

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION

UNIT 1

REACTOR CONTAINMENT BUILDING

INTEGRATED LEAKAGE RATE TEST

FINAL REPORT

Prepared by  
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San Francisco, CA  
November 1985

SU-088b

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## 1.0 INTRODUCTION

The reactor containment building Integrated Leakage Rate Test (Type A) is performed to demonstrate that leakage through the primary reactor containment and systems and components penetrating primary containment does not exceed the allowable leakage rate specified in the Fort Calhoun Station Unit 1 Technical Specifications.

The successful periodic Type A and supplemental verification tests were performed according to the requirements of the Fort Calhoun Station Unit 1 Technical Specifications and 10CFR50, Appendix J. The Type A test method used is the absolute method described in ANSI/N45.4-1972, "Leakage Rate Testing of Containment Structures for Nuclear Reactors", and ANSI/ANS 56.8-1981, "Containment Systems Leakage Testing Requirements". The leakage rate was calculated using the mass point method formulas from ANSI/ANS 56.8-1981.

The mass point analysis method calculates air mass at each time step as a function of absolute pressure and temperature. A linear regression analysis is used to calculate the rate of change of air mass with respect to time. The leakage rate is equal to the ratio of the rate of change of air mass to the initial air mass. A 95 percent upper confidence limit is calculated to assure a 95 percent probability that the calculated leakage rate is within the acceptance limits. Following the ILRT, the verification test leakage rate was calculated using the mass point method.

Calculations were done with OPPD's ILRT computer program described in Appendix A. The calculated air mass, leakage rate and 95 percent upper confidence limit were verified against Bechtel Power Corporation's ILRT program. The calculated air masses agreed within 1 lbm throughout the test. The calculated leakage rates and 95 percent upper confidence limits agreed within 0.001 %/day after the first four to six data points. As expected, very early in the test larger differences occurred due to the sensitivity of leakage rate to very small differences (1 lbm) in air mass. The results of the two programs are tabulated and compared in Appendix B.

## 2.0 SUMMARY

This report presents data, analysis, and conclusions pertaining to the Fort Calhoun Station Unit 1 Integrated Leakage Rate Test (ILRT) performed in October 1985. The ILRT was performed at the beginning of the 1985 refueling outage. Included in the report is a presentation of the Local Leakage Rate Test results required by the U.S. Code of Federal Regulations, 10CFR50, Appendix J.

The ILRT was successfully performed from 1500 October 9 to 0100 October 10, 1985. This was followed by a successful verification (imposed leakage) test to assure satisfactory instrument performance. The following is a summary of test results expressed in weight percent per day:

|                            | <u>Test Results</u> | <u>Acceptance Criteria</u> |
|----------------------------|---------------------|----------------------------|
| ILRT $L_{am}$              | 0.034               | 0.075                      |
| 95% Upper Confidence Limit | 0.043               | 0.075                      |
| Verification $L_c$         | 0.137               | 0.109 to 0.159             |

A chronological summary of events, a summary of plant data, and a discussion of test results are included in subsequent portions of this report.

### 3.0 TEST SYNOPSIS

Valve line-ups were conducted on all systems to establish post-accident conditions except for component cooling, hydrogen purge and three penetrations necessary to conduct the ILRT. The containment was tested in an "as found" condition. The inspection of the containment's accessible interior and exterior surfaces was conducted prior to pressurization. No evidence of structural deterioration was noted which would have affected containment integrity or leak tightness.

Containment pressurization started at 1600 October 7, 1985, and test pressure of 60.0 psig was reached at 0545 on October 8. The pressurization line was vented. Containment coolers and fans were stopped at 0645. Following a four-hour stabilization period the ILRT was started at 1100 on October 8. A leakage rate of 0.030%/day was calculated during the 10-hour period from 1100 to 2100 on October 8. Following the ILRT a 3.7 scfm verification leak was imposed. During the verification test an instrument air line was discovered to be connected to a test connection between the two isolation valves on penetration M-40. The ILRT procedure called for attaching the instrument air line during depressurization to assist in opening the purge valves. The instrument air line was disconnected and penetration M-40 was tested for possible in-leakage. With a 90 psig test pressure, which is equal to instrument air pressure, the in-leakage rate was measured at 2600 sccm. Since the leak testing equipment was calibrated at 60 psig, a correction factor equal to the square root of the pressure ratio was applied yielding an in-leakage rate of 3078 sccm or 0.003%/day. Although the in-leakage rate was shown to be small, it was decided to repeat the ILRT with the instrument air disconnected, to assure the validity of the test results.

The verification flow was disconnected and the ILRT restarted at 1500 on October 9, 1985. The previous four hours from 1000 to 1500 were used to verify that the temperature stabilization criteria was satisfied. The leakage rate for the 10-hour period from 1500 on October 9 to 0100 on October 10 was 0.034%/day with a 95 percent upper confidence limit of 0.043%/day. The 95 percent upper confidence limit was less than the acceptance limit of 0.075%/day.

The data points at 1545 and 2000 on October 9 were not used in the leakage rate calculations due to bad data points from temperature sensors 8 and 17. These bad data points were singular occurrences as can be seen from the temperature plots for these sensors in Appendix F. No data point was obtained at 1845 on October 9 due to a data acquisition malfunction.

A verification flow of 3.7 scfm (0.1%/day) was imposed at 0215 on October 10. Following a one-hour stabilization period, a four-hour verification test was performed from 0330 to 0730. The calculated verification test leakage rate of 0.13%/day was within the acceptance range of 0.109%/day to 0.159%/day.

Containment depressurization commenced at 1220 October 10, 1985. Following depressurization determination was made that no measurable water level changes requiring corrections to the calculated leakage rates had occurred during the test.

4.0 TEST DATA SUMMARY  
 A. Plant Information

|                      |                              |
|----------------------|------------------------------|
| Owner:               | Omaha Public Power District  |
| Plant:               | Fort Calhoun Station, Unit 1 |
| Location:            | Fort Calhoun, Nebraska       |
| Containment Type:    | Post-tensioned, PWR          |
| Date Test Completed: | October 10, 1985             |
| Docket Number:       | 50-285                       |

B. Technical Data

|  |                   |
|--|-------------------|
| 1. Containment Net Free Air Volume             | 1,050,000 cu. ft. |
| 2. Design Pressure                             | 60 psig           |
| 3. Design Temperature                          | 305°F             |
| 4. Calculated Peak Accident Pressure, $P_a$    | 60 psig           |
| 5. Containment ILRT Average Temperature Limits | 60-110°F          |

C. Test Results - Type "A" Test

|  |   |                               |
|--|---|-------------------------------|
| 1. Test Method                                   | Absolute  |                               |
| 2. Data Analysis Technique                       | Mass Point per ANSI/ANS 56.9-1981                           |                               |
| 3. Test Pressure                                 | 60.0 psig + 1.0<br>- 0.0                                    |                               |
| 4. Maximum Allowable Leakage Rate, $L_a$         | 0.1%/day  |                               |
| 5. 75% of $L_a$                                  | 0.075%/day  |                               |
| 6. Integrated Leakage Rate Test Result           | From Regression Line, $L_{am}$                              | At 95% Upper Confidence Limit |
|  | <u>0.034%/day</u>   | <u>0.043%/day</u>             |
| 7. Verification Test Imposed Leakage Rate, $L_o$ | 3.7 scfm<br>0.100%/day                                      |                               |
| 8. Verification Test Results                     | <u>From Regression Line, <math>L_c</math></u><br>0.137%/day |                               |



| <u>Penetration</u> | <u>Description</u>       | <u>"As Left"</u>            |
|--------------------|--------------------------|-----------------------------|
| M-69               | Hydrogen Purge           | 0.0 SCCM                    |
| M-40               | Temporary Instrument Air | 0.0 SCCM                    |
|                    | Total                    | 860.0 SCCM<br>(0.001 %/day) |

E. Integrated Leakage Rate Measurement System

The following instrumentation system was used:

| <u>No.</u>              | <u>Description</u>  | <u>Date</u>   |
|-------------------------|---|---|
| 1. Absolute Pressure    |   |   |
| 2                       | Precision Pressure Gages<br>Mensor Corporation<br>Model 16721 | Range: 0-100 psia<br>Accuracy: 0.02% f.s.<br>Sensitivity: 0.001 psia<br>Calibration: 8/6/85 |
| 2. Drybulb Temperature  |   |   |
| 30                      | RTD<br>100 Ohm Platinum<br>Hy-Cal engineering                 | Range: 60-100°F<br>Accuracy: 0.10°F<br>Sensitivity: 0.01°F<br>Calibration: 6/20/85          |
| 3. Dewpoint Temperature |   |   |
| 10                      | Lithium Chloride<br>Foxboro Corp.<br>Model 2701 RG            | Range: 40-100°F<br>Accuracy: 1.0°F<br>Sensitivity: 0.01°F<br>Calibration: 7/1/85            |
| 4. Flow Meter           |   |   |
| 1                       | Rotometer<br>Fischer and Porter<br>SB 087615588               | Range: 0-4 scfm<br>Accuracy: 1% f.s.<br>Calibration: 8/23/85                                |
| 5. Display              |   |   |
| 1                       | Digitec<br>Model 3000<br>Datalogger                           | Range: -400 to 400 Ohm<br>Resolution: 0.01 Ohm<br>(0.05°F)<br>Repeatability: 0.01 ohm       |

(0.05°F)



6. Overall Instrument Selection Guide (ISG)

The calculation of the ISG per ANSI/ANS 56.8 1981 is provided in Appendix G.

7. Drybulb and Dewpoint Temperature Sensor Locations and Volume Fraction.

Sensor locations and volume fractions are provided in Table 1.

