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

8204160572 820414 PDR ADDCK 05000416 A PDR

TABLE OF CONTENTS

		Page No.
ı.	INTRODUCTION	1-1
II	. TEST SYNOPSIS	2-1
II	I. TEST DATA SUMMARY	3-1
IV	. ANALYSIS AND INTERPRETATION	4-1
٧.	COMPUTER REPORT AND DATA PRINTOUT	5-1
A D I	PENDIXES	
A.	Bechtel ILRT Computer Program	A-1
в.	ILRT Stabilization Data	B-1
c.	ILRT Summary Data	C-1
D.	ILRT Calculations	
	Mass Point Analysis Total Time Analysis Trend Report Analysis	D-1 D-2 D-3
Ε.	ILRT Plots	
	Temperature Versus Time Pressure Versus Time Air Mass Versus Time	E-1 E-3 E-5
F.	Verification Flow Test Summary Data	F-1
G.	Verification Flow Test Calculations	
	Mass Point Analysis Total Time Analysis Trend Report Analysis	G-1 G-2 G-3
н.	Bypass Leakage Rate Calculation	H-1
I.	Local Leakage Test Summary Data	I-1

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 (La) 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 La).

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_0) 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:

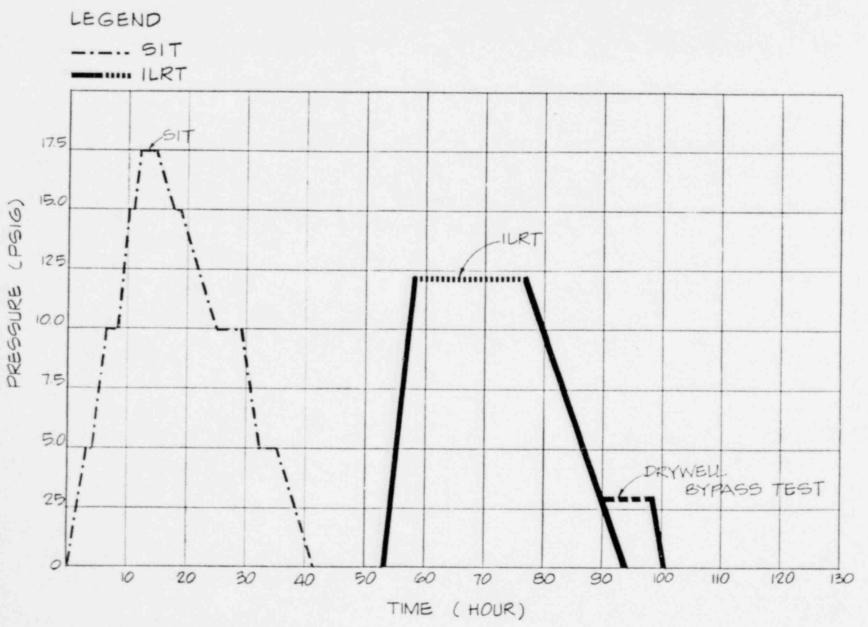
Test Method		Measured Lea	95% UCL wt.%/day	
a.	ILRT/Mass Point ILRT/Total Time	0.072 0.068	(0.328) (0.328)	0.079 0.139
ь.	Verification/Mass Point Verification/Total Time	0.431	(0.327-0.545) (0.323-0.541)	NA NA

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.

DH-103 2-3

GGNS SIT/ILRT PRESSURE VS. TIME CURVE



PRESSURIZATION PROGRAM TEST

,

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 Pa= 11.5 psig

5. Calculated Peak Accident Temperature Ta= 181°F

6. Containment ILRT Average Temperature 40°F-120°F Limits

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 $L_a = 0.437 \text{ wt.} \%/\text{day}$

5. 75% of La 0.328 wt.%/day

6. Integrated Leakage Rate Test Results Leakage Rate, Lam wt.%/day

From Regres- At Upper sion Line 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, Lvm, wt.%/day

Mass Point Analysis Total Time Analysis 0.431

9. Verification Test Limits:

Test Limits, Ly, wt.%/day

				Mass Point Analysis	Total Time Analysis
			0.25L _a) 0.25L _a)	0.545 0.327	0.541 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: $1.0 \text{ millivolt/}^{\circ}\text{F}; 32^{\circ}\text{F} = 32 \text{ mv.},$

100°F = 100 mv.; 3-wire configuration with

constant current

Adjustment: Zero, span and linearity (limited)

Accuracy: $+ 0.1^{\circ}F$ Sensitivity: $0.01^{\circ}F$ Repeatability: $0.01^{\circ}F$

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: $+ 0.1^{\circ}F$ Sensitivity: $0.01^{\circ}F$ Repeatability: $0.05^{\circ}F$

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:

- 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.
- A system lineup (at time of test) showing required valve positions and status of piping systems.
- A continuous, sequential log of events from initial survey of containment to restoration of all tested systems.
- Documentation of instrumentation calibrations and standards (included with documentation should be an error analysis of instrumentation).
- 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	Containmen 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
				Containment
ME Instrument No.	Elevation	Azimuth (Degrees)	Distance from Center	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	501-8"	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"	$\frac{0.080}{1.000}$

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 ME-N002-06	158'-5" 118'-2"	41 278	27'-3" 26'-9"	0.5
	777		77.5	1.0

DH-103

ILRT DATA ACQUISITION SYSTEM

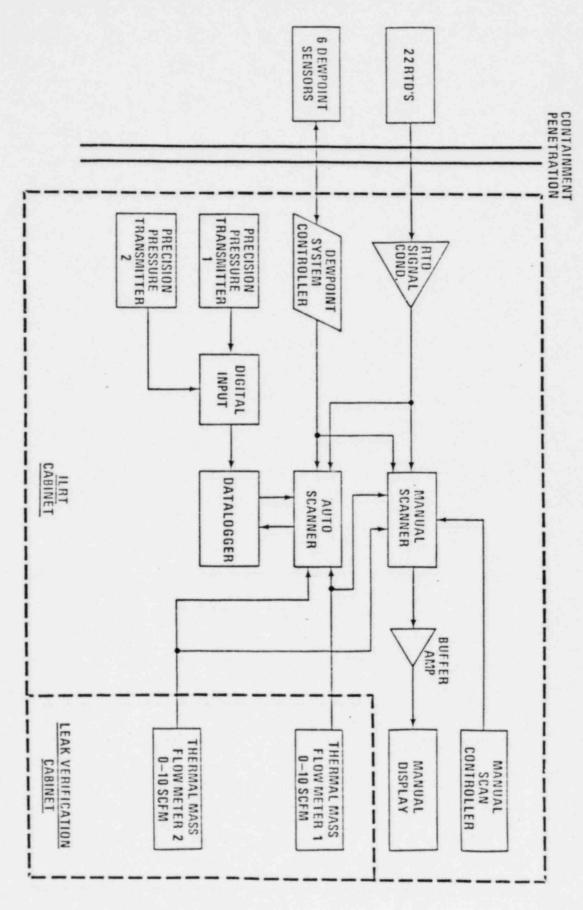


FIGURE 2

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 drywell 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 ILRT/Total Time		0.076		0.079 0.139	0.083	
2.	Verification/ Mass Point Total Time	0.431 0.434		0.327-0.545 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,€
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

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

= $[(0.01)^2 + (0.01)^2]^{1/2}/(22)^{1/2}$
= $0.003^\circ F$ (°R)

2. Pressures

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

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

$$= 0.0014 \text{ psia}$$

3. Vapor Pressure

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

The sensitivity and repeatability in terms of pressure are:

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

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

Therefore,

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

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

$$= 0.00025 \text{ psi}$$

c. ISG Calculation for 8 hour ILRT

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

$$T = 77^{\circ}F + 460 = 537^{\circ}R$$

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

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

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

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

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

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

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

DH-103

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).
- DATE: Calendar date (month and day).
- TEMP: Containment weighted-average drybulb temperature in absolute units, degrees Rankine (°R).
- 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.

- 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:

- 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 (1bm) 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.
- 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 leaka e rate, from data:

$$P_1V = W_1RT_1 \tag{1}$$

$$P_{i}V = W_{i}RT_{i}$$
 (2)

$$L_{i} = \frac{2400 (W_{1} - W_{i})}{\Delta t_{i} W_{1}}$$
 (3)

Solving for \mathtt{W}_1 and \mathtt{W}_i and substituting equations (1) and (2) into (3) yields:

$$L_i = 2400/\Delta t_i (1-T_1 P_i/T_i P_1)$$
 (4)

where:

 W_1 , W_i = Weight of contained mass of dry air at times t_1 and t_i respectively, 1bm.

 T_1 , T_i = Containment atmosphere drybulb temperature at times t_1 and t_i respectively, ${}^{\circ}R$.

 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 1st and ith 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.

$$a = \frac{\sum L_{i}(\sum \Delta t_{i}^{2}) - \sum \Delta t_{i}(\sum L_{i}\Delta t_{i})}{N(\sum \Delta t_{i}^{2}) - (\sum \Delta t_{i})^{2}}$$
(6)

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

N = Number of data points

$$\Sigma = \Sigma$$

$$i=1$$

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

$$\overline{L}_{95} = a + b\Delta t_{N} + S_{\overline{L}}$$
(8)

where:

 L_{95} = Calculated leakage rate at the 95% confidence level, %/day, at elapsed time $\Delta t_{\rm N}$.

For $\Delta t_N < 24$

$$S_{\overline{L}} = t_0.025; N-2 \left[\Sigma (L_i - \overline{L}_i)^2 / (N-2) \right]^{1/2} \times \left[1 + \frac{1}{N} + (\Delta t_N - \overline{\Delta t})^2 / \Sigma (\Delta t_i - \overline{\Delta t})^2 \right]^{1/2}$$
 (9a)

where,
$$t_0.025; N-2 = 1.95996 + \frac{2.37226}{N-2} + \frac{2.82250}{(N-2)^2}$$
;

For $\Delta t_N > 24$

$$S_{\overline{L}} = t_0.025; N-2 \left[\Sigma (L_i - \overline{L}_i)^2 / (N-2) \right]^{1/2} \times \left[\frac{1}{N} + (\Delta t_N - \overline{\Delta t})^2 / \Sigma (\Delta t_i - \overline{\Delta t})^2 \right]^{1/2}$$
 (9b)

where,
$$t_0.025; N-2 = \frac{1.6449(N-2)^2 + 3.5283(N-2) + 0.85602}{(N-2)^2 + 1.2209(N-2) - 1.5162}$$

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

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

2. Computation using the Mass Point Method

a. Contained mass of dry air from data:

$$W_{i} = 144 \frac{P_{i}V}{RT_{i}}$$
 (10)

where:

All symbols as previously defined.

b. Calculated leakage rate from regression analysis:

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

where:

Calculated leakage rate, %/day, as determined from the regression line.

$$a = \frac{\sum W_i - b \sum \Delta t_i}{N}$$
 (12)

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

 Δt_i = Total elapsed time at time of ith data point, hours

N = Number of data points

Wi " Contained mass of dry air at ith data point, 1bm, 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.

