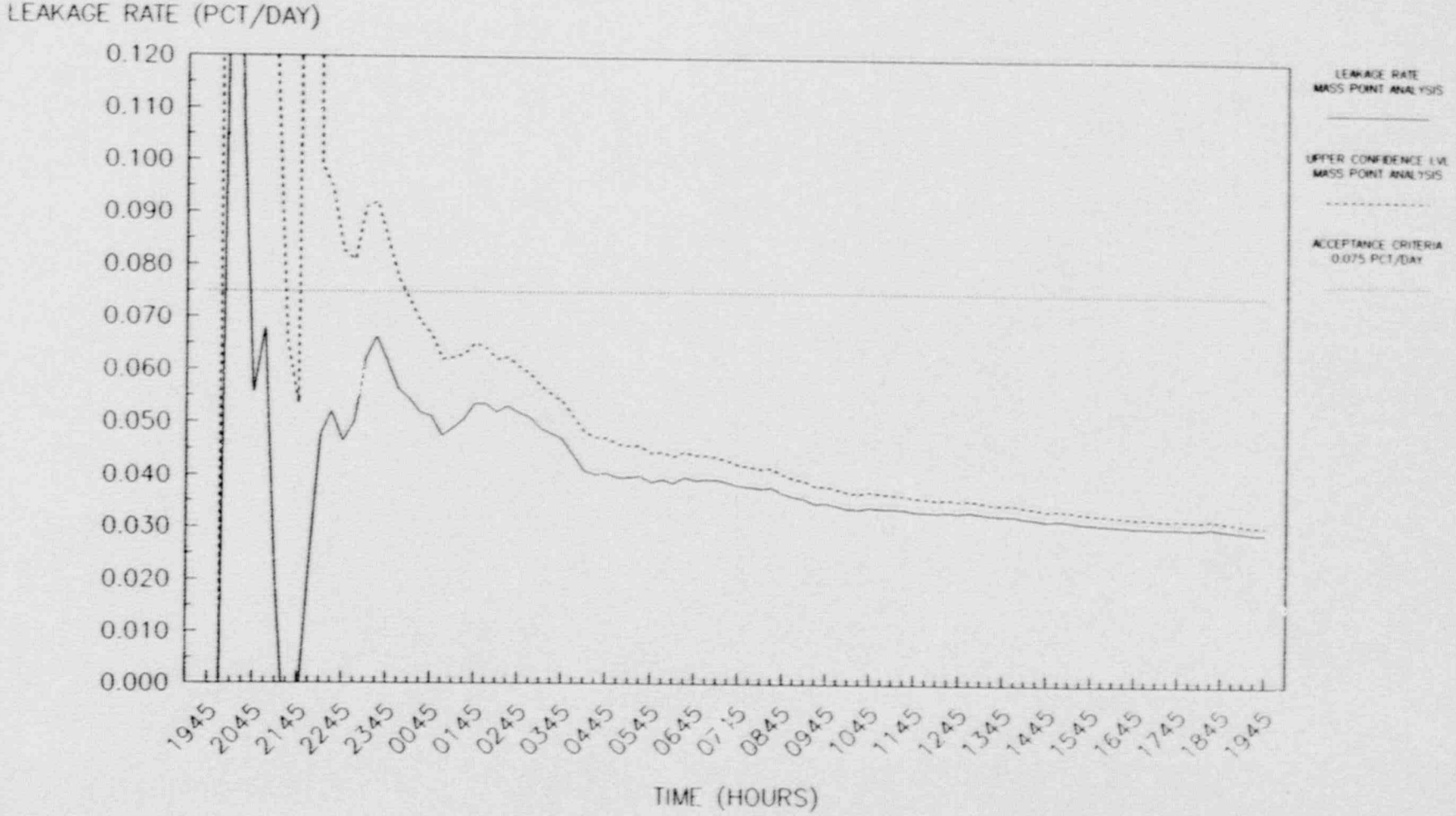
| TIME (HR) | MASS (LBM) | LEAKAGE (PCT/DAY) | CONFIDENCE (PCT/DAY) | UCL (PCT/DAY) |
|---|---|---|---|---|
| 20.000 | 504857.92 | 0.031142 | 0.001916 | 0.033058 |
| 20.250 | 504855.75 | 0.030996 | 0.001874 | 0.032870 |
| 20.500 | 504851.04 | 0.030910 | 0.001831 | 0.032740 |
| 20.750 | 504856.72 | 0.030713 | 0.001797 | 0.032510 |
| 21.000 | 504853.43 | 0.030556 | 0.001761 | 0.032317 |
| 21.250 | 504840.63 | 0.030580 | 0.001720 | 0.032300 |
| 21.500 | 504848.76 | 0.030458 | 0.001684 | 0.032142 |
| 21.750 | 504843.15 | 0.030402 | 0.001646 | 0.032048 |
| 22.000 | 504834.01 | 0.030457 | 0.001610 | 0.032067 |
| 22.250 | 504840.61 | 0.030394 | 0.001575 | 0.031969 |
| 22.500 | 504834.70 | 0.030394 | 0.001540 | 0.031935 |
| 22.750 | 504819.97 | 0.030569 | 0.001516 | 0.032085 |
| 23.000 | 504854.74 | 0.030259 | 0.001513 | 0.031772 |
| 23.250 | 504844.93 | 0.030073 | 0.001491 | 0.031564 |
| 23.500 | 504847.25 | 0.029849 | 0.001475 | 0.031325 |
| 23.750 | 504855.43 | 0.029520 | 0.001479 | 0.030999 |
| 24.000 | 504825.07 | 0.029556 | 0.001448 | 0.031005 |

BEAVER VALLEY POWER STATION UNIT NO. 1
INTEGRATED LEAKAGE RATE TEST
ATTACHMENT 3.3C – CNMT AIR MASS vs TIME




12/5/89 @ 1945 TO 12/6/89 @ 1945

BEAVER VALLEY POWER STATION UNIT NO. 1
INTEGRATED LEAKAGE RATE TEST
ATTACHMENT 3.3D – CNMT LEAKAGE RATE vs TIME




12/5/89 @ 1945 TO 12/6/89 @ 1945

ATTACHMENT 3.3E

SUPERIMPOSED LEAKAGE VERIFICATION TEST

FROM 20:45 HOURS ON 12/6/89 TO 00:45 HOURS ON 12/7/89

REDUCED INPUT VARIABLES

| TIME (HR) | ABS. PRES (PSIA) | VAP. PRES (PSI) | ABS. TEMP (°R) | DEWPOINT (°F) | MASS (LBM) |
|---|---|---|---|---|---|
| 0.000 | 56.040 | 0.1912 | 525.562 | 51.936 | 504813.91 |
| 0.250 | 56.039 | 0.1898 | 525.549 | 51.743 | 504829.46 |
| 0.500 | 56.039 | 0.1914 | 525.549 | 51.970 | 504810.22 |
| 0.750 | 56.038 | 0.1914 | 525.546 | 51.970 | 504804.55 |
| 1.000 | 56.037 | 0.1900 | 525.536 | 51.766 | 504818.16 |
| 1.250 | 56.036 | 0.1914 | 525.548 | 51.958 | 504785.85 |
| 1.500 | 56.034 | 0.1907 | 525.540 | 51.859 | 504786.29 |
| 1.750 | 56.034 | 0.1917 | 525.532 | 52.003 | 504785.14 |
| 2.000 | 56.033 | 0.1907 | 525.527 | 51.860 | 504790.29 |
| 2.250 | 56.032 | 0.1901 | 525.513 | 51.776 | 504794.83 |
| 2.500 | 56.030 | 0.1890 | 525.529 | 51.618 | 504776.19 |
| 2.750 | 56.030 | 0.1907 | 525.530 | 51.861 | 504760.67 |
| 3.000 | 56.029 | 0.1915 | 525.522 | 51.986 | 504751.01 |
| 3.250 | 56.029 | 0.1903 | 525.500 | 51.803 | 504779.74 |
| 3.500 | 56.028 | 0.1911 | 525.518 | 51.916 | 504746.51 |
| 3.750 | 56.027 | 0.1909 | 525.508 | 51.889 | 504752.53 |
| 4.000 | 56.023 | 0.1927 | 525.504 | 52.151 | 504700.07 |