TABLE 1

Drybulb and Dewpoint Temperature Sensor Location  
and Volume Fractions

| <u>Sensor</u> | <u>Elevation<br/>Feet</u> | <u>Azimuth<br/>Degree</u> | <u>Distance From<br/>Center, Feet</u> | <u>Volume<br/>Fraction</u> |
|---------------|---------------------------|---------------------------|---------------------------------------|----------------------------|
| RTD'S         |                           |                           |                                       |                            |
| 1             | 1010                      | 155                       | 45                                    | 0.0163                     |
| 2             | 1013                      | 35                        | 45                                    | 0.0163                     |
| 3             | 1013                      | 170                       | 25                                    | 0.0265                     |
| 4             | 1013                      | 40                        | 25                                    | 0.0286                     |
| 5             | 1030                      | 90                        | 25                                    | 0.0235                     |
| 6             | 1075                      | 0                         | 0                                     | 0.0405                     |
| 7             | 1048                      | 230                       | 30                                    | 0.0405                     |
| 8             | 1048                      | 50                        | 35                                    | 0.0405                     |
| 9             | 1098                      | 0                         | 40                                    | 0.0512                     |
| 10            | 1098                      | 180                       | 40                                    | 0.0512                     |
| 11            | 1113                      | 270                       | 25                                    | 0.0512                     |
| 12            | 1060                      | 55                        | 35                                    | 0.0405                     |
| 13            | 1113                      | 90                        | 25                                    | 0.0512                     |
| 14            | 1050                      | 200                       | 35                                    | 0.0265                     |
| 15            | 1050                      | 340                       | 35                                    | 0.0286                     |
| 16            | 1020                      | 230                       | 35                                    | 0.0235                     |
| 17            | 1048                      | 130                       | 35                                    | 0.0405                     |
| 18            | 1030                      | 330                       | 45                                    | 0.0235                     |
| 19            | 1010                      | 320                       | 45                                    | 0.0163                     |
| 20            | 1060                      | 270                       | 15                                    | 0.0405                     |
| 21            | 1000                      | 90                        | 45                                    | 0.0163                     |
| 22            | 1020                      | 0                         | 45                                    | 0.0235                     |
| 23            | 1048                      | 320                       | 45                                    | 0.0405                     |
| 24            | 1060                      | 130                       | 25                                    | 0.0405                     |
| 25            | 1060                      | 60                        | 15                                    | 0.0405                     |
| 26            | 1025                      | 270                       | 15                                    | 0.0405                     |
| 27            | 1000                      | 225                       | 40                                    | 0.0163                     |
| 28            | 1030                      | 190                       | 45                                    | 0.0235                     |
| 29            | 1088                      | 270                       | 25                                    | 0.0405                     |
| 30            | 1088                      | 90                        | 25                                    | 0.0405                     |
| DEWCELLS      |                           |                           |                                       |                            |
| 1             | 998                       | 90                        | 45                                    | 0.1                        |
| 2             | 1013                      | 90                        | 40                                    | 0.1                        |
| 3             | 1045                      | 50                        | 35                                    | 0.1                        |
| 4             | 1045                      | 230                       | 30                                    | 0.1                        |
| 5             | 1095                      | 270                       | 45                                    | 0.1                        |
| 6             | 1095                      | 90                        | 45                                    | 0.1                        |
| 7             | 1060                      | 55                        | 25                                    | 0.1                        |
| 8             | 1020                      | 230                       | 35                                    | 0.1                        |
| 9             | 1060                      | 130                       | 35                                    | 0.1                        |
| 10            | 1048                      | 320                       | 45                                    | 0.1                        |

## 5.0 ANALYSIS AND INTERPRETATION

The calculated leakage rate at the 95% upper confidence limit is 0.043%/day. The minimum pathway local leakage rate for penetrations not in post-LOCA lineup is 0.001%/day. The sum of the ILRT 95% upper confidence limit and the local leakage rates is 0.044%/day. This "as left" leakage rate at the 95% upper confidence limit is less than the acceptance limit of 0.075%/day at 60.0 psig.

The containment was tested in an "as found" condition. Therefore, the "as found" 95% upper confidence leakage is equal to the 95% upper confidence leakage measured during the ILRT, 0.044%/day.

Prior to the ILRT, the mechanical sleeves for penetrations M-49 and M-95 were found to have bad test connections. The test connections were repaired and the sleeves were tested and found to have zero leakage.

## 6.0 REFERENCES

1. Fort Calhoun Station Unit 1 Technical Specification.
2. Surveillance Test Procedure ST-CONT-7, Revision 10.
3. 10CFR50, Appendix J, Reactor Containment Leakage Testing for Water Cooled Power Reactors.
4. ANSI N45.4-1972, Leakage Rate Testing of Containment Structures for Nuclear Reactors.
5. ANSI/ANS 56.8-1981, Containment System Leakage Testing Requirements.

APPENDIX A

Description of Fort Calhoun ILRT  
Computer Program

## APPENDIX A

### DISCRIPTION OF OPPD ILRT COMPUTER PROGRAM

The OPPD ILRT computer program calculates the leakage rate using the mass point method of ANSI/ANS 56.8-1981. The air mass, M, at each data point is calculated from the containment free air volume, absolute pressure, weighted average drybulb temperature and weighted average dewpoint temperature. The air mass equation is:

$$M = \frac{(\sum \alpha_i P_i - \sum \beta_i P_{v_i}) V}{R \sum \gamma_i T_i}$$

where, M = Calculated air mass, lbm.

$P_i$  = Absolute pressure sensor readings (2 sensors), psia

$P_{v_i}$  = Vapor pressure corresponding to dewpoint temperature sensor readings (10 sensors), psia

$T_i$  = Drybulb temperature readings (30 sensors), °F

$\alpha_i$  = Pressure sensor volume fractions ( $\alpha_1 = \alpha_2 = .5$ )

$\beta_i$  = Dewpoint Temperature sensor volume fractions  
(See Table 1)

$\gamma_i$  = Drybulb temperature sensor volume fractions  
(See Table 1)

V = Containment free air volume ( 1,050,000 ft<sup>3</sup> )

R = Gas constant ( 53.35 ft - lbf / lbm )

A linear regression analysis yields the following regression line for  $n$  data points.

$$\bar{M} = A t + B$$

where,

$$A = \frac{n (\sum t_i M_i) - (\sum M_i) (\sum t_i)}{n (\sum t_i^2) - (\sum t_i)^2}$$

$$B = \frac{(\sum M_i) (\sum t_i^2) - (\sum t_i M_i) (\sum t_i)}{n (\sum t_i^2) - (\sum t_i)^2}$$

$M_i$  = Calculated air mass at elapsed time  $t_i$

The leakage rate,  $L_{am}$ , is evaluated at time  $t_n$  as:

$$\begin{aligned} L_{am} &= - \frac{2400}{M_{t=0}} \frac{\partial \bar{M}}{\partial t} \\ &= - 2400 \frac{A}{B} \end{aligned}$$

The leakage rate at the 95% upper confidence limit, UCL, is:

$$UCL = L_{am} + 2400 t_{0.95} S_A / B$$

where,

$t_{0.95}$  = one sided Student's t function evaluated at 0.95

$$S_A = \frac{\left[ \frac{\sum (\bar{M}_1 - M_1)^2}{n-2} \right]^{\frac{1}{2}}}{\left[ n(\sum t_1^2) - (\sum t_1)^2 \right]^{\frac{1}{2}}}$$

$$\bar{M}_1 = A t_1 + B$$

The following approximation is used for  $t_{0.95}$  :

$$t_{0.95} = \frac{1.6449 (n-2)^2 + 3.5283 (n-2) + 0.85602}{(n-2)^2 + 1.2209 (n-2) - 1.5163}$$

Attached are computer printouts of the calculated ILRT and verification test leakage rates as a function of time.



VALUES FOR 'WAM' 'LAM' '95% UCL' FOR TEST PERIOD

DATE 11-05-1985

TIME 14 04

FILE NAME TILRT.DTA

| TIME  | RECORD # | WAM (lbm)     | Lam (%/DAY)         | 95% LCL (%/DAY) |
|-------|----------|---------------|---------------------|-----------------|
| 0 00  | 1        | 401,369.2     | N/A                 | N/A             |
| 0 25  | 5        | 401,328.3     | 0.977               | N/A             |
| 0 50  | 9        | 401,353.6     | 0.186               | 3.067           |
| 0 75  | 13       | 401,165.0-    | -REJECTED DATA SET- |                 |
| 1 00  | 17       | 401,349.0     | 0.051               | 0.526           |
| 1 25  | 21       | 401,355.4     | 0.007               | 0.298           |
| 1 50  | 25       | 401,346.8     | 0.015               | 0.158           |
| 1 75  | 29       | 401,333.0     | 0.035               | 0.136           |
| 2 00  | 33       | 401,339.5     | 0.039               | 0.115           |
| 2 25  | 37       | 401,352.5     | 0.022               | 0.084           |
| 2 50  | 41       | 401,326.3     | 0.040               | 0.094           |
| 2 75  | 45       | 401,318.4     | 0.056               | 0.104           |
| 3 00  | 49       | 401,327.3     | 0.057               | 0.097           |
| 3 25  | 53       | 401,361.8     | 0.032               | 0.075           |
| 3 50  | 57       | 401,319.8     | 0.041               | 0.079           |
| 3 75  | 61       | 40,697,892.7- | -REJECTED DATA SET- |                 |
| 4 00  | 65       | 401,332.8     | 0.057               | 0.070           |
| 4 25  | 69       | 401,326.0     | 0.038               | 0.066           |
| 4 50  | 73       | 401,355.7     | 0.025               | 0.053           |
| 4 75  | 77       | 401,330.5     | 0.025               | 0.050           |
| 5 00  | 81       | 402,361.2-    | -REJECTED DATA SET- |                 |
| 5 25  | 85       | 401,317.4     | 0.029               | 0.051           |
| 5 50  | 89       | 401,321.0     | 0.030               | 0.050           |
| 5 75  | 93       | 401,308.1     | 0.034               | 0.053           |
| 6 00  | 97       | 401,328.6     | 0.032               | 0.049           |
| 6 25  | 101      | 401,338.7     | 0.026               | 0.043           |
| 6 50  | 105      | 401,292.4     | 0.034               | 0.049           |
| 6 75  | 109      | 401,324.4     | 0.032               | 0.046           |
| 7 00  | 113      | 401,301.7     | 0.034               | 0.048           |
| 7 25  | 117      | 401,309.7     | 0.035               | 0.047           |
| 7 50  | 121      | 401,305.4     | 0.035               | 0.047           |
| 7 75  | 125      | 401,314.1     | 0.034               | 0.045           |
| 8 00  | 129      | 401,305.7     | 0.035               | 0.045           |
| 8 25  | 133      | 401,306.6     | 0.035               | 0.044           |
| 8 50  | 137      | 401,337.4     | 0.031               | 0.041           |
| 8 75  | 141      | 401,302.2     | 0.031               | 0.041           |
| 9 00  | 145      | 401,325.5     | 0.029               | 0.038           |
| 9 25  | 149      | 401,295.0     | 0.030               | 0.039           |
| 9 50  | 153      | 401,308.7     | 0.030               | 0.038           |
| 9 75  | 157      | 401,257.1     | 0.034               | 0.043           |
| 10 00 | 161      | 401,292.8     | 0.034               | 0.043           |

VALUES FOR 'WAM' 'LAM' '95% UCL' FOR TEST PERIOD

DATE 11-05-1985

TIME 14 02

FILE NAME: VILRT DTA

| TIME | RECORD # | WAM (15m) | Lam (%/DAY) | 95% UCL (%/DAY) |
|------|----------|-----------|-------------|-----------------|
| 0 00 | 1        | 401,268.3 | N/A         | N/A             |
| 0 35 | 5        | 401,297.3 | -0.692      | N/A             |
| 0 50 | 9        | 401,274.5 | -0.074      | 2.177           |
| 0 75 | 13       | 401,233.2 | 0.306       | 1.099           |
| 1 00 | 17       | 401,269.9 | 0.146       | 0.574           |
| 1 35 | 21       | 401,348.7 | 0.083       | 0.349           |
| 1 50 | 25       | 401,232.1 | 0.146       | 0.337           |
| 1 75 | 29       | 401,245.0 | 0.134       | 0.272           |
| 2 00 | 33       | 401,245.1 | 0.119       | 0.225           |
| 2 35 | 37       | 401,218.0 | 0.141       | 0.227           |
| 2 50 | 41       | 401,176.4 | 0.191       | 0.279           |
| 2 75 | 45       | 401,250.3 | 0.145       | 0.232           |
| 3 00 | 49       | 401,216.1 | 0.139       | 0.212           |
| 3 25 | 53       | 401,214.2 | 0.132       | 0.195           |
| 3 30 | 57       | 401,206.0 | 0.130       | 0.184           |
| 3 75 | 61       | 401,206.5 | 0.125       | 0.172           |
| 4 00 | 65       | 401,170.9 | 0.136       | 0.179           |

