

Kansas Gas and Electric Company

# WOLF CREEK GENERATING STATION

Primary Reactor Containment  
Integrated Leakage Rate Test

December 1984  
Final Report

Bechtel Power Corporation

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KANSAS GAS AND ELECTRIC COMPANY

WOLF CREEK GENERATING STATION

PREOPERATIONAL  
REACTOR CONTAINMENT BUILDING  
INTEGRATED LEAKAGE RATE TEST  
FINAL REPORT

Submitted by  
Bechtel Power Corporation  
December 1984

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1. SUMMARY

This report presents data, analyses, and conclusions pertaining to the Wolf Creek Generating Station preoperational Integrated Leakage Rate Test (ILRT) performed in December, 1984. 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, for adjustment of the ILRT results.

The test sequence of a Structural Integrity Test (SIT), a 24-hour reduced pressure ILRT and an 8-hour peak pressure ILRT was successfully performed from 1505 on December 16 to 1445 on December 21, 1984. The containment was depressurized to atmospheric pressure following the SIT for internal and external inspections. Subsequently the containment was repressurized in two stages to conduct the reduced pressure ILRT and the peak pressure ILRT. Both ILRTs were followed by successful verification (imposed leakage) tests to demonstrate satisfactory instrument performance. The following is a summary of the test results for both ILRTs expressed in weight percent per day:

Reduced Pressure Test

<u>Total Time Method</u>	<u>Test Result</u>	<u>Acceptance Criteria</u>
ILRT Lam	-0.021	0.108
ILRT UCL*	-0.003	0.108
Verification Lam	0.126	0.088 to 0.160

<u>Mass Point Method</u>	<u>Test Result</u>	<u>Acceptance Criteria</u>
ILRT Lam	0.005	0.108
ILRT UCL*	0.007	0.108
Verification Lam	0.147	0.112 to 0.184

Peak Pressure Test

<u>Total Time Method</u>	<u>Test Result</u>	<u>Acceptance Criteria</u>
ILRT Lam	0.050	0.150
ILRT UCL*	0.092	0.150
Verification Lam	0.236	0.157 to 0.257

<u>Mass Point Method</u>	<u>Test Result</u>	<u>Acceptance Criteria</u>
ILRT Lam	0.053	0.150
ILRT UCL*	0.058	0.150
Verification Lam	0.236	0.160 to 0.260

\* UCL = 95% Upper Confidence Level



The results of the SIT are presented in a separate report. A chronological summary of events, a summary of plant technical data and a discussion of test results are included in this report.

The Mass Point Analysis method was used for the calculations during the 24-hour reduced pressure test in accordance with ANSI/ANS 56.8 - 1981. Both the Mass Point method of ANSI/ANS 56.8 - 1981, and Total Time method of BN-TOP-1 were used for calculation during the 8-hour peak Pressure Test in accordance with startup procedure SU3-GP01.

During the ILRT the tendon end anchorage areas of the surveillance tendons were visually inspected in accordance with the requirements of Regulatory Guide 1.35, Revision 2, Section C, Paragraph 3. The tendon end anchorage inspection report is included in Appendix K.

#### Conclusions:

Both reduced pressure and peak pressure ILRTs satisfied the acceptance criteria specified in startup procedure SU3-GP01 and meet the requirements of 10CFR50, Appendix J and Wolf Creek FSAR.

For the purpose of future tests, the following criteria shall be applied:

#### Peak Pressure Test (Leakage Rates in Weight %/day)

La = 0.2  
75% La = 0.15  
Lam = 0.053 (Preoperational test)

#### Reduced Pressure Test (Leakage Rates in Weight %/day)

Lt = 0.144  
75% Lt = 0.108  
Ltm = 0.005 (Preoperational test)

Lt for future test =  $La \times (Ltm/Lam)$   
=  $0.2 \times (0.005/0.053)$   
= 0.0189

75% Lt for future test = 0.0142

## 2. TEST SYNOPSIS

The reactor containment building preoperational Integrated Leakage Rate Test (Type A) is performed to demonstrate that leakage through the primary reactor containment and systems or components penetrating the primary containment does not exceed the allowable leakage rate specified in the Wolf Creek Generating Station Final Safety Analysis Report.

Two successful preoperational Type A tests and supplemental verification tests were conducted in accordance with preoperational test procedure SU3-GP01 and met the requirements of the Wolf Creek Generating Station Final Safety Analysis Report and 10CFR50, Appendix J. The Type A test method used is the absolute method described in ANSI/N 45.4 - 1972, "Leakage Rate Testing of Containment Structures for Nuclear Reactors." The leakage rate was calculated using formulas from the above ANSI Standard and BN-TOP-1, Rev. 1, "Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plants." Type A and verification test durations were in accordance with 10CFR50, Appendix J, and BN-TOP-1.

The test results are reported in accordance with the requirements of 10CFR50, Appendix J, Section V.

The containment leakage rate testing method applied was the Absolute Method as described in references 5 and 6. This is a direct application of the ideal gas law:  $PV = WRT$ , and application consisted of two distinct analysis techniques. The Total Time analysis technique measures leakage rate based on the most recent data point and the data point taken at the start of the test. The overall calculated leakage rate is determined by applying linear regression analysis to all measured leakage rate data at the end of the test period. The Mass Point technique calculates the containment air mass at each data point. The leakage rate is then determined by applying linear regression analysis to the measured air masses.

Ninety-five percent confidence levels are calculated for leakage rates as required by references 5 and 6. This is to ensure a 95% probability that the calculated leakage rate value is within the acceptance limits. All calculations were done with Bechtel's ILRT computer program described in Appendix A.

The temperature and pressure history, containment air mass, Mass Point and Total Time leakage rates were plotted by the computer program. These plots are in Appendix C for reduced pressure ILRT and in Appendix F for peak pressure ILRT.

Following a successful SIT the containment was depressurized for internal and external inspections. Containment pressure was maintained below 85% of the reduced pressure test pressure for more than 24 hours in accordance with ANSI/ANS 56.8 - 1981.

Pressurization for the reduced pressure ILRT was started at 2141 on December 18, 1984. Test pressure was reached at 0354 on December 19, 1984 and the required stabilization period was started. Official starting time for the test was declared at 0900 on December 19, 1984. No major leak paths were identified that would prevent a successful test.

The 24-hour test period ended at 0900 on December 20, 1984. The calculated Mass Point leakage rate was 0.005%/day with an upper confidence level of 0.007%/day. The Total Time leakage rate was -0.021%/day with an upper confidence level of -0.003%/day. With a maximum post test leakage rate of 0.0005%/day for penalties and penetration used during the test, all reduced pressure test leakage rate acceptance criteria were satisfied. The upper confidence level (UCL) of the mass point leakage rate calculated at the 95% level, plus the post test local leakage rate test results for the penetrations utilized for the tests, was less than 0.75 Lt ( $0.75 \times 0.144\%/day = 0.108\%/day$ ).

The Instrument Selection Guide (ISG) for a 24-hour test was less than the upper limit of 0.25 Lt (See Appendix G).

In order to verify the leakage measurement system, a 6.8 SCFM leak was imposed. Following the required stabilization period a 4-1/2-hour verification test was conducted between 1000 and 1430 on December 20, 1984. The 1100 hour data on December 20, 1984 were rejected from verification calculations due to erratic behavior of all the dew point sensors. Data rejection criteria of ANSI/ANS 56.8 were applied before removing the data point from calculation. The rejected data point and the standardized residual for the verification data set are given in Appendix H. The calculated Mass Point leakage rate excluding the 1100 datapoint, was 0.157%/day which satisfied the acceptance criteria of being in the range of 0.112 to 0.184%/day. The imposed leak was then stopped in preparation for the peak pressure ILRT.

Pressurization for the peak pressure ILRT was started at 1443 on December 20, 1984. Test pressure was reached at 2055 on the same day, and the required stabilization period was started. The official start time for the test was declared at 0230 on December 21, 1984. No major leaks were identified that would prevent a successful test.

The 8-hour test period ended at 1030 on December 21, 1984. The calculated Total Time leakage rate was 0.050%/day with an upper confidence level of 0.092%/day. The calculated Mass Point leakage rate was 0.053%/day with a upper confidence level of 0.058%/day. With a maximum post test leakage rate of 0.0005%/day for penetrations used for the test, all peak pressure test leakage rate acceptance criteria were satisfied. The upper confidence level (UCL) of the Total Time leakage rate calculated at the 95% level, plus the post test local leakage rate test results for the test penetrations, was less than 0.75 La ( $0.75 \times 0.2\%/day = 0.150\%/day$ ). The Instrument Selection Guide (ISG) for an 8-hour test was also less than the upper limit of 0.25 La (See Appendix G).

In order to verify the leakage measurement system, a 14.85 SCFM leak was imposed. Following the required stabilization period a 4-hour verification test was conducted between 1145 and 1545 on December 21, 1984. The Total Time calculated leakage rate was 0.236%/day which satisfied the acceptance criteria of being in the range of 0.157 to 0.257%/day.

A description of the computer program used to calculate the leakage rates is given in Appendix A. Test summary data, leakage rate reports, verification data and plots are given in Appendices B through F. The first half of each appendix is for the 24-hour reduced pressure test and the last half is for the 8-hour peak pressure test. Local leakage rate test results are given in Appendix H.

The reduced pressure ILRT was performed to ANSI/ANS 56.8 - 1981 standards. The Mass Point leakage rate was used for the acceptance criteria. Total Time analysis leakage rate is shown for information only.

The peak pressure ILRT was performed to both BN-TOP-1 and ANSI/ANS 56.8 - 1981 standards. Total Time and Mass Point leakage rates were used for the acceptance criteria.

### 3. TEST DATA SUMMARY

#### A. Plant Information

Owner: Kansas Gas and Electric Company  
NRC Docket No: 50-482  
Plant: Wolf Creek Generation Station  
Location: 5 miles S. East of Hwy 75, New Strawn, KS  
Containment Type: Reinforced, Post Tensioned Concrete  
Date Test Completed: December 21, 1984

#### B. Technical Data

1. Containment Net Free Air Volume 2,500,000 cu. ft.
2. Design Pressure 60 psig
3. Design Temperature 320°F
4. Calculated Peak Accident Pressure, Pa 48.1 psig
5. Peak Accident Temperature 384.9°F
6. Containment ILRT Average Temperature Limits 60-120°F

#### C. Test Results - Type A Test - Reduced Pressure

1. Test Method Absolute
2. Data Analysis Techniques Mass Point per ANSI/ANS 56.8- 1981  
Total Time per BN-TOP-1
3. Test Pressure 25.1 psig + 2.0  
- 0.0
4. Maximum Allowable Leakage Rate, Lt 0.144%/day
5. 75% of Lt 0.108%/day
6. Integrated Leakage Rate Test Results Leakage Rate, %/day

	<u>From Regression Line (Ltm)</u>	<u>At Upper 95% Confidence Level</u>
Mass Point Analysis	0.005	0.007
Total Time Analysis	-0.021	-0.003
7. Verification Test Imposed Leakage Rate, Lt%/day	6.8 scfm 0.144%/day	



8. Verification Test Results      Leakage Rate, %/day

Mass Point Analysis	0.147
Total Time Analysis	0.126

9. Verification Test Limits      Test Limit, %/day

	<u>Mass Point Analysis</u>	<u>Total Time Analysis</u>
(1) Upper Limit (Li + Ltm + 0.25 Lt)	0.184	0.160
(2) Lower Limit (Li + Ltm - 0.25 Lt)	0.112	0.088

10. Report Printouts

The Report Printouts of the Type A and Verification Test calculations are provided for the Mass Point Analysis (Appendices C through F). Stabilization data are also provided (Appendix B).

11. ILRT Adjustment and Other Penalties

Containment Sump Water Level Changes

The containment sump water levels were measured before and after the Type A tests. The change in water levels in the two containment sumps were 0" and 5.5" respectively. The sump level change did not change the ILRT results because the water that filled the sumps came from within the containment boundary.

Local Leakage Rate Penalties

Two penetrations were not in their normal post LOCA line up during the ILRT. They were the containment pressurization line and the containment pressure sensing line. In addition, a penalty is being taken for LF-FV-96, which was not local leakage rate tested before the ILRT. Adjustment for these two penetrations and the penalty for LF-FV-96 is 0.0005%/day.

D. Test Results - Type A Test Peak Pressure

1. Test Method	Absolute
2. Data Analysis Techniques	Total Time per BN-TOP-1 Mass Point per ANSI/ANS 56.8 - 1981
3. Test Pressure	48.1 psig + 2.0 - 0.0



4. Maximum Allowable Leakage Rate, La	0.2%/day		
5. 75% of La	0.150%/day		
6. Integrated Leakage Rate Test Results	<u>Leakage Rate, %/day</u>		
	<u>From Regression Line (Lam)</u>	<u>At Upper 95% Confidence Level</u>	
Total Time Analysis	0.050	0.092	
Mass Point Analysis	0.053	0.058	
7. Verification Test Imposed Leakage Rate, Li%/day	14.85 scfm 0.2%/day		
8. Verification Test Results	<u>Leakage Rate, %/day</u>		
Total Time Analysis	0.236		
Mass Point Analysis	0.236		
9. Verification Test Limits	<u>Test Limit, %/day</u>		
	<u>Total Time Analysis</u>	<u>Mass Point Analysis</u>	
(1) Upper Limit (Li + Lam + 0.25 La)	0.257	0.260	
(2) Lower Limit (Li + Lam - 0.25 La)	0.157	0.160	
10. Report Printouts			

The Report Printouts of the Type A and Verification Test calculations are provided in Appendices B through G.

11. Local Leak Rate Adjustment and Other Penalties - same as C-11 of this section for the reduced pressure test.

E. Local Leakage Rate Test Results - Type B and C Tests (see also Appendix I)

1. LLRT Results

LLRT Subtotal of Type B and C Tests: 54,000 SCCM

Total LLRT Leakage: 0.024%/day

2. Leakage of penetrations not in post-LOCA lineup during ILRT:

<u>Penetration</u>	<u>Description</u>	<u>As Left (SCCM)</u>
P-35	Pressurization line	306+20
P-51A&B	Containment Pressure sensing	(6+6)+20
P-32	Floor and Equipment Drain (LF-FV-96)	790+20

F. Integrated Leakage Rate Measurement System

The following instrument system was used:

<u>No. Required</u>	<u>Description</u>	<u>Data</u>
1. <u>Absolute Pressure</u>		
2	Mensor Precision Pressure Gages	Range: 0-100 psia Accuracy: + 0.002% F.S. Sensitivity: 0.001 psia Repeatability: 0.002 psia
2. <u>Drybulb Temperature</u>		
24	100 Ohm platinum Temperature Sensors	Range: 60-120°F Accuracy: 0.1°F Sensitivity: 0.01°F Repeatability: 0.01°F
3. <u>Dewpoint Temperature</u>		
6*	Chilled Mirror Dewpoint Detectors	Range: 40-100°F Accuracy: + 0.54°F Sensitivity: ± 0.1°F Repeatability: ± 0.1°F
* 1 failed during the test, 5 used for data and analysis.		
4. <u>Flow</u>		
2	Mass Flow Meter	Range: 0-10 scfm Accuracy: + 1% F.S. Sensitivity: NA Repeatability: 0.05% F.S.
5. Overall Instrumentation Selection Guide (ISG) value (from ANSI/ANS 56.8-1981, Appendix G) based on ILRT instrumentation, a 24-hour duration and a reduced pressure test = 0.0084%/day. The ISG for the 8-hour duration and peak pressure test = 0.0136%/day (See Appendix I).		
6. For Drybulb and Dewpoint Temperature Sensor Locations and Volume Fractions, see Table 1.		

TABLE 1

DRYBULB AND DEWPOINT TEMPERATURE SENSOR LOCATIONS

DAS Channel No.	Sensor No.	Elevation (ft)	Azimuth (degrees)	Distance From Center (ft)	Volume Fraction/ Sensor
10	GP-TE-1	2180	0	28' 0"	0.0327
11	GP-TE-2	2180	90	28' 0"	0.0327
12	GP-TE-3	2180	180	28' 0"	0.0327
13	GP-TE-4	2180	270	28' 0"	0.0327
14	GP-TE-5	2140	45	35' 0"	0.0553
15	GP-TE-6	2140	135	35' 0"	0.0553
16	GP-TE-7	2140	225	35' 0"	0.0553
17	GP-TE-8	2140	315	35' 0"	0.0553
18	GP-TE-9	2100	0	35' 0"	0.0530
19	GP-TE-10	2100	90	35' 0"	0.0530
20	GP-TE-11	2100	180	35' 0"	0.0530
21	GP-TE-12	2100	270	35' 0"	0.0530
22	GP-TE-13	2060	60	56' 0"	0.0405
23	GP-TE-14	2060	80	56' 0"	0.0406
24	GP-TE-15	2060	300	56' 0"	0.0405
25	GP-TE-16	2070	180	15' 0"	0.0406
26	GP-TE-17	2070	0	22' 0"	0.0406
27	GP-TE-18	2030	0	61' 0"	0.0380
28	GP-TE-19	2030	120	59' 0"	0.0380
29	GP-TE-20	2030	240	61' 0"	0.0380
30	GP-TE-21	2030	0	27' 0"	0.0380
31	GP-TE-22	2010	90	33' 0"	0.0380
32	GP-TE-23	2010	270	22' 0"	0.0380
33	GP-TE-24	1988	0	22' 0"	0.0052
					1.0000
40	GP-ME-19	2180	Center	0' 0"	0.1309
41	GP-ME-20	2140	Center	0' 0"	0.2213
42	GP-ME-21	2100	Center	0' 0"	0.2119
43	GP-ME-22	2060	Center	0' 0"	0.2025
44	GP-ME-23	2030	120	59' 0"	0.2334
45	GP-ME-24	2010	0	27' 0"	0.0000*
					1.0000

\* Failed During Test

G. Information Retained at Plant

The following information is available for review at the facility:

1. A listing of all containment penetrations, including the total number of like penetrations, penetration size and function.
2. A listing of normal operations instrumentation used for the leakage rate test.
3. A system lineup (at time of test), showing required valve positions and status of piping systems.
4. A continuous, sequential log of events from initial survey of containment to restoration of all tested systems.
5. Documentation of instrumentation calibrations and standards, including an error analysis of instrumentation (Appendix G).
6. Data to verify temperature stabilization criteria as established by test procedure (Appendix B).
7. The working copy of the test procedure that includes signature signoff of procedural steps.
8. The procedure and all data that would verify completion of penetrations and valve testing (Type B & C tests).
9. Computer printouts of Integrated Leakage Rate Test Data along with a summary description of the computer program (Appendix A).
10. Quality Assurance Audit, verifying test conformance with Procedure SU3-GP01 and applicable regulatory requirements.
11. A listing of all test exceptions instituted by licensee to conclude successful testing.
12. Descriptions of sensor malfunctions, repairs, and methods used to redistribute volume fractions to operating instrumentation (Table 1 and Appendix H).
13. A review of confidence limits of test results with accompanying computer printouts where applicable.
14. A description of the method of leak rate verification of instrument measuring system (super-imposed leakage), with calibration information on flowmeters along with calculations that were used to measure the verification leakage rate.
15. Plots presenting ILRT data obtained during the test (Appendix E).
16. The P&IDs of pertinent systems.
17. Tendon end anchorage concrete inspection results.

#### 4. ANALYSIS AND INTERPRETATION

During the ILRTs no penetrations were blocked or found to be leaking excessively. Only penetrations number 34, and 51A & B, which were used for the pressurization line and the pressure sensing and flow verifications lines had to be post-test Local Leakage Rate Tested. Also, an outboard valve on penetration 32, LF-FV-96 was local leak rate tested after the ILRT.

Adding the leakage rate from these penetrations to the 95% upper confidence levels yields the corrected leakage rates as follows:

##### Reduced Pressure Test

	<u>Leakage Rate, %/day</u>			
	<u>Mass Point</u>		<u>Total Time</u>	
	<u>Leakage Rate</u>	<u>95% UCL</u>	<u>Leakage Rate</u>	<u>95% UCL</u>
Calculated	0.005	0.007	-0.021	-0.003
LLRT's*	0.0005	0.0005	0.0005	0.0005
Corrected	0.006	0.008	0.021	0.003

##### Peak Pressure Test

	<u>Leakage Rate, %/day</u>			
	<u>Total Time</u>		<u>Mass Point</u>	
	<u>Leakage Rate</u>	<u>95% UCL</u>	<u>Leakage Rate</u>	<u>95% UCL</u>
Calculated	0.050	0.092	0.053	0.058
LLRT's*	0.0005	0.0005	0.0005	0.0005
Corrected	0.051	0.093	0.054	0.059

\* Local leakage rate measurements were at 48 psig.

The corrected 95% upper confidence level for the Mass Point leakage rate for the reduced pressure test is less than 0.75 Lt and the corrected 95% upper confidence levels for the Total Time leakage rate for the peak pressure test is less than 0.75 La. The test results demonstrate that leakage through the primary reactor containment and systems and components penetrating the primary containment do not exceed the allowable leakage rate specified in the Wolf Creek Generating Station Final Safety Analysis Report, Reference 1.

5. REFERENCES

1. Wolf Creek Generating Station - Final Safety Analysis Report.
2. Wolf Creek Generating Station Preoperational Test Procedure: Primary Reactor Containment Integrated Leakage Rate Test (ILRT), SU3-GP01, Rev 1.
3. 10CFR50, Appendix J, "Reactor Containment Leakage Test 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."
6. Bechtel Topical Report BN-TOP-1, Rev. 1, "Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plants," November 1, 1972.



APPENDIX A

DESCRIPTION OF BECHTEL MIRT COMPUTER PROGRAM

## APPENDIX A

### DESCRIPTION OF BECHTEL ILRT COMPUTER PROGRAM

#### A. Program and Report Description

1. The Bechtel ILRT computer program is used to determine the integrated leakage rate of a nuclear primary containment structure. The program is used to compute leakage rate based on input values of time, free air volume, containment atmosphere total pressure, drybulb temperature, and dewpoint temperature (water vapor pressure). Leakage rate is computed using the Absolute Method as defined in ANSI/ANS 56.8-1981, "Containment System Leakage Testing Requirements" and BN-TOP-1, Rev 1, "Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plants". The program is designed to allow the user to evaluate containment leakage rate test results at the jobsite during containment leakage testing. Current leakage rate values may be obtained at any time during the testing period using one of two computational methods, yielding three different report printouts.
2. In the first printout, the Total Time Report, leakage rate is computed from initial values of free air volume, containment atmosphere drybulb temperature and partial pressure of dry air, the latest values of the same parameters, and elapsed time. These individually computed leakage rates are statistically averaged using linear regression by the method of least squares. The Total Time Method is the computational technique upon which the short duration test criteria of BN-TOP-1, Rev 1, "Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plant," are based.
3. The second printout is the Mass Point Report and is based on the Mass Point Analysis Technique described in ANSI/ANS 56.8-1981, "Containment System Leakage Testing Requirements." The mass of dry air in the containment is computed at each data point (time) using the Equation of State, from current values of containment atmosphere drybulb temperature and partial pressure of dry air. Contained mass is "plotted" versus time and a regression line is fit to the data using the method of least squares. Leakage rate is determined from the statistically derived slope and intercept of the regression line.
4. The third printout, the Trend Report, is a summary of leakage rate values based on Total time and Mass Point computations presented as a function of number of data points and elapsed time (test duration). The Trend Report provides all leakage rate values required for comparison to the acceptance criteria of BN-TOP-1 for conduct of a short duration test.

5. The program generates a predictor report based on Reference 7. The "predictor" is an estimate of the upper bound on the change in mass point calculated leakage rate which will occur during the next four hours. The estimate is based on the mass point calculated leakage rates and 95% UCLs during the previous four hours.
6. The program is written in a high level language and is designed for use on a micro-computer with direct data input from the data acquisition system. Brief descriptions of program use, formulae used for leakage rate computations, and program logic are provided in the following paragraphs.

B. Explanation of Program

1. The Bechtel ILRT computer program is written, for use by experienced ILRT personnel, to determine containment integrated leakage rates based on the Absolute Method described in ANSI/ANS 56.8-1981 and BN-TOP-1.
2. Information loaded into the program prior to or at the start of the test:
  - a. Number of containment atmosphere drybulb temperature sensors, dewpoint temperature (water vapor pressure) sensors and pressure gages to be used in leakage rate computations for the specific test
  - b. Volume fractions assigned to each of the above sensors
  - c. Calibration data for above sensors
  - d. Test title
  - e. Test pressure
  - f. Maximum allowable leakage rate at test pressure
3. Data received from the data acquisition system during the test, and used to compute leakage rates:
  - a. Time and date
  - b. Containment atmosphere drybulb temperatures
  - c. Containment atmosphere pressure(s)
  - d. Containment atmosphere dewpoint temperatures
  - e. Containment free air volume.
4. After all data at a given time are received, a Summary of Measured Data report (refer to "Program Logic," Paragraph D, "Data" option command) is printed.

5. If drybulb and dewpoint temperature sensors should fail during the test, the data from the sensor(s) are not used. The volume fractions for the remaining sensors are recomputed and reloaded into the program for use in ensuing leakage rate computations.

### C. Leakage Rate Formulae

#### 1. Computation Using the Total Time Method:

##### a. Measured leakage rate from data:

$$P_1 V_1 = W_1 R T_1 \quad (1)$$

$$P_i V_i = W_i R T_i \quad (2)$$

$$L_i = \frac{2400 (W_1 - W_i)}{\Delta t_i W_1} \quad (3)$$

Solving for  $W_1$  and  $W_i$  and substituting equations (1) and (2) into (3) yields:

$$L_i = \frac{2400}{\Delta t_i} \left( 1 - \frac{T_1 P_i V_i}{T_i P_1 V_1} \right) \quad (4)$$

where

$W_1, W_i$  = Weight of contained mass of dry air at times  $t_1$  and  $t_i$ , respectively, lbm.

$T_1, T_i$  = Containment atmosphere drybulb temperature at times  $t_1$  and  $t_i$ , respectively, °R.

$P_1, P_i$  = Partial pressure of the dry air component of the containment atmosphere at times  $t_1$  and  $t_i$ , respectively, psia.

$V_1, V_i$  = Containment free air volume at times  $t_1$  and  $t_i$ , respectively (constant or variable during the test), ft<sup>3</sup>.

$t_1, t_i$  = Time at 1<sup>st</sup> and i<sup>th</sup> data points respectively, hr.

$\Delta t_i$  = Elapsed time from  $t_1$  to  $t_i$ , hr.

$R$  = Specific gas constant for air = 53.35 ft.lbf/lbm.°R.

$L_i$  = Measured leakage rate computed during time interval  $t_1$  to  $t_i$ , wt.%/day.

To reduce truncation error, the computer program uses the following equivalent formulation:

$$L_i = \frac{-2400}{\Delta t_i} \left( \frac{\Delta W_i}{W_1} \right)$$

where

$$\frac{\Delta W_1}{W_1} = \frac{W_1 - W_1}{W_1}$$

$$= \frac{\frac{\Delta P_1}{P_1} + \frac{\Delta V_1}{V_1} + \frac{\Delta P_1 \Delta V_1}{P_1 V_1} - \frac{\Delta T_1}{T_1}}{1 + \frac{\Delta T_1}{T_1}}$$

$$\Delta P_1 = P_1 - P_1$$

$$\Delta V_1 = V_1 - V_1$$

$$\Delta T_1 = T_1 - T_1$$

b. Calculated leakage rate from regression analysis:

$$\bar{L} = a + b \Delta t_N \quad (5)$$

where

$\bar{L}$  = Calculated leakage rate, wt.%/day, as determined from the regression line.

$$a = (\Sigma L_1 - b \Sigma \Delta t_1) / N \quad (6)$$

$$b = \frac{N(\Sigma L_1 \Delta t_1) - (\Sigma L_1)(\Sigma \Delta t_1)}{N(\Sigma \Delta t_1^2) - (\Sigma \Delta t_1)^2} \quad (7)$$

N = Number of data points

$$\Sigma = \sum_{i=1}^N$$

c. 95% upper confidence limit on the calculated leakage rate:

$$UCL = a + b \Delta t_N + S_{\bar{L}} \quad (8)$$

where

UCL = 95% upper confidence limit wt.%/day, at elapsed time  $\Delta t_N$ .