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

where:

L95 = Calculated leakage rate at the 95% confidence level, %/day.

$$S_b = t_0.025; N-2 \left[\frac{\Sigma (W_i - \overline{W_i})^2}{(N-2)\Sigma (\Delta t_i - \overline{\Delta t})^2} \right] 1/2$$
 (15)

where,
$$t_0.025; N-2 = \frac{1.6449(N-2)^2 + 3.5283 (N-2)^2 + 0.85602}{(N-2)^2 + 1.2209 (N-2) - 1.5162}$$

$$\overline{W}_{i}$$
 = Contained mass of dry air, 1bm, computed at the ith data point from the regression equation
$$= a + b\Delta t_{i}$$
 (16)

All other symbols are previously defined.

DH-103

D. Program Logic

 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	
DATA	

FUNCTION

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 Fime Report.

MASS Terminal will print out a Mass Point Report.

TERM Enables operator to sign-off temporarily or permanently.

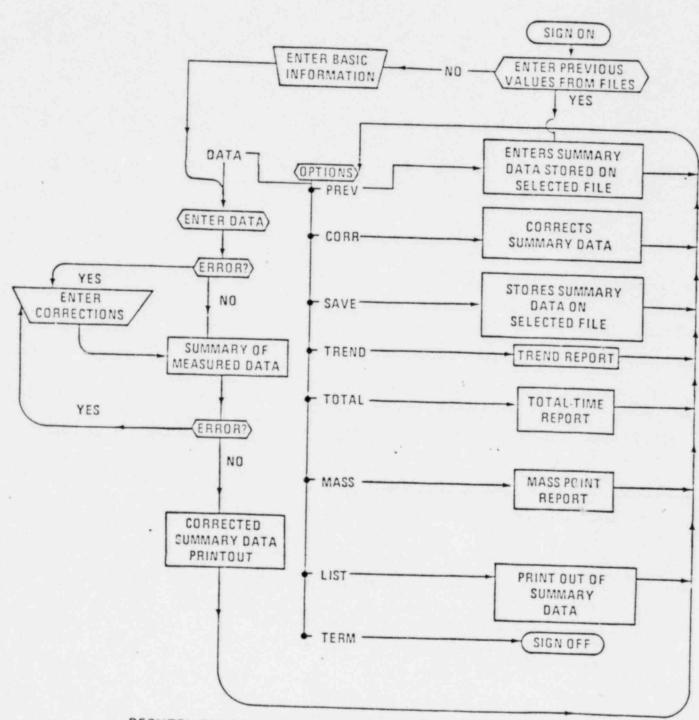
SAVE Enables operator to store the Data Summary on a file.

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

		TES	T.STA			
GRAND	GULF		IZATION			
	(= 0.			VOL	= 1670000.00	
VRATE	ET = (0.000	VRATEM	= 0.000	VRATEP = 0.00	
TIME	DATE		TEMP	PRESSURE	VPRS	V
1529	103	537.		26.425938		
1545	103		01373	26.402582	0.34475750	
1603	103		61597	26.383574	0.34468400	
1615	103		46893	26.377193	0.34303159	
1630	103		30707	26.368984	0.34303139	
1645	103		20459	26.363253	0.34291309	
1700	103		09918	26.357325	0.34281561	
1715	103	536.	03223	26.353136		
1730	103		95685	26.348457		
1745	103		88220	26.344131	The second of the second of	
1800	103		82629	26.340103	0.34296569	
1815	103		76117	26.337587	0.34246781	
1830	103		70874	26.334372	0.34267199	
1845	103		66150	26.332005	0.34202629	
1900	103		61688	26.329777	0.34224480	
1915	103		56860	26.327791	0.34222180	
1930	103		54742	26.324705	0.34229621	
1945	103		43054	26.323195	0.34179929	
2000	103		44885	26.320612	0.34237379	
2015	103		40631	26.318562	0.34241500	