APPENDIX B

Comparison of Fort Calhoun and  
Bechtel ILRT Computer Results

COMPARISON OF FORT CALHOUN AND BECHTEL  
 COMPUTER PROGRAM CALCULATED AIR MASS,  
 LEAKAGE RATE AND 95% UCL

| Data Point | Air Mass (lbm.) |         |   | Leakage Rate (%/day) |         |      | 95% UCL (%/day) |         |      |
|------------|-----------------|---------|---|----------------------|---------|------|-----------------|---------|------|
|            | Fort Calhoun    | Bechtel | d | Fort Calhoun         | Bechtel | d    | Fort Calhoun    | Bechtel | d    |
| ILRT       |                 |         |   |                      |         |      |                 |         |      |
| 1          | 401369          | 401370  | 1 |                      |         |      |                 |         |      |
| 2          | 401328          | 401329  | 1 | .977                 |         |      |                 |         |      |
| 3          | 401354          | 401354  | 0 | .186                 |         |      | 3.067           |         |      |
| 4          | 401349          | 401349  | 0 | .051                 | .053    | .002 | .526            | .530    | .004 |
| 5          | 401355          | 401356  | 1 | .007                 | .007    | .000 | .238            | .238    | .000 |
| 6          | 401347          | 401347  | 0 | .015                 | .016    | .001 | .158            | .158    | .000 |
| 7          | 401338          | 401338  | 0 | .035                 | .035    | .000 | .136            | .137    | .001 |
| 8          | 401340          | 401340  | 0 | .039                 | .039    | .000 | .115            | .115    | .000 |
| 9          | 401353          | 401353  | 0 | .022                 | .023    | .001 | .084            | .085    | .001 |
| 10         | 401327          | 401327  | 0 | .040                 | .041    | .001 | .094            | .095    | .001 |
| 11         | 401318          | 401319  | 1 | .056                 | .057    | .001 | .104            | .105    | .001 |
| 12         | 401328          | 401328  | 0 | .057                 | .058    | .001 | .097            | .098    | .001 |
| 13         | 401362          | 401362  | 0 | .032                 | .033    | .001 | .075            | .076    | .001 |
| 14         | 401320          | 401320  | 0 | .041                 | .041    | .000 | .079            | .080    | .001 |
| 15         | 401333          | 401333  | 0 | .037                 | .038    | .001 | .070            | .071    | .001 |
| 16         | 401326          | 401327  | 1 | .038                 | .038    | .000 | .066            | .066    | .000 |
| 17         | 401356          | 401356  | 0 | .025                 | .025    | .000 | .053            | .053    | .000 |
| 18         | 401331          | 401331  | 0 | .025                 | .025    | .000 | .050            | .050    | .000 |
| 19         | 401317          | 401318  | 1 | .029                 | .029    | .000 | .051            | .051    | .000 |
| 20         | 401321          | 401321  | 0 | .030                 | .031    | .001 | .050            | .050    | .000 |
| 21         | 401308          | 401309  | 1 | .034                 | .035    | .001 | .053            | .053    | .000 |
| 22         | 401329          | 401329  | 0 | .032                 | .032    | .000 | .049            | .049    | .000 |
| 23         | 401339          | 401339  | 0 | .028                 | .028    | .000 | .043            | .043    | .000 |
| 24         | 401292          | 401293  | 1 | .034                 | .034    | .000 | .049            | .049    | .000 |
| 25         | 401324          | 401325  | 1 | .032                 | .032    | .000 | .046            | .046    | .000 |
| 26         | 401302          | 401302  | 0 | .034                 | .034    | .000 | .048            | .048    | .000 |
| 27         | 401310          | 401310  | 0 | .035                 | .035    | .000 | .047            | .047    | .000 |
| 28         | 401305          | 401305  | 0 | .035                 | .036    | .001 | .047            | .047    | .000 |
| 29         | 401314          | 401314  | 0 | .034                 | .035    | .001 | .045            | .046    | .001 |
| 30         | 401306          | 401306  | 0 | .035                 | .035    | .000 | .045            | .045    | .000 |
| 31         | 401307          | 401307  | 0 | .035                 | .035    | .000 | .044            | .045    | .001 |
| 32         | 401337          | 401337  | 0 | .031                 | .031    | .000 | .041            | .041    | .000 |
| 33         | 401302          | 401302  | 0 | .031                 | .032    | .001 | .041            | .041    | .000 |
| 34         | 401326          | 401326  | 0 | .029                 | .029    | .000 | .038            | .038    | .000 |
| 35         | 401295          | 401295  | 0 | .030                 | .031    | .001 | .039            | .039    | .000 |
| 36         | 401309          | 401309  | 0 | .030                 | .030    | .000 | .038            | .038    | .000 |
| 37         | 401257          | 401257  | 0 | .034                 | .034    | .000 | .043            | .043    | .000 |
| 38         | 401293          | 401293  | 0 | .034                 | .034    | .000 | .043            | .043    | .000 |

## Air Mass (lbs.)

## Leakage Rate (x/day)

| Data<br>Point | Fort    |         |   | Fort    |         |   |
|---------------|---------|---------|---|---------|---------|---|
|               | Calhoun | Bechtel | d | Calhoun | Bechtel | d |

## Verification

|    |        |        |   |       |      |      |
|----|--------|--------|---|-------|------|------|
| 1  | 401268 | 401269 | 1 |       |      |      |
| 2  | 401297 | 401297 | 0 | -.692 |      |      |
| 3  | 401275 | 401275 | 0 | -.074 |      |      |
| 4  | 401233 | 401234 | 1 | .306  | .307 | .001 |
| 5  | 401270 | 401270 | 0 | .146  | .148 | .002 |
| 6  | 401269 | 401269 | 0 | .083  | .085 | .002 |
| 7  | 401232 | 401232 | 0 | .146  | .147 | .001 |
| 8  | 401245 | 401245 | 0 | .134  | .134 | .000 |
| 9  | 401245 | 401245 | 0 | .119  | .120 | .001 |
| 10 | 401218 | 401218 | 0 | .141  | .141 | .000 |
| 11 | 401176 | 401177 | 1 | .191  | .192 | .001 |
| 12 | 401250 | 401251 | 1 | .145  | .145 | .000 |
| 13 | 401216 | 401216 | 0 | .139  | .140 | .001 |
| 14 | 401215 | 401215 | 0 | .132  | .133 | .001 |
| 15 | 401206 | 401206 | 0 | .130  | .130 | .000 |
| 16 | 401207 | 401207 | 0 | .125  | .126 | .001 |
| 17 | 401171 | 401171 | 0 | .136  | .137 | .001 |

APPENDIX C

Stabilization Summary Data

FORT CALHOUN ILRT  
TEMPERATURE STABILIZATION

FROM A STARTING TIME AND DATE OF: 1030 1009 1985

| TIME<br>(HOURS) | TEMP<br>( R ) | AVE T<br>(4HRS) | ANSI<br>AVE T<br>(1HR) | DIFF |
|-----------------|---------------|-----------------|------------------------|------|
|-----------------|---------------|-----------------|------------------------|------|

|      |        |      |      |       |
|------|--------|------|------|-------|
| .00  | 529.87 |      |      |       |
| .25  | 529.88 |      |      |       |
| .50  | 529.88 |      |      |       |
| .75  | 529.87 |      |      |       |
| 1.00 | 529.90 |      |      |       |
| 1.25 | 529.87 |      |      |       |
| 1.50 | 529.86 |      |      |       |
| 1.75 | 529.92 |      |      |       |
| 2.00 | 529.89 |      |      |       |
| 2.25 | 529.89 |      |      |       |
| 2.50 | 529.92 |      |      |       |
| 2.75 | 529.89 |      |      |       |
| 3.00 | 529.86 |      |      |       |
| 3.25 | 529.89 |      |      |       |
| 3.50 | 529.89 |      |      |       |
| 3.75 | 529.89 |      |      |       |
| 4.00 | 529.94 | .015 | .071 | -.06* |

\* INDICATES TEMPERATURE STABILIZATION HAS BEEN SATISFIED

APPENDIX D

ILRT Summary Data and Mass Point Report

SU-088b



FORT CALHOUN ILRT  
SUMMARY DATA

| TIME | DATE | TEMP    | PRESSURE | VPRS  | VOLUME   |
|------|------|---------|----------|-------|----------|
| 1500 | 1009 | 529.893 | 75.0437  | .1697 | 1050000. |
| 1515 | 1009 | 529.930 | 75.0414  | .1715 | 1050000. |
| 1530 | 1009 | 529.912 | 75.0436  | .1703 | 1050000. |
| 1600 | 1009 | 529.907 | 75.0420  | .1709 | 1050000. |
| 1615 | 1009 | 529.911 | 75.0438  | .1702 | 1050000. |
| 1630 | 1009 | 529.909 | 75.0419  | .1726 | 1050000. |
| 1645 | 1009 | 529.928 | 75.0429  | .1716 | 1050000. |
| 1700 | 1009 | 529.927 | 75.0430  | .1709 | 1050000. |
| 1715 | 1009 | 529.912 | 75.0434  | .1701 | 1050000. |
| 1730 | 1009 | 529.922 | 75.0400  | .1735 | 1050000. |
| 1745 | 1009 | 529.945 | 75.0416  | .1713 | 1050000. |
| 1800 | 1009 | 529.930 | 75.0412  | .1712 | 1050000. |
| 1815 | 1009 | 529.898 | 75.0431  | .1694 | 1050000. |
| 1830 | 1009 | 529.938 | 75.0409  | .1711 | 1050000. |
| 1900 | 1009 | 529.939 | 75.0435  | .1689 | 1050000. |
| 1915 | 1009 | 529.925 | 75.0402  | .1717 | 1050000. |
| 1930 | 1009 | 529.898 | 75.0420  | .1700 | 1050000. |
| 1945 | 1009 | 529.934 | 75.0423  | .1696 | 1050000. |
| 2015 | 1009 | 529.935 | 75.0401  | .1704 | 1050000. |
| 2030 | 1009 | 529.931 | 75.0402  | .1703 | 1050000. |
| 2045 | 1009 | 529.947 | 75.0401  | .1704 | 1050000. |
| 2100 | 1009 | 529.915 | 75.0393  | .1711 | 1050000. |
| 2115 | 1009 | 529.895 | 75.0384  | .1720 | 1050000. |
| 2130 | 1009 | 529.955 | 75.0382  | .1718 | 1050000. |
| 2145 | 1009 | 529.917 | 75.0388  | .1701 | 1050000. |
| 2200 | 1009 | 529.940 | 75.0378  | .1706 | 1050000. |
| 2215 | 1009 | 529.922 | 75.0367  | .1712 | 1050000. |
| 2230 | 1009 | 529.941 | 75.0386  | .1700 | 1050000. |
| 2245 | 1009 | 529.924 | 75.0379  | .1700 | 1050000. |
| 2300 | 1009 | 529.929 | 75.0369  | .1710 | 1050000. |
| 2315 | 1009 | 529.922 | 75.0361  | .1708 | 1050000. |
| 2330 | 1009 | 529.880 | 75.0359  | .1715 | 1050000. |
| 2345 | 1009 | 529.917 | 75.0346  | .1718 | 1050000. |
| 0    | 1010 | 529.896 | 75.0359  | .1710 | 1050000. |
| 15   | 1010 | 529.924 | 75.0343  | .1721 | 1050000. |
| 30   | 1010 | 529.922 | 75.0365  | .1694 | 1050000. |
| 45   | 1010 | 529.958 | 75.0320  | .1729 | 1050000. |
| 100  | 1010 | 529.919 | 75.0331  | .1718 | 1050000. |

