MISSISSIPPI POWER AND LIGHT CO.
GRAND GULF NUCLEAR STATION
UNIT 1
DOCKET NO. 50-416

PRIMARY REACTOR CONTAINMENT INTEGRATED LEAKAGE RATE TEST REPORT

Submitted To
The United States Nuclear Regulatory Commission
Pursuant To Facility Operating License

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I. INTRODUCTION

The Reactor Containment Building Integrated Leakage Rate (Type A) test is performed to demonstrate that leakage through the primary reactor containment systems and components penetrating the primary containment does not exceed the allowable leakage rate specified in the Grand Gulf Nuclear Station Final Safety Analysis Report (FSAR).

The successful preoperational Integrated Leakage Rate Test (ILRT), Verification Test, and Drywell Bypass Test were completed on January 5, 1982 at Grand Gulf Nuclear Station Unit 1. Acceptance criteria for both ANSI/ANS 56.8-1981, "Containment System Leakage Testing Requirements," and BN-TOP-1, "Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plants," were met for an 8-hour short duration test. Calculations were performed using the ANSI/ANS 56.8-1981 "Mass Point Analysis Method" and BN-TOP-1, "Total Time Analysis Method." The test results are reported in accordance with the requirements of ANSI/ANS 56.8-1981, Section 5.8 and 10CFR50, Appendix J, Section V.B.3.

The purpose of this report is to provide information pertinent to the activities related to the preparation, test performance, and reporting of the Grand Gulf Nuclear Station Unit 1 ILRT.

Section II, Test Synopsis, presents the highlights of activities and events which occurred prior to and during the ILRT.

Section III, Test Data Summary, contains the data and results necessary to demonstrate containment atmosphere stabilization, an acceptable leakage rate, and a successful verification test. In addition, plots provided in Appendix E supply a visual history of containment atmospheric conditions beginning with the stabilization condition, throughout the 8-hour short duration ILRT period, and ending with the verification test.

Section IV, Analysis and Interpretation, contains technical details of the integrated leakage rate measuring system used during the ILRT, and provides analysis to show that the containment 95% upper confidence limit leakage rate does not exceed 75% of the allowable rate as specified in the plant FSAR.

Section V, Computer Report and Data Printout, describes the ILRT computer program and report printouts.

II. TEST SYNOPSIS

TEST PREPARATION ACTIVITIES

Prior to containment pressurization for the Structural Integrity Test (SIT) on January 1, 1982, Grand Gulf Nuclear Station Unit 1 test personnel were engaged in measuring containment leakage to ensure a successful preoperational ILRT. Sources of containment leakage were identified through Types B and C leakage rate testing programs and reduced by repairing those systems and containment components having relatively excessive leakage rates. The results of the Local Leakage Rate Test (LLRT) are presented in Appendix I.

Highlights of the test preparation activities included monitoring both upper and lower personnel hatch pneumatic systems leakage and repairing MSIV guard pipe inspection port seals, positioning sensors, verifying associated volume fractions, and conducting a temperature survey to ensure that all sensors could accurately monitor their respective subvolumes. An in-situ check, as specified in ANSI/ANS 56.8-1981, Section 4.2.3, was conducted to verify that all ILRT instrumentation was indicating correctly. The following items are presented in chronological order, and detail significant activities performed during the test preparation and successful execution.

The Type A test procedure was reviewed to verify compliance with Plant Technical Specifications, 10CFR50 Appendix J, ANSI/ANS 56.8-1981, BN-TOP-1, and the FSAR. In addition, test personnel reviewed the valve lineups to verify that the containment systems were in as close to post-accident alignment as possible.

CONTAINMENT PRESSURIZATION

Containment pressurization for the ILRT began at 1030 on January 3, 1982. At the start of pressurization, containment fans M41-B001A and M41-B001B, and the containment, steam tunnel, and drywell cooling systems were operating. During pressurization with the containment at 10 to 12 psig, containment fan M41-B001B tripped off on overcurrent at approximately 68 amperes. ILRT pressure of 12.27 psig (26.24 psia) was reached at 1525. Containment fan M41-B001A was then manually tripped to prevent a possible uncontrolled trip.

CONTAINMENT STABILIZATION

After reaching ILRT pressure, the containment atmosphere was allowed to stabilize. The temperature stabilization criteria of ANSI/ANS 56.8-1981, Section 5.3.1.3, and BN-TOP-1, Section 2.2.B, were satisfied. The ILRT stabilization data are given in Appendix B.

During containment stabilization the outer doors on the upper and lower personnel locks were opened. A number of small leaks were detected through the inner door seals. Leaks were repaired on the upper and lower lock containment pressure sensing systems. The outer doors were closed at 1853.

DURING ILRT

Subsequent to containment air mass temperature stabilization, the ILRT for Grand Gulf Nuclear Station Unit 1 started at 2030 on January 3, 1982, and terminated at 0430 on the following day, for an 8-hour short duration test. The accumulated data were statistically analyzed (see Section III (C), Test Results - Type A Test.) The maximum allowable leakage rate (L_a) for the primary containment is 0.437 wt.%/day. The Total Time Analysis (BN-TOP-1) yields a leakage rate of 0.068 wt.%/day with an upper 95% confidence limit of 0.139 wt.%/ day. Based on the Mass Point Analysis (ANSI/ANS 56.8-1981), the calculated leakage rate is 0.072 wt.%/day with an upper 95% confidence limit of 0.079 wt.%/day. These values are well below the Grand Gulf Nuclear Station Unit 1 acceptance criterion of 0.328 wt.%/day (0.75 L_a).

VERIFICATION FLOW TEST

A successful verification flow test was performed subsequent to the ILRT from 0615 to 1015 on January 4, 1982. ILRT instrumentation performance was checked by imposing a leakage rate (L_o) of 0.364 wt.%/day (7.67 scfm). After imposing the leakage rate, the containment atmospheric conditions were allowed to stabilize for one (1) hour.

Due to an apparent flow restriction in the verification flow line, the imposed leakage rate could not reach the maximum allowable leakage rate (La) of 0.437 wt.%/day. The imposed leakage rate (Lo) of 0.364 wt.%/day is within the acceptance limits of La $\pm$ 25% as given in ANSI/ANS 56.8-1981, Section 3.2.6(b)(1). The results of the verification test correlated to the ILRT are summarized as follows:

Test Method	Measured Leakage wt.%/day	(Acceptance Limit)	95% UCL wt.%/day
a. ILRT/Mass Point	0.072	(0.328)	0.079
ILRT/Total Time	0.068	(0.328)	0.139
b. Verification/Mass Point	0.431	(0.327-0.545)	NA
Verification/Total Time	0.434	(0.323-0.541)	NA

DEPRESSURIZATION AND DRYWELL BYPASS TEST

Following the successful completion of the ILRT and verification flow test, containment depressurization began at 1030 on January 4, 1982. At 4.3 psig, a containment entry was made to close the drywell lock for the Drywell Bypass Test. The containment was then depressurized to 0 psig and the drywell, whose pressure had dropped to 2.2 psig, was repressurized to 3 psig. During repressurization of the drywell it was necessary to raise the suppression pool level to prevent leakage through the weir wall. After raising the suppression pool level, leakage through the weir wall was observed at 3.02 psig. The drywell pressure was then maintained between 3.00 and 3.01 psig with no observed leakage through the weir wall. The drywell atmosphere was allowed to stabilize for one hour, after which the Bypass Leakage Test began at 0400 on January 4, 1982. The Bypass Leakage Test was successfully completed at 0800. The calculated bypass leakage rate of 609.7 scfm is well below the allowable rate of 3500 scfm. Refer to Appendix H, Drywell Bypass Test Summary Data for calculations.

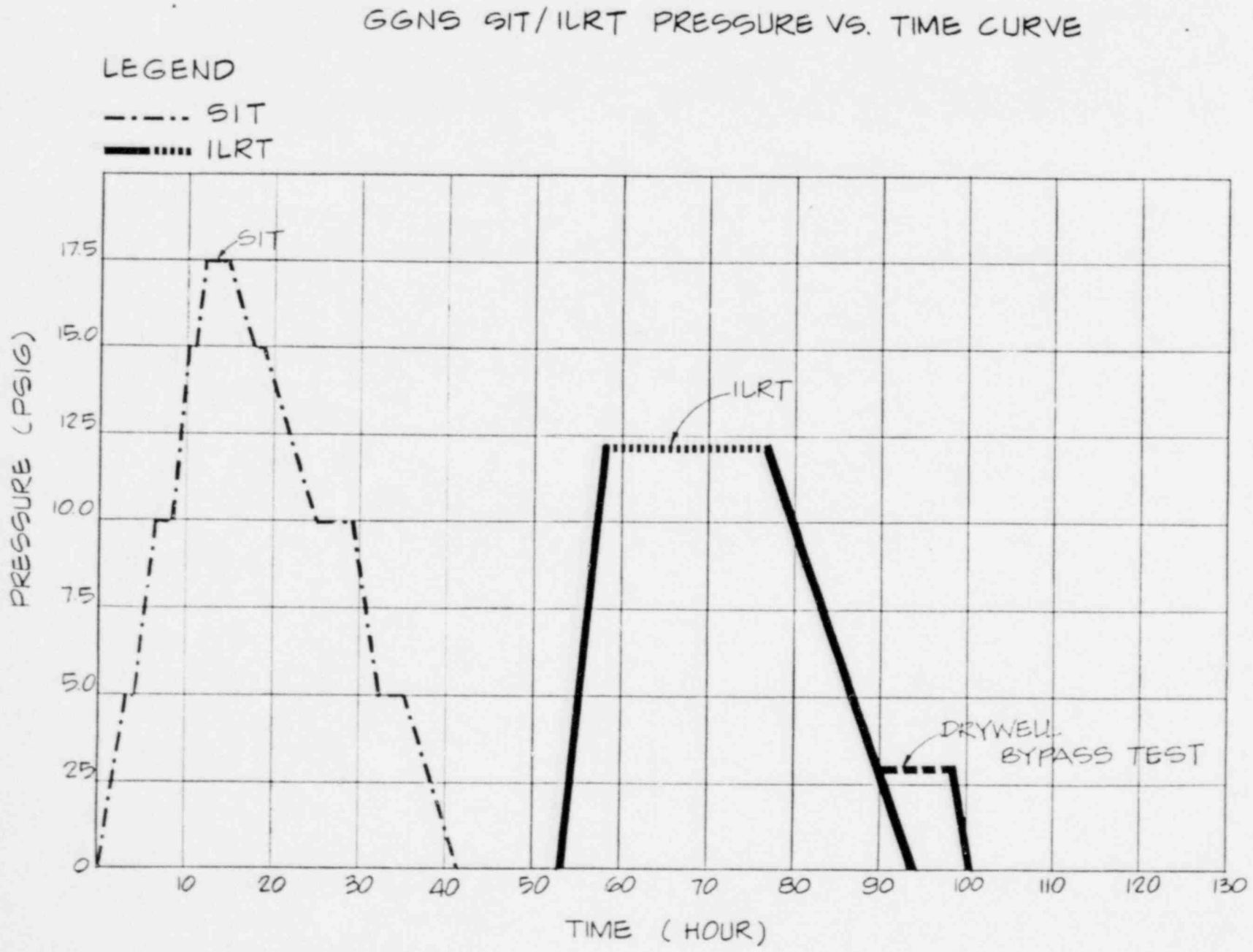


FIGURE 1, TEST PROGRAM PRESSURIZATION SEQUENCE

III. TEST DATA SUMMARY

Pursuant to the requirements of ANSI/ANS 56.8-1981, Section 5.8, Reporting of Results, the information in this section is provided to supply adequate data for an independent review of the containment system leakage rate test results and instrumentation.

A. Plant Information

Owner:	Mississippi Power and Light Company
Plant:	Grand Gulf Nuclear Station Unit 1
Location:	Port Gibson, MS
Containment Type:	Mark III
NSSS Supplier, Type:	General Electric, BWR
Date Test Completed:	January 5, 1982

B. Technical Data

1.	Containment Net Free Air Volume	1,670,360 cu ft
2.	Design Pressure	P_d= 15 psig
3.	Design Temperature	T = 185°F
4.	Calculated Peak Accident Pressure	P_a= 11.5 psig
5.	Calculated Peak Accident Temperature	T_a= 181°F
6.	Containment ILRT Average Temperature Limits	40°F-120°F

C. Test Results - Type A Test

1.	Test Method	Absolute
2.	Data Analysis Technique	Mass Point Leakage Rate per ANSI/ANS 56.8-1981 Total Time per BN-TOP-1
3.	Test Pressure (actual)	P = 11.97 to 12.27 psig
4.	Maximum Allowable Leakage Rate	L_a = 0.437 wt.%/day
5.	75% of L_a	0.328 wt.%/day

6. Integrated Leakage Rate Test Results

	Leakage Rate, L_{am} wt.%/day	
	From Regression Line	At Upper 95% Confidence Limit
Mass Point Analysis	0.072	0.079
Total Time Analysis	0.068	0.139

7. Verification Test Imposed Leakage Rate: Lo = 0.364 wt.%/day (7.67 scfm)

8. Verification Test Results

	Leakage Rate, L_{vm}, wt.%/day
Mass Point Analysis	0.431
Total Time Analysis	0.434

9. Verification Test Limits:

	Test Limits, L_v, wt.%/day	
	Mass Point Analysis	Total Time Analysis
Upper Limit ($L_o + L_{am} + 0.25L_a$)	0.545	0.541
Lower Limit ($L_o + L_{am} - 0.25L_a$)	0.327	0.323

10. Report Printouts:

The report printouts and data plots for the Type A and verification test calculations are provided in Appendixes C through G.

D. Drywell Bypass test results are provided in Appendix H.

E. Test Results - Type B and C Tests

Refer to Appendix I for a summary of local leakage rate test results.

F. Integrated Leakage Rate Measurement System (For ILRT Data Acquisition System, see Figure 2).

1. Absolute Pressure (2 channels):

Mensor Quartz Manometer
Model No. 10100-001
PI-1 Capsule S/N 2407, Gage S/N 1522
PI-2 (Spare) Capsule S/N 2406, Gage S/N 1555

Range:	0-100,000 counts; 0-100 psia
Accuracy:	± 0.015% reading
Sensitivity:	0.001 psia
Repeatability:	0.001 psia
Calibration Date:	12/23/81

2. Drybulb Temperature (22 sensors):

Rosemount resistance temperature detector
Model No. 14632 Series 78

Element:	Platinum
Resistance:	Ro = 100 ohms @ 32°F
Lead Type:	3 lead potentiometric configuration
Temperature Range:	32° to 120°F (from calibration data)

Volumetrics Bridge
Model No. VSTD 333

Input Voltage:	± 15 volts and 5.2 volt
Resistance:	100 ohms @ 32°F
Output:	1.0 millivolt/°F; 32°F = 32 mv., 100°F = 100 mv.; 3-wire configuration with constant current
Adjustment:	Zero, span and linearity (limited)
Accuracy:	± 0.1°F
Sensitivity:	0.01°F
Repeatability:	0.01°F
Calibration Date:	12/21/81

3. Dewpoint Temperature (6 sensors):

Dewpoint Temperature Systems - EG&G, Inc., Dewpoint Hygrometer, Model No. 660 with 6 sensors and signal conditioning.

Accuracy:	± 0.1°F
Sensitivity:	0.01°F
Repeatability:	0.05°F
Calibration Date:	12/18/81

4. Verification Flow (1 channel):

Volumetric thermal mass flow meter, TSI model No. 2013 S/N 1516

Range:	0-10.0 scfm
Accuracy:	± 1% F.S.
Sensitivity:	± 0.01 scfm
Repeatability:	± 0.01 scfm
Calibration date:	10/20/81

5. Drybulb and Dewpoint Temperature Sensor Volume Fractions (see Tables 1 and 2).

G. Information Retained at Plant

The following information is available for review at the facility:

1. Access control procedures established to limit ingress to containment during testing.

2. A listing of all containment penetrations, including the total number of like penetrations, penetration size, and function.

3. A listing of normal operating instrumentation used for the leakage rate test.

4. A system lineup (at time of test) showing required valve positions and status of piping systems.

5. A continuous, sequential log of events from initial survey of containment to restoration of all tested systems.

6. Documentation of instrumentation calibrations and standards (included with documentation should be an error analysis of instrumentation).

7. Data to verify temperature stabilization criteria as established by test procedure (Appendix B).

8. The working copy of the test procedure that includes signature sign-off of procedural steps.

9. The procedure and all data that verify completion of penetrations and valve testing (B&C-type tests) including as-found leak rates, corrective action taken, and final leak rate.

10. Computer printouts of ILRT data and manual data accumulation along with summary description of computer program (Appendix C).

11. The Quality Assurance audit plan or checklist used to monitor ILRT with proper sign-offs.

12. A listing of all test exceptions including changes in containment system boundaries instituted by licensee to conclude successful testing.

13. Description of sensor malfunctions, repairs, and methods used to redistribute volume fractions to operating instrumentation where applicable.

14. A review of confidence limits of test results with accompanying computer printouts where applicable.

15. Description of method of leakage rate verification of instrument measuring system (superimposed leakage), with calibration information on flow meters along with calculations used to measure the verification leakage rate (Appendixes F and G).

16. Plots presenting ILRT data obtained during the test (Appendix E).

17. The P&IDs of systems which penetrate the containment.

TABLE 1

CONTAINMENT TEMPERATURE AND DEWPOINT SENSOR LOCATIONS AND VOLUME FRACTIONS (ILRT)

RTD Instrument No.	Elevation	Azimuth (Degrees)	Distance from Center	Containment Volume Fraction
TE-N001-01	274'-0"	352	20'-0"	0.062
TE-N001-02	274'-0"	172	20'-0"	0.062
TE-N001-03	247'-9"	90	30'-8"	0.062
TE-N001-04	245'-9"	265	27'-6"	0.062
TE-N001-05	214'-4"	45	50'-6"	0.062
TE-N001-06	229'-2"	155	49'-8"	0.062
TE-N001-07	216'-0"	225	49'-8"	0.062
TE-N001-08	227'-0"	319	49'-0"	0.062
TE-N001-09	173'-0"	220	52'-0"	0.058
TE-N001-10	163'-0"	305	50'-8"	0.057
TE-N001-11	164'-6"	155	28'-8"	0.022
TE-N001-12	141'-6"	162	50'-3"	0.058
TE-N001-13	141'-2"	90	55'-6"	0.057
TE-N001-14	122'-2"	335	41'-2"	0.057
TE-N001-15	124'-0"	177	51'-6"	0.057
TE-N001-16	150'-6"	219	25'-4"	0.022
TE-N001-17	120'-0"	95	27'-8"	0.022
TE-N001-18	129'-0"	187	29'-0"	0.022
TE-N001-19	168'-0"	350	30'-3"	0.022
TE-N001-20	153'-5"	41	27'-3"	0.023
TE-N001-21	119'-9"	278	26'-9"	0.022
TE-N001-22	102'-6"	0	4'	0.005
				1.000

ME Instrument No.	Elevation	Azimuth (Degrees)	Distance from Center	Containment Volume Fraction
ME-N002-01	247'-9"	90	30'-8"	0.210
ME-N002-02	216'-0"	225	49'-9"	0.210
ME-N002-03	167'-0"	305	50'-8"	0.210
ME-N002-04	122'-2"	355	41'-2"	0.210
ME-N002-05	158'-5"	41	27'-3"	0.080
ME-N002-06	118'-2"	278	26'-9"	0.080
				1.000

TABLE 2

DRYWELL TEMPERATURE AND DEWPOINT SENSOR LOCATIONS AND VOLUME FRACTIONS (BYPASS TEST)

RTD Instrument No.	Elevation	Azimuth (Degrees)	Distance from Center	Drywell Volume Fraction
TE-N001-11	164'-6"	155	28'-8"	0.138
TE-N001-16	150'-6"	219	25'-4"	0.138
TE-N001-17	120'	95	27'-8"	0.138
TE-N001-18	129'	187	29'-0"	0.138
TE-N001-19	168'	350	30'-3"	0.138
TE-N001-20	153'-5"	41	27'-3"	0.138
TE-N001-21	119'-9"	278	26'-9"	0.138
TE-N001-22	102'-6"	0	4'-0"	0.034
				1.000

ME Instrument No.	Elevation	Azimuth (Degrees)	Distance from Center	Drywell Volume Fraction
ME-N002-05	158'-5"	41	27'-3"	0.5
ME-N002-06	118'-2"	278	26'-9"	0.5
				1.0

ILRT DATA ACQUISITION SYSTEM

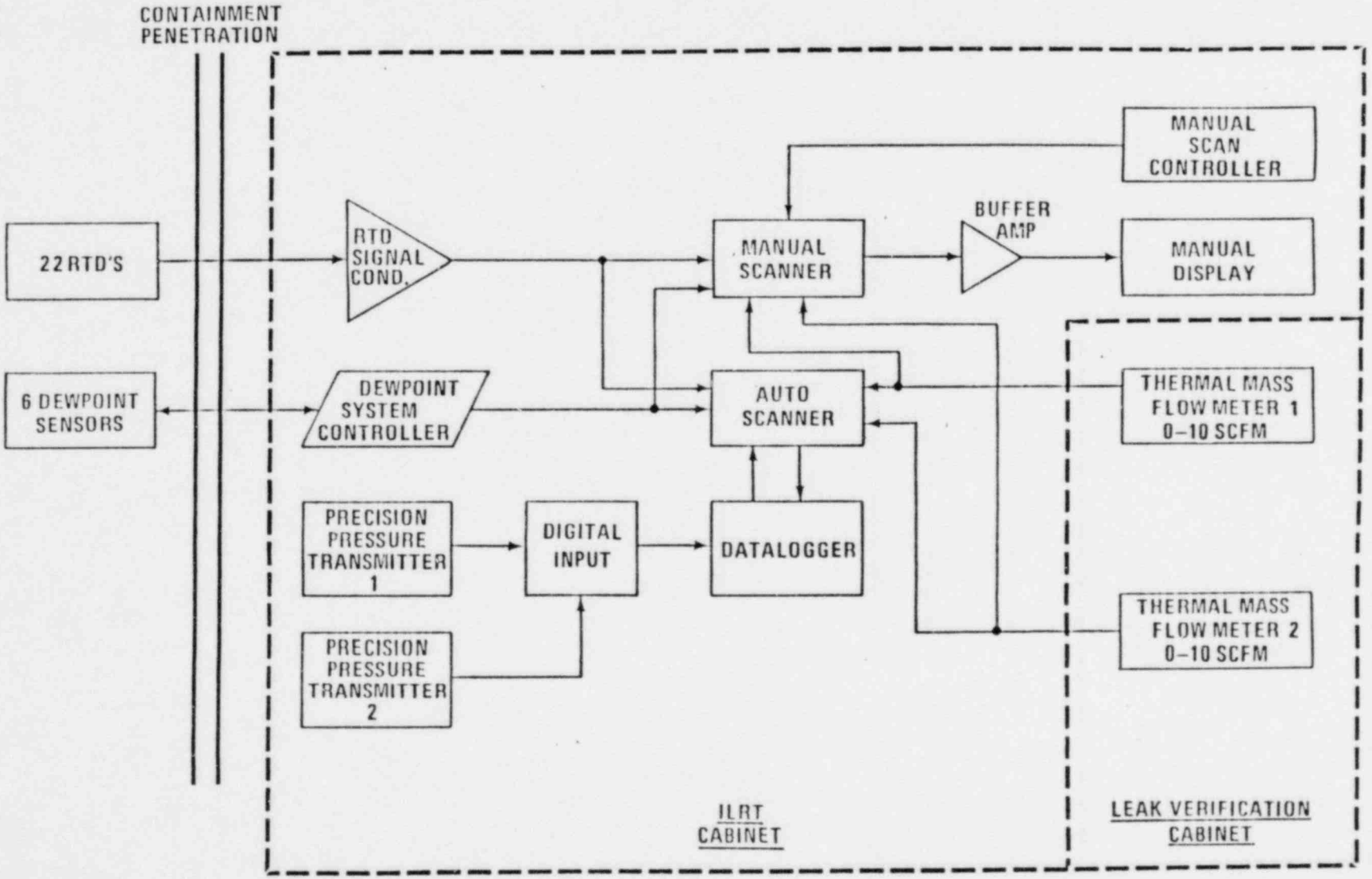


FIGURE 2

IV. ANALYSIS AND INTERPRETATION

A. This section is provided pursuant to ANSI/ANS 56.8-1981, Section 5.8.6, which requires analysis of leakage rate data and provides an interpretation of the test results to show proper compliance with acceptance criteria specified in ANSI/ANS 56.8-1981, 10CFR50, Appendix J, and the Grand Gulf Nuclear Station FSAR.