APPENDIX C ILRT SUMMARY DATA

TEST. DAT

0 104 535.06689 26.296225 0.343 15 104 535.05304 26.297117 0.342 30 104 535.03369 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293665 0.343 115 104 534.98413 26.292389 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96783 26.291492 0.343 200 104 534.96344 26.290226 0.343 201 104 534.96344 26.290226 0.343 201 104 534.93909 26.289738 0.343 215 104 534.9371 26.289738 0.344 230 104 534.9371 26.287523 0.344 245 104 534.91162 26.287708 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.89233 26.285236 0.344 330 104 534.89233 26.285236 0.344		
TIME DATE TEMP PRESSURE 2030 103 535.38818 26.316441 0.342 2045 103 535.37219 26.315517 0.342 2100 103 535.34686 26.313202 0.342 2115 103 535.32245 26.311718 0.342 2130 103 535.28601 26.310568 0.342 2145 103 535.26984 26.307184 0.342 2200 103 535.23566 26.307184 0.342 2215 103 535.21973 26.304913 0.342 2230 103 535.19214 26.304295 0.342 2245 103 535.16925 26.302761 0.343 2230 103 535.16925 26.301828 0.343 2315 103 535.14685 26.301828 0.343 2315 103 535.10406 26.299398 0.342 2330 103 535.10406 26.299398 0.342 2345 103 535.06689 26.296225 0.343 0 104 535.06689 26.295589 0.343 0 104 535.05304 26.297117 0.342 30 104 535.05304 26.297117 0.342 15 104 535.05304 26.293724 0.344 100 104 534.99390 26.293665 0.343 15 104 534.99390 26.29389 0.343 15 104 534.96783 26.291492 0.343 15 104 534.96783 26.291492 0.343 230 104 534.96783 26.291492 0.343 230 104 534.9757 26.289938 0.343 2315 104 534.9757 26.289938 0.343 230 104 534.93909 26.288767 0.343 230 104 534.93909 26.288767 0.344 230 104 534.93909 26.288767 0.344 230 104 534.93909 26.288767 0.344 245 104 534.93909 26.288767 0.344 230 104 534.93909 26.288767 0.344 230 104 534.93909 26.288767 0.344 245 104 534.89338 26.286375 0.344 350 104 534.89338 26.285236 0.344 350 104 534.89233 26.285236 0.344 350 104 534.89233 26.285236 0.344 350 104 534.89233 26.285236 0.344 350 104 534.89233 26.285236 0.344 350 104 534.89233 26.285236 0.344	200 00	
TIME DATE		
2030 103 535.38818 26.315441 0.343 2045 103 535.37219 26.315517 0.343 2100 103 535.34686 26.313202 0.343 2115 103 535.32245 26.311718 0.343 2130 103 535.28601 26.310568 0.343 2145 103 535.26984 26.307896 0.343 2200 103 535.23566 26.307184 0.343 2215 103 535.21973 26.304913 0.343 2230 103 535.19214 26.304295 0.343 2245 103 535.19214 26.304295 0.343 2245 103 535.16925 26.301828 0.343 2315 103 535.11749 26.300154 0.343 2315 103 535.10406 26.299388 0.343 2345 103 535.05304 26.299589 0.343 15 104 535.05304 26.295589		Q
2045 103 535.37219 26.315517 0.34 2100 103 535.34686 26.313202 0.34 2115 103 535.32245 26.311718 0.34 2130 103 535.28601 26.310568 0.34 2145 103 535.26984 26.307896 0.34 2200 103 535.23566 26.307184 0.34 2215 103 535.21973 26.304913 0.34 2230 103 535.19214 26.304295 0.34 2245 103 535.16925 26.302761 0.343 2315 103 535.16925 26.301828 0.343 2315 103 535.11749 26.301828 0.343 2315 103 535.10406 26.299398 0.343 2345 103 535.05304 26.299583 0.343 2345 104 535.05304 26.295589 0.343 30 104 534.99390 26.293665	VPRS	
2100 103 535.34686 26.313202 0.343 2115 103 535.32245 26.311718 0.343 2130 103 535.28601 26.310568 0.343 2145 103 535.26984 26.309896 0.343 2200 103 535.23566 26.307184 0.343 2215 103 535.19214 26.304913 0.343 2230 103 535.19214 26.304913 0.343 2245 103 535.16925 26.302761 0.343 2300 103 535.14685 26.301828 0.343 2315 103 535.14685 26.301828 0.343 2315 103 535.14685 26.301828 0.343 2315 103 535.10406 26.299398 0.343 2345 103 535.065304 26.296225 0.343 15 104 535.03369 26.295589 0.343 45 104 534.99390 26.293465<		
2115 103 535.32245 26.311718 0.343 2130 103 535.28601 26.310568 0.343 2145 103 535.26984 26.309896 0.343 2200 103 535.23566 26.307184 0.343 2215 103 535.21973 26.304913 0.343 2230 103 535.19214 26.304295 0.343 2245 103 535.16925 26.302761 0.343 2300 103 535.14685 26.301828 0.343 2315 103 535.14685 26.301828 0.343 2315 103 535.14685 26.301828 0.343 2330 103 535.14685 26.301828 0.343 2315 103 535.14685 26.301828 0.343 2315 103 535.14685 26.299378 0.342 230 104 535.06889 26.299383 0.343 45 104 535.05304 26.295389<		
2130 103 535.28601 26.310568 0.343 2145 103 535.26984 26.309896 0.343 2200 103 535.23566 26.307184 0.343 2215 103 535.21973 26.304913 0.343 2230 103 535.19214 26.304295 0.343 2245 103 535.16925 26.302761 0.343 2300 103 535.14685 26.301828 0.343 2315 103 535.14685 26.301828 0.343 2330 103 535.14685 26.301828 0.343 2345 103 535.14685 26.301828 0.343 2345 103 535.14685 26.301828 0.342 2350 103 535.14685 26.301828 0.342 2345 103 535.14685 26.299378 0.342 235 104 535.06889 26.299583 0.342 245 104 535.06889 26.295589		
2145 103 535.26984 26.309896 0.342 2200 103 535.23566 26.307184 0.342 2215 103 535.21973 26.304913 0.343 2230 103 535.19214 26.304295 0.343 2245 103 535.16925 26.302761 0.343 2300 103 535.14685 26.301828 0.343 2315 103 535.1749 26.300154 0.342 2330 103 535.10406 26.299398 0.342 2345 103 535.09546 26.299583 0.342 0 104 535.05304 26.296225 0.343 15 104 535.05304 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293865 0.343 115 104 534.96783 26.291492 0.343 145 104 534.96783 26.291492 0.343 145 104 534.96783 26.299389 0.3		
2200 103 535.23566 26.307184 0.342 2215 103 535.21973 26.304913 0.343 2230 103 535.19214 26.304295 0.343 2245 103 535.16925 26.302761 0.343 2300 103 535.14685 26.301828 0.343 2315 103 535.11749 26.300154 0.342 2330 103 535.10406 26.299398 0.343 2345 103 535.06689 26.299583 0.342 0 104 535.06689 26.297589 0.343 0 104 535.05304 26.297117 0.342 30 104 535.05304 26.297589 0.343 45 104 535.01672 26.293724 0.343 15 104 534.99390 26.29389 0.343 15 104 534.96783 26.291492 0.343 15 104 534.96783 26.299286 <		
2215 103 535.21973 26.304913 0.343 2230 103 535.19214 26.304295 0.343 2245 103 535.16925 26.302761 0.343 2300 103 535.14685 26.301828 0.343 2315 103 535.11749 26.300154 0.342 2330 103 535.10406 26.299378 0.343 2345 103 535.09546 26.299583 0.343 0 104 535.06689 26.296225 0.343 15 104 535.05304 26.2975589 0.343 15 104 535.05304 26.293724 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293899 0.343 115 104 534.96783 26.291492 0.343 145 104 534.96344 26.290226 0.343 145 104 534.97377 26.289738		
2230 103 535.19214 26.304295 0.343 2245 103 535.16925 26.302761 0.343 2300 103 535.14685 26.301828 0.343 2315 103 535.11749 26.300154 0.343 2330 103 535.10406 26.299398 0.343 2345 103 535.09546 26.299583 0.343 0 104 535.05304 26.296225 0.343 15 104 535.05304 26.297117 0.343 30 104 535.03369 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293665 0.343 115 104 534.98413 26.292389 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96344 26.290226 0.343 215 104 534.97377 26.289738 0.344 230 104 534.93797 26.287708 0.344<		
2245 103 535.16925 26.302761 0.343 2300 103 535.14685 26.301828 0.343 2315 103 535.11749 26.300154 0.343 2330 103 535.10406 26.299398 0.343 2345 103 535.09546 26.299583 0.343 0 104 535.06689 26.296225 0.343 15 104 535.05304 26.297117 0.343 30 104 535.05304 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293665 0.343 115 104 534.98413 26.292389 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96783 26.291492 0.343 200 104 534.96787 26.289738 0.343 215 104 534.97277 26.2897523 0.344 230 104 534.932371 26.287708 0.344		
2300 103 535.14685 26.301828 0.343 2315 103 535.11749 26.300154 0.343 2330 103 535.10406 26.299398 0.343 2345 103 535.09546 26.299583 0.343 0 104 535.06689 26.296225 0.343 15 104 535.05304 26.297117 0.342 30 104 535.03369 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293665 0.343 115 104 534.96783 26.291492 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96783 26.291492 0.343 200 104 534.96783 26.291492 0.343 215 104 534.96344 26.290226 0.343 230 104 534.93909 26.289738 0.343 2315 104 534.93909 26.2897523 0.344 230 104 534.93909 26.2897523 0.344 230 104 534.93909 26.287708 0.344 2315 104 534.89838 26.285236 0.344 330 104 534.89838 26.285236 0.344 330 104 534.89838 26.285236 0.344 330 104 534.89838 26.285236 0.344 330 104 534.89838 26.285236 0.344 330 104 534.89838 26.285236 0.344		
2315 103 535.11749 26.300154 0.342 2330 103 535.10406 26.299398 0.342 2345 103 535.09546 26.299583 0.342 0 104 535.05304 26.297117 0.342 30 104 535.03369 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293665 0.343 115 104 534.98413 26.292389 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96783 26.291492 0.343 200 104 534.96344 26.290226 0.343 200 104 534.96787 26.289938 0.343 215 104 534.93909 26.2897523 0.344 230 104 534.9371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89838 26.285236 0.344 330 104 534.89838 26.285236 0.344 330 104 534.89838 26.285236 0.344 330 104 534.89838 26.285236 0.344 330 104 534.89233 26.285236 0.344		
2330 103 535.10406 26.299398 0.342 2345 103 535.09546 26.299583 0.342 0 104 535.06689 26.296225 0.343 15 104 535.05304 26.297117 0.342 30 104 535.03369 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293665 0.343 115 104 534.98413 26.292389 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96783 26.291492 0.343 200 104 534.96344 26.290226 0.343 200 104 534.9757 26.289938 0.343 215 104 534.93909 26.288767 0.344 230 104 534.93909 26.288767 0.344 230 104 534.93909 26.288767 0.344 230 104 534.93909 26.2887523 0.344 245 104 534.91162 26.287523 0.344 330 104 534.89838 26.286375 0.344 330 104 534.89838 26.286375 0.344 330 104 534.89838 26.285236 0.344 330 104 534.89838 26.285236 0.344 330 104 534.89838 26.285236 0.344		
2345 103 535.09546 26.299583 0.342 0 104 535.06689 26.296225 0.343 15 104 535.05304 26.297117 0.342 30 104 535.03369 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293865 0.343 115 104 534.98413 26.292389 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96783 26.291492 0.343 200 104 534.96344 26.290226 0.343 215 104 534.93909 26.289738 0.344 230 104 534.92371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.87921 26.285433 0.344		
0 104 535.06689 26.296225 0.343 15 104 535.05304 26.297117 0.342 30 104 535.03369 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293665 0.343 115 104 534.98413 26.292389 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96783 26.291492 0.343 200 104 534.96344 26.290226 0.343 200 104 534.94757 26.289938 0.343 215 104 534.93909 26.288767 0.344 230 104 534.93909 26.288767 0.344 245 104 534.91162 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89838 26.285236 0.344 330 104 534.89233 26.285236 0.344 330 104 534.89233 26.285236 0.344	249672	
15 104 535.05304 26.297117 0.342 30 104 535.05304 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293665 0.343 115 104 534.98413 26.292389 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96783 26.291492 0.343 200 104 534.96344 26.290226 0.343 200 104 534.94757 26.289938 0.343 215 104 534.93909 26.288767 0.344 230 104 534.9371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89838 26.285236 0.344 330 104 534.89233 26.285236 0.344 330 104 534.89233 26.285236 0.344	231171	
30 104 535.03369 26.295589 0.343 45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293665 0.343 115 104 534.96783 26.291492 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96344 26.290226 0.343 200 104 534.94757 26.289938 0.343 215 104 534.93909 26.288767 0.344 230 104 534.9371 26.287523 0.344 245 104 534.91162 26.287708 0.344 330 104 534.89838 26.286375 0.344 330 104 534.89838 26.285236 0.344 330 104 534.89233 26.285236 0.344 330 104 534.89233 26.285236 0.344	666253	
45 104 535.01672 26.293724 0.344 100 104 534.99390 26.293665 0.343 115 104 534.96783 26.291492 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96344 26.290226 0.343 200 104 534.94757 26.289938 0.343 215 104 534.93909 26.288767 0.344 230 104 534.92371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.89233 26.285236 0.344 330 104 534.89233 26.285236 0.344 330 104 534.89233 26.285236 0.344	277007	
100 104 534.99390 26.293665 0.343 115 104 534.98413 26.292389 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96344 26.290226 0.343 200 104 534.94757 26.289938 0.343 215 104 534.93909 26.288767 0.344 230 104 534.92371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.87921 26.285433 0.344	29468	
115 104 534.98413 26.292389 0.343 130 104 534.96783 26.291492 0.343 145 104 534.96344 26.290226 0.343 200 104 534.94757 26.289938 0.343 215 104 534.93909 26.288767 0.344 230 104 534.92371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.89233 26.285236 0.344 330 104 534.8721 26.285433 0.344	15492	
130 104 534.96783 26.291492 0.343 145 104 534.96344 26.290226 0.343 200 104 534.94757 26.289938 0.343 215 104 534.93909 26.288767 0.344 230 104 534.92371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.89233 26.285236 0.344 330 104 534.87921 26.285433 0.344	21022	
145 104 534.96344 26.290226 0.343 200 104 534.94757 26.289938 0.343 215 104 534.93909 26.288767 0.344 230 104 534.92371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.87921 26.285433 0.344 345 104 534.87921 26.285433 0.344	48071	
200 104 534.94757 26.289938 0.343 215 104 534.93909 26.288767 0.344 230 104 534.92371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.87921 26.285433 0.344	37339	
215 104 534.93909 26.288767 0.344 230 104 534.92371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.87921 26.285433 0.344	63529	
230 104 534.92371 26.287523 0.344 245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.87921 26.285433 0.344	92363	
245 104 534.91162 26.287708 0.344 300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.87921 26.285433 0.344	09159	
300 104 534.89838 26.286375 0.344 315 104 534.89233 26.285236 0.344 330 104 534.87921 26.285433 0.344	32954	
315 104 534.89233 26.285236 0.344 330 104 534.87921 26.285433 0.344	14417	
330 104 534.87921 26.285433 0.344	47473	
745 104 571 20.203433 0.344	60890	
340 104 534.86578 26 284437 0 744	41105	
	40356	
400 104 534.85150 26.283850 0.344	99204	
415 104 534.84827 26.283432 0.344	40419	
	75130	