ATTACHMENT 3.3F

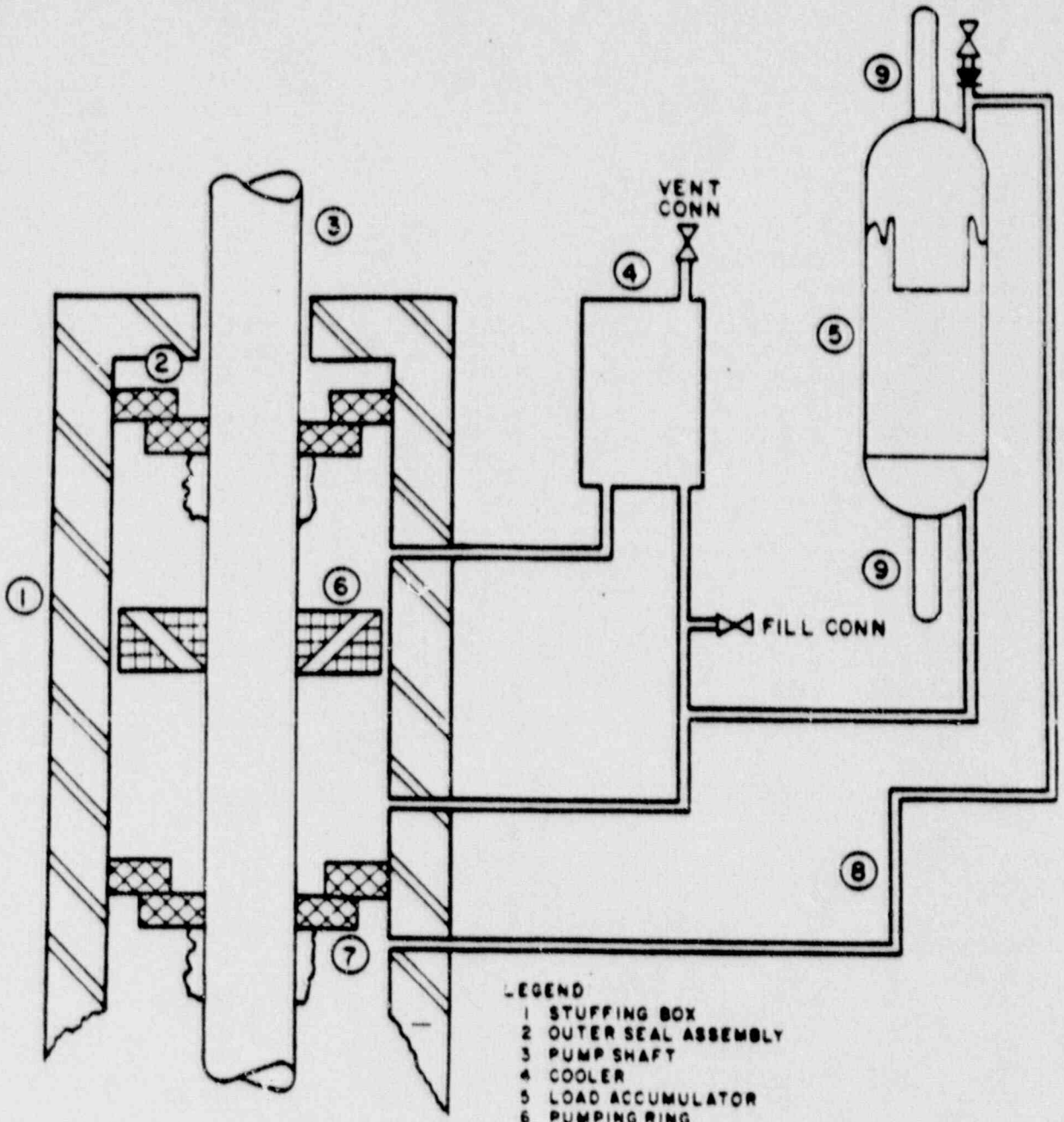
SUPERIMPOSED LEAKAGE VERIFICATION TEST

FROM 20:45 HOURS ON 12/6/89 TO 00:45 HOURS ON 12/7/89

ABSOLUTE TEST METHOD - MASS POINT ANALYSIS TEST RESULTS

| TIME (HR) | MASS (LBM) | LEAKAGE (PCT/DAY) | CONFIDENCE (PCT/DAY) | UCL (PCT/DAY) |
|---|---|---|---|---|
| 0.000 | 504813.91 | 0.000000 | 0.000000 | 0.000000 |
| 0.250 | 504829.46 | 0.000000 | 0.000000 | 0.000000 |
| 0.500 | 504810.22 | 0.035063 | 1.633559 | 1.668622 |
| 0.750 | 504804.55 | 0.090010 | 0.268006 | 0.358016 |
| 1.000 | 504818.16 | 0.031212 | 0.147385 | 0.178597 |
| 1.250 | 504785.85 | 0.097730 | 0.119725 | 0.217455 |
| 1.500 | 504786.29 | 0.110115 | 0.081306 | 0.191421 |
| 1.750 | 504785.14 | 0.107924 | 0.058493 | 0.166418 |
| 2.000 | 504790.29 | 0.093179 | 0.047029 | 0.140208 |
| 2.250 | 504794.83 | 0.075886 | 0.041239 | 0.117125 |
| 2.500 | 504776.19 | 0.079114 | 0.033368 | 0.112482 |
| 2.750 | 504760.67 | 0.089286 | 0.029443 | 0.118729 |
| 3.000 | 504751.01 | 0.098544 | 0.026459 | 0.125002 |
| 3.250 | 504779.74 | 0.085936 | 0.025960 | 0.111897 |
| 3.500 | 504746.51 | 0.091392 | 0.023025 | 0.114417 |
| 3.750 | 504752.53 | 0.090501 | 0.020046 | 0.110547 |
| 4.000 | 504700.07 | 0.107675 | 0.024734 | 0.132410 |

ATTACHMENT 3.3G




LEGEND
1 STUFFING BOX
2 OUTER SEAL ASSEMBLY
3 PUMP SHAFT
4 COOLER
5 LOAD ACCUMULATOR
6 PUMPING RING
7 INNER SEAL ASSEMBLY
8 CONNECTION TO PROCESS SIDE PRESSURE
9 LEVEL INDICATOR ALARM TO MAIN CONTROL ROOM

TANDEM MECHANICAL SEAL
ARRANGEMENT
FOR RECIRCULATION PUMPS

SECTION 4

LOCAL LEAKAGE RATE TESTS (TYPES B AND C)

Local Leak Rate Testing (LLRT) of containment penetrations is performed on a periodic basis (normally each refueling, but not exceeding 24 months), in accordance with 10 CFR 50 Appendix J and Beaver Valley Power Station #1 Technical Specifications. These LLRT's are performed by pressurizing the required penetrations with air or nitrogen and either measuring leakage across the containment isolation valves boundary (Type C), or across the resilient seals (Type B). The combined leakage rate of containment penetrations subject to LLRT's shall be less than 60 percent La, at a minimum test pressure of Pa.

Additionally LLRT's (Total Volume Type B) are performed for each containment airlock at 6 month intervals in accordance with 10 CFR 50 Appendix J, and Beaver Valley Power Station #1 Technical Specifications.

This attachments for this section are:

| Attachment No. | Title |
|---|---|
| 4.1A | Sixth Refueling (12/87 - 2/88) LLRT Data |
| 4.1B | Sixth Refueling (9/89 - 12/89) LLRT Repairs |
| 4.1C | Seventh Refueling (9/89 - 12/89) LLRT Data |
| 4.1D | Seventh Refueling (9/89 - 12/89) LLRT Repairs |
| 4.1E | Sixth and Seventh Fuel Cycle LLRT Data |

ATTACHMENT 4.1A (continued)
SIXTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 1 | MOV-CC-112A2 | X | | 01-23-88 | 0.46 | 0.47 | 0.56 |
| | CCR-247 | | X | 01-11-88 | 0.56 | 0.56 | |
| 2 | MOV-CC-112B3 | X | | 01-26-88 | 0.56 | 0.47 | 0.56 |
| | CCR-252 | | X | 01-08-88 | 561.3 | 0.56 | |
| 4 | MOV-CC-112A3 | X | | 01-25-88 | 3.10 | 8.37 | 179.8 |
| | CCR-251 | | X | 01-11-88 | 179.8 | 179.8 | |
| 5 | MOV-CC-112B2 | X | | 01-26-88 | 0.46 | 9.33 | 9.33 |
| | CCR-248 | | X | 01-06-88 | 7.87 | 7.87 | |
| 8 | TV-CC-107D1 | X | | 12-23-87 | 0.46 | 0.46 | 0.56 |
| | TV-CC-107D2 | | X | | 0.56 | 0.56 | |
| 9 | TV-CC-111D1 | X | | 12-16-87 | 8.75 | 8.75 | 8.75 |
| | TV-CC-111D2 | | X | | 3.46 | 3.46 | |
| 11 | TV-CC-110D | X | | 01-11-88 | 0.46 | 0.46 | 0.49 |
| | TV-CC-110F1 | | X | | 0.49 | 0.49 | |
| | TV-CC-110F2 | | X | | | | |
| 13 | FP-827 | X | | 01-07-88 | 0.46 | 0.46 | 0.47 |
| | TV-FP-107 | | X | 01-23-88 | 230.4 | 0.47 | |
| 14 | TV-CC-110E3 | X | | 01-08-88 | 0.46 | 0.46 | 0.46 |
| | TV-CC-110E2 | | X | | 0.46 | 0.46 | |
| 16 | TV-CC-111A2 | X | | 01-07-88 | 45.32 | 45.32 | 45.32 |
| | TV-CC-111A1 | | X | | 1.40 | 1.40 | |
| 17 | TV-CC-103B1 | X | | 01-11-88 | 0.74 | 0.74 | 11.18 |
| | TV-CC-103B | | X | | 11.18 | 11.18 | |
| TOTAL PENETRATION LEAKAGE SHEET 1 (SCF/D) | | | | | | | 257.48 |

ATTACHMENT 4.1A (continued)
SIXTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 18 | TV-CC-103C1 | X | | 01-20-88 | 7.46 | 7.46 | 62.21 |
| | TV-CC-103C | | X | | 62.21 | 62.21 | |
| 19 | MOV-CH-378 | X | | 12-22-87 | 24.09 | 24.09 | 24.09 |
| | CH-369 | X | | | | | |
| | MOV-CH-381 | | X | | 0.46 | 0.46 | |
| 20 | SI-42 | X | | 02-02-88 | 0.61 | 0.61 | 0.61 |
| | SI-41 | | X | | 0.46 | 0.46 | |
| 24 | RH-14 | X | | 01-14-88 | 0.85 | 0.85 | 1.60 |
| | RH-16 | X | | | 0.75 | 0.75 | |
| | RH-15 | | X | | 0.75 | 0.75 | |
| 25 | TV-CC-105D1 | X | | 12-16-87 | 11.95 | 11.95 | 11.95 |
| | TV-CC-105D2 | | X | | 6.69 | 6.69 | |
| 26 | TV-CC-107E1 | X | | 12-24-87 | 69.57 | 69.57 | 69.57 |
| | TV-CC-107E2 | | X | | 0.56 | 0.56 | |
| 27 | TV-CC-105E1 | X | | 01-21-88 | 193.5 | 31.69 | 31.69 |
| | TV-CC-105E2 | | X | 01-11-88 | 15.66 | 15.66 | |
| 28 | TV-CH-200A | X | | 01-05-88 | 0.75 | 0.75 | 54.43 |
| | TV-CH-200B | X | | | | | |
| | TV-CH-200C | X | | | | | |
| | RV-CH-203 | X | | | 2.38 | 2.38 | |
| | MOV-CH-142 | X | | | 51.30 | 51.30 | |
| | TV-CH-204 | | X | | 1.91 | 1.91 | |
| TOTAL PENETRATION LEAKAGE SHEET 2 (SCF/D) | | | | | | | 256.15 |

ATTACHMENT 4.1A (continued)
SIXTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 29 | TV-DG-108A | X | | 01-16-88 | 11.67 | 11.67 | 11.67 |
| | TV-DG-108B | | X | | 9.80 | 9.80 | |
| 31 | FP-804 | X | | 12-21-87 | 0.46 | 0.46 | 4.39 |
| | TV-FP-105 | | X | | 4.39 | 4.39 | |
| 32 | FP-800 | X | | 12-19-87 | 0.46 | 0.46 | 19.91 |
| | TV-FP-106 | | X | 12-21-87 | 19.91 | 19.91 | |
| 38 | TV-DA-100A | X | | 01-23-88 | 168.9 | 83.88 | 83.88 |
| | TV-DA-100B | | X | | 304.9 | 24.23 | |
| 42 | SA-15 | X | | 12-16-87 | 1.87 | 1.87 | 1.87 |
| | SA-14 | | X | | 1.12 | 1.12 | |
| 43 | TV-CV-102-1 | X | | 02-01-88 | 238.1 | 6.03 | 6.03 |
| | TV-CV-102 | | X | 12-15-87 | 0.46 | 0.46 | |
| 44 | TV-CV-101A | X | | 12-17-87 | 69.63 | 6.94 | 6.94 |
| | TV-CV-101B | | X | | 64.99 | 3.89 | |
| 45 | RC-72 | X | | 12-18-87 | 10.64 | 10.64 | 10.64 |
| | TV-RC-519 | | X | | 1.25 | 1.25 | |
| 47 | IA-91 | X | | 12-15-87 | 28.41 | 28.41 | 28.41 |
| | IA-90 | | X | | 11.90 | 11.90 | |
| 48 | TV-DG-109A2 | X | | 12-22-87 | 0.46 | 0.46 | 2.78 |
| | TV-DG-109A1 | | X | | 2.78 | 2.78 | |
| 49 | RC-68 | X | | 12-18-87 | 41.01 | 41.01 | 41.01 |
| | TV-RC-101 | | X | | 3.59 | 3.59 | |
| TOTAL PENETRATION LEAKAGE SHEET 3 (SCF/D) | | | | | | | 217.53 |