For  $\Delta t_N < 24$

$$\frac{S}{L} = t_{0.025; N-2} [(\sum L_i^2 - a \sum L_i - b \sum L_i \Delta t_i) / (N-2)]^{1/2} \times [1 + \frac{1}{N} + (\Delta t_N - \overline{\Delta t})^2 / (\sum \Delta t_i^2 - (\sum \Delta t_i)^2 / N)]^{1/2} \quad (9a)$$

$$\text{where } t_{0.025; N-2} = 1.95996 + \frac{2.37226}{N-2} + \frac{2.82250}{(N-2)^2} ;$$

For  $\Delta t_N \geq 24$

$$\frac{S}{L} = t_{0.025; N-2} [(\sum L_i^2 - a \sum L_i - b \sum L_i \Delta t_i) / (N-2)]^{1/2} \times [\frac{1}{N} + (\Delta t_N - \overline{\Delta t})^2 / (\sum \Delta t_i^2 - (\sum \Delta t_i)^2 / N)]^{1/2} \quad (9b)$$

$$\text{where } t_{0.025; N-2} = \frac{1.6449(N-2)^2 + 3.5283(N-2) + 0.85602}{(N-2)^2 + 1.2209(N-2) - 1.5162}$$

$\overline{L}_i$  = Calculated leakage rate computed using equation (5) at total elapsed time  $\Delta t_i$ , %/day.

$$\overline{\Delta t} = \frac{\sum \Delta t_i}{N}$$

## 2. Computation using the Mass Point Method

a. Contained mass of dry air from data:

$$W_1 = 144 \frac{P_1 V_1}{RT_1} \quad (10)$$

where

All symbols as previously defined.

b. Calculated leakage rate from regression analysis,  $W = a + b \Delta t$

$$\overline{L} = -2400 \frac{b}{a} \quad (11)$$

where

$\overline{L}$  = Calculated leakage rate, wt. %/day, as determined from the regression line.



$$a = (\sum W_i - b \sum \Delta t_i) / N \quad (12)$$

$$b = \frac{N(\sum W_i \Delta t_i) - (\sum W_i)(\sum \Delta t_i)}{N(\sum \Delta t_i^2) - (\sum \Delta t_i)^2} \quad (13)$$

$\Delta t_i$  = Total elapsed time at time of  $i^{\text{th}}$  data point, hr

$N$  = Number of data points

$W_i$  = Contained mass of dry air at  $i^{\text{th}}$  data point, lbm, as computed from equation (10).

$$\sum = \sum_{i=1}^N$$

To reduce truncation error, the computer program uses the following equivalent formulation:

$$a = W_1 \left[ 1 + \left( \sum \frac{\Delta W_i}{W_1} - \frac{b}{W_1} \sum \Delta t_i \right) / N \right] \quad (14)$$

$$b = W_1 \left[ \frac{N \left( \sum \frac{\Delta W_i}{W_1} \Delta t_i \right) - \sum \frac{\Delta W_i}{W_1} \sum \Delta t_i}{N(\sum \Delta t_i^2) - (\sum \Delta t_i)^2} \right] \quad (15)$$

where  $\frac{\Delta W_i}{W_1}$  is as previously defined.

c. 95% upper confidence limit.

$$UCL = \frac{-2400}{a} (b - S_b) \quad (16)$$

where

UCL = 95% upper confidence limit, wt.%/day.

$$S_b = t_{0.025; N-2} \frac{SN^{1/2}}{[N\sum \Delta t_1^2 - (\sum \Delta t_1)^2]^{1/2}} \quad (17)$$

$$\text{where } t_{0.025; N-2} = \frac{1.6449(N-2)^2 + 3.5283(N-2) + 0.85602}{(N-2)^2 + 1.2209(N-2) - 1.5162}$$

$$S = \left[ \frac{\sum [W_1 - (a + b \Delta t_1)]^2}{N-2} \right]^{1/2}$$

$$= W_1 \left\{ \frac{1}{N-2} \left[ \sum (\Delta W_1 / W_1)^2 - [\sum (\Delta W_1 / W_1)]^2 / N - \frac{[\sum (\Delta W_1 / W_1) \Delta t_1 - \sum (\Delta W_1 / W_1)(\sum \Delta t_1) / N]^2}{\sum \Delta t_1^2 - (\sum \Delta t_1)^2 / N} \right] \right\}^{1/2} \quad (18)$$

d. Predictor:

$$\text{Predictor} = \frac{2[(UCL-L) + 4(|A| + 2 S_A)]}{100 L_a}$$

where

UCL = 95% upper confidence limit of mass point calculated leakage rate at end of test

Lm = mass point calculated leakage rate at end of test

A = value of linear regression analysis slope of mass point calculated leakage rate vs. time for last 4 hours of test data

S<sub>A</sub> = linear regression analysis standard deviation of slope

L<sub>a</sub> = allowable leakage rate

In terms of elapsed time, Δt and mass point calculated leakage rate L<sub>m<sub>1</sub></sub> calculated at the end of 1<sup>th</sup> time interval.

$$A = \frac{1}{M} \left[ \sum_{4 \text{ hr}} Lm_1 - B \sum_{4 \text{ hr}} \Delta t_1 \right] \quad (19)$$

$$B = \frac{M \sum_{4 \text{ hr}} Lm_1 \Delta t_1 - \sum_{4 \text{ hr}} Lm_1 \sum_{4 \text{ hr}} \Delta t_1}{M \sum_{4 \text{ hr}} \Delta t_1^2 - \left( \sum_{4 \text{ hr}} \Delta t_1 \right)^2} \quad (20)$$

$$S_A = \frac{\sum_{4 \text{ hr}} Lm_1 - A \sum_{4 \text{ hr}} Lm_1 - B \sum_{4 \text{ hr}} Lm_1 \Delta t_1}{\sqrt{[M-2] \left[ M \sum_{4 \text{ hr}} \Delta t_1^2 - \left( \sum_{4 \text{ hr}} \Delta t_1 \right)^2 \right]}} \quad (21)$$

$Lm_1$  = mass point calculated leakage rate evaluated using data up to time  $\Delta t_1$ .

$\sum_{4 \text{ hr}}$  = summation over last 4 hours of test data.

$$= \sum_{N-M+1}^N$$

$M$  = number of data points for last 4 hours of test.

#### D. Program Logic

1. The Bechtel ILRT computer program logic flow is controlled by a set of user options. The user options and a brief description of their associated function are presented below.

<u>OPTION</u> <u>COMMAND</u>	<u>FUNCTION</u>
	After starting the program execution, the user either enters the name of the file containing previously entered data or initializes a new data file.
DATA	Enables user to enter raw data. When the system requests values of time, volume, temperature, pressure and vapor pressure, the user enters the appropriate data. After completing the data entry, a summary is printed out. The user then verifies that the data were entered correctly. If errors are detected, the user will then be given the opportunity to correct the errors. After the user verifies that the data were entered correctly, a Corrected Data Summary Report of time, data, average temperature, partial pressure of dry air, and water vapor pressure is printed.
TREND	A Trend Report is printed.
TOTAL	A Total Time Report is printed.
MASS	A Mass Point Report is printed.
TERM	Enables user to sign-off temporarily or permanently. All data is saved on a file for restarting.
CORR	Enables user to correct previously entered data.
LIST	A Summary Data Report is printed.
READ	Enable the computer to receive the next set of data from the data acquisition system directly.
PLOT	Enables user to plot summary data, individual sensor data or air mass versus time.
DELETE	Enables user to delete a data point.
INSERT	Enables user to reinstate a previously deleted data point.
VOLFRA	Enable user to change volume fractions.
PRED	A predictor report is printed.

OPTION  
COMMAND

FUNCTION

TIME	Enable the user to specify the time interval for a report or plot.
VERF	Enable the user to input imposed leakage rate and calculated ILRT leakage rates at start of verification test.

E. COMPUTER REPORT AND DATA PRINTOUT

MASS POINT REPORT

The Mass Point Report presents leakage rate data (wt%/day) as determined by the Mass Point Method. The "Calculated Leakage Rate" is the value determined from the regression analysis. The "Containment Air Mass" values are the masses of dry air in the containment (lbm). These air masses, determined from the Equation of State, are used in the regression analysis.

TOTAL TIME REPORT

The Total Time Report presents data leakage rate (wt%/day) as determined by the Total Time Method. The "Calculated Leakage Rate" is the value determined from the regression analysis. The "Measured Leakage Rates" are the leakage rate values determined using Total Time calculations. These values of leakage rate are used in the regression analysis.

TREND REPORT

The Trend Report presents leakage rates as determined by the Mass Point and Total Time methods in percent of the initial contained mass of dry air per day (wt%/day), versus elapsed time (hours) and number of data points.

PREDICTOR REPORT

The predictor reports presents a predicted upper bound on the change in calculated mass point leakage rate over the next four hours.

SUMMARY DATA REPORT

The Summary Data report presents the actual data used to calculate leakage rates by the various methods described in the "Computer Program" section of this report. The six column headings are TIME, DATE, TEMP, PRESSURE, VPRS, and VOLUME and contain data defined as follows:

1. TIME: Time in 24-hour notations (hours and minutes).
2. DATE: Calendar date (month and day).
3. TEMP: Containment weighted-average drybulb temperature in absolute units, degrees Rankine ( $^{\circ}\text{R}$ ).
4. PRESSURE: Partial pressure of the dry air component of the containment atmosphere in absolute units (psia).
5. VPRS: Partial pressure of water vapor of the containment atmosphere in absolute units (psia).
6. VOLUME: Containment free air volume (cu. ft.).

#### F. SUMMARY OF MEASURED DATA AND SUMMARY OF CORRECTED DATA

The Summary of Measured Data presents the individual containment atmosphere drybulb temperatures, dewpoint temperatures, absolute total pressure and free air volume measured at the time and date.

1. TEMP 1 through TEMP N are the drybulb temperatures, where N = No. of RTD's. The values in the right-hand column are temperatures ( $^{\circ}\text{F}$ ), multiplied by 100, as read from the data acquisition system (DAS). The values in the left-hand column are the corrected temperatures expressed in absolute units ( $^{\circ}\text{R}$ ).
2. PRES 1 through PRES N are the total pressures, absolute, where N = No. of pressure sensors. The right-hand value, in parentheses, is a number in counts as read from the DAS. This count value is converted to a value in psia by the computer via the instrument's calibration table, counts versus psia. The left-hand column is the absolute total pressure, psia.
3. VPRS 1 through VPRS N are the dewpoint temperatures (water vapor pressures), where N = No. of dewpoint sensors. The values in the right-hand column are temperatures ( $^{\circ}\text{F}$ ), multiplied by 100 as read from the DAS. The values in the left-hand column are the water vapor pressures (psia) from the steam tables for saturated steam corresponding to the dewpoint (saturation) temperatures in the center column.

The Summary of Corrected Data presents corrected temperature and pressure values and calculated air mass determined as follows:

1. TEMPERATURE ( $^{\circ}\text{R}$ ) is the volume weighted average containment atmosphere drybulb temperature derived from TEMP 1 through TEMP N.



2. CORRECTED PRESSURE (psia) is the partial pressure of the dry air component of the containment atmosphere, absolute. The volume weighted average containment atmosphere water vapor pressure is subtracted from the volume weighted average total pressure, yielding the partial pressure of the dry air.
3. VAPOR PRESSURE (psia) is the volume weighted average containment atmosphere water vapor pressure, absolute derived from VPRS 1 through VPRS N.
4. VOLUME (cu. ft.) is the containment free air volume.
5. CONTAINMENT AIR MASS (lbm) is the calculated mass of dry air in the containment. The mass of dry air is calculated using the containment free air volume and the above TEMPERATURE and CORRECTED PRESSURE of the dry air.

Appendix B

REDUCED PRESSURE ILRT

ILRT STABILIZATION

1. Summary Data
2. Temperature Stabilization
3. Temperature vs Time Plot
4. Pressure vs Time Plot

WOLF CREEK REDUCED PRESSURE ILRT  
SUMMARY DATA

ALMAX = .144  
VRATET = .000

VOLUME = 2500000.  
VRATEM = .000

TIME	DATE	TEMP	PRESSURE	VPRS	VOLUME
345	1219	534.931	39.8872	.1661	2500000.
400	1219	534.057	40.4361	.1668	2500000.
415	1219	532.842	40.3508	.1664	2500000.
430	1219	532.276	40.3109	.1663	2500000.
445	1219	531.944	40.2857	.1662	2500000.
500	1219	531.445	40.2511	.1657	2500000.
515	1219	531.078	40.2257	.1657	2500000.
530	1219	530.799	40.2063	.1657	2500000.
545	1219	530.597	40.1896	.1658	2500000.
600	1219	530.411	40.1760	.1657	2500000.
645	1219	529.994	40.1422	.1655	2500000.
700	1219	529.862	40.1332	.1656	2500000.
715	1219	529.763	40.1264	.1656	2500000.
730	1219	529.664	40.1174	.1659	2500000.
745	1219	529.584	40.1099	.1656	2500000.
800	1219	529.485	40.1040	.1657	2500000.
815	1219	529.409	40.0971	.1657	2500000.
830	1219	529.344	40.0913	.1657	2500000.
845	1219	529.276	40.0857	.1654	2500000.
900	1219	529.204	40.0805	.1658	2500000.

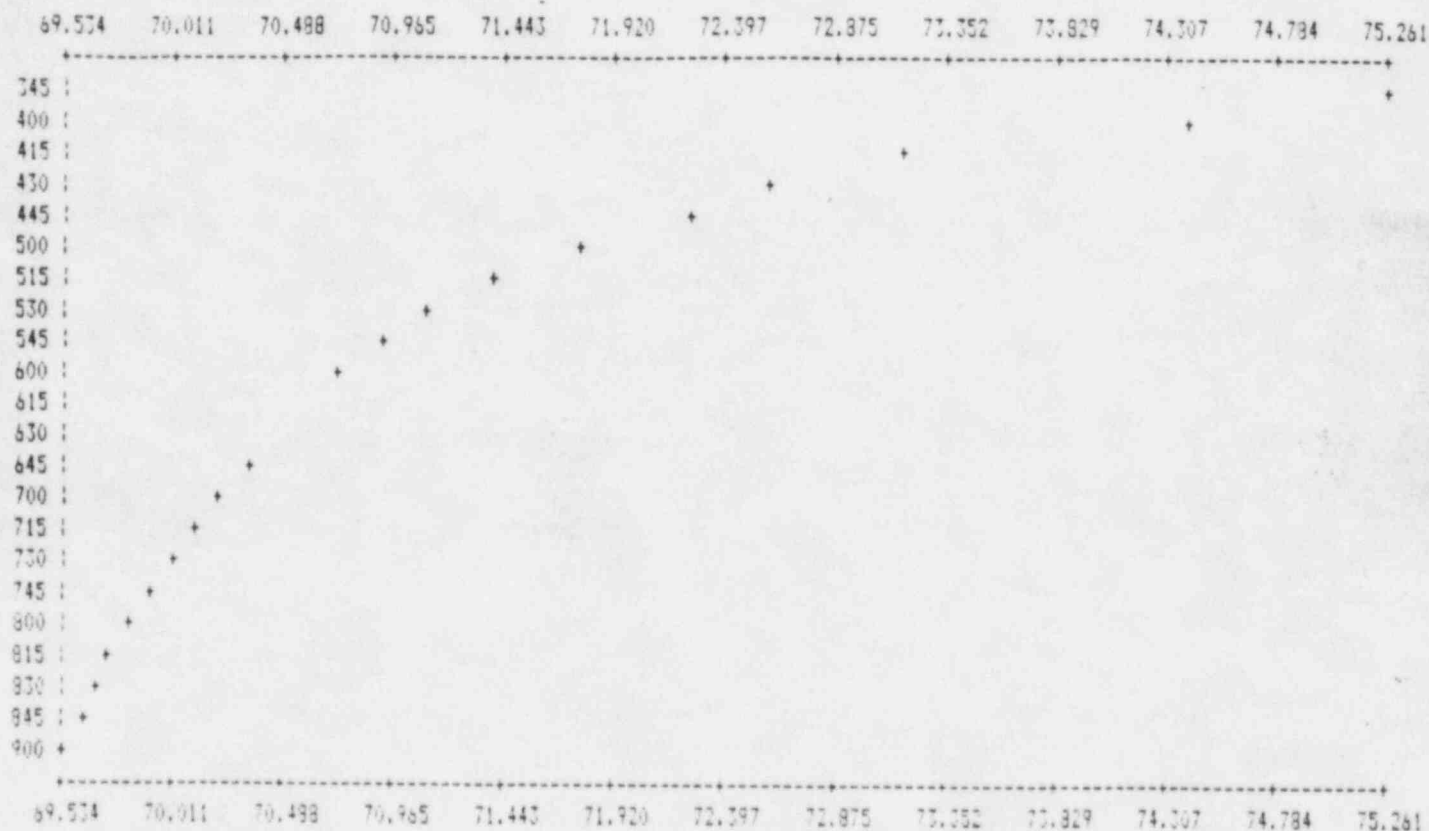
WOLF CREEK REDUCED PRESSURE ILRT  
TEMPERATURE STABILIZATION

FROM A STARTING TIME AND DATE OF: 345 1219 1984

TIME (HOURS)	TEMP ( R )	AVE T (4HRS)	ANSI AVE T (1HR)	DIFF	BN-TOP-1 AVE T (2HRS)
.00	534.93				
.25	534.06				
.50	532.84				
.75	532.28				
1.00	531.94				
1.25	531.45				
1.50	531.08				
1.75	530.80				
2.00	530.60				-2.167
2.25	530.41				-1.823
3.00	529.99				-.975
3.25	529.86				-.792
3.50	529.76				-.657
3.75	529.66				-.568
4.00	529.58	-1.337	-.410	-.93	-.253*
4.25	529.49	-1.143	-.377	-.77	-.232*
4.50	529.41	-.858	-.354	-.50*	
4.75	529.34	-.733	-.320	-.41*	
5.00	529.28	-.667	-.308	-.36*	-.180*
5.25	529.20	-.560	-.282	-.28*	-.165*

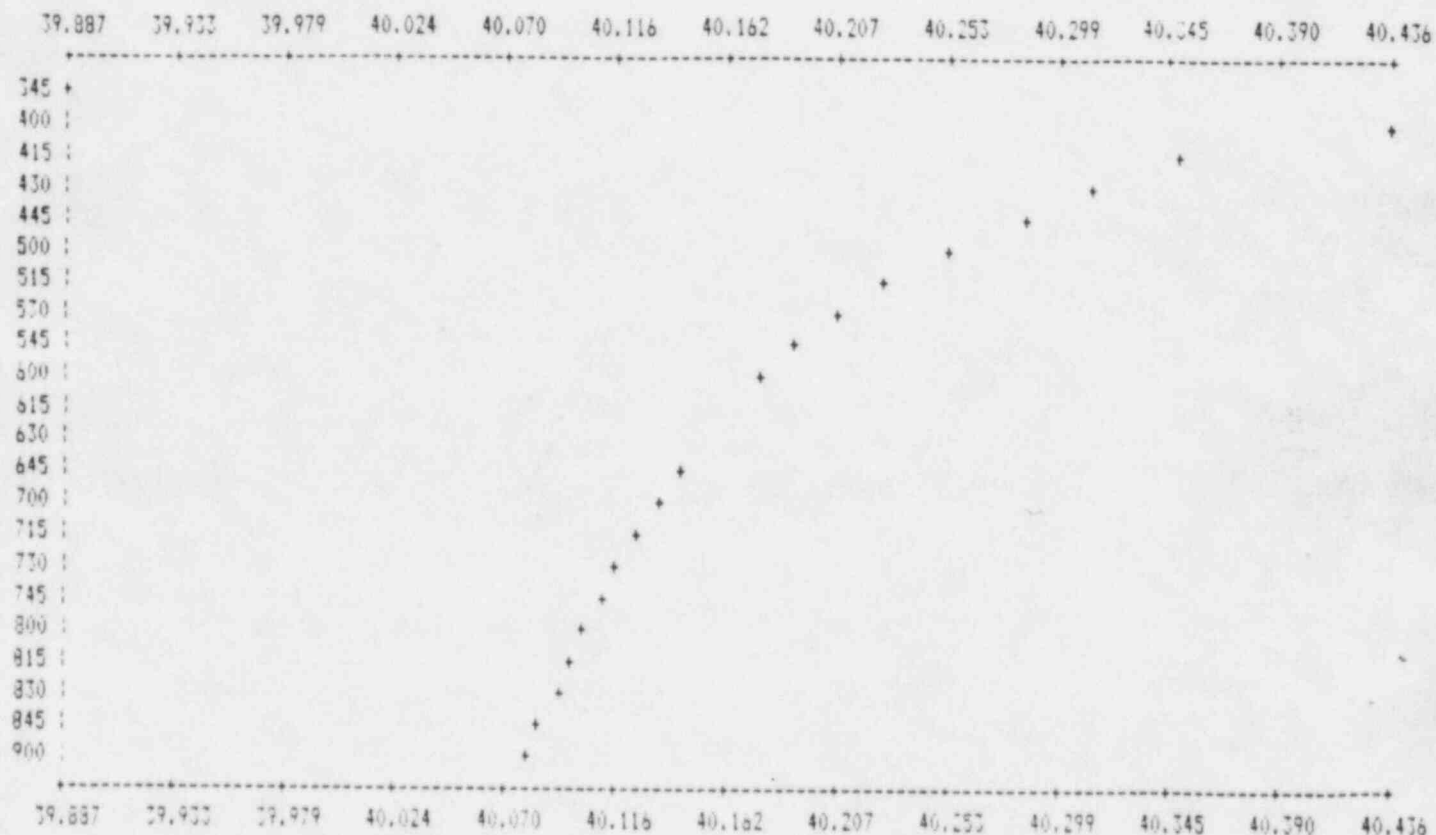
\* INDICATES TEMPERATURE STABILIZATION HAS BEEN SATISFIED

WOLF CREEK REDUCED PRESSURE LLRT  
TEMPERATURE DEGREES F





WOLF CREEK REDUCED PRESSURE ILRT  
PRESSURE PSIA



WOLF CREEK REDUCED PRESSURE ILRT  
AIRMASS LBM X 1000

	503.039	503.714	504.388	505.062	505.736	506.411	507.085	507.759	508.434	509.108	509.782	510.457	511.131
345 :													
400 :													
415 :													+
430 :													+
445 :													+
500 :													+
515 :													+
530 :													+
545 :													+
600 :													+
615 :													
630 :													
645 :													+
700 :													+
715 :													+
730 :													+
745 :													+
800 :													+
815 :													+
830 :													+
845 :													+
900 :													+
	503.039	503.714	504.388	505.062	505.736	506.411	507.085	507.759	508.434	509.108	509.782	510.457	511.131

## Appendix C

### REDUCED PRESSURE ILRT SUMMARY DATA AND ANALYSIS

1. ILRT Summary Data
2. Mass Point Analysis
3. Total Time Analysis
4. Trend Report

### REDUCED PRESSURE ILRT PLOTS

1. Temperature vs Time
2. Pressure vs Time
3. Vapor Pressure vs Time
4. Air Mass vs Time
5. Mass Point Leakage vs Time
6. Total Time Leakage vs Time

WOLF CREEK REDUCED PRESSURE ILRT  
SUMMARY DATA

ALMAX = .144  
VRATET = .124

VOLUME = 2500000.  
VRATEH = .148

TIME	DATE	TEMP	PRESSURE	VPRS	VOLUME
800	1219	529.204	40.0805	.1658	2500000.
915	1219	529.152	40.0744	.1660	2500000.
930	1219	529.080	40.0703	.1662	2500000.
945	1219	529.036	40.0654	.1662	2500000.
1000	1219	529.009	40.0608	.1660	2500000.
1015	1219	528.951	40.0572	.1657	2500000.
1030	1219	528.879	40.0531	.1659	2500000.
1045	1219	528.864	40.0491	.1660	2500000.
1100	1219	528.817	40.0464	.1657	2500000.
1115	1219	528.764	40.0420	.1663	2500000.
1130	1219	528.728	40.0394	.1659	2500000.
1145	1219	528.676	40.0364	.1660	2500000.
1200	1219	528.657	40.0327	.1658	2500000.
1215	1219	528.603	40.0294	.1662	2500000.
1230	1219	528.572	40.0262	.1665	2500000.
1245	1219	528.528	40.0233	.1664	2500000.
1300	1219	528.495	40.0205	.1663	2500000.
1315	1219	528.436	40.0172	.1667	2500000.
1330	1219	528.418	40.0142	.1668	2500000.
1345	1219	528.389	40.0132	.1638	2500000.
1400	1219	528.353	40.0098	.1663	2500000.
1415	1219	528.330	40.0079	.1663	2500000.
1430	1219	528.296	40.0046	.1667	2500000.
1445	1219	528.277	40.0023	.1668	2500000.
1500	1219	528.238	40.0011	.1663	2500000.
1515	1219	528.211	39.9988	.1666	2500000.
1530	1219	528.159	39.9957	.1668	2500000.
1545	1219	528.156	39.9939	.1666	2500000.
1600	1219	528.112	39.9919	.1667	2500000.
1615	1219	528.071	39.9897	.1669	2500000.
1630	1219	528.050	39.9882	.1665	2500000.
1645	1219	528.037	39.9845	.1672	2500000.
1700	1219	527.987	39.9829	.1669	2500000.
1715	1219	527.992	39.9819	.1669	2500000.
1730	1219	527.946	39.9791	.1668	2500000.
1745	1219	527.923	39.9767	.1672	2500000.
1800	1219	527.909	39.9750	.1670	2500000.
1815	1219	527.874	39.9728	.1672	2500000.
1830	1219	527.891	39.9726	.1675	2500000.
1845	1219	527.883	39.9733	.1677	2500000.
1900	1219	527.892	39.9733	.1677	2500000.
1915	1219	527.865	39.9731	.1679	2500000.
1930	1219	527.866	39.9728	.1682	2500000.
1945	1219	527.877	39.9728	.1682	2500000.
2000	1219	527.845	39.9715	.1686	2500000.
2015	1219	527.847	39.9712	.1689	2500000.
2030	1219	527.839	39.9717	.1683	2500000.
2045	1219	527.819	39.9694	.1687	2500000.
2100	1219	527.798	39.9683	.1688	2500000.

WOLF CREEK REDUCED PRESSURE ILRT  
SUMMARY DATA

ALMAX = .144

VOLUME = 2500000.

VRATET = .124

VRATEM = .148

TIME	DATE	TEMP	PRESSURE	VPRS	VOLUME
2115	1219	527.782	39.9678	.1683	2500000.
2130	1219	527.777	39.9683	.1688	2500000.
2145	1219	527.768	39.9653	.1689	2500000.
2200	1219	527.759	39.9644	.1688	2500000.
2215	1219	527.740	39.9630	.1692	2500000.
2230	1219	527.736	39.9623	.1690	2500000.
2245	1219	527.693	39.9617	.1686	2500000.
2300	1219	527.716	39.9601	.1692	2500000.
2315	1219	527.676	39.9590	.1693	2500000.
2330	1219	527.676	39.9576	.1698	2500000.
2345	1219	527.651	39.9567	.1697	2500000.
0	1220	527.652	39.9557	.1697	2500000.
15	1220	527.640	39.9548	.1697	2500000.
30	1220	527.622	39.9535	.1699	2500000.
45	1220	527.613	39.9525	.1700	2500000.
100	1220	527.604	39.9517	.1699	2500000.
115	1220	527.575	39.9503	.1703	2500000.
130	1220	527.566	39.9492	.1703	2500000.
145	1220	527.544	39.9486	.1700	2500000.
200	1220	527.544	39.9479	.1707	2500000.
215	1220	527.536	39.9463	.1704	2500000.
230	1220	527.534	39.9450	.1707	2500000.
245	1220	527.497	39.9448	.1709	2500000.
300	1220	527.492	39.9442	.1705	2500000.
315	1220	527.493	39.9430	.1708	2500000.
330	1220	527.463	39.9420	.1708	2500000.
345	1220	527.449	39.9408	.1709	2500000.
400	1220	527.447	39.9396	.1712	2500000.
415	1220	527.431	39.9389	.1710	2500000.
430	1220	527.399	39.9374	.1714	2500000.
445	1220	527.395	39.9375	.1713	2500000.
500	1220	527.384	39.9356	.1713	2500000.
515	1220	527.251	39.9278	.1713	2500000.
530	1220	527.181	39.9227	.1716	2500000.
545	1220	527.156	39.9215	.1708	2500000.
600	1220	527.137	39.9208	.1715	2500000.
615	1220	527.128	39.9189	.1714	2500000.
630	1220	527.222	39.9252	.1720	2500000.
645	1220	527.243	39.9283	.1718	2500000.
700	1220	527.274	39.9278	.1723	2500000.
715	1220	527.266	39.9269	.1723	2500000.
730	1220	527.272	39.9270	.1721	2500000.
745	1220	527.242	39.9261	.1720	2500000.
800	1220	527.236	39.9244	.1728	2500000.
815	1220	527.219	39.9241	.1721	2500000.
830	1220	527.233	39.9224	.1728	2500000.
845	1220	527.204	39.9214	.1729	2500000.
900	1220	527.193	39.9202	.1731	2500000.