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)		TOT.AVG	
2030	535.388	26.3164	221566.			
2045	535.372	26.3155	221565.	1.1		0. 7
2100	535.347	26.3132	221556.			4.6
2115	535.322	26.3117	221553.	2.4		0.3 6.8
2130		26.3106	221559.	-5.4		
2145		25.3099	221550.	-1.0		7.2
2200		26.3072	221551.	8.7		4.9
2215		25.3049	221539.	12.5		9.9
) 2230	The same of the sa		221545.	-6.2		5.6
2245		26.3028	221541.	3.4		0.6
2300		26.3018	221543.			0.9
2315		26.3002	221541.	-1.4		9.3
2330			221540.	1.9		9.1
2345		26.2996	221545.	0.8		8.6
0			221529.	-5.1		6.4
15		The second secon	221542.	16.5	. 1	
30			221542.	-13.3		6.4
45	And the control of the control of	26.2937	221528.			7.2
100		26.2937				8.8
115		26.2924	221537.			6.4
130		26.2915	221531.			7.4
145		26.2713	221530.	0.8		7.2
200		26.2899	221521.	8.9		8.5
215	The second secon	26.2888	221525.	-4.2		7.4
230		26.2875	221519.			8.2
245		26.2877	221515.			8.5
300		26.2864	221521.			7.2
315		26.2852	221515.	5.8		7.8
330		26.2854	221508.			8.5
345		26.2844	221515.			7.2
400		26.2938	221513.			7.4
415	And the second of the second o	26.2834	221514.			7.0
430			221511.	2.2		7.0
750	554.627	26.2831	221517.	-5.2		6.2
)		VOLUME USED	(MILLIONS	CF CU. FT.)	=	1.670
	REGRESS!					
		EPT (LBM)			= 2215	01.
	SLOPE	(LBM/HR)			=	-6.7
	MAXIMUM	ALLOWABLE LE	AKAGE RATE		=	0.437
	75 % OF	MAXIMUM ALLO	WABLE LEAKA	GE RATE	=	0.328
		R 95% CONFID			==	0.079
	THE CALC	ULATED LEAKA	GE 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: 2.00 HOURS

TIME	TEMP.	PRESSURE (PSIA)	MEASURE LEAKAGE F		
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	535.284	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		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		
	535.017	26.2937	0.096		
	534.994	26.2937	0.069		
	534.984		0.081		
	534.968		0.078		
145	534.963	26.2902	0.093		
200	534.948	26.2899	0.080		
215	534.939		0.089		
230	534.924	26.2875	0.093		
245	534.912	26.2877	0.078		
200	534.998	26.2864	0.084		
315	534.892	26.2852	0.092		
220	534.879	26.2854	0.078		
345	534.866	26.2844	0.080		
400	534.852	26.2838	0.076		
415		26.2834	0.076		
430	534.829	26.2831	0.067		
MEAN OF MEASUR	RED LEAKAG	E RATES		=	0.095
MAXIMUM ALLOW	ADIE LEAVE				
MAXIMUM ALLOW	HOLE LEAKA	GE RATE		=	0.437
75 % OF MAXIMU	JM ALLOWAR	LE LEAKAGE	RATE	=	0.328
THE UPPER 95%	COMP I DENC	ELIMIT		=	0.139
THE CALCULATE	LEAKAGE I	RATE		=	0.048

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 FOINTS	ELAPSED TIME	TOTAL -T MEAN	IME ANALYSIS CALCULATED	MASS-POINT ,	
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	2.25 2.50 2.75 3.00 3.25 3.50 3.75 4.00 4.25 4.50 4.75 5.00 5.25 5.75 6.25 6.25 6.25 7.00	0.121 0.119 0.117 0.115 0.112 0.112 0.109 0.107 0.107 0.105 0.103 0.102 0.103 0.102 0.101 0.100 0.099 0.098 0.098	0.119 0.112 0.107 0.101 0.091 0.094 0.082 0.082 0.082 0.077 0.075 0.073 0.074 0.073 0.073 0.074 0.073 0.074	0.119 0.110 0.104 0.098 0.093 0.083 0.079 0.081 0.075 0.075 0.075 0.075 0.075 0.075 0.075 0.075	0.162 0.162 0.146 0.134 0.124 0.111 0.115 0.099 0.099 0.099 0.099 0.089 0.087 0.088 0.086 0.086 0.085
30 31 32 33	7.25 7.50 7.75 8.00	0.095 0.095 0.095	0.072 0.071 0.070 0.048	0.077 0.076 0.075 0.072	0.084 0.083 0.081 0.079

APPENDIX E

ILRT

2200	532.0	533.00	534.00	TEMPERATU 535.00	JRE 536.00	537.00	578.00	539.
2200 -		-						
2200 -								
2200 -	2100							
2500 -					*			
2500 -		-			*			
2500 -		-			_			
200 + + + + + + + + + + + + + + + + +	2200	-		4				
200 + + + + + + + + + + + + + + + + +		-		+				
200 + + + + + + + + + + + + + + + + +		-						
200 + + + + + + + + + + + + + + + + +	0700	-		+				
100 -				+				
100 -				+				
100 -]		+				
100 -	Ö	_		+				
200 - + + + + + + + + + + + + + + + + + +		_		+				
200 - + + + + + + + + + + + + + + + + + +		_		+				
200 - + + + + + + + + + + + + + + + + + +		-		+				
200 - + + + + + + + + + + + + + + + + + +	100	-		Ţ.				
300 - - - 400 - - - - - - - - - - - - - - - - - - -		-		+				
300 - - - 400 - - - - - - - - - - - - - - - - - - -		-						
300 - - - 400 - - - - - - - - - - - - - - - - - - -		-		+				
400 - + + + + + + + + + + + + + + + + + +	200	-		+				
400 - + + + + + + + + + + + + + + + + + +		-	1.0	+				
400 - + + + + + + + + + + + + + + + + + +				+				
400 - + + + + + + + + + + + + + + + + + +	700	_		+				
	200			+				
		_		+				
		_		*				
	400			*				
		-		. *				
		- / - /		-				
				+				
500 - +	500			+				

VERIFICATION

532.00	533.00	534.00	TEMPERATU 535.00	RE 536.00	537.00	538.00	539.00
			+				
-			+				
			+				
600 -			+				
			+				
			+				
700 -			+				
_			+				
			+				
			1				
800 -			+				
-			+				
-			+				
900 -			+				
700 -			+				
			+				
_			+				
1000 -			+				
-			Ţ				

STABILIZATION

532.0	00 +	533.00	534.00	TEMPERATUR 535.00	S36.00	537.00	538.00	539.00
	-							+
1603	_					+	+	
1000	_					+		
	_					+		
	_					+		
1700	-				+			
	-				+			
	-							
	-				, *			
1800	-							
	-				_			
	-				+			
10000	-				+			
1900	_				+			
	_				+			
					+			
2000	_				+			
2000	_				+			
					+			

ILRT

26.150	25.200	26.250	PRESSURE 26.300	26.350	25.400	26.450	26.50
				×			
2100 -							
-							
2200 -							
	•						
			+				
-	•		+				
2300 -			+				
			+				
			+				
0 -			+				
_			+				
_			*				
			+				
100 -							
-							
-							
-			+				
200 -			+				,
-			+				
-			+				
700			+				
300 -			+				
			+				
			+				
400 -			+				
_	- 75 E. T. () E. (+				
_			+				
-	71 11 11 11 11 11 11		+				
500 -							
			+				

VERIFICATION

25.15	50	26.200	26.250	PRESSURE 26.300	25.350	26.400	25.450	25.500
	-			+				+
	-							
	-			+				
500				+				
	744			+				
	-			+				
700	_			+				
,00				+				
	-			+				
	-			+				
800	-			+				
	-			+				
	-			+				
	-			+				
900	-		+					
	**		+					
	_		+					
1000	_		+					
1000	_		+					
			+					

STABILIZATION

26.15	0 25.200	26.250	PRESSURE 26.300	26.350	26.400	26.450	26.500
1603					. + +	+	+
1700				:	+		
1800				; ·			
1900	-			:			
2000				+			

ILRT

201.550	79774 4 4 4 4	A	IRMASS				
4	221100.	221200.	221300.	221400.	221500.	221600.	2217
						_T	
2100 -							
* · ·						+	
						+	
						+	
2200 -						+	
_					+		
					+		
2300 -					+		
					+		
_					+		
_					+		
0 -						+	
-					+		
-					*		
-							
100 -					*_		
-					+		
-					+		
_					+		
200 -					+		
					+		
					+		
300 -					+		
-					+		
-					, +		
					+		
400 -							
-					•		
-							
500 -							

VERIFICATION

22	1000.	221100.	221200.	1RMASS 221300.				
	+			+	221400.	221500.	221600.	2217
						+		
	_					+		
600	-					+		
	+					. +		
	7					+		
700						+		
	-				+			
	-				+			
	-				+			
800					+			
	_				+			
	-				+			
900	-				. +			
	-				*			
	-			+				
1000	_			+				
	_			+				
				+				

STABILIZATION

221000.	221100.	221200.	IRMASS 221300.	221400.	221500.	221600.	22170
-							+
1603 -						+	
1603 -						+	
-						+	
-						+	
4700						+	
1700 -						+	
_						+	
-						+	
						+	
1800 -						+	
						+	
-						+	
-						+	
1900 -						+	
						+	
-						+	
-						+	
2000 -						+	
-						+	

APPENDIX F VERIFICATION FLOW TEST

SUMMARY DATA

TEST. VER GRAND GULF VERIFICATION ALMAX = 0.437VOL = 1570000.00 **VRATET** = 0.432 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		8.2	
545	534.764	26.2720	221450.	9.1	32.8
700	534.744	26.2697	221439.		34.7
715	534.735	26.2683	221431.	11.5	38.6
730	534.732	26.2675	221425.		36.3
745	534.728	26.2655		5.4	34.2
800	534.714	26.2646	221408.	14.5	38.1
815	534.704	26.2623	221400.	2.2	34.0
830	534.699	26.2510	221373.	15.0	37.2
845	534.687	26.2592	221385.	9.5	
900	534.687	26.2570	221374.	10.7	~/. ~
915	534.673		221356.	18.3	40.7
930			221353.	2.2	38.1
945	534 449		221329.	25.5	43.0
1000	534 441	26.2504	221331.	-3.4	39.0
1015	534 431	26.2499	221319.	12.3	39.7
	004.001	20.2499	221319.	-0.1	37.2
	FREE AIR	VOLUME USED	(MILLIONS C	OF CU. FT.)	= 1.670
	REGRESSI INTERC	ON LINE EPT (LBM)			
		(LBM/HR)			= 221471.
					= -39.8
	VERIFICA	TION TEST LE	AKAGE RATE I	IPPER I THIT	
	·	TON IEDI LE	AKAGE RATE I	OWER LIMIT	= 0.545 = 0.327
	THE CALC	ULATED LEAKAD	SE RATE	CONTENT LINE	
					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.	PRESSURE (PSIA)	MEASURED LEAKAGE RATE	
630 645 700 715 730 745 800 815 830 845 900 915 930 945	534.764 534.744 534.735 534.732 534.728 534.714 534.699 534.687 534.687 534.659 534.648 534.648	26.2728 26.2720 26.2697 26.2683 26.2675 26.2655 26.2646 26.2623 26.2610 26.2592 26.2570 26.2570	0.376 0.418 0.394 0.370 0.413 0.368 0.403 0.399 0.406 0.441 0.413 0.466 0.423	
MEAN OF MEASUR	RED LEAKAGE	RATES	=	0.405
VERIFICATION 1 VERIFICATION 1 THE CALCULATED	ESI LEMMA	THE RATE LOUIS	ER LIMIT = ER LIMIT =	0.541 0.323 0.434

GRAND GULF VERIFICATION

TREND REPORT LEAKAGE RATES (WEIGHT PERCENT/DAY)

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

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

 $L_{\rm L}$ = 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).

