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Docket No. 50-397

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

Gentlemen:

Subject: NUCLEAR PLANT NO. 2
REACTOR CONTAINMENT BUILDING
INTEGRATED LEAK RATE TEST

References:
1) WNP-2 Final Safety Analysis Report, Washington Public Power Supply System.
2) Primary Reactor Containment Leakage Testing for Water Cooled Power Reactors, Code of Federal Regulations, Title 10, Part 50, Appendix J, January 1983
3) Leakage Rate Testing Containment Structures for Nuclear Reactors, American National Standards Institute, Inc., N.Y., NY; ANSI N45.4-1972
4) Letter, D. M. Crutchfield (NRC) to G. C. Sorensen (SS), "Issuance of Exemption to a Provision of Appendix J and Amendment No. 41 to Facility Operating License No. NPF-21 WPPSS Nuclear Project No. 2 (TAC No. 60740)", dated April 29, 1987

In accordance with the reporting requirements stipulated in reference 2), and in compliance with the testing commitments, regulations, and guidelines specified in references 1), 2), 3), and 4), the Reactor Containment Building Integrated Leak Rate Test, September 1987 is submitted.

Very truly yours,

G. C. Sorensen, Manager
Regulatory Programs

DAI/PJI/bk
Attachment

cc: JB Martin - NRC RV
NS Reynolds - BCP&R
RB Samworth - NRC
DL Williams - BPA, 399
NRC Site Inspector - 901A

A017
1/1

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REACTOR CONTAINMENT BUILDING
INTEGRATED LEAK RATE TEST

Washington Nuclear Plant Number Two (WNP-2)
Washington Public Power Supply System
Richland, Washington

September, 1987

A017

PCILRT FINAL REPORT

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PCILRT FINAL REPORT

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1.0 INTRODUCTION

This report documents the periodic Type A, B, and C testing performed on the Primary Reactor Containment of Washington Nuclear Plant Number Two (WNP-2) from February 1984 to June 1987. The plant consists of a GE BWR/5 NSSS System housed within a Mark II Over/ Under Containment.

Chronologically, the Preoperational Type A test, the "Preoperational Primary Contaminant Integrated Leak Rate Test" (PCILRT) (Ref. 5.11) was conducted from February 3, 1984 to February 16, 1984, various Type B&C tests were conducted, mostly occurring during the spring outages of 1985, 1986, and 1987, the second Type A Test was conducted from June 3, 1987 to June 17, 1987, then non-Type A tested penetration leak rates were summed with the calculated Type A test leak rate to arrive at the corrected "as-left" Type A test result.

This report is organized into three broad topics: SUMMARY, DISCUSSION, and CONCLUSION. Each topic consists of an appropriate level of information pertaining to the Type B & C Tests and the Type A Test. Finally, supporting information is provided in the ATTACHMENTS in sufficient detail to justify the CONCLUSIONS and to comply with regulatory and plant requirements (Ref. 5.1, 5.2 and 5.3).

Acronyms used in this report are listed in Attachment IV.

2.0 SUMMARY

2.1 Type B & C Tests

Type B&C local leak rate testing was performed during each of three annual spring outages since the pre-operational Integrated Leak Rate Test (ILRT), with the last testing period occurring just prior to the 1987 ILRT. The leakage rates listed below represent a summation of as-left maximum pathway penetration leakages applying single failure criteria to active containment boundary valves. The allowable leakage rate for the sum of each Type B&C test sequence was 67,920 sccm (0.6La). The summation of the as-found maximum pathway leakage rates exceeded 0.6La. An analysis and interpretation of the as-found test results is included in a supplement to this report.

2.1.1 Spring 1985 Outage

The measured leak rate for the sum of the as-left Type B&C tests was 54,859 sccm (0.485La).

2.1.2 Spring 1986 Outage

The measured leak rate for the sum of the as-left Type B&C tests was 36,741 sccm (0.325La).

2.1.3 Spring 1987 Outage

The measured leak rate for the sum of the as-left Type B&C tests was 21,616 sccm (0.191La).

2.2 Type A Test

The plant systems were lined up consistent with the requirements of references 5.1 and 5.2. Emergency Core Cooling Systems (RHR, LPCS and HPCS) were filled and available to perform their safety functions, with RHR Loops A and B used to maintain Reactor Pressure Vessel temperature within Technical Specification (Ref. 5.1) limits. SLC, RWCU, RFW, and the normally water filled portions of the PSR, RCIC, and FPC systems were also filled and, as in the case of RHR, LPCS and HPCS, were vented to see Pa via the head vent. The RCC, RWCU, and CRD systems, as well as the RRC seal injection and sample lines were filled and operating; therefore, the CIVs in these systems were not exposed to Pa. The remaining systems were drained and vented to both the Primary Reactor Containment (PRC) Atmosphere as well as outside the outermost CIV to the Reactor Building atmosphere.

The 23-hour Primary Containment Integrated Leak Rate Test (PCILRT) quantified the Overall Integrated Leakage Rate (OILR) of the PRC. The PCILRT was followed by the Leakage Rate Verification Test (LRVT), which was a four hour and 40 minute supplemental test using a constant-rate superimposed leak.

The recorded 95% Upper Confidence Level (UCL) leakage rate (LR) for the PCILRT was 0.2837 weight percent per day (w/o/day) (based on Total Time Calculated method) which was then corrected for valve lineup exceptions and drywell sumps water level increases to give 0.3241 w/o/day. Since 0.75 L_a is 0.375 w/o/day, the leakage rate is less than the acceptance criterion. For the LRVT, the corrected acceptance criterion, (based on a superimposed constant leakage rate of 0.4987 w/o/day, the measured Total Time PCILRT LR of 0.1615 w/o/day, and a correction factor), was 0.6629 w/o/day $\pm$ 0.125 w/o/day. The Total Time Calculated Leakage Rate, corrected for valve lineup test exceptions, was 0.6924 w/o/day; thus, the LRVT substantiated the validity of the PCILRT results.

3.0 DISCUSSION

3.1 Type B&C Tests

3.1.1 Methods

The penumatic Type B&C tests were performed utilizing the Pressure Decay and Makeup Flowrate methods. Hydrostatic Type C testing on water sealed valves was accomplished using the Makeup Flow Rate Method.

3.1.2 Specific Testing Categories, Acceptance Criteria, and Results

The first category consists of air and nitrogen - tested Type B&C penetrations. The measured Type B&C Leakage rate summations are tablulated in Table 1.

Outage Year	$\leq$ Type B	Σ Type C	$\leq$ B&C	Allowable Limit
1985	5587 sccm	49,272 sccm	54,859 sccm	67,920 sccm
1986	411 sccm	36,330 sccm	36,741 sccm	67,920 sccm
1987[1]	397 sccm	21,219 sccm	21,616 sccm	67,920 sccm

TABLE 1
LLRT RESULTS FOR TYPE B&C TESTING PERFORMED
SINCE PRE-OPERATIONAL ILRT

NOTE: 1 During the 1987 outage, all Type B penetrations were local leak rate tested. Type C testing was performed as allowed by the Exemption to Appendix J Testing issued by the NRC with Amendment No. 41 to Facility Operating License NPF-21. This allowed testing of approximately half of the Type C penetrations at each shutdown for refueling. During the 1987 outage, 46 of 75 Type C penetrations were tested. For those not tested, the leakage rates from the 1986 outage were used to calculate the total Type C Leakage rate listed in Table 1.

The second category is a subset of the above Type C tests, being the measured leakage rates on the secondary containment bypass lines that must be included in the sum of the Type B&C tests. The allowable leakage rate from these secondary containment bypass sources is 349.2 sccm. The measured leakage rates are tabulated in Table 2.

PENETRATION	SERVICE	LEAKAGE RATES (sccm) 1985	1986	1987
X-14	RWCU from RPV	16.24	98.8	98.8
X-22	MS Drain	2.14	13.0	133.4
X-77Aa	RRC Sample	11.44	176.7	81.2
X-92	DW Service to Drywell	2.4	0.0	4.0
	TOTALS	32.22	288.5	317.4

TABLE 2
LLRT Results for Secondary Bypass Leakage Sources

A special case of the above category makes up the third category and applies to the Main Steam Isolation Valves (MSIVs). They are similar to the second category in that any process line leakage passes directly from the PRC to the Turbine Building, thereby "bypassing" the SGT System. The line leakage is not added to the sum of the Type C leakage rates because the Main Steam Leakage Control System intercepts all leakage past the inboard CIV up to the allowable limit (See Ref. 5.1). The allowable leakage rate is 5428 sccm per valve and the test results are tabulated in Table 4.3. Testing was performed at a test pressure of 25 psig (per Ref. 5.1).

PENETRATION	LEAKAGE RATES (sccm) 1,2 1985	1986	1987
X-18A	3634	425	675
X-18B	1133	330	4932
X-18C	708	4955	589
X-18D	3964	142	411

TABLE 3
LLRT Results for the MSIV's

NOTES: 1 Pressure decay test performed between the inboard MSIV and the outboard MSIV; therefore, the LRs assigned to the penetrations are conservative with respect to the acceptance criteria.

2 Measured Leakage rates shown are as-left values. As-found leakage rates in excess of 5428 sccm are discussed in the Supplemental Report.

The fourth and last category pertains to Containment Isolation Valves (CIV) sealed with fluid from a seal system (Ref. 5.2). Hydrostatic tests were performed on 64 valves sealed by water during an accident event requiring Primary Reactor Coolant integrity. Leak rate testing was performed at a pressure equal to 1.1 Pa using the make-up flowrate method with water. The maximum allowable leakage rate per Reference 5.1 is 1.0 gpm per valve. The total measured leakage from all 64 valves was 0.069 gpm for the 1985 outage, 0.032 gpm for the 1986 outage, and 0.039 gpm for the 1987 outage. These values are not required to be included in the sum of the Type B&C leakage rates (see Refs. 5.1 and 5.2).

3.2 Type A Test

3.2.1 Methods

The absolute method of pressure decay testing was used for the PCILRT and the LRVT.

3.2.2 Data Collection and Reduction

The Data Acquisition System consisted of 17 drybulb temperature probes, 4 dew cells and 2 pressure sensors. Reference 5.13 indicated the location of each sensor and the volume of each containment subvolume. The only significant changes made to the sensors or their utilization since that documented in Ref. 5.13 for the preoperational PCICRT were the programmatic deletion of the output from the installed wetwell drybulb sensor TE-17 (it failed just prior to the PCICRT, necessitating the ignoring of its output and rearrangement of Wetwell subvolume assignments) and the physical deletion of ME-5 & 6 (these Wetwell dew cells were not installed because the Suppression Chamber atmosphere is essentially saturated under equilibrium conditions; hence, the program below was tailored to process the drybulb data as if it were reading water-saturated air). The sensors were connected to a Volumetrics Integrated Leak Rate Monitoring System (ILRMS), model 14629LC (Ref. 5.4), which printed out the measured value of each drybulb sensor and dew cell every 15 minutes. The quartz crystal pressure transducer outputs were continuously displayed on a digital readout panel and were likewise printed out every 15 minutes. The

raw data were then automatically transmitted to a computer located in the Main Control Room for the plant into which the ILRT computer program (Ref. 5.12) had been loaded. The pressure data were individually corrected for calibration inaccuracies by a subroutine in the program. The data were then accessed and the computer was directed to process same periodically by a terminal at the Test Center in the Reactor Building. The data printout tapes were simply a hard-copy backup of the data. Hardcopy printouts of the data and the attendant analyses were then obtained.

The computer program printouts consisted of individual sensor data, averaged sensor data, air partial pressure, calculated dry air mass and leakage rate. The program also allows determination of temperature stabilization based on Reference 5.6. The program allows the operator to examine and correct any data at any point in time. Plots of average temperature, dew point, pressure and calculated air mass may be displayed on the terminal and can be printed at any time. The program was developed in-house and was verified against data and results accepted for a prior ILRT at another plant. The same basic program was used for the preoperational PCILRT.

Reference 5.1 committed WNP-2 to using Reference 5.3 as the basic document for PRC leakage rate testing; therefore, there are two possible calculation methods that could be used for the reduction of the data for the PCILRT and the LRVT: The Total Time method and the Point to Point method. Of the two, the Total Time method has heen chosen as the basic method used at WNP-2. References 5.5 and 5.6 present the superior Mass Point method, which was also used for data reduction, the results of which are included for information only.