FORT CALHOUN ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
MASS POINT ANALYSIS

TIME AND DATE AT START OF TEST: 1500 1009 1985  
TEST DURATION: 10.00 HOURS

| TIME | TEMP<br>(R) | PRESSURE<br>(PSIA) | CTMT. AIR<br>MASS (LBM) | MASS LOSS<br>(LBM) | AVERAGE MASS<br>LOSS (LBM/HR) |
|------|-------------|--------------------|-------------------------|--------------------|-------------------------------|
| 1500 | 529.893     | 75.0437            | 401370.                 |                    |                               |
| 1515 | 529.930     | 75.0414            | 401329.                 | 40.6               | 162.4                         |
| 1530 | 529.912     | 75.0436            | 401354.                 | -25.0              | 31.2                          |
| 1600 | 529.907     | 75.0420            | 401349.                 | 4.7                | 20.3                          |
| 1615 | 529.911     | 75.0438            | 401356.                 | -6.6               | 11.0                          |
| 1630 | 529.909     | 75.0419            | 401347.                 | 8.6                | 14.9                          |
| 1645 | 529.928     | 75.0429            | 401338.                 | 9.0                | 17.9                          |
| 1700 | 529.927     | 75.0430            | 401340.                 | -1.5               | 14.9                          |
| 1715 | 529.912     | 75.0434            | 401353.                 | -13.0              | 7.5                           |
| 1730 | 529.922     | 75.0400            | 401327.                 | 26.1               | 17.1                          |
| 1745 | 529.945     | 75.0416            | 401319.                 | 8.0                | 18.5                          |
| 1800 | 529.930     | 75.0412            | 401328.                 | -9.3               | 13.8                          |
| 1815 | 529.898     | 75.0431            | 401362.                 | -34.0              | 2.3                           |
| 1830 | 529.938     | 75.0409            | 401320.                 | 41.9               | 14.1                          |
| 1900 | 529.939     | 75.0435            | 401333.                 | -13.0              | 9.1                           |
| 1915 | 529.925     | 75.0402            | 401327.                 | 6.6                | 10.1                          |
| 1930 | 529.898     | 75.0420            | 401356.                 | -29.7              | 3.0                           |
| 1945 | 529.934     | 75.0423            | 401331.                 | 25.4               | 8.2                           |
| 2015 | 529.935     | 75.0401            | 401318.                 | 13.1               | 9.9                           |
| 2030 | 529.931     | 75.0402            | 401321.                 | -3.6               | 8.8                           |
| 2045 | 529.947     | 75.0401            | 401309.                 | 12.7               | 10.6                          |
| 2100 | 529.915     | 75.0393            | 401329.                 | -20.3              | 6.8                           |
| 2115 | 529.895     | 75.0384            | 401339.                 | -10.3              | 4.9                           |
| 2130 | 529.955     | 75.0382            | 401293.                 | 46.3               | 11.8                          |
| 2145 | 529.917     | 75.0388            | 401325.                 | -31.9              | 6.6                           |
| 2200 | 529.940     | 75.0378            | 401302.                 | 22.9               | 9.7                           |
| 2215 | 529.922     | 75.0367            | 401310.                 | -8.0               | 8.2                           |
| 2230 | 529.941     | 75.0386            | 401305.                 | 4.6                | 8.6                           |
| 2245 | 529.924     | 75.0379            | 401314.                 | -8.9               | 7.2                           |
| 2300 | 529.929     | 75.0369            | 401306.                 | 8.8                | 8.0                           |
| 2315 | 529.922     | 75.0361            | 401307.                 | -1.0               | 7.7                           |
| 2330 | 529.880     | 75.0359            | 401337.                 | -30.8              | 3.8                           |
| 2345 | 529.917     | 75.0346            | 401302.                 | 35.0               | 7.7                           |
| 0    | 529.896     | 75.0359            | 401326.                 | -23.3              | 4.9                           |
| 15   | 529.924     | 75.0343            | 401295.                 | 30.3               | 8.0                           |
| 30   | 529.922     | 75.0365            | 401309.                 | -13.6              | 6.4                           |
| 45   | 529.958     | 75.0320            | 401257.                 | 51.7               | 11.5                          |
| 100  | 529.919     | 75.0331            | 401293.                 | -35.8              | 7.7                           |

|                                       |           |
|---------------------------------------|-----------|
| FREE AIR VOLUME USED (CU. FT.)        | =1050000. |
| REGRESSION LINE                       |           |
| INTERCEPT (LBM)                       | = 401354. |
| SLOPE (LBM/HR)                        | = -5.8    |
| MAXIMUM ALLOWABLE LEAKAGE RATE        | = .100    |
| 75% OF MAXIMUM ALLOWABLE LEAKAGE RATE | = .075    |
| THE UPPER 95% CONFIDENCE LIMIT        | = .043    |
| THE CALCULATED LEAKAGE RATE           | = .034    |

APPENDIX E

Verification Summary Data and Mass Point Report

FORT CALHOUN ILRT  
SUMMARY DATA

| TIME | DATE | TEMP    | PRESSURE | VPRS  | VOLUME   |
|------|------|---------|----------|-------|----------|
| 330  | 1010 | 529.991 | 75.0388  | .1722 | 1050000. |
| 345  | 1010 | 529.978 | 75.0423  | .1729 | 1050000. |
| 400  | 1010 | 529.986 | 75.0393  | .1701 | 1050000. |
| 415  | 1010 | 530.010 | 75.0349  | .1730 | 1050000. |
| 430  | 1010 | 529.979 | 75.0373  | .1701 | 1050000. |
| 445  | 1010 | 529.959 | 75.0343  | .1716 | 1050000. |
| 500  | 1010 | 529.998 | 75.0330  | .1719 | 1050000. |
| 515  | 1010 | 529.981 | 75.0330  | .1706 | 1050000. |
| 530  | 1010 | 529.977 | 75.0324  | .1700 | 1050000. |
| 545  | 1010 | 529.988 | 75.0289  | .1717 | 1050000. |
| 600  | 1010 | 530.037 | 75.0280  | .1706 | 1050000. |
| 615  | 1010 | 529.934 | 75.0273  | .1701 | 1050000. |
| 630  | 1010 | 529.959 | 75.0244  | .1720 | 1050000. |
| 645  | 1010 | 529.958 | 75.0242  | .1702 | 1050000. |
| 700  | 1010 | 529.940 | 75.0199  | .1722 | 1050000. |
| 715  | 1010 | 529.953 | 75.0219  | .1700 | 1050000. |
| 730  | 1010 | 529.964 | 75.0167  | .1722 | 1050000. |

FORT CALHOUN ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
MASS POINT ANALYSIS

TIME AND DATE AT START OF TEST: 330 1010 1985  
TEST DURATION: 4.00 HOURS

| TIME | TEMP<br>(R) | PRESSURE<br>(PSIA) | CTMT. AIR<br>MASS (LBM) | MASS LOSS<br>(LBM) | AVERAGE MASS<br>LOSS (LBM/HR) |
|------|-------------|--------------------|-------------------------|--------------------|-------------------------------|
| 330  | 529.991     | 75.0388            | 401269.                 |                    |                               |
| 345  | 529.978     | 75.0423            | 401297.                 | -28.7              | -114.7                        |
| 400  | 529.986     | 75.0393            | 401275.                 | 22.4               | -12.6                         |
| 415  | 530.010     | 75.0349            | 401234.                 | 41.5               | 47.0                          |
| 430  | 529.979     | 75.0373            | 401270.                 | -36.3              | -1.0                          |
| 445  | 529.959     | 75.0343            | 401269.                 | 1.0                | .0                            |
| 500  | 529.998     | 75.0330            | 401232.                 | 36.5               | 24.3                          |
| 515  | 529.981     | 75.0330            | 401245.                 | -13.1              | 13.4                          |
| 530  | 529.977     | 75.0324            | 401245.                 | .2                 | 11.8                          |
| 545  | 529.988     | 75.0289            | 401218.                 | 26.9               | 22.5                          |
| 600  | 530.037     | 75.0280            | 401177.                 | 41.6               | 36.9                          |
| 615  | 529.934     | 75.0273            | 401251.                 | -74.0              | 6.6                           |
| 630  | 529.959     | 75.0244            | 401216.                 | 34.3               | 17.5                          |
| 645  | 529.958     | 75.0242            | 401215.                 | 1.1                | 16.5                          |
| 700  | 529.940     | 75.0199            | 401206.                 | 9.1                | 17.9                          |
| 715  | 529.953     | 75.0219            | 401207.                 | -.8                | 16.5                          |
| 730  | 529.964     | 75.0167            | 401171.                 | 35.8               | 24.4                          |

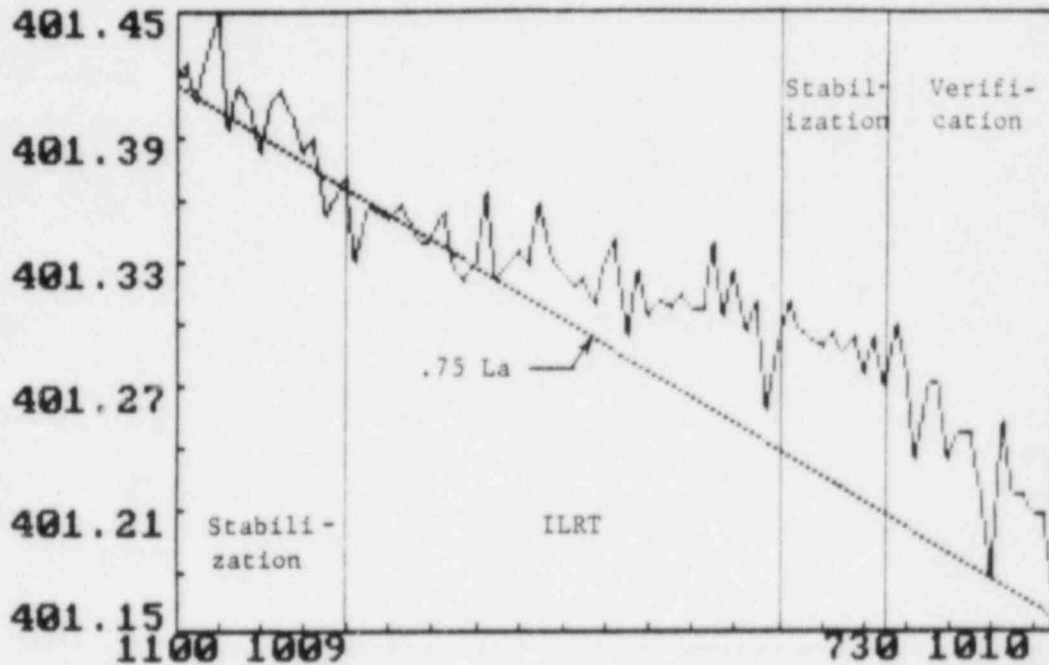
|  |           |
|--|-----------|
| FREE AIR VOLUME USED (CU. FT.)             | =1050000. |
| REGRESSION LINE                            |           |
| INTERCEPT (LBM)                            | = 401281. |
| SLOPE (LBM/HR)                             | = -22.8   |
| VERIFICATION TEST LEAKAGE RATE UPPER LIMIT | = .159    |
| VERIFICATION TEST LEAKAGE RATE LOWER LIMIT | = .109    |
| THE CALCULATED LEAKAGE RATE                | = .137    |