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:

 $P_1 = 17.793 \text{ psia}$

 $P_2 = 17.785 \text{ psia}$

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

$$F_1 = 118070$$
 cu.ft.

$$F_2 = 86350 \text{ cu.ft}$$

$$F = (F_1 - F_2) \left(\frac{50+14.6959}{14.6959}\right) \times \left(\frac{68+459.67}{44+459.67}\right)$$
$$= 31720 \left(\frac{64.6959}{14.6959}\right) \times \left(\frac{527.67}{503.67}\right)$$

- = 146295.19 cu.ft.
- (4) Bypass Leakage Rate Calculation:

$$L_{L} = \left(\frac{17.793}{535.772} - \frac{17.785}{535.941}\right) \left(\frac{270,128x68}{60x4x14.6959}\right) + \frac{146295.19}{60x4}$$

APPENDIX I

Local Leakage Test Summary Data Type B Test Results

enetration	Description	Leakage, SCCM
1	Equipment Hatch	2 + 2
2 3	Upper Personnel Lock	
3	Lower Personnel Lock	
4	Fuel Transfer Tube	0 + 11
201	Reactor Protection System	0 + 0
202	Low Voltage Power	0 7 0
203	Instrumentation	0 + 0
204	Instrumentation	0 + 0
205	Neutron Monitoring	0 7 0
206	Low Voltage Power	0 7 0
207	Control and Power	0 + 0
208	Control	0 7 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	$0 + 0 \\ 0 + 0$
240	Instrumentation	0 + 0
241	LV Power and Control	0 + 0
242	LV Power and Control	0 + 0

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 0 ± 0 0 ± 0
	Drywell Personnel Hatch	
	Drywell Head	
	Drywell Equipment Hatch	30 + 11
	Drywell Head Manhole	= =
	T	OTAL = 32 + 16

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

Penetration	Description	Leakage,	SCCM
		11.11.11.11	
5	Main Steam Line A	10,500 +	
6	Main Steam Line B	552 +	
7	Main Steam Line C	20 +	
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 +	
33	CRD Pump Discharge	0 +	12
34	Containment Purge Supply	135 +	17
35	Containment Purge Exhaust	80 +	
36	Plant Service Water Return	58 +	
37	Plant Service Water Supply	_	
38	Chilled Water Supply	1,250 +	120
39	Chilled Water Return	20 +	
40*	ILRT Containment Pressurization/	20 -	
	Depressurization	286 +	12
41	Plant Service Air	220 +	
42	Instrument Air	800 +	
43	RWCU to Main Condenser	10 +	
44	Component Cooling Water Supply	40 +	
45	Component Cooling Water Return		
47	Reactor Recirculate Post Accident	48 +	17
**/		0.1	
49	Sample	0 +	11
42	RWCU Backwash Transfer Pump to Spent	70 .	10
50	Resin Storage Tank	72 <u>+</u>	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
56	Containment Normal Vent and Combustible	-	
	Gas Exchange	30 +	17
		30 1	Mr. F

^{*} 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
7.5	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 +	
103D	Containment Pressure (Wide Range)	10 +	
104D	Containment Pressure (Wide Range)	10 +	
105A	Containment Drywell H2 Analyzing	110 +	12
106A	Drywell H2 Analyzing Sample	14 +	12
106B	Drywell H ₂ Analyzing Sample Return	10 +	12
106E	Containment H2 Analyzing Sample Return	10 +	12
107B	Drywell H ₂ Analyzing Sample Return	158 +	12
107D	Drywell H ₂ Analyzing Sample	50 +	12
107E	Drywell H2 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
		14974	

TOTAL = 22822 + 300

 $[\]star$ 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	e,	SCCM
9	Feedwater A	3.8	+	2.5
10	Feedwater B	16-2/3	-	
11	RHR Pump A Suction	180	-	
12	RHR Pump B Suction	503		
13	RHR Pump C Suction	917	-	
14	RHR Shutdown Suction		+	
18	RHR to RPV Head Spray	3.8	-	
20	RHR A to LPCI		+	
21	RHR B to LPCI	5.60	make an	
22	RHR C to LPCI	519		
23	RHR A Pump Test Line to Suppression Pool	180	-	
24	RHR C Pump Test Line to Suppression Pool	917	_	
25	HPCS Pump Suction	6.23	minutes.	
26	HPCS Pump Discharge to RPV			20
27	HPCS Test Line to Suppression Pool	6.3	paints.	
28	RCIC Pump Suction		+	
29	RCIC Turbine Exhaust		+	
30	LPCS Pump Suction		+	
31	LPCS Pump Discharge to RPV	471	-	
32	LPCS Test Line to Suppression Pool	0	Taken and	
46	RCIC Pump Discharge Minimum Flow Line		+	
48	RHR Hx B Relief Valve Vent Header to	8.5	-	
	Suppression Pool	0.0	_	3
67	RHR Pump B Test Line to Suppression Pool	503	1	5/
69	Refueling Water Transfer Pump Suction	503	_	54
0,	From Suppression Pool	50		7
71A	LPCS Relief Valve Discharge to Suppression	50	_	/
/ IA	Pool			0
71B		0	+	0
/ 10	RHR "C" Relief Valve Discharge to Suppression Pool	017		7/
73		917	+	/4
/3	RHR Shutdown Relief Valve Discharge to	00 (0.1
76B	Suppression Pool (H.P.)	82.6	+	24
700	RHR A Shutdown Suction Relief Valve	10 75		
77	Discharge to Suppression Pool (H.P.)	12.75	+	5
//	RHR HT. Exchanger A Relief Valve Discharge	100		
89	to Suppression Pool	180	-	
90	Standby Service Water Supply A	22	Street, or other last	
	Standby Service Water Return A		+	
91	Standby Service Water Supply B	0	+	~
92	Standby Service Water Return B	5	-	6
113	Suppression Pool Water Level Control		+	
115	Suppression Pool Water Level Control		+	
117 119	Suppression Pool Water Level Control		-	12
	Suppression Pool Water Level Control	17	-1	12

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

Duge of 8204160592

TABLE OF CONTENTS

		Page No.
ı.	INTRODUCTION	1-1
II.	TEST SYNOPSIS	2-1
III	. TEST DATA SUMMARY	3-1
IV.	ANALYSIS AND INTERPRETATION	4-1
٧.	COMPUTER REPORT AND DATA PRINTOUT	5-1
APP	PENDIXES	
Α.	Bechtel ILRT Computer Program	A-1
В.	ILRT Stabilization Data	B-1
c.	ILRT Summary Data	C-1
D.	ILRT Calculations	
	Mass Point Analysis Total Time Analysis Trend Report Analysis	D-1 D-2 D-3
Ε.	ILRT Plots	
	Temperature Versus Time Pressure Versus Time Air Mass Versus Time	E-1 E-3 E-5
F.	Verification Flow Test Summary Data	F-1
G.	Verification Flow Test Calculations	
	Mass Point Analysis Total Time Analysis Trend Report Analysis	G-1 G-2 G-3
н.	Bypass Leakage Rate Calculation	H-1
I.	Local Leakage Test Summary Data	I-1

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 (La) 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 La).

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 ($\rm L_{\rm O}$) 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:

Tes	t Method	Measured Lea	95% UCL wt.%/day	
а.	ILRT/Mass Point	0.072	(0.328)	0.079
	ILRT/Total Time	0.068	(0.328)	0.139
ь.	Verification/Mass Point	0.431	(0.327-0.545)	NA
	Verification/Total Time	0.434	(0.323-0.541)	NA

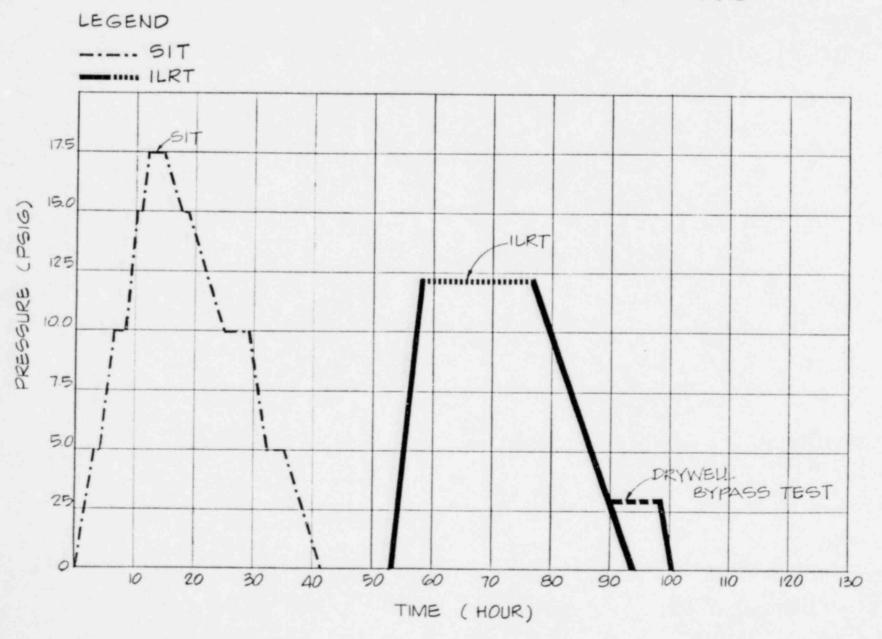
DH-103 2-2

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.

DH-103 2-3

GGNS SIT/ILRT PRESSURE VS. TIME CURVE



SEQUENCE PRESSURIZATION PROGRAM TEST

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.