WOLF CREEK REDUCED PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
MASS POINT ANALYSIS

TIME AND DATE AT START OF TEST: 900 1219 1984  
TEST DURATION: 24.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LBM)	MASS LOSS (LBM)	AVERAGE MASS LOSS (LBM/HR)
900	529.204	40.0805	511068.		
915	529.152	40.0744	511041.	27.9	111.5
930	529.080	40.0703	511058.	-17.7	20.4
945	529.036	40.0654	511037.	21.0	41.6
1000	529.009	40.0608	511005.	31.8	63.0
1015	528.951	40.0572	511015.	-9.2	43.1
1030	528.879	40.0531	511032.	-17.8	24.0
1045	528.864	40.0491	510996.	36.4	41.4
1100	528.817	40.0464	511007.	-10.7	30.8
1115	528.764	40.0420	511002.	5.2	29.7
1130	528.728	40.0394	511004.	-2.1	25.9
1145	528.676	40.0364	511015.	-11.1	19.5
1200	528.657	40.0327	510987.	27.6	27.1
1215	528.603	40.0294	510996.	-9.2	22.2
1230	528.572	40.0262	510986.	10.4	23.5
1245	528.528	40.0233	510992.	-5.8	20.4
1300	528.495	40.0205	510988.	3.8	20.1
1315	528.436	40.0172	511002.	-13.6	15.7
1330	528.418	40.0142	510982.	19.8	19.2
1345	528.389	40.0132	510997.	-13.3	15.0
1400	528.353	40.0098	510988.	9.1	16.1
1415	528.330	40.0079	510985.	2.5	15.8
1430	528.296	40.0046	510976.	9.3	16.8
1445	528.277	40.0025	510969.	7.1	17.3
1500	528.238	40.0011	510988.	-16.9	13.4
1515	528.211	39.9988	510985.	2.7	13.3
1530	528.159	39.9957	510996.	-10.3	11.2
1545	528.136	39.9939	510977.	19.0	13.6
1600	528.112	39.9919	510993.	-16.0	10.8
1615	528.071	39.9897	511004.	-11.6	8.9
1630	528.050	39.9882	511005.	-1.9	8.4
1645	528.037	39.9845	510971.	33.8	12.3
1700	527.987	39.9829	510999.	-27.4	8.7
1715	527.992	39.9819	510981.	17.3	10.6
1730	527.946	39.9791	510990.	-9.3	9.2
1745	527.923	39.9767	510981.	8.7	9.9
1800	527.909	39.9750	510973.	8.6	10.6
1815	527.874	39.9728	510979.	-6.2	9.7
1830	527.891	39.9726	510960.	18.9	11.4
1845	527.983	39.9733	510976.	-15.7	9.5
1900	527.892	39.9733	510969.	6.9	9.9
1915	527.865	39.9731	510991.	-22.3	7.5
1930	527.866	39.9728	510987.	4.2	7.7
1945	527.877	39.9723	510977.	10.4	8.5
2000	527.845	39.9715	510990.	-13.7	7.1

WOLF CREEK REDUCED PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
MASS POINT ANALYSIS

TIME AND DATE AT START OF TEST: 900 1219 1984  
TEST DURATION: 24.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LBM)	MASS LOSS (LBM)	AVERAGE MASS LOSS (LBM/HR)
2015	527.847	39.9712	510984.	6.3	7.5
2030	527.839	39.9717	510999.	-14.7	6.1
2045	527.819	39.9694	510989.	9.8	6.8
2100	527.798	39.9683	510995.	-6.1	6.1
2115	527.782	39.9678	511004.	-9.0	5.3
2130	527.777	39.9663	510990.	14.1	6.3
2145	527.768	39.9653	510986.	4.4	6.5
2200	527.759	39.9644	510983.	2.4	6.6
2215	527.740	39.9630	510984.	-7	6.4
2230	527.736	39.9623	510979.	5.0	6.6
2245	527.693	39.9617	511011.	-32.4	4.2
2300	527.716	39.9601	510970.	41.6	7.1
2315	527.676	39.9590	510995.	-25.4	5.2
2330	527.676	39.9576	510976.	19.1	6.4
2345	527.651	39.9567	510990.	-13.8	5.3
0	527.652	39.9557	510975.	14.6	6.2
15	527.640	39.9548	510975.	-1	6.1
30	527.622	39.9535	510977.	-1.5	5.9
45	527.613	39.9525	510972.	4.9	6.1
100	527.604	39.9517	510970.	2.3	6.2
115	527.575	39.9503	510980.	-10.7	5.4
130	527.566	39.9492	510976.	4.1	5.6
145	527.544	39.9486	510989.	-12.8	4.7
200	527.544	39.9479	510980.	8.7	5.2
215	527.536	39.9463	510967.	13.0	5.9
230	527.534	39.9450	510953.	14.1	6.6
245	527.497	39.9448	510985.	-32.0	4.7
300	527.492	39.9442	510983.	2.0	4.7
315	527.493	39.9430	510966.	17.1	5.6
330	527.463	39.9420	510983.	-16.6	4.6
345	527.449	39.9408	510982.	.9	4.6
400	527.447	39.9396	510967.	14.3	5.3
415	527.431	39.9389	510974.	-6.9	4.9
430	527.399	39.9374	510987.	-12.6	4.2
445	527.393	39.9375	510992.	-4.6	3.9
500	527.384	39.9356	510978.	13.3	4.5

WOLF CREEK REDUCED PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
MASS POINT ANALYSIS

TIME AND DATE AT START OF TEST: 900 1219 1984  
TEST DURATION: 24.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LBM)	MASS LOSS (LBM)	AVERAGE MASS LOSS (LBM/HR)
515	527.251	39.9278	511008.	-29.5	3.0
530	527.181	39.9227	511009.	-1.7	2.9
545	527.156	39.9215	511018.	-8.2	2.4
600	527.137	39.9208	511028.	-10.1	1.9
615	527.128	39.9189	511012.	15.3	2.6
630	527.222	39.9252	511002.	10.7	3.1
645	527.243	39.9283	511021.	-19.6	2.2
700	527.274	39.9278	510984.	36.9	3.8
715	527.266	39.9269	510980.	4.1	4.0
730	527.272	39.9270	510977.	3.5	4.1
745	527.242	39.9261	510994.	-16.9	3.3
800	527.236	39.9244	510977.	16.5	4.0
815	527.219	39.9241	510991.	-13.3	3.3
830	527.233	39.9224	510955.	15.3	4.8
845	527.204	39.9214	510971.	-13.3	4.1
900	527.193	39.9202	510965.	9.4	4.3

FREE AIR VOLUME USED (CU. FT.)	=2500000.
REGRESSION LINE	
INTERCEPT (LBM)	= 511003.
SLOPE (LBM/HR)	= -1.1
MAXIMUM ALLOWABLE LEAKAGE RATE	= .144
75% OF MAXIMUM ALLOWABLE LEAKAGE RATE	= .108
THE UPPER 95% CONFIDENCE LIMIT	= .007
THE CALCULATED LEAKAGE RATE	= .003

WOLF CREEK REDUCED PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
TOTAL TIME ANALYSIS

TIME AND DATE AT START OF TEST: 900 1219 1984  
TEST DURATION: 24.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	MEASURED LEAKAGE RATE
900	529.204	40.0805	
915	529.152	40.0744	.524
930	529.080	40.0703	.096
945	529.036	40.0654	.195
1000	529.009	40.0608	.296
1015	528.951	40.0572	.202
1030	528.879	40.0531	.113
1045	528.864	40.0491	.194
1100	528.817	40.0464	.145
1115	528.764	40.0420	.139
1130	528.728	40.0394	.122
1145	528.676	40.0364	.092
1200	528.637	40.0327	.127
1215	528.603	40.0294	.104
1230	528.572	40.0262	.111
1245	528.528	40.0233	.098
1300	528.495	40.0205	.094
1315	528.476	40.0172	.074
1330	528.418	40.0142	.090
1345	528.389	40.0132	.070
1400	528.353	40.0098	.075
1415	528.339	40.0079	.074
1430	528.296	40.0046	.079
1445	528.277	40.0025	.081
1500	528.238	40.0011	.063
1515	528.211	39.9998	.062
1530	528.159	39.9957	.052
1545	528.156	39.9939	.064
1600	528.112	39.9919	.051
1615	528.071	39.9897	.042
1630	528.050	39.9882	.040
1645	528.037	39.9845	.059
1700	527.987	39.9829	.041
1715	527.992	39.9819	.050
1730	527.946	39.9791	.043
1745	527.933	39.9767	.047
1800	527.909	39.9750	.050
1815	527.874	39.9728	.045
1830	527.891	39.9726	.054
1845	527.883	39.9733	.043
1900	527.892	39.9733	.047
1915	527.865	39.9731	.035
1930	527.866	39.9728	.036
1945	527.877	39.9728	.040
2000	527.845	39.9715	.033

WOLF CREEK REDUCED PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
TOTAL TIME ANALYSIS

TIME AND DATE AT START OF TEST: 900 1219 1984  
TEST DURATION: 24.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	MEASURED LEAKAGE RATE
2015	527.847	39.9712	.033
2030	527.839	39.9717	.028
2045	527.819	39.9694	.032
2100	527.798	39.9683	.029
2115	527.782	39.9678	.025
2130	527.777	39.9683	.029
2145	527.768	39.9653	.031
2200	527.759	39.9644	.031
2215	527.740	39.9630	.030
2230	527.736	39.9623	.031
2245	527.693	39.9617	.020
2300	527.716	39.9601	.033
2315	527.676	39.9590	.024
2330	527.676	39.9576	.030
2345	527.651	39.9567	.023
0	527.652	39.9557	.029
15	527.640	39.9548	.029
30	527.622	39.9535	.028
45	527.613	39.9525	.029
100	527.604	39.9517	.029
115	527.575	39.9503	.025
130	527.566	39.9492	.026
145	527.544	39.9486	.022
200	527.544	39.9479	.024
215	527.536	39.9463	.028
230	527.534	39.9450	.031
245	527.497	39.9443	.022
300	527.492	39.9442	.022
315	527.493	39.9430	.026
330	527.463	39.9420	.022
345	527.449	39.9402	.022
400	527.447	39.9396	.025
415	527.431	39.9389	.021
430	527.399	39.9374	.020
445	527.395	39.9375	.018
500	527.384	39.9356	.021



WOLF CREEK REDUCED PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
TOTAL TIME ANALYSIS

TIME AND DATE AT START OF TEST: 900 1219 1984  
TEST DURATION: 24.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	MEASURED LEAKAGE RATE
515	527.251	39.9278	.014
530	527.181	39.9227	.013
545	527.156	39.9215	.011
600	527.137	39.9208	.009
615	527.128	39.9189	.012
630	527.222	39.9252	.015
645	527.243	39.9283	.010
700	527.274	39.9278	.018
715	527.266	39.9269	.019
730	527.272	39.9270	.019
745	527.242	39.9261	.015
800	527.236	39.9244	.019
815	527.219	39.9241	.016
830	527.233	39.9224	.023
845	527.204	39.9214	.019
900	527.193	39.9202	.020

MEAN OF THE MEASURED LEAKAGE RATES	=	.058
MAXIMUM ALLOWABLE LEAKAGE RATE	=	.144
75% OF MAXIMUM ALLOWABLE LEAKAGE RATE	=	.108
THE UPPER 95% CONFIDENCE LIMIT	=	-.003
THE CALCULATED LEAKAGE RATE	=	-.021

WOLF CREEK REDUCED PRESSURE ILRT  
TREND REPORT

TIME AND DATE AT START OF TEST: 900 1219 1984

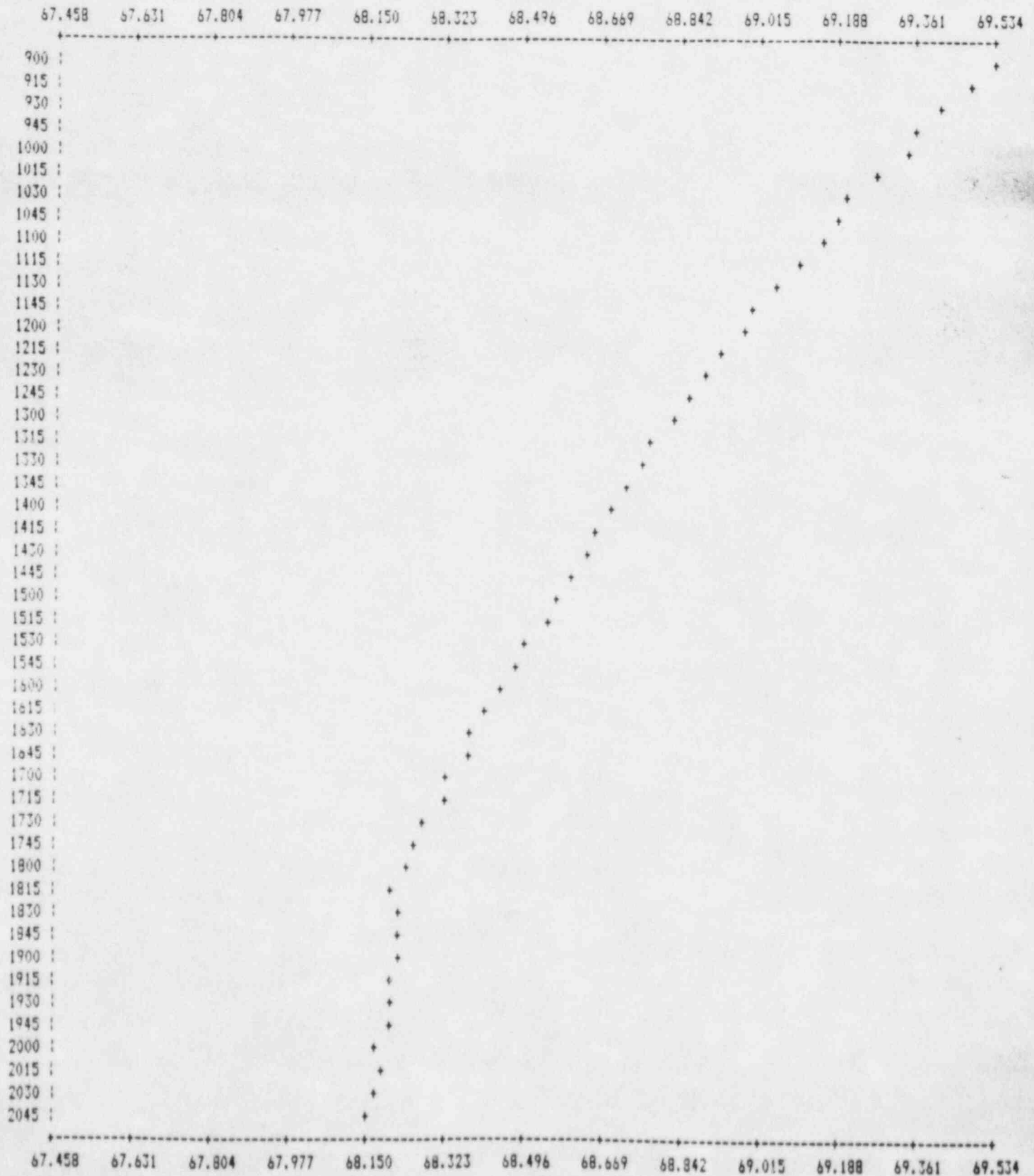
NO.	END	TOTAL TIME ANALYSIS			MASS POINT ANALYSIS	
PTS	TIME	MEAS.	CALCULATED	UCL	CALCULATED	UCL
4	945	.195	.107	2.194	.143	.477
5	1000	.296	.190	1.218	.243	.449
6	1015	.202	.174	.829	.212	.340
7	1030	.113	.121	.815	.143	.260
8	1045	.194	.130	.552	.159	.245
9	1100	.145	.118	.481	.142	.210
10	1115	.139	.107	.432	.131	.186
11	1130	.122	.095	.390	.118	.164
12	1145	.092	.077	.348	.097	.141
13	1200	.127	.076	.331	.099	.135
14	1215	.104	.069	.310	.092	.124
15	1230	.111	.066	.295	.090	.118
16	1245	.096	.060	.279	.084	.109
17	1300	.094	.056	.266	.080	.102
18	1315	.074	.048	.250	.072	.093
19	1330	.090	.046	.241	.070	.089
20	1345	.070	.040	.229	.064	.082
21	1400	.075	.037	.220	.061	.077
22	1415	.074	.034	.213	.058	.073
23	1430	.079	.032	.207	.057	.071
24	1445	.081	.031	.204	.058	.070
25	1500	.063	.028	.196	.054	.066
26	1515	.062	.025	.190	.051	.063
27	1530	.033	.022	.183	.047	.058
28	1545	.064	.020	.179	.046	.057
29	1600	.051	.017	.173	.042	.053
30	1615	.042	.013	.166	.038	.049
31	1630	.040	.010	.160	.034	.045
32	1645	.059	.009	.158	.034	.044
33	1700	.041	.007	.153	.032	.041
34	1715	.050	.008	.150	.031	.040
35	1730	.043	.004	.147	.029	.038
36	1745	.047	.003	.144	.029	.037
37	1800	.050	.002	.143	.028	.036
38	1815	.045	.001	.140	.028	.035
39	1830	.054	.002	.140	.028	.036
40	1845	.045	.001	.138	.028	.035
41	1900	.047	.000	.136	.028	.034
42	1915	.035	-.001	.133	.026	.033
43	1930	.036	-.002	.131	.025	.031
44	1945	.040	-.003	.129	.024	.030
45	2000	.033	-.004	.127	.023	.029
46	2015	.035	-.005	.125	.022	.028
47	2030	.028	-.006	.123	.021	.026
48	2045	.032	-.007	.121	.020	.025
49	2100	.029	-.008	.119	.019	.024

WOLF CREEK REDUCED PRESSURE ILRT  
TREND REPORT

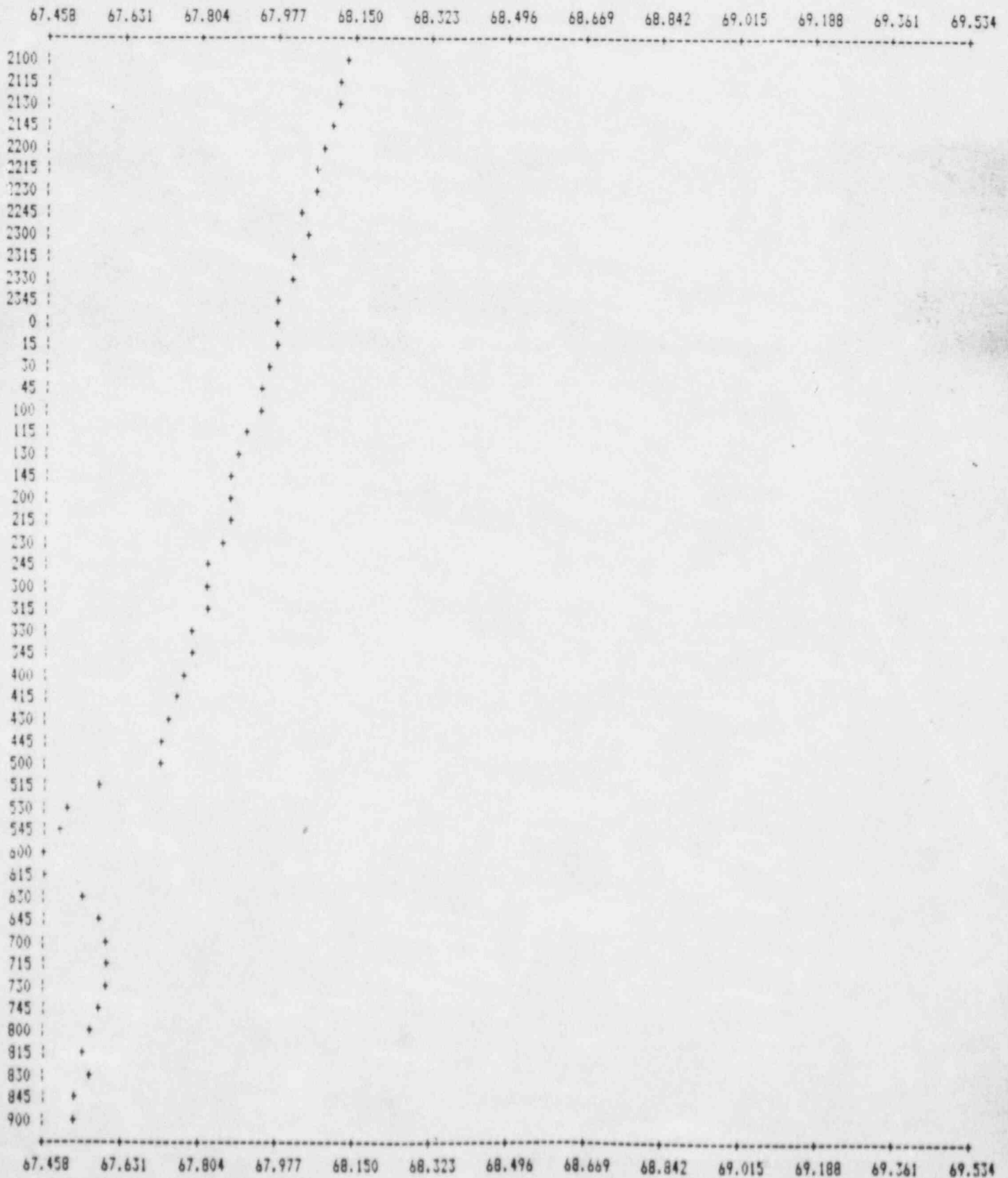
TIME AND DATE AT START OF TEST: 900 1219 1984

NO. PTS	END TIME	TOTAL TIME ANALYSIS			MASS POINT ANALYSIS	
		MEAS.	CALCULATED	UCL	CALCULATED	UCL
50	2115	.025	-.009	.116	.017	.022
51	2130	.029	-.010	.115	.016	.021
52	2145	.031	-.011	.113	.016	.021
53	2200	.031	-.011	.112	.015	.020
54	2215	.030	-.012	.111	.015	.020
55	2230	.031	-.012	.110	.015	.019
56	2245	.020	-.013	.108	.013	.018
57	2300	.033	-.013	.107	.014	.018
58	2315	.024	-.014	.106	.013	.017
59	2330	.030	-.014	.105	.013	.017
60	2345	.025	-.014	.104	.012	.016
61	0	.029	-.015	.104	.012	.016
62	15	.029	-.015	.103	.012	.016
63	30	.028	-.015	.102	.012	.016
64	45	.029	-.015	.102	.012	.016
65	100	.029	-.015	.101	.012	.016
66	115	.025	-.015	.101	.012	.015
67	130	.026	-.015	.100	.012	.015
68	145	.022	-.016	.099	.011	.014
69	200	.024	-.016	.098	.011	.014
70	215	.028	-.016	.098	.011	.014
71	230	.031	-.016	.098	.012	.014
72	245	.022	-.016	.097	.011	.014
73	300	.022	-.016	.097	.011	.014
74	315	.026	-.016	.096	.011	.014
75	330	.022	-.017	.096	.011	.013
76	345	.022	-.017	.095	.010	.013
77	400	.025	-.017	.095	.010	.013
78	415	.023	-.017	.094	.010	.013
79	430	.020	-.017	.093	.010	.012
80	445	.018	-.017	.093	.010	.012
81	500	.021	-.017	.092	.009	.012
82	515	.014	-.018	.091	.009	.011
83	530	.013	-.018	.090	.008	.011
84	545	.011	-.019	.089	.007	.010
85	600	.009	-.019	.088	.007	.009
86	615	.012	-.020	.087	.006	.009
87	630	.015	-.020	.087	.006	.008
88	645	.010	-.021	.086	.005	.008
89	700	.013	-.021	.085	.005	.007
90	715	.019	-.021	.085	.005	.007
91	730	.019	-.021	.085	.005	.007
92	745	.015	-.021	.084	.005	.007
93	800	.019	-.021	.084	.005	.007
94	815	.016	-.021	.084	.005	.007
95	830	.023	-.021	.084	.005	.007
96	845	.019	-.021	.083	.005	.007
97	900	.020	-.021	-.003	.005	.007