ATTACHMENT 4.1A (continued)
SIXTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 53 | TV-SI-101-2 | X | | 01-18-88 | 11.37 | 11.37 | 11.37 |
| | TV-SI-101-1 | | X | | 6.64 | 6.64 | |
| 55-1 | TV-SS-109A1 | X | | 12-22-87 | 0.46 | 0.46 | 0.46 |
| | TV-SS-109A2 | | X | | 0.46 | 0.46 | |
| 55-2 NOTE 1 | TV-LM-100A1 | | X | 12-14-87 | 0.46 | 0.46 | 0.46 |
| | TV-LM-100A2 | | X | | 0.46 | 0.46 | |
| 55-4 | TV-SS-111A1 | X | | 12-22-87 | 0.46 | 0.46 | 0.46 |
| | TV-SS-111A2 | | X | | 0.46 | 0.46 | |
| 56-1 | TV-SS-100A1 | X | | 12-22-87 | 0.46 | 0.46 | 0.46 |
| | TV-SS-100A2 | | X | | 0.46 | 0.46 | |
| 56-2 | TV-SS-102A1 | X | | 01-27-88 | 0.47 | 0.47 | 0.47 |
| | TV-SS-102A2 | | X | | 0.47 | 0.47 | |
| 56-3 | TV-SS-105A1 | X | | 01-27-88 | 0.47 | 0.47 | 0.47 |
| | TV-SS-105A2 | | X | | 0.47 | 0.47 | |
| 57-3 | TV-LM-101A | X | | 12-18-87 | 9.72 | 9.72 | 9.72 |
| | CV-35 | | X | | 9.72 | 9.72 | |
| 57-4 | TV-LM-101B | X | | 12-18-87 | 4.07 | 4.07 | 4.07 |
| | CV-36 | | X | | 3.94 | 3.94 | |
| 58 | TV-CC-103A1 | X | | 01-15-88 | 0.75 | 0.75 | 2.17 |
| | TV-CC-103A | | X | | 2.17 | 2.17 | |
| 63 | QS-4 | X | | 01-13-88 | 0.75 | 0.75 | 0.75 |
| | MOV-QS-101B | | X | | 0.75 | 0.75 | |
| TOTAL PENETRATION LEAKAGE SHEET 4 (SCF/D) | | | | | | | 30.86 |

NOTE 1 - INCLUDES PENETRATIONS 57-1,57-2, AND 97-3 WHICH ALSO SHARE THESE CNMT ISOLATION VALVES THROUGH A COMMON 4-WAY VALVE.

ATTACHMENT 4.1A (continued)
SIXTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 64 | QS-3 | X | | 01-13-88 | 32.59 | 32.59 | 42.49 |
| | MOV-QS-101A | | X | | 42.49 | 42.49 | |
| 70 | RS-101 | X | | 01-21-88 | 18.66 | 18.66 | 18.66 |
| 71 | RS-100 | X | | 12-23-87 | 5.57 | 5.57 | 5.57 |
| 87 | HY-197 | | X | 01-15-88 | 1.55 | 1.55 | 1.92 |
| | HY-111 | | X | | 1.92 | 1.92 | |
| 88 | HY-196 | | X | 01-15-88 | 17.14 | 8.44 | 8.44 |
| | HY-110 | | X | | 0.47 | 1.92 | |
| 89 | AS-278 | X | | 12-19-87 | 10.16 | 10.16 | 10.16 |
| | TV-SV-100A | | X | | 4.16 | 4.16 | |
| 90 | VS-D-5-3B | X | | 02-08-88 | 370.7 | 0.46 | 0.46 |
| | VS-D-5-3A | | X | | | | |
| 91 | VS-D-5-5B | X | | 01-27-88 | 176.1 | 1.25 | 1.25 |
| | VS-D-5-5A | | X | | | | |
| | VS-D-5-6 | | X | | | | |
| 92 | TV-CV-150C & HY-102 | X | | 01-14-88 | 6.56 | 6.56 | 17.81 |
| | TV-VC-150D & HY-104 | X | | | 17.81 | 17.81 | |
| 93 | TV-CV-150B & HY-101 | X | | 01-14-88 | 0.75 | 0.75 | 2.16 |
| | TV-CV-150A & HY-103 | X | | | 2.16 | 2.16 | |
| TOTAL PENETRATION LEAKAGE SHEET 5 (SCF/D) | | | | | | | 108.92 |

ATTACHMENT 4.1A (continued)
SIXTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 94 | HCV-CV-151 | X | | 01-04-88 | 13.89 | 1.58 | 1.58 |
| | HCV-VC-151-1 | | X | | 0.46 | 0.46 | |
| 95-64 | SOV-HY-102B1 | X | | 12-19-87 | 0.46 | 0.46 | 0.46 |
| | SOV-HY-102B2 | | X | | 0.46 | 0.46 | |
| 95-69 | SOV-HY-103B1 | X | | 12-19-87 | 0.46 | 0.46 | 0.46 |
| | SOV-HY-103B2 | | X | | 0.46 | 0.46 | |
| 95-72 | SOV-HY-104B1 | X | | 12-19-87 | 0.46 | 0.46 | 0.46 |
| | SOV-HY-104B2 | | X | | 0.46 | 0.46 | |
| 97-1 | TV-SS-104A1 | X | | 01-15-88 | 0.75 | 0.75 | 0.75 |
| | TV-SS-104A2 | | X | | 0.75 | 0.75 | |
| 97-2 | TV-SS-103A1 | X | | 01-15-88 | 0.75 | 0.75 | 0.75 |
| | TV-SS-103A2 | | X | | 0.75 | 0.75 | |
| 103 | PC-38 | X | | 12-17-87 | 18.52 | 18.52 | 18.52 |
| | PC-37 | | X | | 10.18 | 10.18 | |
| 104 | PC-9 | X | | 12-17-87 | 0.46 | 0.46 | 0.46 |
| | PC-10 | | X | | 0.46 | 0.46 | |
| 105-2 | TV-SS-112A1 | X | | 01-15-88 | 13.90 | 0.75 | 4.69 |
| | TV-SS-112A2 | | X | | 4.64 | 4.69 | |
| 106 | MOV-SI-842 | X | | 12-19-87 | 0.46 | 0.46 | 0.46 |
| | TV-SI-889 | | X | | 0.46 | 0.46 | |
| 109-44 | SOV-HY-102A1 | X | | 12-19-87 | 0.46 | 0.46 | 0.46 |
| | SOV-HY-102A2 | | X | | 0.46 | 0.46 | |
| TOTAL PENETRATION LEAKAGE SHEET 6 (SCF/D) | | | | | | | 29.05 |

ATTACHMENT 4.1A (continued)
SIXTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 109-49 | SOV-HY-103A1 | X | | 12-19-87 | 0.46 | 0.46 | 0.46 |
| | SOV-HY-103A2 | | X | | 0.46 | 0.46 | |
| 109-52 | SOV-HY-104A1 | X | | 12-19-87 | 0.46 | 0.46 | 0.46 |
| | SOV-HY-104A2 | | X | | 0.46 | 0.46 | |
| 110-1 | RC-277 | | X | 01-15-88 | 0.46 | 0.46 | 0.46 |
| | RC-278 | | X | | 0.46 | 0.46 | |
| P.A.L. | VS-169 | X | | 01-15-88 | 0.75 | 0.75 | (NOTE 2) |
| | VS-170 | X | | | 0.75 | 0.75 | |
| | VS-167 | | X | | 0.75 | 0.75 | |
| | VS-168 | | X | | 0.75 | 0.75 | |
| TOTAL PENETRATION LEAKAGE SHEET 7 (SCF/D) | | | | | | | 1.38 |

NOTE 2 - THE ASSIGNED PENETRATION LEAKAGE FOR THESE VALVES IS ADDED WITH THE PERSONNEL AIRLOCK OVERALL TYPE B LEAKAGE, AND NOT INCLUDED IN THE TYPE C TOTAL. P.A.L. = PERSONNEL AIRLOCK

| | | |
|---|---|---|
| TOTAL PENETRATION LEAKAGE SHEET 1 | (SCF/D) | 257.48 |
| TOTAL PENETRATION LEAKAGE SHEET 2 | (SCF/D) | 256.15 |
| TOTAL PENETRATION LEAKAGE SHEET 3 | (SCF/D) | 217.53 |
| TOTAL PENETRATION LEAKAGE SHEET 4 | (SCF/D) | 30.86 |
| TOTAL PENETRATION LEAKAGE SHEET 5 | (SCF/D) | 108.92 |
| TOTAL PENETRATION LEAKAGE SHEET 6 | (SCF/D) | 29.05 |
| TOTAL PENETRATION LEAKAGE SHEET 7 | (SCF/D) | 1.38 |
| TOTAL CONTAINMENT TYPE C LEAKAGE - SUM OF SHEETS 1 THRU 7 | (SCF/D) | 901.37 |

ATTACHMENT 4.1A (continued)
SIXTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE B TESTS