4. 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	Pd= 15 psig
3. Design Temperature	T = 185°F
4. Calculated Peak Accident Pressure	$P_a = 11.5 \text{ psig}$
5. Calculated Peak Accident Temperature	T _a = 181°F
6. Containment ILRT Average Temperature	40°F-120°F

C. Test Results - Type A Test

Total Time Analysis

Limits

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	$L_a = 0.437 \text{ wt.}\%/\text{day}$
5.	75% of L _a	0.328 wt.%/day
6.	Integrated Leakage Rate Test Results	Leakage Rate, L _{am} wt.%/day From Regres- At Upper sion Line 95% Confidence Limit
	Mass Point Analysis	0.072 0.079

0.068

0.139

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

8. Verification Test Results

Leakage Rate, Lvm, wt.%/day

Mass Point Analysis Total Time Analysis 0.431

9. Verification Test Limits:

Test Limits, Ly, wt.%/day

				Mass Point Analysis	Total Time Analysis
			0.25L _a) 0.25L _a)	0.545	0.541 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: Sensitivity: Repeatability:

+ 0.1°F 0.01°F 0.01°F

Calibration Date:

12/21/81

3. Dewpoint Temperature (6 sensors):

Dewpoint Temperature Systems - EC&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:

- Access control procedures established to limit ingress to containment during testing.
- A listing of all containment penetrations, including the total number of like penetrations, penetration size, and function.
- A listing of normal operating instrumentation used for the leakage rate test.
- A system lineup (at time of test) showing required valve positions and status of piping systems.
- A continuous, sequential log of events from initial survey of containment to restoration of all tested systems.
- 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.
- Computer printouts of ILRT data and manual data accumulation along with summary description of computer program (Appendix C).
- 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-N001-01	274'-0"	172	20'-0"	0.062
	TE-N001-02	247'-9"	90	30'-8"	0.062
	TE-N001-03	245'-9"	265	27'-6"	0.062
	TE-N001-04	214'-4"	45	50'-6"	0.062
	TE-N001-06	229'-2"	155	49'-8"	0.062
	TE-N001-06	216'-0"	225	49'-8"	0.062
	TE-N001-07	227'-0"	319	49'-0"	0.062
	TE-N001-08	173'-0"	220	52'-0"	0.058
	TE-N001-10	163'-0"	305	50'-8"	0.057
	TE-N001-10	164'-6"	155	28'-8"	0.022
	TE-N001-11	141'-6"	162	50'-3"	0.058
	TE-N001-12 TE-N001-13	141'-2"	90	55'-6"	0.057
	TE-N001-13	122'-2"	335	41'-2"	0.057
	TE-N001-14	124'-0"	177	51'-6"	0.057
	TE-N001-15	150'-6"	219	25'-4"	0.022
	TE-N001-10	120'-0"	95	27'-8"	0.022
	TE-N001-17	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
					Containment
			Azimuth	Distance from	Volume
ME	Instrument No.	Elevation	(Degrees)	Center	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
				271 211	0 000

41

278

27'-3"

26'-9"

0.080

0.080

1.000

3-6 DH-103

158'-5"

118'-2"

ME-N002-05

ME-N002-06

TABLE 2

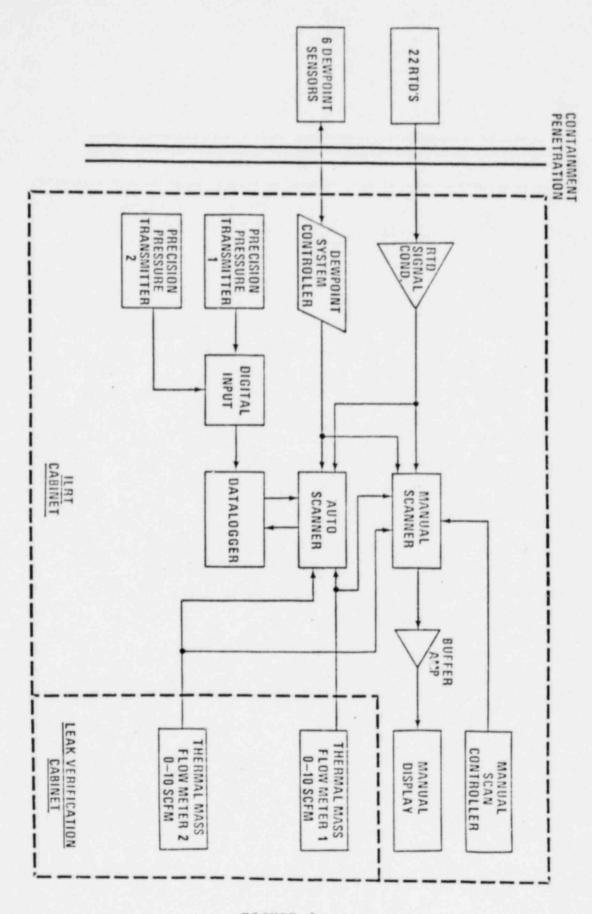
DRYWELL TEMPERATURE AND DEWPOINT SENSOR LOCATIONS AND VOLUME FRACTIONS (BYPASS TEST)

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"	$\frac{0.034}{1.000}$

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

DH-103 3-7

ILRT DATA ACQUISITION SYSTEM



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:

		Lam wt%/day			95% UCL wt%/day			
		I	II	III	I	II	III	
1.	ILRT/Mass Point ILRT/Total Time	0.072 0.068	0.076 0.072		0.079	0.083		
2.	Verification/ Mass Point Total Time	0.431		0.327-0.545 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,€
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

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

= $[(0.01)^2 + (0.01)^2]^{1/2}/(22)^{1/2}$
= $0.003^\circ F$ (°R)

2. Pressures

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

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

$$= 0.0014 \text{ psia}$$

3. Vapor Pressure

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

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,

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

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

$$= 0.00025 \text{ psi}$$

c. ISG Calculation for 8 hour ILRT

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

$$T = 77^{\circ}F + 460 = 537^{\circ}R$$

ISG =
$$\frac{+2400}{t}$$
 $\left[2\left(\frac{e}{P}p\right)^2 + 2\left(\frac{e}{P}pv\right)^2 + 2\left(\frac{e}{T}t\right)^2 \right]^{1/2}$

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

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

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

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

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:

- TIME: Time in 24-hour notations (hours and minutes).
- 2. DATE: Calendar date (month and day).
- 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:

- 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 (1bm) 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

- 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.
- 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

- 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:

$$P_1V = W_1RT_1 \tag{1}$$

$$P_{i}V = W_{i}RT_{i}$$
 (2)

$$L_{i} = \frac{2400 (W_{1} - W_{i})}{\Delta t_{i} W_{1}}$$
 (3)

Solving for ${\rm W}_1$ and ${\rm W}_i$ and substituting equations (1) and (2) into (3) yields:

$$L_{i} = 2400/\Delta t_{i} (1-T_{1}P_{i}/T_{i}P_{1})$$
(4)

where:

 W_1 , W_i = Weight of contained mass of dry air at times t_1 and t_i respectively, 1bm.

 T_1 , T_i = Containment atmosphere drybulb temperature at times t_1 and t_i respectively, ${}^{\circ}R$.

P₁, P_i = Partial pressure of the dry air component of the containment atmosphere at times t₁ and t_i respectively, psia.

V = Containment free air volume (assumed to be constant during the test), ft³.

 t_1 , t_i = Time at 1st and ith data points respectively, hours.

 Δt_i = Elapsed time from t_i to t_i , hours.

R = Specific gas constant for air = 53.35 ft.1bf/1bm.°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.

$$a = \frac{\sum L_{i}(\sum \Delta t_{i}^{2}) - \sum \Delta t_{i}(\sum L_{i}\Delta t_{i})}{N(\sum \Delta t_{i}^{2}) - (\sum \Delta t_{i})^{2}}$$
(6)

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

N = Number of data points

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

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

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

where:

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

For $\Delta t_N < 24$

$$S_{\overline{L}} = t_0.025; N-2 \left[\Sigma (L_i - \overline{L}_i)^2 / (N-2) \right]^{1/2} \times \left[1 + \frac{1}{N} + (\Delta t_N - \overline{\Delta t})^2 / \Sigma (\Delta t_i - \overline{\Delta t})^2 \right]^{1/2}$$
 (9a)

where,
$$t_0.025; N-2 = 1.95996 + \frac{2.37226}{N-2} + \frac{2.82250}{(N-2)^2};$$

For $\Delta t_N > 24$

$$S_{\overline{L}} = t_0.025; N-2 \left[\Sigma (L_i - \overline{L}_i)^2 / (N-2) \right]^{1/2} \times \left[\frac{1}{N} + (\Delta t_N - \overline{\Delta t})^2 / \Sigma (\Delta t_i - \overline{\Delta t})^2 \right]^{1/2}$$
 (9b)

where,
$$t_0.025; N-2 = \frac{1.6449(N-2)^2 + 3.5283(N-2) + 0.85602}{(N-2)^2 + 1.2209(N-2) - 1.5162}$$

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

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

- 2. Computation using the Mass Point Method
 - a. Contained mass of dry air from data:

$$W_{i} = 144 \frac{P_{i}V}{RT_{i}} \tag{10}$$

where:

All symbols as previously defined.

b. Calculated leakage rate from regression analysis:

$$\overline{L} = -2400 - a \tag{11}$$

where:

L = Calculated leakage rate, %/day, as determined from the regression line.

$$a = \frac{\sum W_i - b\sum \Delta t_i}{N}$$
 (12)

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

 Δt_i = Total elapsed time at time of ith data point, hours

N = Number of data points

W_i = Contained mass of dry air at ith data point, 1bm, as computed from equation (10).

$$\Sigma = \Sigma$$

$$i=1$$

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

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

$$\overline{L}_{95} = \frac{-2400}{a} (b + s_b)$$
 (14)

where:

L95 = Calculated leakage rate at the 95% confidence level, %/day.

$$S_b = t_0.025; N-2 \left[\frac{\Sigma(W_i - \overline{W_i})^2}{(N-2)\Sigma(\Delta t_i - \overline{\Delta t})^2} \right] 1/2$$
 (15)

where,
$$t_0.025; N-2 = \frac{1.6449(N-2)^2 + 3.5283 (N-2)^2 + 0.85602}{(N-2)^2 + 1.2209 (N-2) - 1.5162}$$

$$\overline{W}_{i}$$
 = Contained mass of dry air, 1bm, computed at the ith data point from the regression equation (16)

 $= a + b\Delta t_i$

All other symbols are previously defined.

DH-103

D. Program Logic

 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:

v	P	4	١,	Ť.	U	Ä	¥	
~	0	1	n					+
C	U	r	u	1	Э	Ω	¥	Ł

DATA

FUNCTION

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 Fime Report.

MASS Terminal will print out a Mass Point Report.

TERM Enables operator to sign-off temporarily or permanently.