3.2.3 Plant Status During Tests

The systems were placed in the following four broad categories:

A. Systems filled with water and not vented to the Primary Reactor Containment atmosphere.

   1. Reactor Closed Cooling (RCC)

   2. Control Rod Drive (CRD)

   3. Reactor Recirculation (RRC), Seal Injection

B. Systems filled with water but vented to the Primary Reactor Containment atmosphere.

1. Residual Heat Removal (RHR)
2. High Pressure Core Spray (HPCS)
3. Low Pressure Core Spray (LPCS)
4. Standby Liquid Control (SLC)
5. Reactor Water Cleanup (RWCU)
6. Reactor Feed Water (RFW)
7. Reactor Core Isolation Cooling (RCIC), water-filled portions
8. Post Accident Sampling (PSR), Water-filled Portions
9. Fuel Pool Cooling (FPC), Supply

C. Systems On-Line

1. Control Rod Drive (CRD)
2. Reactor Recirculation (RRC), Seal Injection
3. Residual Heat Removal (RHR), A and B Loops
4. Reactor Water Cleanup (RWCU)
5. Containment Atmosphere Control (CAC)*
6. Sample Handling Equipment Hydrogen Oxygen Monitors
7. Reactor Closed Cooling (RCC)

*CIV's open but air pumps not running

D. All other systems penetrating the PRC were drained and vented to the PRC atmosphere as well as to the Reactor Building atmosphere.

In the above listing all of the CIVs and Boundary Valves were closed except those used for specific purposes (e.g. X-53: dual series Boundary Valves opened to give a flow path during the LRVT).

3.2.4 Major Test Events

This section discusses the testing, which and consisted of the following three major phases:

1. Temperature and Pressure Stabilization

2. 23 Hour PCILRT

3. 4+ Hour (Induced) LRVT

Temperature and Pressure Stabilization

Pressurization of the containment began at 1532 on June 7, 1987. The ILRT test pressure, P_a, was reached at about 2315 on June 7. Data were continuously collected from this time up to the conclusion of the ILRT testing sequence at 1244 on June 9. The stabilization period was started at 2334 on June 7 and was considered satisfactorily completed at 0334 on June 8.

Primary Containment Integrated Leakage Rate Test

The ILRT test was initiated at 0619 on June 8. The total containment pressure at this time was 50.459 psia (36.067 psig). Data were collected at 15 minute intervals for the next 23 hours.

Leakage Rate Verification Test

A four hour and 40 minute flow verification test was run immediately following the ILRT test. The verification test provides a method for assuring that systematic error or bias is given adequate consideration. This test consisted of superimposing a known leakage rate upon the existing leakage rate.

The verification test was started at 0804 on June 9 with an average superimposed LR of 3.94 scfm, which corresponds to a LR of 0.4987 w/o/day (see Attachment I.C). The data collection interval was reduced to ten minutes.

3.2.5 Acceptance Criteria and Results

Temperature Stabilization

The acceptance criterion used for the PCILRT was:

$$\left| \frac{(T_t - T_{t4})}{4\ \text{hrs}} - \frac{(T_t - T_{t1})}{1\ \text{hr}} \right| \leq 0.5°F/\text{hr}$$

where:

T_t = weighted average containment temperature at time, t

T_{t4} = weighted average containment temperature 4 hours prior to time, t

T_{t1} = containment temperature 1 hour prior to time, t

This method requires that the absolute average temperature change per hour over the last 4 hours minus the absolute average temperature change per hour over the last hour be less than 0.5°F. The result of using this analysis method, gleaned from Reference 5.6, is given in Attachment II, Table II.1, which presents the average dry bulb temperature, the 1 hour, 4 hour, and 4 hour minus 1 hour calculations for the time period of 2334 on June 7 to 0334 on June 8. As can be seen, the 4 hours minus 1 hour differential was only -0.0837°F, which meets the requirements of Ref. 5.14.

Primary Containment Integrated Leakage Rate Test

The acceptance criteria for the PCILRT is that the calculated 95 percent UCL leakage rate, L_{am} 95%, be less than 75 percent of the maximum allowable leakage rate, L_a. L_a is 0.5 weight percent per day and 75 percent of L_a is 0.375 weight percent per day. Therefore, the 95 percent UCL leakage rate, L_{am}, 95%, must be less than 0.375 weight percent per day.

The average temperature, pressure and air mass for the 23 hour ILRT are presented in Attachment II, Tables II.2 and II.3. Figure III presents the time history of the air mass in graphical form and is included for information only.

Attachment II, Table II.4 presents the summary of the leakage rate calculation based on the Total Time method. The Total Time L_{am}, 95% for the 23 hour test was 0.2837 percent per day, which is well below the acceptance criterion of 0.375 weight percent per day. The column labeled Calculated Leakage Rate is the calculated mean leakage rate.

The leakage rate calculated by the mass point method is presented in Table II.5. L_{am}, 95% based on the mass point method was 0.2080 weight percent per day, which is well below the acceptance criterion of 0.375 weight percent per day.

The PCILRT calculated result was corrected for the effects of improper valve lineup and water inventory changes, which are discussed below.

The effects caused by the improper valve lineup used during the PCILRT (and the LRVT) are tabulated in Table 4.

Penetration Number	Valve Numbers	Exception Discussion	Leakage Rate[1] (SCCM)
X-5	RCC-V-5 RCC-V-104	Note 4	86.1
X-14	RWCU-V-1 RWCU-V-4	Note 4	49.4
X-17A/17B	RFW-V-10A RFW-V-10B RFW-V-32A RFW-V-32B RFW-V-65A RFW-V-65B	Note 5	193.5
X-18B	MS-V-22B MS-V-28B MS-V-67B MSLC-V-3B	MS-V-67B manually blocked during PCILRT and LRVT	89.0
X-23	EDR-V-19 EDR-V-20	Note 5	18.0
X-24	FDR-V-3 FDR-V-4	Note 5	10.8
X-46	RCC-V-40 RCC-V-21	Note 4	10.1
X-533	CSP-V-800-2 CSP-V-800-24	Used for LRVT flow path	3.2
X-662	PI-V-X66-1 PI-V-X66-2	Used for PI-1 tap (wetwell pressure)	25.0[6]
X-77Aa	RRC-V-19 RRC-V-20	Note 4	6.3
X-93	SA-V-109 Pipe Cap	Pressurization path (pipe cap removed during PCILRT and LRVT)	0.0

Penetration Number	Valve Numbers	Exception Discussion	Leakage Rate[1] (SCCM)
X-95	MWR-V-125 Pipe Cap	Pressurization path (valve and cap removed; temporary valve and cap in place during PCILRT and LRVT)	0.0

TABLE 4

Valve Lineup Exceptions During the PCILRT and the LRVT

NOTES: 1. Obtained from LLRT Program.

2. Used in lieu of an instrument line.

3. Used only during the LRVT.

4. Line filled with water and CIVs open during both the PCILRT and the LRVT.

5. Line filled with water and CIVs closed but accident fluid is considered to be a gas.

6. These are small instrumentation test connections that are normally closed and capped and only tested during the PCILRT. The value given was simply assigned and was conservatively based on historic response of this type of valve to LLRTing.

Combining all of the factors of table 4 except for the LRVT-related penetration but adding an additonal factor for statiscial uncertainty adds 610.2 sccm to the PCILRT leakage rate, which is equivalent to 0.00272 w/o/day (see Attachment I.A). All of the factors were summed to add 614.2 sccm to the LRVT result (discussed later). This is equivalent to 0.00274 w/o/day (see Attachment I.B).

Two other correction factors were applied to the PCILRT results:

1) The drywell floor sump collected 20 inches of water during the course of the PCILRT and LRVT, and

2) The equipment drain sump collected eight inches of water during the course of the tests.

These two events added the equivalent of 0.0376 w/o/day to the PCILRT leakage rate (see Attachment I.A). Thus, the correction factor that was applied to the 95% UCL PCILRT LR was 0.0404 w/o/day (see Attachment I.A), which resulted in a total time 95% UCL PCILRT LR of 0.3241 w/o/day.

Leakage Rate Verification Test

The acceptance criteria for the Leakage Rate Verification test is:

$(L_o + L_{am} - 0.25\ L_a) \leq L_c \leq (L_o + L_{am} + 0.25\ L_a)$

where: L_o = Known superimposed leakage rate, w/o/day

L_{am} = Previously measured leakage rate, w/o/day

L_a = Maximum allowable leakage rate, w/o/day

L_c = Measured composite leakage rate, w/o/day

The superimposed leakage rate should be between 75 to 125 percent of L_a.

Data were collected at 10 minute intervals. Attachment II, Tables II.6 and II.7 present the data summary for the test. Attachment II, Table II.8 presents the leakage rate calculation based on the Total Time method. The measured composite leakage rate, L_c, was 0.6897 weight percent per day. The leakage rate based on a Mass Point calculation is given, for information only, in Attachment II, Table II.9.

Correcting L_c for the valve lineup factor previously presented (614.2sccm, or 0.00274 w/o/day) gives 0.6924 w/o/day.

Based on corrected lower and upper band limits of 0.5379 w/o/day and 0.7879 w/o/day, respectively, it is apparent that the instrumentation accurately tracked actual PRC atmospheric parameters.

Therefore, the LRVT was successfully passed and the agreement between the expected and measured LRs indicates that systematic errors were not a factor in the performance of the PCILRT.

Comparison of Results with Acceptance Criteria

The acceptance criteria and results for all tests are presented in Table 5.

Test	Date Completed	Acceptance Criteria (w/o/day)	Results		Corrections (w/o/day)	Corrected Results (Total Time) (w/o/day)
			Total Time (w/o/day)	Mass Point (w/o/day)		
PCILRT	6-09-87	0.375[3]	0.2837[1]	0.2080[1]	0.0404	0.3241[1]
LRVT	6-09-87	0.6629 ± 0.125[4]	0.6897[2]	0.6897[2]	0.0027	0.6924[2]

TABLE 5

Tabulation of the PCILRT and LRVT Results with Corrections

NOTES:

1. 95% UCL Value
2. Measured Value
3. Based on 0.75 La, where La = 0.5 w/o/day
4. Based on an induced leakage rate of 0.4987 w/o/day, a measured Primary Containment Integrated Leakage Rate of 0.1615 w/o/day, and a correction factor of 0.0027 w/o/day.

4.0 CONCLUSION

The as-left Type B&C tests performed since the completion of the Pre-Operational Type A test were in compliance with the acceptance criterion (67,920 sccm). Specifically, the 1985 outage result was 54,859 sccm, the 1986 outage result was 36,741 sccm, and the 1987 outage result was 21,616 sccm; thus, the respective Type B&C test sequences are considered to be successful.

The Type A test performed for this Report was the first Operational PCILRT. It commenced on June 8, 1987 at 0619 and was successfully completed on June 9, 1987 at 0519. This was followed by a successful LRVT on the same date between the hours of 0804 and 1244. Quantitatively, the Total Time 95% UCL PCILRT LR was 0.2837 w/o/day, uncorrected, and 0.3241 w/o/day when corrected for valve alignment and other irregularities. The Total Time measured LRVT LR, uncorrected, was 0.6897 w/o/day, with an induced LR of 0.4987 w/o/day, and a corrected LR of 0.6924 w/o/day. Since the acceptance criteria were 0.375 w/o/day and 0.6629 w/o/day +0.125 w/o/day, respectively, the former was considered successful and the latter adequately verified instrumentation and methodology veracity for the former.

5.0 REFERENCES

5.1 WNP-2 Final Safety Analysis Report, Washington Public Power Supply System.

5.2 Primary Reactor Containment Leakage Testing for Water Cooled Power Reactors, Code of Federal Regulations, Title 10, Part 50, Appendix J, January 1983.

5.3 Leakage Rate Testing of Containment Structures for Nuclear Reactors, American National Standards Institute, Inc., N.Y., NY; ANSI N45.4, 1972.

5.4 ILRT Console Operation, Volumetrics, Inc., for Model 14629-LC.

5.5 Containment System Leakage Testing Requirements, American Nuclear Society, LaGrange Park, IL; ANSI/ANS-56.8-1981.

5.6 Containment System Leakage Testing Requirements, American Nuclear Society, LaGrange Park, IL; N274, Draft No. 2, Revision 3, November 15, 1978.