APPENDIX F

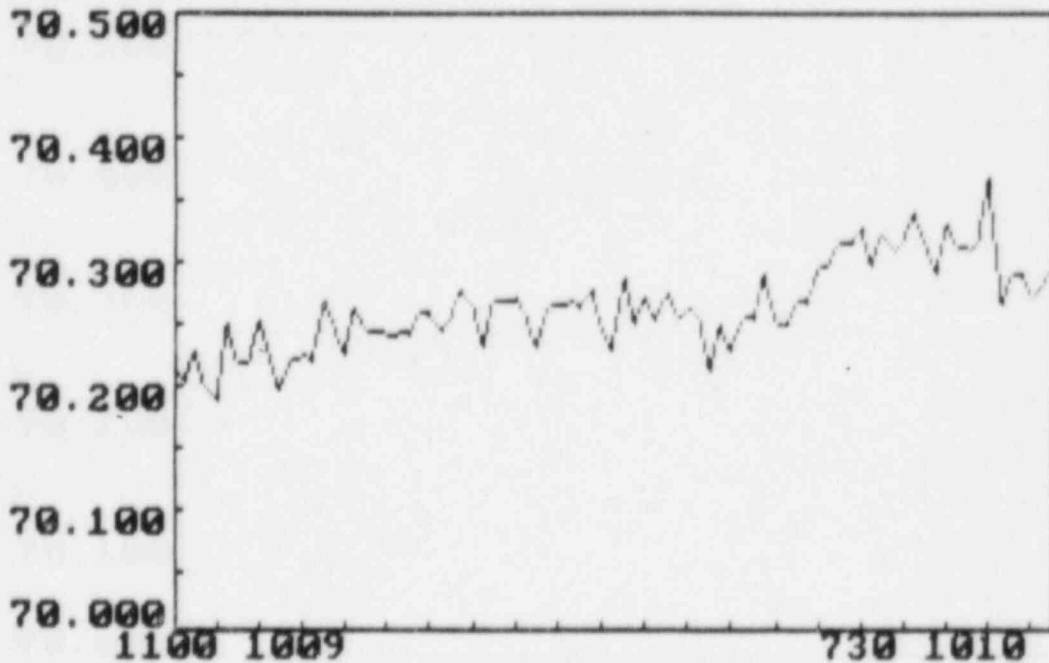
PLOTS

- Stabilization & ILRT & Verification
- Air Mass
- Temperature
- Pressure
- Vapor Pressure

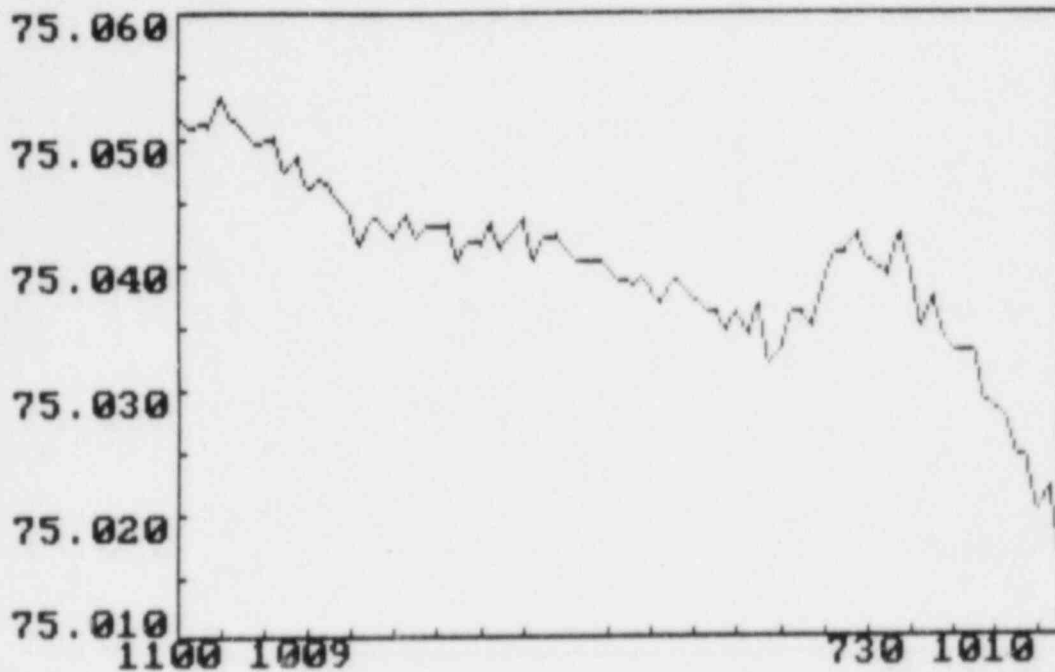
FORT CALHOUN ILRT  
AIRMASS LBM X 1000



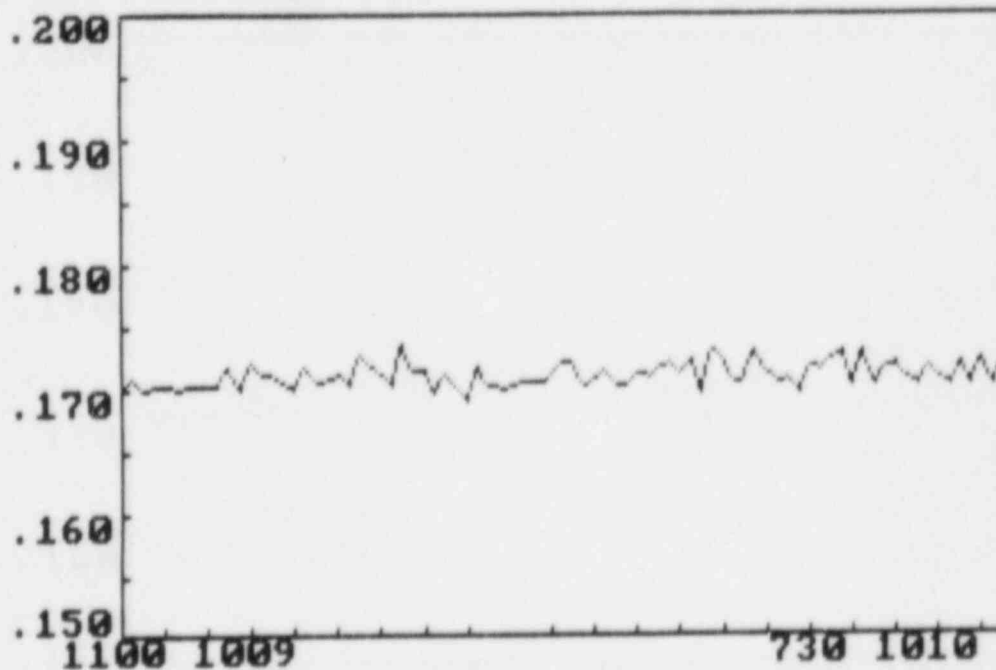
FORT CALHOUN ILRT  
TEMPERATURE DEGREES F



FORT CALHOUN ILRT  
PRESSURE PSIA (DRY AIR)



FORT CALHOUN ILRT  
VAPOR PRESSURE PSIA

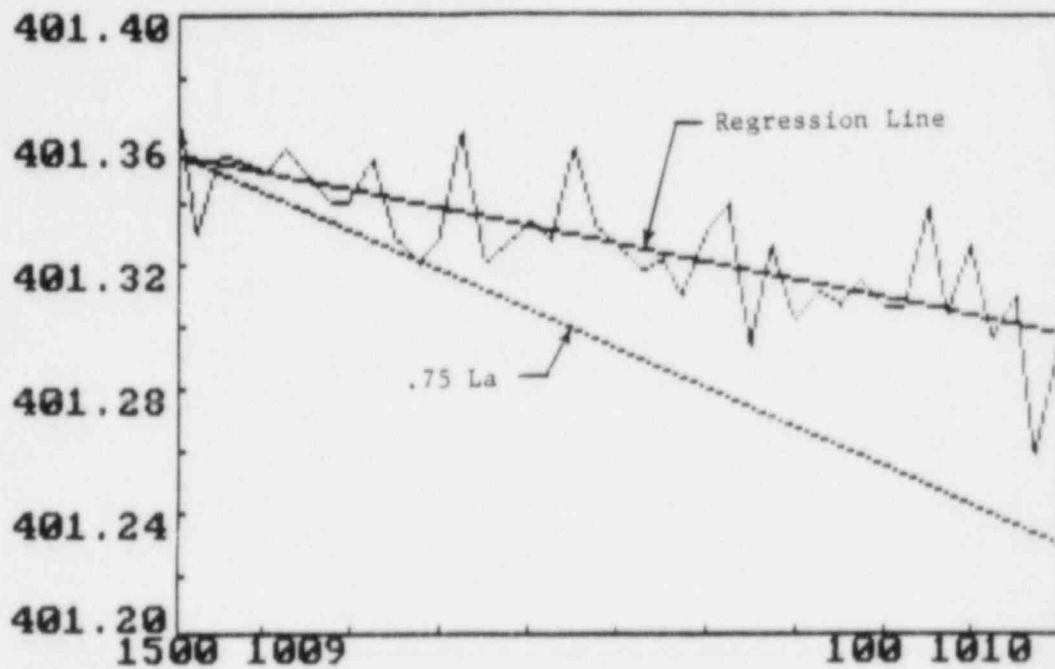




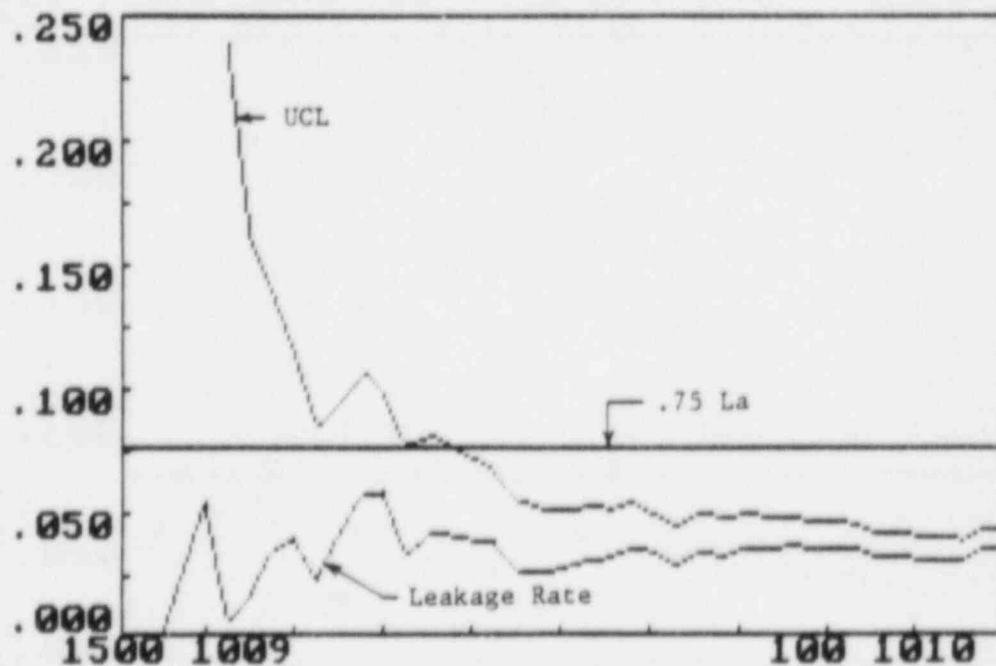
PLOTS

- ILRT
- Air Mass
- Mass Point Leakage Rate and UCL
- Bad Data Points (Temperature Sensors)