Several corrections must be added to the calculated results of the Unit 1 ILRT. The Plant Chilled Water System (Pen 38 + 39) was not in the post LOCA lineup position and therefore the LLRT result of 2.69 SCFH must be added to the ILRT calculated results. The seal systems on the upper and lower personnel locks required makeup flows of 0.12 and 0.005 SCFH respectively during the ILRT period. The total correction to be added to the calculated Type A leakage rate is 2.82 SCFH or 0.004%/day.

Pre-and post-test containment water level measurements indicated that the upper pool water volume had decreased by 574 cu ft from 1700 December 31, 1981, to 1200 January 5, 1982, and that the dry-well sump water volume had increased by 95 cu ft from 1000 January 3 to 1200 January 5, 1982. This resulted in a net water volume decrease rate of 74 cu ft per day. The indicated water volume change is most likely due to measurement accuracy. At any rate, a decrease in water volume would not mask an in-leakage, and therefore is not added as a correction.

The corrected and uncorrected Type A leakage rates are tabulated below:

	L_{am} wt%/day			95% UCL wt%/day		
	I	II	III	I	II	III
1. ILRT/Mass Point	0.072	0.076	0.328	0.079	0.083	0.328
ILRT/Total Time	0.068	0.072	0.328	0.139	0.143	0.328
2. Verification/						
Mass Point	0.431		0.327-0.545			
Total Time	0.434		0.323-0.541			

where Column I = Uncorrected leakage rate calculated during ILRT.

Column II = Corrected leakage rate corresponding to Column I plus corrections.

Column III = Acceptance limits

The ILRT results at the upper 95% confidence level satisfy the acceptance criterion of $L_{am} < 0.75L_a = 0.328\%/day$, at $P_a = 11.5$ psig.

B. ISG CALCULATION

The ISG calculation provided below was performed according to the format specified in ANSI/ANS 56.8-1981, Appendix G.

a. Calibration Data

	Number of Sensors	Sensitivity, E	Repeatability, ϵ
Temperature, T	22	0.01°F (°R)	0.01°F (°R)
Pressure, P	1	0.001 psia	0.001 psia
Vapor Pressure (Dewpoint), Pv	6	0.01°F	0.05°F

b. Instrument Measurement Errors

1. Temperatures

$$e_T = [(E_T)^2 + (\epsilon_T)^2]^{1/2}/(\text{No. of Sensors})^{1/2}$$

$$= [(0.01)^2 + (0.01)^2]^{1/2}/(22)^{1/2}$$

$$= 0.003°F\ (°R)$$

2. Pressures

$$e_p = [(E_p)^2 + (\epsilon_p)^2]^{1/2}/(\text{No. of Sensors})^{1/2}$$

$$= [(0.001)^2 + (0.001)^2]^{1/2}/(1)^{1/2}$$

$$= 0.0014 \text{ psia}$$

3. Vapor Pressure

For a dewpoint temperature range of 68.25°F $\pm$ 0.05°F the average rate of change in dewpoint pressure is 0.0118 psi/°F, i.e.,

vapor pressure @ 68.3°F = 0.34243 psi
@ 68.2°F = 0.34125 psi
change for 0.1°F = 0.00118 psi

The sensitivity and repeatability in terms of pressure are:

$$E_{pv} = (0.0118 \text{ psi/°F})(0.01°F) = 0.000118 \text{ psi}$$

$$\epsilon_{pv} = (0.0118 \text{ psi/°F})(0.05°F) = 0.00059 \text{ psi}$$

Therefore,

$$e_{pv} = [(E_{pv})^2 + (\epsilon_{pv})^2]^{1/2}/(\text{No. of Sensors})^{1/2}$$

$$= [(0.000118)^2 + (0.00059)^2]^{1/2}/(6)^{1/2}$$

$$= 0.00025 \text{ psi}$$

c. ISG Calculation for 8 hour ILRT

$P = 12.27 \text{ psig} + 14.7 = 26.97 \text{ psia}$

$T = 77°F + 460 = 537°R$

$$ISG = \pm \frac{2400}{t} \left[2\left(\frac{e_p}{P}\right)^2 + 2\left(\frac{e_{pv}}{P}\right)^2 + 2\left(\frac{e_t}{T}\right)^2 \right]^{1/2}$$

$$ISG = \pm \frac{2400}{8} \left[2\left(\frac{0.0014}{26.97}\right)^2 + 2\left(\frac{0.00025}{26.97}\right)^2 + 2\left(\frac{0.003}{537}\right)^2 \right]^{1/2}$$

$$= \pm 300 \ (0.54 \times 10^{-8} + 0.0169 \times 10^{-8} + 0.006 \times 10^{-8})^{1/2}$$

$$= \pm 300 \ (0.75 \times 10^{-4})$$

$$= 0.0225 \text{ wt.\%/day}$$

$25\% \text{ La} = 0.437 \times 0.25 = 0.10925 \text{ wt.\%/day}$

$0.0225 \leq 0.10925$ meets the criterion of ANSI/ANS 56.8-1981 and BN-TOP-1.

V. COMPUTER REPORT AND DATA PRINTOUT

A. MASS POINT REPORT

The Mass Point Report presents leakage rate data (wt%/day) as determined by the Mass Point Method described in the "Computer Program" section of this report. 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 values, determined from the Equation of State, are used in the regression analysis.

B. 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 used in the above regression analysis.

C. TREND REPORT

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

D. 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 five column headings are TIME, DATE, TEMP, PRESSURE, and VPRS, 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 (°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).

E. SUMMARY OF MEASURED DATA AND SUMMARY OF CORRECTED DATA

The Summary of Measured Data presents the individual containment atmosphere drybulb temperatures, dewpoint temperatures, and absolute total pressure measured at the time and date as indicated and is used to determine the temperature and pressure described in V.D.3-5 above.

1. TEMP 1 through TEMP 22 are the drybulb temperatures. The values in the right-hand column are temperatures (°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 (°R).

2. PRES 1 is the total pressure, absolute. 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 6 are the dewpoint temperatures (water vapor pressures). The values in the right-hand column are temperatures (°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 (°F) is the volume weighted average containment atmosphere drybulb temperature (refer to Section III, Tables 1 and 2, for sensor volume fractions) derived from TEMP 1 through TEMP 22.

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 PRES 1, 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 (refer to Section III, Tables 1 and 2 for sensor volume fractions), derived from VPRS 1 through VPRS 6.

4. 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 CORRRECTED PRESSURE of the dry air.

   Note: This printout is not included in the report, but is retained at the facility.

APPENDIX A

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, containment atmosphere total pressure, drybulb temperature, and dewpoint temperature (water vapor pressure). Leakage rate is computer 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. The first printout, the Total Time Report, is based on the Total Time Method described in BN-TOP-1. 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 fuction of number of data points and elapsed time (test duration). The Trend Report provides all leakage rate values required for comparision to the acceptance criteria of BN-TOP-1 for conduct of a short duration test.

5. The program is written in a high level language and is designed for use on a mini-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 the start of the test:

   a. Number of containment atmosphere drybulb temperature sensors and dewpoint temperature (water vapor pressure) sensors 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 sensor, if required

   d. Calibration data for pressure sensor.

3. Information entered into the program at the start of the test:

   a. Test title

   b. Current test pressure and peak test pressure

   c. Maximum allowable leakage rate at peak test pressure

   d. If the test is a verification test:

      (1) Imposed leakage rate

      (2) Leakage rates determined using the two computational methods described in Paragraph A above during the ILRT.

4. Data received from the data acquistion system during the test, and used to compute leakage rates:

   a. Time and date

   b. Containment atmosphere drybulb temperatures

   c. Containment atmosphere pressure

   d. Containment atmosphere dewpoint temperatures

5. 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 on the data terminal. The date, containment atmosphere weighted average drybulb temperature, partial pressure of the dry air and water vapor pressure are stored on a data file.

6. 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:

$$P_1V = W_1RT_1 \quad (1)$$

$$P_iV = W_iRT_i \quad (2)$$

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

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

$$L_i = 2400/\Delta t_i(1-T_1P_i/T_iP_1) \quad (4)$$

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 = Containment free air volume (assumed to be constant during the test), ft^3.

t_1, t_i = Time at 1^{st} and i^{th} data points respectively, hours.

Δt_i = Elapsed time from t_1 to t_i, hours.

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, %/day.

b. Calculated leakage rate from regression analysis:

$$\bar{L} = a + b\Delta t_N \tag{5}$$

where:

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

$$a = \frac{\Sigma L_i(\Sigma \Delta t_i^2) - \Sigma \Delta t_i(\Sigma L_i \Delta t_i)}{N(\Sigma \Delta t_i^2) - (\Sigma \Delta t_i)^2} \tag{6}$$

$$b = \frac{N(\Sigma L_i \Delta t_i) - \Sigma L_i(\Sigma \Delta t_i)}{N(\Sigma \Delta t_i^2) - (\Sigma \Delta t_i)^2} \tag{7}$$

N = Number of data points

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

c. Calculated leakage rate at the 95% confidence level.

$$\bar{L}_{95} = a + b\Delta t_N + S_{\bar{L}} \tag{8}$$

where:

$\bar{L}_{95}$ = Calculated leakage rate at the 95% confidence level, %/day, at elapsed time Δt_N.

For $\Delta t_N < 24$

$$S_{\bar{L}} = t_{0.025;N-2}\,[\Sigma(L_i-\bar{L}_i)^2/(N-2)]^{1/2} \times [1 + \frac{1}{N} + (\Delta t_N-\overline{\Delta t})^2/\Sigma(\Delta t_i-\overline{\Delta t})^2]^{1/2} \tag{9a}$$

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

For $\Delta t_N \geq 24$

$$S_{\bar{L}} = t_{0.025;N-2}\,[\Sigma(L_i - \bar{L}_i)^2/(N-2)]^{1/2} \times [\frac{1}{N} + (\Delta t_N - \overline{\Delta t})^2/\Sigma(\Delta t_i - \overline{\Delta t})^2]^{1/2} \tag{9b}$$

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

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

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

2. Computation using the Mass Point Method

a. Contained mass of dry air from data:

$$W_i = 144 \frac{P_i V}{R T_i} \tag{10}$$

where:

All symbols as previously defined.

b. Calculated leakage rate from regression analysis:

$$\bar{L} = -2400 \frac{b}{a} \tag{11}$$

where:

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

$$a = \frac{\Sigma W_i - b\Sigma\Delta t_i}{N} \tag{12}$$

$$b = \frac{\Sigma[(W_i - \Sigma W_i/N)\ (\Delta t_i - \overline{\Delta t})]}{\Sigma(\Delta t_i - \overline{\Delta t})^2} \tag{13}$$

Δt_i = Total elapsed time at time of i^{th} data point, hours

N = Number of data points

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

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

$$\overline{\Delta t} = \Sigma\Delta t_i/N$$

c. Calculated leakage rate at the 95% confidence level.

$$\bar{L}_{95} = \frac{-2400}{a}(b + S_b) \tag{14}$$

where:

$\bar{L}_{95}$ = Calculated leakage rate at the 95% confidence level, %/day.

$$S_b = t_{0}.025;N-2 \left[\frac{\Sigma(W_i - \overline{W_i})^2}{(N-2)\Sigma(\Delta t_i - \overline{\Delta t})^2} \right] 1/2 \qquad (15)$$

where, $t_{0}.025;N-2 = \dfrac{1.6449(N-2)^2 + 3.5283\ (N-2)^2 + 0.85602}{(N-2)^2 + 1.2209\ (N-2) - 1.5162}$

$\overline{W}_i$ = Contained mass of dry air, lbm, computed at the i^{th} data point from the regression equation (16)

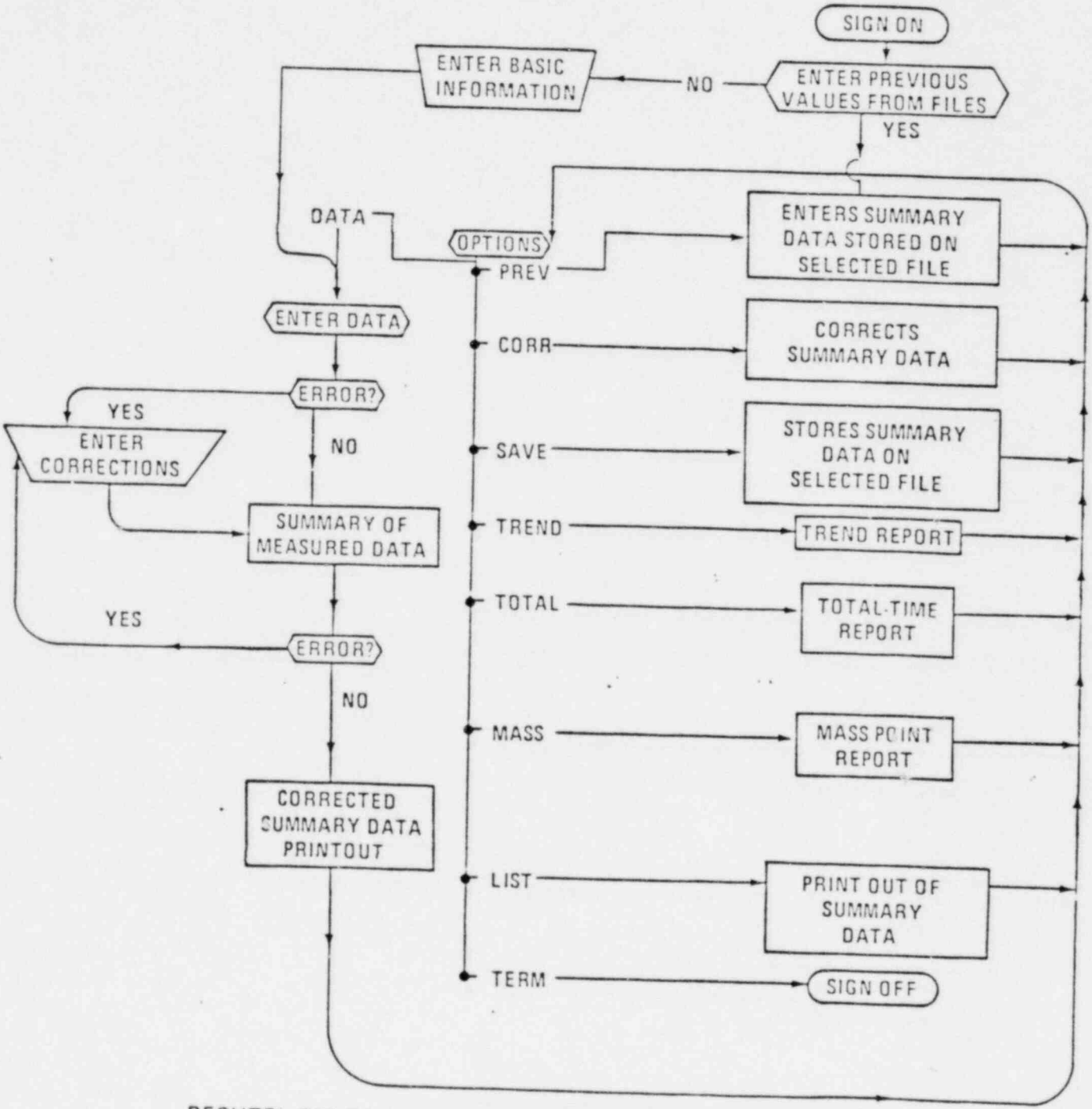
$= a + b\Delta t_i$

All other symbols are previously defined.

D. Program Logic

1. A flow chart of Bechtel ILRT computer program usage is presented in Figure 1, following. The various user options and a brief description of their associated function are presented below:

OPTION COMMAND	FUNCTION
DATA	Enables operator 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, date, average temperature, partial pressure of dry air, and water vapor pressure is printed.
TREND	Terminal will print out a Trend Report.
TOTAL	Terminal will print out a Total Time Report.
MASS	Terminal will print out a Mass Point Report.
TERM	Enables operator to sign-off temporarily or permanently.
SAVE	Enables operator to store the Data Summary on a file.
PREV	Enables operator to call up an old, previously stored, file.
CORR	Enables operator to correct data stored on a file.
LIST	When used with a given file name, the printer will print out a list of the Summary Data stored on the file.
READ	Enable the computer to receive the next set of raw data from the data acquisition system directly.



BECHTEL CONTAINMENT INTEGRATED LEAKAGE RATE TEST
COMPUTER PROGRAM FLOW CHART
FIGURE 1

APPENDIX B
ILRT STABILIZATION DATA

TEST.STA
GRAND GULF STABILIZATION
ALMAX = 0.437 VOL = 1670000.00
VRATET = 0.000 VRATEM = 0.000 VRATEP = 0.000

TIME	DATE	TEMP	PRESSURE	VPRS
1529	103	537.56366	26.425938	0.34851480
1545	103	537.01373	26.402582	0.34475750
1603	103	536.61597	26.383574	0.34468400
1615	103	536.46893	26.377193	0.34303159
1630	103	536.30707	26.368984	0.34320599
1645	103	536.20459	26.363253	0.34291309
1700	103	536.09918	26.357325	0.34281561
1715	103	536.03223	26.353136	0.34298769
1730	103	535.95685	26.348457	0.34264520
1745	103	535.88330	26.344131	0.34295520
1800	103	535.82629	26.340103	0.34296569
1815	103	535.76117	26.337587	0.34246781
1830	103	535.70874	26.334372	0.34267199
1845	103	535.66150	26.332005	0.34202629
1900	103	535.61688	26.329777	0.34224480
1915	103	535.56860	26.327791	0.34222180
1930	103	535.54742	26.324705	0.34229621
1945	103	535.43054	26.323195	0.34179929
2000	103	535.44885	26.320612	0.34237379
2015	103	535.40631	26.318562	0.34241500

APPENDIX C
ILRT SUMMARY DATA

TEST.DAT

GRAND GULF ILRT

ALMAX = 0.437 VOL = 1670000.00

VRATET = 0.000 VRATEM = 0.000 VRATEP = 0.000

TIME	DATE	TEMP	PRESSURE	VPRS
2030	103	535.38818	26.316441	0.34252653
2045	103	535.37219	26.315517	0.34244490
2100	103	535.34686	26.313202	0.34275225
2115	103	535.32245	26.311718	0.34222719
2130	103	535.28601	26.310568	0.34237543
2145	103	535.26984	26.309896	0.34204134
2200	103	535.23566	26.307184	0.34274417
2215	103	535.21973	26.304913	0.34300748
2230	103	535.19214	26.304295	0.34262270
2245	103	535.16925	26.302761	0.34315175
2300	103	535.14685	26.301828	0.34307989
2315	103	535.11749	26.300154	0.34274691
2330	103	535.10406	26.299398	0.34249672
2345	103	535.09546	26.299583	0.34231171
0	104	535.06689	26.296225	0.34366253
15	104	535.05304	26.297117	0.34277007
30	104	535.03369	26.295589	0.34329468
45	104	535.01672	26.293724	0.34415492
100	104	534.99390	26.293665	0.34321022
115	104	534.98413	26.292389	0.34348071
130	104	534.96783	26.291492	0.34337339
145	104	534.96344	26.290226	0.34363529
200	104	534.94757	26.289938	0.34392363
215	104	534.93909	26.288767	0.34409159
230	104	534.92371	26.287523	0.34432954
245	104	534.91162	26.287708	0.34414417
300	104	534.89838	26.286375	0.34447473
315	104	534.89233	26.285236	0.34460890
330	104	534.87921	26.285433	0.34441105
345	104	534.86578	26.284437	0.34440356
400	104	534.85150	26.283850	0.34499204
415	104	534.84827	26.283432	0.34440419
430	104	534.82874	26.283085	0.34475130

APPENDIX D
ILRT CALCULATIONS

GRAND GULF ILRT

LEAKAGE RATE (WEIGHT PERCENT/DAY)
MASS-POINT ANALYSIS

TIME AND DATE AT START OF TEST: 2030 0103
ELAPSED TIME: 8.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LBM)	MASS LOSS (LBM)	TOT.AVG. MASS LOSS (LBM/HR)
2030	535.389	26.3164	221566.		
2045	535.372	26.3155	221565.	1.1	4.6
2100	535.347	26.3132	221556.	9.0	20.3
2115	535.322	26.3117	221553.	2.4	16.8
2130	535.286	26.3106	221559.	-5.4	7.2
2145	535.270	26.3099	221560.	-1.0	4.9
2200	535.236	26.3072	221551.	8.7	9.9
2215	535.220	26.3049	221539.	12.5	15.6
2230	535.192	26.3043	221545.	-6.2	10.6
2245	535.169	26.3028	221541.	3.4	10.9
2300	535.147	26.3018	221543.	-1.4	9.3
2315	535.117	26.3002	221541.	1.9	9.1
2330	535.104	26.2994	221540.	0.8	8.6
2345	535.095	26.2996	221545.	-5.1	6.4
0	535.067	26.2962	221529.	16.5	10.6
15	535.053	26.2971	221542.	-13.3	6.4
30	535.034	26.2956	221537.	4.9	7.2
45	535.017	26.2937	221528.	8.7	8.8
100	534.994	26.2937	221537.	-9.0	6.4
115	534.984	26.2924	221531.	6.7	7.4
130	534.968	26.2915	221530.	0.8	7.2
145	534.963	26.2902	221521.	8.9	8.6
200	534.948	26.2899	221525.	-4.2	7.4
215	534.939	26.2888	221519.	6.4	8.2
230	534.924	26.2875	221515.	4.1	8.5
245	534.912	26.2877	221521.	-6.6	7.2
300	534.898	26.2864	221515.	5.8	7.8
315	534.892	26.2852	221508.	7.1	8.5
330	534.879	26.2854	221515.	-7.1	7.2
345	534.866	26.2844	221513.	2.8	7.4
400	534.852	26.2838	221514.	-1.0	7.0
415	534.848	26.2834	221511.	2.2	7.0
430	534.829	26.2831	221517.	-5.2	6.2

FREE AIR VOLUME USED (MILLIONS OF CU. FT.) = 1.670

REGRESSION LINE
INTERCEPT (LBM) = 221561.
SLOPE (LBM/HR) = -6.7

MAXIMUM ALLOWABLE LEAKAGE RATE = 0.437
75 % OF MAXIMUM ALLOWABLE LEAKAGE RATE = 0.328
THE UPPER 95% CONFIDENCE LIMIT = 0.079
THE CALCULATED LEAKAGE RATE = 0.072

GRAND GULF ILRT

LEAKAGE RATE (WEIGHT PERCENT/DAY)
TOTAL-TIME ANALYSIS

TIME AND DATE AT START OF TEST: 2030 0103
ELAPSED TIME: 8.00 HOURS

TIME	TEMP. (R)	PRESSURE (PSIA)	MEASURED LEAKAGE RATE
2030	535.388	26.3164	
2045	535.372	26.3155	0.050
2100	535.347	26.3132	0.220
2115	535.322	26.3117	0.181
2130	535.286	26.3106	0.078
2145	535.270	26.3099	0.053
2200	535.236	26.3072	0.107
2215	535.220	26.3049	0.169
2230	535.192	26.3043	0.115
2245	535.169	26.3028	0.118
2300	535.147	26.3018	0.100
2315	535.117	26.3002	0.099
2330	535.104	26.2994	0.094
2345	535.095	26.2996	0.069
0	535.067	26.2962	0.115
15	535.053	26.2971	0.069
30	535.034	26.2956	0.078
45	535.017	26.2937	0.096
100	534.994	26.2937	0.069
115	534.984	26.2924	0.081
130	534.968	26.2915	0.078
145	534.963	26.2902	0.093
200	534.948	26.2899	0.080
215	534.939	26.2888	0.089
230	534.924	26.2875	0.093
245	534.912	26.2877	0.078
300	534.898	26.2864	0.084
315	534.892	26.2852	0.092
330	534.879	26.2854	0.078
345	534.866	26.2844	0.080
400	534.852	26.2838	0.076
415	534.848	26.2834	0.076
430	534.829	26.2831	0.067

MEAN OF MEASURED LEAKAGE RATES	=	0.095
MAXIMUM ALLOWABLE LEAKAGE RATE	=	0.437
75 % OF MAXIMUM ALLOWABLE LEAKAGE RATE	=	0.328
THE UPPER 95% CONFIDENCE LIMIT	=	0.139
THE CALCULATED LEAKAGE RATE	=	0.068