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5.10 O.A. Hougen, K.M. Watson and R.A. Ragatz, Chemical Process Principles, Part 1, 2nd Edition, McGraw Hill Book Company, 1956.

5.11 Primary Containment Integrated Leak Rate Test, WNP-2 Pre-Operational Test Number PT 201.0-A, Revision 1, with Two Test Change Notices, February 2, 1984.

5.12 Integrated Leak Rate Test Analysis, Washington Public Power Supply System, February 1984.

5.13 Reactor Containment Building Integrated Leak Rate Test, WNP-2, May 1984.

5.14 Primary Containment Integrated Leak Rate Test, WNP-2 Plant Procedure Manual Number 7.4.6.1.2.1, Revision 0, with one Procedure Deviation, June 2, 1987.

ATTACHMENT I

LEAKAGE RATE CALCULATIONS

A. Corrections to the PCILRT Calculated Result.

1. LLRT Correction (Refer to Table 4)

a. $\Sigma LR = 86.1 + 49.4 + 193.5 + 89.0 + 18.0 + 10.8 + 10.1 + 25.0 + 6.3 + 0.0 + 0.0 + 122.0$ sccm
(25% of 488.2 included for statistical variance)
$= 610.2$ sccm

b. Conversion

$$\text{Correction} = \frac{(610.2)(60)(24)(100)\left(\frac{14.696}{50.414}\right)\left(\frac{76.948 + 459.69}{519.69}\right)}{(30.48)^3\ (343{,}040)}$$

$$= 0.002723 \text{ w/o/day}$$

2. Floor Drain, Radioactive (FDR) Sump Level change correction.

a. Level change: + 20 inches
(equivalent to 94.2 ft^3)

b. $$\text{Correction} = \frac{94.2}{343{,}040}\ (100)$$

$$= 0.02746 \text{ w/o/day}$$

3. Equipment Drain, Radioactive (EDR) sump level change correction.

a. Level change: +8 inches (equivalent to 34.9 ft^3)

b. $$\text{Correction} = \frac{34.9}{343{,}040}\ (100)$$

$$= 0.01017 \text{ w/o/day}$$

4. Overall correction

$$\text{Correction} = 0.00272 + 0.02746 + 0.01017$$
$$= 0.04035 \text{ w/o/day}$$

NOTE: No correction performed for an observed Suppression Pool level decrease of 0.85 inches because it was an assumed loss out of ECCS loops to other systems via Boundary Valves.

B. Correction to the LRVT measured result

NOTE: Liquid level changes were wholly incorporated into the PCILRT correction, this Attachment, Section A; therefore, this correction shall deal only with penetration corrections.

1. LLRT Correction (Refer to Table 4 and Section A.1, this Attachment)

a. $\leq$ LR = 488.2 + 3.2 + 122.8 sccm
[25% of 491.4 included for statistical variance]
= 614.2 sccm

b. conversion

$$\text{Correction} = \frac{(614.2)(60)(24)(100)\left(\frac{14.696}{50.279}\right)\left(\frac{76.405 + 459.69}{519.69}\right)}{(30.48)^3\ (343{,}040)}$$

$$= 0.002745 \text{ w/o/day}$$

C. LRVT CALCULATIONS

The superimposed leakage was 3.94 scfm. The average containment temperature and pressure were 76.405°F and 50.279 psia, respectively. The total containment volume was 343,040 ft^3. Therefore the superimposed leakage rate, L_o was:

$$L_o = (100\%)\ \frac{3.94 \text{ scfm}\left(\frac{14.696 \text{ psia}}{50.279 \text{ psia}}\right)\ \left(\frac{76.405 + 459.69 \text{ R}}{60 + 459.69 \text{ R}}\right)}{343{,}040 \text{ Ft}^3}\left(60\ \frac{\text{min}}{\text{hr}}\right)\left(\frac{24 \text{ hr}}{\text{Day}}\right)$$

= 0.49868 weight percent per day

The following values are therefore used to demonstrate compliance with the acceptance criteria.

L_o = 0.4987 weight percent per day

L_{am} = 0.1615 weight percent per day (measured)

L_a = 0.5 weight percent per day

L_c = 0.6897 weight percent per day (measured)

Using these values in the acceptance criteria equation:

$$(L_o + L_{am} - .25\ L_a) \leq L_c \leq (L_o + L_{am} + .25\ L_a)$$

$$[0.4987 + 0.1615 - .25(.5) \leq 0.6897 \leq [0.4987 + 0.1615 + .25(.5)]$$
$$0.5352 \leq 0.6897 \leq 0.7852$$

Incorporating the LRVT correction factor (This Attachment, Section B.1.b) produces:

$$0.5379 \text{ w/o/d} \leq 0.6924 \text{ w/o/d} \leq 0.7879 \text{ w/o/d}$$

ATTACHMENT II
DATA SUMMARIES

Table of Contents

TABLE II.1

ILRT, REFUELING OUTAGE 1987
TEST STARTED AT 2334 ON 6/ 7/87
TEMPERATURE STABILIZATION

DATA SET #	TIME (HR)	TEMP R	DELTA T 4-HR	DELTA T 1-HR	DELTA
1	23.57	537.1425			
5	0.57	536.8621			
9	1.57	536.8708			
13	2.57	536.8356			
17	3.57	536.9640	0.0446	0.1283	-0.0837

TABLE II.2

ILRT, REFUELING OUTAGE 1987
TEST STARTED AT 619 ON 6/ 8/87

AVERAGED MEASURED DATA

DATA SET #	TIME (HR)	TEMP (F)	DEWPT (F)	PRESSURE (PSI)
1	619	76.913	72.933	50.459
2	634	76.914	72.889	50.458
3	649	76.918	72.791	50.458
4	704	76.933	72.776	50.455
5	719	76.928	72.918	50.456
6	734	76.897	72.981	50.456
7	749	76.896	72.867	50.457
8	804	76.935	72.894	50.457
9	819	76.962	73.028	50.457
10	834	76.954	73.131	50.458
11	849	76.969	73.165	50.459
12	904	76.987	73.216	50.458
13	919	76.978	73.095	50.458
14	934	76.969	73.174	50.459
15	949	77.038	73.236	50.458
16	1004	77.011	72.880	50.456
17	1019	76.997	72.965	50.453
18	1034	76.955	73.204	50.450
19	1049	76.954	73.196	50.448
20	1104	76.944	73.217	50.447
21	1119	76.964	73.215	50.446
22	1149	76.959	73.121	50.440
23	1204	76.948	72.977	50.436
24	1219	76.900	72.973	50.430
25	1234	76.852	72.773	50.425
26	1249	76.856	72.630	50.422
27	1304	76.837	72.663	50.417
28	1319	76.831	72.631	50.415
29	1334	76.801	72.648	50.415
30	1349	76.810	72.615	50.416

TABLE II.2 (CONT'D)

DATA SET #	TIME (HR)	AVERAGED MEASURED DATA TEMP (F)	DEWPT (F)	PRESSURE (PSI)
31	1404	76.822	72.742	50.420
32	1419	76.871	72.725	50.424
33	1434	76.888	72.755	50.428
34	1449	76.920	72.795	50.433
35	1504	76.920	72.993	50.437
36	1519	76.987	73.017	50.441
37	1534	76.981	73.037	50.444
38	1549	77.017	73.051	50.445
39	1604	77.057	72.955	50.448
40	1619	77.090	73.155	50.452
41	1634	77.132	73.071	50.452
42	1649	77.132	72.795	50.453
43	1704	77.166	73.091	50.451
44	1719	77.179	73.288	50.449
45	1734	77.116	72.951	50.445
46	1749	77.158	72.198	50.441
47	1804	77.107	73.101	50.438
48	1819	77.109	73.039	50.435
49	1834	77.124	73.184	50.433
50	1849	77.088	72.917	50.429
51	1904	77.044	73.140	50.426
52	1919	77.052	73.230	50.423
53	1934	77.102	73.344	50.420
54	1949	77.037	73.110	50.419
55	2004	77.090	73.235	50.417
56	2019	77.051	73.425	50.415
57	2034	77.027	73.408	50.413
58	2049	77.037	73.421	50.412
59	2104	77.039	73.190	50.410
60	2119	77.021	73.010	50.409

TABLE II. 2 (CONT'D)

DATA SET #	TIME (HR)	AVERAGED MEASURED DATA TEMP (F)	DEWPT (F)	PRESSURE (PSI)
61	2134	77.075	73.338	50.408
62	2149	77.038	73.112	50.407
63	2204	77.047	73.470	50.407
64	2219	77.061	73.411	50.406
65	2234	77.091	73.325	50.404
66	2249	77.073	73.326	50.403
67	2304	77.057	73.543	50.403
68	2319	77.060	73.297	50.403
69	2334	77.077	73.264	50.404
70	2349	77.123	73.464	50.404
71	4	77.090	73.124	50.404
72	19	77.078	73.043	50.403
73	34	77.113	73.077	50.401
74	49	77.103	73.124	50.400
75	104	77.086	73.067	50.399
76	119	77.085	73.189	50.397
77	134	77.067	72.913	50.395
78	149	77.041	72.935	50.391
79	204	77.081	73.024	50.389
80	219	77.034	72.968	50.386
81	234	77.003	72.892	50.383
82	249	76.996	72.741	50.380
83	304	76.954	72.691	50.376
84	319	76.913	72.531	50.372
85	334	76.918	72.257	50.368
86	349	76.879	72.372	50.364
87	404	76.855	72.106	50.359
88	419	76.813	72.334	50.355
89	434	76.783	71.729	50.351
90	449	76.722	71.736	50.347
91	504	76.723	71.620	50.343
92	519	76.650	71.537	50.339

TABLE II.3

ILRT, REFUELING OUTAGE 1987
TEST STARTED AT 619 ON 6/ 8/87
CORRECTED DATA SUMMARY

DATA SET #	TIME (HRS)	TEMP (F)	PRESSURE AIR (PSI)	AIR MASS (LB)	PRESSURE TOTAL (PSI)
1	619	76.913	50.0578	86361.86	50.4590
2	634	76.914	50.0577	86361.55	50.4583
3	649	76.918	50.0585	86362.24	50.4578
4	704	76.933	50.0562	86355.86	50.4553
5	719	76.928	50.0548	86354.23	50.4558
6	734	76.897	50.0545	86358.62	50.4563
7	749	76.896	50.0565	86362.27	50.4568
8	804	76.935	50.0562	86355.40	50.4568
9	819	76.962	50.0549	86348.77	50.4573
10	834	76.954	50.0545	86349.47	50.4583
11	849	76.969	50.0552	86348.38	50.4595
12	904	76.987	50.0535	86342.47	50.4585
13	919	76.978	50.0544	86345.52	50.4578
14	934	76.969	50.0549	86347.80	50.4593
15	949	77.038	50.0530	86333.53	50.4583
16	1004	77.011	50.0553	86341.76	50.4558
17	1019	76.997	50.0512	86336.89	50.4528
18	1034	76.955	50.0450	86332.82	50.4498
19	1049	76.954	50.0430	86329.83	50.4478
20	1104	76.944	50.0417	86329.20	50.4468
21	1119	76.964	50.0408	86324.28	50.4458
22	1149	76.959	50.0365	86317.74	50.4403
23	1204	76.948	50.0340	86315.06	50.4357
24	1219	76.900	50.0285	86313.48	50.4302
25	1234	76.852	50.0262	86317.10	50.4252
26	1249	76.856	50.0246	86313.80	50.4217
27	1304	76.837	50.0195	86307.88	50.4170
28	1319	76.831	50.0184	86306.96	50.4155
29	1334	76.801	50.0177	86310.64	50.4150
30	1349	76.810	50.0193	86312.03	50.4162
31	1404	76.822	50.0216	86314.08	50.4202
32	1419	76.871	50.0254	86312.57	50.4237
33	1434	76.888	50.0295	86316.97	50.4282
34	1449	76.920	50.0339	86319.60	50.4332
35	1504	76.920	50.0348	86320.92	50.4368
36	1519	76.987	50.0385	86316.57	50.4408
37	1534	76.981	50.0412	86322.20	50.4438
~~38~~	~~1549~~	~~77.017~~	~~50.0425~~	~~86318.65~~	~~50.4453~~
39	1604	77.057	50.0463	86318.75	50.4478
40	1619	77.090	50.0476	86315.79	50.4518