WOLF CREEK REDUCED PRESSURE ILRT  
TEMPERATURE DEGREES F

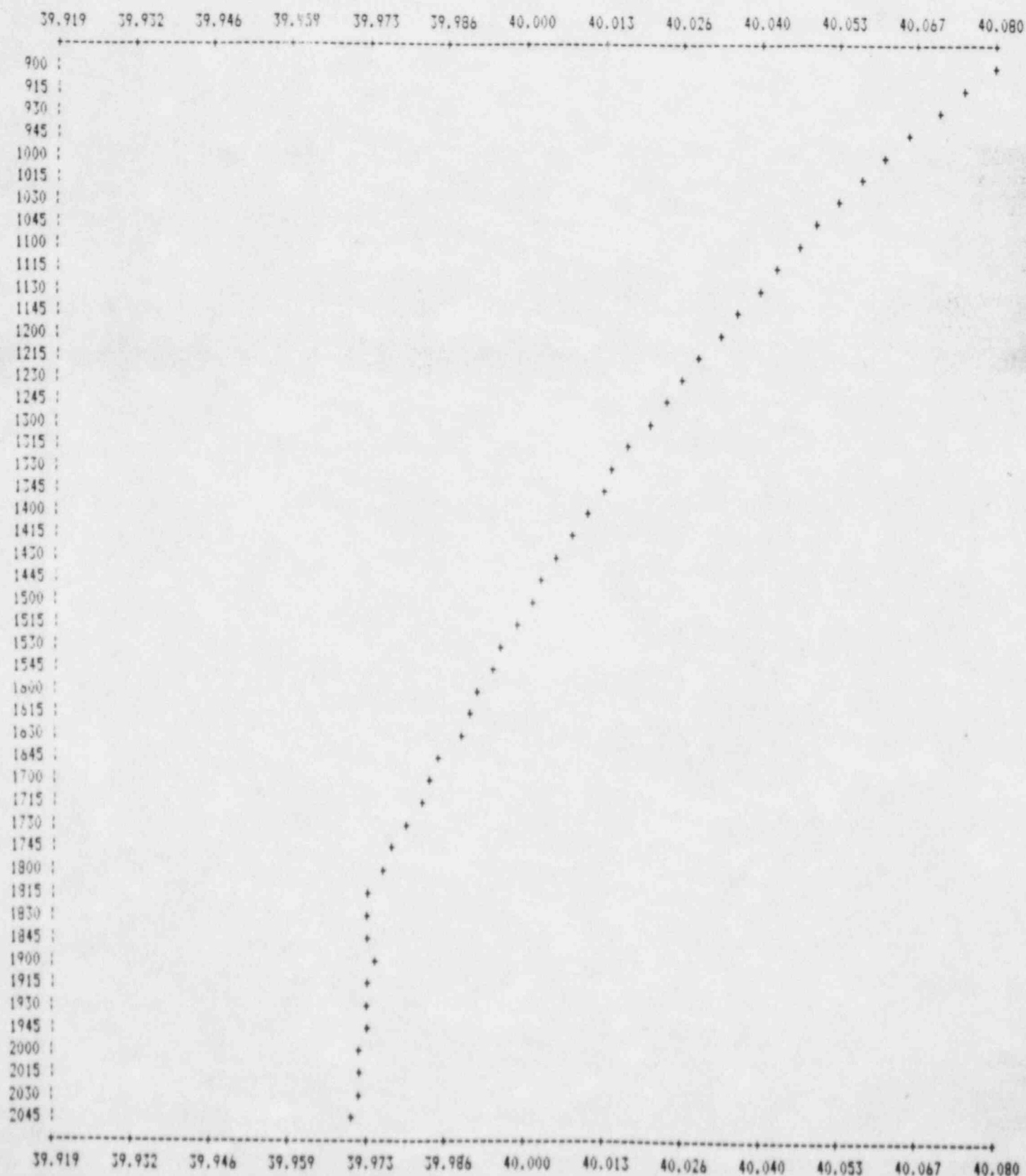


WOLF CREEK REDUCED PRESSURE ILRT  
TEMPERATURE DEGREES F

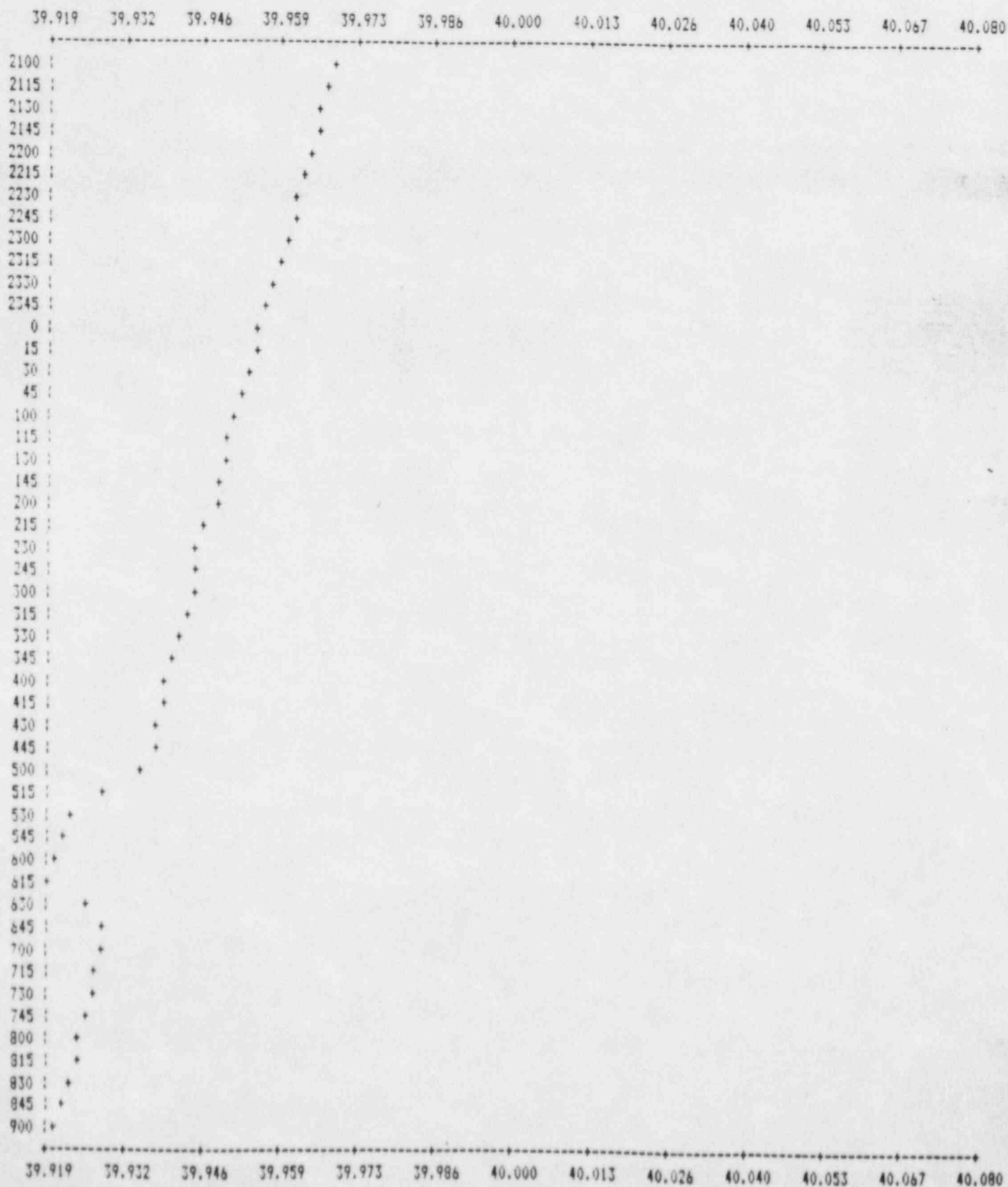




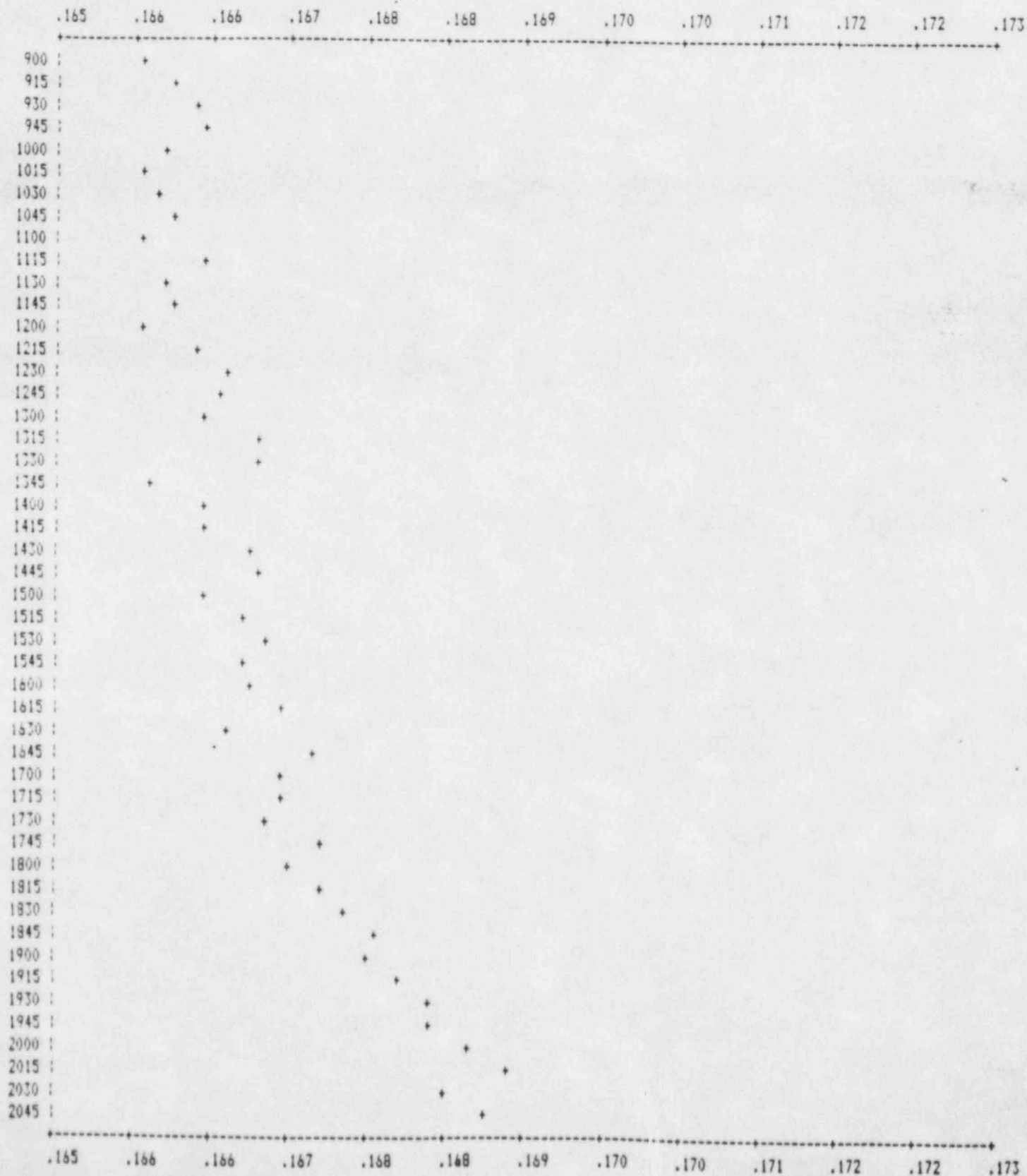
# WOLF CREEK REDUCED PRESSURE ILRT PRESSURE PSIA



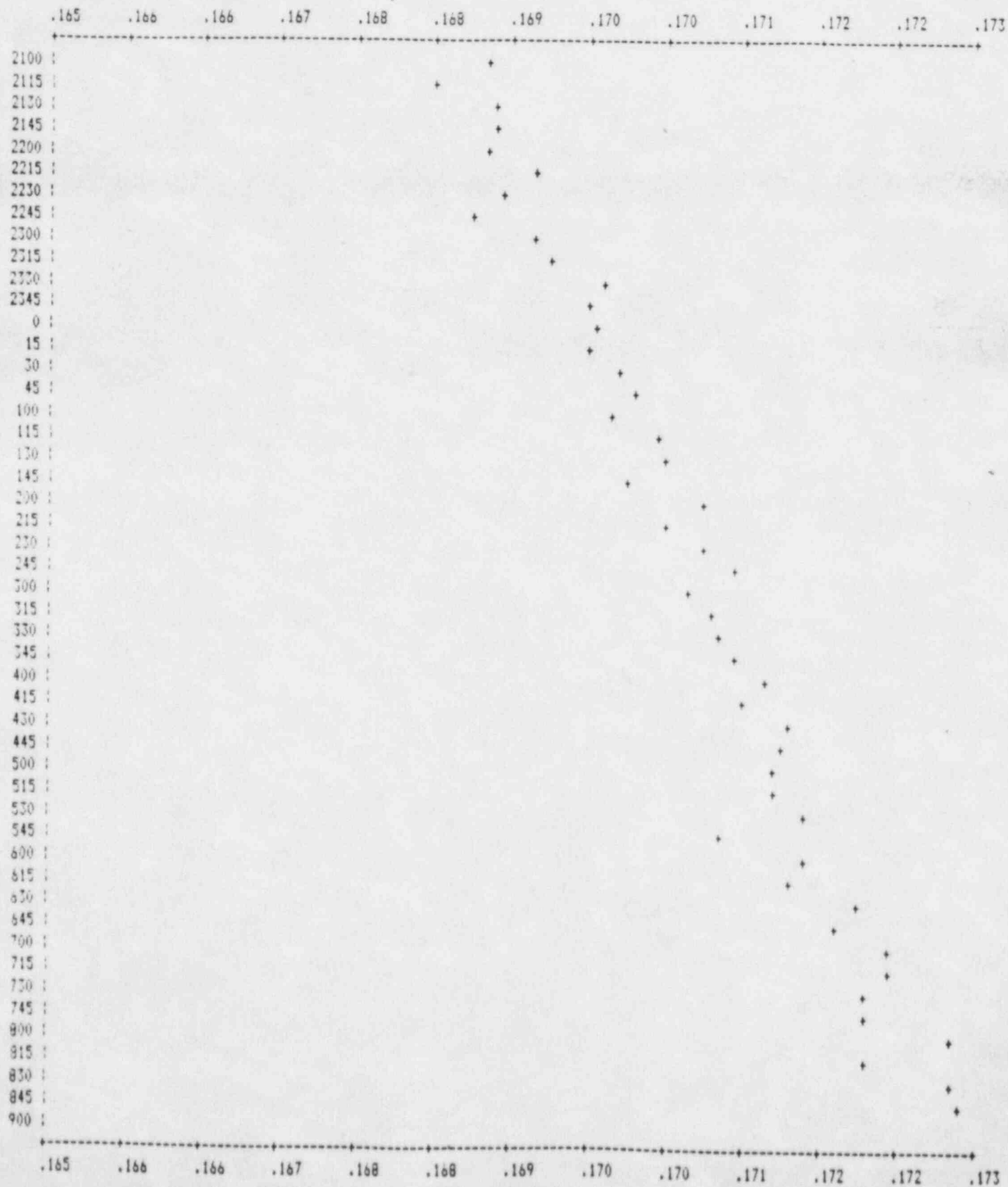
WOLF CREEK REDUCED PRESSURE ILRT  
PRESSURE PSIA



WOLF CREEK REDUCED PRESSURE ILRT  
VAPOR PRESSURE PSIA



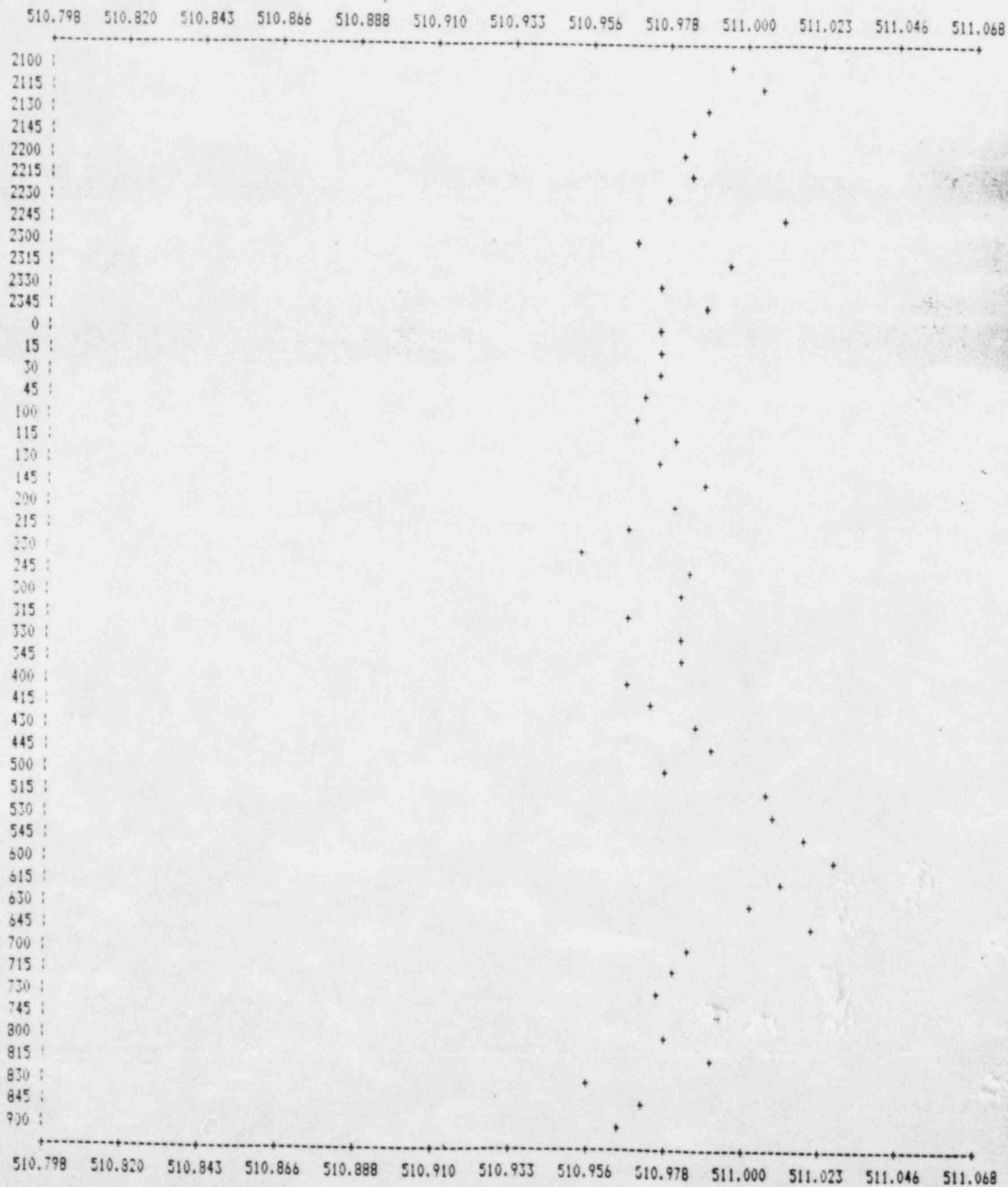
WOLF CREEK REDUCED PRESSURE ILRT  
VAPOR PRESSURE PSIA



WOLF CREEK REDUCED PRESSURE ILRT  
AIRMASS LBM X 1000

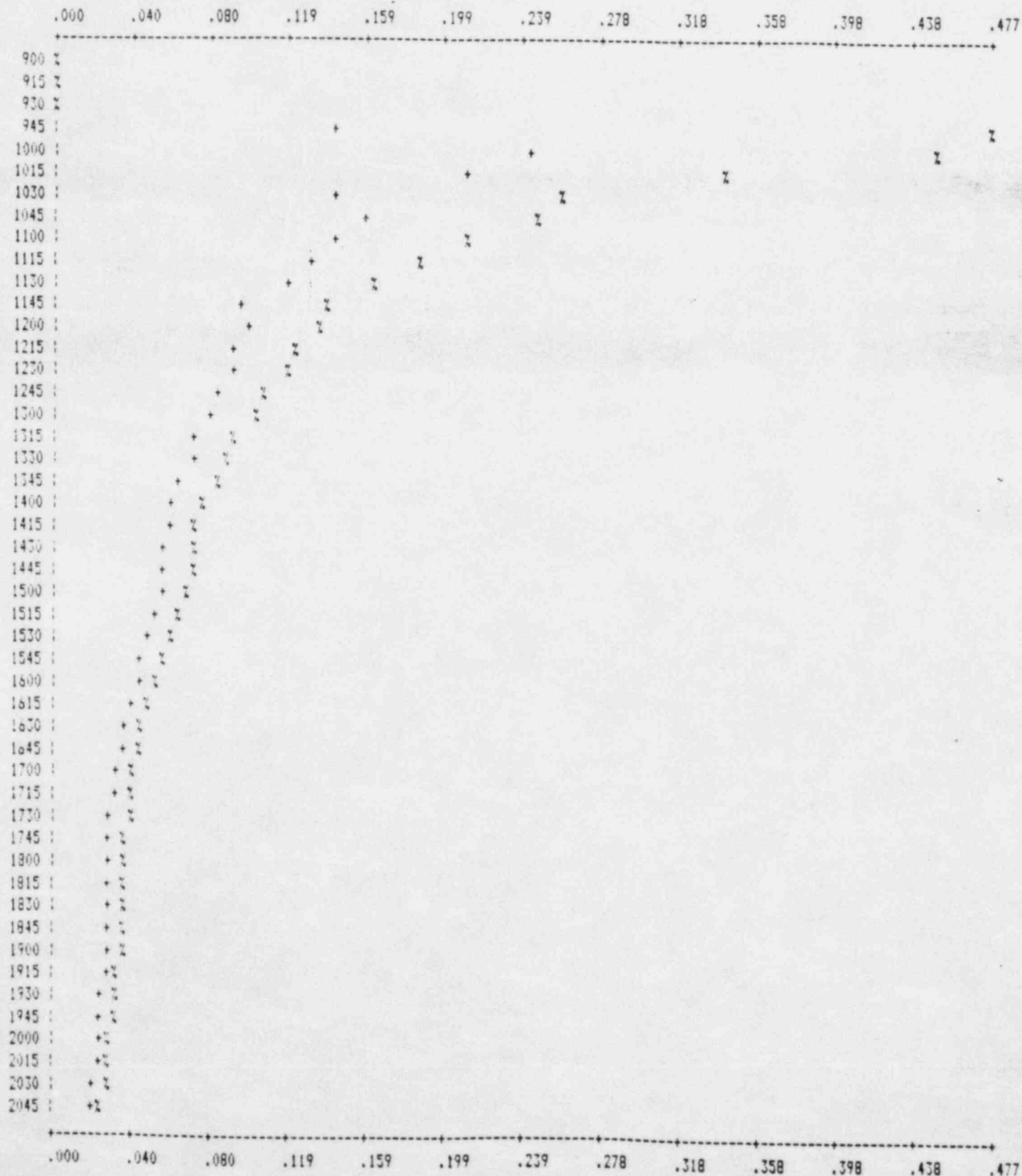


WOLF CREEK REDUCED PRESSURE ILRT  
AIRMASS LBM X 1000

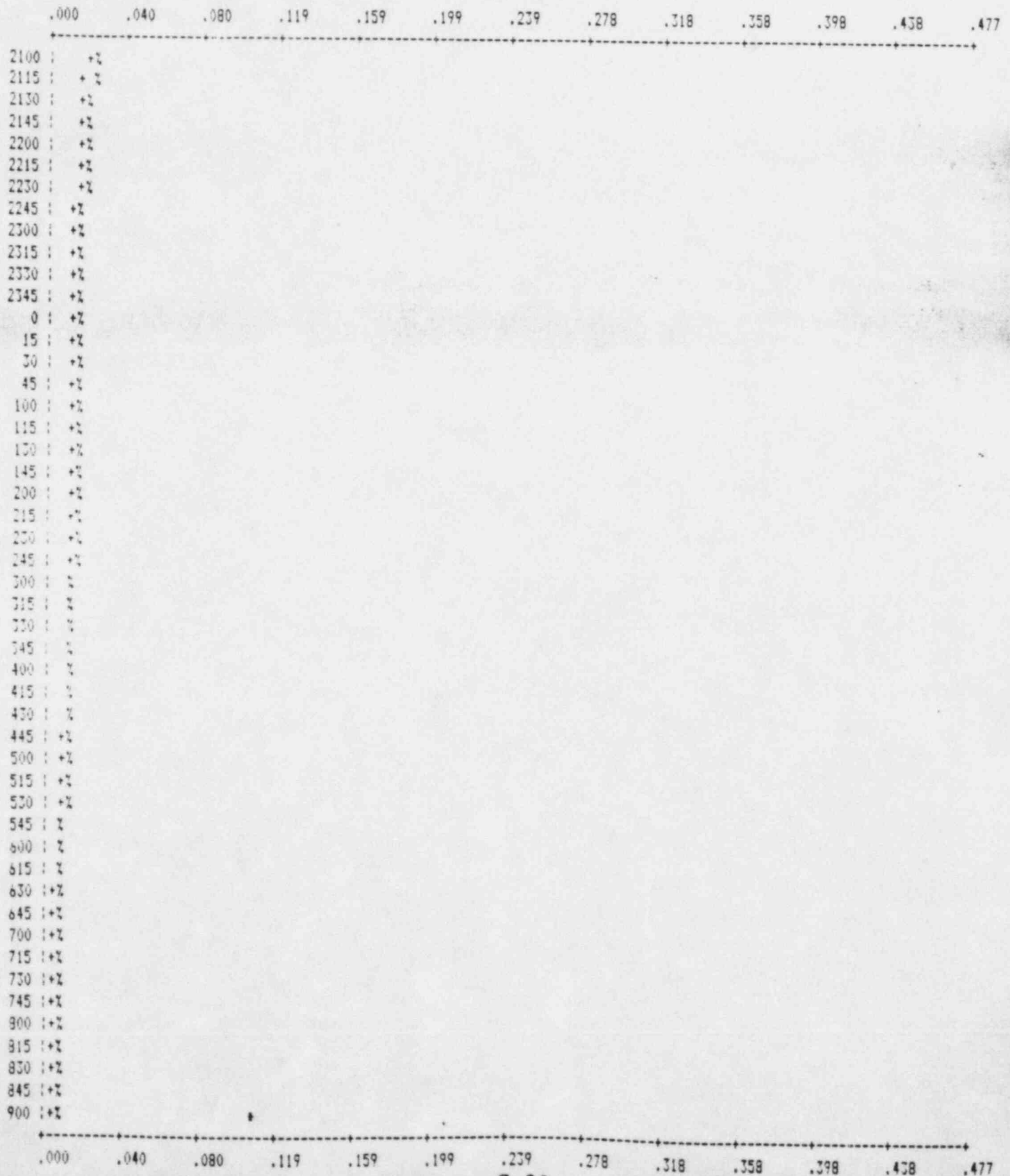




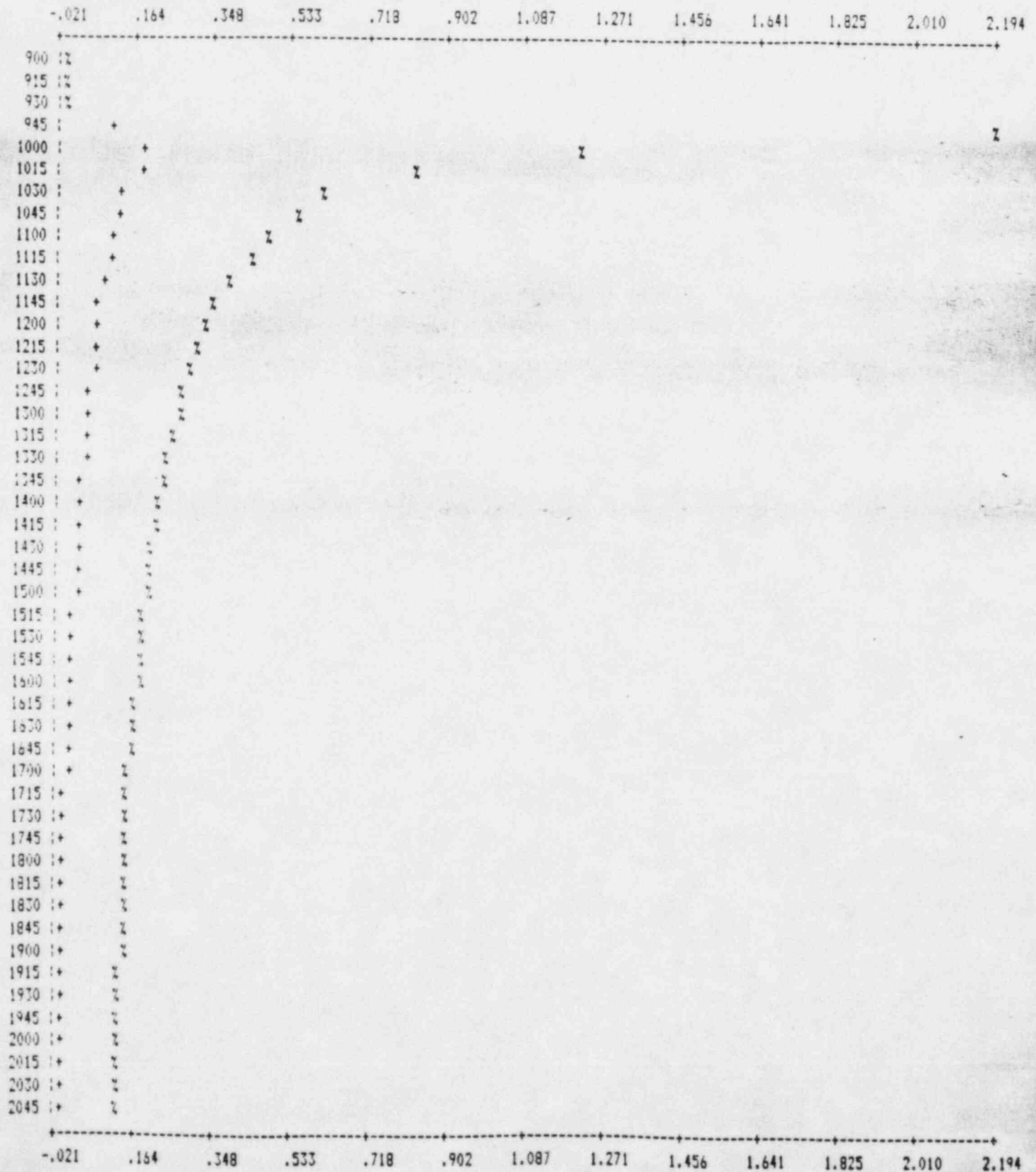
WOLF CREEK REDUCED PRESSURE ILRT  
MASS POINT LEAKAGE RATE (+) AND UCL (%)



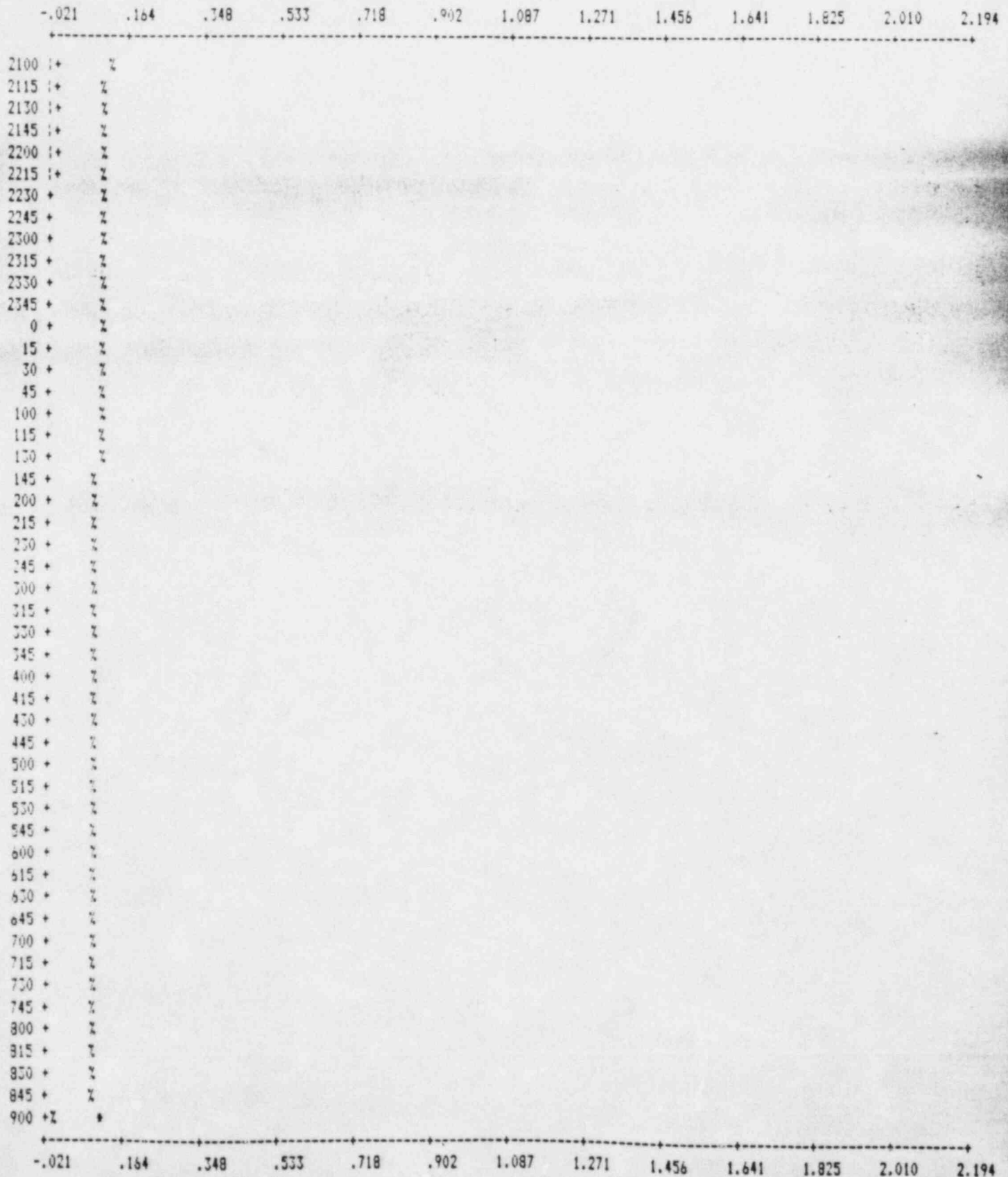
WOLF CREEK REDUCED PRESSURE ILRT  
MASS POINT LEAKAGE RATE (+) AND UCL (%)



WOLF CREEK REDUCED PRESSURE ILRT  
TOTAL TIME LEAKAGE RATE (+) AND UCL (%)



WOLF CREEK REDUCED PRESSURE ILRT  
TOTAL TIME LEAKAGE RATE(+) AND UCL(%)



Appendix D

REDUCED PRESSURE ILRT

VERIFICATION TEST SUMMARY DATA AND ANALYSIS

1. Summary Data
2. Mass Point Analysis
3. Total Time Analysis
4. Verification Plots - Temperatures,  
Pressure, Vapor Pressure, Air Mass,  
Mass Point Leakage and Total Time  
Leakage Rate.