GRAND GULF ILRT

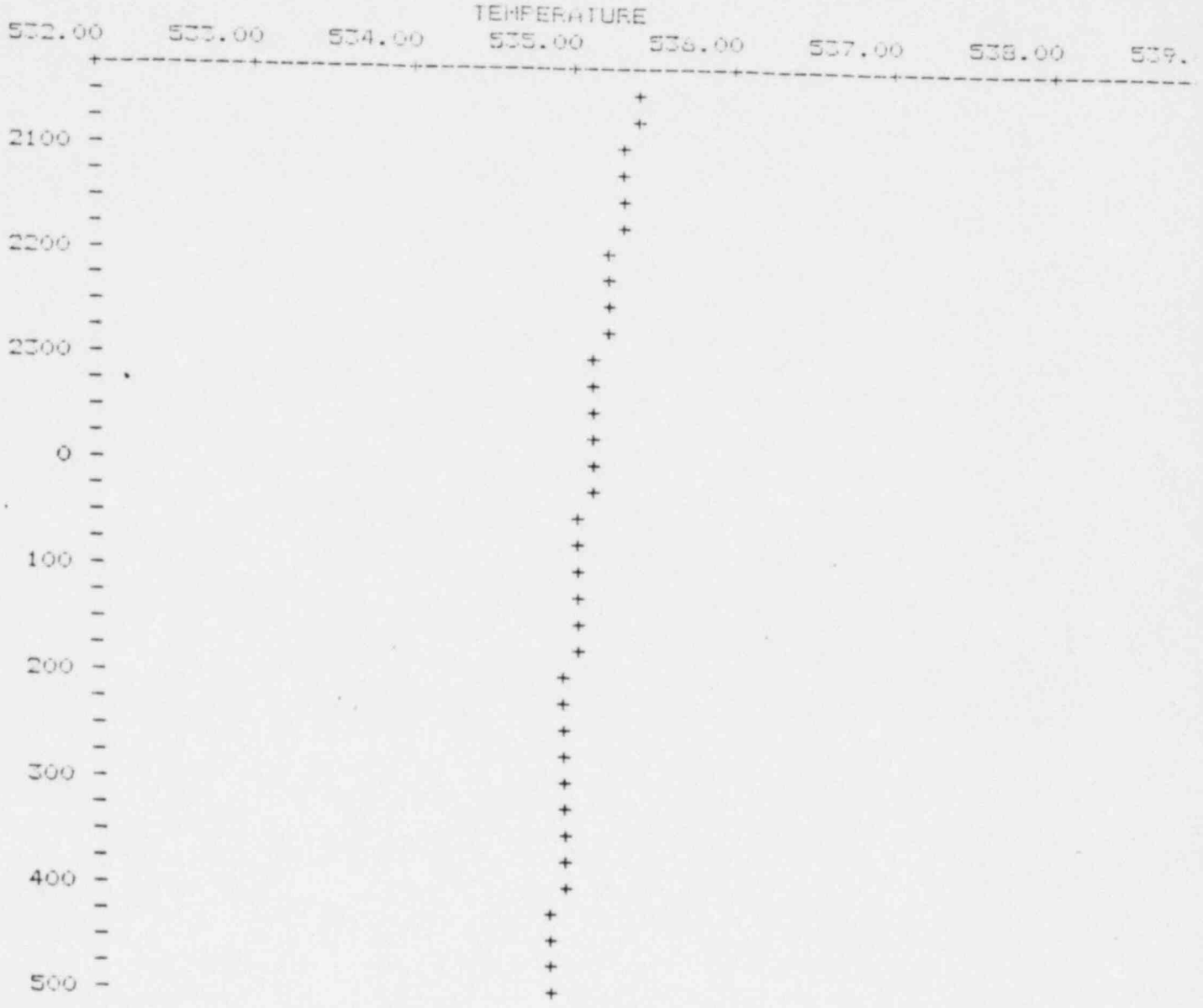
TREND REPORT
LEAKAGE RATES (WEIGHT PERCENT/DAY)

TIME AND DATE AT START OF TEST: 2030 0103
ELAPSED TIME: 8.00 HOURS

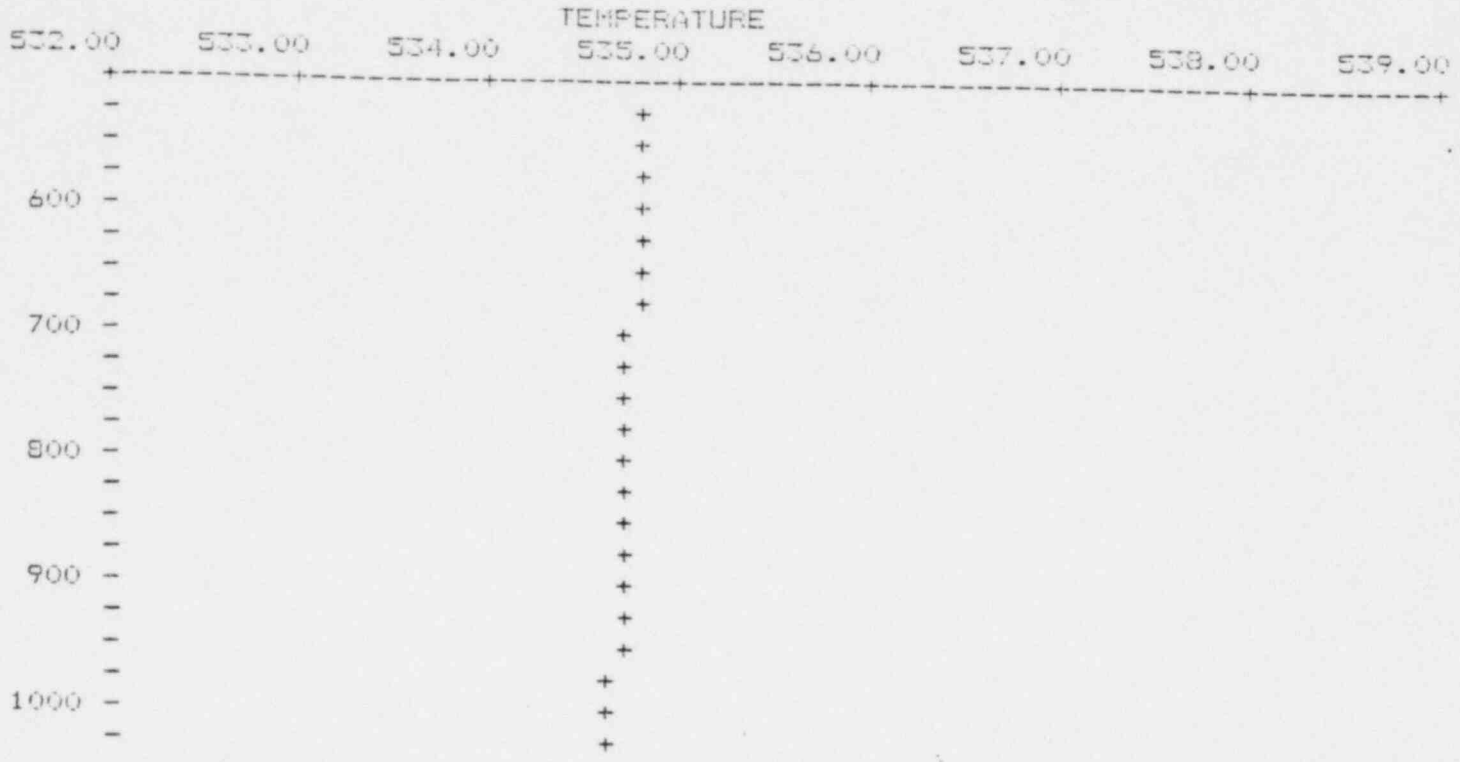
NO. DATA POINTS	ELAPSED TIME	TOTAL-TIME ANALYSIS MEAN	TOTAL-TIME ANALYSIS CALCULATED	MASS-POINT ANALYSIS CALCULATED	MASS-POINT ANALYSIS 95% UCL
10	2.25	0.121	0.119	0.119	0.162
11	2.50	0.119	0.112	0.110	0.146
12	2.75	0.117	0.107	0.104	0.134
13	3.00	0.115	0.101	0.098	0.124
14	3.25	0.112	0.091	0.085	0.111
15	3.50	0.112	0.094	0.093	0.116
16	3.75	0.109	0.086	0.083	0.105
17	4.00	0.107	0.082	0.079	0.099
18	4.25	0.107	0.082	0.081	0.099
19	4.50	0.105	0.077	0.075	0.092
20	4.75	0.103	0.075	0.074	0.089
21	5.00	0.102	0.073	0.073	0.087
22	5.25	0.102	0.074	0.075	0.088
23	5.50	0.101	0.073	0.075	0.086
24	5.75	0.100	0.073	0.076	0.087
25	6.00	0.100	0.074	0.078	0.088
26	6.25	0.099	0.073	0.077	0.086
27	6.50	0.098	0.073	0.077	0.086
28	6.75	0.098	0.074	0.079	0.087
29	7.00	0.097	0.073	0.078	0.085
30	7.25	0.097	0.072	0.077	0.084
31	7.50	0.096	0.071	0.076	0.083
32	7.75	0.095	0.070	0.075	0.081
33	8.00	0.095	0.068	0.072	0.079