| PENT NO | LEAKAGE O-RING SEAL / CANISTER (SCCM) | PENT NO | LEAKAGE O-RING SEAL / CANISTER (SCCM) |
|---|---|---|---|
| 1-B | 2.0 / 2.0 | 7-E | 2.0 / 2.0 |
| 1-D | 2.0 / 2.0 | 7-F | 2.0 / 2.0 |
| 1-F | 2.0/2.0 * / N/A | 7-G | N/A ** / 2.0 |
| 2-B | 2.0 / 2.0 | 8-A | 2.0 / 2.0 |
| 2-D | 2.0 / 2.0 | 8-B | 2.0 / 2.0 |
| 2-F | 2.0 / 2.0 | 8-C | 2.0 / 2.0 |
| 3-A | 2.0 / 2.0 | 8-D | 2.0 / 2.0 |
| 3-B | 2.0 / 2.0 | 8-E | 2.0 / 2.0 |
| 3-C | 2.0 / 2.0 | 8-F | 2.0/2.0 * / N/A |
| 3-D | 2.0 / 2.0 | 8-G | 2.0 / 2.0 |
| 3-E | 2.0 / 2.0 | 9-A | 2.0 / 2.0 |
| 3-F | 2.0 / 2.0 | 9-B | 2.0 / 2.0 |
| 3-G | 2.0/2.0 * / N/A | 9-C | 2.0 / 2.0 |
| 4-A | 2.0 / 2.0 | 9-D | 2.0 / 2.0 |
| 4-B | 2.0 / 2.0 | 9-E | 2.0 / 2.0 |
| 4-C | 2.0 / 2.0 | 9-F | 2.0 / 2.0 |
| 4-D | 2.0 / 2.0 | 9-G | 2.0 / 2.0 |
| 4-E | 2.0 / 2.0 | 10-A | 2.0 / 2.0 |
| 4-F | 2.0 / 2.0 | 10-B | 2.0 / 6.0 |
| 4-G | 2.0 / 2.0 | 10-C | 2.0 / 2.0 |
| 5-A | 2.0 / 2.0 | 10-D | 2.0 / 2.0 |
| 5-B | 2.0 / 2.0 | 10-E | 2.0 / 2.0 |
| 5-C | 2.0 / 2.0 | 10-F | 2.0 / 2.0 |
| 5-D | 2.0 / 2.0 | 10-G | 2.0 / 5.8 |
| 5-E | 2.0 / 2.0 | 11-A | 2.0 / 4.2 |
| 5-F | 2.0 / 2.0 | 11-B | 2.0 / 2.0 |
| 5-G | 2.0 / 2.0 | 11-C | 2.0/2.0 * / N/A |
| 6-A | 2.0 / 2.0 | 11-D | 2.0 / 2.0 |
| 6-B | 2.0/2.0 * / N/A | 11-E | 2.0 / 9.3 |
| 6-C | 2.0 / 2.0 | 11-F | 2.0 / 2.0 |
| 6-D | 2.0 / 2.0 | 11-G | 2.0 / 2.0 |
| 6-E | 2.0 / 2.0 | 12-A | 2.0 / 2.0 |
| 6-F | 2.0 / 2.0 | 12-B | 2.0 / 2.0 |
| 6-G | 2.0 / 2.0 | 12-C | 2.0 / 2.0 |
| 7-A | 2.0/3.2 * / N/A | 12-D | 2.0 / 2.0 |
| 7-B | 2.0 / 2.0 | 12-E | 2.0 / 4.2 |
| 7-C | 2.0 / 2.0 | 12-F | 2.0 / 2.0 |
| 7-D | 2.0 / 2.0 | 12-G | 2.0 / 2.0 |
| TOTALS SHT 1 | 85.2 / 68.0 | | 78.0 / 91.5 |

* SPARE PENETRATION INSIDE/OUTSIDE CONTAINMENT
** CONAX ELECTRICAL PENETRATION INSTALLED AT 6R, O-RINGS AND FEED THROUGHS TESTED SIMULTANEOUSLY

ATTACHMENT 4.1A (continued)
SIXTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE B TESTS

| PENT NO | LEAKAGE O-RING SEAL / CANISTER (SCCM) | PENT NO | LEAKAGE O-RING SEAL / CANISTER (SCCM) |
|---|---|---|---|
| 13-A | 2.0/2.0 * / N/A | 15-E | 2.0 / 2.0 |
| 13-B | N/A ** / 2.0 | 15-F | 2.0 / 2.0 |
| 13-C | 2.0 / 2.0 | 15-G | 2.0 / 2.0 |
| 13-D | 2.0/2.0 * / N/A | 16-A | 2.0 / 2.0 |
| 13-E | 2.0 / 2.0 | 16-B | 2.0 / 2.0 |
| 13-F | 2.0 / 5.9 | 16-C | 2.0 / 2.0 |
| 13-G | 2.0 / 2.0 | 16-D | 2.0 / 2.0 |
| 14-A | 2.0 / 2.0 | 16-E | 2.0 / 2.0 |
| 14-B | 2.0 / 2.0 | 16-F | 2.0 / 2.0 |
| 14-C | 2.0 / 2.0 | 16-G | 2.0/2.0 * / N/A |
| 14-D | 2.0 / 2.0 | 17-B | 2.0 / 2.0 |
| 14-E | 2.0 / 2.0 | 17-D | 2.0/2.0 * / N/A |
| 14-F | 2.0 / 2.0 | 17-F | 2.0/2.0 * / N/A |
| 14-G | 2.0 / 2.0 | 18-B | 2.0 / 2.0 |
| 15-A | 2.0 / 2.0 | 18-D | 2.0 / 2.0 |
| 15-B | 2.0 / 2.0 | 18-F | 2.0/2.0 * / N/A |
| 15-C | 2.0 / 2.0 | FB-1 | 2.0 / 2.0 |
| 15-D | 2.0 / 2.0 | | |
| TOTALS SHT 2 | 38.0 35.9 | | 42.0 26.0 |

* SPARE PENETRATION INSIDE/OUTSIDE CONTAINMENT
** CONAX ELECTRICAL PENETRATION INSTALLED AT 6R, O-RINGS AND FEED THROUGHS TESTED SIMULTANEOUSLY

| TOTALS | LEAKAGE O-RING SEAL / CANISTER (SCCM) |
|---|---|
| SHT 1 | 163.2 / 159.5 |
| SHT 2 | 80.0 / 61.9 |
| TOTAL LEAKAGE (SCCM) | 243.2 / 221.4 |
| TOTAL LEAKAGE (SCF/D) | 12.4 / 11.2 |

ATTACHMENT 4.1A (continued)
SIXTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE B TESTS

| PENETRATION | DATE TESTED | AS FOUND LEAKAGE (SCF/D) | AS LEFT LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE |
|---|---|---|---|---|
| Fuel Transfer Tube | 2-10-88 | 0.46 | 0.46 | 0.46 |
| Penetration #111 | 12-30-87 | 1.67 | 1.11 | 1.11 |
| Penetration #112 | 12-30-87 | 0.47 | 0.46 | 0.46 |
| Equipment Hatch Outer Flange | 2-16-88 | 0.46 | 0.46 | 0.46 |
| Equipment Hatch Inner Flange | 2-17-88 | 0.46 | 0.48 | 0.48 |
| Personnel Airlock | 1-12-88 | 4.98 | 3.46 | 3.46 |
| Equipment Hatch Airlock | 2-17-88 | 0.46 | 0.47 | 0.47 |

Summary of Type B and C Leakage Rates

| | As Left # | As Found ## |
|---|---|---|
| Total Type B Leakage | 30.50 SCF/D | 39.22 SCF/D |
| Total Type C Leakage | 901.37 SCF/D | 679.34 SCF/D |
| Total Type B and C Leakage * | 931.87 SCF/D | 718.56 SCF/D |

* Acceptance Criteria < 60% La [< 3,893 SCF/D[1]]

# Maximum pathway leakage rate.
## Minimum pathway leakage rate.

[1]Pa = 38.3 PSIG.

ATTACHMENT 4.1B

SIXTH REFUELING LOCAL LEAKAGE RATE TEST REPAIRS

Type B Repairs

The following electrical penetrations required maintenance due to high leak rates, or physical damage:

| PENT NO. | MWR NO. | AS FOUND LEAKAGE (SCCM) | AS LEFT LEAKAGE (SCCM) |
|---|---|---|---|
| 4-D Canister | 875278 | 65.0 | 2.0 |
| 10-B Canister | 875281 | 37.5 | 7.5 |
| 10-C Canister | 875282 | 11.2 | 2.0 |
| 10-G Canister | 875265 | 18.5 | 5.8 |
| 12-E Canister | 875277 | 2.0 | 4.2 |
| 13-F Canister | 875276 | 8.1 | 5.9 |
| 15-E Canister | 875275 | 8.3 | 2.0 |

The high leak rate on the 4-D penetration was due to a leaking canister pressure gauge. The gauge was replaced, and the canister was satisfactorily retested.

The high leak rate on the 10-B penetration was due to a tubing leak near the canister test isolation valve. The tubing was repaired with high shear strength adhesive, and the canister was satisfactorily retested.

The high leak rate on the 10-C penetration was due to a tubing leak near the canister test isolation valve. The tubing was repaired with high shear strength adhesive, and the canister was satisfactorily retested.

Type B Repairs (continued)

The high leak rate on the 10-G penetration was due to a tubing leak where its connects to the canister test isolation valve. The connection was repaired with high shear strength adhesive, and the canister was satisfactorily retested.

The canister pressure gauge and test isolation valve assembly for 12-E penetration was accidently broken off during work in the penetration area. The assembly was rewelded onto the penetration canister, and was satisfactorily retested.

The high leak rate on the 13-F penetration was due to a tubing leak where its connects to the canister test isolation valve. The tubing was repaired with high shear strength adhesive, and the canister was satisfactorily retested.

The high leak rate on the 13-F penetration was due to a tubing leak where its connects to the canister test isolation valve. The tubing was repaired with high shear strength adhesive, and the canister was satisfactorily retested.

The high leak rate on the 15-E penetration was due to a tubing leak where its connects to the canister test isolation valve. The tubing was repaired with high shear strength adhesive, and the canister was satisfactorily retested.

Two new electrical penetrations were installed per DCP-800 during the Sixth Refueling at locations 7-G and 13-B replacing the existing blank flanges. Both new electrical penetrations were satisfactorily tested.

Type B Repairs (continued)

Personnel Airlock [PH-P-1]

Inner and outer door o-rings were replaced. Door bearings on outer door were replaces, and the door was balanced. Work was per Maintenance Work Request 878123.

Type C Repairs

Penetration No. 1

The initial leak test was performed January 11, 1988. Due to EQ Requirements, the limit switch and torque switch for valve MOV-CC-112A2 were replaced per Maintenance Work Request 882052. Following the replacement, the Type C retest was performed on January 23, 1988, with a leakage of 0.47 SCF/D.

Penetration No. 2

The initial leak test was performed January 7, 1988. Valve CCR-252 leaked at 561.3 SCF/D. The high leakage rate was due to the valve being closed beyond its optimum seating position (butterfly valve). The valve was recycled and the retest performed on January 8, 1988, with a leakage of 0.56 SCF/D. The valve stop was adjusted to ensure the valve would not over travel its optimum seating position.

Due to EQ Requirements, the limit switch and torque switch for valve MOV-CC-112B3 were replaced per Maintenance Work Request 882055. Following the replacement, the Type C retest was performed on January 26, 1988, with a leakage of 0.47 SCF/D.

Type C Repairs (continued)

Penetration No. 4

The initial leak test was performed January 11, 1988. Due to EQ Requirements, the limit switch and torque switch for valve MOV-CC-112A3 were replaced per Maintenance Work Request 882053. Following the replacement, the Type C retest was performed on January 25, 1988, with a leakage of 8.37 SCF/D.

Penetration No. 5

The initial leak test was performed January 6, 1988. Due to EQ Requirements, the limit switch and torque switch for valve MOV-CC-112B2 were replaced per Maintenance Work Request 882054. Following the replacement, the Type C retest was performed on January 26, 1988, with a leakage of 9.33 SCF/D.

Penetration No. 13

The initial leak test was performed January 7, 1988. Valve TV-FP-107 leaked at 230.4 SCF/D. The valve was rebuilt per Maintenance Work Request 878106 and Design Change 833. The valve trim was replaced with a later design, soft seat trim. The Type C retest was performed on January 23, 1988, with a leakage of 0.47 SCF/D.