WOLF CREEK REDUCED PRESSURE ILRT  
SUMMARY DATA

ALMAX = .144  
VRATET = .124

VOLUME = 2500000.  
VRATEM = .148

TIME	DATE	TEMP	PRESSURE	VPRS	VOLUME
1000	1220	527.144	39.9156	.1728	2500000.
1015	1220	527.144	39.9146	.1728	2500000.
1030	1220	527.124	39.9133	.1731	2500000.
1045	1220	527.126	39.9110	.1735	2500000.
1100	1220	527.095	39.9775	.1060	2500000.
1115	1220	527.090	39.9114	.1692	2500000.
1130	1220	527.066	39.9066	.1720	2500000.
1145	1220	527.040	39.9050	.1727	2500000.
1200	1220	527.042	39.9037	.1730	2500000.
1215	1220	527.026	39.9029	.1729	2500000.
1230	1220	527.028	39.9005	.1733	2500000.
1245	1220	527.007	39.8991	.1727	2500000.
1300	1220	526.974	39.8977	.1731	2500000.
1315	1220	526.965	39.8967	.1732	2500000.
1330	1220	526.955	39.8941	.1739	2500000.
1345	1220	526.973	39.8927	.1743	2500000.
1400	1220	526.960	39.8913	.1737	2500000.
1415	1220	526.935	39.8901	.1740	2500000.
1430	1220	526.934	39.8878	.1743	2500000.



WOLF CREEK REDUCED PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
MASS POINT ANALYSIS

TIME AND DATE AT START OF TEST: 1000 1220 1984  
TEST DURATION: 4.50 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LBM)	MASS LOSS (LBM)	AVERAGE MASS LOSS (LBM/HR)
1000	527.144	39.9156	510955.		
1015	527.144	39.9146	510941.	13.3	53.3
1030	527.124	39.9133	510945.	-3.8	19.1
1045	527.126	39.9110	510914.	31.4	54.6
1115	527.090	39.9114	510953.	-39.0	1.5
1130	527.066	39.9066	510915.	37.8	26.5
1145	527.040	39.9050	510920.	-4.7	20.0
1200	527.042	39.9037	510901.	18.4	26.7
1215	527.026	39.9029	510905.	-3.9	22.0
1230	527.028	39.9005	510873.	32.2	32.7
1245	527.007	39.8991	510876.	-3.1	28.6
1300	526.974	39.8977	510890.	-14.2	21.5
1315	526.965	39.8967	510886.	4.3	21.1
1330	526.955	39.8941	510861.	24.6	36.7
1345	526.973	39.8927	510827.	34.6	34.1
1400	526.960	39.8913	510822.	4.7	33.1
1415	526.935	39.8901	510830.	-8.1	29.3
1430	526.934	39.8878	510801.	28.7	34.0

FREE AIR VOLUME USED (CU. FT.) = 2500000.  
REGRESSION LINE  
INTERCEPT (LBM) = 510962.  
SLOPE (LBM/HR) = -31.3  
VERIFICATION TEST LEAKAGE RATE UPPER LIMIT = .184  
VERIFICATION TEST LEAKAGE RATE LOWER LIMIT = .112  
THE CALCULATED LEAKAGE RATE = .147

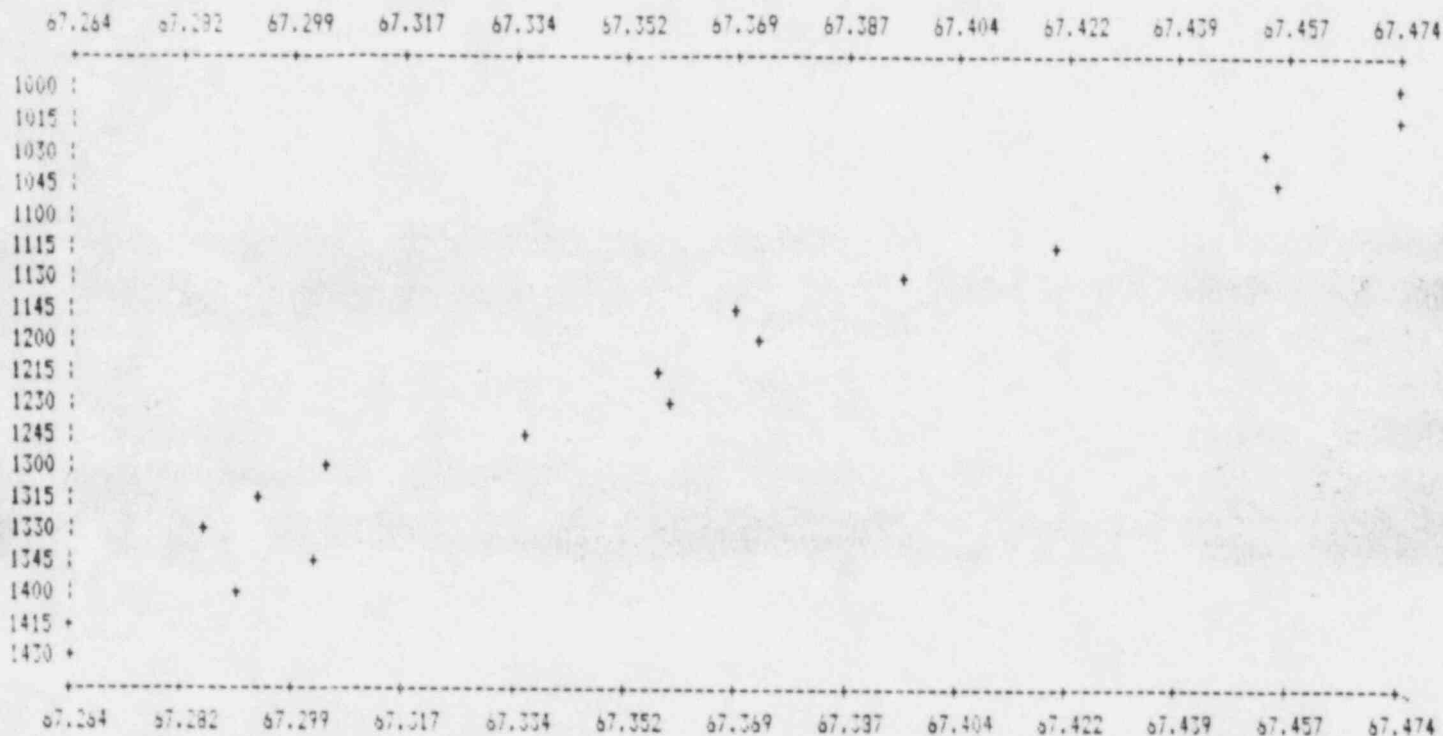
WOLF CREEK REDUCED PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
TOTAL TIME ANALYSIS

TIME AND DATE AT START OF TEST: 1000 1220 1984  
TEST DURATION: 4.50 HOURS

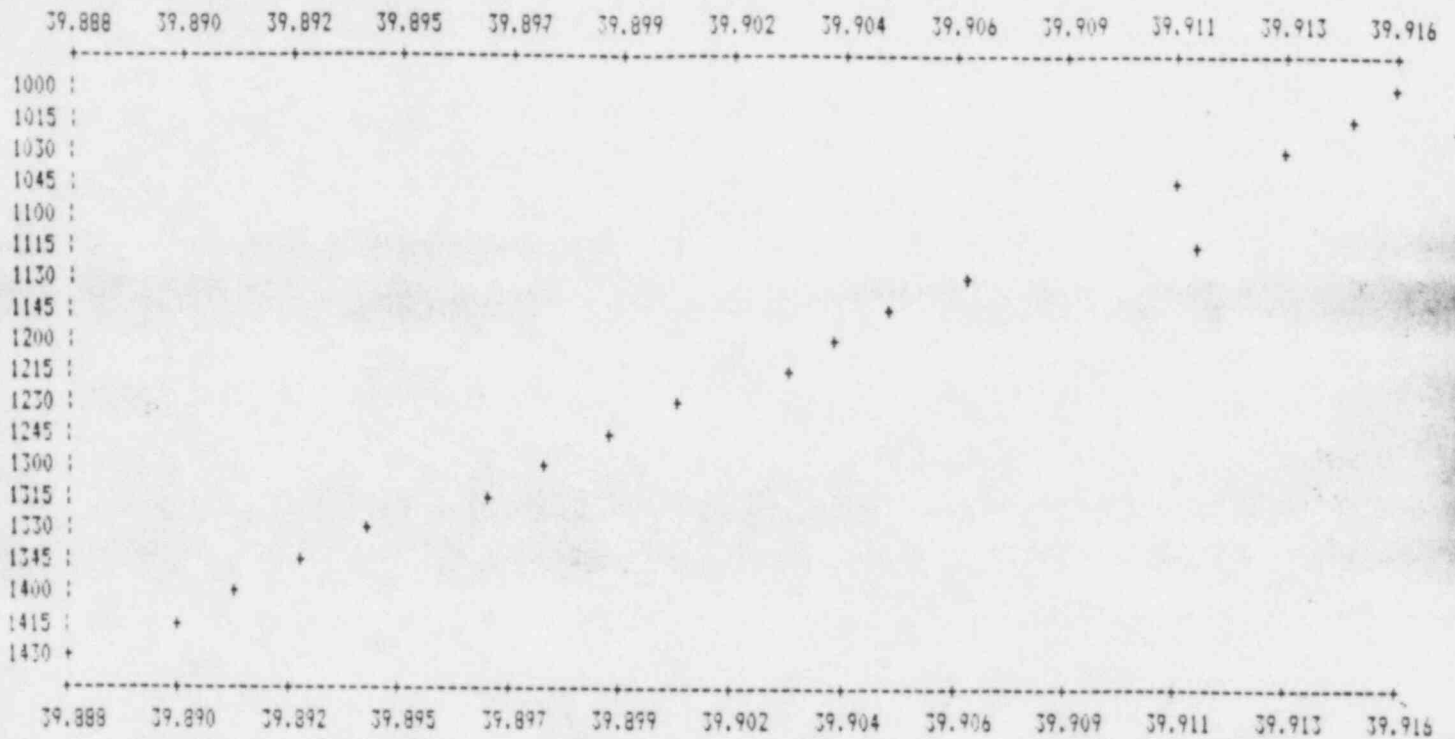
TIME	TEMP (R)	PRESSURE (PSIA)	MEASURED LEAKAGE RATE
1000	527.144	39.9156	
1015	527.144	39.9146	.250
1030	527.124	39.9133	.090
1045	527.126	39.9110	.256
1115	527.090	39.9114	.007
1130	527.066	39.9066	.124
1145	527.040	39.9050	.094
1200	527.042	39.9037	.125
1215	527.026	39.9029	.103
1230	527.028	39.9005	.153
1245	527.007	39.8991	.134
1300	526.974	39.8977	.101
1315	526.965	39.8967	.099
1330	526.955	39.8941	.125
1345	526.973	39.8927	.160
1400	526.960	39.8913	.156
1415	526.935	39.8901	.138
1430	526.934	39.8878	.160

MEAN OF THE MEASURED LEAKAGE RATES	=	.134
VERIFICATION TEST LEAKAGE RATE UPPER LIMIT	=	.160
VERIFICATION TEST LEAKAGE RATE LOWER LIMIT	=	.088
THE CALCULATED LEAKAGE RATE	=	.126

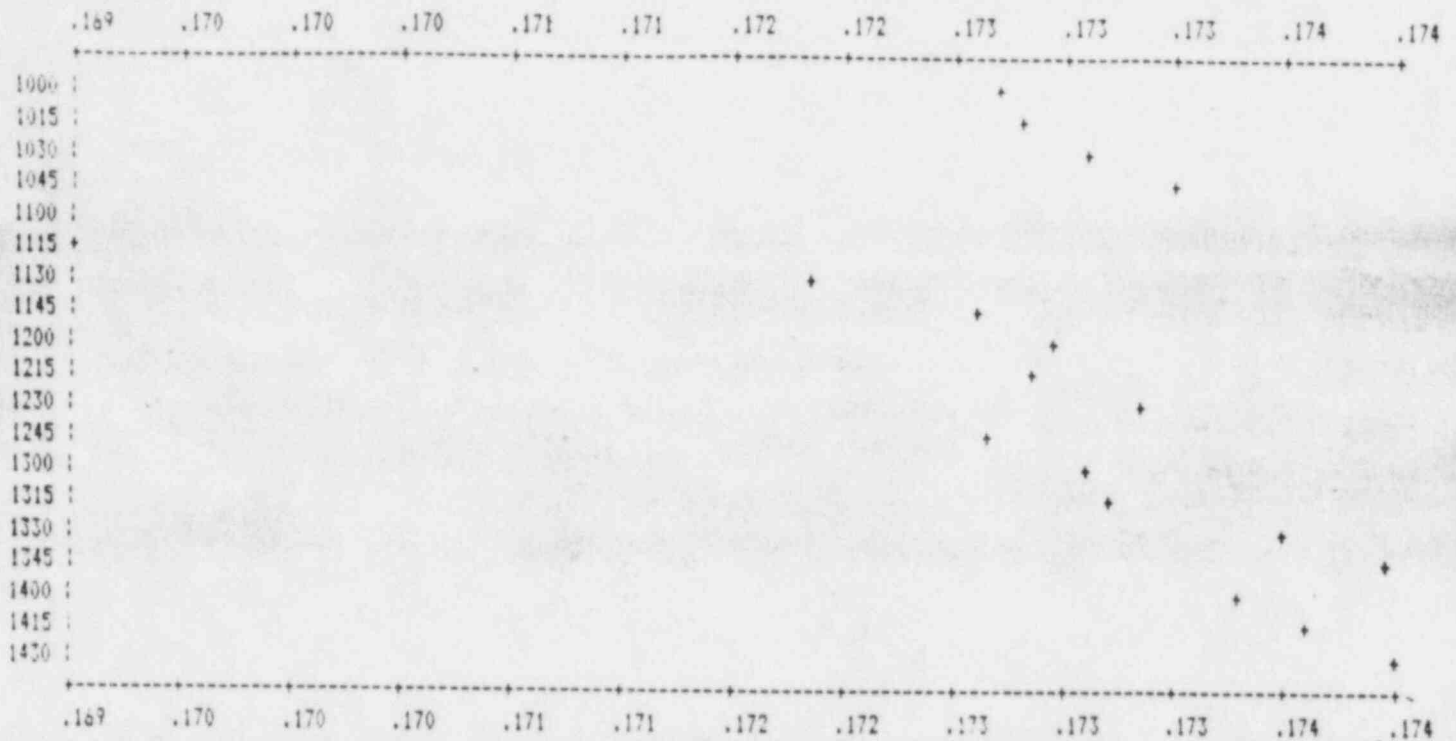
WOLF CREEK REDUCED PRESSURE ILRT  
TEMPERATURE DEGREES F



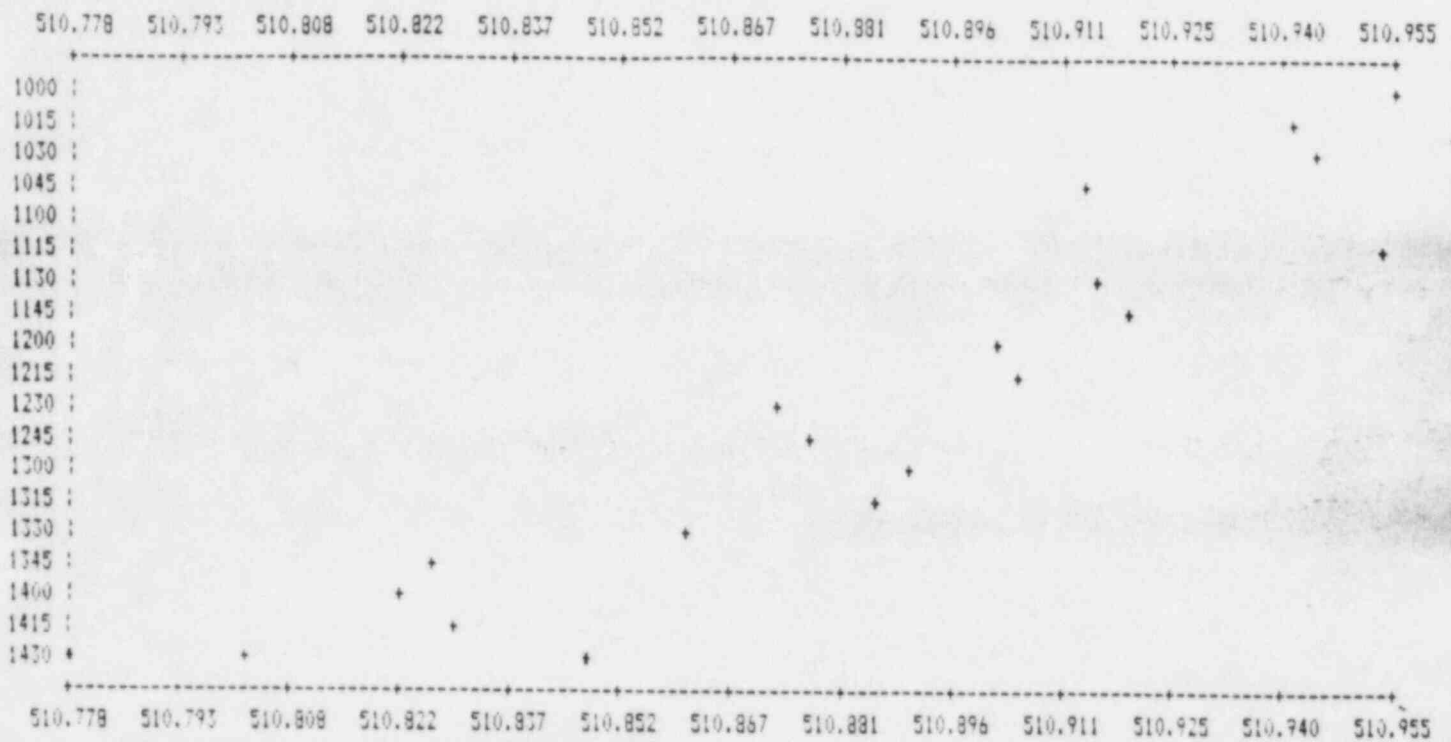
# WOLF CREEK REDUCED PRESSURE ILRT PRESSURE PSIA



WOLF CREEK REDUCED PRESSURE ILRT  
VAPOR PRESSURE PSIA

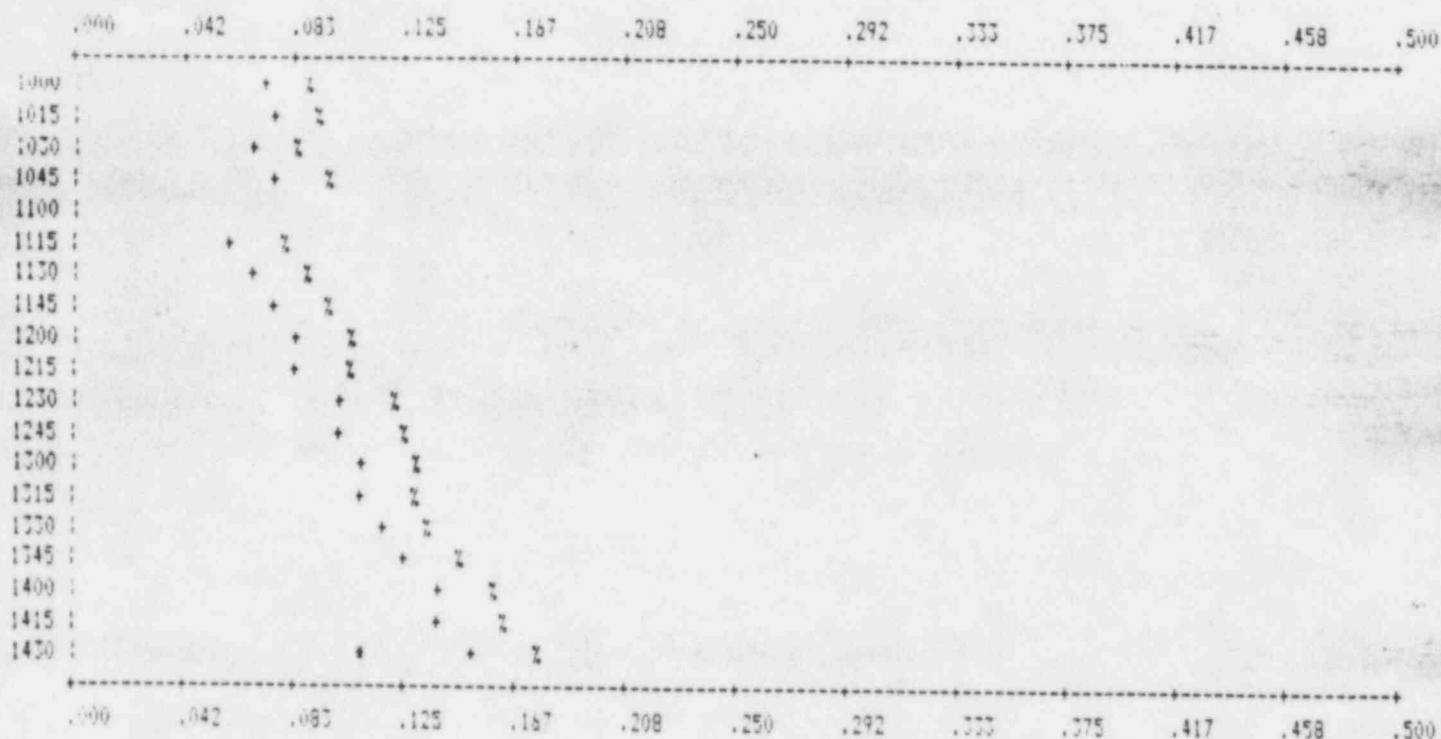


WOLF CREEK REDUCED PRESSURE ILRT  
AIRMASS LBM X 1000

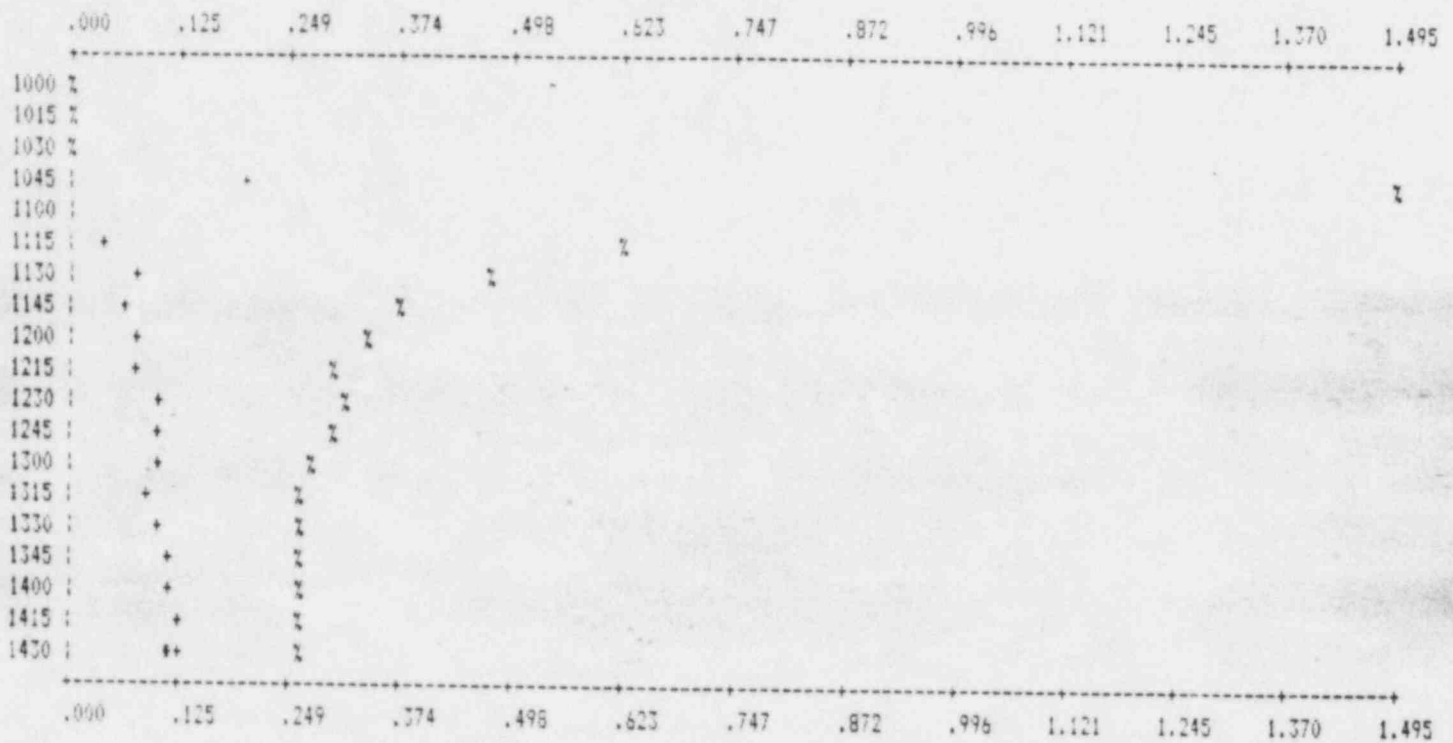




WOLF CREEK REDUCED PRESSURE ILRT  
MASS POINT LEAKAGE RATE(+) AND UCL(%)



WOLF CREEK REDUCED PRESSURE ILRT  
TOTAL TIME LEAKAGE RATE(+) AND UCL(%)