APPENDIX E
ILRT PLOTS

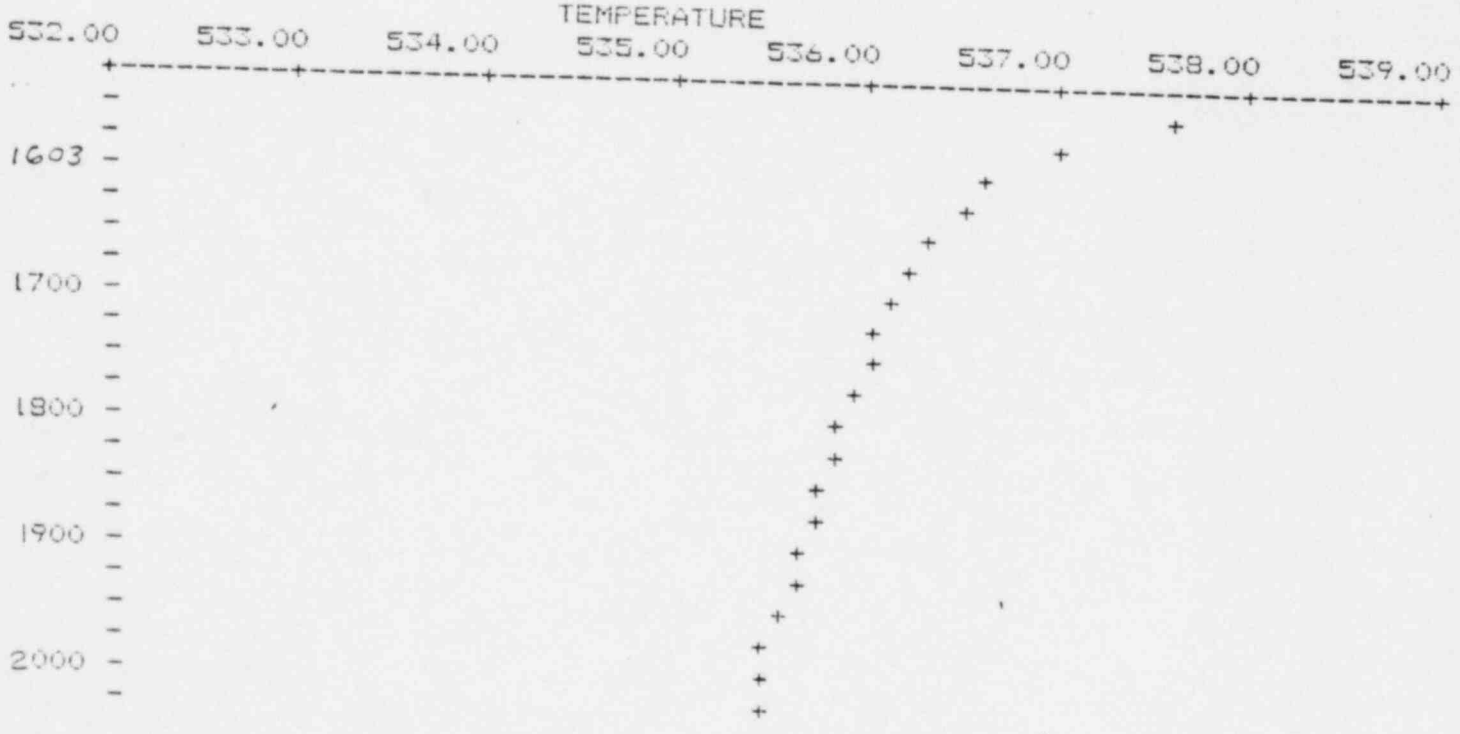
ILRT



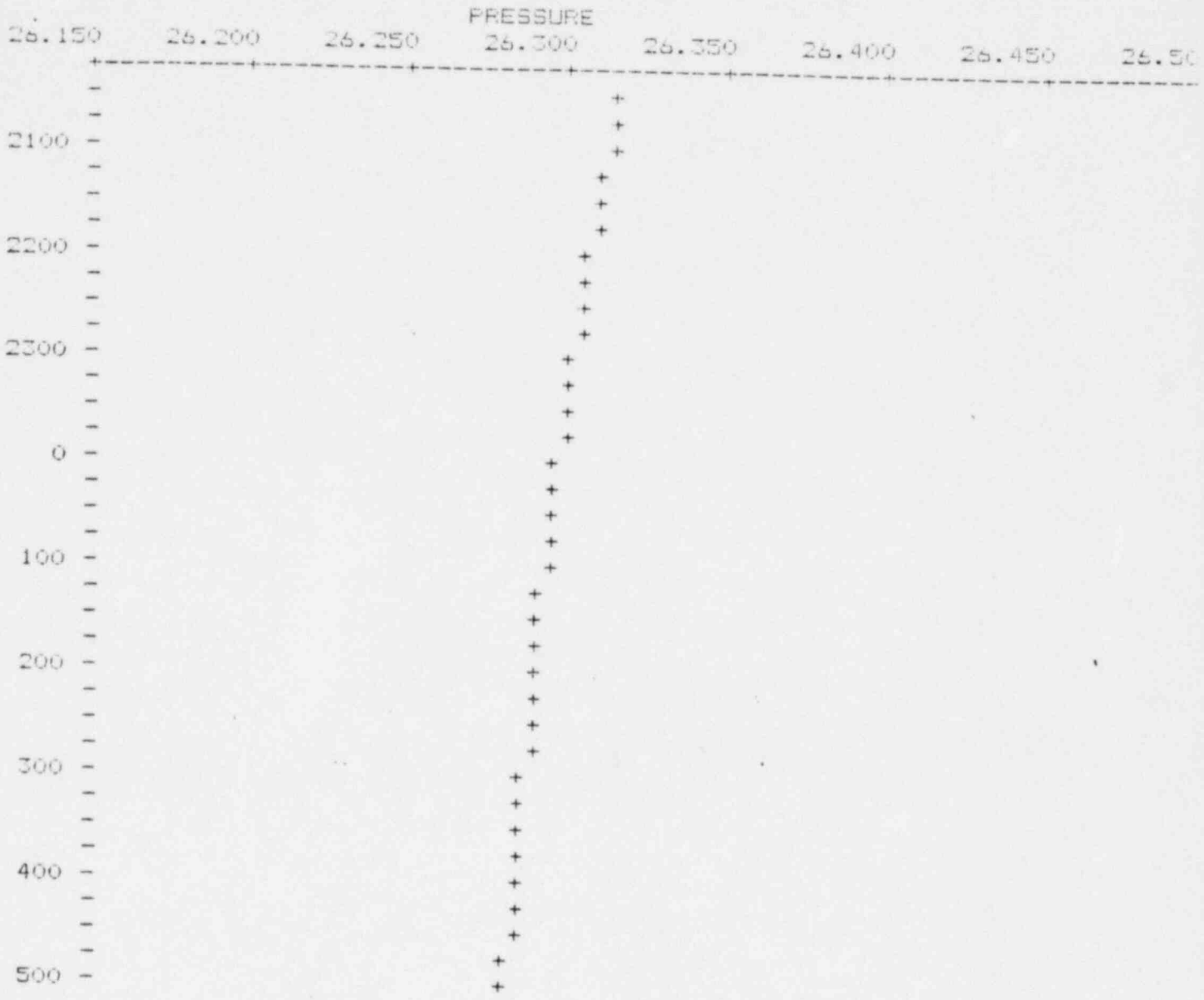
VERIFICATION



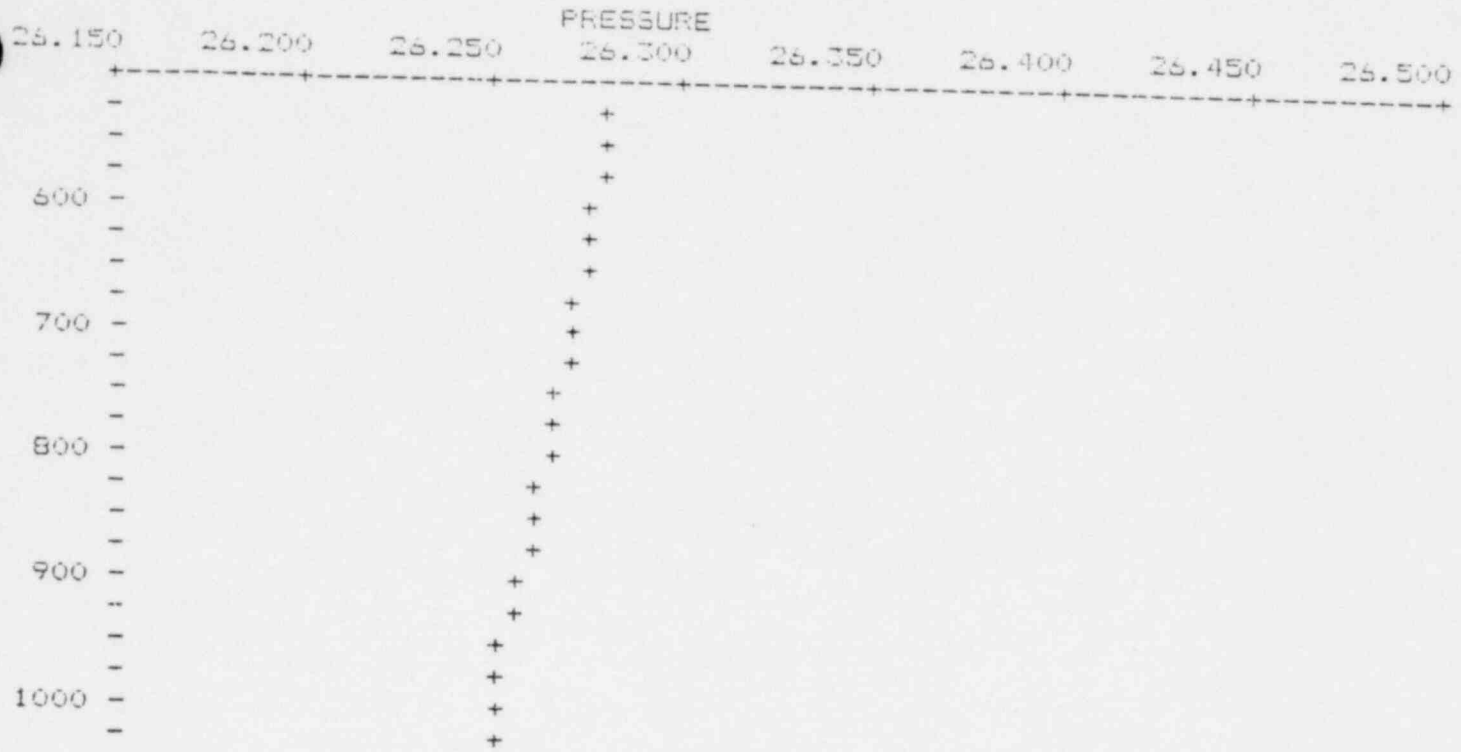
STABILIZATION



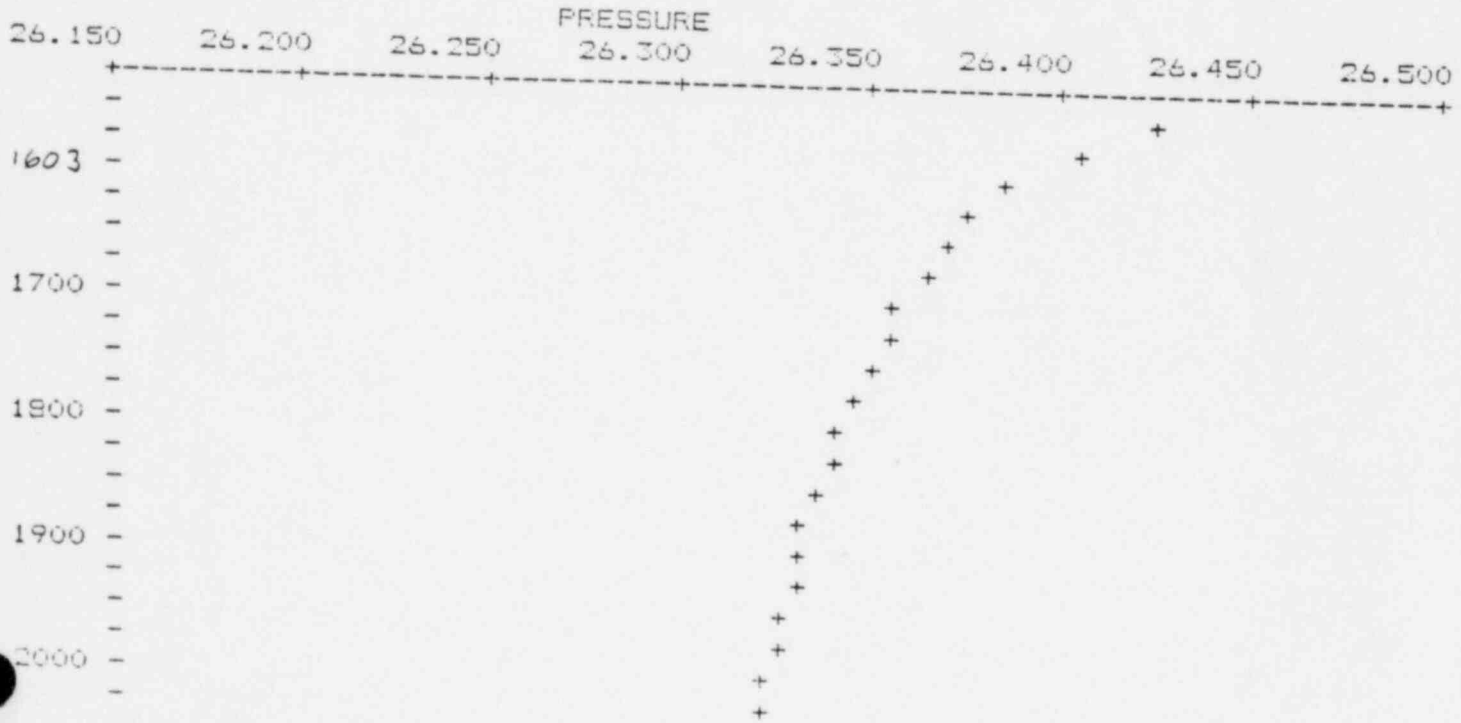
ILRT


PRESSURE
26.150
26.200
26.250
26.300
26.350
26.400
26.450
2100
2200
2300
0
100
200
300
400
500

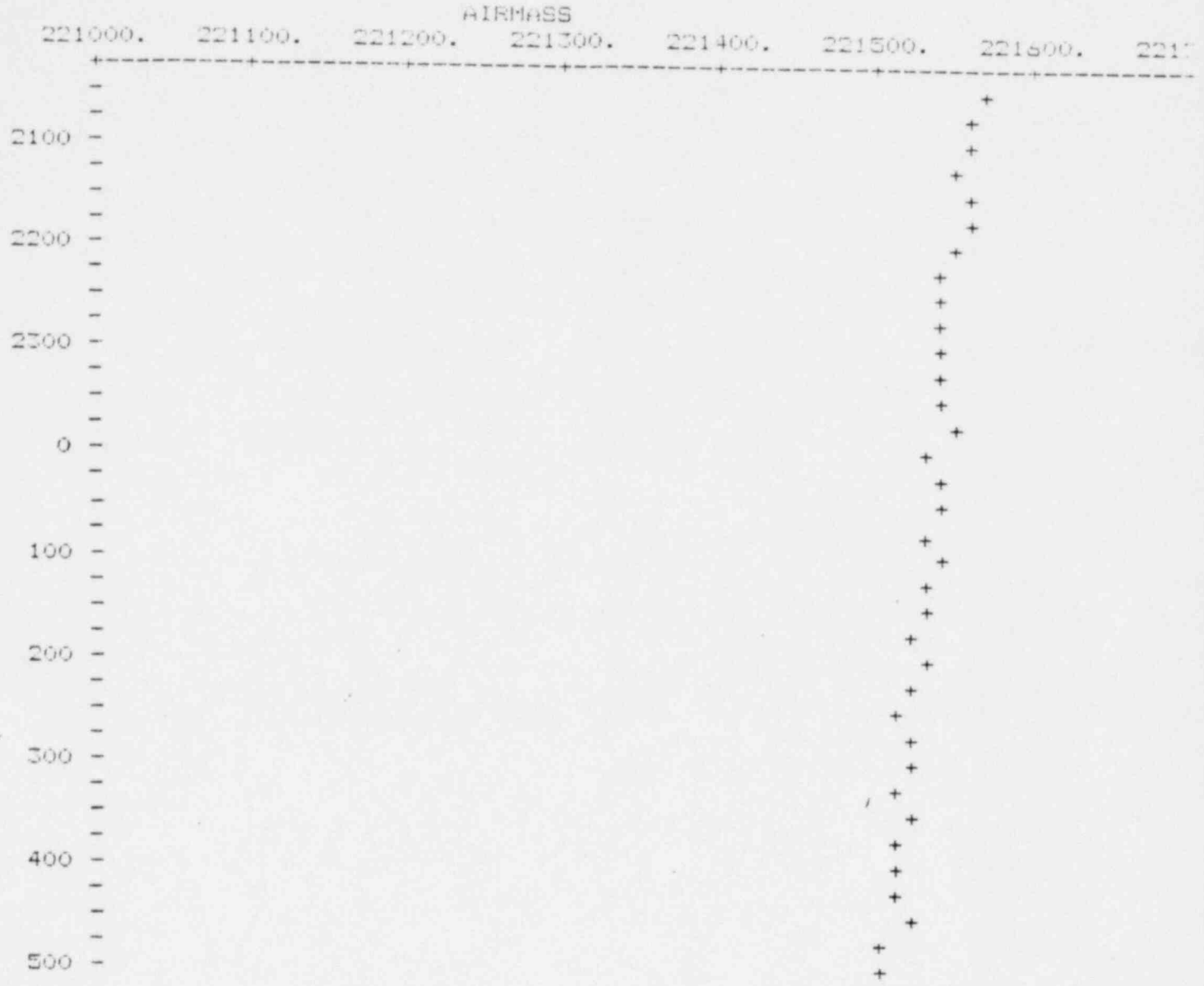
VERIFICATION



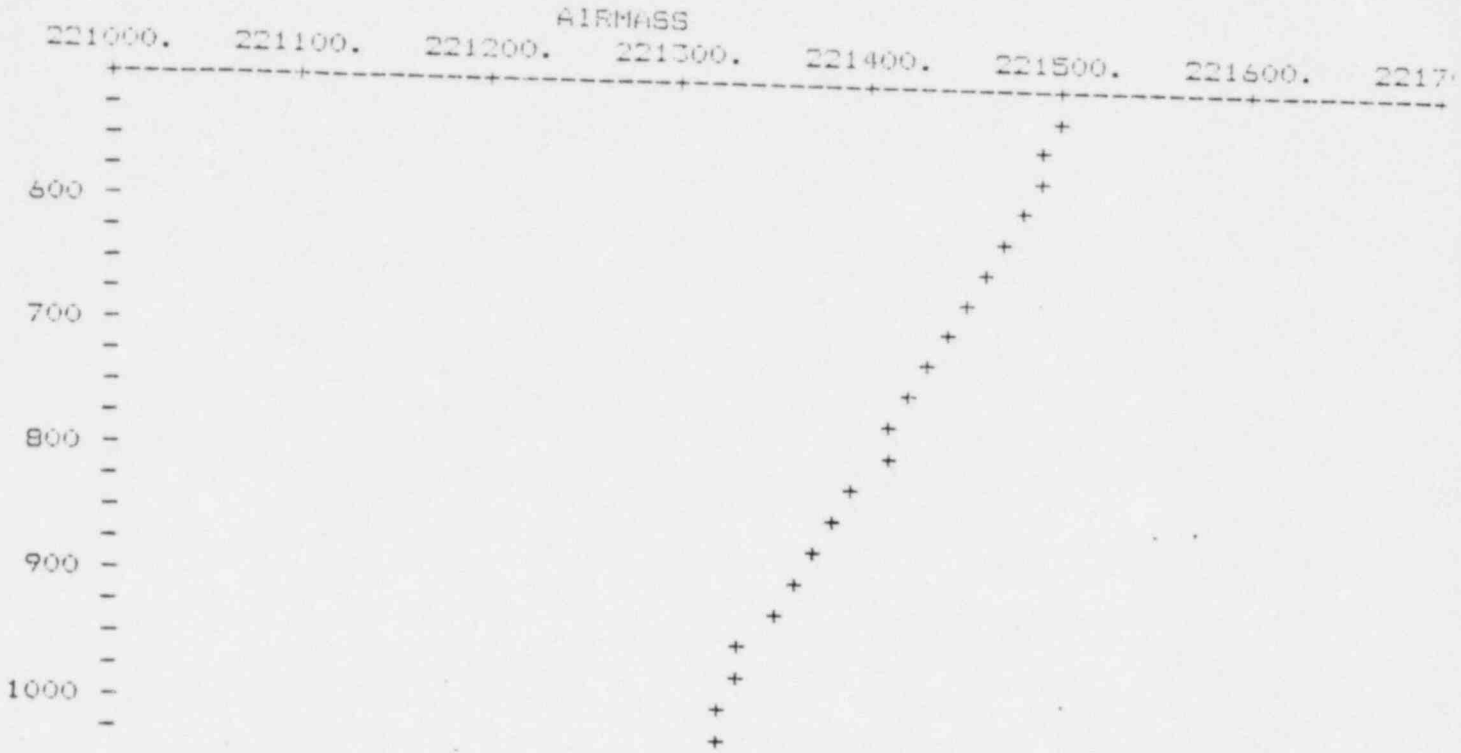
STABILIZATION



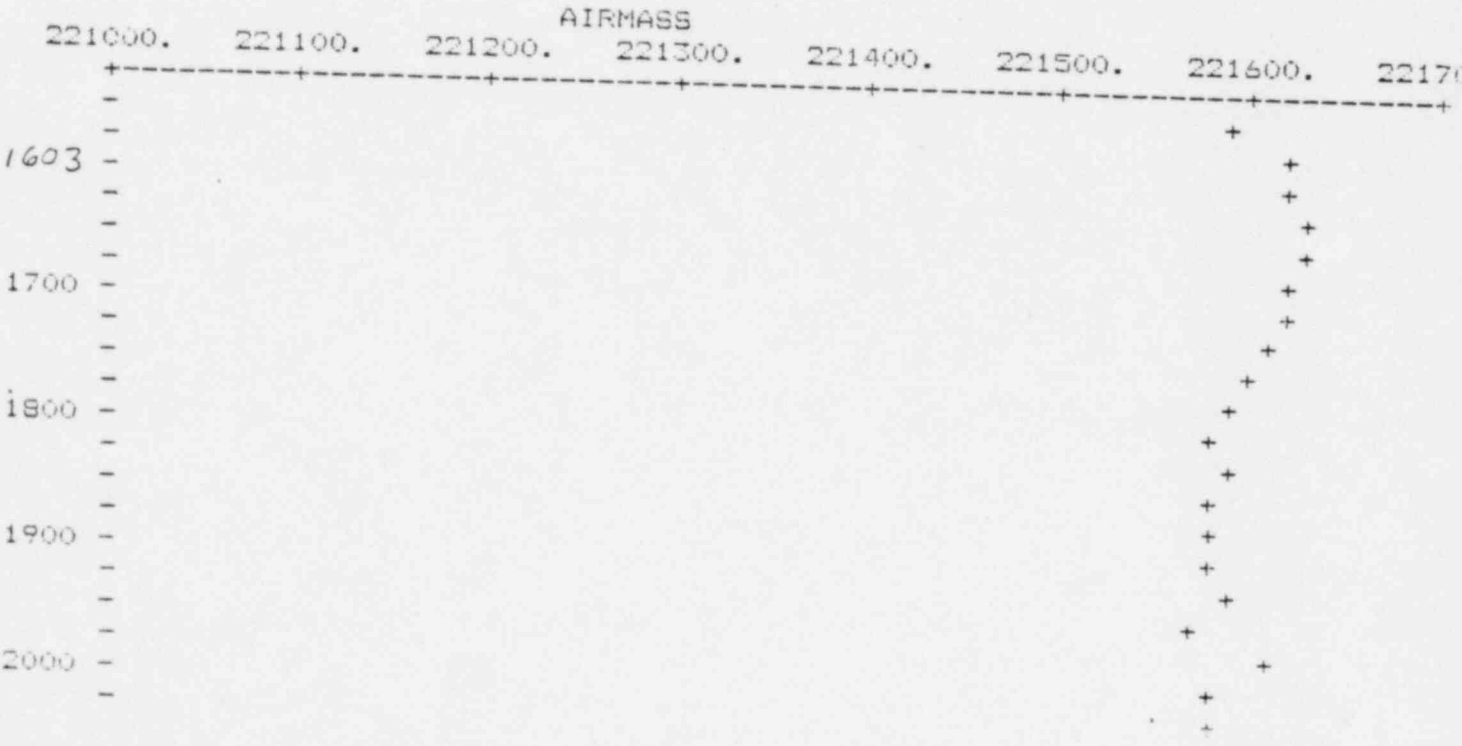
ILRT


AIRMASS
221000.
221100.
221200.
221300.
221400.
221500.
221600.
2100
2200
2300
0
100
200
300
400
500

VERIFICATION



STABILIZATION



APPENDIX F
VERIFICATION FLOW TEST

SUMMARY DATA

TEST.VER
GRAND GULF VERIFICATION
ALMAX = 0.437 VOL = 1670000.00
VRATET = 0.432 VRATEM = 0.436 VRATEP = 0.364

TIME	DATE	TEMP	PRESSURE	VFRS
515	104	534.80566	26.280268	0.34556079
530	104	534.79596	26.278370	0.34544951
545	104	534.78748	26.277615	0.34520060
600	104	534.77368	26.276218	0.34559339
615	104	534.76746	26.274252	0.34554970
630	104	534.75714	26.272772	0.34602681
645	104	534.76361	26.272007	0.34578761
700	104	534.74396	26.269663	0.34612215
715	104	534.73499	26.268349	0.34643370
730	104	534.73236	26.267462	0.34631500
745	104	534.72797	26.265524	0.34624526
800	104	534.71405	26.264580	0.34618655
815	104	534.70410	26.262316	0.34644118
830	104	534.69879	26.261040	0.34671304
845	104	534.68665	26.259174	0.34656873
900	104	534.68726	26.257030	0.34670511
915	104	534.67273	26.256052	0.34667951
930	104	534.65894	26.252333	0.34738570
945	104	534.64771	26.252180	0.34753838
1000	104	534.64069	26.250376	0.34733403
1015	104	534.63062	26.249893	0.34681413

APPENDIX G
VERIFICATION FLOW TEST CALCULATIONS

GRAND GULF VERIFICATION

LEAKAGE RATE (WEIGHT PERCENT/DAY)
MASS-POINT ANALYSIS

TIME AND DATE AT START OF TEST: 615 0104
ELAPSED TIME: 4.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LBM)	MASS LOSS (LBM)	TOT.AVG. MASS LOSS (LBM/HR)
615	534.767	26.2743	221467.		
630	534.757	26.2728	221459.	8.2	32.8
645	534.764	26.2720	221450.	9.1	34.7
700	534.744	26.2697	221439.	11.6	38.6
715	534.735	26.2683	221431.	7.4	36.3
730	534.732	26.2675	221425.	6.4	34.2
745	534.728	26.2655	221410.	14.5	38.1
800	534.714	26.2646	221408.	2.2	34.0
815	534.704	26.2623	221393.	15.0	37.2
830	534.699	26.2610	221385.	8.6	36.9
845	534.687	26.2592	221374.	10.7	37.5
900	534.687	26.2570	221356.	18.3	40.7
915	534.673	26.2561	221353.	2.2	38.1
930	534.659	26.2523	221328.	25.6	43.0
945	534.648	26.2522	221331.	-3.4	39.0
1000	534.641	26.2504	221319.	12.3	39.7
1015	534.631	26.2499	221319.	-0.1	37.2

FREE AIR VOLUME USED (MILLIONS OF CU. FT.) = 1.670

REGRESSION LINE
INTERCEPT (LBM) = 221471.
SLOPE (LBM/HR) = -39.8

VERIFICATION TEST LEAKAGE RATE UPPER LIMIT = 0.545
VERIFICATION TEST LEAKAGE RATE LOWER LIMIT = 0.327
THE CALCULATED LEAKAGE RATE = 0.431

GRAND GULF VERIFICATION

LEAKAGE RATE (WEIGHT PERCENT/DAY)
TOTAL-TIME ANALYSIS

TIME AND DATE AT START OF TEST: 615 0104
ELAPSED TIME: 4.00 HOURS

TIME	TEMP. (R)	PRESSURE (PSIA)	MEASURED LEAKAGE RATE
615	534.767	26.2743	
630	534.757	26.2728	0.356
645	534.764	26.2720	0.376
700	534.744	26.2697	0.418
715	534.735	26.2683	0.394
730	534.732	26.2675	0.370
745	534.728	26.2655	0.413
800	534.714	26.2646	0.368
815	534.704	26.2623	0.403
830	534.699	26.2610	0.399
845	534.687	26.2592	0.406
900	534.687	26.2570	0.441
915	534.673	26.2561	0.413
930	534.659	26.2523	0.466
945	534.648	26.2522	0.423
1000	534.641	26.2504	0.430
1015	534.631	26.2499	0.403

MEAN OF MEASURED LEAKAGE RATES = 0.405

VERIFICATION TEST LEAKAGE RATE UPPER LIMIT = 0.541
VERIFICATION TEST LEAKAGE RATE LOWER LIMIT = 0.323
THE CALCULATED LEAKAGE RATE = 0.434

GRAND GULF VERIFICATION

TREND REPORT
LEAKAGE RATES (WEIGHT PERCENT/DAY)

TIME AND DATE AT START OF TEST: 615 0104
ELAPSED TIME: 4.00 HOURS

NO. DATA POINTS	ELAPSED TIME	TOTAL-TIME ANALYSIS MEAN	TOTAL-TIME ANALYSIS CALCULATED	MASS-POINT ANALYSIS CALCULATED
10	2.25	0.389	0.400	0.397
11	2.50	0.390	0.404	0.402
12	2.75	0.395	0.418	0.420
13	3.00	0.396	0.420	0.420
14	3.25	0.402	0.436	0.440
15	3.50	0.403	0.436	0.438
16	3.75	0.405	0.439	0.439
17	4.00	0.405	0.434	0.431

APPENDIX H

BYPASS LEAKAGE RATE CALCULATIONS

The formula for computing leakage rate by flow totalizer method is:

$$L_L = (P_1/T_1 - P_2/T_2) \times (VT_s/60tP_s) + F/60t$$

where:

L_L = Leakage rate, standard cubic feet per minute (SCFM)

P_1, P_2 = Test volume absolute pressure at start and end of test respectively, absolute units

T_1, T_2 = Test volume absolute temperature at start and end of test respectively, absolute units

V = Total test free air volume, cubit feet (270,128 cu.ft.)

Ts = Standard temperature (68°F)

Ps = Standard pressure (14.6959 psia)

t = Test duration, hours (4 hrs.)

F = Makeup air (to maintain test pressure), standard cubic feet = $F_2 - F_1$

F_1, F_2 = Makeup air flow meter reading at start and end of test respectively, SCF (convert from actual cubic feet to standard cubic feet).

(1) Calculate drywell average temperature at start and end of test, where VF = Volume Friction.

T_1 = 76.102°F = 535.772°R

T_2 = 76.271°F = 535.941°R

(2) Drywell pressure at start and end of test:

P_1 = 17.793 psia

P_2 = 17.785 psia

(3) Calculate drywell makeup air volume, convert from actual cubic feet to standard cubic feet:

F_1 = 118070 cu.ft.

F_2 = 86350 cu.ft

$$F = (F_1 - F_2)\left(\frac{50+14.6959}{14.6959}\right)\times\left(\frac{68+459.67}{44+459.67}\right)$$

$$= 31720\left(\frac{64.6959}{14.6959}\right)\times\left(\frac{527.67}{503.67}\right)$$

= 146295.19 cu.ft.

(4) Bypass Leakage Rate Calculation:

$$L_L = \left(\frac{17.793}{535.772} - \frac{17.785}{535.941}\right)\left(\frac{270,128\text{x}68}{60\text{x}4\text{x}14.6959}\right) + \frac{146295.19}{60\text{x}4}$$

= 609.7 SCFM

APPENDIX I

Local Leakage Test Summary Data
Type B Test Results

Penetration	Description	Leakage, SCCM
1	Equipment Hatch	2 ± 2
2	Upper Personnel Lock	-
3	Lower Personnel Lock	-
4	Fuel Transfer Tube	0 ± 11
201	Reactor Protection System	0 ± 0
202	Low Voltage Power	0 ± 0
203	Instrumentation	0 ± 0
204	Instrumentation	0 ± 0
205	Neutron Monitoring	0 ± 0
206	Low Voltage Power	0 ± 0
207	Control and Power	0 ± 0
208	Control	0 ± 0
209	Low Voltage Power	0 ± 0
210	Radiation Monitoring	0 ± 0
211	Control	0 ± 0
212	Instrumentation	0 ± 0
213	Rod Position Indication	0 ± 0
214	T.I.P.	0 ± 0
215	6.9 Kv-Reactor Recirculate Pump A	0 ± 0
216	Spare	0 ± 0
217	LV Power and Control	0 ± 0
218	Neutron Monitoring	0 ± 0
219	Instrumentation	0 ± 0
220	Instrumentation	0 ± 0
221	Spare	0 ± 0
222	Reactor Protection	0 ± 0
223	LV Power and Control	0 ± 0
224	Spare	0 ± 0
225	LV Power	0 ± 0
226	Control	0 ± 0
227	Instrumentation	0 ± 0
228	Instrumentation (Neutron Monitoring)	0 ± 0
229	LV Power and Control	0 ± 0
230	Reactor Protection	0 ± 0
231	Instrumentation	0 ± 0
232	Neutron Monitoring	0 ± 0
233	Rod Position Indication	0 ± 0
234	Spare	0 ± 0
235	Neutron Monitoring	0 ± 0
237	Instrumentation (SRV Inplant Test)	0 ± 0
238	Reactor Protection System	0 ± 0
239	Control	0 ± 0
240	Instrumentation	0 ± 0
241	LV Power and Control	0 ± 0
242	LV Power and Control	0 ± 0

APPENDIX I (Cont'd)

Local Leakage Test Summary Data
Type B Test Results (Cont'd)

Penetration	Description	Leakage, SCCM
243	Spare	0 ± 0
244	LV Power	0 ± 0
245	Control Bop	0 ± 0
246	Radiation Monitoring	0 ± 0
247	6.9 KV Reactor Recirculate Pump B	0 ± 0
249	Instrumentation	0 ± 0
	Drywell Personnel Hatch	-
	Drywell Head	
	Drywell Equipment Hatch	30 ± 11
	Drywell Head Manhole	-
		TOTAL = 32 ± 16

Local Leakage Test Summary Data
Type C Test Results (Pneumatic)

Penetration	Description	Leakage, SCCM
5	Main Steam Line A	10,500 ± 150
6	Main Steam Line B	552 ± 19
7	Main Steam Line C	20 ± 17
8	Main Steam Line D	3,390 ± 148
17	Steam Supply to RCIC Turbine and RHR Hx	114.0 ± 17
19	Main Steam Drain to Condenser	4 ± 12
33	CRD Pump Discharge	0 ± 12
34	Containment Purge Supply	135 ± 17
35	Containment Purge Exhaust	80 ± 17
36	Plant Service Water Return	58 ± 12
37	Plant Service Water Supply	
38	Chilled Water Supply	1,250 ± 120
39	Chilled Water Return	20 ± 12
40*	ILRT Containment Pressurization/ Depressurization	286 ± 12
41	Plant Service Air	220 ± 12
42	Instrument Air	800 ± 12
43	RWCU to Main Condenser	10 ± 17
44	Component Cooling Water Supply	40 ± 17
45	Component Cooling Water Return	48 ± 17
47	Reactor Recirculate Post Accident Sample	0 ± 11
49	RWCU Backwash Transfer Pump to Spent Resin Storage Tank	72 ± 12
50	DW & Containment CRW Sump Pumps Discharge to Auxiliary Building Collector Tank	1,385 ± 104
51	DW & Containment DRW Sump Pumps Discharge to Auxiliary Building Collector Tank	1,395 ± 100
54	To Upper Containment Pool and from Refueling Water Storage Tank	5 ± 12
56	Condensate Makeup to Upper Containment Pool	230 ± 11
57	Discharge from Fuel Pool Cooling and C.U. System to Upper Containment Pool	172 ± 12
58	Inlet Upper Containment Pool skimmer Tanks to Fuel Pool Cooling and C.U. System	142 ± 12
60	Auxiliary Building Floor and Equipment Drain Return	23 ± 17
65	Containment Normal Vent Supply and Combustible Gas	350 ± 17
66	Containment Normal Vent and Combustible Gas Exchange	30 ± 17

* Leakage rate for penetration 40 and 82 is included in this total

Local Leakage Test Summary Data
Type C Test Results (Pneumatic)(Cont'd)

Penetration	Description	Leakage, SCCM
70	Automatic Depressurization System (Instrument Air)	20 ± 17
75	RCIC Pump Turbine Exhaust Vaccum Relief	12 ± 12
81	Reactor Recirculate Sample	0 ± 12
82*	ILRT Drywell Pressurization/Depressurization	286 ± 12
83	RWCV Line from Regenerative Ht. Exchange to Feedwater	100 ± 12
84	Drywell and Containment Chemical Waste	60 ± 12
85	Suppression Pool Cleanup Return	180 ± 21
86	Demineralization Water Supply to Containment	330 ± 12
87	RWCV Pump Suction from Recirculate Loops	60 ± 17
88	RWCV Pump Discharge to RWCV Ht. Exchange	40 ± 12
101C	Drywell Pressure Instrumentation (Narrow Range)	0 ± 12
101F	Drywell Pressure Instrumentation (Wide Range)	6 ± 12
102D	Drywell Pressure (Wide Range)	15 ± 12
103D	Containment Pressure (Wide Range)	10 ± 12
104D	Containment Pressure (Wide Range)	10 ± 12
105A	Containment Drywell H_2 Analyzing	110 ± 12
106A	Drywell H_2 Analyzing Sample	14 ± 12
106B	Drywell H_2 Analyzing Sample Return	10 ± 12
106E	Containment H_2 Analyzing Sample Return	10 ± 12
107B	Drywell H_2 Analyzing Sample Return	158 ± 12
107D	Drywell H_2 Analyzing Sample	50 ± 12
107E	Drywell H_2 Analyzing Sample Return	15 ± 12
108A	Containment H_2 Analyzing	95 ± 12
109A	Drywell - Fission Products Monitor Sample	0 ± 12
109B	Drywell - Fission Products Monitor Sample Return	100 ± 12
109D	Containment Pressure Instrument (Narrow Range)	10 ± 12
110A	ILRT Instrumentation Drywell Pressure	0 ± 11
110C	ILRT Instrumentation Verification Flow	0 ± 11
110F	ILRT Instrumentation Containment Pressure	10 ± 11
114	Suppression Pool Water Level Control	9 ± 12
116	Suppression Pool Water Level Control	45 ± 12
118	Suppression Pool Water Level Control	7 ± 12
120	Suppression Pool Water Level Control	5 ± 12
		TOTAL = 22822 ± 300

* Leakage rate for penetration 40 and 82 is included in this total.