TABLE II.3 (CONT'D)

DATA SET #	TIME (HRS)	TEMP (F)	PRESSURE AIR (PSI)	AIR MASS (LB)	PRESSURE TOTAL (PSI)
41	1634	77.132	50.0492	86311.89	50.4523
42	1649	77.132	50.0535	86319.19	50.4528
43	1704	77.166	50.0482	86304.57	50.4515
44	1719	77.179	50.0430	86293.53	50.4490
45	1734	77.116	50.0434	86304.29	50.4448
46	1749	77.158	50.0497	86308.42	50.4410
47	1804	77.107	50.0346	86290.56	50.4380
48	1819	77.109	50.0321	86286.08	50.4348
49	1834	77.124	50.0282	86276.73	50.4327
50	1849	77.088	50.0278	86281.82	50.4287
51	1904	77.044	50.0217	86278.63	50.4257
52	1919	77.052	50.0175	86270.04	50.4227
53	1934	77.102	50.0135	86255.00	50.4202
54	1949	77.037	50.0151	86268.32	50.4187
55	2004	77.090	50.0119	86254.25	50.4172
56	2019	77.051	50.0073	86252.54	50.4152
57	2034	77.027	50.0051	86252.54	50.4127
58	2049	77.037	50.0039	86248.92	50.4117
59	2104	77.039	50.0050	86250.51	50.4097
60	2119	77.021	50.0065	86255.89	50.4087

TABLE II.3 (CONT'D)

DATA SET #	TIME (HRS)	TEMP (F)	PRESSURE AIR (PSI)	AIR MASS (LB)	PRESSURE TOTAL (PSI)
61	2134	77.075	50.0010	86237.84	50.4077
62	2149	77.038	50.0036	86248.21	50.4072
63	2204	77.047	49.9987	86238.38	50.4072
64	2219	77.061	49.9980	86234.92	50.4057
65	2234	77.091	49.9972	86228.72	50.4037
66	2249	77.073	49.9967	86230.61	50.4032
67	2304	77.057	49.9937	86228.08	50.4032
68	2319	77.060	49.9971	86233.42	50.4032
69	2334	77.077	49.9980	86232.37	50.4037
70	2349	77.123	49.9958	86221.10	50.4042
71	4	77.090	50.0004	86234.47	50.4042
72	19	77.078	50.0005	86236.56	50.4032
73	34	77.113	49.9981	86226.69	50.4012
74	49	77.103	49.9964	86225.45	50.4002
75	104	77.086	49.9962	86227.75	50.3992
76	119	77.085	49.9925	86221.59	50.3972
77	134	77.067	49.9942	86227.48	50.3951
78	149	77.041	49.9899	86224.18	50.3911
79	204	77.081	49.9868	86212.39	50.3892
80	219	77.034	49.9845	86215.86	50.3861
81	234	77.003	49.9825	86217.45	50.3831
82	249	76.996	49.9811	86216.05	50.3796
83	304	76.954	49.9782	86217.93	50.3761
84	319	76.913	49.9764	86221.28	50.3721
85	334	76.918	49.9755	86219.00	50.3676
86	349	76.879	49.9700	86215.76	50.3636
87	404	76.855	49.9690	86217.88	50.3591
88	419	76.813	49.9620	86212.44	50.3551
89	434	76.783	49.9659	86224.15	50.3511
90	449	76.722	49.9618	86226.83	50.3471
91	504	76.723	49.9588	86221.55	50.3426
92	519	76.650	49.9559	86228.17	50.3386

TABLE II.4

ILRT, REFUELING OUTAGE 1987
TEST STARTED AT 619 ON 6/ 8/87
TOTAL TIME LEAK RATE
ELAPSED TIME = 23.00

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
2	0.26	76.9140	50.0577	0.03434	0.14533
3	0.51	76.9184	50.0585	-0.02050	0.14604
4	0.76	76.9333	50.0562	0.22042	0.14675
5	1.01	76.9283	50.0548	0.21078	0.14747
6	1.26	76.8974	50.0545	0.07170	0.14818
7	1.51	76.8964	50.0565	-0.00742	0.14889
8	1.76	76.9353	50.0562	0.10227	0.14961
9	2.01	76.9625	50.0549	0.18134	0.15032
10	2.26	76.9538	50.0545	0.15260	0.15103
11	2.51	76.9685	50.0552	0.14951	0.15175
12	2.76	76.9870	50.0535	0.19548	0.15246
13	3.01	76.9782	50.0544	0.15110	0.15317
14	3.26	76.9686	50.0549	0.12001	0.15389
15	3.51	77.0376	50.0530	0.22454	0.15460
16	3.76	77.0113	50.0553	0.14872	0.15531
17	4.01	76.9971	50.0512	0.17324	0.15603
18	4.26	76.9555	50.0450	0.18960	0.15674
19	4.51	76.9535	50.0430	0.19752	0.15745
20	4.76	76.9436	50.0417	0.19082	0.15817
21	5.01	76.9638	50.0408	0.20859	0.15888
22	5.51	76.9591	50.0365	0.22266	0.16031
23	5.75	76.9482	50.0340	0.22621	0.16100
24	6.01	76.8996	50.0285	0.22384	0.16173
25	6.26	76.8524	50.0262	0.19885	0.16245
26	6.51	76.8558	50.0246	0.20530	0.16316
27	6.76	76.8372	50.0195	0.22203	0.16387
28	7.01	76.8314	50.0184	0.21778	0.16459
29	7.26	76.8006	50.0177	0.19616	0.16530
30	7.51	76.8099	50.0193	0.18451	0.16601

TABLE II.4 (CONT'D)

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
31	7.76	76.8219	50.0216	0.17122	0.16673
32	8.01	76.8714	50.0254	0.17109	0.16744
33	8.26	76.8881	50.0295	0.15111	0.16815
34	8.51	76.9195	50.0339	0.13808	0.16887
35	8.76	76.9203	50.0348	0.12995	0.16958
36	9.01	76.9868	50.0385	0.13975	0.17029
37	9.26	76.9812	50.0412	0.11909	0.17101
38	9.51	77.0174	50.0425	0.12632	0.17172
39	9.76	77.0575	50.0463	0.12280	0.17243
40	10.01	77.0899	50.0476	0.12797	0.17315
41	10.26	77.1317	50.0492	0.13542	0.17386
42	10.51	77.1317	50.0535	0.11288	0.17457
43	10.76	77.1659	50.0482	0.14803	0.17529
44	11.00	77.1789	50.0430	0.17264	0.17598
45	11.25	77.1161	50.0434	0.14221	0.17669
46	11.50	77.1576	50.0497	0.12914	0.17741
47	11.75	77.1068	50.0346	0.16863	0.17812
48	12.01	77.1088	50.0321	0.17541	0.17885
49	12.26	77.1244	50.0282	0.19304	0.17957
50	12.51	77.0884	50.0278	0.17787	0.18028
51	12.75	77.0435	50.0217	0.18140	0.18098
52	13.00	77.0516	50.0175	0.19628	0.18169
53	13.25	77.1017	50.0135	0.22411	0.18240
54	13.50	77.0369	50.0151	0.19256	0.18312
55	13.75	77.0900	50.0119	0.21749	0.18383
56	14.00	77.0512	50.0073	0.21699	0.18454
57	14.25	77.0269	50.0051	0.21319	0.18526
58	14.50	77.0368	50.0039	0.21645	0.18597
59	14.75	77.0393	50.0050	0.20979	0.18668
60	15.00	77.0212	50.0065	0.19632	0.18740

TABLE II.4 (CONT'D)

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
61	15.25	77.0748	50.0010	0.22599	0.18811
62	15.50	77.0381	50.0036	0.20376	0.18882
63	15.75	77.0468	49.9987	0.21787	0.18954
64	16.00	77.0608	49.9980	0.22047	0.19025
65	16.25	77.0905	49.9972	0.22768	0.19096
66	16.50	77.0733	49.9967	0.22106	0.19168
67	16.75	77.0571	49.9937	0.22194	0.19239
68	17.00	77.0601	49.9971	0.20996	0.19310
69	17.25	77.0767	49.9980	0.20860	0.19382
70	17.50	77.1229	49.9958	0.22353	0.19453
71	17.75	77.0897	50.0004	0.19944	0.19524
72	18.00	77.0777	50.0005	0.19345	0.19596
73	18.25	77.1125	49.9981	0.20582	0.19667
74	18.50	77.1026	49.9964	0.20491	0.19738
75	18.75	77.0859	49.9962	0.19877	0.19810
76	19.00	77.0849	49.9925	0.20516	0.19881
77	19.25	77.0667	49.9942	0.19400	0.19952
78	19.50	77.0411	49.9899	0.19621	0.20024
79	19.75	77.0806	49.9868	0.21031	0.20095
80	20.00	77.0345	49.9845	0.20287	0.20166
81	20.25	77.0032	49.9825	0.19817	0.20238
82	20.50	76.9962	49.9811	0.19766	0.20309
83	20.75	76.9540	49.9782	0.19276	0.20380
84	21.00	76.9132	49.9764	0.18603	0.20452
85	21.25	76.9181	49.9755	0.18683	0.20523
86	21.50	76.8789	49.9700	0.18884	0.20594
87	21.75	76.8550	49.9690	0.18396	0.20666
88	22.00	76.8135	49.9620	0.18874	0.20737
89	22.25	76.7831	49.9659	0.17199	0.20808
90	22.50	76.7224	49.9618	0.16678	0.20880
91	22.75	76.7230	49.9588	0.17139	0.20951
92	23.00	76.6503	49.9559	0.16153	0.21022

TOTAL TIME LEAK RATE = 0.210222
ESTIMATE OF STANDARD DEVIATION = 0.0433
95% UPPER CONFIDENCE LIMIT LEAK RATE = 0.2837
MAXIMUM ALLOWABLE LEAK RATE = 0.375

TABLE II.5

ILRT, REFUELING OUTAGE 1987
TEST STARTED AT 619 ON 6/ 8/87
MASS POINT LEAK RATE
ELAPSED TIME = 23.00

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
3	0.51	76.9184	50.0585	-0.02050	0.19966
4	0.76	76.9333	50.0562	0.22042	0.19966
5	1.01	76.9283	50.0548	0.21078	0.19966
6	1.26	76.8974	50.0545	0.07170	0.19966
7	1.51	76.8964	50.0565	-0.00742	0.19966
8	1.76	76.9353	50.0562	0.10227	0.19966
9	2.01	76.9625	50.0549	0.18134	0.19966
10	2.26	76.9538	50.0545	0.15260	0.19966
11	2.51	76.9685	50.0552	0.14951	0.19966
12	2.76	76.9870	50.0535	0.19548	0.19966
13	3.01	76.9782	50.0544	0.15110	0.19966
14	3.26	76.9686	50.0549	0.12001	0.19966
15	3.51	77.0376	50.0530	0.22454	0.19966
16	3.76	77.0113	50.0553	0.14872	0.19966
17	4.01	76.9971	50.0512	0.17324	0.19966
18	4.26	76.9555	50.0450	0.18960	0.19966
19	4.51	76.9535	50.0430	0.19752	0.19966
20	4.76	76.9436	50.0417	0.19082	0.19966
21	5.01	76.9638	50.0408	0.20859	0.19966
22	5.51	76.9591	50.0365	0.22266	0.19966
23	5.75	76.9482	50.0340	0.22621	0.19966
24	6.01	76.8996	50.0285	0.22384	0.19966
25	6.26	76.8524	50.0262	0.19885	0.19966

TABLE II-5 (CONT'D)