Appendix E

PEAK PRESSURE ILRT

ILRT STABILIZATION

1. Summary Data
2. Temperature Stabilization
3. Temperature v/s Time Plot
4. Pressure v/s Time Plot

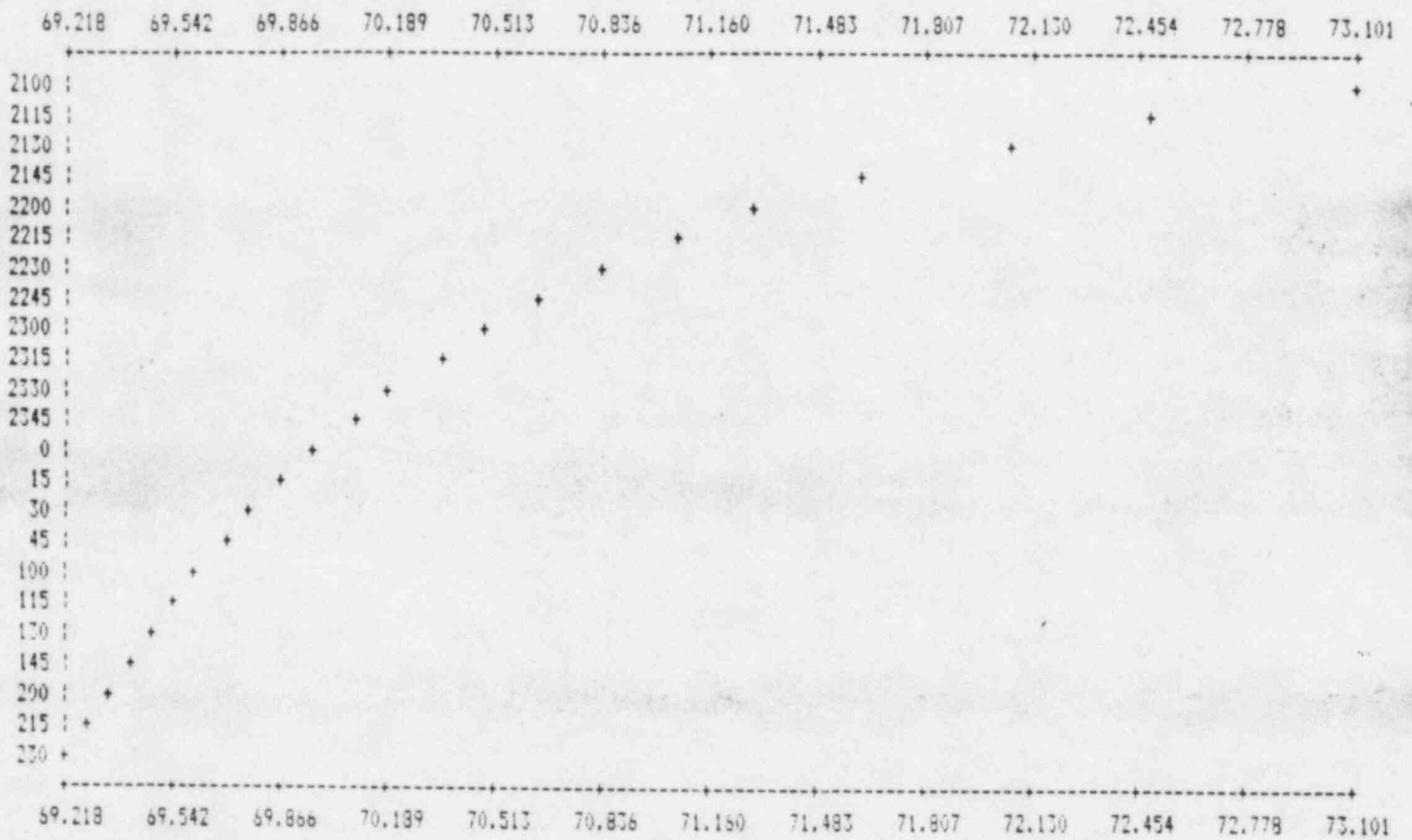
WOLF CREEK PEAK PRESSURE ILRT  
TEMPERATURE STABILIZATION

FROM A STARTING TIME AND DATE OF: 2100 1220 1984

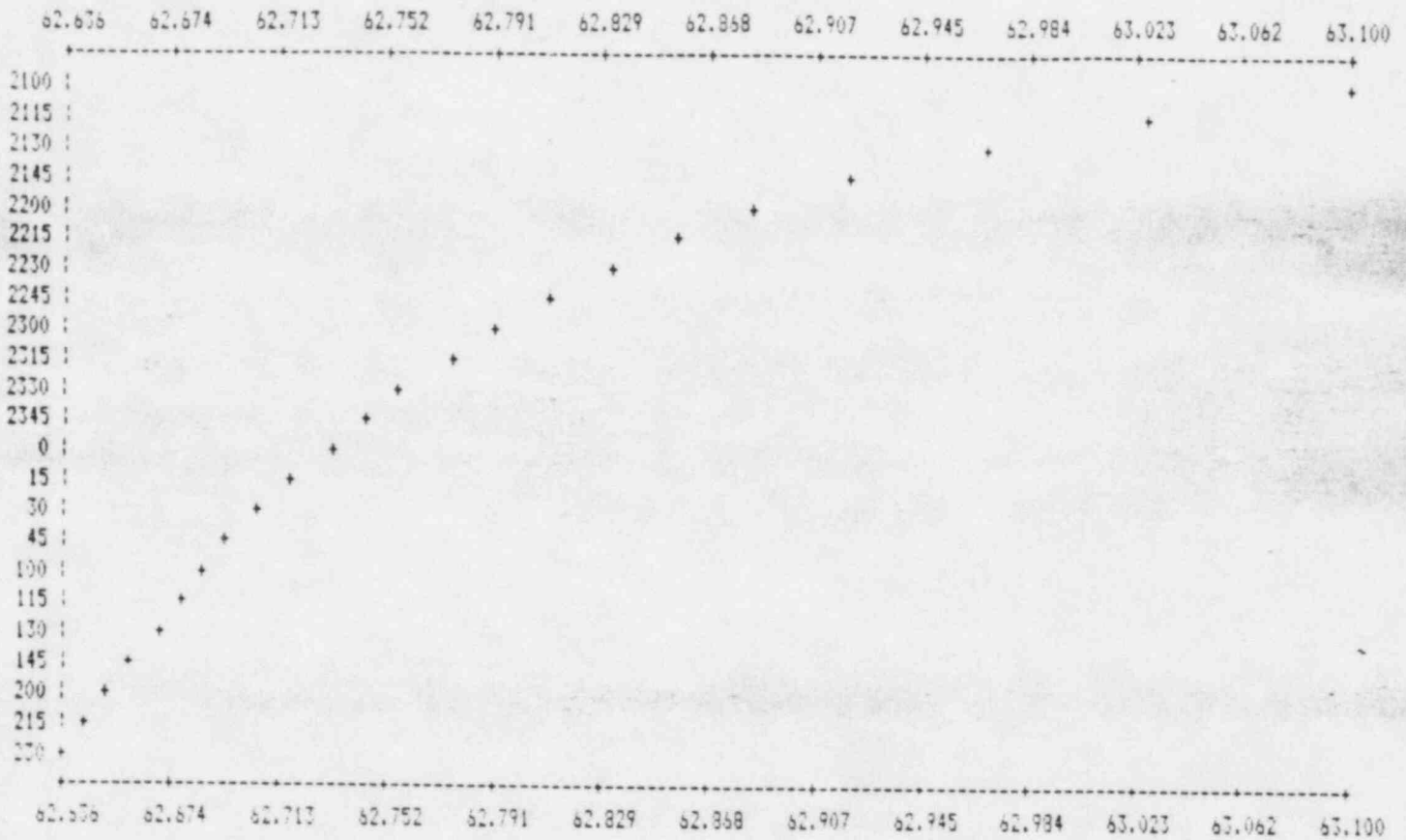
TIME (HOURS)	TEMP ( R)	AVE T (4HRS)	ANSI AVE T (1HR)	DIFF	BN-TOP-1 AVE T (2HRS)
.00	532.77				
.25	532.15				
.50	531.72				
.75	531.27				
1.00	530.95				
1.25	530.72				
1.50	530.50				
1.75	530.32				
2.00	530.16				-1.306
2.25	530.02				-1.066
2.50	529.87				-.927
2.75	529.76				-.752
3.00	529.64				-.656
3.25	529.55				-.585
3.50	529.44				-.528
3.75	529.38				-.471*
4.00	529.27	-.874*	-.366	-.51	-.221*
4.25	529.22	-.733	-.330	-.40*	-.200*
4.50	529.15	-.643	-.298	-.35*	-.179*
4.75	529.07	-.549	-.305	-.24*	-.173*
5.00	529.03	-.482	-.248	-.23*	-.153*
5.25	528.95	-.442	-.268	-.17*	-.150*
5.50	528.89	-.402	-.264	-.14*	-.138*

\* INDICATES TEMPERATURE STABILIZATION HAS BEEN SATISFIED

WOLF CREEK PEAK PRESSURE ILRT  
TEMPERATURE DEGREES F

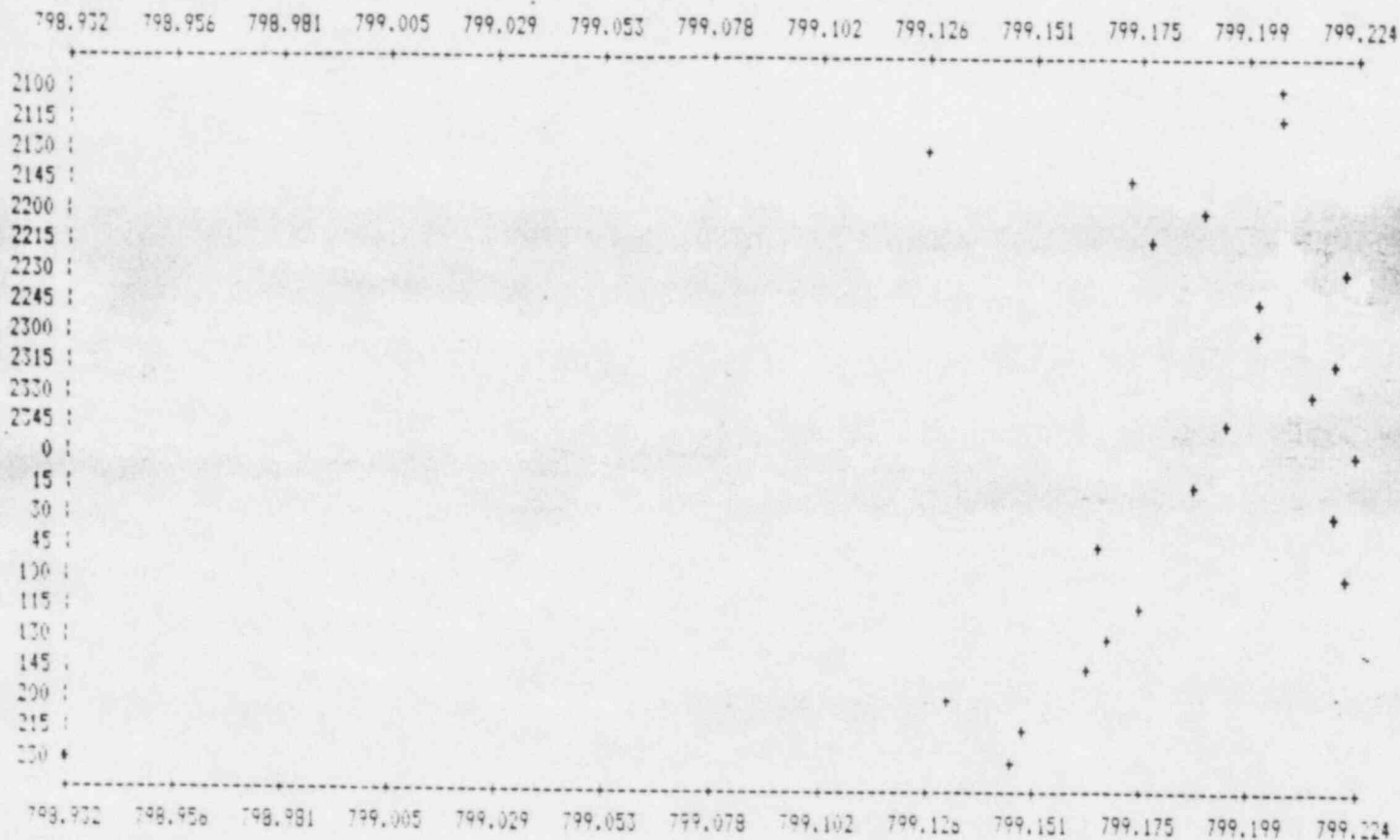


WOLF CREEK PEAK PRESSURE ILRT  
PRESSURE PSIA





WOLF CREEK PEAK PRESSURE LLRT  
AIRMASS LBM X 1000



## Appendix F

### PEAK PRESSURE ILRT SUMMARY DATA AND ANALYSIS

1. ILRT Summary Data
2. Mass Point Analysis
3. Total Time Analysis
4. Trend Report

### PEAK PRESSURE ILRT PLOTS

1. Temperature vs Time
2. Pressure vs Time
3. Vapor Pressure vs Time
4. Air Mass vs Time
5. Mass Point Leakage vs Time
6. Total Time Leakage vs Time

WOLF CREEK PEAK PRESSURE ILRT  
SUMMARY DATA

ALMAX = .200  
VRATET = .207

VOLUME = 2500000.  
VRATEM = .210

TIME	DATE	TEMP	PRESSURE	VPRS	VOLUME
230	1221	528.888	62.6357	.2196	2500000.
245	1221	528.836	62.6289	.2195	2500000.
300	1221	528.776	62.6223	.2183	2500000.
315	1221	528.734	62.6163	.2194	2500000.
330	1221	528.674	62.6096	.2193	2500000.
345	1221	528.646	62.6034	.2196	2500000.
400	1221	528.585	62.5975	.2187	2500000.
415	1221	528.527	62.5923	.2190	2500000.
430	1221	528.498	62.5879	.2195	2500000.
445	1221	528.455	62.5826	.2189	2500000.
500	1221	528.423	62.5786	.2181	2500000.
515	1221	528.370	62.5717	.2191	2500000.
530	1221	528.338	62.5672	.2187	2500000.
545	1221	528.293	62.5626	.2194	2500000.
600	1221	528.271	62.5596	.2185	2500000.
615	1221	528.229	62.5540	.2192	2500000.
630	1221	528.199	62.5494	.2190	2500000.
645	1221	528.152	62.5453	.2191	2500000.
700	1221	528.130	62.5410	.2185	2500000.
715	1221	528.102	62.5362	.2184	2500000.
730	1221	528.080	62.5334	.2183	2500000.
745	1221	528.056	62.5291	.2187	2500000.
800	1221	528.023	62.5253	.2186	2500000.
815	1221	527.999	62.5216	.2184	2500000.
830	1221	527.977	62.5173	.2188	2500000.
845	1221	527.924	62.5149	.2182	2500000.
900	1221	527.907	62.5104	.2188	2500000.
915	1221	527.885	62.5070	.2183	2500000.
930	1221	527.865	62.5053	.2181	2500000.
945	1221	527.838	62.5007	.2188	2500000.
1000	1221	527.805	62.4979	.2187	2500000.
1015	1221	527.780	62.4955	.2181	2500000.
1030	1221	527.769	62.4940	.2177	2500000.

WOLF CREEK PEAK PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
MASS POINT ANALYSIS

TIME AND DATE AT START OF TEST: 230 1221 1984  
TEST DURATION: 8.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LBM)	MASS LOSS (LBM)	AVERAGE MASS LOSS (LBM/HR)
230	528.888	62.6357	799146.		
245	528.836	62.6289	799139.	6.9	27.6
300	528.776	62.6223	799145.	-5.9	2.0
315	528.734	62.6163	799133.	12.7	18.3
330	528.674	62.6096	799138.	-5.9	7.8
345	528.646	62.6034	799102.	36.8	35.6
400	528.585	62.5975	799117.	-15.5	19.4
415	528.527	62.5923	799139.	-22.3	3.9
430	528.498	62.5879	799127.	12.5	9.6
445	528.455	62.5826	799125.	1.6	9.4
500	528.423	62.5786	799121.	4.1	10.1
515	528.370	62.5717	799114.	7.5	11.9
530	528.338	62.5672	799105.	8.8	13.8
545	528.293	62.5626	799114.	-9.1	10.0
600	528.271	62.5596	799109.	5.1	10.7
615	528.229	62.5540	799101.	7.9	12.1
630	528.199	62.5494	799088.	13.3	14.7
645	528.182	62.5453	799106.	-18.3	9.4
700	528.130	62.5410	799084.	22.1	13.8
715	528.102	62.5362	799065.	19.0	17.0
730	528.080	62.5334	799063.	2.7	16.7
745	528.056	62.5291	799045.	17.3	19.2
800	528.023	62.5253	799045.	.3	18.4
815	527.999	62.5216	799035.	9.6	19.3
830	527.977	62.5173	799014.	21.7	22.1
845	527.924	62.5149	799063.	-48.9	13.4
900	527.907	62.5104	799031.	31.8	17.7
915	527.885	62.5070	799022.	9.2	18.5
930	527.865	62.5053	799030.	-8.5	16.8
945	527.838	62.5007	799011.	18.8	19.6
1000	527.805	62.4979	799025.	-13.9	16.1
1015	527.780	62.4935	799034.	-8.1	14.6
1030	527.769	62.4940	799030.	3.5	14.5

FREE AIR VOLUME USED (CU. FT.)

42300000.

REGRESSION LINE

INTERCEPT (LBM)

= 799154.

SLOPE (LBM/HR)

= -17.5

MAXIMUM ALLOWABLE LEAKAGE RATE

= .200

75% OF MAXIMUM ALLOWABLE LEAKAGE RATE

= .150

THE UPPER 95% CONFIDENCE LIMIT

= .058

THE CALCULATED LEAKAGE RATE

= .053

WOLF CREEK PEAK PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT-DAY)  
TOTAL TIME ANALYSIS

TIME AND DATE AT START OF TEST: 230 1221 1984  
TEST DURATION: 8.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	MEASURED LEAKAGE RATE
230	528.888	62.6357	
245	528.836	62.6289	.083
300	528.776	62.6223	.006
315	528.734	62.6163	.055
330	528.674	62.6096	.023
345	528.646	62.6034	.107
400	528.585	62.5975	.058
415	528.527	62.5923	.012
430	528.498	62.5879	.029
445	528.455	62.5826	.028
500	528.423	62.5786	.030
515	528.370	62.5717	.036
530	528.338	62.5672	.042
545	528.293	62.5626	.030
600	528.271	62.5596	.032
615	528.229	62.5540	.036
630	528.199	62.5494	.044
645	528.152	62.5453	.028
700	528.130	62.5410	.041
715	528.102	62.5362	.051
730	528.080	62.5334	.050
745	528.056	62.5291	.058
800	528.023	62.5253	.055
815	527.999	62.5216	.058
830	527.977	62.5173	.066
845	527.924	62.5149	.040
900	527.907	62.5104	.053
915	527.885	62.5070	.055
930	527.865	62.5053	.050
945	527.838	62.5007	.056
1000	527.805	62.4979	.048
1015	527.780	62.4955	.044
1030	527.769	62.4940	.044

MEAN OF THE MEASURED LEAKAGE RATES	=	.045
MAXIMUM ALLOWABLE LEAKAGE RATE	=	.200
75% OF MAXIMUM ALLOWABLE LEAKAGE RATE	=	.150
THE UPPER 95% CONFIDENCE LIMIT	=	.092
THE CALCULATED LEAKAGE RATE	=	.050

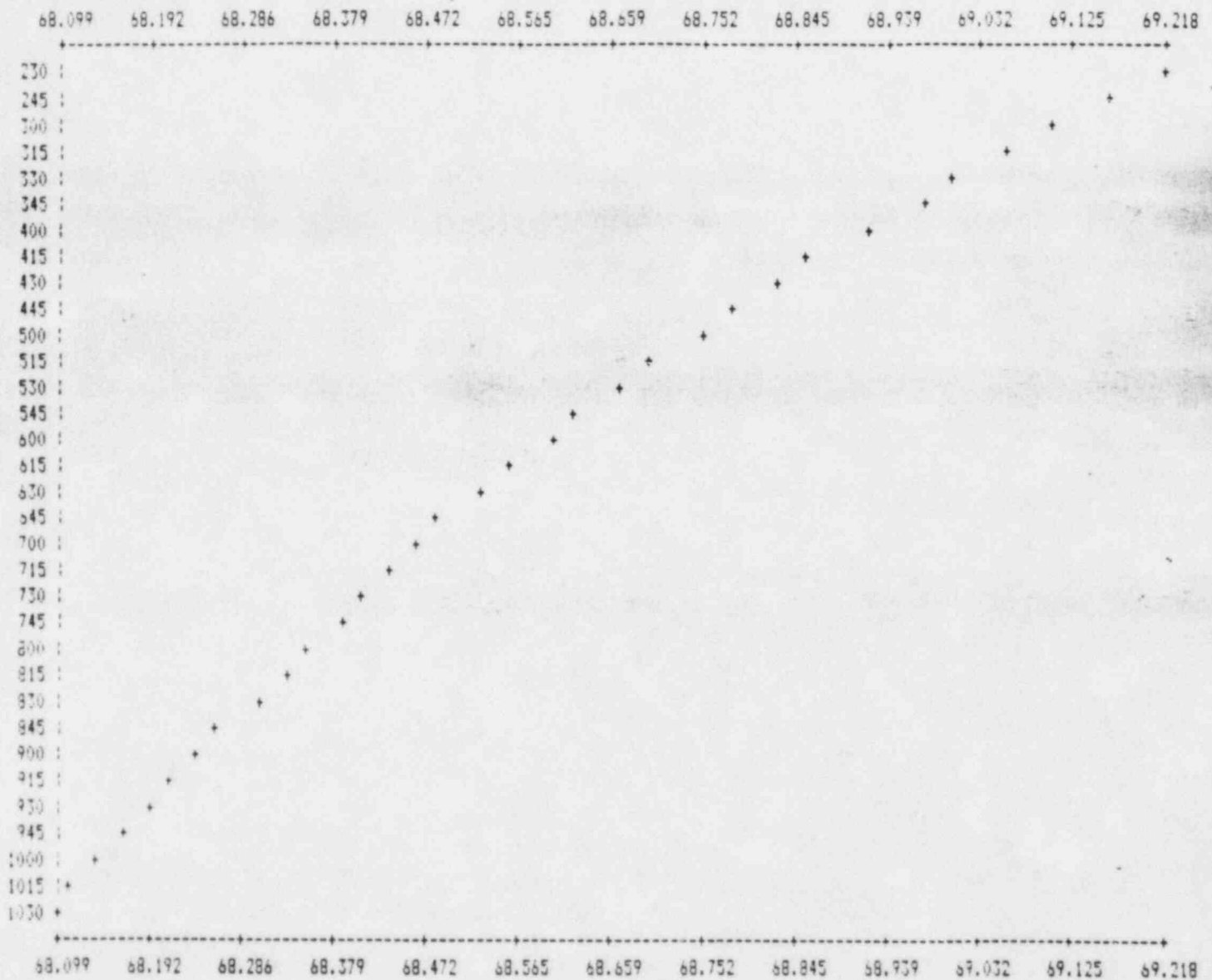
WOLF CREEK PEAK PRESSURE ILRT  
TREND REPORT

TIME AND DATE AT START OF TEST: 230 1221 1984

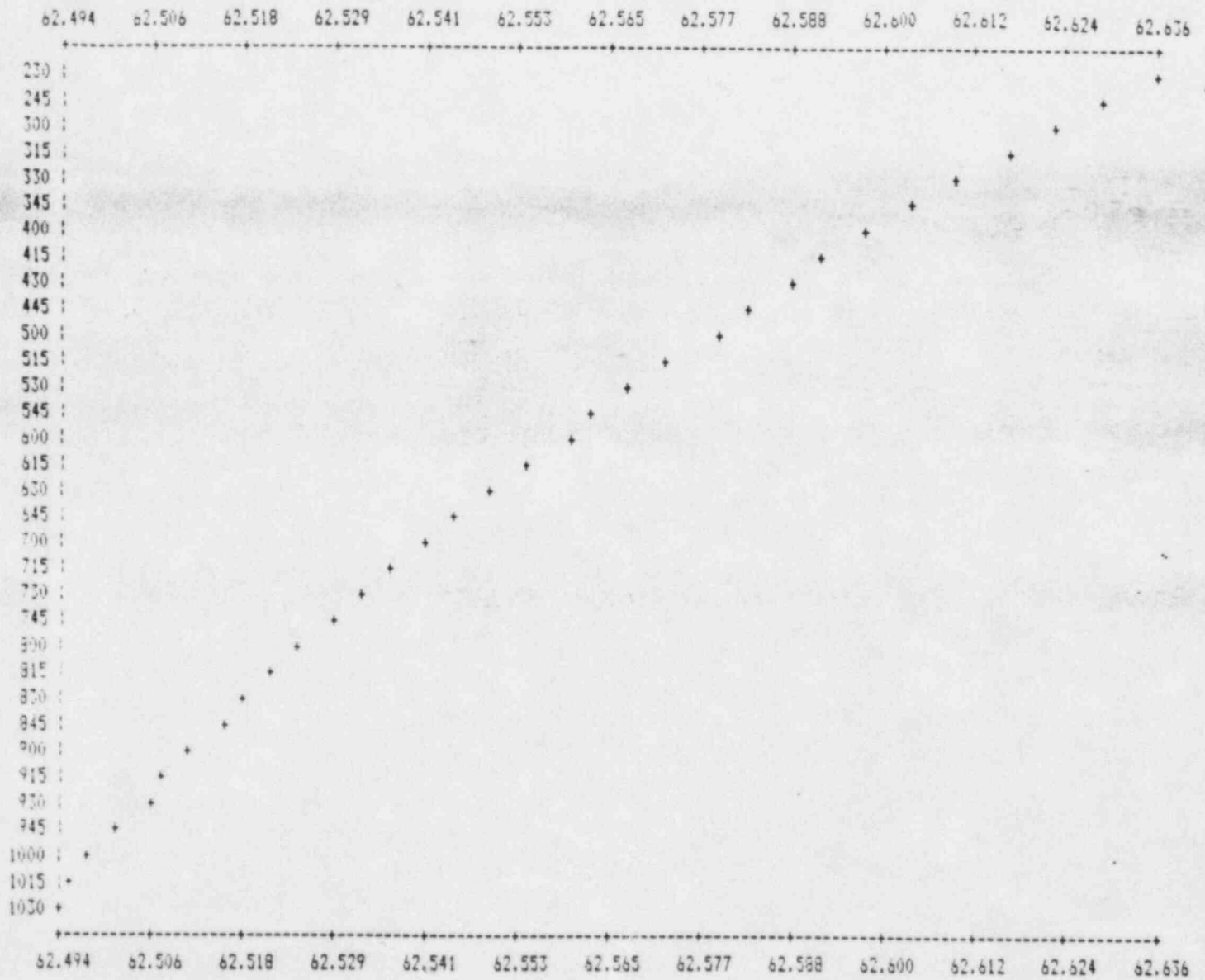
NO. PTS	END TIME	TOTAL TIME ANALYSIS			MASS POINT ANALYSIS	
		MEAS.	CALCULATED	UCL	CALCULATED	UCL
4	315	.055	.034	.531	.042	.127
5	330	.023	.022	.205	.027	.071
6	345	.107	.068	.248	.082	.154
7	400	.058	.066	.203	.073	.122
8	415	.012	.043	.169	.040	.091
9	430	.029	.036	.145	.040	.072
10	445	.028	.031	.128	.028	.059
11	500	.030	.029	.116	.027	.052
12	515	.036	.029	.109	.028	.049
13	530	.042	.031	.106	.032	.050
14	545	.030	.029	.099	.030	.045
15	600	.032	.028	.094	.030	.043
16	615	.036	.029	.091	.031	.042
17	630	.044	.031	.091	.034	.045
18	645	.028	.029	.087	.032	.041
19	700	.041	.031	.087	.034	.043
20	715	.051	.034	.089	.038	.047
21	730	.050	.036	.090	.041	.050
22	745	.058	.040	.092	.046	.055
23	800	.035	.042	.094	.048	.057
24	815	.058	.045	.095	.051	.060
25	830	.066	.048	.098	.055	.064
26	845	.040	.047	.096	.053	.062
27	900	.053	.048	.096	.054	.062
28	915	.055	.050	.096	.055	.062
29	930	.050	.050	.095	.055	.062
30	945	.056	.051	.096	.056	.062
31	1000	.048	.051	.095	.055	.061
32	1015	.044	.050	.093	.054	.060
33	1030	.044	.050	.092	.053	.058