Local Leakage Test Summary Data
Type C Test Results (Hydraulic)

Penetration	Description	Leakage, SCCM
9	Feedwater A	3.8 ± 2.5
10	Feedwater B	16-2/3 ± 2.5
11	RHR Pump A Suction	180 ± 36
12	RHR Pump B Suction	503 ± 92
13	RHR Pump C Suction	917 ± 74
14	RHR Shutdown Suction	0 ± 0
18	RHR to RPV Head Spray	3.8 ± 5
20	RHR A to LPCI	0 ± 0
21	RHR B to LPCI	5.60 ± 3.5
22	RHR C to LPCI	519 ± 28
23	RHR A Pump Test Line to Suppression Pool	180 ± 35
24	RHR C Pump Test Line to Suppression Pool	917 ± 74
25	HPCS Pump Suction	6.23 ± 4.3
26	HPCS Pump Discharge to RPV	25 ± 20
27	HPCS Test Line to Suppression Pool	6.3 ± 2.5
28	RCIC Pump Suction	0 ± 0
29	RCIC Turbine Exhaust	0 ± 0
30	LPCS Pump Suction	0 ± 0
31	LPCS Pump Discharge to RPV	471 ± 53
32	LPCS Test Line to Suppression Pool	0 ± 0
46	RCIC Pump Discharge Minimum Flow Line	0 ± 0
48	RHR Hx B Relief Valve Vent Header to Suppression Pool	8.5 ± 5
67	RHR Pump B Test Line to Suppression Pool	503 ± 54
69	Refueling Water Transfer Pump Suction From Suppression Pool	50 ± 7
71A	LPCS Relief Valve Discharge to Suppression Pool	0 ± 0
71B	RHR "C" Relief Valve Discharge to Suppression Pool	917 ± 74
73	RHR Shutdown Relief Valve Discharge to Suppression Pool (H.P.)	82.6 ± 24
76B	RHR A Shutdown Suction Relief Valve Discharge to Suppression Pool (H.P.)	12.75 ± 5
77	RHR HT. Exchanger A Relief Valve Discharge to Suppression Pool	180 ± 35
89	Standby Service Water Supply A	22 ± 7
90	Standby Service Water Return A	0 ± 0
91	Standby Service Water Supply B	0 ± 0
92	Standby Service Water Return B	5 ± 6
113	Suppression Pool Water Level Control	5.3 ± 5
115	Suppression Pool Water Level Control	0 ± 0
117	Suppression Pool Water Level Control	5 ± 12
119	Suppression Pool Water Level Control	17 ± 12
		TOTAL = 5563 ± 192

MISSISSIPPI POWER AND LIGHT CO.
GRAND GULF NUCLEAR STATION
UNIT 1
DOCKET NO. 50-416

PRIMARY REACTOR CONTAINMENT INTEGRATED LEAKAGE RATE TEST REPORT

Submitted To
The United States Nuclear Regulatory Commission
Pursuant To Facility Operating License

TABLE OF CONTENTS

I. INTRODUCTION

The Reactor Containment Building Integrated Leakage Rate (Type A) test is performed to demonstrate that leakage through the primary reactor containment systems and components penetrating the primary containment does not exceed the allowable leakage rate specified in the Grand Gulf Nuclear Station Final Safety Analysis Report (FSAR).

The successful preoperational Integrated Leakage Rate Test (ILRT), Verification Test, and Drywell Bypass Test were completed on January 5, 1982 at Grand Gulf Nuclear Station Unit 1. Acceptance criteria for both ANSI/ANS 56.8-1981, "Containment System Leakage Testing Requirements," and BN-TOP-1, "Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plants," were met for an 8-hour short duration test. Calculations were performed using the ANSI/ANS 56.8-1981 "Mass Point Analysis Method" and BN-TOP-1, "Total Time Analysis Method." The test results are reported in accordance with the requirements of ANSI/ANS 56.8-1981, Section 5.8 and 10CFR50, Appendix J, Section V.B.3.

The purpose of this report is to provide information pertinent to the activities related to the preparation, test performance, and reporting of the Grand Gulf Nuclear Station Unit 1 ILRT.

Section II, Test Synopsis, presents the highlights of activities and events which occurred prior to and during the ILRT.

Section III, Test Data Summary, contains the data and results necessary to demonstrate containment atmosphere stabilization, an acceptable leakage rate, and a successful verification test. In addition, plots provided in Appendix E supply a visual history of containment atmospheric conditions beginning with the stabilization condition, throughout the 8-hour short duration ILRT period, and ending with the verification test.

Section IV, Analysis and Interpretation, contains technical details of the integrated leakage rate measuring system used during the ILRT, and provides analysis to show that the containment 95% upper confidence limit leakage rate does not exceed 75% of the allowable rate as specified in the plant FSAR.

Section V, Computer Report and Data Printout, describes the ILRT computer program and report printouts.

II. TEST SYNOPSIS

TEST PREPARATION ACTIVITIES

Prior to containment pressurization for the Structural Integrity Test (SIT) on January 1, 1982, Grand Gulf Nuclear Station Unit 1 test personnel were engaged in measuring containment leakage to ensure a successful preoperational ILRT. Sources of containment leakage were identified through Types B and C leakage rate testing programs and reduced by repairing those systems and containment components having relatively excessive leakage rates. The results of the Local Leakage Rate Test (LLRT) are presented in Appendix I.

Highlights of the test preparation activities included monitoring both upper and lower personnel hatch pneumatic systems leakage and repairing MSIV guard pipe inspection port seals, positioning sensors, verifying associated volume fractions, and conducting a temperature survey to ensure that all sensors could accurately monitor their respective subvolumes. An in-situ check, as specified in ANSI/ANS 56.8-1981, Section 4.2.3, was conducted to verify that all ILRT instrumentation was indicating correctly. The following items are presented in chronological order, and detail significant activities performed during the test preparation and successful execution.

The Type A test procedure was reviewed to verify compliance with Plant Technical Specifications, 10CFR50 Appendix J, ANSI/ANS 56.8-1981, BN-TOP-1, and the FSAR. In addition, test personnel reviewed the valve lineups to verify that the containment systems were in as close to post-accident alignment as possible.

CONTAINMENT PRESSURIZATION

Containment pressurization for the ILRT began at 1030 on January 3, 1982. At the start of pressurization, containment fans M41-B001A and M41-B001B, and the containment, steam tunnel, and drywell cooling systems were operating. During pressurization with the containment at 10 to 12 psig, containment fan M41-B001B tripped off on overcurrent at approximately 68 amperes. ILRT pressure of 12.27 psig (26.24 psia) was reached at 1525. Containment fan M41-B001A was then manually tripped to prevent a possible uncontrolled trip.

CONTAINMENT STABILIZATION

After reaching ILRT pressure, the containment atmosphere was allowed to stabilize. The temperature stabilization criteria of ANSI/ANS 56.8-1981, Section 5.3.1.3, and BN-TOP-1, Section 2.2.B, were satisfied. The ILRT stabilization data are given in Appendix B.

During containment stabilization the outer doors on the upper and lower personnel locks were opened. A number of small leaks were detected through the inner door seals. Leaks were repaired on the upper and lower lock containment pressure sensing systems. The outer doors were closed at 1853.

DURING ILRT

Subsequent to containment air mass temperature stabilization, the ILRT for Grand Gulf Nuclear Station Unit 1 started at 2030 on January 3, 1982, and terminated at 0430 on the following day, for an 8-hour short duration test. The accumulated data were statistically analyzed (see Section III (C), Test Results - Type A Test.) The maximum allowable leakage rate (L_a) for the primary containment is 0.437 wt.%/day. The Total Time Analysis (BN-TOP-1) yields a leakage rate of 0.068 wt.%/day with an upper 95% confidence limit of 0.139 wt.%/ day. Based on the Mass Point Analysis (ANSI/ANS 56.8-1981), the calculated leakage rate is 0.072 wt.%/day with an upper 95% confidence limit of 0.079 wt.%/day. These values are well below the Grand Gulf Nuclear Station Unit 1 acceptance criterion of 0.328 wt.%/day (0.75 L_a).

VERIFICATION FLOW TEST

A successful verification flow test was performed subsequent to the ILRT from 0615 to 1015 on January 4, 1982. ILRT instrumentation performance was checked by imposing a leakage rate (L_o) of 0.364 wt.%/day (7.67 scfm). After imposing the leakage rate, the containment atmospheric conditions were allowed to stabilize for one (1) hour.

Due to an apparent flow restriction in the verification flow line, the imposed leakage rate could not reach the maximum allowable leakage rate (La) of 0.437 wt.%/day. The imposed leakage rate (Lo) of 0.364 wt.%/day is within the acceptance limits of La $\pm$ 25% as given in ANSI/ANS 56.8-1981, Section 3.2.6(b)(1). The results of the verification test correlated to the ILRT are summarized as follows:

Test Method	Measured Leakage wt.%/day	(Acceptance Limit)	95% UCL wt.%/day
a. ILRT/Mass Point	0.072	(0.328)	0.079
ILRT/Total Time	0.068	(0.328)	0.139
b. Verification/Mass Point	0.431	(0.327-0.545)	NA
Verification/Total Time	0.434	(0.323-0.541)	NA

DEPRESSURIZATION AND DRYWELL BYPASS TEST

Following the successful completion of the ILRT and verification flow test, containment depressurization began at 1030 on January 4, 1982. At 4.3 psig, a containment entry was made to close the drywell lock for the Drywell Bypass Test. The containment was then depressurized to 0 psig and the drywell, whose pressure had dropped to 2.2 psig, was repressurized to 3 psig. During repressurization of the drywell it was necessary to raise the suppression pool level to prevent leakage through the weir wall. After raising the suppression pool level, leakage through the weir wall was observed at 3.02 psig. The drywell pressure was then maintained between 3.00 and 3.01 psig with no observed leakage through the weir wall. The drywell atmosphere was allowed to stabilize for one hour, after which the Bypass Leakage Test began at 0400 on January 4, 1982. The Bypass Leakage Test was successfully completed at 0800. The calculated bypass leakage rate of 609.7 scfm is well below the allowable rate of 3500 scfm. Refer to Appendix H, Drywell Bypass Test Summary Data for calculations.

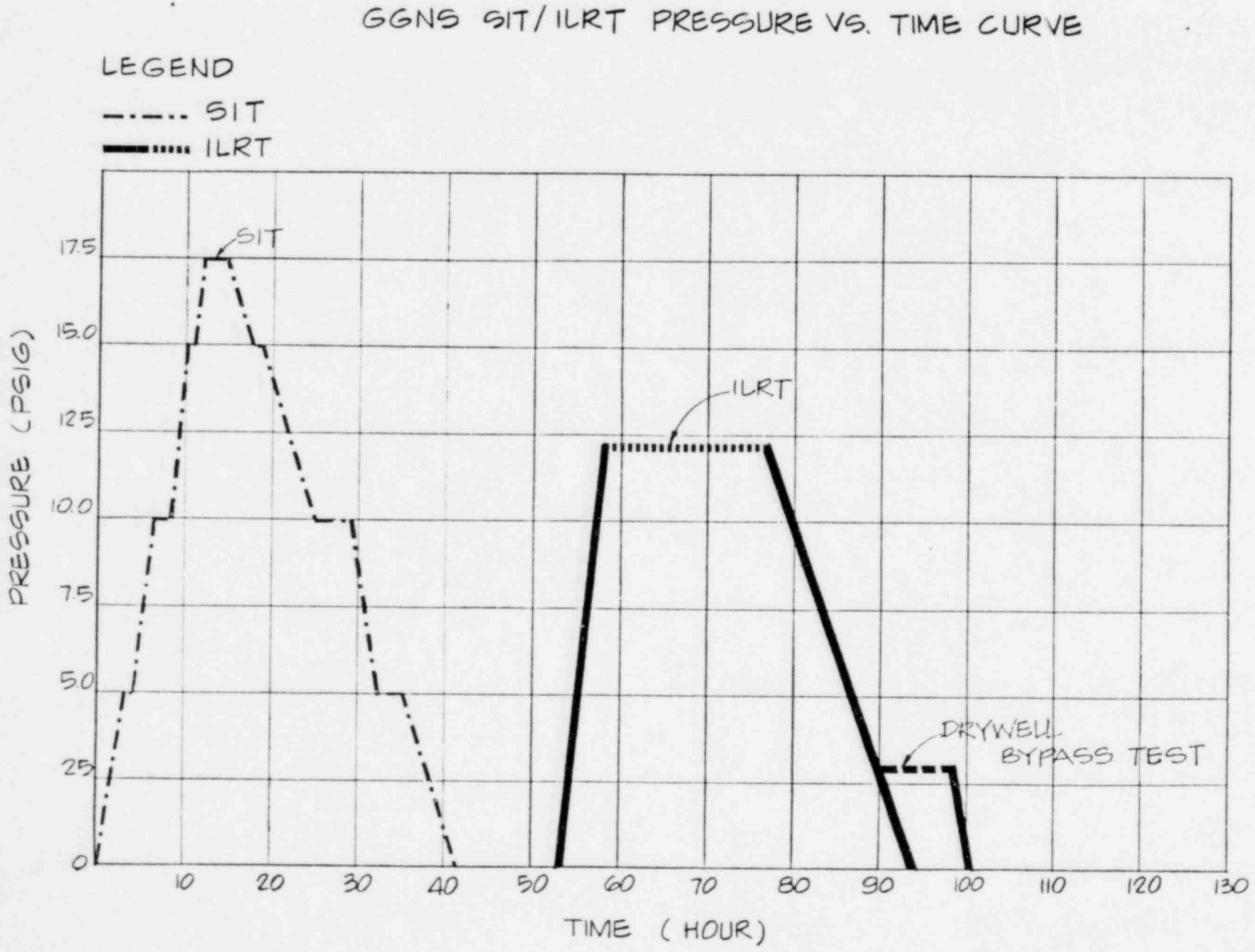


FIGURE 1, TEST PROGRAM PRESSURIZATION SEQUENCE

III. TEST DATA SUMMARY

Pursuant to the requirements of ANSI/ANS 56.8-1981, Section 5.8, Reporting of Results, the information in this section is provided to supply adequate data for an independent review of the containment system leakage rate test results and instrumentation.

A. Plant Information

Owner:	Mississippi Power and Light Company
Plant:	Grand Gulf Nuclear Station Unit 1
Location:	Port Gibson, MS
Containment Type:	Mark III
NSSS Supplier, Type:	General Electric, BWR
Date Test Completed:	January 5, 1982

B. Technical Data

1.	Containment Net Free Air Volume	1,670,360 cu ft
2.	Design Pressure	P_d= 15 psig
3.	Design Temperature	T = 185°F
4.	Calculated Peak Accident Pressure	P_a= 11.5 psig
5.	Calculated Peak Accident Temperature	T_a= 181°F
6.	Containment ILRT Average Temperature Limits	40°F-120°F

C. Test Results - Type A Test

1.	Test Method	Absolute
2.	Data Analysis Technique	Mass Point Leakage Rate per ANSI/ANS 56.8-1981 Total Time per BN-TOP-1
3.	Test Pressure (actual)	P = 11.97 to 12.27 psig
4.	Maximum Allowable Leakage Rate	L_a = 0.437 wt.%/day
5.	75% of L_a	0.328 wt.%/day

6. Integrated Leakage Rate Test Results

	Leakage Rate, L_{am} wt.%/day	
	From Regression Line	At Upper 95% Confidence Limit
Mass Point Analysis	0.072	0.079
Total Time Analysis	0.068	0.139

7. Verification Test Imposed Leakage Rate: Lo = 0.364 wt.%/day (7.67 scfm)

8. Verification Test Results

	Leakage Rate, L_{vm}, wt.%/day
Mass Point Analysis	0.431
Total Time Analysis	0.434

9. Verification Test Limits:

	Test Limits, L_v, wt.%/day	
	Mass Point Analysis	Total Time Analysis
Upper Limit ($L_o + L_{am} + 0.25L_a$)	0.545	0.541
Lower Limit ($L_o + L_{am} - 0.25L_a$)	0.327	0.323

10. Report Printouts:

The report printouts and data plots for the Type A and verification test calculations are provided in Appendixes C through G.

D. Drywell Bypass test results are provided in Appendix H.

E. Test Results - Type B and C Tests

Refer to Appendix I for a summary of local leakage rate test results.

F. Integrated Leakage Rate Measurement System (For ILRT Data Acquisition System, see Figure 2).

1. Absolute Pressure (2 channels):

Mensor Quartz Manometer
Model No. 10100-001
PI-1 Capsule S/N 2407, Gage S/N 1522
PI-2 (Spare) Capsule S/N 2406, Gage S/N 1555

Range:	0-100,000 counts; 0-100 psia
Accuracy:	± 0.015% reading
Sensitivity:	0.001 psia
Repeatability:	0.001 psia
Calibration Date:	12/23/81

2. Drybulb Temperature (22 sensors):

Rosemount resistance temperature detector
Model No. 14632 Series 78

Element:	Platinum
Resistance:	Ro = 100 ohms @ 32°F
Lead Type:	3 lead potentiometric configuration
Temperature Range:	32° to 120°F (from calibration data)

Volumetrics Bridge
Model No. VSTD 333

Input Voltage:	± 15 volts and 5.2 volt
Resistance:	100 ohms @ 32°F
Output:	1.0 millivolt/°F; 32°F = 32 mv., 100°F = 100 mv.; 3-wire configuration with constant current
Adjustment:	Zero, span and linearity (limited)
Accuracy:	± 0.1°F
Sensitivity:	0.01°F
Repeatability:	0.01°F
Calibration Date:	12/21/81

3. Dewpoint Temperature (6 sensors):

Dewpoint Temperature Systems - EG&G, Inc., Dewpoint Hygrometer, Model No. 660 with 6 sensors and signal conditioning.

Accuracy:	± 0.1°F
Sensitivity:	0.01°F
Repeatability:	0.05°F
Calibration Date:	12/18/81

4. Verification Flow (1 channel):

Volumetric thermal mass flow meter, TSI model No. 2013 S/N 1516

Range:	0-10.0 scfm
Accuracy:	± 1% F.S.
Sensitivity:	± 0.01 scfm
Repeatability:	± 0.01 scfm
Calibration date:	10/20/81

5. Drybulb and Dewpoint Temperature Sensor Volume Fractions (see Tables 1 and 2).

G. Information Retained at Plant

The following information is available for review at the facility:

1. Access control procedures established to limit ingress to containment during testing.

2. A listing of all containment penetrations, including the total number of like penetrations, penetration size, and function.

3. A listing of normal operating instrumentation used for the leakage rate test.

4. A system lineup (at time of test) showing required valve positions and status of piping systems.

5. A continuous, sequential log of events from initial survey of containment to restoration of all tested systems.

6. Documentation of instrumentation calibrations and standards (included with documentation should be an error analysis of instrumentation).

7. Data to verify temperature stabilization criteria as established by test procedure (Appendix B).

8. The working copy of the test procedure that includes signature sign-off of procedural steps.

9. The procedure and all data that verify completion of penetrations and valve testing (B&C-type tests) including as-found leak rates, corrective action taken, and final leak rate.

10. Computer printouts of ILRT data and manual data accumulation along with summary description of computer program (Appendix C).

11. The Quality Assurance audit plan or checklist used to monitor ILRT with proper sign-offs.

12. A listing of all test exceptions including changes in containment system boundaries instituted by licensee to conclude successful testing.

13. Description of sensor malfunctions, repairs, and methods used to redistribute volume fractions to operating instrumentation where applicable.

14. A review of confidence limits of test results with accompanying computer printouts where applicable.

15. Description of method of leakage rate verification of instrument measuring system (superimposed leakage), with calibration information on flow meters along with calculations used to measure the verification leakage rate (Appendixes F and G).

16. Plots presenting ILRT data obtained during the test (Appendix E).

17. The P&IDs of systems which penetrate the containment.

TABLE 1

CONTAINMENT TEMPERATURE AND DEWPOINT SENSOR LOCATIONS AND VOLUME FRACTIONS (ILRT)

RTD Instrument No.	Elevation	Azimuth (Degrees)	Distance from Center	Containment Volume Fraction
TE-N001-01	274'-0"	352	20'-0"	0.062
TE-N001-02	274'-0"	172	20'-0"	0.062
TE-N001-03	247'-9"	90	30'-8"	0.062
TE-N001-04	245'-9"	265	27'-6"	0.062
TE-N001-05	214'-4"	45	50'-6"	0.062
TE-N001-06	229'-2"	155	49'-8"	0.062
TE-N001-07	216'-0"	225	49'-8"	0.062
TE-N001-08	227'-0"	319	49'-0"	0.062
TE-N001-09	173'-0"	220	52'-0"	0.058
TE-N001-10	163'-0"	305	50'-8"	0.057
TE-N001-11	164'-6"	155	28'-8"	0.022
TE-N001-12	141'-6"	162	50'-3"	0.058
TE-N001-13	141'-2"	90	55'-6"	0.057
TE-N001-14	122'-2"	335	41'-2"	0.057
TE-N001-15	124'-0"	177	51'-6"	0.057
TE-N001-16	150'-6"	219	25'-4"	0.022
TE-N001-17	120'-0"	95	27'-8"	0.022
TE-N001-18	129'-0"	187	29'-0"	0.022
TE-N001-19	168'-0"	350	30'-3"	0.022
TE-N001-20	153'-5"	41	27'-3"	0.023
TE-N001-21	119'-9"	278	26'-9"	0.022
TE-N001-22	102'-6"	0	4'	0.005
				1.000

ME Instrument No.	Elevation	Azimuth (Degrees)	Distance from Center	Containment Volume Fraction
ME-N002-01	247'-9"	90	30'-8"	0.210
ME-N002-02	216'-0"	225	49'-9"	0.210
ME-N002-03	167'-0"	305	50'-8"	0.210
ME-N002-04	122'-2"	355	41'-2"	0.210
ME-N002-05	158'-5"	41	27'-3"	0.080
ME-N002-06	118'-2"	278	26'-9"	0.080
				1.000

TABLE 2

DRYWELL TEMPERATURE AND DEWPOINT SENSOR LOCATIONS AND VOLUME FRACTIONS (BYPASS TEST)

RTD Instrument No.	Elevation	Azimuth (Degrees)	Distance from Center	Drywell Volume Fraction
TE-N001-11	164'-6"	155	28'-8"	0.138
TE-N001-16	150'-6"	219	25'-4"	0.138
TE-N001-17	120'	95	27'-8"	0.138
TE-N001-18	129'	187	29'-0"	0.138
TE-N001-19	168'	350	30'-3"	0.138
TE-N001-20	153'-5"	41	27'-3"	0.138
TE-N001-21	119'-9"	278	26'-9"	0.138
TE-N001-22	102'-6"	0	4'-0"	0.034
				1.000

ME Instrument No.	Elevation	Azimuth (Degrees)	Distance from Center	Drywell Volume Fraction
ME-N002-05	158'-5"	41	27'-3"	0.5
ME-N002-06	118'-2"	278	26'-9"	0.5
				1.0

ILRT DATA ACQUISITION SYSTEM

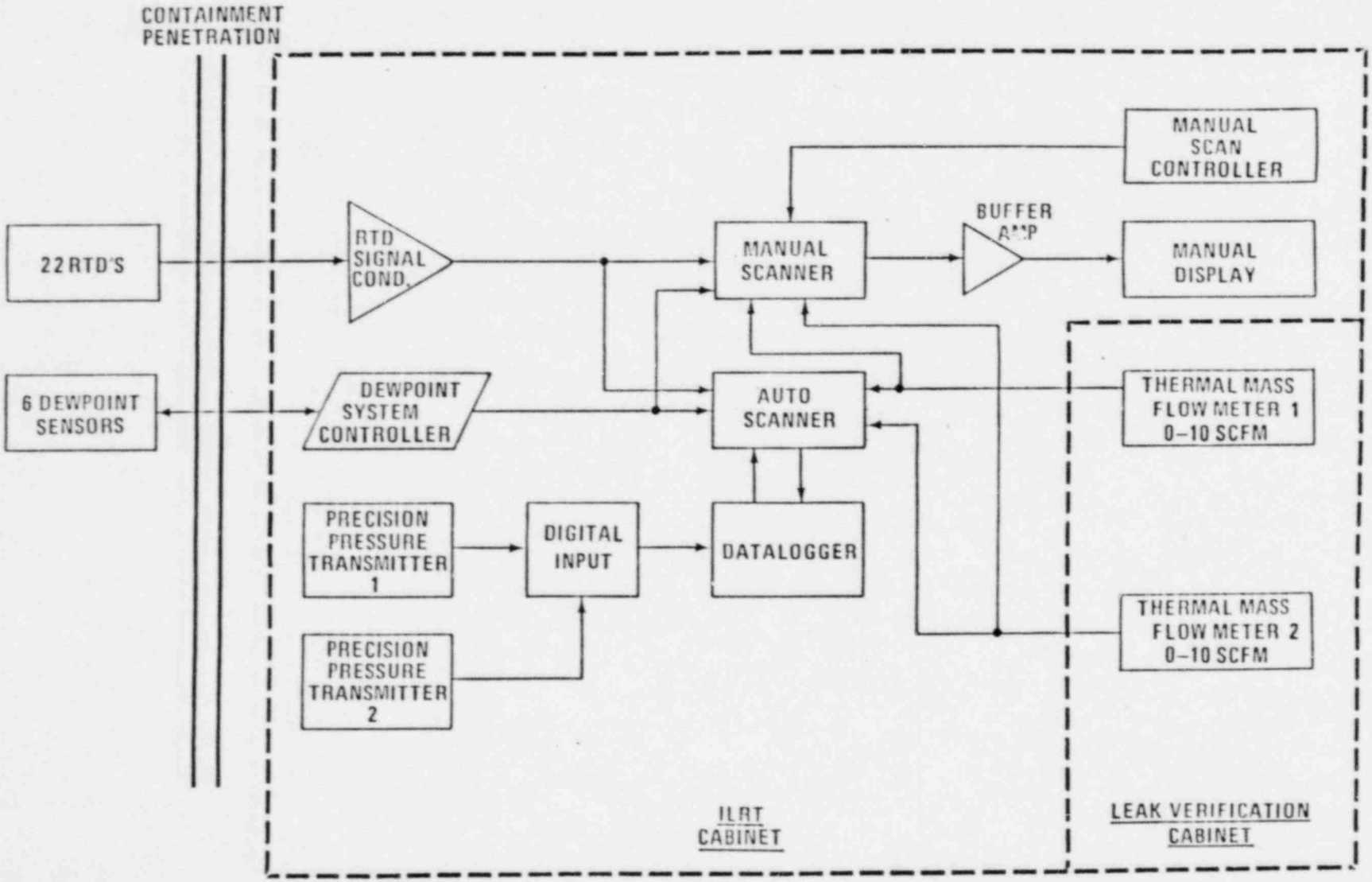


FIGURE 2

IV. ANALYSIS AND INTERPRETATION

A. This section is provided pursuant to ANSI/ANS 56.8-1981, Section 5.8.6, which requires analysis of leakage rate data and provides an interpretation of the test results to show proper compliance with acceptance criteria specified in ANSI/ANS 56.8-1981, 10CFR50, Appendix J, and the Grand Gulf Nuclear Station FSAR.