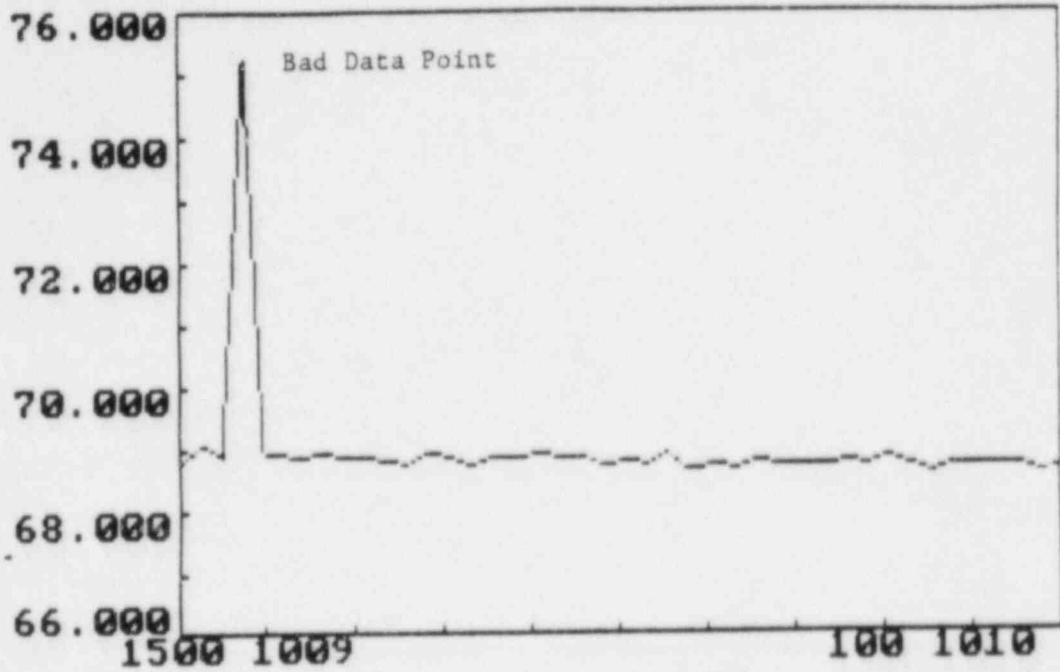
FORT CALHOUN ILRT  
AIRMASS LBM X 1000



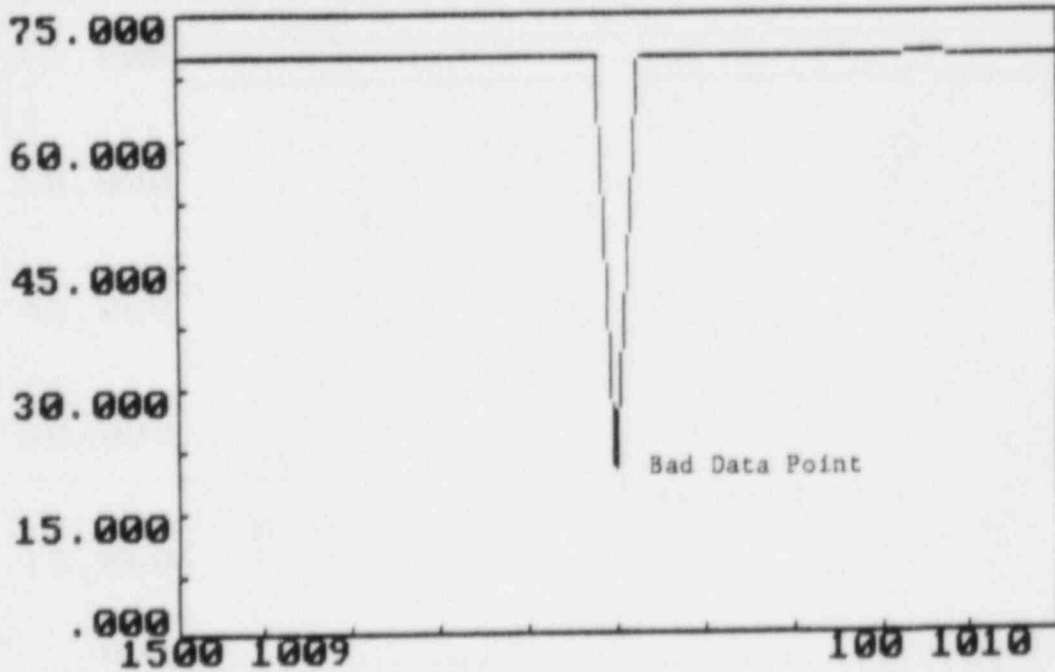
FORT CALHOUN ILRT  
MASS POINT LEAKAGE RATE AND UCL - %/DAY



FORT CALHOUN ILRT  
TEMPERATURE SENSOR 8 DEGREES F



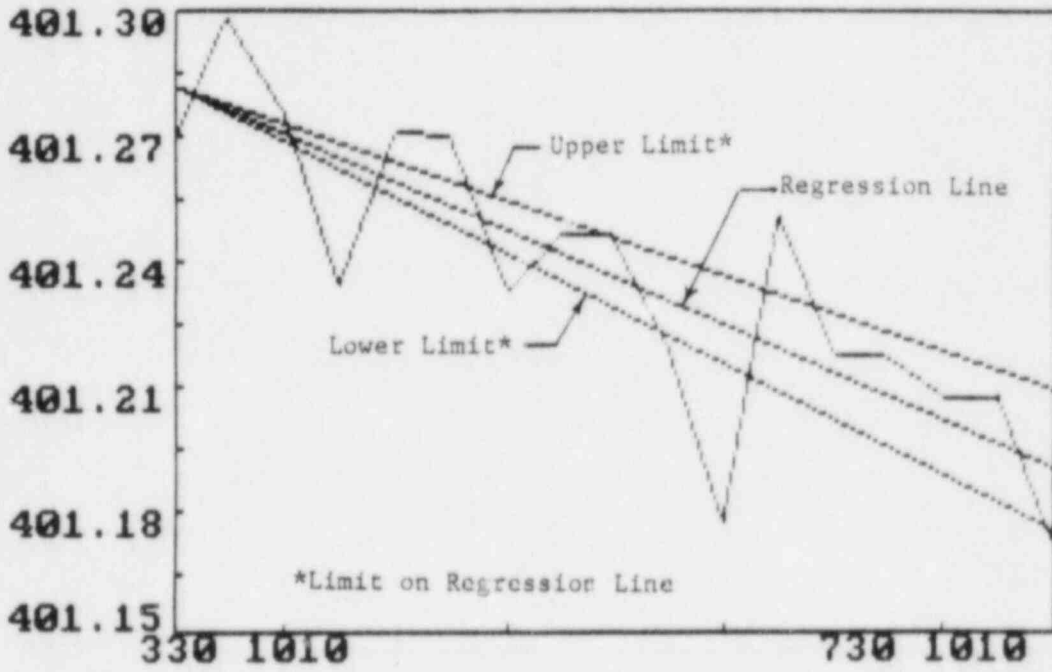
FORT CALHOUN ILRT  
TEMPERATURE SENSOR 17 DEGREES F



PLOTS

- Verification
- Air Mass
- Mass Point Leakage Rate

FORT CALHOUN ILRT (Verification)  
 AIRMASS LBM X 1000



APPENDIX G  
ISG Calculation

ISG CALCULATION  
( ANSI/ANS 56.8 - 1981 )

=====

CALIBRATION DATA

|                  | # OF SENSORS | SENSITIVITY(E) | REPEATABILITY(r) |
|------------------|--------------|----------------|------------------|
| TEMPERATURE (T)  | 30           | 0.0100 deg. F  | 0.0500 deg. F    |
| PRESSURE (P)     | 2            | 0.0010 psia    | 0.0010 psia      |
| VAPOR PRESS (Pv) | 10           | 0.0100 deg. F  | 0.0500 deg. F    |

-----

Length of Test (t)      10.0 hrs

Test Pressure (P)      60.0 psig ==>    74.7 psia

From Steam Table      0.0063 psi/deg. F (at 43 deg. F)

La                      0.1000 wt%/day

-----

INSTRUMENT MEASUREMENT ERRORS

$$e_T = [ (e_T)^2 + (r_T)^2 ]^{1/2} / [\# \text{ of sensors}]^{1/2}$$

$$e_T = 0.0093 \text{ deg. F}$$

$$e_P = [ (e_P)^2 + (r_P)^2 ]^{1/2} / [\# \text{ of sensors}]^{1/2}$$

$$e_P = 0.0010 \text{ psia}$$

$$e_{Pv} = [ (e_{Pv})^2 + (r_{Pv})^2 ]^{1/2} / [\# \text{ of sensors}]^{1/2}$$

$$e_{Pv} = 0.0001 \text{ psia}$$

-----

INSTRUMENT SELECTION GUIDE

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

$$ISG = 0.0074 \text{ wt\%/day}$$

$$25\% \text{ of } La = 0.0250 \text{ wt\%/day}$$

=====

APPENDIX H

Local Leakage Rate Test Results



PERSONNEL AIR LOCK LEAK RATE TEST

ST-CONT-2, F.2

From previous ILRT-Type A to most recent, 1-11-83 to 10-7-85

|         |           |
|---------|-----------|
| 4-12-83 | 3150 sccm |
| 1-25-84 | 3800 sccm |
| 7-14-84 | 1950 sccm |
| 1-23-85 | 3560 sccm |
| 6-6-85  | 3600 sccm |