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
26	6.51	76.8558	50.0246	0.20530	0.19966
27	6.76	76.8372	50.0195	0.22203	0.19966
28	7.01	76.8314	50.0184	0.21778	0.19966
29	7.26	76.8006	50.0177	0.19616	0.19966
30	7.51	76.8099	50.0193	0.18451	0.19966
31	7.76	76.8219	50.0216	0.17122	0.19966
32	8.01	76.8714	50.0254	0.17109	0.19966
33	8.26	76.8881	50.0295	0.15111	0.19966
34	8.51	76.9195	50.0339	0.13808	0.19966
35	8.76	76.9203	50.0348	0.12995	0.19966
36	9.01	76.9868	50.0385	0.13975	0.19966
37	9.26	76.9812	50.0412	0.11909	0.19966
38	9.51	77.0174	50.0425	0.12632	0.19966
39	9.76	77.0575	50.0463	0.12280	0.19966
40	10.01	77.0899	50.0476	0.12797	0.19966
41	10.26	77.1317	50.0492	0.13542	0.19966
42	10.51	77.1317	50.0535	0.11288	0.19966
43	10.76	77.1659	50.0482	0.14803	0.19966
44	11.00	77.1789	50.0430	0.17264	0.19966
45	11.25	77.1161	50.0434	0.14221	0.19966
46	11.50	77.1576	50.0497	0.12914	0.19966
47	11.75	77.1068	50.0346	0.16863	0.19966
48	12.01	77.1088	50.0321	0.17541	0.19966
49	12.26	77.1244	50.0282	0.19304	0.19966
50	12.51	77.0884	50.0278	0.17787	0.19966
51	12.75	77.0435	50.0217	0.18140	0.19966
52	13.00	77.0516	50.0175	0.19628	0.19966
53	13.25	77.1017	50.0135	0.22411	0.19966
54	13.50	77.0369	50.0151	0.19256	0.19966
55	13.75	77.0900	50.0119	0.21749	0.19966
56	14.00	77.0512	50.0073	0.21699	0.19966

TABLE II.5 (CONT'D)

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
57	14.25	77.0269	50.0051	0.21319	0.19966
58	14.50	77.0368	50.0039	0.21645	0.19966
59	14.75	77.0393	50.0050	0.20979	0.19966
60	15.00	77.0212	50.0065	0.19632	0.19966
61	15.25	77.0748	50.0010	0.22599	0.19966
62	15.50	77.0381	50.0036	0.20376	0.19966
63	15.75	77.0468	49.9987	0.21787	0.19966
64	16.00	77.0608	49.9980	0.22047	0.19966
65	16.25	77.0905	49.9972	0.22768	0.19966
66	16.50	77.0733	49.9967	0.22106	0.19966
67	16.75	77.0571	49.9937	0.22194	0.19966
68	17.00	77.0601	49.9971	0.20996	0.19966
69	17.25	77.0767	49.9980	0.20860	0.19966
70	17.50	77.1229	49.9958	0.22353	0.19966
71	17.75	77.0897	50.0004	0.19944	0.19966
72	18.00	77.0777	50.0005	0.19345	0.19966
73	18.25	77.1125	49.9981	0.20582	0.19966
74	18.50	77.1026	49.9964	0.20491	0.19966
75	18.75	77.0859	49.9962	0.19877	0.19966
76	19.00	77.0849	49.9925	0.20516	0.19966
77	19.25	77.0667	49.9942	0.19400	0.19966
78	19.50	77.0411	49.9899	0.19621	0.19966
79	19.75	77.0806	49.9868	0.21031	0.19966
80	20.00	77.0345	49.9845	0.20287	0.19966
81	20.25	77.0032	49.9825	0.19817	0.19966
82	20.50	76.9962	49.9811	0.19766	0.19966
83	20.75	76.9540	49.9782	0.19276	0.19966
84	21.00	76.9132	49.9764	0.18603	0.19966
85	21.25	76.9181	49.9755	0.18683	0.19966
86	21.50	76.8789	49.9700	0.18884	0.19966
87	21.75	76.8550	49.9690	0.18396	0.19966
88	22.00	76.8135	49.9620	0.18874	0.19966
89	22.25	76.7831	49.9659	0.17199	0.19966
90	22.50	76.7224	49.9618	0.16678	0.19966
91	22.75	76.7230	49.9588	0.17139	0.19966
92	23.00	76.6503	49.9559	0.16153	0.19966

MASS POINT LEAK RATE = 0.199657
ESTIMATE OF STANDARD DEVIATION = 11.6535
STANDARD DEVIATION OF SLOPE = 0.181
STANDARD ESTIMATE OF INTERCEPT = 2.4210
COVARIANCE OF SLOPE AND INTERCEPT = -0.3790
95% UPPER CONFIDENCE LIMIT LEAK RATE = 0.2080
MAXIMUM ALLOWABLE LEAK RATE = 0.375

TABLE II.6

ILRT, INDUCED LEAK VERIFICATION 1987
TEST STARTED AT 804 ON 6/ 9/87

AVERAGED MEASURED DATA

DATA SET #	TIME (HR)	TEMP (F)	DEWPT (F)	PRESSURE (PSI)
1	804	76.309	71.030	50.296
2	814	76.309	71.181	50.295
3	824	76.327	71.329	50.293
4	834	76.303	71.339	50.290
5	844	76.316	71.263	50.289
6	854	76.277	71.222	50.288
7	904	76.325	71.277	50.287
8	914	76.280	71.135	50.284
9	924	76.313	71.338	50.283
10	934	76.299	71.260	50.283
11	944	76.304	71.264	50.282
12	954	76.366	71.493	50.281
13	1004	76.352	71.572	50.277
14	1014	76.325	71.678	50.276
15	1024	76.357	71.390	50.276
16	1034	76.403	71.533	50.275
17	1044	76.404	71.446	50.275
18	1054	76.410	71.585	50.274
19	1104	76.398	71.431	50.274
20	1114	76.442	71.707	50.274
21	1124	76.479	71.623	50.273
22	1134	76.464	71.709	50.273
23	1144	76.502	71.717	50.272
24	1154	76.478	71.944	50.272
25	1204	76.479	71.728	50.267
26	1214	76.482	71.843	50.267
27	1224	76.504	71.932	50.267
28	1234	76.527	71.797	50.267
29	1244	76.570	72.042	50.267

TABLE II.7

ILRT, INDUCED LEAK VERIFICATION 1987
TEST STARTED AT 804 ON 6/ 9/87
CORRECTED DATA SUMMARY

DATA SET #	TIME (HRS)	TEMP (F)	PRESSURE AIR (PSI)	AIR MASS (LB)	PRESSURE TOTAL (PSI)
1	804	76.309	49.9203	86221.67	50.2965
2	814	76.309	49.9174	86216.53	50.2955
3	824	76.327	49.9135	86206.96	50.2935
4	834	76.303	49.9103	86205.36	50.2905
5	844	76.316	49.9103	86203.24	50.2895
6	854	76.277	49.9099	86208.71	50.2885
7	904	76.325	49.9082	86198.06	50.2875
8	914	76.280	49.9065	86202.41	50.2840
9	924	76.313	49.9034	86191.71	50.2835
10	934	76.299	49.9039	86194.82	50.2830
11	944	76.304	49.9028	86192.28	50.2820
12	954	76.366	49.8994	86176.39	50.2815
13	1004	76.352	49.8943	86169.76	50.2774
14	1014	76.325	49.8919	86170.10	50.2764
15	1024	76.357	49.8952	86170.52	50.2760
16	1034	76.403	49.8928	86159.05	50.2755
17	1044	76.404	49.8935	86160.02	50.2750
18	1054	76.410	49.8912	86155.09	50.2745
19	1104	76.398	49.8932	86160.46	50.2745
20	1114	76.442	49.8891	86146.31	50.2740
21	1124	76.479	49.8897	86141.44	50.2735
22	1134	76.464	49.8886	86141.89	50.2735
23	1144	76.502	49.8875	86133.94	50.2725
24	1154	76.478	49.8845	86132.68	50.2725
25	1204	76.479	49.8817	86127.72	50.2669
26	1214	76.482	49.8802	86124.59	50.2669
27	1224	76.504	49.8791	86119.16	50.2669
28	1234	76.527	49.8808	86118.48	50.2669
29	1244	76.570	49.8776	86106.04	50.2669

TABLE II.8

ILRT, INDUCED LEAK VERIFICATION 1987
TEST STARTED AT 804 ON 6/ 9/87
TOTAL TIME LEAK RATE
ELAPSED TIME = 4.67

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
2	0.17	76.3095	49.9174	0.85783	0.73597
3	0.33	76.3272	49.9135	1.22819	0.73103
4	0.50	76.3032	49.9103	0.90788	0.72609
5	0.67	76.3162	49.9103	0.76937	0.72115
6	0.83	76.2773	49.9099	0.43277	0.71621
7	1.00	76.3252	49.9082	0.65706	0.71128
8	1.17	76.2800	49.9065	0.45945	0.70634
9	1.33	76.3132	49.9034	0.62546	0.70140
10	1.50	76.2993	49.9039	0.49826	0.69646
11	1.67	76.3040	49.9028	0.49085	0.69152
12	1.83	76.3657	49.8994	0.68742	0.68658
13	2.00	76.3524	49.8943	0.72243	0.68164
14	2.17	76.3249	49.8919	0.66256	0.67670
15	2.33	76.3571	49.8952	0.61020	0.67177
16	2.50	76.4033	49.8928	0.69719	0.66683
17	2.67	76.4040	49.8935	0.64348	0.66189
18	2.83	76.4099	49.8912	0.65407	0.65695
19	3.00	76.3980	49.8932	0.56796	0.65201
20	3.17	76.4423	49.8891	0.66241	0.64707
21	3.33	76.4790	49.8897	0.67000	0.64213
22	3.50	76.4641	49.8886	0.63448	0.63719
23	3.67	76.5020	49.8875	0.66601	0.63226
24	3.83	76.4778	49.8845	0.64617	0.62732
25	4.00	76.4791	49.8817	0.65379	0.62238
26	4.17	76.4824	49.8802	0.64854	0.61744
27	4.33	76.5037	49.8791	0.65849	0.61250
28	4.50	76.5269	49.8808	0.63830	0.60756
29	4.67	76.5698	49.8776	0.68967	0.60262

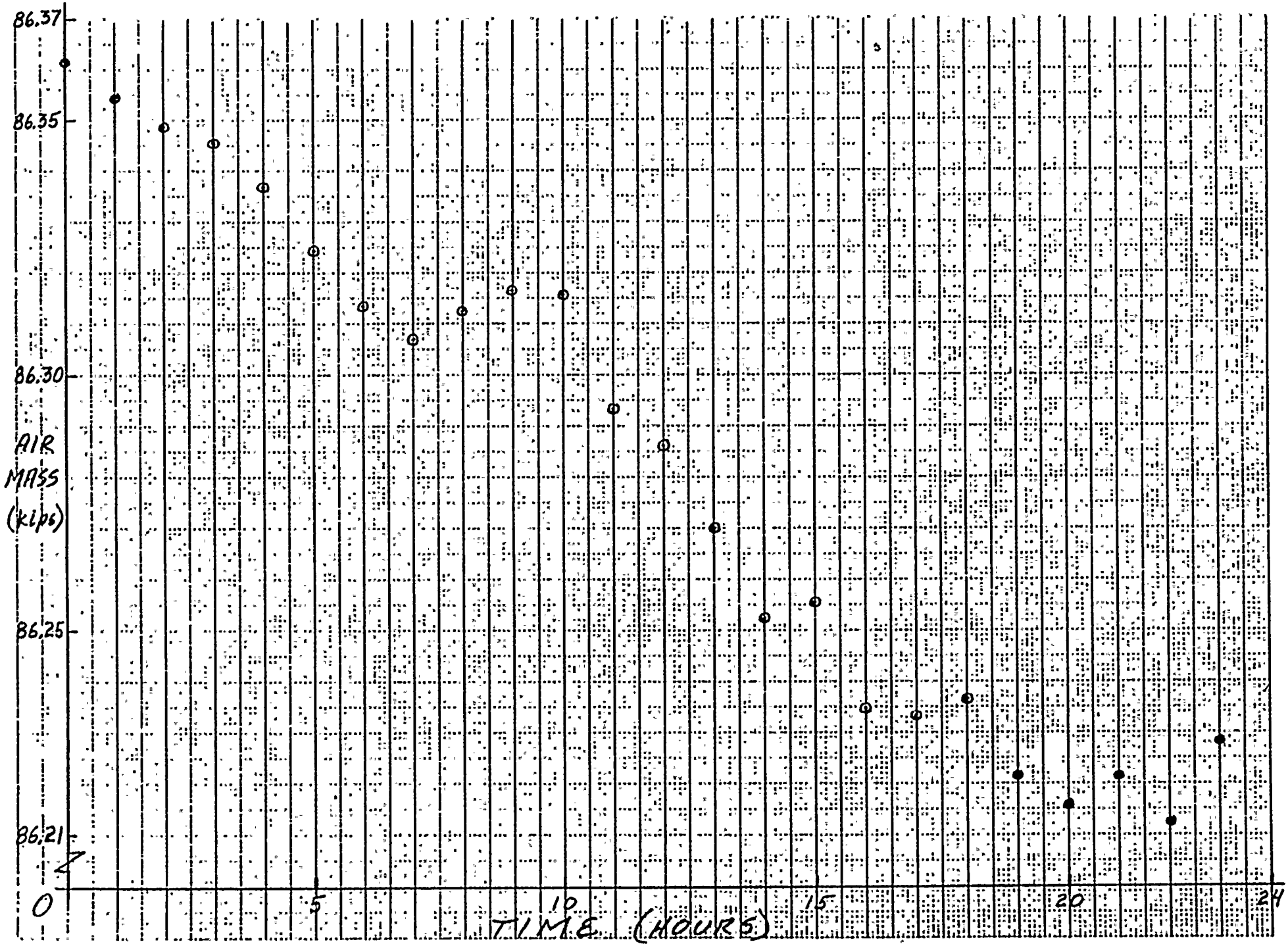
TOTAL TIME LEAK RATE = 0.602624
ESTIMATE OF STANDARD DEVIATION = 0.1462
95% UPPER CONFIDENCE LIMIT LEAK RATE = 0.8684
MAXIMUM ALLOWABLE LEAK RATE = 0.375