Several corrections must be added to the calculated results of the Unit 1 ILRT. The Plant Chilled Water System (Pen 38 + 39) was not in the post LOCA lineup position and therefore the LLRT result of 2.69 SCFH must be added to the ILRT calculated results. The seal systems on the upper and lower personnel locks required makeup flows of 0.12 and 0.005 SCFH respectively during the ILRT period. The total correction to be added to the calculated Type A leakage rate is 2.82 SCFH or 0.004%/day.

Pre-and post-test containment water level measurements indicated that the upper pool water volume had decreased by 574 cu ft from 1700 December 31, 1981, to 1200 January 5, 1982, and that the dry-well sump water volume had increased by 95 cu ft from 1000 January 3 to 1200 January 5, 1982. This resulted in a net water volume decrease rate of 74 cu ft per day. The indicated water volume change is most likely due to measurement accuracy. At any rate, a decrease in water volume would not mask an in-leakage, and therefore is not added as a correction.

The corrected and uncorrected Type A leakage rates are tabulated below:

		L_{am} wt%/day			95% UCL wt%/day		
		I	II	III	I	II	III
1.	ILRT/Mass Point	0.072	0.076	0.328	0.079	0.083	0.328
	ILRT/Total Time	0.068	0.072	0.328	0.139	0.143	0.328
2.	Verification/						
	Mass Point	0.431		0.327-0.545			
	Total Time	0.434		0.323-0.541			

where Column I = Uncorrected leakage rate calculated during ILRT.

Column II = Corrected leakage rate corresponding to Column I plus corrections.

Column III = Acceptance limits

The ILRT results at the upper 95% confidence level satisfy the acceptance criterion of $L_{am} < 0.75L_a = 0.328\%/day$, at $P_a = 11.5$ psig.

B. ISG CALCULATION

The ISG calculation provided below was performed according to the format specified in ANSI/ANS 56.8-1981, Appendix G.

a. Calibration Data

	Number of Sensors	Sensitivity, E	Repeatability, ϵ
Temperature, T	22	0.01°F (°R)	0.01°F (°R)
Pressure, P	1	0.001 psia	0.001 psia
Vapor Pressure (Dewpoint), Pv	6	0.01°F	0.05°F

b. Instrument Measurement Errors

1. Temperatures

$$e_T = [(E_T)^2 + (\epsilon_T)^2]^{1/2}/(\text{No. of Sensors})^{1/2}$$

$$= [(0.01)^2 + (0.01)^2]^{1/2}/(22)^{1/2}$$

$$= 0.003°F\ (°R)$$

2. Pressures

$$e_p = [(E_p)^2 + (\epsilon_p)^2]^{1/2}/(\text{No. of Sensors})^{1/2}$$

$$= [(0.001)^2 + (0.001)^2]^{1/2}/(1)^{1/2}$$

$$= 0.0014 \text{ psia}$$

3. Vapor Pressure

For a dewpoint temperature range of 68.25°F ± 0.05°F the average rate of change in dewpoint pressure is 0.0118 psi/°F, i.e.,

vapor pressure @ 68.3°F = 0.34243 psi
@ 68.2°F = 0.34125 psi
change for 0.1°F = 0.00118 psi

The sensitivity and repeatability in terms of pressure are:

$$E_{pv} = (0.0118 \text{ psi/°F})(0.01°F) = 0.000118 \text{ psi}$$

$$\epsilon_{pv} = (0.0118 \text{ psi/°F})(0.05°F) = 0.00059 \text{ psi}$$

Therefore,

$$e_{pv} = [(E_{pv})^2 + (\epsilon_{pv})^2]^{1/2}/(\text{No. of Sensors})^{1/2}$$

$$= [(0.000118)^2 + (0.00059)^2]^{1/2}/(6)^{1/2}$$

$$= 0.00025 \text{ psi}$$

c. ISG Calculation for 8 hour ILRT

$P = 12.27 \text{ psig} + 14.7 = 26.97 \text{ psia}$

$T = 77°F + 460 = 537°R$

$$ISG = \pm \frac{2400}{t}\left[2\left(\frac{e_p}{P}\right)^2 + 2\left(\frac{e_{pv}}{P}\right)^2 + 2\left(\frac{e_t}{T}\right)^2\right]^{1/2}$$

$$ISG = \pm \frac{2400}{8}\left[2\left(\frac{0.0014}{26.97}\right)^2 + 2\left(\frac{0.00025}{26.97}\right)^2 + 2\left(\frac{0.003}{537}\right)^2\right]^{1/2}$$

$$= \pm 300\ (0.54 \times 10^{-8} + 0.0169 \times 10^{-8} + 0.006 \times 10^{-8})^{1/2}$$

$$= \pm 300\ (0.75 \times 10^{-4})$$

$$= 0.0225 \text{ wt.\%/day}$$

$25\%\ La = 0.437 \times 0.25 = 0.10925 \text{ wt.\%/day}$

$0.0225 \leq 0.10925$ meets the criterion of ANSI/ANS 56.8-1981 and BN-TOP-1.

V. COMPUTER REPORT AND DATA PRINTOUT

A. MASS POINT REPORT

The Mass Point Report presents leakage rate data (wt%/day) as determined by the Mass Point Method described in the "Computer Program" section of this report. 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 values, determined from the Equation of State, are used in the regression analysis.

B. 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 used in the above regression analysis.

C. TREND REPORT

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

D. 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 five column headings are TIME, DATE, TEMP, PRESSURE, and VPRS, 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 (°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).

E. SUMMARY OF MEASURED DATA AND SUMMARY OF CORRECTED DATA

The Summary of Measured Data presents the individual containment atmosphere drybulb temperatures, dewpoint temperatures, and absolute total pressure measured at the time and date as indicated and is used to determine the temperature and pressure described in V.D.3-5 above.

1. TEMP 1 through TEMP 22 are the drybulb temperatures. The values in the right-hand column are temperatures (°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 (°R).

2. PRES 1 is the total pressure, absolute. 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 6 are the dewpoint temperatures (water vapor pressures). The values in the right-hand column are temperatures (°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 (°F) is the volume weighted average containment atmosphere drybulb temperature (refer to Section III, Tables 1 and 2, for sensor volume fractions) derived from TEMP 1 through TEMP 22.

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 PRES 1, 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 (refer to Section III, Tables 1 and 2 for sensor volume fractions), derived from VPRS 1 through VPRS 6.

4. 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 CORRRECTED PRESSURE of the dry air.

Note: This printout is not included in the report, but is retained at the facility.

APPENDIX A

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, containment atmosphere total pressure, drybulb temperature, and dewpoint temperature (water vapor pressure). Leakage rate is computer 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. The first printout, the Total Time Report, is based on the Total Time Method described in BN-TOP-1. 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 fuction of number of data points and elapsed time (test duration). The Trend Report provides all leakage rate values required for comparision to the acceptance criteria of BN-TOP-1 for conduct of a short duration test.

5. The program is written in a high level language and is designed for use on a mini-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 the start of the test:

   a. Number of containment atmosphere drybulb temperature sensors and dewpoint temperature (water vapor pressure) sensors 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 sensor, if required

   d. Calibration data for pressure sensor.

3. Information entered into the program at the start of the test:

   a. Test title

   b. Current test pressure and peak test pressure

   c. Maximum allowable leakage rate at peak test pressure

   d. If the test is a verification test:

      (1) Imposed leakage rate

      (2) Leakage rates determined using the two computational methods described in Paragraph A above during the ILRT.

4. Data received from the data acquistion system during the test, and used to compute leakage rates:

   a. Time and date

   b. Containment atmosphere drybulb temperatures

   c. Containment atmosphere pressure

   d. Containment atmosphere dewpoint temperatures

5. 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 on the data terminal. The date, containment atmosphere weighted average drybulb temperature, partial pressure of the dry air and water vapor pressure are stored on a data file.

6. 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:

$$P_1V = W_1RT_1 \quad (1)$$

$$P_iV = W_iRT_i \quad (2)$$

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

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

$$L_i = 2400/\Delta t_i(1-T_1P_i/T_iP_1) \quad (4)$$

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 = Containment free air volume (assumed to be constant during the test), ft^3.

t_1, t_i = Time at 1^{st} and i^{th} data points respectively, hours.

Δt_i = Elapsed time from t_1 to t_i, hours.

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, %/day.

b. Calculated leakage rate from regression analysis:

$$\overline{L} = a + b\Delta t_N \tag{5}$$

where:

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

$$a = \frac{\Sigma L_i(\Sigma \Delta t_i^2) - \Sigma \Delta t_i(\Sigma L_i \Delta t_i)}{N(\Sigma \Delta t_i^2) - (\Sigma \Delta t_i)^2} \tag{6}$$

$$b = \frac{N(\Sigma L_i \Delta t_i) - \Sigma L_i(\Sigma \Delta t_i)}{N(\Sigma \Delta t_i^2) - (\Sigma \Delta t_i)^2} \tag{7}$$

N = Number of data points

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

c. Calculated leakage rate at the 95% confidence level.

$$\overline{L}_{95} = a + b\Delta t_N + S_{\overline{L}} \tag{8}$$

where:

$\overline{L}_{95}$ = Calculated leakage rate at the 95% confidence level, %/day, at elapsed time Δt_N.

For $\Delta t_N < 24$

$$S_{\overline{L}} = t_{0.025;N-2}\,[\Sigma(L_i-\overline{L}_i)^2/(N-2)]^{1/2} \times [1 + \frac{1}{N} + (\Delta t_N-\overline{\Delta t})^2/\Sigma(\Delta t_i-\overline{\Delta t})^2]^{1/2} \tag{9a}$$

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

For $\Delta t_N \geq 24$

$$S_{\overline{L}} = t_{0.025;N-2}\,[\Sigma(L_i - \overline{L}_i)^2/(N-2)]^{1/2} \times [\frac{1}{N} + (\Delta t_N - \overline{\Delta t})^2/\Sigma(\Delta t_i - \overline{\Delta t})^2]^{1/2} \tag{9b}$$

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

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

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

2. Computation using the Mass Point Method

a. Contained mass of dry air from data:

$$W_i = 144 \frac{P_i V}{R T_i} \tag{10}$$

where:

All symbols as previously defined.

b. Calculated leakage rate from regression analysis:

$$\bar{L} = -2400 \frac{b}{a} \tag{11}$$

where:

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

$$a = \frac{\Sigma W_i - b\Sigma\Delta t_i}{N} \tag{12}$$

$$b = \frac{\Sigma[(W_i - \Sigma W_i/N)\ (\Delta t_i - \overline{\Delta t})]}{\Sigma(\Delta t_i - \overline{\Delta t})^2} \tag{13}$$

Δt_i = Total elapsed time at time of i^{th} data point, hours

N = Number of data points

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

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

$$\overline{\Delta t} = \Sigma\Delta t_i/N$$

c. Calculated leakage rate at the 95% confidence level.

$$\bar{L}_{95} = \frac{-2400}{a}(b + S_b) \tag{14}$$

where:

$\bar{L}_{95}$ = Calculated leakage rate at the 95% confidence level, %/day.

$$S_b = t_{0.025;N-2} \left[\frac{\Sigma(W_i - \overline{W_i})^2}{(N-2)\Sigma(\Delta t_i - \overline{\Delta t})^2} \right]^{1/2} \quad (15)$$

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

$\overline{W}_i$ = Contained mass of dry air, lbm, computed at the i^{th} data point from the regression equation (16)

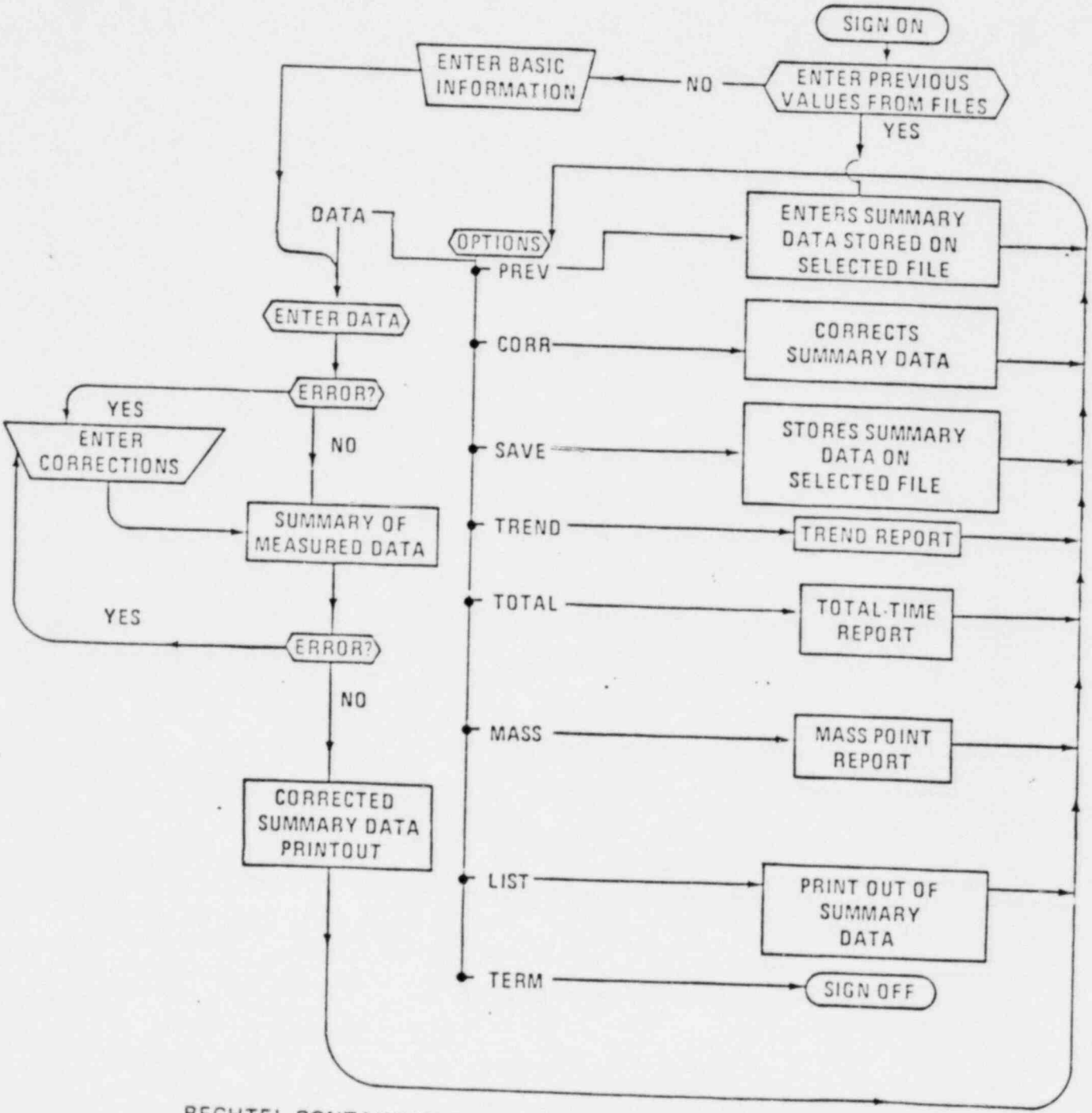
$= a + b\Delta t_i$

All other symbols are previously defined.

D. Program Logic

1. A flow chart of Bechtel ILRT computer program usage is presented in Figure 1, following. The various user options and a brief description of their associated function are presented below:

OPTION COMMAND	FUNCTION
DATA	Enables operator 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, date, average temperature, partial pressure of dry air, and water vapor pressure is printed.
TREND	Terminal will print out a Trend Report.
TOTAL	Terminal will print out a Total Time Report.
MASS	Terminal will print out a Mass Point Report.
TERM	Enables operator to sign-off temporarily or permanently.
SAVE	Enables operator to store the Data Summary on a file.
PREV	Enables operator to call up an old, previously stored, file.
CORR	Enables operator to correct data stored on a file.
LIST	When used with a given file name, the printer will print out a list of the Summary Data stored on the file.
READ	Enable the computer to receive the next set of raw data from the data acquisition system directly.



BECHTEL CONTAINMENT INTEGRATED LEAKAGE RATE TEST
COMPUTER PROGRAM FLOW CHART
FIGURE 1

APPENDIX B
ILRT STABILIZATION DATA

TEST.STA
GRAND GULF STABILIZATION
ALMAX = 0.437 VOL = 1670000.00
VRATET = 0.000 VRATEM = 0.000 VRATEP = 0.000

TIME	DATE	TEMP	PRESSURE	VPRS
1529	103	537.56366	26.425938	0.34851480
1545	103	537.01373	26.402582	0.34475750
1603	103	536.61597	26.383574	0.34468400
1615	103	536.46893	26.377193	0.34303159
1630	103	536.30707	26.368984	0.34320599
1645	103	536.20459	26.363253	0.34291309
1700	103	536.09918	26.357325	0.34281561
1715	103	536.03223	26.353136	0.34298769
1730	103	535.95685	26.348457	0.34264520
1745	103	535.88330	26.344131	0.34295520
1800	103	535.82629	26.340103	0.34296569
1815	103	535.76117	26.337587	0.34246781
1830	103	535.70874	26.334372	0.34267199
1845	103	535.66150	26.332005	0.34202629
1900	103	535.61688	26.329777	0.34224480
1915	103	535.56860	26.327791	0.34222180
1930	103	535.54742	26.324705	0.34229621
1945	103	535.43054	26.323195	0.34179929
2000	103	535.44885	26.320612	0.34237379
2015	103	535.40631	26.318562	0.34241500

APPENDIX C
ILRT SUMMARY DATA

TEST.DAT

GRAND GULF ILRT

ALMAX = 0.437 VOL = 1670000.00

VRATET = 0.000 VRATEM = 0.000 VRATEP = 0.000

TIME	DATE	TEMP	PRESSURE	VPRS
2030	103	535.38818	26.316441	0.34252653
2045	103	535.37219	26.315517	0.34244490
2100	103	535.34686	26.313202	0.34275225
2115	103	535.32245	26.311718	0.34222719
2130	103	535.28601	26.310568	0.34237543
2145	103	535.26984	26.309896	0.34204134
2200	103	535.23566	26.307184	0.34274417
2215	103	535.21973	26.304913	0.34300748
2230	103	535.19214	26.304295	0.34262270
2245	103	535.16925	26.302761	0.34315175
2300	103	535.14685	26.301828	0.34307989
2315	103	535.11749	26.300154	0.34274691
2330	103	535.10406	26.299398	0.34249672
2345	103	535.09546	26.299583	0.34231171
0	104	535.06689	26.296225	0.34366253
15	104	535.05304	26.297117	0.34277007
30	104	535.03369	26.295589	0.34329468
45	104	535.01672	26.293724	0.34415492
100	104	534.99390	26.293665	0.34321022
115	104	534.98413	26.292389	0.34348071
130	104	534.96783	26.291492	0.34337339
145	104	534.96344	26.290226	0.34363529
200	104	534.94757	26.289938	0.34392363
215	104	534.93909	26.288767	0.34409159
230	104	534.92371	26.287523	0.34432954
245	104	534.91162	26.287708	0.34414417
300	104	534.89838	26.286375	0.34447473
315	104	534.89233	26.285236	0.34460890
330	104	534.87921	26.285433	0.34441105
345	104	534.86578	26.284437	0.34440356
400	104	534.85150	26.283850	0.34499204
415	104	534.84827	26.283432	0.34440419
430	104	534.82874	26.283085	0.34475130

APPENDIX D
ILRT CALCULATIONS

GRAND GULF ILRT

LEAKAGE RATE (WEIGHT PERCENT/DAY)
MASS-POINT ANALYSIS

TIME AND DATE AT START OF TEST: 2030 01/13
ELAPSED TIME: 8.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LBM)	MASS LOSS (LBM)	TOT.AVG. MASS LOSS (LBM/HR)
2030	535.388	26.3164	221566.		
2045	535.372	26.3155	221565.	1.1	4.6
2100	535.347	26.3132	221556.	9.0	20.3
2115	535.322	26.3117	221553.	2.4	16.8
2130	535.286	26.3106	221559.	-5.4	7.2
2145	535.270	26.3099	221560.	-1.0	4.9
2200	535.236	26.3072	221551.	8.7	9.9
2215	535.220	26.3049	221539.	12.5	15.6
2230	535.192	26.3043	221545.	-6.2	10.6
2245	535.169	26.3028	221541.	3.4	10.9
2300	535.147	26.3018	221543.	-1.4	9.3
2315	535.117	26.3002	221541.	1.9	9.1
2330	535.104	26.2994	221540.	0.8	8.6
2345	535.095	26.2996	221545.	-5.1	6.4
0	535.067	26.2962	221529.	16.5	10.6
15	535.053	26.2971	221542.	-13.3	6.4
30	535.034	26.2956	221537.	4.9	7.2
45	535.017	26.2937	221528.	8.7	8.8
100	534.994	26.2937	221537.	-9.0	6.4
115	534.984	26.2924	221531.	6.7	7.4
130	534.968	26.2915	221530.	0.8	7.2
145	534.963	26.2902	221521.	8.9	8.6
200	534.948	26.2899	221525.	-4.2	7.4
215	534.939	26.2888	221519.	6.4	8.2
230	534.924	26.2875	221515.	4.1	8.5
245	534.912	26.2877	221521.	-6.6	7.2
300	534.898	26.2864	221515.	5.9	7.8
315	534.892	26.2852	221508.	7.1	8.5
330	534.879	26.2854	221515.	-7.1	7.2
345	534.866	26.2844	221513.	2.8	7.4
400	534.852	26.2838	221514.	-1.0	7.0
415	534.848	26.2834	221511.	2.2	7.0
430	534.829	26.2831	221517.	-5.2	6.2

FREE AIR VOLUME USED (MILLIONS OF CU. FT.) = 1.670

REGRESSION LINE
INTERCEPT (LBM) = 221561.
SLOPE (LBM/HR) = -6.7

MAXIMUM ALLOWABLE LEAKAGE RATE = 0.437
75 % OF MAXIMUM ALLOWABLE LEAKAGE RATE = 0.328
THE UPPER 95% CONFIDENCE LIMIT = 0.079
THE CALCULATED LEAKAGE RATE = 0.072