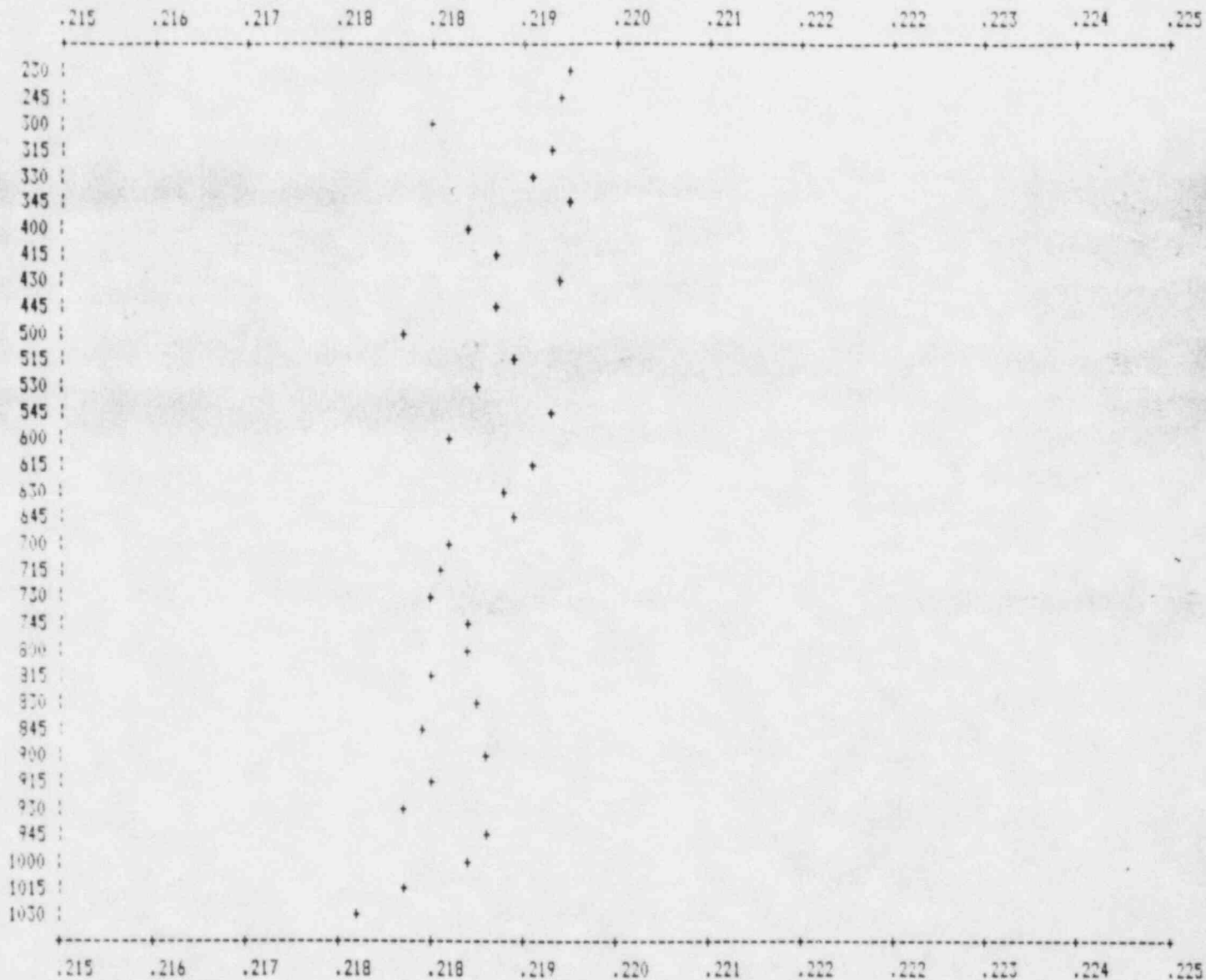
WOLF CREEK PEAK PRESSURE ILRT  
TEMPERATURE DEGREES F



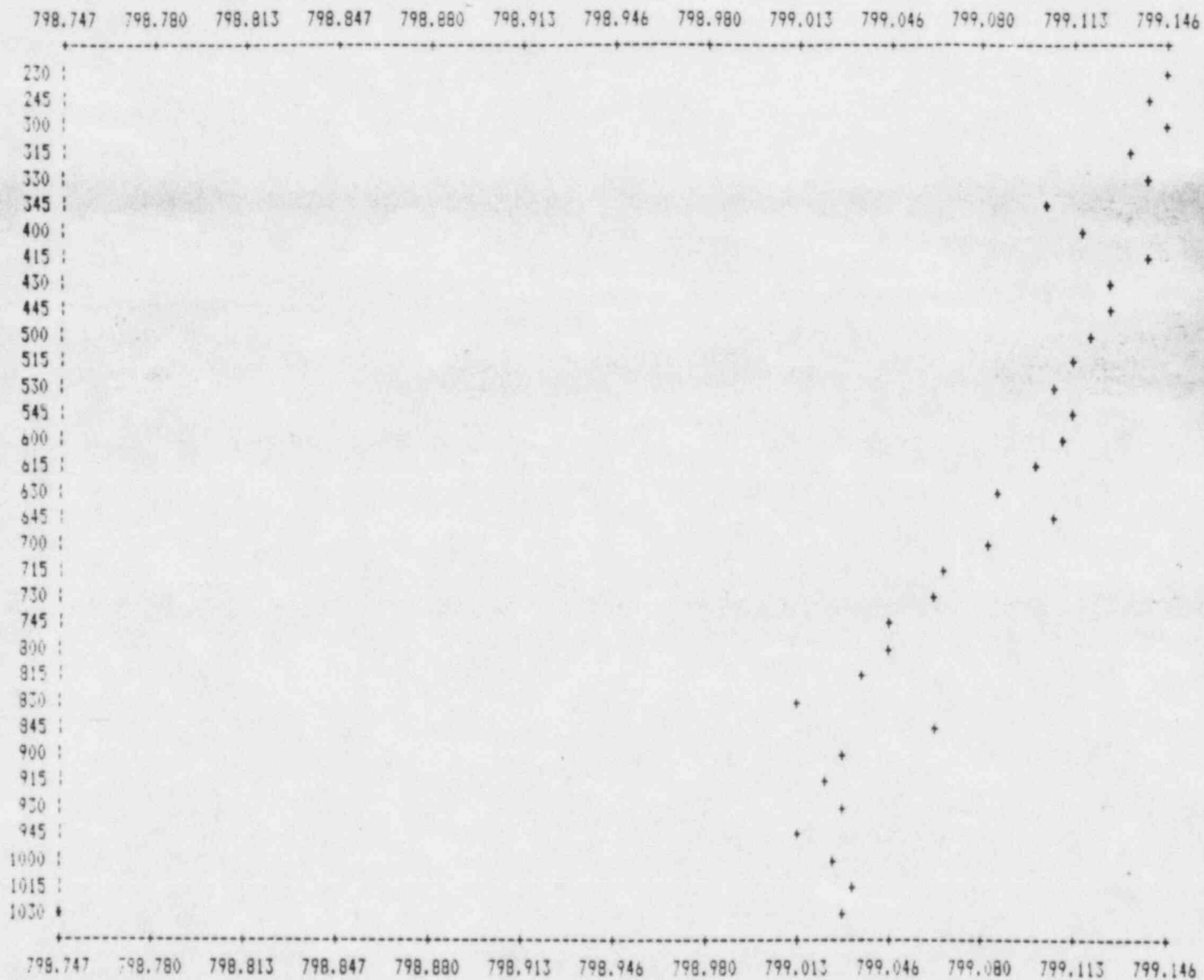
# WOLF CREEK PEAK PRESSURE ILRT PRESSURE PSIA



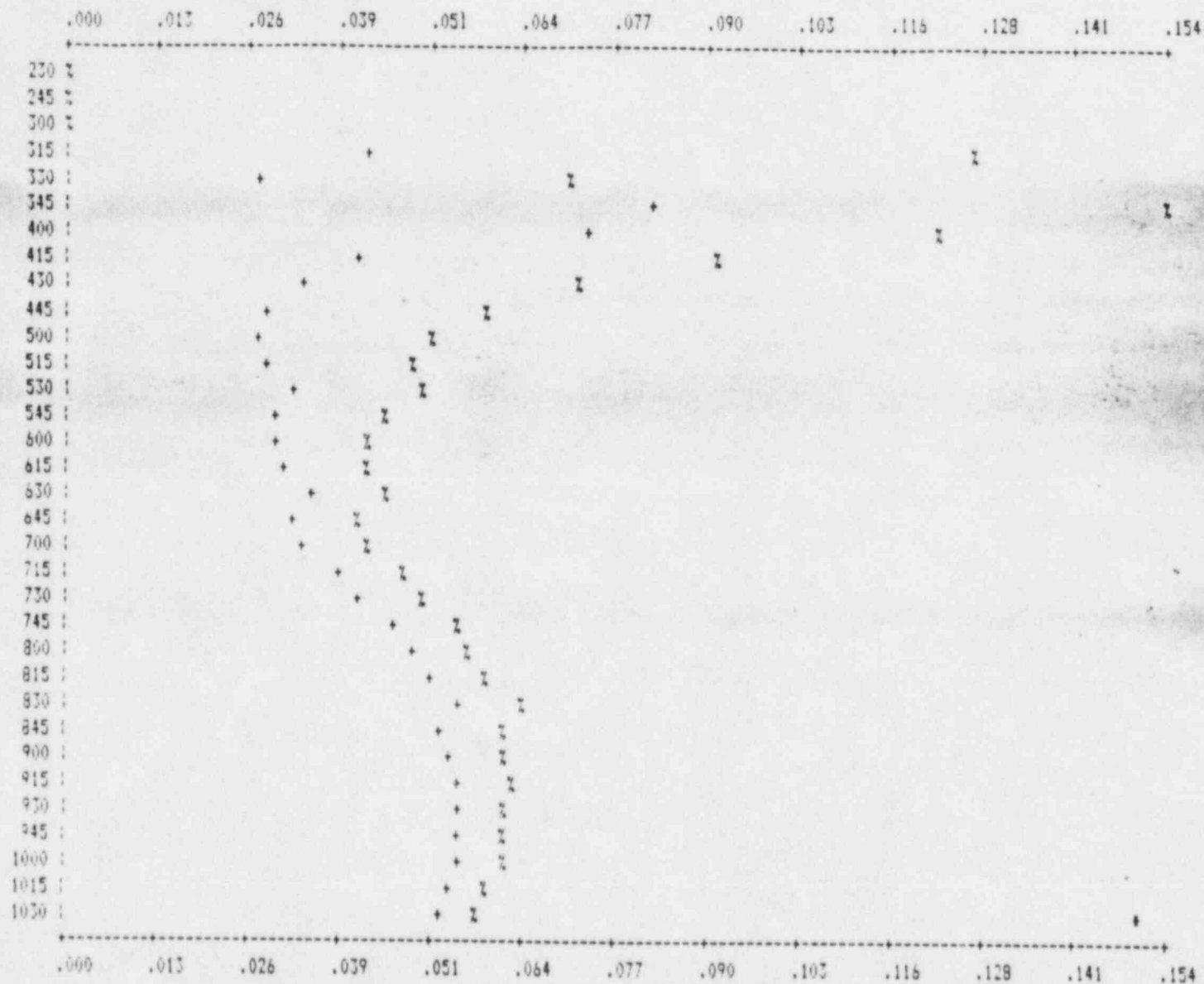
WOLF CREEK PEAK PRESSURE ILRT  
VAPOR PRESSURE PSIA



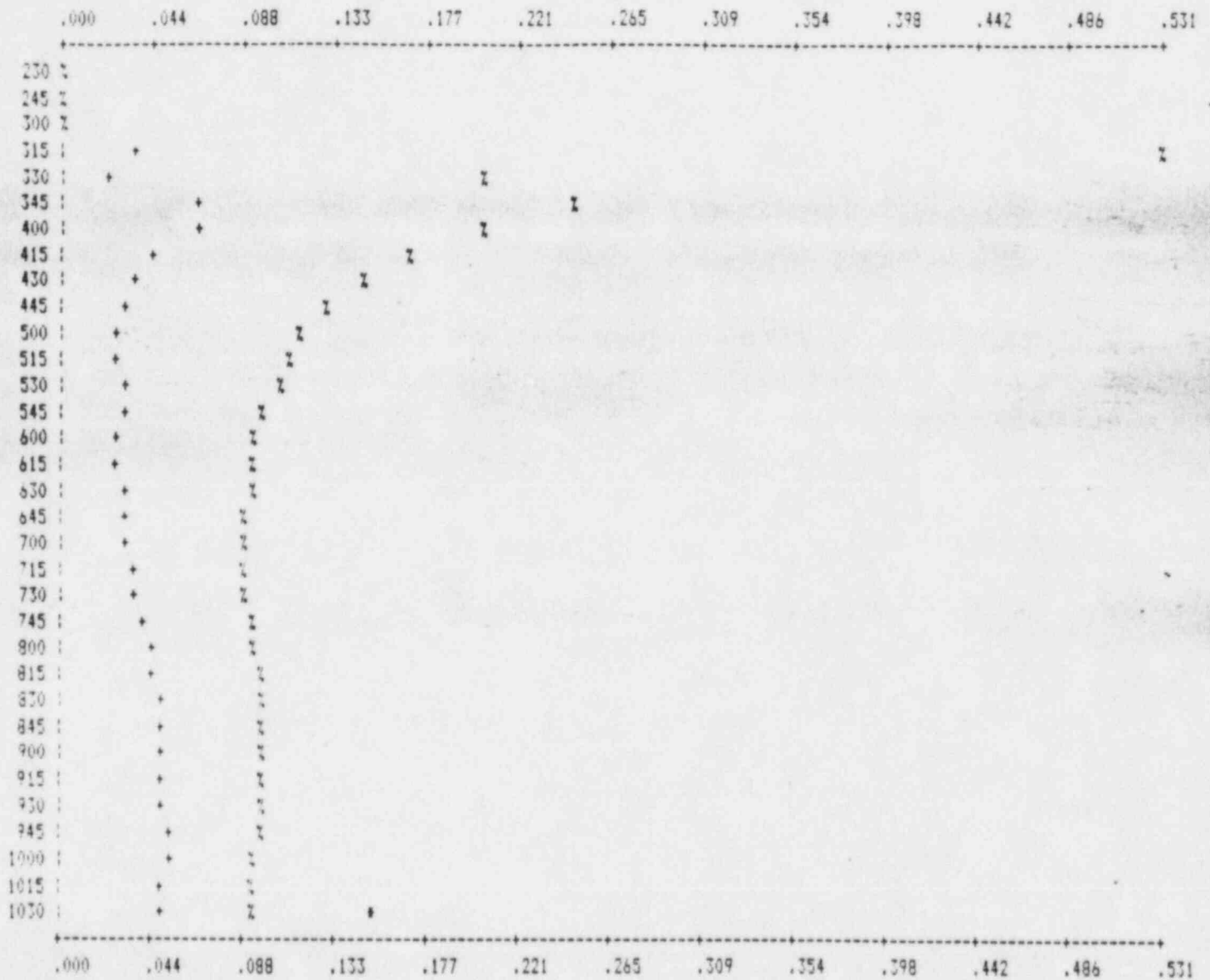
WOLF CREEK PEAK PRESSURE ILRT  
AIRMASS LBM X 1000



WOLF CREEK PEAK PRESSURE ILRT  
MASS POINT LEAKAGE RATE(+) AND UCL(%)



WOLF CREEK PEAK PRESSURE ILRT  
TOTAL TIME LEAKAGE RATE(+) AND UCL(%)



Appendix G

PEAK PRESSURE ILRT

VERIFICATION TEST SUMMARY DATA AND ANALYSIS

1. Summary Data
2. Mass Point Analysis
3. Total Time Analysis
4. Verification Plots - Temperatures, Pressure, Vapor Pressure, Air Mass, Mass Point Leakage, and Total Time Leakage Rate.



WOLF CREEK PEAK PRESSURE ILRT  
SUMMARY DATA

ALMAX = .200  
VRATET = .207

VOLUME = 2500000.  
VRATEM = .210

TIME	DATE	TEMP	PRESSURE	VPRS	VOLUME
1145	1221	527.657	62.4742	.2159	2500000.
1200	1221	527.625	62.4696	.2167	2500000.
1215	1221	527.618	62.4642	.2182	2500000.
1230	1221	527.594	62.4598	.2177	2500000.
1245	1221	527.559	62.4558	.2178	2500000.
1300	1221	527.543	62.4515	.2182	2500000.
1315	1221	527.526	62.4485	.2173	2500000.
1330	1221	527.494	62.4439	.2180	2500000.
1345	1221	527.477	62.4402	.2178	2500000.
1400	1221	527.467	62.4368	.2182	2500000.
1415	1221	527.450	62.4331	.2180	2500000.
1430	1221	527.424	62.4295	.2177	2500000.
1445	1221	527.410	62.4261	.2181	2500000.
1500	1221	527.403	62.4221	.2183	2500000.
1515	1221	527.375	62.4184	.2181	2500000.
1530	1221	527.350	62.4145	.2190	2500000.
1545	1221	527.345	62.4120	.2176	2500000.

WOLF CREEK PEAK PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
TOTAL TIME ANALYSIS

TIME AND DATE AT START OF TEST: 1145 1221 1984  
TEST DURATION: 4.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	MEASURED LEAKAGE RATE
1145	527.657	62.4742	
1200	527.625	62.4696	.140
1215	527.618	62.4642	.418
1230	527.594	62.4598	.356
1245	527.559	62.4558	.262
1300	527.543	62.4515	.285
1315	527.526	62.4485	.263
1330	527.494	62.4439	.243
1345	527.477	62.4402	.245
1400	527.467	62.4368	.255
1415	527.450	62.4331	.257
1430	527.424	62.4295	.240
1445	527.410	62.4261	.242
1500	527.403	62.4221	.261
1515	527.375	62.4184	.247
1530	527.350	62.4145	.240
1545	527.345	62.4120	.244

MEAN OF THE MEASURED LEAKAGE RATES	=	.262
VERIFICATION TEST LEAKAGE RATE UPPER LIMIT	=	.257
VERIFICATION TEST LEAKAGE RATE LOWER LIMIT	=	.157
THE CALCULATED LEAKAGE RATE	=	.236

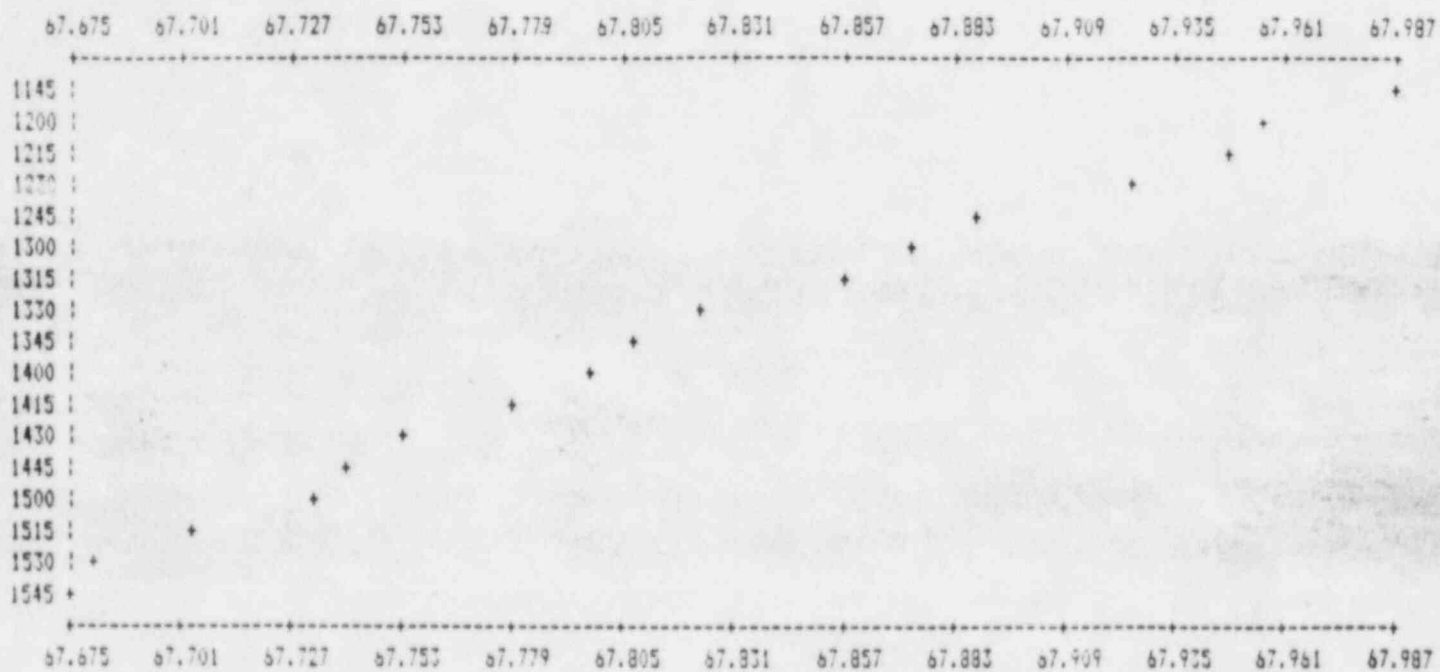
WOLF CREEK PEAK PRESSURE ILRT  
LEAKAGE RATE (WEIGHT PERCENT/DAY)  
MASS POINT ANALYSIS

TIME AND DATE AT START OF TEST: 1145 1221 1984  
TEST DURATION: 4.00 HOURS

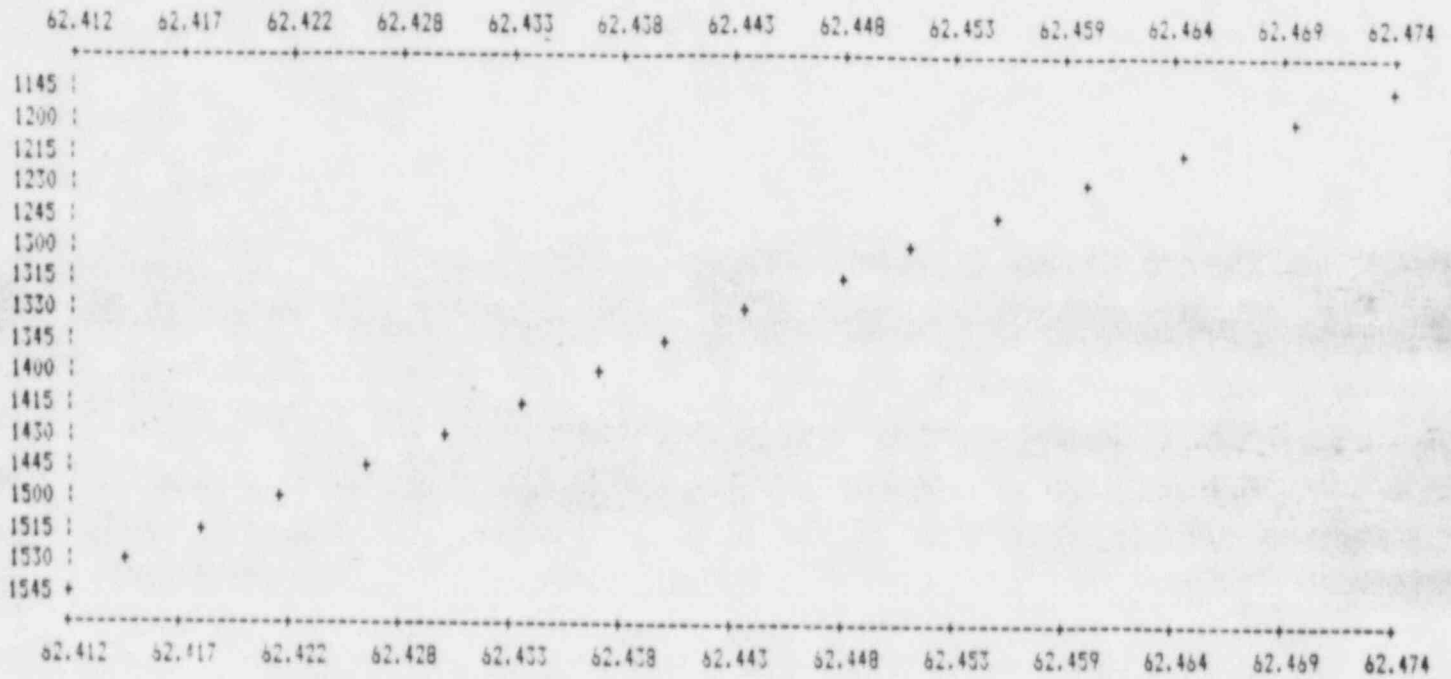
TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LBM)	MASS LOSS (LBM)	AVERAGE MASS LOSS (LBM/HR)
1145	527.657	62.4742	798947.		
1200	527.625	62.4696	798936.	11.6	46.5
1215	527.618	62.4642	798878.	58.0	139.3
1230	527.594	62.4598	798858.	19.2	118.4
1245	527.559	62.4558	798860.	-1.6	87.2
1300	527.543	62.4515	798829.	31.4	94.9
1315	527.526	62.4485	798816.	12.5	87.4
1330	527.494	62.4439	798806.	10.4	80.9
1345	527.477	62.4402	798784.	21.9	81.7
1400	527.467	62.4368	798756.	27.9	85.0
1415	527.450	62.4331	798734.	22.2	85.4
1430	527.424	62.4295	798728.	6.2	79.9
1445	527.410	62.4261	798705.	22.4	80.7
1500	527.403	62.4221	798665.	39.8	86.7
1515	527.375	62.4184	798660.	5.4	82.1
1530	527.350	62.4145	798648.	11.8	79.7
1545	527.345	62.4120	798623.	25.3	81.1

FREE AIR VOLUME USED (CU. FT.)	= 2500000.
REGRESSION LINE	
INTERCEPT (LBM)	= 798935.
SLOPE (LBM/HR)	= -78.6
VERIFICATION TEST LEAKAGE RATE UPPER LIMIT	= .260
VERIFICATION TEST LEAKAGE RATE LOWER LIMIT	= .180
THE CALCULATED LEAKAGE RATE	= .236

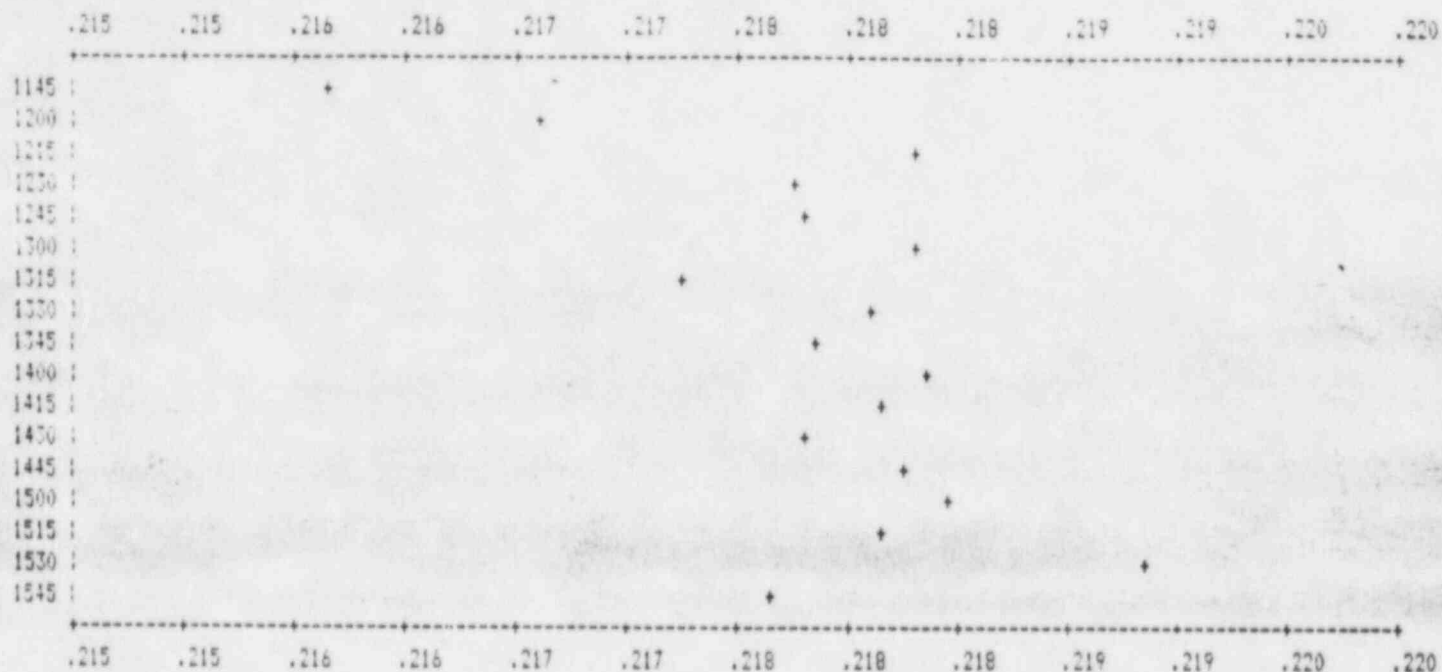
WOLF CREEK PEAK PRESSURE ILRT  
TEMPERATURE DEGREES F



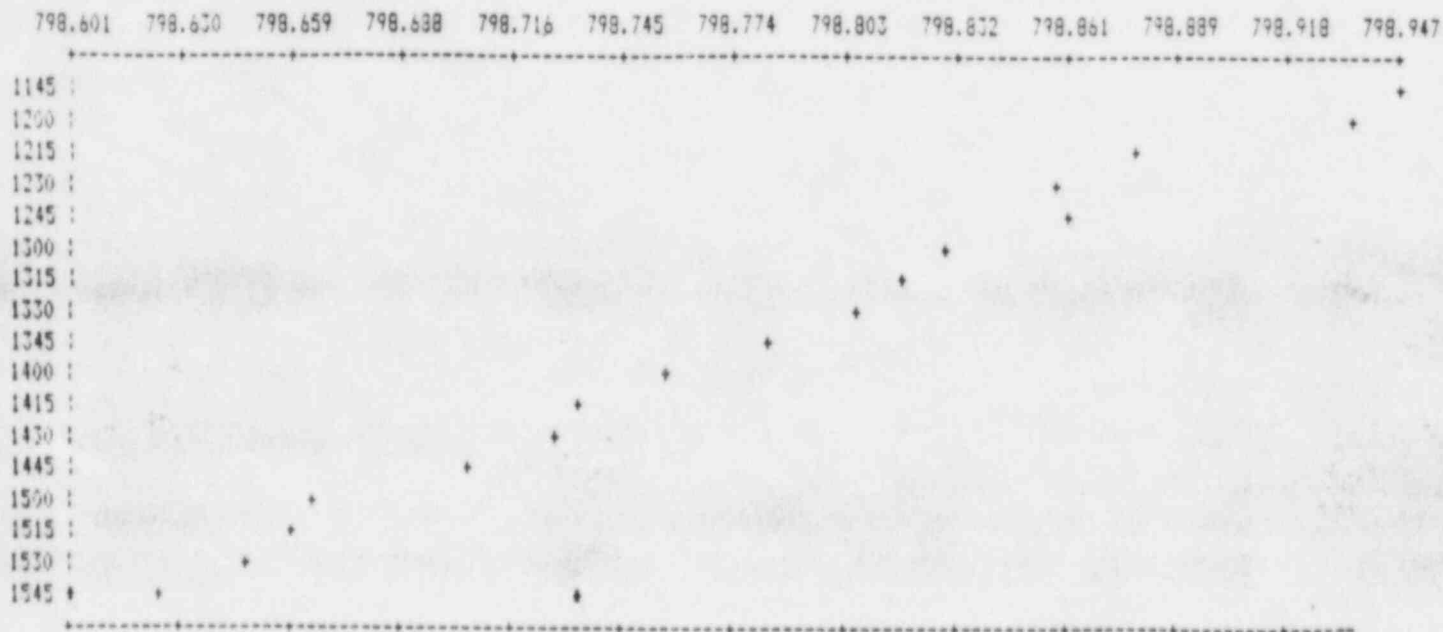
WOLF CREEK PEAK PRESSURE ILRT  
PRESSURE PSIA