TABLE II.9

ILRT, INDUCED LEAK VERIFICATION 1987
TEST STARTED AT 804 ON 6/ 9/87
MASS POINT LEAK RATE
ELAPSED TIME = 4.67

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
3	0.33	76.3272	49.9135	1.22819	0.65634
4	0.50	76.3032	49.9103	0.90788	0.65634
5	0.67	76.3162	49.9103	0.76937	0.65634
6	0.83	76.2773	49.9099	0.43277	0.65634
7	1.00	76.3252	49.9082	0.65706	0.65634
8	1.17	76.2800	49.9065	0.45945	0.65634
9	1.33	76.3132	49.9034	0.62546	0.65634
10	1.50	76.2993	49.9039	0.49826	0.65634
11	1.67	76.3040	49.9028	0.49085	0.65634
12	1.83	76.3657	49.8994	0.68742	0.65634
13	2.00	76.3524	49.8943	0.72243	0.65634
14	2.17	76.3249	49.8919	0.66256	0.65634
15	2.33	76.3571	49.8952	0.61020	0.65634
16	2.50	76.4033	49.8928	0.69719	0.65634
17	2.67	76.4040	49.8935	0.64348	0.65634
18	2.83	76.4099	49.8932	0.65407	0.65634
19	3.00	76.3980	49.8932	0.56796	0.65634
20	3.17	76.4423	49.8891	0.66241	0.65634
21	3.33	76.4790	49.8897	0.67000	0.65634
22	3.50	76.4641	49.8886	0.63448	0.65634
23	3.67	76.5020	49.8875	0.66601	0.65634
24	3.83	76.4778	49.8845	0.64617	0.65634
25	4.00	76.4791	49.8817	0.65379	0.65634
26	4.17	76.4824	49.8802	0.64854	0.65634
27	4.33	76.5037	49.8791	0.65849	0.65634
28	4.50	76.5269	49.8808	0.63830	0.65634
29	4.67	76.5698	49.8776	0.68967	0.65634

MASS POINT LEAK RATE = 0.656335
ESTIMATE OF STANDARD DEVIATION = 4.5042
STANDARD DEVIATION OF SLOPE = 0.600
STANDARD ESTIMATE OF INTERCEPT = 1.6305
COVARIANCE OF SLOPE AND INTERCEPT = -0.8395
95% UPPER CONFIDENCE LIMIT LEAK RATE = 0.6847
MAXIMUM ALLOWABLE LEAK RATE = 0.375


86.37
86.35
86.30
AIR MASS (klbs)
86.25
86.21
0
5
10
15
20
24
TIME (HOURS)

ATTACHMENT IV
GLOSSARY

CIV - Containment Isolation Valve

DAS - Data Acquisition System

DF - Drywell Floor (horizontal concrete slab separating the Drywell from the Wetwell)

FVM - Flow Verification Monitor (part of ILRMS)

ILRMS - Integrated Leak Rate Monitoring System

ILRT - Same as PCILRT

ILRTA - Integrated leak Rate Test Analysis (Ref. 5.12)

La - Maximum Allowable PRC LR, in w/o/d (=0.5 w/o/d for WNP-2)

Lam Measured PRC LR, in w/o/d

Lc - Measured composite LR, in w/o/d (= value obtained by performance of the LRVT)

LLRT - Local Leakage Rate Test (Type B or C test)

LR - Leakage Rate

LRVT - Leakage Rate Verification Test (the supplemental test performed just after the Type A test)

MSIV - Main Steam Isolation Valve (CIVs in Main Steam Lines)

OILR - Overall Integrated Leakage Rate

Pa - Peak Accident Pressure (34.7 psig)

PCILRT - Primary Containment Integrated Leakage Rate Test (Type A Test)

Pd - PRC Design Pressure (45 psig)

PRC - Primary Reactor Containment

RB - Reactor Building

RPV - Reactor Pressure Vessel

SCCM - Standard Cubic Centimeters per Minute

UCL - Upper Confidence Limit

w/o/d - Weight Percent Per Day

X -____- PRC Penetration (Blank filled in with the specific identifying numeral)

SUPPLEMENTAL SUMMARY REPORT
APPENDIX J - TYPE A, B & C
AS-FOUND TEST RESULTS

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PLANT NO. 2

September 1987

PCILRT SUPPLEMENTAL SUMMARY REPORT
AS-FOUND TEST ANALYSIS

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PCILRT SUPPLEMENTAL SUMMARY REPORT

LIST OF TABLES

1.0 INTRODUCTION

During each annual spring outage in 1985, 1986 and 1987, Type B and C local leak rate testing was performed on Primary Containment Isolation Valves as prescribed by Appendix J, WNP-2 FSAR and Plant Technical Specifications. Leak testing is initially performed with valves in their "as-found" condition, i.e., prior to any adjustments or repairs which would affect a valve's leakage characteristics. Each Type C penetration is analyzed for total leakage using single failure criteria to arrive at the 'maximum pathway' leakage rate total for that containment penetration. The total penetration leakage reported is the greatest leak rate calculated from considering all possible single failures of active isolation boundaries.

The Primary Containment Integrated Leak Rate Test (PCILRT) was conducted at the end of the 1987 outage, after Type B & C testing was complete. Several isolation valves were repaired prior to the PCILRT due to excessive leakage detected from LLRT's or due to scheduled maintenance on resilient seals. The ILRT results (as-left) are adjusted by the difference in minimum pathway leakage rates before and after repairs or maintenance activities to arrive at the Type A "as-found" value.

The totals for Type B & C testing for the 1985, 1986 and 1987 outages yielded as-found values greater than 0.6 La. The deficiencies which led to the excessive leakages and the corrective actions taken to reduce the total leakage to below 0.6 La are included in the discussion section of this report.

The adjusted Type A As-Found leakage results, corrected for the differences in minimum pathway leakage rates before and after repairs on Type C valves, exceeded the maximum allowable rate of 0.75 La. The factors contributing to the as-found failure are detailed below in the discussion section of this report.

2.0 DISCUSSION

2.1 Type B & C Testing

During the 1985, 1986 and 1987 testing sequences, the total Type B & C As-Found leakage rates exceed 0.6 La (67,920 sccm). Several valves had leakage rates in excess of the measuring capabilities of the testing instruments used or could not be pressurized to the required test pressure (Pa). For these valves, the as-found leakage rate is conservatively reported as greater than 0.6 La.

During the 1987 outage testing sequence, significant efforts were made to establish the leakage quantity of each isolation valve in series when tested simultaneously by pressurizing between the two valves. In this way, the as-found minimum pathway leakage rate for a given penetration could be established for use in arriving at the As-Found Type A leakage rate.

Tables 1, 2 & 3 list the isolation valves repaired or otherwise adjusted due to excessive as-found leakage and includes a description of the deficiency which caused the excessive leakage and the corrective action taken to reduce the leakage, thus lowering the overall Type B and C leak rate below 0.6 La.

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-5	RCC-V-107	3/4"	Test Connection	327	4.2	Damaged Seat/Disassembled and Machined Seats
X-5	RCC-V-5	10"	Closed Cooling Isolation	10,313.5	8.8	Torque Switch Set Too Low/Reset Torque Switch
X-17A	RFW-V-32A	24"	Feedwater Check Valve	>0.6 La	176	Soft Seat Damaged/Replaced Seat
X-17A	RFW-V-65A	24"	Feedwater Manual Remote Isolation	25,066.3	5746	Defect Unknown/Disassembled and Cleaned
X-17B	RFW-V-10B	24"	Feedwater Check Valve	>0.6 La	0	Soft Seat Damaged/Replaced Seat
X-17B	RFW-V-32B	24"	Feedwater Check Valve	>0.6 La	579	Soft Seat Damaged/Replaced Seat
X-22	MS-V-16	3"	Main Steam Drains Isolation	170.6	2.14	Debris Under Seat/Flushed and Stroked
X-23	EDR-V-20	3"	Equipment Drains Isolation	254	4.44	Debris on Seats/Flushed with Water
X-24	FDR-V-3	3"	Floor Drains Isolation	>0.6 La	920	Debris on Seats/Disassembled and Lapped
X-24	FDR-V-4	3"	Floor Drains Isolation	548.4	521	Debris on Seats/Disassembled and Lapped
X-25A	RHR-V-27A	6"	Spray Header Isolation	2330	0.08	Debris under Seat/Disassembled and Cleaned
X-25A	RHR-V-130A	3"	Spray Header Test Line Isolation	>0.6 La	2.9	Seat Damaged/Valve Locked Shut & Added Valve Downstream

TABLE 1
1985 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-25B	RHR-V-27B	6"	Spray Header Isolation	>0.6 La	4360	Debris under Seat/Flushed with Water
X-46	RCC-V-21	10"	Closed Cooling Isolation	3566	24.88	Damaged Seat/Disassembled and Lapped
X-49	HPCS-V-12	4"	Min Flow Line Isolation	>0.6 La	2044	Torque Switch Malfunction/Replaced Torque Switch
X-56	CIA-V-21	3/4"	Instrument Air Isolation	1686.3	89.1	Debris under Seat/Flushed with air
X-63	LPCS-V-57	3/4"	Test Connection	117.8	14.34	Debris under Seat/Flushed with water
X-64	RCIC-V-28	1.5"	RCIC Vacuum Pump Return	868	219.95	Damaged Seat/Disassembled and Lapped
X-89B	CIA-V-31A	1/2"	Instrument Air Isolation	4385.9	64.06	Debris under Seat/Disassembled and Cleaned
X-102	CAC-V-4	4"	H_2 Recombiner Isolation	>0.6 La	1067.2	Torque Switch set too Low/Increased Switch Setting
X-103	CAC-V-13	4"	H_2 Recombiner Isolation	>0.6 La	492	Debris under Seat/Disassembled and Cleaned
X-119	CSP-V-10	24"	Containment Purge Isolation Vacuum Breaker	>0.6 La	25.5	Worn Seal/Replaced Seal
X-119	CSP-V-9	24"	Containment Purge Isolation	>0.6 La	25.5	Worn Seal Ring and Packing Leak/Replaced Seal Ring

TABLE 1 (Cont'd)
1985 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-3	CEP-V-800-2	3/4"	Test Connection	1490	20	Seat Damage/Disassembled, Machined and Lapped
X-4	RCIC-V-40	10"	RCIC Turbine Exhaust Return	10,360	188.9	Seat Damage/Disassembled and Lapped Seat
X-11A	RHR-V-154A	3/4"	Test Connection	355	0	Debris Underseat/Disassembled Machined and Lapped
X-21	RCIC-V-76	1"	Min. Flow Bypass Isolaton	13,970	0	Valve Packing Leak/Repacked Valve Stem
X-24	FDR-V-3	3"	Floor Drains Isolation	>0.6 La	1.1	Debris on Seats/Disassembled, Cleaned, Lapped
X-24	FDR-V-4	3"	Floor Drains Isolation	>0.6 La	420	Debris on Seats/Disassembled, Clean, Lapped
X-25B	RHR-V-27B	6"	Spray Header Isolation	>0.6 La	9	Damaged Seats/Disassembled and Lapped
X-49	HPCS-V-12	4"	Min. Flow Line Isolation	>0.6 La	93.7	Seat Damage/Disassembled and Lapped Seats
X-49	HPCS-V-36	3/4"	Test Connection	588	302	Debris under Seat/Flushed with Water
X-49	HPCS-V-72	3/4"	Test Connection	>0.6 La	0.7	Seat Damage/Disassembled Lapped Seat
X-56	CIA-V-21	3/4"	Instrument Air Isolation	>0.6 La	378	Seat Damaged/Installed New Valve
X-64	RCIC-V-28	1.5"	RCIC Vacuum Pump Return	679	447	Debris under Seat/Disassembled and Cleaned