Penetration No. 27

The initial leak test was performed January 11, 1988. Valve TV-CC-105E1 leaked at 193.5 SCF/D. Maintenance Work Request 882502 was initiated. The valve plug was machined to remove indications. The valve seat was machined to remove raised metal. The Type C retest was performed on January 21, 1988, with a leakage of 31.69 SCF/D.

Type C Repairs (continued)

Penetration No. 38

The initial leak test was performed January 15, 1988. Valve TV-DA-100A leaked at 168.9 SCF/D, and valve TV-DA-100B leaked at 304.9 SCF/D. Maintenance Work Requests 882509 for TV-DA-100A, and 882510 for TV-DA-100B were initiated.

The seat ring and seat was replaced on valve TV-DA-100A, and the seat lapped. The Type C retest was performed on January 23, 1988, with a leakage of 83.88 SCF/D. The seat and plug of valve TV-DA-100B was cleaned of debris, and the valve re-assembled. The Type C retest was performed on January 23, 1988, with a leakage of 24.23 SCF/D.

Penetration No. 43

The initial leak test was performed December 15, 1987. Valve TV-CV-102-1 leaked at 238.1 SCF/D. The valve was rotated in the system per Design Change 666 to permit leak testing the valve on top of the valve seat, rather than from under the valve seat. The Type C retest was performed on February 1, 1988, with a leakage of 6.03 SCF/D.

Penetration No. 44

The initial leak test was performed December 14, 1987. Valve TV-CV-101A leaked at 69.63 SCF/D, and valve TV-CV-101B leaked at 64.99 SCF/D. Since no air leakage was detected at the downstream vent for either valve, Maintenance Work Request 879156 was initiated for the inboard penetration boundary valve CV-14. Corrosion was removed from the seat and disc of valve CV-14. The Type C retest was performed on December 17, 1987, with a leakage of 6.94 SCF/D for TV-CV-101A, and 3.89 SCF/D for TV-CV-101B.

Type C Repairs (continued)

Penetration No. 63

The initial leak test was performed January 13, 1988. Valve QS-4 leaked at 0.47 SCF/D. Maintenance Work Request 882506 was initiated due to binding when QS-4 was cycled. The valve shaft was lubricated to eliminate the binding. A Type C retest was not performed, since the seating surfaces of the valve were not affected.

Penetration No. 70

The initial leak test was performed December 23, 1987. Valve RS-101 leaked at 0.46 SCF/D. Maintenance Work Request 879160 was initiated due to binding when RS-101 was cycled. The valve shaft was lubricated to eliminate the binding. A Type C retest was not to be performed, since the seating surface of the valve was not affected; however, it was discovered that the downstream piping was not properly vented during the initial leak test, due to water in Recirculation Spray Pump RS-P-2B casing. The Type C retest was performed on January 21, 1988, with a leakage of 18.66 SCF/D.

Penetration No. 71

The initial leak test was performed December 23, 1987. Valve RS-100 leaked at 5.57 SCF/D. Maintenance Work Request 879161 was initiated due to binding when RS-100 was cycled. The valve shaft was lubricated to eliminate the binding. A Type C retest was not performed, since the seating surface of the valve was not affected.

Penetration No. 88

The initial leak test was performed January 12, 1988. Valve HY-196 leaked at 17.14 SCF/D, and valve HY-110 leaked at 0.47 SCF/D. Maintenance Work Request 882511 was initiated for penetration boundary valve HY-119 shaft leakage.

Type C Repairs (continued)

The internals of valve HY-119 had been removed during the 5th Refueling Outage. The valve shaft was removed and the opening temporarily plugged. The Type C retest was performed on January 15, 1988, with a leakage of 8.44 SCF/D for HY-196, and 1.64 SCF/D for HY-110.

Penetration No. 90

The initial leak test was performed January 18, 1988. Valves VS-D-5-3A and VS-D-5-3B leaked at 370.7 SCF/D (pressurized between CIV's). Maintenance Work Request 882319 was initiated for a packing leak on valve VS-D-5-3A, and Maintenance Work Request 882313 was initiated for a packing leak on VS-D-5-3B. The old packing was removed, and both valves repacked. The Type C retest was performed on February 8, 1988, with a leakage of 0.46 SCF/D.

Penetration No. 91

The initial leak test was performed January 18, 1988. Valves VS-D-5-5A and VS-D-5-5B, and VS-D-5-6 leaked at 176.1 SCF/D (pressurized between CIV's). Maintenance Work Request 875577 was initiated to inspect the seat and repack valve VS-D-5-5A. Maintenance Work Request 875439 was initiated for a crack on the Motor Operator of VS-D-5-5A. The seat was inspected satisfactorily, the valve repacked, and the motor operator replaced on valve VS-D-5-5A. The Type C retest was performed on January 27, 1988, with a leakage of 1.25 SCF/D.

Penetration No. 94

The initial leak test was performed December 21, 1987. Valve HCV-CV-151 leaked at 13.89 SCF/D. Maintenance Work Request 879158 was initiated.

Type C Repairs (continued)

Prior to any work being performed by Maintenance, it was discovered that valve HCV-CV-151 had not gone fully closed to the mechanical stop (chain operated valve). The Type C retest was performed on January 4, 1988, with a leakage of 1.58 SCF/D. Maintenance Work Request 879158 was voided.

Penetration No. 105-2

The initial leak test was performed December 22, 1987. Valve TV-SS-112A1 leaked at 13.90 SCF/D. Since no air leakage was detected at the downstream vent, Maintenance Work Request 879162 was initiated for inboard penetration boundary valve TV-SS-110. The packing for valve TV-SS-110 was adjusted. The Type C retest was performed on January 15, 1988, with a leakage of 0.47 SCF/D.

ATTACHMENT 4.1C
SEVENTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 1 | MOV-CC-112A2 | X | | 09-29-89 | 0.47 | 0.47 | 2.83 |
| | CCR-247 | | X | 09-29-89 | 2.83 | 2.83 | |
| 2 | MOV-CC-112B3 | X | | 09-25-89 | 0.47 | 0.47 | 10.78 |
| | CCR-252 | | X | 09-25-89 | 1988.6 | 10.78 | |
| 4 | MOV-CC-112A3 | X | | 10-19-89 | 2.44 | 1.18 | 14.16 |
| | CCR-251 | | X | 09-29-89 | 14.16 | 14.16 | |
| 5 | MOV-CC-112B2 | X | | 09-25-89 | 0.47 | 0.47 | 6.25 |
| | CCR-248 | | X | 09-25-89 | 6.25 | 6.25 | |
| 8 | TV-CC-107D1 | X | | 09-29-89 | 1.50 | 1.50 | 1.50 |
| | TV-CC-107D2 | | X | 09-29-89 | 0.47 | 0.47 | |
| 9 | TV-CC-111D1 | X | | 11-11-89 | 2.81 | 43.88 | 43.88 |
| | TV-CC-111D2 | | X | 09-08-89 | 4.69 | 4.69 | |
| 11 | TV-CC-110D | X | | 09-13-89 | 2.34 | 2.34 | 2.34 |
| | TV-CC-110F1 | | X | 09-13-89 | 0.49 | 0.49 | |
| | TV-CC-110F2 | | X | | | | |
| 13 | FP-827 | X | | 09-28-89 | 0.47 | 0.47 | 0.47 |
| | TV-FP-107 | | X | 09-28-89 | 0.47 | 0.47 | |
| 14 | TV-CC-110E3 | X | | 09-13-89 | 1.31 | 1.31 | 1.31 |
| | TV-CC-110E2 | | X | 09-13-89 | 0.47 | 0.47 | |
| 16 | TV-CC-111A2 | X | | 09-11-89 | 0.47 | 0.47 | 62.38 |
| | TV-CC-111A1 | | X | 09-11-89 | 62.38 | 62.38 | |
| 17 | TV-CC-103B1 | X | | 10-02-89 | 1.88 | 1.88 | 22.71 |
| | TV-CC-103B | | X | 10-02-89 | 22.71 | 22.71 | |
| TOTAL PENETRATION LEAKAGE SHEET 1 (SCF/D) | | | | | | | 168.61 |

ATTACHMENT 4.1C (continued)
SEVENTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 18 | TV-CC-103C1 | X | | 10-03-89 | 2.59 | 2.59 | 52.27 |
| | TV-CC-103C | | X | 10-03-89 | 52.27 | 52.27 | |
| 19 | MOV-CH-378 | X | | 10-06-89 | 25.38 | 30.08 | 30.08 |
| | CH-369 | X | | | | | |
| | MOV-CH-381 | | X | 10-06-89 | 0.47 | 0.47 | |
| 20 | SI-42 | X | | 09-06-89 | 1.41 | 1.41 | 1.41 |
| | SI-41 | | X | 09-06-89 | 1.13 | 1.13 | |
| 24 | RH-14 | X | | 09-25-89 | 0.47 | 0.47 | 0.94 |
| | RH-16 | X | | 09-25-89 | 0.47 | 0.47 | |
| | RH-15 | | X | 09-25-89 | 0.47 | 0.47 | |
| 25 | TV-CC-105D1 | X | | 11-10-89 | 13.62 | 2.08 | 5.16 |
| | TV-CC-105D2 | | X | 09-08-89 | 5.16 | 5.16 | |
| 26 | TV-CC-107E1 | X | | 09-09-89 | 60.87 | 60.87 | 60.87 |
| | TV-CC-107E2 | | X | 09-09-89 | 3.84 | 3.84 | |
| 27 | TV-CC-105E1 | X | | 09-09-89 | 16.86 | 16.86 | 16.86 |
| | TV-CC-105E2 | | X | 09-09-89 | 9.61 | 9.61 | |
| 28 | TV-CH-200A | X | | 10-11-89 | 1.32 | 1.32 | 48.79 |
| | TV-CH-200B | X | | | | | |
| | TV-CH-200C | X | | | | | |
| | RV-CH-203 | X | | 10-11-89 | 0.47 | 0.47 | |
| | MOV-CH-142 | X | | 10-11-89 | 84.68 | 47.00 | |
| | TV-CH-204 | | X | 09-23-89 | 0.47 | 0.47 | |
| TOTAL PENETRATION LEAKAGE SHEET 2 (SCF/D) | | | | | | | 216.38 |