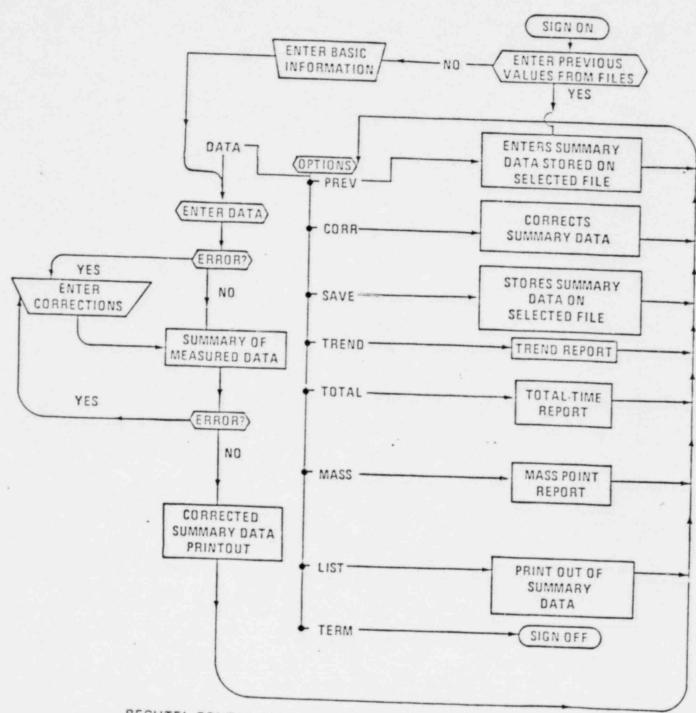
SAVE Enables operator to store the Data Summary on a file.

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 = 0.437VOL = 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 25.368984 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 103 535.95485 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 535.66150 103 26.332005 0.34202629 1900 103 535.61688 26.329777 0.34224480 103 1915 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

		IESI DHI		
GRAND (
	X = 0		VOL	= 1670000.00
VRATE	ET = (0.000 VRATEM	= 0.000	VRATEP = 0.000
ITME	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	535.04689	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		26.284437	0.34440356
400	104		26.283850	0.34499204
415	104		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(3 ELAPSED TIME: 8.00 HOURS

				O.VV HUUND		
TIME	TEMP (R)	PRESSURE (PSIA)	CTMT. AIR MASS (LEM)			AVG. MASS (LBM/HR)
2030	535.388	26.3164	221566.			
2045	535.372	25.3155	221565.	1.1		0. /
2100	535.347	26.3132	221556.	9.0		4.5
2115	535.322	26.3117	221553.	2.4		20.3
2130	535.286	26.3106	221559.			16.8
2145	535.270	26.3099		-5.4 -1.0		7.2
2200	535.236	26.3072				4.9
2215	535.220	26.3049	221551.			9.9
1 2230	535.192			12.5		15.6
2245	535.142	26.3043	221545.			10.6
2300		26.3028	221541.			10.9
	535.147	26.3018	221543.	-1.4		9.3
2315	535.117	26.3002	221541.	1.9		9.1
2330	535.104	25.2994	221540.	0.8		8.6
2345	535.095	26.2996	221545.	-5.1		6.4
0	535.067	26.2962	221529.	15.5		10.6
15	535.053	26.2971	221542.			6.4
30	535.034	26.2956	221537.	4.9		7.2
45	535.017	26.2937	221528.			8.8
100	534.994	26.2937	221537.			
115	534.984	26.2924	221531.			6.4
130	534.968	26.2915	221530.			7.4
145	534.963	26.2902	221521.	0.8		7.2
200	534.948	26.2899	221525.	8.9		8.6
215	534.939	26.2888		-4.2		7.4
230	534.924	26.2875	221519.	6.4		8.2
245	534.912	26.2877	221515.	4.1		8.5
300	534.898		221521.	-6.5		7.2
315	534.892	26.2864	221515.	5.9		7.8
330		26.2852	221508.	7.1		8.5
	534.879		221515.	-7.1		7.2
345	534.866	25.2844	221513.	2.8		7.4
400	534.852	26.2938	221514.	-1.0		7.0
415	534.848	25.2834	221511.	2.2		7.0
430	534.829	26.2831	221517.	-5.2		6.2
)	FREE AIR	VOLUME USE	D (MILLIONS (OF CU. FT.)	=	1.670
	REGRESSI					
		EFT (LBM)			= 2	21561.
	SLOPE	(LBM/HR)			=	-6.7
	MAXIMUM	ALLOWABLE L	EAKAGE RATE		=	0.437
	75 % DF	MAXIMUM ALL	OWABLE LEAKA	GE RATE	=	0.328
	THE UPPE	R 95% CONFI	DENCE LIMIT		=	0.079
		ULATED LEAK				0.077

0.072

THE CALCULATED LEAKAGE RATE

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.	PRESSURE (PSIA)	MEASURED LEAKAGE RATE	
	2030	The second secon			
	2045	the second of the A special	26.3155	0.050	
		535.347	26.3132		
	2115		26.3117	The second secon	
	2130	535.286	26.3106		
	2145	535.270	26.3099		
	2200	535.236	26.3072		
	2215	535.220	26.3049		
	2230	535.192	26.3043		
	2245				
	2300	535.147		The state of the s	
	2315	535.117	26.3002		
	2330	535.104	25.2994		
	2345	535.095	26.2996		
	0		26.2962	0.115	
	15	535.033	26.2971	0.069	
	30	535.034	26.2956	0.078	
	45	535.017	26.2937	0.096	
	100	534.994	26.2937		
	115	534.984			
	130	534.968			
	145			0.093	
	200	534.948		0.080	
	215	534.939		0.089	
	230	534.924	26.2875	0.093	
	245	534.912		0.078	
	300	534.898		0.078	
	315	534.892		0.092	
	330	534.879	26.2854	0.072	
	345	534.866	26. 2944		
	400	534.952	26.2838		
	415	534.848	25.2834	0.076	
	430	534.829	26.2831	0.067	
MEAN C	F MEASUR	RED LEAKAG	E RATES	=	0.09
MAXIME	M ALLOW	ABLE LEAKA	GE BATE		
75 % 0	F MAXIM	IM ALLOWAR	LE LEARAGE	RATE =	0.43
THE LIE	PER 95%	CONFIDENC	E LEAKAGE		0.33
THE CA	LCULATER	LEAKAGE	DATE	=	0.13
101		LEHRHUE	MHIE	=	0.08

GRAND GULF ILRI

TREND REPORT LEAKAGE RATES (WEIGHT PERCENT/DAY)

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

NO. DATA	ELAPSED	TOTAL-T	IME ANALYSIS	MASS-POINT	ANALYSIS
FOINTS	TIME	MEAN	CALCULATED	CALCULATED	95% UCL
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33	2.25 2.50 2.75 3.25 3.25 3.25 3.75 4.00 4.25 4.75 5.25 5.50 5.75 6.25 5.75 6.25 7.00 7.25 7.75 8.00	0.121 0.119 0.117 0.115 0.112 0.112 0.109 0.107 0.107 0.105 0.105 0.102 0.102 0.101 0.100 0.100 0.099 0.098 0.098 0.097 0.095 0.095	0.119 0.107 0.101 0.091 0.094 0.086 0.082 0.082 0.077 0.075 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.073 0.074 0.073 0.073 0.074 0.073 0.074 0.073 0.074 0.073	0.119 0.110 0.104 0.098 0.085 0.093 0.083 0.079 0.031 0.075 0.074 0.075 0.075 0.075 0.076 0.077 0.077 0.077 0.079 0.079	0.162 0.146 0.134 0.124 0.111 0.115 0.105 0.099 0.099 0.099 0.089 0.088 0.086 0.086 0.085 0.085 0.084 0.083 0.081

APPENDIX E ILRT PLOTS

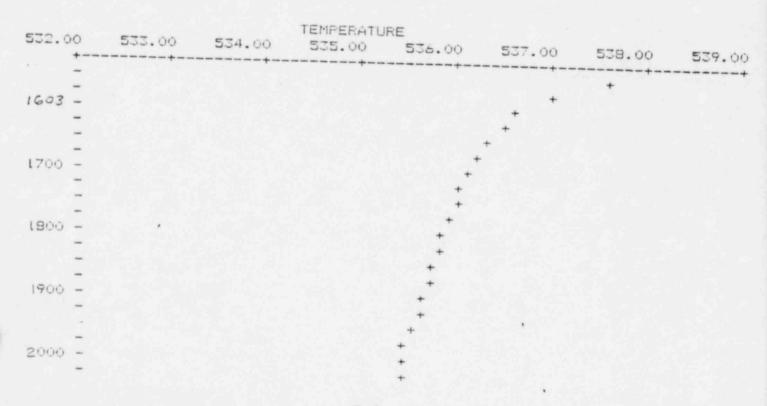
ILRT

			TEMPERATURE 533.00 534.00 535.00 536.00 537.00 538						
502.0	00	533.00	534.00	535.00	536.00	537.00	538.00	539.	
	_								
	-				+				
2100	-				+				
	-				+				
	-				+				
	-				+				
2200	-			+					
	-			+					
	-			+					
	-			+					
2200	-			+					
				+					
	-			+					
	-			+					
0	_			+					
	_			+					
	_			+					
100	_			+					
100				+					
				+					
				+					
200	_			+					
	_			+					
	_			+					
	_			+					
300	_			+					
	-								
	-			+					
	-			+					
400	-								
	-			+					
	-			+					
	-			+					
500	-			+					

VERIFICATION

532.0	00	533.00 534	TEMPERATION 535.00	URE 536.00	537.00	538.00	539.00
	-		+				+
	-						
	-						
600	-						
	-		+				
	_		+				
700	_		+				
700			+				
	-		+				
	_		+				
800	-						
	-						
	-		+				
	-		+				
900	-		+				
	-		* * * * * * * * * * * * * * * * * * * *				
	-		+				
1000	_		+				
1000			+				
			+				

STABILITATION



ILRT

26.15	N 74 DAD DI BEL	PRESSURE			
-0.10	0 26.200 26.250	26.300 26.35	0 25.400	26.450	26.50
	-		+		
		-			
2100	-	+			
		+			
	-	+			
	-	+			
2200	-	+			
	_	+			
		+			
2200	I	+			
		+			
		+			
	_	*			
Ù	-				
	-	+			
		+			
100		+			
		+			
		+			
200		+			
200		*			
		+			
		+			
300 -		. +			
		*			
400 -		+			
		+			
		+			
		+			
500 -		+			

VERIFICATION

25.15	50 26.200	26.250	PRESSURE 26.300	26.350	25.400	26.450	25.500
	-		+				+
			+				
	*** 1.11 T		+				
600			+				
	-		+				
			+				
-	-		+				
700	_		+				
	-		+				
			+				
800			+				
0.000			+				
	-	+					
		*					
900	_	, ,					
	-						
	_						
1000	-	-					
	-	+					