WOLF CREEK PEAK PRESSURE ILRT  
VAPOR PRESSURE PSIA

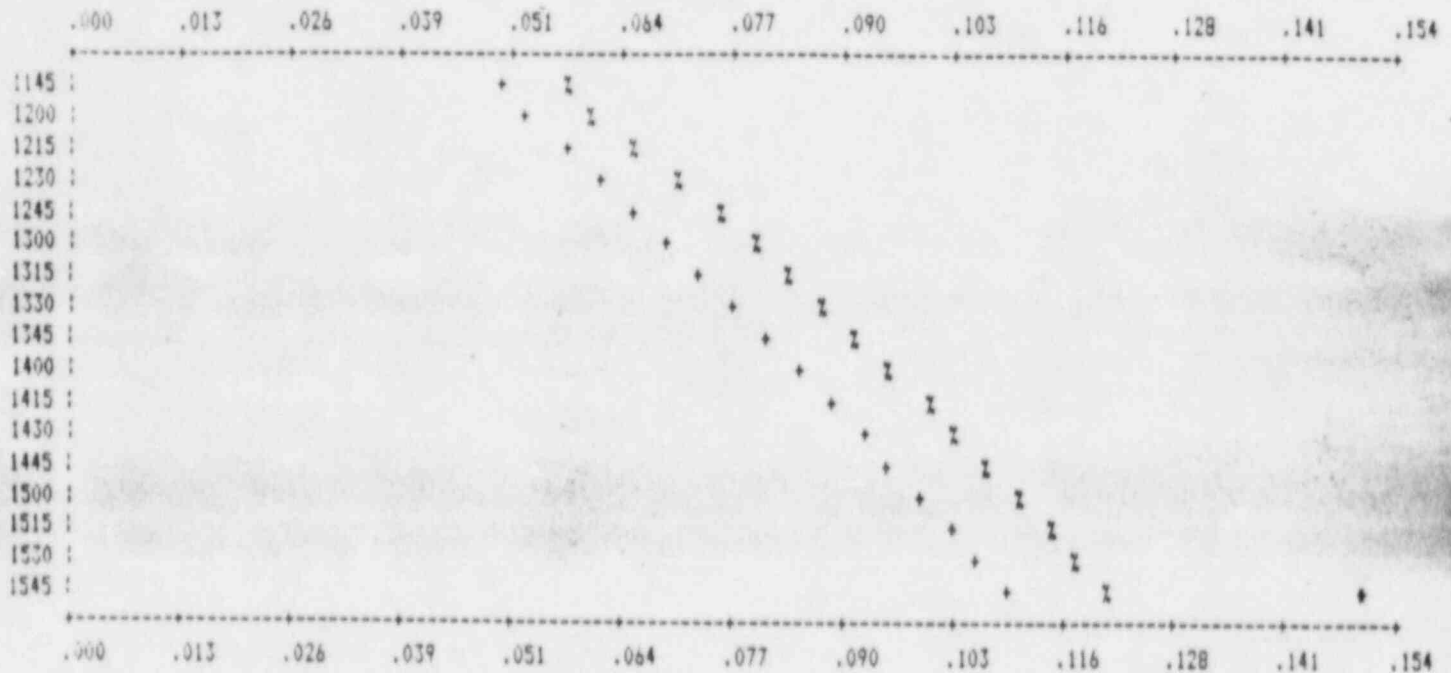


WOLF CREEK PEAK PRESSURE ILRT  
AIRMASS LBM \* 1000

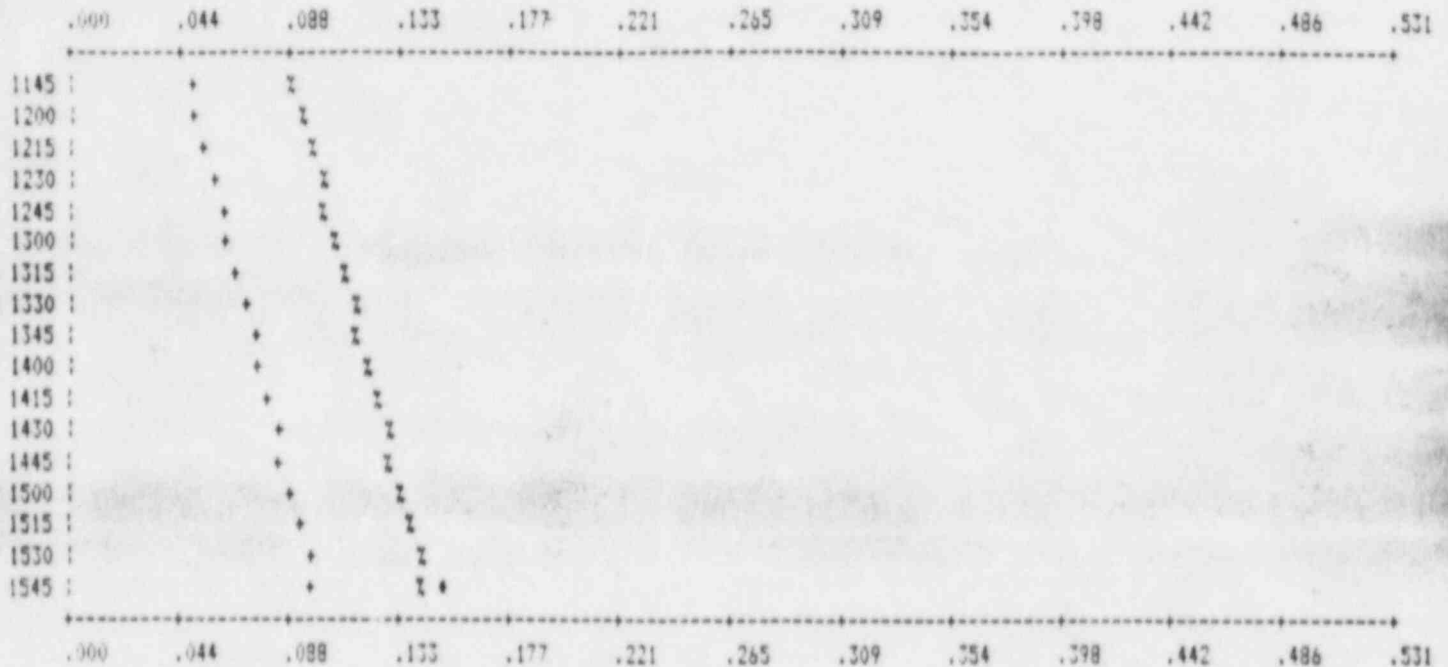




WOLF CREEK PEAK PRESSURE ILRT  
MASS POINT LEAKAGE RATE (+) AND UCL (%)



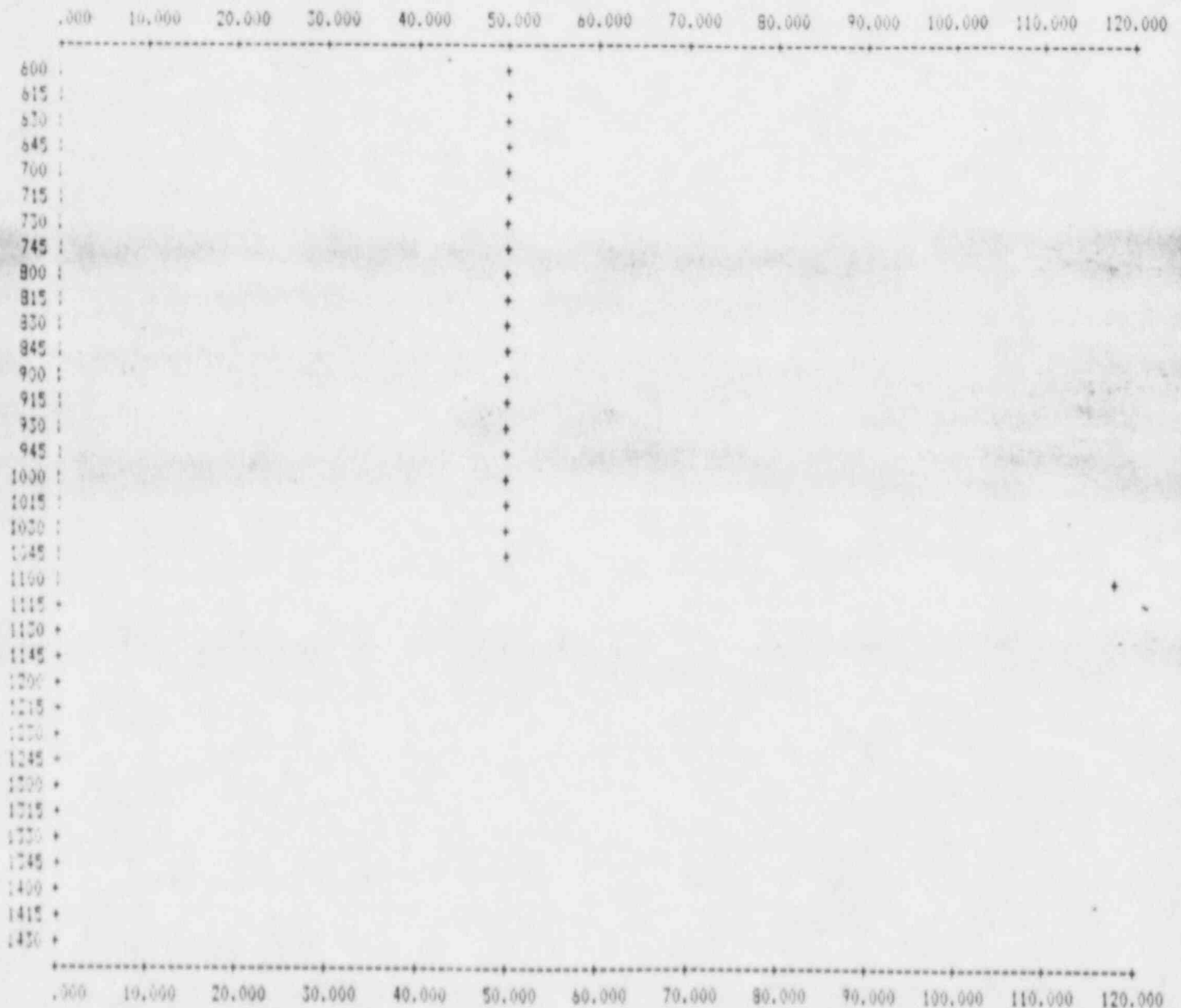
WOLF CREEK PEAK PRESSURE ILRT  
TOTAL TIME LEAKAGE RATE (+) AND UCL (%)



Appendix H

MALFUNCTIONING SENSOR PLOTS AND DATA REJECTION

WOLF CREEK REDUCED PRESSURE ILRT  
DEWPOINT TEMPERATURE SENSOR & DEGREES F



WOLF CREEK REDUCED PRESSURE ILRT  
DATA REJECTION REPORT

TIME AND DATE AT START OF TEST: 1000 1220 1984  
NUMBER OF DATA POINTS: 19

TIME	CTMT. AIR MASS (LBM)	STANDARDIZED RESIDUAL	(* > 5% REJ. LEV. = 2.74) (** > 1% REJ. LEV. = 3.03)
1000	510955.	-.677	
1015	510941.	-.653	
1030	510945.	-.540	
1045	510914.	-.618	
1100	511795.	4.110	**
1115	510953.	-.241	
1130	510915.	-.356	
1145	510920.	-.251	
1200	510901.	-.265	
1215	510905.	-.166	
1230	510873.	-.252	
1245	510876.	-.157	
1300	510890.	-.005	
1315	510866.	.053	
1330	510861.	.005	
1345	510827.	-.097	
1400	510822.	-.041	
1415	510830.	.087	
1430	510801.	.014	

# SUMMARY OF MEASURED DATA AT 1100 1220

TEMP	1	=	527.4200	(	67.750	)
TEMP	2	=	527.4800	(	67.810	)
TEMP	3	=	527.3100	(	67.640	)
TEMP	4	=	527.6000	(	67.930	)
TEMP	5	=	527.7200	(	68.030	)
TEMP	6	=	527.7300	(	68.060	)
TEMP	7	=	527.8200	(	68.150	)
TEMP	8	=	527.6900	(	68.020	)
TEMP	9	=	527.9900	(	68.320	)
TEMP	10	=	525.7300	(	66.060	)
TEMP	11	=	525.2300	(	65.560	)
TEMP	12	=	526.7600	(	67.090	)
TEMP	13	=	526.4000	(	66.730	)
TEMP	14	=	528.1100	(	68.440	)
TEMP	15	=	526.1900	(	66.520	)
TEMP	16	=	530.3300	(	70.660	)
TEMP	17	=	526.1200	(	66.450	)
TEMP	18	=	526.6100	(	66.940	)
TEMP	19	=	526.0700	(	66.400	)
TEMP	20	=	527.0500	(	67.380	)
TEMP	21	=	526.9200	(	67.250	)
TEMP	22	=	526.2400	(	66.570	)
TEMP	23	=	526.6100	(	66.940	)
TEMP	24	=	527.1200	(	67.450	)

PRES	1	=	40.0867	(	40730.0	)
PRES	2	=	40.0835	(	41152.0	)

VPRS	1	=	.1748	(	49.520	)
VPRS	2	=	.1601	(	47.170	)
VPRS	3	=	.0979	(	34.480	)
VPRS	4	=	.1330	(	42.310	)
VPRS	5	=	.0000	(	29.560	)
VPRS	6	=	1.6230	(	118.490	)

## SUMMARY OF CORRECTED DATA

TIME = 1100

DATE = 1220

TEMPERATURE (DEGREES R.)	=	527.6747
CORRECTED PRESSURE (PSIA)	=	39.9775
VAPOR PRESSURE (PSIA)	=	.1060
VOLUME (CU.FT.)	=	2500000.0
AIR MASS (LBM)	=	511795.2

Appendix I

ISG CALCULATIONS



ISG CALCULATION

8-HOUR PEAK PRESSURE TEST

La = 0.2%/day

P = 62.52 psia

T = 528.3°R

Vap Pres = 0.218 psia, @70°F, 1°F = 0.0125 psia change VPRS

t = 8 hours

Pressure  $e_p = \frac{0.002}{\sqrt{1}} = 0.002$

Vapor Pressure  $C_{vp} = \frac{(0.01) \times (0.125)}{\sqrt{5}} = 0.000559$

Temperature  $C_T = \frac{0.01}{\sqrt{24}} = 0.0020412$

$$ISG = \frac{2400}{8} \left[ 2 \left( \frac{0.002}{62.738} \right)^2 + 2 \left( \frac{0.000559}{62.738} \right)^2 + 2 \left( \frac{0.0020412}{528.3} \right)^2 \right]^{1/2}$$

ISG = 0.013629

ISG CALCULATION

24-HOUR REDUCED PRESSURE TEST

La = 0.144%/day

P = 39.96 psia

T = 528.2°R

Vap Pres = 0.172 psia, @70°F, 1°F = 0.0125 psia change VPRS

t = 24 hours

Pressure  $e_p = \frac{[(0.002)^2 + (0.001)^2]^{1/2}}{\sqrt{1}} = 0.002236$

Vapor Pressure  $C_{v_p} = \left( \frac{[(0.1)^2 + (0.1)^2]^{1/2} \times (0.125)}{\sqrt{5}} \right) = 0.0007905$

Temperature  $C_T = \frac{[(0.01)^2 + (0.02)^2]^{1/2}}{\sqrt{24}} = 0.0028867$

$$ISG = \frac{2400}{24} \left[ 2 \left( \frac{0.002236}{40.132} \right)^2 + 2 \left( \frac{0.0007905}{40.132} \right)^2 + 2 \left( \frac{0.0028867}{528.2} \right)^2 \right]^{1/2}$$

ISG = 0.00839

Appendix J

LOCAL LEAKAGE RATE TEST RESULTS

Appendix J

LOCAL LEAKAGE RATE TEST RESULTS

# Appendix J

## LOCAL LEAKAGE RATE TEST SUMMARY

### 1. Local Leakage Rate Type 'B' Test

<u>Pen. No.</u>	<u>Description</u>	<u>Leakage SCCM</u>
L-1	Personnel Lock	793 $\pm$ 20
L-2	Equipment Hatch	10.26 $\pm$ 0.2
L-3	Emergency Personnel Lock	266 $\pm$ 20
ZSE 207	Medium Voltage (18")	0
ZSE 208	Medium Voltage (18")	0
ZNE 264	Medium Voltage (18")	0
ZNE 265	Medium Voltage (18")	0
ZSE 226	High Current Density (12")	0
ZSE 219	High Current Density (12")	0
ZNE 268	High Current Density (12")	0
ZSE 210	High Current Density (12")	0
ZNE 274	High Current Density (12")	0
ZSE 218	Power and Control (12")	0
ZNE 269	Power and Control (12")	0
ZSE 234	Power and Control (12")	0
ZSE 225	Power and Control (12")	0
ZNE 283	Power and Control (12")	0
ZNE 284	Power and Control (12")	0
ZNE 276	Power and Control (12")	0
ZNE 275	Power and Control (12")	0
ZSE 233	Power and Control (12")	0
ZNE 277	Power and Control (12")	0
ZSE 224	Power and Control (12")	0
ZSE 222	Power and Control (12")	0
ZSE 223	Power and Control (12")	0
ZSE 240	Power and Control (12")	0
ZNE 278	Power and Control (12")	0
ZNE 280	CRD Mechanism (12")	0
ZNE 271	CRD Mechanism (12")	0

## Appendix J

LOCAL LEAKAGE RATE TEST SUMMARY

## 1. Local Leakage Rate Type 'B' Test (Cont'd)

<u>Pen. No.</u>	<u>Description</u>	<u>Leakage SCCM</u>
ZNE 272	CRD Mechanism (12")	0
ZNE 290	CRD Mechanism (12")	0
ZNE 281	CRD Mechanism (12")	0
ZNE 285	Power and Control (12")	0
ZNE 291	General Instrumentation (12")	0
ZSE 250	Ex-core Neutron Detector (12")	7.03 $\pm$ 0.2
ZSE 258	Ex-core Neutron Detector (12")	0.67 $\pm$ 0.2
ZNE 295	Ex-core Neutron Detector (12")	0.30 $\pm$ 0.2
ZNE 288	Ex-core Neutron Detector (12")	8.61 $\pm$ 0.2
ZNE 292	General Instrumentation (12")	2.62 $\pm$ 0.2
ZNE 293	General Instrumentation (12")	0
ZNE 289	CRD Mechanism (12")	0
ZSE 252	General Instrumentation (12")	0
ZSE 255	General Instrumentation (12")	0
ZSE 253	General Instrumentation (12")	0
ZNE 294	General Instrumentation (12")	0
ZNE 287	General Instrumentation (12")	0
ZSE 287	General Instrumentation (12")	0
ZNE 279	General Instrumentation (12")	0
ZSE 249	General Instrumentation (12")	0
ZSE 254	General Instrumentation (12")	0
ZNE 267	Power and Control (12")	0
ZNE 282	Power and Control (12")	0
ZSE 215	Encapsulated Valve (3")	0
ZSE 216	Encapsulated Valve (3")	0
ZSE 217	Encapsulated Valve (3")	0
ZNE 296	Encapsulated Valve (3")	0
ZNE 297	Encapsulated Valve (3")	0
ZNE 298	Encapsulated Valve (3")	0
Total Type 'B' Leakage		1088.5

## Appendix J

LOCAL LEAKAGE RATE TEST SUMMARY

## 2. Local Leakage Rate Type 'C' Test

<u>Pen. No.</u>	<u>Description</u>	<u>Leakage SCCM</u>
P-14	CTMT Spray and RHR Pump Suction	508 $\pm$ 20
P-15	CTMT Spray and RHR Pump Suction	11.15 $\pm$ 0.2
P-17	Fuel Transfer Tube	1.75 $\pm$ 0.2
P-22	RC Pump "B" Seal Water Supply	211.0 $\pm$ 20
P-23	CVCS Letdown Line	66.10 $\pm$ 2.0
P-24	RC Pump Seal Water Return	17.36 $\pm$ 0.4
P-25	Reactor Make Up Water supply	1029 $\pm$ 20
P-26	Reactor Coolant Drain Tank Discharge	1070 $\pm$ 20
P-28	Essential Service Water Supply to CTMT Coolers	(0 gpm)*
P-29	Essential Service Water Return from CTMT Coolers	(0 gpm)*
P-30	Instrument Air supply and H2 Control Makeup Air	55.4 $\pm$ 2.0
P-32	Containment Sump Pump Discharge Line	3333 $\pm$ 20
P-34	CTMT Test Line - ILRT Pressurization	68.2 $\pm$ 2.0
P-39	RC Pump "C" Seal Water Supply	4.4 $\pm$ 0.2
P-40	RC Pump "D" Seal Water Supply	165.5 $\pm$ 2.0
P-41	RC Pump "A" Seal Water Supply	8.59 $\pm$ 0.08
P-43	Auxiliary Steam Decontamination	9.43 $\pm$ 0.2
P-44	Reactor Coolant Drain Tank Vent/H2 Supply	150.5 $\pm$ 2.0
P-45	Accumulator N2 Supply	37.11 $\pm$ 2.0
P-51	Integrated Leakage Rate Test Pressure Sensing	507. $\pm$ 207
P-53	Refueling Pool cooling and Cleanup Supply	216 $\pm$ 20
P-54	Refueling Pool cooling and Cleanup Supply	1255 $\pm$ 20
P-55	Refueling Pool Skimmer Line	934 $\pm$ 20
P-56	Hydrogen Sample Return	394.3 $\pm$ 20
P-57	Liquid Sample Return to RCDT	164.8 $\pm$ 20
P-58	Accumulator Fill Line , HPC1	223 $\pm$ 20
P-62	Pressurizer Relief Tank Nitrogen Supply	13.0 $\pm$ 0.2
P-63	Service Air Supply	240 $\pm$ 20



# Appendix J

## LOCAL LEAKAGE RATE TEST SUMMARY

### 2. Local Leakage Rate Type 'C' Test (Cont'd)

<u>Pen. No.</u>	<u>Description</u>	<u>Leakage SCCM</u>
P-64	RCS and Pressurizer Liquid Sample	90.1 $\pm$ 2.0
P-65	CTMT Hydrogen Purge	13.25 $\pm$ 0.2
P-67	Fire Protection	266 $\pm$ 20
P-69	Pressurizer Vapor Sample Line	252 $\pm$ 20
P-71	Essential Service Water Supply to CTMT Coolers	(0 gpm)*
P-73	Essential Service Water Return from CTMT Coolers	(0 gpm)*
P-74	Component Cooling Water Supply to RCP's	1276 $\pm$ 20
P-75	Component Cooling Water Return to RCP's	1457 $\pm$ 20
P-76	CCW from RCP Thermal Barrier	6.7 $\pm$ 0.2
P-78	Steam Generator Drain Line	56.6 $\pm$ 2.0
P-80	Chemical Volume and Control Charging	28.8 $\pm$ 2.0
P-92	Emergency Core Cooling Spray Test Line Connection	115 $\pm$ 2.0
P-93	RC Loop and Pressurizer Liquid Sample	23.9 $\pm$ 2.0
P-95	Accumulator Sample Line	94.0 $\pm$ 2.0
P-97	H2 Control System Sample Return	309.3 $\pm$ 20
P-98	Breathing Air	66.0 $\pm$ 2.0
P-99	H2 Control System Sample Line/Pressure Sensing	72.4 $\pm$ 2.8
P-101	H2 Control System Sample	97.5 $\pm$ 2.8
V-160	Containment Purge System	27,441 $\pm$ 275
V-161	Containment Purge System	1839 $\pm$ 20
Total Type 'C' Leakage		<u>44,198.8</u>
Total Type 'B' Leakage		= 1,088.5 SCCM
Total Type 'C' Leakage		= <u>44,198.84</u> SCCM
Total Type 'B' + 'C' leakage		= 45,287.3 SCCM
		= 0.022%/day

Error associated with Type 'B' and 'C' measure  
 =  $\pm$  720 SCCM  
 = 0.00034%/day

\* Type 'C' water test results = 0 gpm

Appendix K

TENDON END ANCHORAGE CONCRETE INSPECTION REPORT

Appendix K

TENDON END ANCHORAGE CONCRETE INSPECTION REPORT

The requirements of US NRC Regulatory Guide 1.35, Rev. 2, Inservice Inspection of Ungerouted Tendons in Prestressed Concrete Containment Structures, were satisfied during ILRT.

At ILRT test pressure of 48.1 psig, the end anchorages of the following tendons were inspected:

Over the Dome Vertical Tendons

Hoop Tendons

V-20	5	26
V-35	9	45
V-65	17	51
V-74	22	51

The concrete surrounding the bearing plates of all the above tendons was checked for abnormal behavior and cracking.

Minor cracks of width less than 0.01 were observed near the end anchorages for vertical tendon V-35 and hoop tendon 51.

The cracks were present due to earlier repair work, and were not aggravated during containment pressurization to ILRT test pressure. Spalling observed near the tendon anchorage ends was due to repair work done earlier, also, and did not result from containment pressurization.

The inspection results are presented in Table K-1 in this Appendix. original data sheets are maintained in plant records.

Table K-1

TENDON END ANCHORAGE INSPECTION RESULTS

<u>Tendon End Anchorage</u>	<u>Cracking</u>	<u>Spalling</u>	<u>Loose Repair</u>	<u>Pop Out Repair</u>	<u>Overall Integrity</u>
5A	No	No	No	No	Satisfactory
5B	No	No	Yes	Yes	Satisfactory
9B	No	No	No	No	Satisfactory
9C	No	No	No	No	Satisfactory
17A	No	No	No	No	Satisfactory
17C	No	Yes	No	No	Satisfactory
22B	No	Yes	No	No	Satisfactory
22C	No	No	No	No	Satisfactory
26A	No	No	No	No	Satisfactory
26C	No	Yes	No	No	Satisfactory
45A	No	No	No	No	Satisfactory
45B	No	No	No	No	Satisfactory
51A	No	Yes	No	No	Satisfactory
51B	Yes	Yes	No	No	Satisfactory
V-20B	No	No	No	No	Satisfactory
V-20T	No	No	No	No	Satisfactory
V-35B	No	No	No	No	Satisfactory
V-35T	Yes	Yes	No	No	Satisfactory
V-65B	No	No	No	No	Satisfactory
V-65T	No	No	No	No	Satisfactory
V-74B	No	No	No	No	Satisfactory
V-74T	No	No	No	No	Satisfactory

Note: The cracks, spalling, loose repair and popout repair are attributed to earlier repair work.

T = Top; B = Bottom; A, B, C are buttress designations