ATTACHMENT 4.1C (continued)
SEVENTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 29 | TV-DG-108A | X | | 09-28-89 | 10.30 | 10.30 | 10.30 |
| | TV-DG-108B | | X | 09-28-89 | 8.40 | 8.40 | |
| 31 | FP-804 | X | | 09-29-89 | 0.47 | 0.47 | 0.47 |
| | TV-FP-105 | | X | 09-28-89 | 2.44 | 0.47 | |
| 32 | FP-800 | X | | 09-30-89 | 0.47 | 0.47 | 0.47 |
| | TV-FP-106 | | X | 09-30-89 | 13.14 | 0.47 | |
| 38 | TV-DA-100A | X | | 10-26-89 | 51.70 | 51.70 | 51.70 |
| | TV-DA-100B | | X | 10-26-89 | 220.90 | 0.47 | |
| 42 | SA-15 | X | | 09-05-89 | 10.47 | 37.39 | 37.39 |
| | SA-14 | | X | 11-03-89 | 0.71 | 0.71 | |
| 43 | TV-CV-102-1 | X | | 09-12-89 | 0.47 | 0.47 | 0.47 |
| | TV-CV-102 | | X | 09-12-89 | 0.47 | 0.47 | |
| 44 | TV-CV-101A | X | | 09-11-89 | 3.53 | 3.53 | 3.53 |
| | TV-CV-101B | | X | 09-11-89 | 1.88 | 1.88 | |
| 45 | RC-72 | X | | 09-05-89 | 20.58 | 20.58 | 20.58 |
| | TV-RC-519 | | X | 09-06-89 | 0.47 | 0.47 | |
| 47 | IA-91 | X | | 09-06-89 | 9.36 | 9.36 | 9.36 |
| | IA-90 | | X | 09-06-89 | 3.27 | 3.27 | |
| 48 | TV-DG-109A2 | X | | 09-11-89 | 3.02 | 3.02 | 6.13 |
| | TV-DG-109A1 | | X | 09-11-89 | 6.13 | 6.13 | |
| 49 | RC-68 | X | | 09-11-89 | 56.46 | 56.46 | 56.46 |
| | TV-RC-101 | | X | 09-11-89 | 2.82 | 2.82 | |
| TOTAL PENETRATION LEAKAGE SHEET 3 (SCF/D) | | | | | | | 196.86 |

ATTACHMENT 4.1C (continued)
SEVENTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 53 | TV-SI-101-2 | X | | 09-23-89 | 0.47 | 0.47 | 0.47 |
| | TV-SI-101-1 | | X | 09-23-89 | 0.47 | 0.47 | |
| 55-1 | TV-SS-109A1 | X | | 09-23-89 | 0.47 | 0.47 | 0.47 |
| | TV-SS-109A2 | | X | 09-23-89 | 0.47 | 0.47 | |
| 55-2 NOTE 1 | TV-LM-100A1 | | X | 09-05-89 | 0.47 | 0.47 | 0.47 |
| | TV-LM-100A2 | | X | 09-05-89 | 0.47 | 0.47 | |
| 55-4 | TV-SS-111A1 | X | | 09-23-89 | 3.30 | 3.30 | 3.30 |
| | TV-SS-111A2 | | X | 09-23-89 | 3.30 | 3.30 | |
| 56-1 | TV-SS-100A1 | X | | 09-23-89 | 0.47 | 0.47 | 0.47 |
| | TV-SS-100A2 | | X | 09-23-89 | 0.47 | 0.47 | |
| 56-2 | TV-SS-102A1 | X | | 11-28-89 | 0.48 | 0.47 | 0.48 |
| | TV-SS-102A2 | | X | 11-03-89 | 0.48 | 0.48 | |
| 56-3 | TV-SS-105A1 | X | | 09-27-89 | 0.56 | 0.56 | 0.56 |
| | TV-SS-105A2 | | X | 09-27-89 | 0.47 | 0.47 | |
| 57-3 | TV-LM-101A | X | | 09-08-89 | 8.06 | 8.06 | This pent was spared by DCP-819 |
| | CV-35 | | X | 09-08-89 | 8.06 | 8.06 | |
| 57-4 | TV-LM-101B | X | | 09-11-89 | 4.71 | 4.71 | This pent was spared by DCP-819 |
| | CV-36 | | X | 09-11-89 | 3.53 | 3.53 | |
| 58 | TV-CC-103A1 | X | | 10-03-89 | 0.47 | 0.47 | 3.52 |
| | TV-CC-103A | | X | 10-03-89 | 3.52 | 3.52 | |
| 63 | QS-4 | X | | 10-25-89 | 0.47 | 0.47 | 70.70 |
| | MOV-QS-101B | | X | 10-25-89 | 205.09 | 70.70 | |
| TOTAL PENETRATION LEAKAGE SHEET 4 (SCF/D) | | | | | | | 80.44 |

NOTE 1 - INCLUDES PENETRATIONS 57-1,57-2, AND 97-3 WHICH ALSO SHARE THESE CNMT ISOLATION VALVES THROUGH A COMMON 4-WAY VALVE.

ATTACHMENT 4.1C (continued)
SEVENTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 64 | QS-3 | X | | 11-02-89 | 35.91 | 11.30 | 11.30 |
| | MOV-QS-101A | | X | 11-02-89 | 40.66 | 0.47 | |
| 70 | RS-101 | X | | 09-15-89 | 3.06 | 3.06 | 3.06 |
| 71 | RS-100 | X | | 09-15-89 | 34.31 | 34.31 | 34.31 |
| 87 | HY-197 | | X | 09-13-89 | 2.67 | 2.67 | 3.38 |
| | HY-111 | | X | 09-13-89 | 3.38 | 3.38 | |
| 88 | HY-196 | | X | 09-13-89 | 0.66 | 0.66 | 0.66 |
| | HY-110 | | X | 09-13-89 | 0.56 | 0.56 | |
| 89 | AS-278 | X | | 09-16-89 | 42.42 | 15.08 | 15.08 |
| | TV-SV-100A | | X | 09-15-89 | 4.71 | 4.71 | |
| 90 | VS-D-5-3B | X | | 11-07-89 | 36.29 | 29.20 | 29.20 |
| | VS-D-5-3A | | X | | | | |
| 91 | VS-D-5-5B | X | | 11-26-89 | 70.70 | 79.75 | 79.75 |
| | VS-D-5-5A | | X | | | | |
| | VS-D-5-6 | | X | | | | |
| 92 | TV-CV-150C | | X | 09-14-89 | 6.12 | 6.12 | 24.48 |
| | HY-102 | | X | 09-14-89 | 6.12 | 6.12 | |
| | TV-CV-150D | | X | 09-14-89 | 17.42 | 17.42 | |
| | HY-104 | | X | 09-14-89 | 7.06 | 7.06 | |
| 93 | TV-CV-150B | | X | 09-14-89 | 0.47 | 0.47 | 7.25 |
| | HY-101 | | X | 09-14-89 | 3.53 | 3.53 | |
| | TV-CV-150A | | X | 09-14-89 | 3.72 | 3.72 | |
| | HY-103 | | X | 09-14-89 | 0.66 | 0.66 | |
| TOTAL PENETRATION LEAKAGE SHEET 5 (SCF/D) | | | | | | | 208.47 |

ATTACHMENT 4.1C (continued)
SEVENTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 94 | HCV-CV-151 | X | | 09-27-89 | 25.78 | 23.93 | 23.93 |
| | HCV-VC-151-1 | | X | 09-27-89 | >2400 | 16.89 | |
| 95-64 | SOV-HY-102B1 | X | | 09-09-89 | 0.47 | 0.47 | 0.47 |
| | SOV-HY-102B2 | | X | 09-09-89 | 0.47 | 0.47 | |
| 95-69 | SOV-HY-103B1 | X | | 09-09-89 | 0.47 | 0.47 | 0.47 |
| | SOV-HY-103B2 | | X | 09-09-89 | 0.47 | 0.47 | |
| 95-72 | SOV-HY-104B1 | X | | 09-09-89 | 0.47 | 0.47 | 0.47 |
| | SOV-HY-104B2 | | X | 09-09-89 | 0.47 | 0.47 | |
| 97-1 | TV-SS-104A1 | X | | 09-23-89 | 0.47 | 0.47 | 0.47 |
| | TV-SS-104A2 | | X | 09-23-89 | 0.47 | 0.47 | |
| 97-2 | TV-SS-103A1 | X | | 09-26-89 | 0.47 | 0.47 | 0.47 |
| | TV-SS-103A2 | | X | 09-26-89 | 0.47 | 0.47 | |
| 103 | PC-38 | X | | 09-08-89 | 0.48 | 0.48 | 0.48 |
| | PC-37 | | X | 09-08-89 | 0.48 | 0.48 | |
| 104 | PC-9 | X | | 09-08-89 | 1.28 | 1.28 | 1.28 |
| | PC-10 | | X | 09-08-89 | 0.48 | 0.48 | |
| 105-2 | TV-SS-112A1 | X | | 09-26-89 | 0.47 | 0.47 | 4.69 |
| | TV-SS-112A2 | | X | 09-26-89 | 4.69 | 4.69 | |
| 106 | MOV-SI-842 | X | | 09-12-89 | 0.66 | 0.66 | 0.90 |
| | TV-SI-889 | | X | 09-12-89 | 0.90 | 0.90 | |
| 109-44 | SOV-HY-102A1 | X | | 09-09-89 | 0.47 | 0.47 | 0.47 |
| | SOV-HY-102A2 | | X | 09-09-89 | 0.47 | 0.47 | |
| TOTAL PENETRATION LEAKAGE SHEET 6 (SCF/D) | | | | | | | 34.10 |

ATTACHMENT 4.1C (continued)
SEVENTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE C TESTS

| PENT NO. | VALVE MARK NO. | CONTAINMENT | | DATE TESTED | AS FOUND VALVE LEAKAGE (SCF/D) | AS LEFT VALVE LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE (SCF/D) |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | | | | |
| 109-49 | SOV-HY-103A1 | X | | 09-09-89 | 0.47 | 0.47 | 0.47 |
| | SOV-HY-103A2 | | X | 09-09-89 | 0.47 | 0.47 | |
| 109-52 | SOV-HY-104A1 | X | | 09-09-89 | 0.47 | 0.47 | 0.47 |
| | SOV-HY-104A2 | | X | 09-09-89 | 0.47 | 0.47 | |
| 110-1 | RC-277 | | X | 09-14-89 | 0.47 | 0.47 | 0.47 |
| | RC-278 | | X | 09-14-89 | 0.47 | 0.47 | |
| P.A.L. | VS-169 | X | | 09-12-89 | 0.47 | 0.47 | (NOTE 2) |
| | VS-170 | X | | 09-12-89 | 0.47 | 0.47 | |
| | VS-167 | | X | 09-12-89 | 0.47 | 0.47 | |
| | VS-168 | | X | 09-12-89 | 0.47 | 0.47 | |
| TOTAL PENETRATION LEAKAGE SHEET 7 (SCF/D) | | | | | | | 1.41 |

NOTE 2 - THE ASSIGNED PENETRATION LEAKAGE FOR THESE VALVES IS ADDED WITH THE PERSONNEL AIRLOCK OVERALL TYPE B LEAKAGE, AND NOT INCLUDED IN THE TYPE C TOTAL. P.A.L. = PERSONNEL AIRLOCK

| | | |
|---|---|---|
| TOTAL PENETRATION LEAKAGE SHEET 1 | (SCF/D) | 168.61 |
| TOTAL PENETRATION LEAKAGE SHEET 2 | (SCF/D) | 216.38 |
| TOTAL PENETRATION LEAKAGE SHEET 3 | (SCF/D) | 196.86 |
| TOTAL PENETRATION LEAKAGE SHEET 4 | (SCF/D) | 80.44 |
| TOTAL PENETRATION LEAKAGE SHEET 5 | (SCF/D) | 208.47 |
| TOTAL PENETRATION LEAKAGE SHEET 6 | (SCF/D) | 34.10 |
| TOTAL PENETRATION LEAKAGE SHEET 7 | (SCF/D) | 1.41 |
| TOTAL CONTAINMENT TYPE C LEAKAGE - SUM OF SHEETS 1 THRU 7 | (SCF/D) | 906.27 |