GRAND GULF ILRT

LEAKAGE RATE (WEIGHT PERCENT/DAY)
TOTAL-TIME ANALYSIS

TIME AND DATE AT START OF TEST: 2030 0103
ELAPSED TIME: 8.00 HOURS

TIME	TEMP. (R)	PRESSURE (PSIA)	MEASURED LEAKAGE RATE
2030	535.388	26.3164	
2045	535.372	26.3155	0.050
2100	535.347	26.3132	0.220
2115	535.322	26.3117	0.181
2130	535.286	26.3106	0.078
2145	533.270	26.3099	0.053
2200	535.236	26.3072	0.107
2215	535.220	26.3049	0.169
2230	535.192	26.3043	0.115
2245	535.169	26.3028	0.118
2300	535.147	26.3018	0.100
2315	535.117	26.3002	0.099
2330	535.104	26.2994	0.094
2345	535.095	26.2996	0.069
0	535.067	26.2962	0.115
15	535.053	26.2971	0.069
30	535.034	26.2956	0.078
45	535.017	26.2937	0.096
100	534.994	26.2937	0.069
115	534.984	26.2924	0.081
130	534.968	26.2915	0.078
145	534.963	26.2902	0.093
200	534.948	26.2899	0.080
215	534.939	26.2888	0.089
230	534.924	26.2875	0.093
245	534.912	26.2877	0.078
300	534.898	26.2864	0.084
315	534.892	26.2852	0.092
330	534.879	26.2854	0.078
345	534.866	26.2844	0.080
400	534.852	26.2838	0.076
415	534.848	26.2834	0.076
430	534.829	26.2831	0.067

MEAN OF MEASURED LEAKAGE RATES	=	0.095
MAXIMUM ALLOWABLE LEAKAGE RATE	=	0.437
75 % OF MAXIMUM ALLOWABLE LEAKAGE RATE	=	0.328
THE UPPER 95% CONFIDENCE LIMIT	=	0.139
THE CALCULATED LEAKAGE RATE	=	0.068

GRAND GULF ILRT

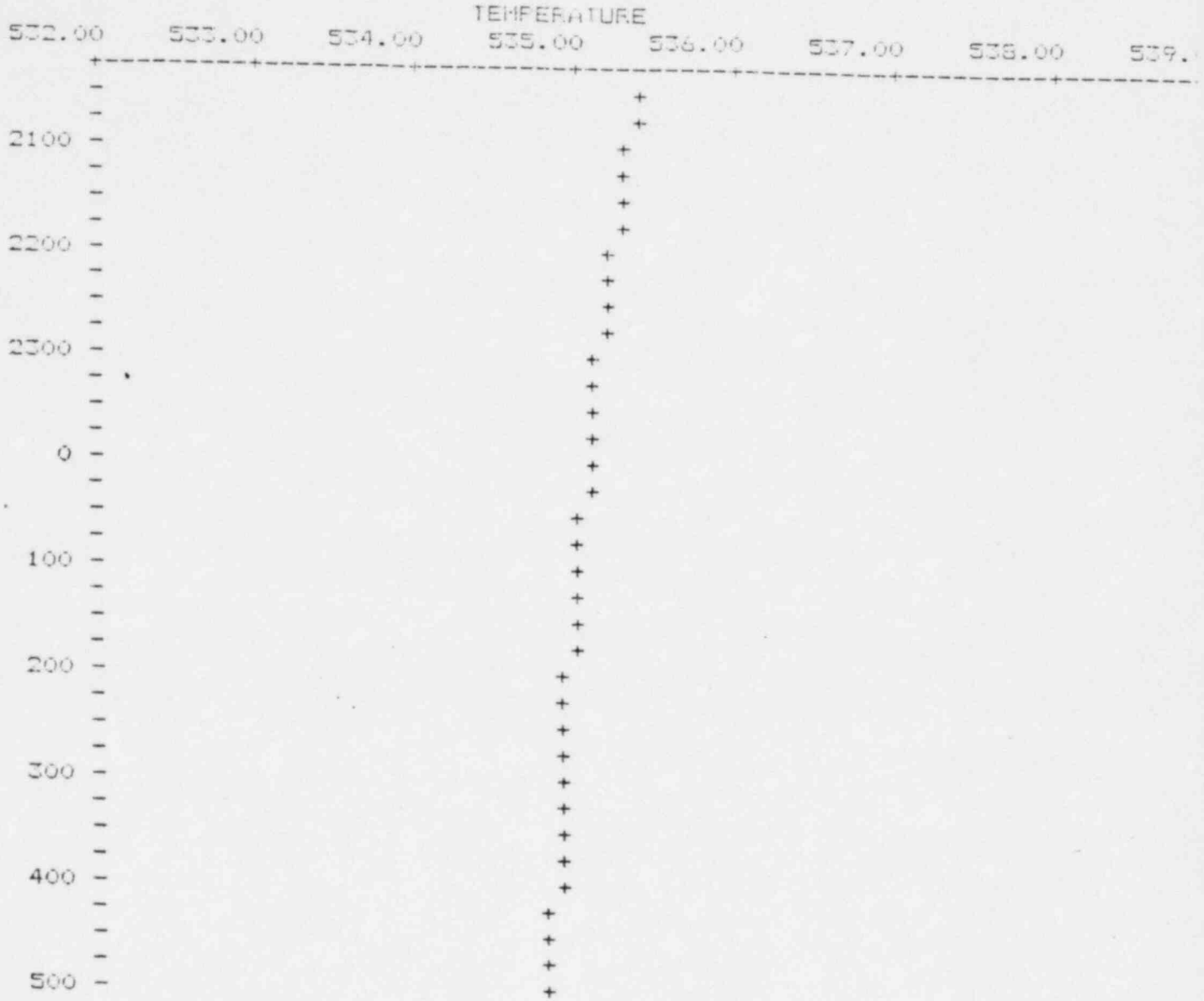
TREND REPORT
LEAKAGE RATES (WEIGHT PERCENT/DAY)

TIME AND DATE AT START OF TEST: 2030 0103
ELAPSED TIME: 9.00 HOURS

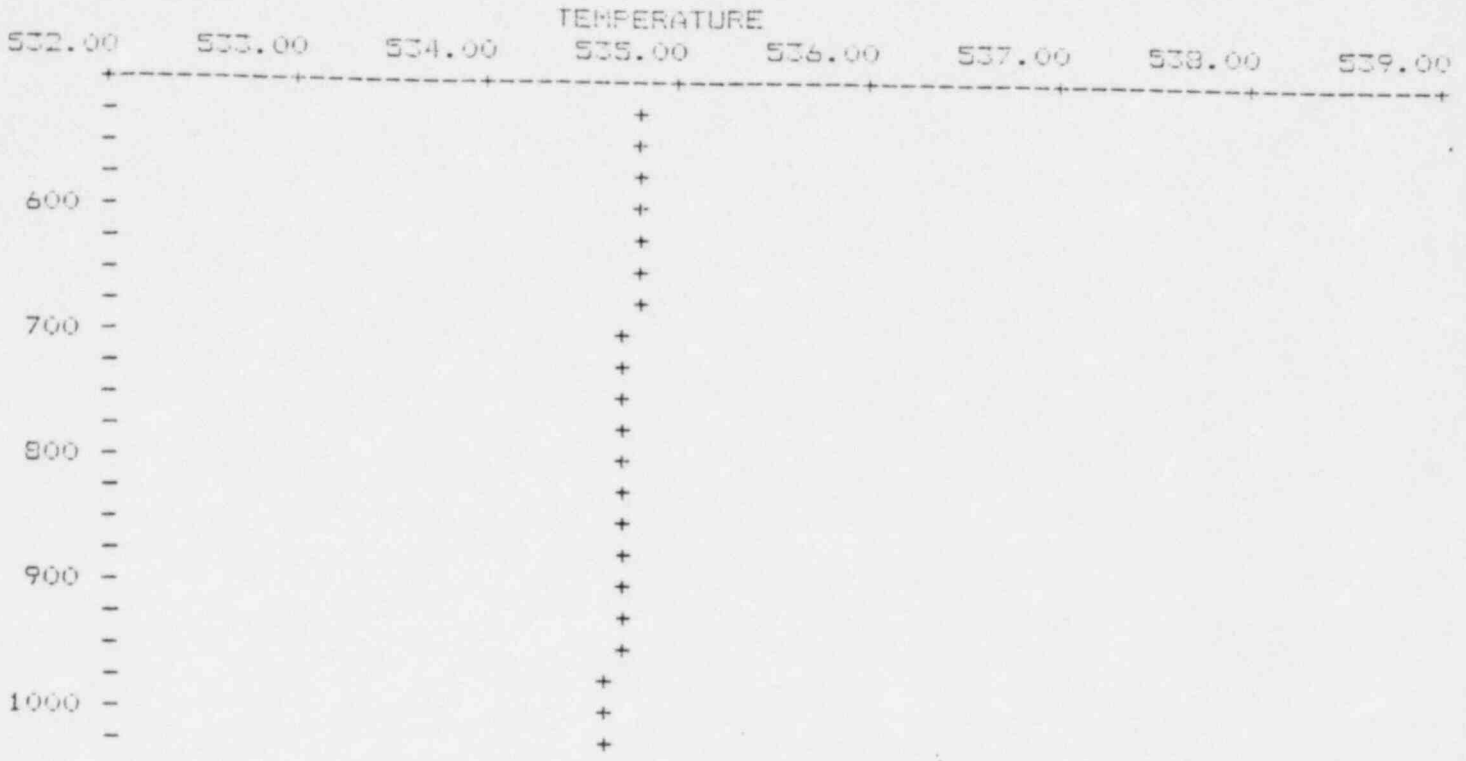
NO. DATA POINTS	ELAPSED TIME	TOTAL-TIME ANALYSIS MEAN	TOTAL-TIME ANALYSIS CALCULATED	MASS-POINT ANALYSIS CALCULATED	MASS-POINT ANALYSIS 95% UCL
10	2.25	0.121	0.119	0.119	0.162
11	2.50	0.119	0.112	0.110	0.146
12	2.75	0.117	0.107	0.104	0.134
13	3.00	0.115	0.101	0.098	0.124
14	3.25	0.112	0.091	0.085	0.111
15	3.50	0.112	0.094	0.093	0.116
16	3.75	0.109	0.086	0.083	0.105
17	4.00	0.107	0.082	0.079	0.099
18	4.25	0.107	0.082	0.081	0.099
19	4.50	0.105	0.077	0.075	0.092
20	4.75	0.103	0.075	0.074	0.089
21	5.00	0.102	0.073	0.073	0.087
22	5.25	0.102	0.074	0.075	0.088
23	5.50	0.101	0.073	0.075	0.086
24	5.75	0.100	0.073	0.076	0.087
25	6.00	0.100	0.074	0.078	0.088
26	6.25	0.099	0.073	0.077	0.086
27	6.50	0.098	0.073	0.077	0.086
28	6.75	0.098	0.074	0.079	0.087
29	7.00	0.097	0.073	0.078	0.085
30	7.25	0.097	0.072	0.077	0.084
31	7.50	0.096	0.071	0.076	0.083
32	7.75	0.095	0.070	0.075	0.081
33	8.00	0.095	0.068	0.072	0.079