STABILIZATION

26.150	26.200	26.250	PRESSURE 26.300	26.350	26.400	26.450	25.500
-							+
1603 -						+	
1003 -							
					+		
1700 -					+		
				+			
_				+			
_				+			
1900 -				+			
_				+			
_				+			
_				+			
1900 -				+			
-				+			
				+			
_				+			
2000 -				+			
-				+			
				+			

ILRT

221000.	221100. 221200	AIRMASS . 221300.	221400.	221500.	221500.	221
					+	
2100 -					+	
-					+	
2200 -					+	
2200 -					+	
-				+		
2300 -				+		
-				+		
_				+		
0 -					+	
-				+		
_				+		
100 -				+		
-				+		
_				+		
200 -				+		
_				+		
-				+		
200 -				+		
-				, +		
400				+		
400 -				+		
-				+		
500 -				+		
				+		

VERIFICATION

22	1000.	221100.	221200. AI	RMASS 221300.	221400.	221500.	221600	2217
	-							
	+ 1					+		
	-					+		
500	F1.					+		
	_					+		
	_					+		
700	_					t		
	_				+			
	-				+			
	-				+			
800	-				Ţ			
	-				+			
	-				+			
900	_				+			
,,,,,	_				+			
	_			Line	+			
	-			+				
1000	-			+				
	-							

STABILIZATION

221	1000.	221100.	221200.	IRMASS 221300.	221400.	221500.	221500.	2217(
	-					+	+	+
1603	-						*	
1603	_						+	
							+	
							+	
1700	_						+	
* 7 500							*	
	_							
	-						_	
1800	_						+	
	_						+	
	_						+	
	_						+	
1900	_						+	
	_						+	
							+	
							+	
2000	-						+	
	-						+	

APPENDIX F VERIFICATION FLOW TEST

SUMMARY DATA

TEST. VER GRAND GULF VERIFICATION ALMAX = 0.437VDL = 1670000.00 **VRATET** = 0.432 VRATEM = 0.436 VRATEP = 0.364 TIME DATE TEMP PRESSURE VERS 515 104 534.80566 26.280268 0.34556079 530 534.79596 104 26.278370 0.34544951 545 104 534.78748 26.277615 0.34520060 600 104 534.77368 26.276218 0.34559339 615 104 534.75746 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 104 534.33062 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.		
645	534.757 534.764		221459.	8.2	32.8
700			221450.	9.1	
715	574.744	26.2697	221439.		38.6
730	534.735	26.2683	221431.	7.4	36.3
745	534.732	26.2575	221425.	6.4	34.2
800	554.728	26.2655	221410.	14.5	38.1
815	554.714	25.2546	221408.	2.2	34.0
1000	534.704	26.2623	221393.	15.0	37.2
830	554.699	26.2610	221385.	8.6	36.9
845	534.687	26.2592	221374.	10.7	37.5
900	534.587		221356.		40.7
915	534.673	THE REAL PROPERTY AND ADDRESS OF THE PARTY AND	221353.	2.2	
930	534.659		221329.	25.6	38.1
945	534.648	26.2522	221331.	-3.4	43.0
1000	534.641	26.2504	221319.	12.3	~ / . 0
1015	534.631	26.2499	221319.	-0.1	39.7 37.2
	FREE AIR	VOLUME USED	(MILLIONS (OF CU. FT.)	= 1.670
	REGRESSI	ON LINE EPT (LBM)			
		(LBM/HR)			= 221471.
					= -39.8
	VERIFICA	TION TEST LEA	AKAGE RATE L	JPPER LIMIT	= 0.545
		TAULT LEDI LED	THUE MAIN	OWER LIMIT	= 0.545 = 0.327
	THE CALC	ULATED LEAKAG	SE RATE	- Lilli	
					= 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.	PRESSURE (PSIA)	MEASURED LEAKAGE RATE	
615	534.767	26.2743		
630	534.757	26.2728	0.354	
040	334.764	26.2720	0.774	
700	554.744	26.2697	0 410	
/13	534.735	26.2683	0.704	
130	534.732	26.2675	0.370	
743	534.728	26.2655	0.413	
000	004.714	26.2646	0.749	
913	534.704	26.2623	0.407	
900	534.699	26.2610	0.700	
043	534.687	26.2592	0.404	
700	554.587	26.2570	0.444	
915	534.673	26, 2561	0.441	
930	534.659	24, 2527	0.413	
945	534.648	24 2522	0.466	
1000	534.641	26.2504	0.423	
1015	534.631	26.2499	0.403	
MEAN OF MEASL				
	ELFACADI	L MAIES	-	0.405
VERIFICATION	TEST LEGRA	SE PATE US	PER LIMIT =	
VERIFICATION	TEST LEAVO	SE PATE LO	VER LIMIT =	0.541
THE CALCULATE	D LEAKAGE	DATE LUI	WER LIMIT =	0.323
	- LLINGHOL I	HIE	=	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-T MEAN	THE ANALYSIS CALCULATED	MASS-POINT ANALYSIS
10 11 12 13 14 15 16	2.25 2.50 2.75 3.00 3.25 3.50 3.75 4.00	0.389 0.390 0.395 0.396 0.402 0.403 0.405	0.400 0.404 0.418 0.420 0.436 0.436 0.439 0.434	0.397 0.402 0.420 0.420 0.440 0.438 0.439 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:

LL = 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 = $F_2 - F_1$

F₁, F₂ = 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

 $P_2 = 17.785 \text{ psia}$

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

$$F_1 = 118070 \text{ cu.ft.}$$

$$F_2 = 86350 \text{ cu.ft}$$

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

$$(64.6959) \times (527.67)$$

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

- = 146295.19 cu.ft.
- (4) Bypass Leakage Rate Calculation:

$$\rm L_{L} = \left(\frac{17.793}{535.772} - \frac{17.785}{535.941}\right) \left(\frac{270,128x68}{60x4x14.6959}\right) + \frac{146295.19}{60x4}$$

= 609.7 SCFM

APPENDIX I

Local Leakage Test Summary Data Type B Test Results

enetration	Description	Leakage, SCC
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 7 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 7 0
218	Neutron Monitoring	0 7 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

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	
	Т	OTAL = 32 + 16

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

		935500		
Penetration	Description	Leakage,	SCCM	
5	Main Steam Line A	10,500 +	150	
6	Main Steam Line B	552 +		
7	Main Steam Line C	20 +		
8	Main Steam Line D	3,390 +		
17	Steam Supply to RCIC Turbine and RHR Hx	114.0 +	17	
19	Main Steam Drain to Condenser	4 +	100.00	
33	CRD Pump Discharge	0 +		
34	Containment Purge Supply	135 T		
35	Containment Purge Exhaust	80 +		
36	Plant Service Water Return	58 +		
37	Plant Service Water Supply	30 <u>+</u>	**	
38	Chilled Water Supply	1,250 +	120	
39	Chilled Water Return	20 +		
40*	ILRT Containment Pressurization/	20 1	12	
	Depressurization	286 +	12	
41	Plant Service Air	220 +		
42	Instrument Air	800 +		
43	RWCU to Main Condenser	10 +		
44				
45	Component Cooling Water Supply	40 +		
47	Component Cooling Water Return Reactor Recirculate Post Accident	48 <u>+</u>	17	
4/				
49	Sample	0 +	11	
49	RWCU Backwash Transfer Pump to Spent	70		
50	Resin Storage Tank	72 <u>+</u>	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 ±		
56	Condensate Makeup to Upper Containment Pool	230 +	11	
57	Discharge from Fuel Pool Cooling and C.U.			
	System to Upper Containment Pool	172 <u>+</u>	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'a)

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 +	
84	Drywell and Containment Chemical Waste	60 +	
85	Suppression Pool Cleanup Return	180 +	
86	Demineralization Water Supply to Containment	330 +	
87	RWCV Pump Suction from Recirculate Loops	60 +	
88	RWCV Pump Discharge to RWCV Ht. Exchange	40 +	
101C	Drywell Pressure Instrumentation	_	
1010	(Narrow Range)	0 +	12
101F	Drywell Pressure Instrumentation		
	(Wide Range)	6 +	12
102D	Drywell Pressure (Wide Range)	15 +	
103D	Containment Pressure (Wide Range)	10 +	
104D	Containment Pressure (Wide Range)	10 +	
105A	Containment Drywell H ₂ Analyzing	110 +	
106A	Drywell H ₂ Analyzing Sample	14 +	
106B	Drywell H ₂ Analyzing Sample Return	10 +	
106E	Containment H ₂ Analyzing Sample Return	10 +	
107B	Drywell H ₂ Analyzing Sample Return	158 +	
107D	Drywell H ₂ Analyzing Sample	50 +	
107E	Drywell H ₂ Analyzing Sample Return	15 +	
108A	Containment H ₂ Analyzing	95 +	
109A	Drywell - Fission Products Monitor Sample	0 +	
109B	Drywell - Fission Products Monitor Sample	_	
	Return	100 +	12
109D	Containment Pressure Instrument		-
1000	(Narrow Range)	10 +	12
110A	ILRT Instrumentation Drywell Pressure	0 +	
110C	ILRT Instrumentation Verification Flow	0 +	
110F	ILRT Instrumentation Containment Pressure	10 +	
114	Suppression Pool Water Level Control	9 +	
116	Suppression Pool Water Level Control	45 +	
118	Suppression Pool Water Level Control	7 +	
120	Suppression Pool Water Level Control	5 +	
120	Suppression root water never control	3 -	1.6

TOTAL = 22822 + 300

I-4

 $[\]star$ 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 7 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	8.5 + 5
40	Suppression Pool	0.5 + 5
67	RHR Pump B Test Line to Suppression Pool	503 + 54
69	Refueling Water Transfer Pump Suction	503 + 54
0,7	From Suppression Pool	50 + 7
71A		50 <u>+</u> 7
114	LPCS Relief Valve Discharge to Suppression Pool	0 + 0
71B		0 + 0
/10	RHR "C" Relief Valve Discharge to Suppression Pool	
73		917 + 74
/3	RHR Shutdown Relief Valve Discharge to	00 6 1 01
76 p	Suppression Pool (H.P.)	82.6 + 24
76B	RHR A Shutdown Suction Relief Valve	10 75 1 5
77	Discharge to Suppression Pool (H.P.)	12.75 + 5
//	RHR HT. Exchanger A Relief Valve Discharge	100 + 25
0.0	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