ATTACHMENT 4.1C (continued)
SEVENTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE B TESTS

| PENT NO | LEAKAGE O-RING SEAL / CANISTER (SCCM) | PENT NO | LEAKAGE O-RING SEAL / CANISTER (SCCM) |
|---|---|---|---|
| 1-B | 2.0 / 2.0 | 7-E | 2.0 / 2.0 |
| 1-D | 2.0 / 2.0 | 7-F | 2.0 / 2.0 |
| 1-F | 2.0/2.0 * / N/A | 7-G | N/A ** / 2.0 |
| 2-B | 2.0 / 2.0 | 8-A | 2.0 / 2.0 |
| 2-D | 2.0 / 2.0 | 8-B | 2.0 / 2.0 |
| 2-F | 2.0 / 2.0 | 8-C | 2.0 / 2.0 |
| 3-A | 2.0 / 2.0 | 8-D | 2.0 / 2.0 |
| 3-B | 2.0 / 2.0 | 8-E | 2.0 / 2.0 |
| 3-C | 2.0 / 2.0 | 8-F | 2.0/2.0 * / N/A |
| 3-D | 2.0 / 2.0 | 8-G | 2.0 / 2.0 |
| 3-E | 2.0 / 2.0 | 9-A | 2.0 / 2.0 |
| 3-F | 2.0 / 2.0 | 9-B | 2.0 / 2.0 |
| 3-G | 2.0/2.0 * / N/A | 9-C | 2.0 / 2.0 |
| 4-A | 2.0 / 2.0 | 9-D | 2.0 / 2.0 |
| 4-B | 2.0 / 2.0 | 9-E | 2.0 / 2.0 |
| 4-C | 2.0 / 2.0 | 9-F | 2.0 / 2.0 |
| 4-D | 2.0 / 2.0 | 9-G | 2.0 / 2.0 |
| 4-E | 2.0 / 2.0 | 10-A | 2.0 / 2.0 |
| 4-F | 2.0 / 2.0 | 10-B | 2.0 / 6.0 |
| 4-G | 2.0 / 2.0 | 10-C | 2.0 / 2.0 |
| 5-A | 2.0 / 2.0 | 10-D | 2.0 / 2.0 |
| 5-B | 2.0 / 2.0 | 10-E | 2.0 / 2.0 |
| 5-C | 2.0 / 2.0 | 10-F | 2.0 / 2.0 |
| 5-D | 2.0 / 2.0 | 10-G | 2.0 / 2.0 |
| 5-E | 2.0 / 2.0 | 11-A | 2.0 / 2.0 |
| 5-F | 2.0 / 2.0 | 11-B | 2.0 / 2.0 |
| 5-G | 2.0 / 2.0 | 11-C | 2.0/2.0 * / N/A |
| 6-A | 2.0 / 2.0 | 11-D | 2.0 / 2.0 |
| 6-B | 2.0/2.0 * / N/A | 11-E | 2.0 / 2.0 |
| 6-C | 2.0 / 2.0 | 11-F | 2.0 / 2.0 |
| 6-D | 2.0 / 2.0 | 11-G | 2.0 / 2.0 |
| 6-E | 2.0 / 2.0 | 12-A | 2.0 / 2.0 |
| 6-F | 2.0 / 2.0 | 12-B | 2.0 / 2.0 |
| 6-G | 2.0 / 2.0 | 12-C | 2.0 / 2.0 |
| 7-A | 2.0/2.2* / N/A | 12-D | 2.0 / 2.0 |
| 7-B | 2.0 / 2.0 | 12-E | 2.0 / 2.0 |
| 7-C | 2.0 / 2.0 | 12-F | 2.0 / 2.0 |
| 7-D | 2.0 / 2.0 | 12-G | 2.0 / 2.0 |
| TOTALS SHT 1 | 84.2 68.0 | | 78.0 76.0 |

* SPARE PENETRATION INSIDE/OUTSIDE CONTAINMENT
** CONAX ELECTRICAL PENETRATION INSTALLED AT 6R, O-RINGS AND FEED THROUGHS TESTED SIMULTANEOUSLY

ATTACHMENT 4.1C (continued)
SEVENTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE B TESTS

| PENT NO | LEAKAGE O-RING SEAL / CANISTER (SCCM) | PENT NO | LEAKAGE O-RING SEAL / CANISTER (SCCM) |
|---|---|---|---|
| 13-A | 2.0/2.0 * / N/A | 15-E | 2.0 / 2.0 |
| 13-B | N/A ** / 2.0 | 15-F | 2.0 / 2.0 |
| 13-C | 2.0 / 2.0 | 15-G | 2.0 / 2.0 |
| 13-D | 2.0/2.0 * / N/A | 16-A | 2.0 / 2.0 |
| 13-E | 2.0 / 2.0 | 16-B | 2.0 / 2.0 |
| 13-F | 2.0 / 2.0 | 16-C | 2.0 / 2.0 |
| 13-G | 2.0 / 2.0 | 16-D | 2.0 / 2.0 |
| 14-A | 2.0 / 2.0 | 16-E | 2.0 / 2.0 |
| 14-B | 2.0 / 2.0 | 16-F | 2.0 / 2.0 |
| 14-C | 2.0 / 2.0 | 16-G | 2.0/2.0 * / N/A |
| 14-D | 2.0 / 2.0 | 17-B | 2.0 / 2.0 |
| 14-E | 2.0 / 2.0 | 17-D | 2.0/2.0 * / N/A |
| 14-F | 2.0 / 2.0 | 17-F | 2.0/2.0 * / N/A |
| 14-G | 2.0 / 2.0 | 18-B | 2.0 / 2.0 |
| 15-A | 2.0 / 2.0 | 18-D | 2.0 / 2.0 |
| 15-B | 2.0 / 2.0 | 18-F | 2.0/2.0 * / N/A |
| 15-C | 2.0 / 2.0 | FB-1 | 2.0 / 2.0 |
| 15-D | 2.0 / 2.0 | | |
| TOTALS SHT 2 | 38.0 32.0 | | 42.0 26.0 |

* SPARE PENETRATION INSIDE/OUTSIDE CONTAINMENT
** CONAX ELECTRICAL PENETRATION INSTALLED AT 6R, O-RINGS AND FEED THROUGHS TESTED SIMULTANEOUSLY

| TOTALS | LEAKAGE O-RING SEAL / CANISTER (SCCM) |
|---|---|
| SHT 1 | 162.2 / 144.0 |
| SHT 2 | 80.0 / 58.0 |
| TOTAL LEAKAGE (SCCM) | 242.2 / 202.0 |
| TOTAL LEAKAGE (SCF/D) | 12.3 / 10.3 |

ATTACHMENT 4.1C (continued)
SEVENTH REFUELING LOCAL LEAKAGE RATE TEST DATA
TYPE B TESTS

| PENETRATION | DATE TESTED | AS FOUND LEAKAGE (SCF/D) | AS LEFT LEAKAGE (SCF/D) | ASSIGNED PENETRATION LEAKAGE |
|---|---|---|---|---|
| Fuel Transfer Tube | 12-04-89 | 0.47 | 0.47 | 0.47 |
| Penetration #111 | 09-04-89 | 0.47 | 0.47 | 0.47 |
| Penetration #112 | 09-04-89 | 0.47 | 0.47 | 0.47 |
| Equipment Hatch Outer Flange | 11-21-89 | 0.47 | 0.47 | 0.47 |
| Equipment Hatch Inner Flange | 11-24-89 | 0.48 | 0.48 | 0.48 |
| Personnel Airlock | 11-28-80 | 105.3 | 105.3 | 105.3 |
| Equipment Hatch Airlock | 11-24-89 | 3.25 | 3.25 | 3.25 |

Summary of Type B and C Leakage Rates

| | As Left # | As Found ## |
|---|---|---|
| Total Type B Leakage | 133.51 SCF/D | 134.28 SCF/D |
| Total Type C Leakage | 906.27 SCF/D | 295.58 SCF/D |
| Total Type B and C Leakage * | 1039.78 SCF/D | 429.86 SCF/D |

* Acceptance Criteria < 60% La [< 3,929 SCF/D[1]]

# Maximum pathway leakage rate.
## Minimum pathway leakage rate.

[1]Pa = 40 PSIG

ATTACHMENT 4.1D

SEVENTH REFUELING LOCAL LEAKAGE RATE TEST REPAIRS

Type B Repairs

The following electrical penetrations required maintenance due to high leak rates or physical damage:

| PENT NO. | MWR NO. | AS FOUND LEAKAGE (SCCM) | AS LEFT LEAKAGE (SCCM) |
|---|---|---|---|
| 6-A O-Ring | 893727 | 7.4 | 2.0 |
| 10-A Canister | 893730 | 9.0 | 2.0 |
| 10-B Canister | 894564 | 2.0 | 6.0 |
| 11-A Canister | 893728 | 6.2 | 2.0 |
| 15-B Canister | 893729 | 4.0 | 2.0 |

The high leak rate on the 6-A penetration was due to a leak on the tubing to pressurize the O-Rings. The tubing was brazed to repair the leak and the O-Rings were satisfactorily retested.

The high leak rate on the 10-A penetration was due to a leak on the tubing connection to pressurize the Canister. When the penetration was repressurized to mark the exact location of the leak prior to repair, no leakage could be detected. The MWR was voided and the Canister was satisfactorily retested.

During the repair of the 10-A penetration it was noted that the canister pressure gage connection for 10-B had been damaged. Possibly during the erection of the scaffolding for the repair of the 10-A penetration. A MWR was written to repair the damaged gage connection. The gage connection was unable to be repaired by brazing so a new gage connection and gage were installed. The Canister was retested following the repair with a leakage rate of 6.0 SCCM measured. No external leakage could be detected following the repair.

Type B Repairs (continued)

The high leak rate on the 11-A penetration was due to a leak on the tubing to pressurize the Canister. The tubing was brazed to repair the leak and the Canister was satisfactorily retested.

The high leak rate on the 15-B penetration was due to a leak on the tubing to pressurize the Canister. The tubing was brazed to repair the leak and the Canister was satisfactorily retested.

Personnel Airlock [PH-P-1]

Inner and outer door o-rings were replaced, and upgraded to material less susceptible to compression set. Breech rings for inner and outer doors were adjusted.