APPENDIX E
ILRT PLOTS

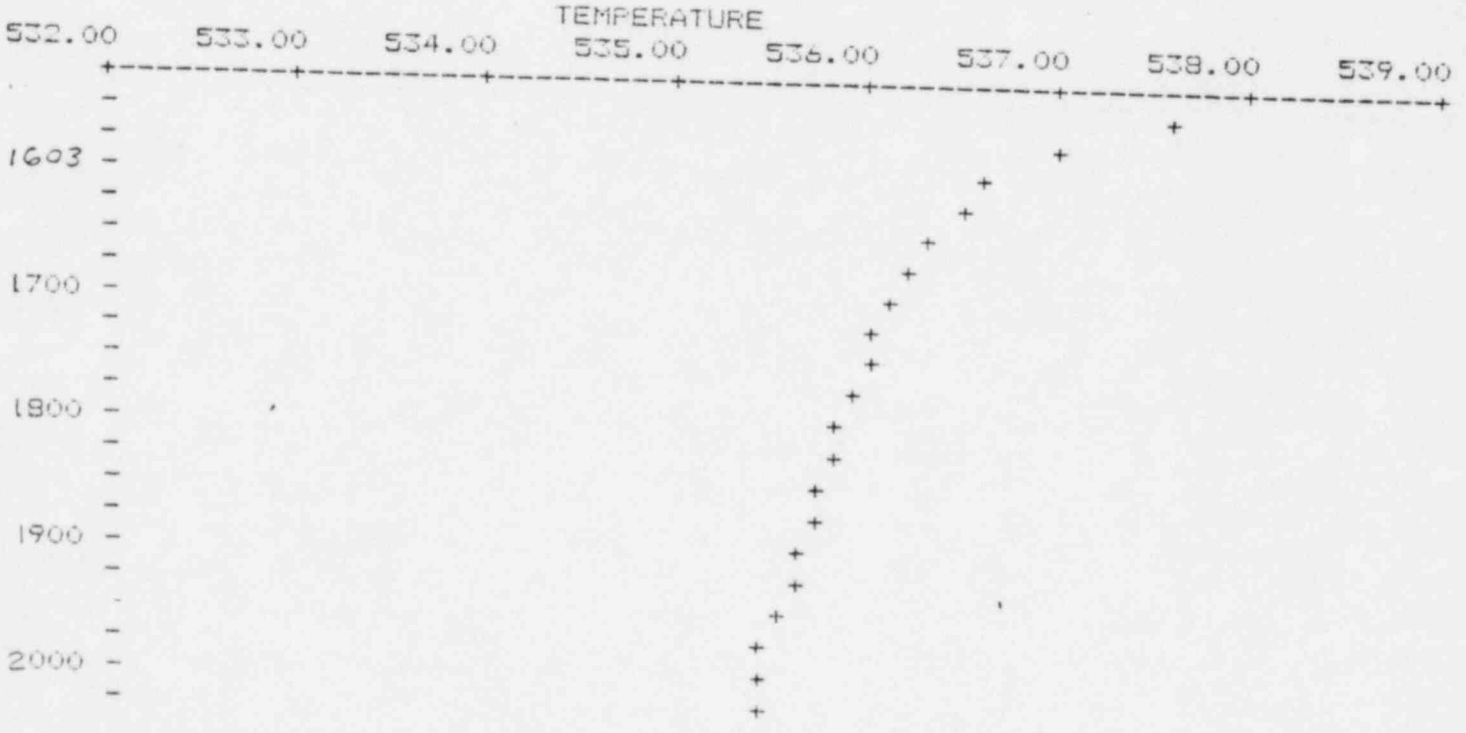
ILRT



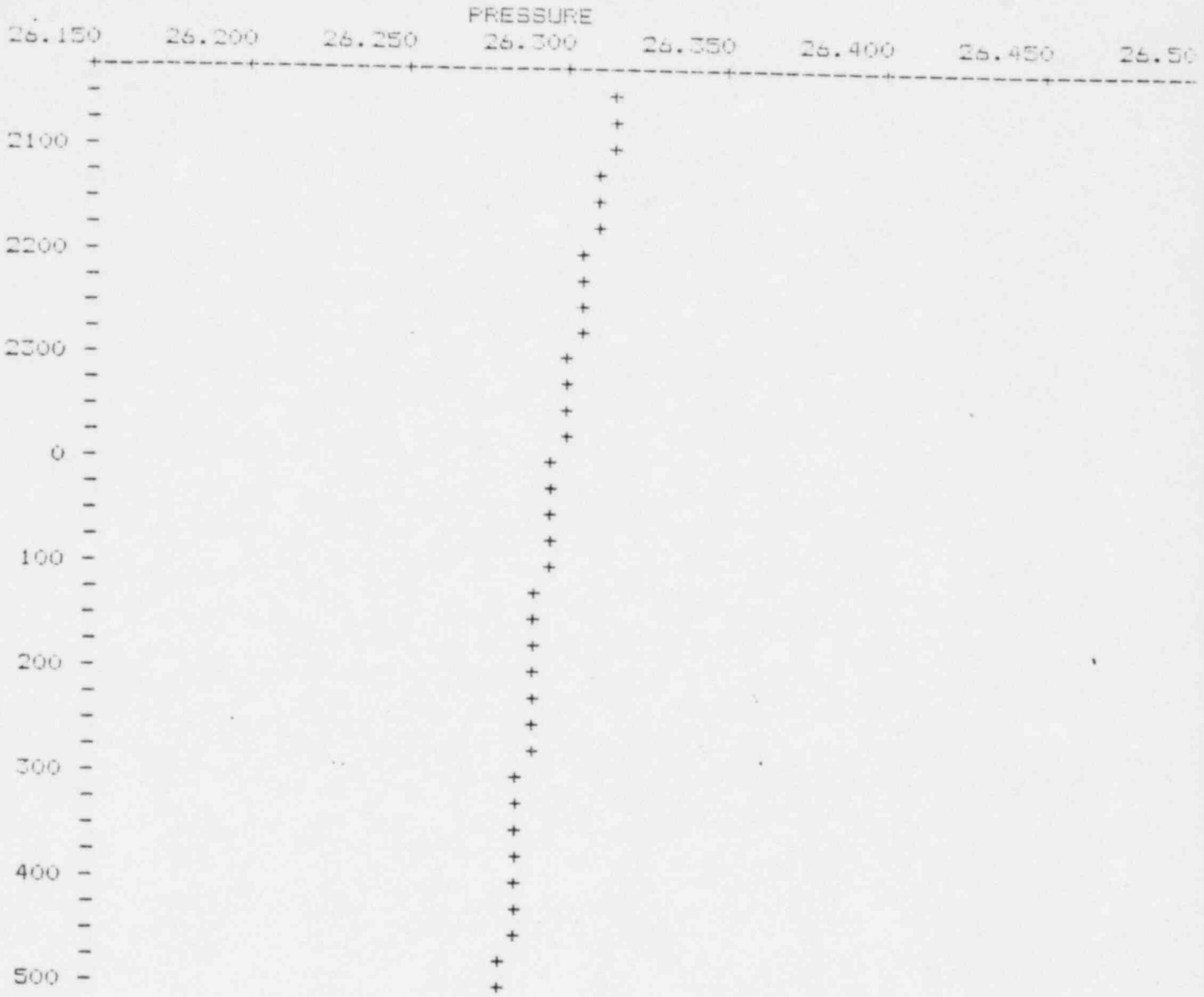
VERIFICATION



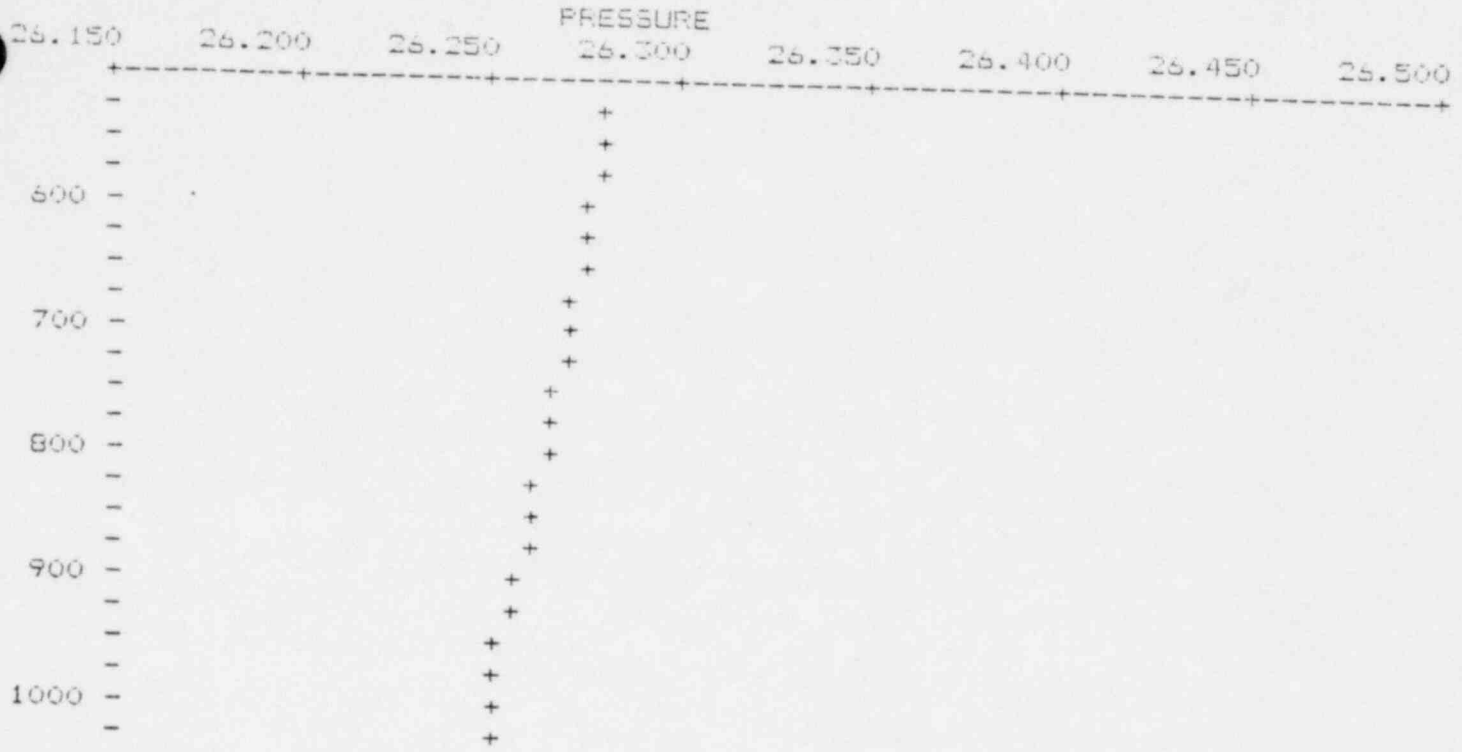
STABILIZATION



ILRT


PRESSURE
26.150
26.200
26.250
26.300
26.350
26.400
26.450
26.50
2100
2200
2300
0
100
200
300
400
500

VERIFICATION



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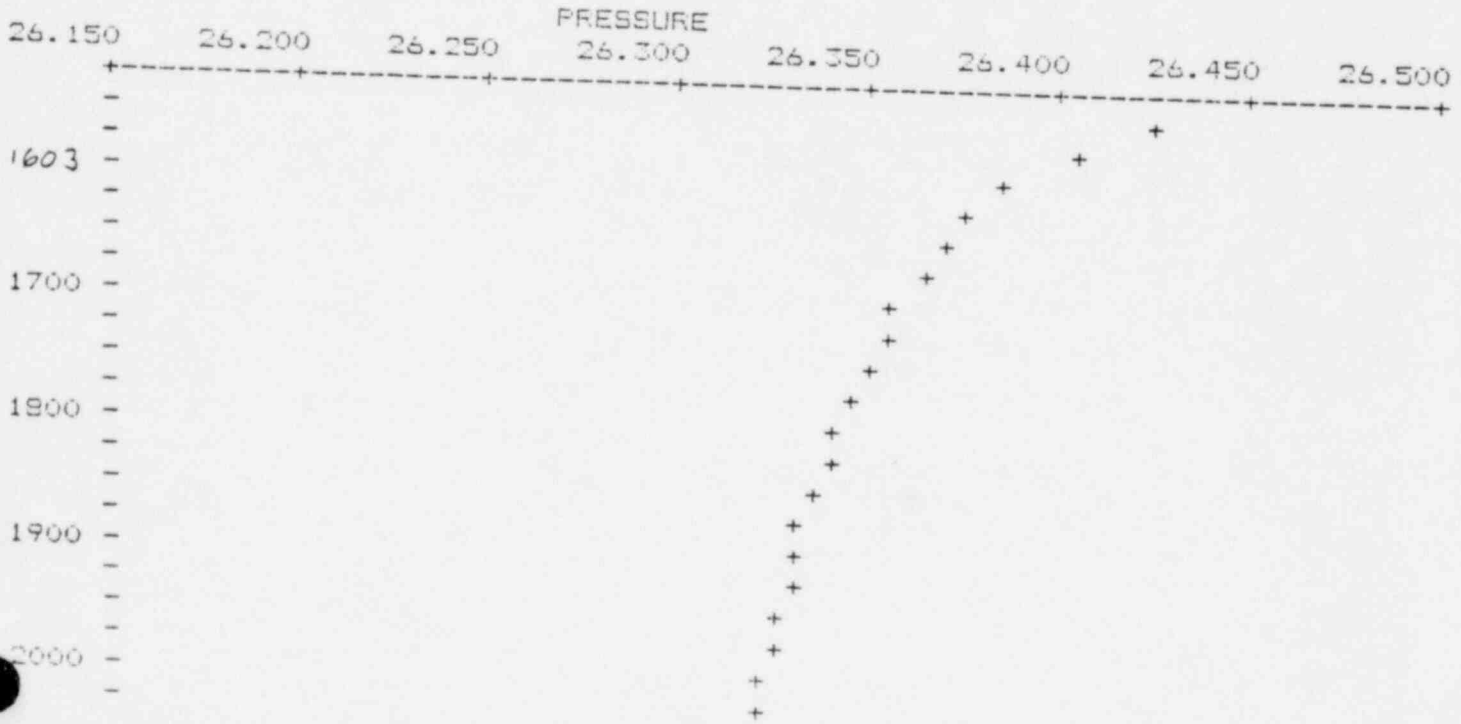
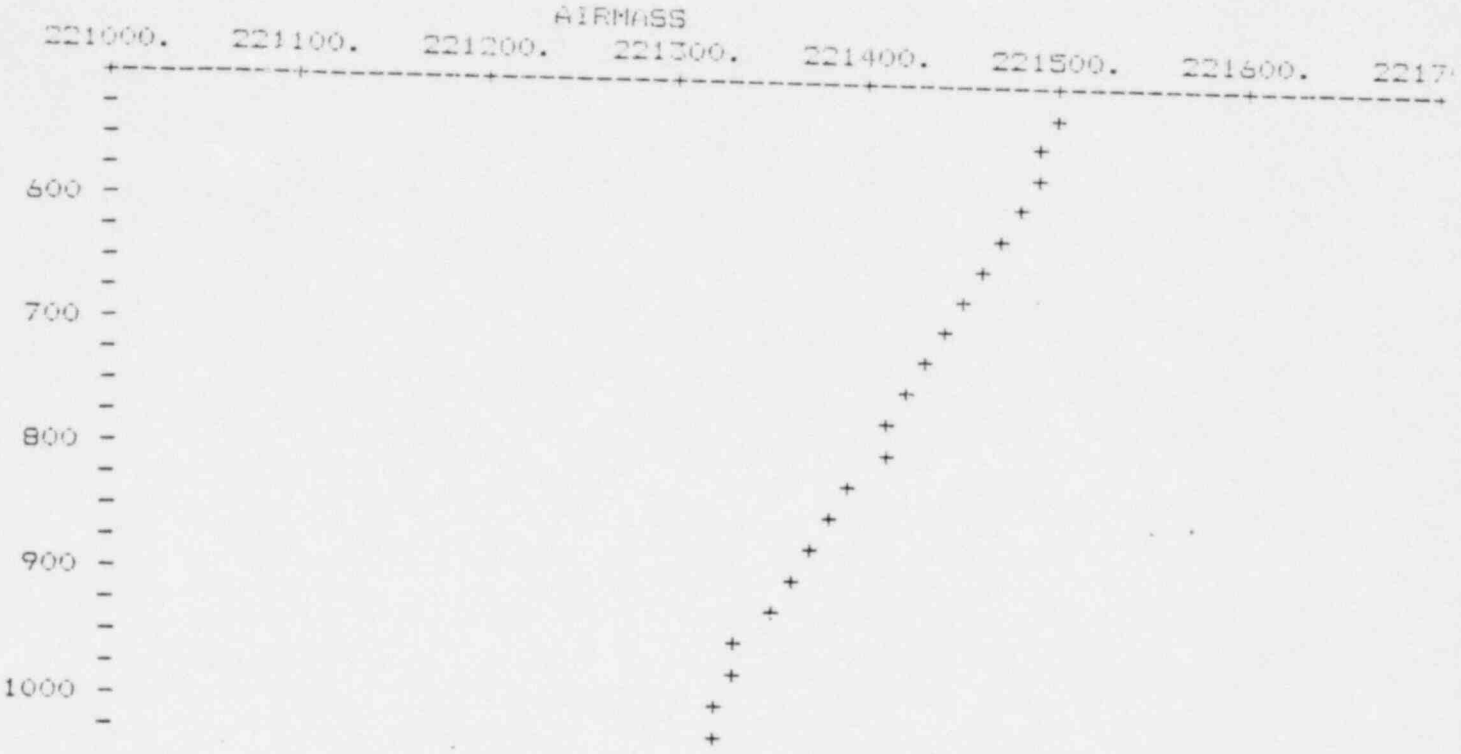


ILRT


AIRMASS
221000.
221100.
221200.
221300.
221400.
221500.
221600.
2100
2200
2300
0
100
200
300
400
500

VERIFICATION



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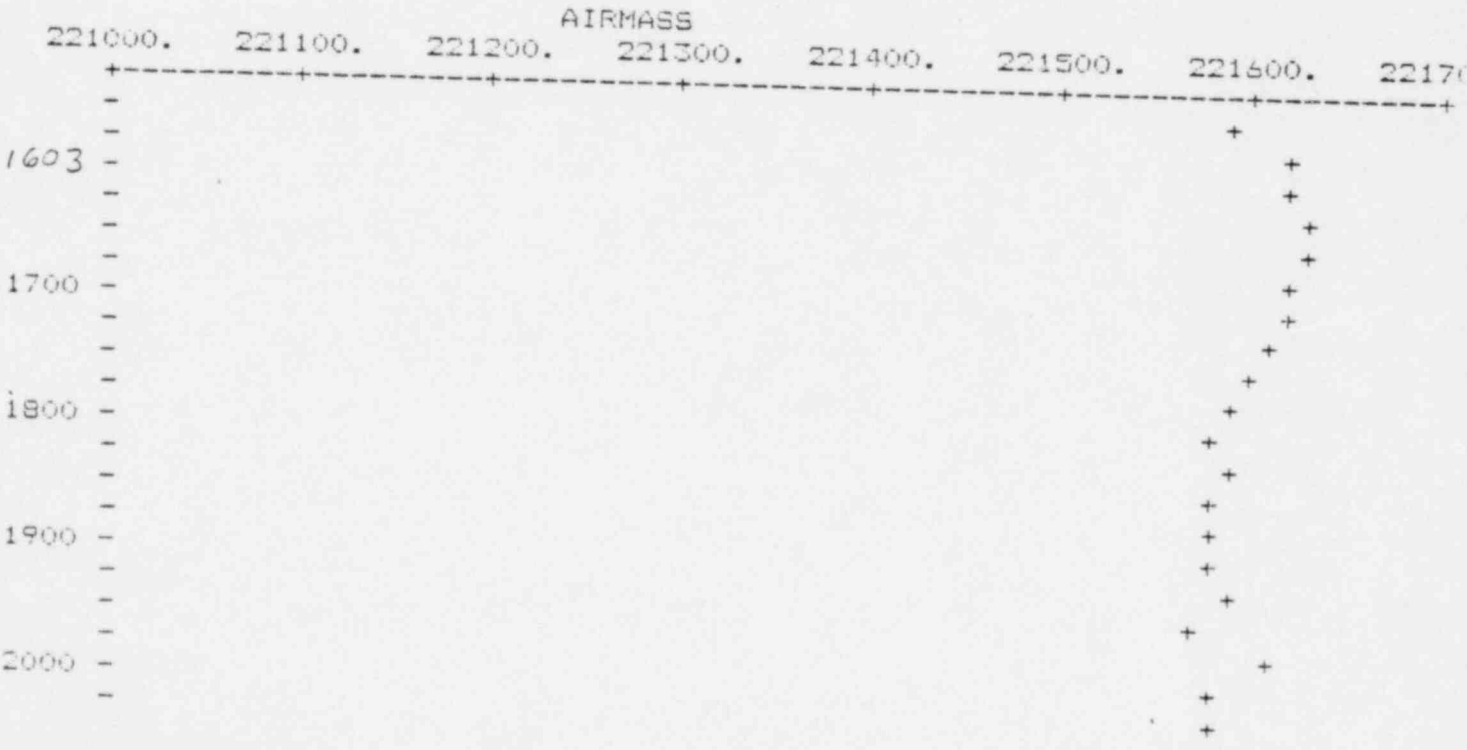

APPENDIX F
VERIFICATION FLOW TEST

SUMMARY DATA

TEST.VER
GRAND GULF VERIFICATION
ALMAX = 0.437 VOL = 1670000.00
VRATET = 0.432 VRATEM = 0.436 VRATEP = 0.364

TIME	DATE	TEMP	PRESSURE	VPRS
515	104	534.80566	26.280268	0.34556079
530	104	534.79596	26.278370	0.34544951
545	104	534.78748	26.277615	0.34520060
600	104	534.77368	26.276218	0.34559339
615	104	534.76746	26.274252	0.34554970
630	104	534.75714	26.272772	0.34602681
645	104	534.76361	26.272007	0.34578761
700	104	534.74396	26.269663	0.34612215
715	104	534.73499	26.268349	0.34643370
730	104	534.73236	26.267462	0.34631500
745	104	534.72797	26.265524	0.34624526
800	104	534.71405	26.264580	0.34618655
815	104	534.70410	26.262316	0.34644118
830	104	534.69879	26.261040	0.34671304
845	104	534.68665	26.259174	0.34656873
900	104	534.68726	26.257030	0.34670511
915	104	534.67273	26.256052	0.34667951
930	104	534.65894	26.252333	0.34738570
945	104	534.64771	26.252180	0.34753838
1000	104	534.64069	26.250376	0.34733403
1015	104	534.63062	26.249893	0.34681413

APPENDIX G
VERIFICATION FLOW TEST CALCULATIONS

GRAND GULF VERIFICATION

LEAKAGE RATE (WEIGHT PERCENT/DAY)
MASS-POINT ANALYSIS

TIME AND DATE AT START OF TEST: 615 0104
ELAPSED TIME: 4.00 HOURS

TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LBM)	MASS LOSS (LBM)	TOT.AVG. MASS LOSS (LBM/HR)
615	534.767	26.2743	221467.		
630	534.757	26.2728	221459.	8.2	32.8
645	534.764	26.2720	221450.	9.1	34.7
700	534.744	26.2697	221439.	11.6	38.6
715	534.735	26.2683	221431.	7.4	36.3
730	534.732	26.2675	221425.	6.4	34.2
745	534.728	26.2655	221410.	14.5	38.1
800	534.714	26.2646	221408.	2.2	34.0
815	534.704	26.2623	221393.	15.0	37.2
830	534.699	26.2610	221385.	8.6	36.9
845	534.687	26.2592	221374.	10.7	37.5
900	534.687	26.2570	221356.	18.3	40.7
915	534.673	26.2561	221353.	2.2	38.1
930	534.659	26.2523	221329.	25.6	43.0
945	534.648	26.2522	221331.	-3.4	39.0
1000	534.641	26.2504	221319.	12.3	39.7
1015	534.631	26.2499	221319.	-0.1	37.2

FREE AIR VOLUME USED (MILLIONS OF CU. FT.) = 1.670

REGRESSION LINE
INTERCEPT (LBM) = 221471.
SLOPE (LBM/HR) = -39.8

VERIFICATION TEST LEAKAGE RATE UPPER LIMIT = 0.545
VERIFICATION TEST LEAKAGE RATE LOWER LIMIT = 0.327
THE CALCULATED LEAKAGE RATE = 0.431

GRAND GULF VERIFICATION

LEAKAGE RATE (WEIGHT PERCENT/DAY)
TOTAL-TIME ANALYSIS

TIME AND DATE AT START OF TEST: 615 0104
ELAPSED TIME: 4.00 HOURS

TIME	TEMP. (R)	PRESSURE (PSIA)	MEASURED LEAKAGE RATE
615	534.767	26.2743	
630	534.757	26.2728	0.356
645	534.764	26.2720	0.376
700	534.744	26.2697	0.418
715	534.735	26.2683	0.394
730	534.732	26.2675	0.370
745	534.728	26.2655	0.413
800	534.714	26.2646	0.368
815	534.704	26.2623	0.403
830	534.699	26.2610	0.399
845	534.687	26.2592	0.406
900	534.687	26.2570	0.441
915	534.673	26.2561	0.413
930	534.659	26.2523	0.466
945	534.648	26.2522	0.423
1000	534.641	26.2504	0.430
1015	534.631	26.2499	0.403

MEAN OF MEASURED LEAKAGE RATES = 0.405

VERIFICATION TEST LEAKAGE RATE UPPER LIMIT = 0.541
VERIFICATION TEST LEAKAGE RATE LOWER LIMIT = 0.323
THE CALCULATED LEAKAGE RATE = 0.434

GRAND GULF VERIFICATION

TREND REPORT
LEAKAGE RATES (WEIGHT PERCENT/DAY)

TIME AND DATE AT START OF TEST: 615 0104
ELAPSED TIME: 4.00 HOURS

NO. DATA POINTS	ELAPSED TIME	TOTAL-TIME ANALYSIS' MEAN	MASS-POINT ANALYSIS CALCULATED	MASS-POINT ANALYSIS CALCULATED
10	2.25	0.389	0.400	0.397
11	2.50	0.390	0.404	0.402
12	2.75	0.395	0.418	0.420
13	3.00	0.396	0.420	0.420
14	3.25	0.402	0.436	0.440
15	3.50	0.403	0.436	0.438
16	3.75	0.405	0.439	0.439
17	4.00	0.405	0.434	0.431

APPENDIX H

BYPASS LEAKAGE RATE CALCULATIONS

The formula for computing leakage rate by flow totalizer method is:

$L_L = (P_1/T_1 - P_2/T_2) \times (VT_s/60tP_s) + F/60t$

where:

L_L = Leakage rate, standard cubic feet per minute (SCFM)

P_1, P_2 = Test volume absolute pressure at start and end of test respectively, absolute units

T_1, T_2 = Test volume absolute temperature at start and end of test respectively, absolute units

V = Total test free air volume, cubit feet (270,128 cu.ft.)

Ts = Standard temperature (68°F)

Ps = Standard pressure (14.6959 psia)

t = Test duration, hours (4 hrs.)

F = Makeup air (to maintain test pressure), standard cubic feet = $F_2 - F_1$

F_1, F_2 = Makeup air flow meter reading at start and end of test respectively, SCF (convert from actual cubic feet to standard cubic feet).

(1) Calculate drywell average temperature at start and end of test, where VF = Volume Friction.

T_1 = 76.102°F = 535.772°R

T_2 = 76.271°F = 535.941°R

(2) Drywell pressure at start and end of test:

P_1 = 17.793 psia

P_2 = 17.785 psia

(3) Calculate drywell makeup air volume, convert from actual cubic feet to standard cubic feet:

F_1 = 118070 cu.ft.

F_2 = 86350 cu.ft

$$F = (F_1 - F_2)\left(\frac{50+14.6959}{14.6959}\right)\times\left(\frac{68+459.67}{44+459.67}\right)$$

$$= 31720\left(\frac{64.6959}{14.6959}\right)\times\left(\frac{527.67}{503.67}\right)$$

= 146295.19 cu.ft.

(4) Bypass Leakage Rate Calculation:

$$L_L = \left(\frac{17.793}{535.772} - \frac{17.785}{535.941}\right)\left(\frac{270,128\text{x}68}{60\text{x}4\text{x}14.6959}\right) + \frac{146295.19}{60\text{x}4}$$

= 609.7 SCFM

APPENDIX I

Local Leakage Test Summary Data
Type B Test Results

Penetration	Description	Leakage, SCCM
1	Equipment Hatch	2 ± 2
2	Upper Personnel Lock	-
3	Lower Personnel Lock	-
4	Fuel Transfer Tube	0 ± 11
201	Reactor Protection System	0 ± 0
202	Low Voltage Power	0 ± 0
203	Instrumentation	0 ± 0
204	Instrumentation	0 ± 0
205	Neutron Monitoring	0 ± 0
206	Low Voltage Power	0 ± 0
207	Control and Power	0 ± 0
208	Control	0 ± 0
209	Low Voltage Power	0 ± 0
210	Radiation Monitoring	0 ± 0
211	Control	0 ± 0
212	Instrumentation	0 ± 0
213	Rod Position Indication	0 ± 0
214	T.I.P.	0 ± 0
215	6.9 Kv-Reactor Recirculate Pump A	0 ± 0
216	Spare	0 ± 0
217	LV Power and Control	0 ± 0
218	Neutron Monitoring	0 ± 0
219	Instrumentation	0 ± 0
220	Instrumentation	0 ± 0
221	Spare	0 ± 0
222	Reactor Protection	0 ± 0
223	LV Power and Control	0 ± 0
224	Spare	0 ± 0
225	LV Power	0 ± 0
226	Control	0 ± 0
227	Instrumentation	0 ± 0
228	Instrumentation (Neutron Monitoring)	0 ± 0
229	LV Power and Control	0 ± 0
230	Reactor Protection	0 ± 0
231	Instrumentation	0 ± 0
232	Neutron Monitoring	0 ± 0
233	Rod Position Indication	0 ± 0
234	Spare	0 ± 0
235	Neutron Monitoring	0 ± 0
237	Instrumentation (SRV Inplant Test)	0 ± 0
238	Reactor Protection System	0 ± 0
239	Control	0 ± 0
240	Instrumentation	0 ± 0
241	LV Power and Control	0 ± 0
242	LV Power and Control	0 ± 0

APPENDIX I (Cont'd)

Local Leakage Test Summary Data
Type B Test Results (Cont'd)

Penetration	Description	Leakage, SCCM
243	Spare	0 ± 0
244	LV Power	0 ± 0
245	Control Bop	0 ± 0
246	Radiation Monitoring	0 ± 0
247	6.9 KV Reactor Recirculate Pump B	0 ± 0
249	Instrumentation	0 ± 0
	Drywell Personnel Hatch	
	Drywell Head	
	Drywell Equipment Hatch	30 ± 11
	Drywell Head Manhole	
		TOTAL = 32 ± 16

APPENDIX I (Cont'd)

Local Leakage Test Summary Data
Type C Test Results (Pneumatic)

Penetration	Description	Leakage, SCCM
5	Main Steam Line A	10,500 ± 150
6	Main Steam Line B	552 ± 19
7	Main Steam Line C	20 ± 17
8	Main Steam Line D	3,390 ± 148
17	Steam Supply to RCIC Turbine and RHR Hx	114.0 ± 17
19	Main Steam Drain to Condenser	4 ± 12
33	CRD Pump Discharge	0 ± 12
34	Containment Purge Supply	135 ± 17
35	Containment Purge Exhaust	80 ± 17
36	Plant Service Water Return	58 ± 12
37	Plant Service Water Supply	
38	Chilled Water Supply	1,250 ± 120
39	Chilled Water Return	20 ± 12
40*	ILRT Containment Pressurization/ Depressurization	286 ± 12
41	Plant Service Air	220 ± 12
42	Instrument Air	800 ± 12
43	RWCU to Main Condenser	10 ± 17
44	Component Cooling Water Supply	40 ± 17
45	Component Cooling Water Return	48 ± 17
47	Reactor Recirculate Post Accident Sample	0 ± 11
49	RWCU Backwash Transfer Pump to Spent Resin Storage Tank	72 ± 12
50	DW & Containment CRW Sump Pumps Discharge to Auxiliary Building Collector Tank	1,385 ± 104
51	DW & Containment DRW Sump Pumps Discharge to Auxiliary Building Collector Tank	1,395 ± 100
54	To Upper Containment Pool and from Refueling Water Storage Tank	5 ± 12
56	Condensate Makeup to Upper Containment Pool	230 ± 11
57	Discharge from Fuel Pool Cooling and C.U. System to Upper Containment Pool	172 ± 12
58	Inlet Upper Containment Pool skimmer Tanks to Fuel Pool Cooling and C.U. System	142 ± 12
60	Auxiliary Building Floor and Equipment Drain Return	23 ± 17
65	Containment Normal Vent Supply and Combustible Gas	350 ± 17
66	Containment Normal Vent and Combustible Gas Exchange	30 ± 17

* Leakage rate for penetration 40 and 82 is included in this total

Local Leakage Test Summary Data
Type C Test Results (Pneumatic)(Cont'd)

Penetration	Description	Leakage, SCCM
70	Automatic Depressurization System (Instrument Air)	20 ± 17
75	RCIC Pump Turbine Exhaust Vaccum Relief	12 ± 12
81	Reactor Recirculate Sample	0 ± 12
82*	ILRT Drywell Pressurization/Depressurization	286 ± 12
83	RWCV Line from Regenerative Ht. Exchange to Feedwater	100 ± 12
84	Drywell and Containment Chemical Waste	60 ± 12
85	Suppression Pool Cleanup Return	180 ± 21
86	Demineralization Water Supply to Containment	330 ± 12
87	RWCV Pump Suction from Recirculate Loops	60 ± 17
88	RWCV Pump Discharge to RWCV Ht. Exchange	40 ± 12
101C	Drywell Pressure Instrumentation (Narrow Range)	0 ± 12
101F	Drywell Pressure Instrumentation (Wide Range)	6 ± 12
102D	Drywell Pressure (Wide Range)	15 ± 12
103D	Containment Pressure (Wide Range)	10 ± 12
104D	Containment Pressure (Wide Range)	10 ± 12
105A	Containment Drywell H_2 Analyzing	110 ± 12
106A	Drywell H_2 Analyzing Sample	14 ± 12
106B	Drywell H_2 Analyzing Sample Return	10 ± 12
106E	Containment H_2 Analyzing Sample Return	10 ± 12
107B	Drywell H_2 Analyzing Sample Return	158 ± 12
107D	Drywell H_2 Analyzing Sample	50 ± 12
107E	Drywell H_2 Analyzing Sample Return	15 ± 12
108A	Containment H_2 Analyzing	95 ± 12
109A	Drywell - Fission Products Monitor Sample	0 ± 12
109B	Drywell - Fission Products Monitor Sample Return	100 ± 12
109D	Containment Pressure Instrument (Narrow Range)	10 ± 12
110A	ILRT Instrumentation Drywell Pressure	0 ± 11
110C	ILRT Instrumentation Verification Flow	0 ± 11
110F	ILRT Instrumentation Containment Pressure	10 ± 11
114	Suppression Pool Water Level Control	9 ± 12
116	Suppression Pool Water Level Control	45 ± 12
118	Suppression Pool Water Level Control	7 ± 12
120	Suppression Pool Water Level Control	5 ± 12
	TOTAL =	22822 ± 300

* Leakage rate for penetration 40 and 82 is included in this total.

Local Leakage Test Summary Data
Type C Test Results (Hydraulic)

Penetration	Description	Leakage, SCCM
9	Feedwater A	3.8 ± 2.5
10	Feedwater B	16-2/3 ± 2.5
11	RHR Pump A Suction	180 ± 36
12	RHR Pump B Suction	503 ± 92
13	RHR Pump C Suction	917 ± 74
14	RHR Shutdown Suction	0 ± 0
18	RHR to RPV Head Spray	3.8 ± 5
20	RHR A to LPCI	0 ± 0
21	RHR B to LPCI	5.60 ± 3.5
22	RHR C to LPCI	519 ± 28
23	RHR A Pump Test Line to Suppression Pool	180 ± 35
24	RHR C Pump Test Line to Suppression Pool	917 ± 74
25	HPCS Pump Suction	6.23 ± 4.3
26	HPCS Pump Discharge to RPV	25 ± 20
27	HPCS Test Line to Suppression Pool	6.3 ± 2.5
28	RCIC Pump Suction	0 ± 0
29	RCIC Turbine Exhaust	0 ± 0
30	LPCS Pump Suction	0 ± 0
31	LPCS Pump Discharge to RPV	471 ± 53
32	LPCS Test Line to Suppression Pool	0 ± 0
46	RCIC Pump Discharge Minimum Flow Line	0 ± 0
48	RHR Hx B Relief Valve Vent Header to Suppression Pool	8.5 ± 5
67	RHR Pump B Test Line to Suppression Pool	503 ± 54
69	Refueling Water Transfer Pump Suction From Suppression Pool	50 ± 7
71A	LPCS Relief Valve Discharge to Suppression Pool	0 ± 0
71B	RHR "C" Relief Valve Discharge to Suppression Pool	917 ± 74
73	RHR Shutdown Relief Valve Discharge to Suppression Pool (H.P.)	82.6 ± 24
76B	RHR A Shutdown Suction Relief Valve Discharge to Suppression Pool (H.P.)	12.75 ± 5
77	RHR HT. Exchanger A Relief Valve Discharge to Suppression Pool	180 ± 35
89	Standby Service Water Supply A	22 ± 7
90	Standby Service Water Return A	0 ± 0
91	Standby Service Water Supply B	0 ± 0
92	Standby Service Water Return B	5 ± 6
113	Suppression Pool Water Level Control	5.3 ± 5
115	Suppression Pool Water Level Control	0 ± 0
117	Suppression Pool Water Level Control	5 ± 12
119	Suppression Pool Water Level Control	17 ± 12
		TOTAL = 5563 ± 192