TABLE 2
1986 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-77Aa	RRC-V-19	1"	Sample Line Isolation	>0.6 La	176.7	Seat Damage/Disassembled and Lapped Seats
X-77Aa	RRC-V-20	1"	Sample Line Isolation	>0.6 La	35.9	Stem Binding and Worn O-Rings/ Disassembled, Straightened Stem and Replaced O-Rings
X-89B	CIA-V-31A	1/2"	Instrument Air Isolation	1107	129	Debris under Seat/Flushed with Air
X-98	CAC-V-800-13	3/4"	Test Connection	1130	0	Damaged Seat/Disassembled, Machined and Lapped
X-101	FPC-V-161	3/4"	Test Connection	796	38.3	Damaged Seat/Disassembled, Machined and Lapped
X-102	CAC-V-4	4"	H_2 Recombiner Isolation	>0.6 La	1529	Deficiency Unknown/Valve Replaced with New Valve
X-103	CAC-V-13	4"	H_2 Recombiner Isolation	859	149	Debris under Seat/Flushed with Air
X-103	CAC-V-800-11	3/4"	Test Connection	8260	16	Debris under Seat/Flushed with Air
X-103	CAC-V-800-12	3/4"	Test Connection	1800	377	Debris under Seat/Flushed with Air
X-119	CSP-V-10	24"	Containment Purge Vacuum Breaker	>0.6 La	32	Limit Switch Holding Vacuum Breaker Open/Reset Limit Switch

TABLE 2 (Cont'd)
1986 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-4	RCIC-V-68	10"	RCIC Turbine Exhaust	591	383	Closing Torque too High/Decreased Torque Setting
X-4	RCIC-V-122	3/4"	Test Connection	509	2.7	Debris under Seat/Flushed with Air
X-14	RWCU-V-612	3/4"	RWCU Test Connection	12,220	6.46	Distorted Seat/Lapped Seat
X-17A/B	RFW-V-65A/B	24"	Feedwater Isolation (Remote Manual Operation)	10,550	7439	Deficiency Unknown/Stroked Valves
X-24	FDR-V-3/4	3"	Floor Drains Isolation Valves	27,000	16.5	Debris under Seat/Flushed with Water
X-49	HPCS-V-23	12"	Test Line Isolation	18.4	78.2	Torque Switch Setting too High/ Decreased Torque Setting
X-49	HPCS-V-36	3/4"	Test Connection	612	3.3	Scored Seats/Lapped Seats
X-56	CIA-V-21	3/4"	Instrument Air Isolation	7380	4.4	Debris under Seat/Disassembled, Cleaned and Lapped
X-65	RCIC-V-120	3/4"	Test Connection	556	0.1	Seat Damage/Lapped Seats
X-66	CSP-V-7	24"	Containment Purge Vacuum Breaker	3720	0	Debris on Seating Surface/Cleaned Seat
X-67	CEP-V-3A	24"	Containment Purge Exhaust Isolation	>0.6 La	59.5	Replaced Resilient Seat

TABLE 3
1987 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-67	CSP-V-8	24"	Containment Purge Vacuum Breaker	>0.6 La	0	Debris on Seating Surface/Cleaned Seat
X-77Aa	RRC-V-20	1"	RRC Sample Point Isolation	859	81.2	Defective Resilient Seals/Replaced Valve
X-91	CIA-V-31B	1/2"	Instrument Air Isolation	1950	39.6	Debris under Seat/Cleaned and Lapped
X-101	FPC-V-156	6"	Effluent Return Line Isolation	9820	20.4	Deficiency Unknown/Stroked Valve
X-119	CSP-V-9	24"	Containment Purge Isolation	3130	43.2	Worn Seat/Replaced Resilient Seat

TABLE 3 (Cont'd)
1987 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

2.2 Main Steam Isolation Valves (MSIV's)

The as-found leak rates for the MSIV's are shown in Table 4. These valves are tested @ 25 psig in accordance with Plant Technical Specifications and are not included in the sum of Type B and C testing. However, these isolation boundaries are subject to the Type A test and as such, their leak rates are reflected in the total Type A results. The allowable leak rate per Technical Specifications is 5427 sccm per valve.

Penetration No.	Valve No.	As-Found Leakage Rates (SCCM) 1985	1986	1987
18A	MS-V-22A	3631	12,460[1]	675
	MS-V-28A		895	
18B	MS-V-22B	10,021[1]	397	10,088[1]
	MS-V-28B	493		2,768
18C	MS-V-22C	697	4,965	37,356[1]
	MS-V-28C			2,568
18D	MS-V-22D	3,957	14,158[1]	411
	MS-V-28D		1,488	

Note 1. Valve repaired and subsequently retested.

TABLE 4
AS-FOUND LEAK RATES FOR MSIV's

2.3 Type A Testing

The as-left Type A test results were corrected to include the minimum pathway leak rate differential for Type B and C containment isolation boundaries which were repaired or otherwise adjusted during the refueling outage just prior to the 1987 PCILRT. This corrected value is referred to as the As-Found Type A leak rate. The containment boundaries which were repaired or adjusted during the 1987 outage and their as-found and as-left minimum pathway leak rates are listed in Table 5.

The total adjustment for repaired or adjusted Type B & C penetrations from Table 4 was 17,627.47 sccm. Adding 25% to this for statistical uncertainty yields a total correction of 0.0983 w/o/day (22,034.33 sccm). Adding this figure to the as-left Type A leak rate (total time 95% UCL value, per Ref. 6.1) of 0.3241 w/o/day, yields a total as-found Type A leak rate of 0.4224 w/o/day. This does not exceed the maximum allowable leakage rate (La) of 0.5 w/o/day (Ref. 6.2) but does exceed the As-Found acceptance criteria set forth in the NRC I.E., Information Notice 85-71 of 0.75 La.

The major contributing factor to the As Found correction value was Penetration X-24 which is the floor drain line exiting containment. This penetration yielded a delta minimum pathway leak rate (As-Found vs. as-left) of 13,491.75 sccm which constitutes 76% of the total delta leak rate. The isolation valves are 3" Ø air operated gate valves. Due to the inherent characteristics of the floor drain water, debris is trapped on the seating surfaces of the valves upon closing. This is evident in that vigorous water flushing of the line corrected the as-found excessive leak rate measured during Type C testing of these isolation valves. This is a reoccurring problem as evidenced in Tables 1, 2, 3. WNP-2 Plant Staff is pursuing design changes to eliminate this source of excessive as-found leakage.

Consistent with the Type C Testing Program as outlined in Reference 6.3, penetration X-24 isolation valves along with all other isolation valves which exhibited excessive leak rates during the 1987 outage testing period will be leak tested yearly during the annual spring refueling outage. This yearly testing will continue until such time that the isolation valves exhibit acceptable leak rates in the as-found condition.

Penetration No.	Test Type	Component Replaced/ Repaired/Adjusted	As-Found Min. Pathway (SCCM)	As-Left Min. Pathway (SCCM)	△Min. Pathway For As-Found ILRT (SCCM)
X-000	B	Containment Head O-Rings Replaced	1527.07	11.6	1515.47
X-4	C	RCIC-V-68 Repaired RCIC-V-122 Repaired	302.9	194.2	108.7
X-13	C	SLC-V-4A Replaced Internals (Squib Valve)	1.4	2.4	-1.0
X-14	C	RWCU-V-612 Repaired	98.8	49.4	49.4
X-15	B	Equipment Hatch	1.49	1.17	.32
X-18B	Note 1	MS-V-22B Repaired MS-V-67B Repaired	2768	2466	302
X-18C	Note 1	MS-V-22C Repaired	2568	294.5	2273.5
X-24	C	FDR-V-3 Adjusted FDR-V-4 Adjusted	13,502.6	10.85	13491.5
X-27F-1	B	TIP Purge Flange - Replaced	24.38	0	24.38
X-28	B	CRD Hatch - Replaced O-Rings	4.67	0	4.67
X-51	B	Wetwell Hatch - Replaced O-Rings	6.33	4.15	2.18
X-56	C	CIA-V-21 Repaired	24.9	4.4	20.5

TABLE 5
MINIMUM PATHWAY LEAK RATES
FOR AS-FOUND TYPE A ADJUSTMENT

Penetration No.	Test Type	Component Replaced/ Repaired/Adjusted	As-Found Min. Pathway (SCCM)	As-Left Min. Pathway (SCCM)	△ Min. Pathway For As-Found ILRT (SCCM)
X-66	C	CSP-V-5 Replaced Seat CSP-V-7 Adjusted	2099.7	391.9	1707.8
X-67	C	CEP-V-3A Replaced Seat CEP-V-4A Replaced Seat CSP-V-6 Replaced Seat CSP-V-8 Adjusted	917.6	2878.5	-1960.9
X-91	C	CIA-V-31B	64.1	39.6	24.5
X-101	C	FPC-V-156 Adjusted	20.4	0	20.4
X-119	C	CSP-V-9 Replaced Seat	135.7	91.9	43.8

Total Adjustment 17627.47 sccm

NOTE 1 Main Steam Isolation Valve (MSIV) testing per Technical Specifications. MISV's are tested at each refueling outage but the leak rate is not included in the sum of Type B & C tests. MISV's are subject to Type A test pressure.

TABLE 5 (Cont'd)
MINIMUM PATHWAY LEAK RATES
FOR AS-FOUND TYPE A ADJUSTMENT

3.0 ILRT LEAKAGE RATE CALCULATIONS

A. PRESSURE DECAY ANALYSIS METHODS

There are several methods available for analysis of containment integrated leak rate data. The most commonly used methods are:

1. Mass point analysis
2. Total time analysis
3. Point to point analysis

A computer program was developed for the purpose of computing the containment leakage rate by all three methods (Ref. 6.9).

The mass point method consists of calculating the mass of air in the containment from the volume averaged temperature, dewpoint and pressure data by application of the perfect gas law. The test data consists of a time series of independent values of air mass. Assuming the leak rate is constant with time, the data lends itself to analysis by the method of linear regression. The slope of the regression line represents the rate of change of air mass with time, or leak rate. Because of its independent nature, any error in a data set does not materially affect the test results. This is the most accurate method of analysis and is recommended in References 6.5 and 6.6.

The total time method is base on comparing the most recent data with the data taken at the start of the test. Thus each successive calculation is based on a longer time period. The leak in percent per day is determined by applying linear regression analysis to the leakage rate calculated at each time point (1).

The point to point method is similar to the total time method except that the leakage rate at each time point is determined using the most recent data and the data imediately preceeding. The leakage rate is determined for each data time interval and the overall leak rate is obtained by application of linear regression to the leakage rate at each time point.

This section presents the theoretical basis, justification and derivations of formulae used in the computer program. The WPPSS ILRT program can calculate the leakage rate by all three methods.

(1) This is one of the methods approved by Reference 6.4 and is the one chosen by WPPSS as the primary reporting methods.

1. Mass Point Method

The individual temperature and dewpoint readings are volume averaged according to a volume fraction assigned to each sensor. This averaging process is the same for all three methods of calculating leak rate.

The average containment drybulb temperature, T_{aj}, at time j is:

$$T_{aj} = \sum_{i=1}^{n} f_i \, T_{i,j}$$

where:

f_i = Volume fraction of containment associated drybulb sensor i

$T_{i,j}$ = Drybulb sensor i reading at time j

The average dewpoint temperature at time j, $T_{DP,j}$ is:

$$T_{DP,j} = \sum f_i \, T_{dp\ i,j}$$

where:

f_i = Volume fraction of containment associated drybulb sensor i

$T_{i,j}$ = Dewpoint reading of sensor i at time j

If two pressure sensors are used, the averaged pressure is simply:

$$P_{Total} = 0.5\ (P_A + P_B)$$

where:

P_A and P_B are the two pressure readings

The mass of air is calculated from the ideal gas law.