Type C Repairs

Penetration No. 2

The "As-Found" leak test was performed September 25, 1989. Valve CCR-252 leaked at 1988.60 SCF/D. The high leakage rate was due to the valve being closed beyond its optimum seating position (butterfly valve). The valve was recycled and an "As-Left" leak test performed on September 25, 1989, with a leakage of 10.78 SCF/D measured. The valve stop was adjusted and its lock nut secured to ensure the valve would not over travel its optimum seating position in the future.

Penetration No. 4

The "As-Found" leak test was performed September 29, 1989. Due to EQ Requirements, the torque switch for valve MOV-CC-112A3 was replaced per Maintenance Work Request 892752. Following the replacement, an "As-Left" leak test was performed on October 19, 1989, with a leakage of 1.18 SCF/D measured.

Type C Repairs (continued)

Penetration No. 9

The "As-Found" leak test was performed September 8, 1989. Due to previous difficulty in repairing the existing actuator on valve TV-CC-111D1, a new smaller actuator was installed per DCP-666. An "As-Left" leak test was performed on November 11, 1989, with a leakage of 43.88 SCF/D measured.

Penetration No. 19

The "As-Found" leak test was performed September 13, 1989. Due to EQ Requirements, the torque switch for valve MOV-CH-378 was replaced per Maintenance Work Request 892769. Following the replacement, an "As-Left" leak test was performed on October 6, 1989, with a leakage of 30.08 SCF/D measured.

Due to EQ Requirements, the torque switch for valve MOV-CH-381 was replaced per Maintenance Work Request 892770. Following the replacement, an "As-Left" leak test was performed on October 6, 1989, with a leakage of 0.47 SCF/D measured. Due to dual indication for valve position, the torque switch and limit switches for valve MOV-CH-381 were adjusted per Maintenance Work Request 891487. Following the adjustment, an "As-Left" leak test was performed on November 27, 1989, with a leakage of 0.47 SCF/D measured.

Penetration No. 25

The "As-Found" leak test was performed September 8, 1989. Due to previous difficulty in repairing the existing actuator on valve TV-CC-105D1, a new smaller actuator was installed per DCP-666. An "As-Left" leak test was performed on November 10, 1989, with a leakage of 2.08 SCF/D measured.

Type C Repairs (continued)

Penetration No. 28

The As-Found" leak test was performed September 23, 1989. Due to excessive seat leakage, Maintenance Work Requsst 890994 was initiated for valve MOV-CH-142. The clamp which connected the valve actuator to the valve stem was repaired to allow the valve to close completely. An "As-Left" leak test was performed on October 10, 1989, with a leakage of 47.00 SCF/D measured.

Relief Valve RV-CH-203 was removed for In-Service Testing per Maintenance Work Request 883184. Following the reinstallation, an "As-Left" leak test was performed on October 11, 1989, with a leakage of 0.47 SCF/D measured.

Penetration No. 31

The "As-Found" leak test was performed September 22, 1989. Due to a misapplication of valve TV-FP-105, the valve trim was replaced with a later design, soft seat trim, per DCP 833. An "As-Left leak test was performed on September 29, 1989, with a leakage of 0.47 SCF/D measured.

Due to binding when Check Valve FP-804 was cycled, Maintenance Work Request 893732 was initiated. The valve shaft was lubricated to eliminate the binding. An "As-Left" leak test was performed on September 29, 1989, with a leakage of 0.47 SCF/D measured.

Penetration No. 32

The "As-Found" leak test was performed September 22, 1989. Due to a misapplication of valve TV-FP-106, the valve trim was replaced with a later design, soft seat trim, per DCP 833. An "As-Left" leak test was performed on September 30, 1989, with a leakage of 0.47 SCF/D measured.

Type C Repairs (continued)

Due to binding when Check Valve FP-800 was cycled, Maintenance Work Request 893733 was initiated. The valve shaft was lubricated to eliminate the binding. An "As-Left" leak test was performed on September 30, 1989, with a leakage of 0.47 SCF/D measured.

Penetration No. 38

The "As-Found" leak test was performed September 26, 1989. Due to excessive leakage, Maintenance Work Request 893731 was initiated for valve TV-DA-100B. The valve seat and plug were cleaned and new seat and bonnet gaskets installed. An "As-Left" leak test was performed on October 26, 1989, with a leakage of 0.47 SCF/D measured.

Penetration No. 42

The "As-Found" leak test was performed September 5, 1989. Due to excessive seat and bonnet leakage, Maintenance Work Request 893719 was initiated for valve SA-15. The valve seat and flapper were cleaned and lapped and the valve reassembled. An "As-Left" leak test was performed on November 3, 1989, with a leakage of 37.39 SCF/D measured.

Penetration No. 56-2

The "As-Found" leak test was performed November 3, 1989. Due to dual indication for valve TV-SS-102A1, the valve switch assembly was replaced per Maintenance Work Request 880966. Following the replacement, an "As-Left" leak test was performed on November 27, 1989, with a leakage of 0.47 SCF/D measured.

Type C Repairs (continued)

Penetration No. 57-3 and 57-4

These penetrations were spared per DCP-819.

Penetration No. 63

The "As-Found" leak test was performed September 7, 1989. Due to recommendations from the valve vendor, check valve QS-4 was modified per Maintenance Work Request 893244. Following the modification, an "As-Left leak test was performed on October 25, 1989, with a leakage of 0.47 SCF/D measured.

Due to excessive seat leakage, Maintenance Work Request 893720 was initiated for MOV-QS-101B. During the "As-Left" leak test of valve QS-4, valve MOV-QS-101B was stroked and an "As-Left" leak test performed on October 25, 1989, with a leakage of 70.70 SCF/D measured. Maintenance Work Request 893720 was voided.

Penetration No. 64

The "As-Found" leak test was performed September 7, 1989. Due to recommendations from the valve vendor, check valve QS-3 was modified per Maintenance Work Request 893243. Following the modification, an "As-Left" leak test was performed on October 30, 1989, with a leakage of 11.30 SCF/D measured.

During the inspection of valve MOV-QS-101A per Maintenance Work Request 892628, bad grease was detected in the valve operator. The operator was completely disassembled, the old grease removed, the new grease installed, and the operator reassembled.

Type C Repairs (continued)

An "As-Left" leak test was performed on October 27, 1989 with excessive seat leakage measured. The closing torque was increased to the operator's maximum allowable value. An "As-Left" leak test was performed on October 30, 1989 with excessive packing leakage detected. The valve's packing was adjusted two flats by mechanical maintenance and an "As-Left" leak test performed on October 31, 1989. Due to excessive packing leakage still being detected, Maintenance Work Request 894565 was initiated to repack the valve. Following the completion of Maintenance Work Request 894565, an "As-Left" leak test was performed on November 2, 1989, with a leakage of 0.47 SCF/D measured.

Penetration No. 89

The "As-Found" leak test was performed September 15, 1989. Due to excessive seat leakage, the flapper of check valve AS-278 was cleaned of dirt and debris by testing personnel (the flapper can be reached through the valve's outlet). An "As-Left" leak test was performed on September 16, 1989, with a leakage of 15.08 SCF/D measured.

Penetration No. 90

The "As-Found" leak test was performed September 11, 1989. Due to the information supplied by NRC Information Notice 88-73, valve VS-D-5-3B was rotated to provide a more conservative leak test. Following the completion of Maintenance Work Request 892327, which rotated the valve, an "As-Left" leak test was performed on November 7, 1989, with a leakage of 29.20 SCF/D measured.

Type C Repairs (continued)

Penetration No. 91

The "As-Found" leak test was performed September 12, 1989. Due to the information supplied by NRC Information Notice 88-73, valve VS-D-5-5B was rotated to provide a more conservative leak test. Following the completion of Maintenance Work Request 892328, which rotated the valve, an "As-Left" leak test was performed on November 26, 1989, with a leakage of 79.75 SCF/D measured.

Penetration No. 94

The "As-Found" leak test was performed September 13, 1989. Due to the external stop being bent for valve HCV-CV-151-1, the valve closed beyond its optimum seating position (butterfly valve). Maintenance Work Request 893723 was written to repair the stop. An "As-Left" leak test was performed on September 27, 1989, with a leakage of 16.89 SCF/D measured.

ATTACHMENT 4.1E

SIXTH AND SEVENTH FUEL CYCLE LOCAL LEAKAGE RATE TEST DATA

I. Sixth Fuel Cycle LLRT Data

A. Type B Tests

1. Airlock Total Volume Type B Tests

a. Personnel Airlock [PH-P-1] (01-28-87) ..... 15.80 SCF/D
Corrective Action(s) - Per Maintenance Work Request 875404; replaced o-rings for outer door, and outer door escape hatch. Outer door breech ring limit switch adjusted to permit additional travel in the closed position.

b. Equipment Hatch Airlock [PH-P-2] (01-27-87) ..... 5.06 SCF/D
Corrective Action(s) - None.

c. Personnel Airlock [PH-P-1] (07-22-87) ..... 3.86 SCF/D
Corrective Action(s) - Per Maintenance Work Request 875688; replaced o-rings for outer door, and adjusted outer door breech ring.

d. Equipment Hatch Airlock [PH-P-2] (07-21-87) ..... 0.46 SCF/D
Corrective Action(s) - None.

B. Type C Tests

None

II. Seventh Fuel Cycle LLRT Data

A. Type B Tests

1. Airlock Total Volume Type B Tests

a. Personnel Airlock [PH-P-1] (08-02-88) ..... 166.35 SCF/D
Corrective Action(s) - Per Maintenance Work Request 883255; interlocking pin limit required a minor adjustment so that the closing hydraulic pump motor would shut off properly.

b. Equipment Hatch Airlock [PH-P-2] (08-03-88) ..... 0.46 SCF/D
Corrective Action(s) - None.

c. Personnel Airlock [PH-P-1] (01-25-89) ..... 225.13 SCF/D
Corrective Action(s) - Per Maintenance Work Request 892202; replaced o-rings for inner and outer door. Adjusted inner door breech ring.

d. Personnel Airlock [PH-P-1] (01-30-89) ..... 71.32 SCF/D
Corrective Action(s) - Inner door o-rings were replaced due to OST 1.47.1, "Personnel Airlock Door(s) Seal Test" not passing the inner door seal test. The Overall Type B of the airlock was performed after o-ring replacement with no problems.

ATTACHMENT 4.1E

SIXTH AND SEVENTH FUEL CYCLE LOCAL LEAKAGE RATE TEST DATA

1. Airlock Total Volume Type B Tests (continued)

e. Equipment Hatch Airlock [PH-P-2] (01-25-89) ----- 0.47 SCF/D
Corrective Action(s) - None.

f. Personnel Airlock [PH-P-1] (07-24-89) ---------- 70.49 SCF/D
Corrective Action(s) - None.

g. Equipment Hatch Airlock [PH-P-2] (07-25-89) ----- 23.22 SCF/D
Corrective Action(s) - None.

B. Type C Tests

None

Note: BVPS #1 administratively limits Type B leakage of each airlock to 5% La (327 SCF/D). Total Type B and C leakage (excluding airlocks) is administratively limited to 50% La to account for airlock retests.