EQUIPMENT HATCH 'O' RING SEAL TEST

ST-CONT-2, F.3

From previous ILRT-Type A to most recent, 1-11-83 to 10-7-85

|         |           |
|---------|-----------|
| 1-14-83 | 0 sccm    |
| 1-19-83 | 0 sccm    |
| 3-26-83 | 3.44 sccm |
| 3-5-84  | 0 sccm    |
| 3-29-84 | 2 sccm    |
| 4-5-84  | 0 sccm    |
| 5-7-85  | 0 sccm    |
| 10-3-85 | 0 sccm    |

FUEL TRANSFER TUBE LEAK RATE TEST

ST-CONT-2, F.4

From previous ILRT-Type A to most recent, 1-11-83 to 10-7-85

|         |           |
|---------|-----------|
| 3-22-83 | 3.10 sccm |
| 3-12-84 | 2 sccm    |
| 4-28-84 | 3000 sccm |
| 4-29-84 | 1 sccm    |
| 10-5-85 | 1.11 sccm |

## ELECTRICAL PENETRATION - TYPE B TEST

ST-CONT-2, F.5

| Penetration | 1983                    | 1984               |                   | 1985                       |
|-------------|-------------------------|--------------------|-------------------|----------------------------|
|             | after 1-11-83<br>(SCCM) | As Found<br>(SCCM) | As Left<br>(SCCM) | Prior to 10-7-85<br>(SCCM) |
| A-1         | N/T                     | 0                  | 0                 | 0                          |
| A-2         | N/T                     | 0                  | 0                 | 0                          |
| A-3         | N/T                     | 0                  | 0                 | 0                          |
| A-4         | N/T                     | 0                  | 0                 | 0                          |
| A-5         | N/T                     | 0                  | 0                 | 0                          |
| A-6         | N/T                     | 0                  | 0                 | 0                          |
| A-7         | N/T                     | 0                  | 0                 | 0                          |
| A-8         | N/T                     | 0                  | 0                 | 0                          |
| A-9         | N/T                     | 0                  | 0                 | 0                          |
| A-10        | 0                       | 0                  | 0                 | 0                          |
| A-11        | N/T                     | 0                  | 0                 | 0                          |
| B-1         | N/T                     | 0                  | 0                 | 0                          |
| B-2         | N/T                     | 0                  | 0                 | 0                          |
| B-3         | N/T                     | 0                  | 0                 | 0                          |
| B-4         | N/T                     | 0                  | 0                 | 0                          |
| B-5         | N/T                     | 0                  | 0                 | 0                          |
| B-6         | N/T                     | 0                  | 0                 | 0                          |
| B-7         | N/T                     | 0                  | 0                 | 0                          |
| B-8         | N/T                     | 0                  | 0                 | 0                          |
| B-9         | N/T                     | 0                  | 0                 | 0                          |
| B-10        | N/T                     | 0                  | 0                 | 0                          |
| B-11        | N/T                     | 0                  | 0                 | 0                          |

| Penetration | 1983                    | 1984               |                   | 1985                       |
|-------------|-------------------------|--------------------|-------------------|----------------------------|
|             | after 1-11-83<br>(SCCM) | As Found<br>(SCCM) | As Left<br>(SCCM) | Prior to 10-7-85<br>(SCCM) |
| C-1         | N/T                     | 0                  | 0                 | 0                          |
| C-2         | N/T                     | 0                  | 0                 | 0                          |
| C-3         | N/T                     | 0                  | 0                 | 0                          |
| C-4         | N/T                     | 0                  | 0                 | 0                          |
| C-5         | N/T                     | 0                  | 0                 | 0                          |
| C-6         | N/T                     | 0                  | 0                 | 0                          |
| C-7         | N/T                     | 0                  | 0                 | 0                          |
| C-8         | N/T                     | 0                  | 0                 | 0                          |
| C-9         | N/T                     | 0                  | 0                 | 0                          |
| C-10        | N/T                     | 0                  | 0                 | 8                          |
| C-11        | N/T                     | 0                  | 0                 | 0                          |
| D-1         | N/T                     | 0                  | 0                 | 0                          |
| D-2         | N/T                     | 0                  | 0                 | 0                          |
| D-3         | N/T                     | 0                  | 0                 | 0                          |
| D-4         | N/T                     | 0                  | 0                 | 0                          |
| D-5         | N/T                     | 0                  | 0                 | 0                          |
| D-6         | N/T                     | 0                  | 0                 | 0                          |
| D-7         | N/T                     | 0                  | 0                 | 0                          |
| D-8         | N/T                     | 0                  | 0                 | 0                          |
| D-9         | N/T                     | 0                  | 0                 | 0                          |
| D-10        | N/T                     | 0                  | 0                 | 0                          |
| D-11        | 0                       | 0                  | 29.67             | 0                          |
| E-1         | N/T                     | 0                  | 0                 | 0                          |
| E-2         | N/T                     | 0                  | 0                 | 0                          |
| E-3         | N/T                     | 0                  | 0                 | 0                          |
| E-4         | N/T                     | 0                  | 0                 | 0                          |
| E-5         | N/T                     | 0                  | 0                 | 0                          |

| Penetration  | 1983<br>after 1-11-83<br>(SCCM) | 1984<br>As Found<br>(SCCM) | 1984<br>As Left<br>(SCCM) | 1985<br>Prior to 10-7-85<br>(SCCM) |
|--------------|---------------------------------|----------------------------|---------------------------|------------------------------------|
| E-6          | N/T                             | 0                          | 0                         | 0                                  |
| E-7          | N/T                             | 0                          | 0                         | 0                                  |
| E-8          | N/T                             | 0                          | 0                         | 0                                  |
| E-9          | N/T                             | 0                          | 0                         | 0                                  |
| E-10         | N/T                             | 0                          | 0                         | 0                                  |
| E-11         | 0                               | 0                          | 0                         | 0                                  |
| F-1          | N/T                             | 0                          | 0                         | 0                                  |
| F-2          | N/T                             | 0                          | 0                         | 0                                  |
| F-3          | N/T                             | 0                          | 0                         | 0                                  |
| F-4          | N/T                             | 0                          | 0                         | 0                                  |
| F-5          | N/T                             | 0                          | 0                         | 0                                  |
| F-6          | N/T                             | 0                          | 0                         | 0                                  |
| F-7          | N/T                             | 0                          | 0                         | 0                                  |
| F-8          | N/T                             | 0                          | 0                         | 0                                  |
| F-9          | N/T                             | 0                          | 0                         | 0                                  |
| F-10         | N/T                             | 0                          | 0                         | 0                                  |
| F-11         | N/T                             | 12.9                       | 12.9                      | 0                                  |
| G-1          | N/T                             | 0                          | 0                         | 0                                  |
| G-2          | N/T                             | 0                          | 0                         | 0                                  |
| G-3          | N/T                             | 0                          | 0                         | 0                                  |
| G-4          | N/T                             | 0                          | 0                         | 0                                  |
| H-1          | N/T                             | 0                          | 0                         | 0                                  |
| H-2          | N/T                             | 0                          | 0                         | 0                                  |
| H-3          | N/T                             | 0                          | 0                         | 0                                  |
| H-4          | N/T                             | 0                          | 0                         | 0                                  |
| E-HCV-383-3A | N/T                             | 4.33                       | 4.33                      | 0                                  |
| E-HCV-383-3B | N/T                             | 0                          | 0                         | 1                                  |

| Penetration  | 1983<br>after 1-11-83<br>(SCCM) | 1984<br>As Found<br>(SCCM) | 1984<br>As Left<br>(SCCM) | 1985<br>Prior to 10-7-85<br>(SCCM) |
|--------------|---------------------------------|----------------------------|---------------------------|------------------------------------|
| E-HCV-383-4A | N/T                             | 0                          | 0                         | 2                                  |
| E-HCV-383-4B | N/T<br>-----                    | 0<br>-----                 | 0<br>-----                | 213<br>-----                       |
| Total        | 0                               | 17.23                      | 46.9                      | 223                                |

N/T - Not Tested

MECHANICAL SLEEVE LEAK RATE - TYPE B TEST

ST-CONT-2, F.6

| Penetration | 1983                    | 1984               |                   | 1985                       |
|-------------|-------------------------|--------------------|-------------------|----------------------------|
|             | after 1-11-83<br>(SCCM) | As Found<br>(SCCM) | As Left<br>(SCCM) | Prior to 10-7-85<br>(SCCM) |
| M-1         | N/T                     | 0                  | 0                 | 0                          |
| M-2         | N/T                     | 0                  | 0                 | 0                          |
| M-3         | N/T                     | 0                  | 0                 | 0                          |
| M-4         | N/T                     | 0                  | 0                 | 0                          |
| M-5         | N/T                     | 0                  | 0                 | 0                          |
| M-6         | N/T                     | 0                  | 0                 | 0                          |
| M-7         | N/T                     | 0                  | 0                 | 0                          |
| M-8         | N/T                     | 0                  | 0                 | 0                          |
| M-9         | N/T                     | 0                  | 0                 | 0                          |
| M-10        | N/T                     | 0                  | 0                 | 0                          |
| M-11        | N/T                     | 0                  | 0                 | 0                          |
| M-12        | N/T                     | 0                  | 0                 | 0                          |
| M-13        | N/T                     | 0                  | 0                 | 0                          |
| M-14        | N/T                     | 0                  | 0                 | 0                          |
| M-15        | N/T                     | 0                  | 0                 | 0                          |
| M-16        | N/T                     | 0                  | 0                 | 0                          |
| M-17        | N/T                     | 0                  | 0                 | 0                          |
| M-18        | N/T                     | 0                  | 0                 | 0                          |
| M-19        | N/T                     | 0                  | 0                 | 0                          |
| M-20        | N/T                     | 0                  | 0                 | 0                          |
| M-21        | N/T                     | 0                  | 0                 | 0                          |
| M-22        | N/T                     | 0                  | 0                 | 0                          |



| Penetration | 1983                    | 1984               |                   | 1985                       |
|-------------|-------------------------|--------------------|-------------------|----------------------------|
|             | after 1-11-83<br>(SCCM) | As Found<br>(SCCM) | As Left<br>(SCCM) | Prior to 10-7-85<br>(SCCM) |
| M-23        | N/T                     | 0                  | 0                 | 0                          |
| M-24        | N/T                     | 0                  | 0                 | 0                          |
| M-25        | N/T                     | 0                  | 0                 | 0                          |
| M-26        | N/T                     | 0                  | 0                 | 0                          |
| M-27        | N/T                     | 0                  | 0                 | 0                          |
| M-28        | N/T                     | 0                  | 0                 | 0                          |
| M-29        | N/T                     | 0                  | 0                 | 0                          |
| M-30        | N/T                     | 0                  | 0                 | 0                          |
| M-31        | N/T                     | 0                  | 0                 | 0                          |
| M-32        | N/T                     | 0                  | 0                 | 0                          |
| M-33        | N/T                     | 0                  | 0                 | 0                          |
| M-34        | N/T                     | 0                  | 0                 | 0                          |
| M-35        | N/T                     | 0                  | 0                 | 0                          |
| M-36        | N/T                     | 0                  | 0                 | 0                          |
| M-37        | N/T                     | 0                  | 0                 | 0                          |
| M-38        | N/T                     | 0                  | 0                 | 0                          |
| M-39        | N/T                     | 0                  | 0                 | 0                          |
| M-40        | N/T                     | 0                  | 0                 | 0                          |
| M-41        | N/T                     | 0                  | 0                 | 0                          |
| M-42        | N/T                     | 0                  | 0                 | 0                          |
| M-43        | N/T                     | 0                  | 0                 | 0                          |
| M-44        | N/T                     | 0                  | 0                 | 0                          |
| M-45        | N/T                     | 0                  | 0                 | 0                          |
| M-46        | N/T                     | 0                  | 0                 | 0                          |
| M-47        | N/T                     | 0                  | 0                 | 0                          |
| M-48        | N/T                     | 6.66               | 6.66              | 7                          |
| M-49        | N/T                     | 0                  | 0                 | 0                          |

| Penetration | 1983<br>after 1-11-83<br>(SCCM) | 1984<br>As Found<br>(SCCM) | 1984<br>As Left<br>(SCCM) | 1985<br>Prior to 10-7-85<br>(SCCM) |
|-------------|---------------------------------|----------------------------|---------------------------|------------------------------------|
| M-50        | N/T                             | 0                          | 0                         | 0                                  |
| M-51        | N/T                             | 0                          | 0                         | 0                                  |
| M-52        | N/T                             | 43.2                       | 43.2                      | 9                                  |
| M-53        | N/T                             | 0                          | 0                         | 0                                  |
| M-54        | N/T                             | 0                          | 0                         | 0                                  |
| M-55        | N/T                             | 0                          | 0                         | 0                                  |
| M-56        | N/T                             | 0                          | 0                         | 0                                  |
| M-57        | N/T                             | 0                          | 0                         | 0                                  |
| M-58        | N/T                             | 0                          | 0                         | 0                                  |
| M-59        | N/T                             | 0                          | 0                         | 0                                  |
| M-60        | N/T                             | 0                          | 0                         | 0                                  |
| M-61        | N/T                             | 0                          | 0                         | 0                                  |
| M-62        | N/T                             | 0                          | 0                         | 0                                  |
| M-63        | N/T                             | 0                          | 0                         | 0                                  |
| M-64        | N/T                             | 0                          | 0                         | 0                                  |
| M-65        | N/T                             | 0                          | 0                         | 0                                  |
| M-66        | N/T                             | 0                          | 0                         | 0                                  |
| M-67        | N/T                             | 0                          | 0                         | 0                                  |
| M-68        | N/T                             | 0                          | 0                         | 0                                  |
| M-69        | N/T                             | 0                          | 0                         | 0                                  |
| M-70        | N/T                             | 0                          | 0                         | 0                                  |
| M-71        | N/T                             | 0                          | 0                         | 0                                  |
| M-72        | N/T                             | 0                          | 0                         | 0                                  |
| M-73        | N/T                             | 0                          | 0                         | 0                                  |
| M-74        | N/T                             | 0                          | 0                         | 0                                  |
| M-75        | N/T                             | 0                          | 0                         | 0                                  |
| M-76        | N/T                             | 0                          | 0                         | 0                                  |

| Penetration | 1983                    | 1984               |                   | 1985                       |
|-------------|-------------------------|--------------------|-------------------|----------------------------|
|             | after 1-11-83<br>(SCCM) | As Found<br>(SCCM) | As Left<br>(SCCM) | Prior to 10-7-85<br>(SCCM) |
| M-77        | N/T                     | 0                  | 0                 | 0                          |
| M-78        | N/T                     | 0                  | 0                 | 0                          |
| M-79        | N/T                     | 0                  | 0                 | 0                          |
| M-80        | N/T                     | 0                  | 0                 | 0                          |
| M-81        | N/T                     | 0                  | 0                 | 0                          |
| M-82        | N/T                     | 0                  | 0                 | 0                          |
| M-83        | N/T                     | 0                  | 0                 | 0                          |
| M-84        | N/T                     | 0                  | 0                 | 0                          |
| M-85        | N/T                     | 11.5               | 11.5              | 2                          |
| M-86        | N/T                     | 0                  | 0                 | 0                          |
| M-87        | N/T                     | 0                  | 0                 | 0                          |
| M-88        | N/T                     | 0                  | 0                 | 0                          |
| M-89        | N/T                     | 0                  | 0                 | 0                          |
| M-90        | N/T                     | 0                  | 0                 | 0                          |
| M-91        | N/T                     | 0                  | 0                 | 0                          |
| M-92        | N/T                     | 0                  | 0                 | 0                          |
| M-93        | N/T                     | 0                  | 0                 | 0                          |
| M-94        | N/T                     | 0                  | 0                 | 0                          |
| M-95        | N/T                     | 520                | 520               | 0                          |
| M-96        | N/T                     | 0                  | 0                 | 0                          |
| M-97        | N/T                     | 0                  | 0                 | 0                          |
| M-98        | N/T                     | 0                  | 0                 | 0                          |
| M-99        | N/T                     | 0                  | 0                 | 0                          |
| M-383-3     | 0                       | 0                  | 0                 | 0                          |
| M-383-4     | 0                       | 1380               | 0                 | 900                        |
|             | -----                   | -----              | -----             | -----                      |
| Total       | 0                       | 1961.36            | 581.36            | 918                        |

N/T - Not Tested

PIPING LEAK RATE - TYPE C TEST

ST-CONT-3

| Penetration | 1983                    | 1984               |                   | 1985                       |
|-------------|-------------------------|--------------------|-------------------|----------------------------|
|             | after 1-11-83<br>(SCCM) | As Found<br>(SCCM) | As Left<br>(SCCM) | Prior to 10-7-85<br>(SCCM) |
| M-2         | N/T                     | 0                  | 0                 | 0                          |
| M-7         | N/T                     | 0                  | 0                 | 0                          |
| M-8         | N/T                     | 0                  | 0                 | N/T                        |
| **M-9       | N/T                     | 0                  | 0                 | 1                          |
| **M-10      | N/T                     | 3000               | 0                 | 220                        |
| M-11        | 0                       | 0                  | 0                 | N/T                        |
| **M-12      | N/T                     | 0                  | 0                 | 0                          |
| **M-13      | 0                       | 120                | 0                 | 23                         |
| M-14        | N/T                     | 10052.5            | 6.67              | 5                          |
| M-15        | 0                       | 0                  | 0                 | N/T                        |
| M-16        | 100                     | 70                 | 70                | N/T                        |
| M-18        | 0                       | 0                  | 0                 | N/T                        |
| M-19        | 0                       | 0                  | 0                 | N/T                        |
| M-20        | N/T                     | 0                  | 0                 | 0                          |
| M-22        | N/T                     | 2300               | 0                 | 0                          |
| M-24        | N/T                     | 0                  | 1                 | 0                          |
| M-25        | N/T                     | 0                  | 0                 | N/T                        |
| M-30        | 35                      | 0                  | 0                 | 0                          |
| M-31-1      | 2                       | 0                  | 0                 | 0                          |
| M-31-2      | N/T                     | 0                  | 0                 | 0                          |
| M-38-1      | N/T                     | 0                  | 0                 | 0                          |
| M-38-2      | N/T                     | 2.6                | 2.6               | 0                          |

| Penetration | 1983                    | 1984               |                   | 1985                       |
|-------------|-------------------------|--------------------|-------------------|----------------------------|
|             | after 1-11-83<br>(SCCM) | As Found<br>(SCCM) | As Left<br>(SCCM) | Prior to 10-7-85<br>(SCCM) |
| M-39        | 4                       | 0                  | 0                 | N/T                        |
| M-40-1      | 0                       | 0                  | 0                 | 2                          |
| M-40-2      | N/T                     | 0                  | 0                 | 0                          |
| M-42        | 0                       | 0                  | 0                 | N/T                        |
| M-43        | N/T                     | 0                  | 0                 | N/T                        |
| M-45        | 5                       | 900                | 0                 | 3700                       |
| M-46-1      | N/T                     | 9.6                | 9.6               | 2                          |
| M-46-2      | N/T                     | 0                  | 0                 | 0                          |
| M-47-1      | N/T                     | 0                  | 0                 | N/T                        |
| M-47-2      | N/T                     | 0                  | 0                 | N/T                        |
| M-48-1      | N/T                     | 250                | 250               | 0                          |
| M-48-2      | N/T                     | 4.5                | 4.5               | 0                          |
| **M-49      | N/T                     | 0                  | 5.6               | 0                          |
| M-50-1      | N/T                     | 0                  | 0                 | 0                          |
| M-50-2      | N/T                     | 0                  | 0                 | 9                          |
| M-51-1      | N/T                     | 2250               | 13.7              | 0                          |
| M-51-2      | N/T                     | 150                | 48                | 13                         |
| M-52-1      | 0                       | 0                  | 0                 | 0                          |
| M-52-2      | 0                       | 200                | 0                 | 330                        |
| M-53        | 3                       | 0                  | 0                 | N/T                        |
| M-57-1      | 0                       | 0                  | 0                 | 6                          |
| M-57-2      | 0                       | 0                  | 0                 | 0                          |
| M-58-1      | 0                       | 0                  | 0                 | 1                          |
| M-58-2      | 0                       | 1100               | 0                 | 0                          |
| **M-63      | N/T                     | 90                 | 0                 | 132                        |
| M-69        | 0                       | 0                  | 0                 | 0                          |
| M-72        | 0                       | N/A                | N/A               | 0                          |

| Penetration | 1983                    | 1984               |                   | 1985                       |
|-------------|-------------------------|--------------------|-------------------|----------------------------|
|             | after 1-11-83<br>(SCCM) | As Found<br>(SCCM) | As Left<br>(SCCM) | Prior to 10-7-85<br>(SCCM) |
| M-73        | N/T                     | 0                  | 0                 | 0                          |
| M-74        | N/T                     | 0                  | 0                 | 0                          |
| M-79        | N/T                     | 0                  | 0                 | 0                          |
| M-80        | N/T                     | 0                  | 0                 | 0                          |
| M-86        | 2100                    | 2000               | 2000              | N/T                        |
| M-87        | 0                       | 2200               | 2700              | 3100                       |
| M-88        | 1000                    | 2250               | 0                 | 1050                       |
| M-89        | 1300                    | 0                  | 0                 | N/T                        |
| **M-91      | N/T                     | 26                 | 26                | 67                         |
| **M-93      | 110                     | 2150               | 145               | 10                         |
| **M-94      | N/T                     | 1800               | 0                 | 4930                       |
| **M-95      | N/T                     | MAX                | 0                 | 11327                      |
| **M-96      | N/T                     | .94 scfm           | 850               | 0                          |
| **M-97      | N/T                     | 300                | 6.54              | 30                         |
| HCV-383-3   | N/T                     | 0                  | 0                 | 0                          |
| HCV-383-4   | N/T                     | 0                  | 0                 | 0                          |
|             | -----                   | -----              | -----             | -----                      |
| Total       | 4,549                   | 23,739.2           | 5,106.07          | 8,218                      |

N/T - Not Tested

\*\* Penetration leak rates referenced to this mark do not contribute towards the 0.6 La maximum allowable leakage.

NOTE: The totals listed above only include those leakages contributing towards the 0.6 La leakage limit.