(1) $PV = NRT$

where:

P = air pressure, psia

V = volume, ft^3

N = lb moles of air

R = ideal gas law constant

$$10.731 \ \frac{\text{Psi} - \text{Ft}^3}{\text{lb mole} - {}^\circ\text{R}}$$

T = absolute containment temperature (°R)

Rearranging equation (1) gives:

$$(2) \quad N = \frac{PV}{RT}$$

The mass of air is simply the product of the number of lb moles and the molecular weight of air.

$$(3) \quad W = N\ (MW) = \frac{PV}{RT}\ (MW)$$

The molecular weight of air is 28.96 $\frac{\text{lb mass}}{\text{lb mole}}$

Therefore the weight of air at any time is:

$$(4) \quad W = \frac{PV\ (28.96)}{10.731\ (T)}$$

It is important to note that P is the partial pressure of air not the total containment pressure as measured by the pressure sensors. The partial pressure of air is the total pressure minus the partial pressure of water vapor, P_{H_2O}.

$$P_{air} = P_{Total} - P_{H_2O}.$$

One of the widely used correlations for vapor pressure is the Antoine correction (Ref. 6.10) which is of the form:

$$\ln P = A - \frac{B}{T-C}$$

If C = 0, this equation reverts to the Clapeyron equation (Ref. 6.7). Rather than use published constants which cover a wide temperature range for water vapor in the Antoine equation, constants were determined to more accurately cover a narrow temperature range by utilizing data from Keenan & Keyes (Ref. 6.8). Two sets of constants were generated; one set for dew points less than 100°F and the second set for the temperature range of 100 to 120°F. The correlations agree with data in Keenan & Keyes to within 0.0001 psia. This functional form gives more accurate results than linear interpolation between the data points.

The correlations developed and used in the ILRTA computer program (Ref. 6.9) are:

$$\ln P = 14.940404 - \frac{4144.18422}{T-34.5}$$

for $60 < T < 100$

where T is in °K

and

$$\ln P = 14.643483 - \frac{3984.9582}{T-39.75}$$

for $100 < T < 120$

where T is in °K

P is in psia

With the equations listed above, the mass of air can be calculated for each data set. Next, a linear regression of the air mass is performed to obtain an estimate of the leak rate. This is done to provide a criteria for obtaining the best fit of the data, assuming a linear relation between air mass and time (i.e. a constant leak rate).

Linear regression or least mean square curve fit is given by:

$$\bar{W} = A + Bt$$

Where the slope, B, and intercept, A, are given by:

$$B = \frac{n(\Sigma t_i W_i) - (\Sigma W_i)\ (\Sigma t_i)}{n\ (\Sigma t_i^2) - (\Sigma t_i)^2}$$

and

$$A = \frac{(\Sigma W_i)\ (\Sigma t_i^2) - (\Sigma t_i W_i)\ (\Sigma t_i)}{n\ (\Sigma t_i^2) - (\Sigma t_i)^2}$$

Each t_1 is the elapsed time between a clock time at which the initial reading is taken and the clock time at which the i th reading is taken. Thus $t_1 = 0$ for all the test durations and the t_2 is the elapsed time before the next reading and so on. In most test applications the time intervals between collected data sets will be essentially constant, but the equations for the slope, B, and intercept, A, do not impose this as a limitation.

The leakage rate for nuclear power plant containments is expressed as the ratio of the rate of change of air mass to the air mass in the containment at the beginning of the test. Since t_i is expressed in hours and percentage daily leakage rates are desired, the mass point leakage rate is expressed as a positive number, as:

$$L_{am} = -2400\ B/A$$

It should be noted that A, the best estimate of the initial air mass, not W_o, is used as the denominator of L_{am}. The units of L_{am} are percent per day.

The uncertainty in the estimated value of L_{am} is assessed in terms of the standard deviations of A and B and their covariance followed by the computation of the 95th confidence level for L_{am}.

The estimate of the common standard deviation of the air mass with respect to the regression line is given by:

$$S = \left[\frac{\Sigma(W - \bar{W})^2}{n - 2}\right]^{1/2}$$

where: W_i = measured air mass at time t_i

$\bar{W}$ = estimated air mass at time t_i

(i.e. $\bar{W} = A + Bt_i$)

The standard deviations of the slope and intercept are:

$$S_B = Kn^{1/2}$$

$$S_A = K(\Sigma t_i^2)^{1/2}$$

where:

$$K = \frac{S}{[n(\Sigma t_i^2) - (\Sigma t_i)^2]^{1/2}}$$

and the covariance of the slope and intercept is:

$$S_{BA} = K^2\ (-\Sigma t_i)$$

The above equations are presented in Reference 6.6 and can be found in most elementary statistical texts.

The exact upper one-sided limit of a 95 percent confidence level for the leakage rate is given by:

$$UCL\ (L_{exact}) = -2400\ [b - (b^2 - ac)^{1/2}]/a$$

where:

$$a = A^2 - t^2_{.95}\, S^2_A$$

$$b = AB - t^2_{.95}\, S_{AB}$$

$$c = B^2 - t^2_{.95}\, S^2_B$$

$t_{.95}$ is the 95th percentile of the "student's t distribution", which is tabulated in Reference 6.6 and most texts on statistics as a function of the number of degrees of freedom. The number of degrees of freedom is (n - 2) where n is the number of observations. If the number of degrees of freedom is equal to or greater than 5, the value of $t_{.95}$ can be calculated from the following equation:

$$t_{.95} = 1.654 + \frac{1.576}{n-2} - \frac{2.4}{(n-2)^2} + \frac{57.6}{(n-2)^3}$$

The equations presented above for calculating the mass point leak rate and appropriate statistical treatment have been programmed into a flexible easy to use computer program.

2. Total Time Method

The mass point method of computing leak rate is the preferred method and is recommended by References 6.5 and 6.6. However, in the past, the total time and point to point leak rate analyses were used to calculate the containment leak rate and are the acceptable methods recognized by Reference 6.4, which is the basic document for this test. Therefore, these methods of computing leak rate were included in the computer program.

The equation for calculating the leak rate by the total time method is taken from Reference 6.4. The formula is:

$$LR_{ni} = \left(\frac{2400}{H_i}\right)\left[1 - \frac{T_o}{T_i}\,\frac{(P_i - P_{vi})}{(P_o - P_{vo})}\right]$$

where:

LR_{ni} = measured leak rate of time i, in weight percent per day

H_i = Elapsed time in hours at time i

T_o = Mean containment absolute temperature at start of test

T_i = Mean containment absolute temperature at time i

P_o = Mean total pressure of containment atmosphere at start of test, psia

P_i = Mean total pressure of containment atmosphere at time i, psia

P_{vo} = Mean containment atmosphere water vapor pressure at start of test

P_{vi} = Mean containment atmosphere water vapor pressure at time i

The calculated leak rate is obtained by performing a linear regression of 3 or more sets of measured leak rate. The regression line is given by:

$$LR_c = A + Bt_i$$

The variance of the measured leak rate (LR_m) from the calculated leak rate (LR_i) is:

$$S = \left\{ \frac{[LR_{ni} - (A + Bt_i)]^2}{n-2} \right\}^{1/2}$$

where:

n = the number of measured data sets

The 95 percent upper confidence limit of the leak rate is:

$$UCL - LR_c + \sigma T$$

where:

T = Student T distribution of n-2 degrees of freedom

$$\sigma = S \left[1 + \frac{1}{n} + \frac{(tp - \bar{t})^2}{(ti - \bar{t})^2} \right]^{1/2}$$

tp = Time after start of test or total elapsed time

$$\bar{t} = \frac{\sum t_i}{n}$$

The above equations have been included in the program.

3. Point to Point Method

The point to point method is essentially the same as the total time method, except rather than referencing the calculations to the values of pressure and temperature at the start of the test, the pressure and temperature at any time i, are referenced to time i - 1. Thus, the measured leak rate equation is:

$$LR_{mi} = \left(\frac{2400}{h}\right)\left[1 - \frac{T_1 (P_2 - P_{v2})}{T_2 (P_1 - P_{v1})}\right]$$

where:

P_i = Mean absolute containment pressure, psia, at time i
T_i = Mean containment atmosphere absolute temperature at time i
h = time interval between time i and i -1

The regression line, variance and 95 percent upper confidence level are in the same manner for the total time method. The equations for the point to point method have been incorporated in the program.

4.0 ILRT INSTRUMENT ERROR ANALYSIS

Referenced 6.6 developes the following formulas:

Overall Instrumentation System Error ("ISG")

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

where,

$$e_p = \frac{(Ep^2 + \epsilon p^2)^{1/2}}{(\#\ P\ Sensors)^{1/2}}$$

$$e_{pv} = \frac{(Epv^2 + \epsilon_{pv}^2)^{1/2}}{(\#\ Dew\ Elements)^{1/2}}$$

$$e_T = \frac{(E_T^2 + \epsilon_T^2)^{1/2}}{(\#\ Drybulb\ Elements)^{1/2}}$$

where, (Refer to Instrumentation Data, Table 6)
Ep = Pressure sensor error = 0.001 psia
ϵp = Pressure system error = 0.0005 psia
Ep_v = vapor pressure sensor error

$$= (0.5°F)\left(\frac{0.5073\ psia - 0.3632\ psia}{80°F - 70°F}\right) = 0.007205\ psia$$

ϵ_{pv} = vapor pressure system error

$$\epsilon_{pv} = (0.01°F)\left(\frac{0.5073\ psia - 0.3632\ psia}{80°F - 70°F}\right) = 0.0001441\ psia$$

E_T = Drybulb temperature sensor error = 0.036°F
ϵ_T = Drybulb temperature system error = 0.01°F

thus:
e_p = 0.0007906 psia
e_{pv} = 0.003603 psia
e_T = 0.009062 R

Resulting in:
Overall Instrumentation System Error = $\pm$0.0111 w/o/day

ERROR ANALYSIS

TABLE 6 - INSTRUMENTATION DATA

Instrument	Make	Model	Accuracy	Cal Range	Cal Date	Sensitivity[2] (E)[3]	Repeatability[2] or Resolution (ϵ)[3]
Drybulb Temp[1]	Rosemount	78-65-17	± 0.5°F	32-120°F	02-19-87	0.036°F	0.01°F
Dewpoint[1]	Foxboro	2711AG	± 2.0°F	35-90°F	05-04-87	0.5°F	0.01°F
Pressure[1]	Mensor	10100-001	± 0.002% FS ± 0.010% RDG	0-100 PSI	04-01-87	0.001 PSIA	0.0005 PSIA

Notes: 1. Primary sensors.

2. Instrumentation was tested specifically for sensor sensitivity and readout repeatability.

3. Symbols defined for ISG formula (see this Attachment and Refs. 6.5 and 6.6).

5.0 CONCLUSION

The As-Found Type A Leak Rate for the 1987 ILRT was less than the allowable limit for containment leakage (La) but exceeded the as-found acceptance criteria clarified in I.E. Notice 85-71 of 0.75 La. The excessive as-found leak rate was not due to any structural deficiencies in the containment vessel but rather to the isolation valves in the floor drain (FDR) system. A design change is being pursued to correct the problem of trapping debris in these isolation valve upon closing.

The Type B and C isolation boundaries which exceeded their leakage limits thus contributing to the excessive as-found Type B & C leak rate will be leak tested yearly during each refueling outage until acceptable leak rates are obtained as outlined in Reference 6.3.

6.0 REFERENCES

6.1 Reactor Containment Building Integrated Leak Rate Test, WNP-2, September 1987.

6.2 Primary Reactor Containment Leakage Testing for Water Cooling Power Reactors, Code of Federal Regulations, Title 10, Part 50, Appendix J, January 1983.

6.3 Exemption to Appendix J Testing, issued by the NRC with Amendment No. 41 to Facility Operating License NPF-2, dated April 29, 1987.

6.4 Leakage Rate Testing of Containment Structures for Nuclear Reactors, American National Standards Institute, Inc., N.Y., NY; ANSI N45.4, 1972.

6.5 Containment System Leakage Testing Requirements, American Nuclear Society, LaGrange Park, IL; ANSI/ANS-56.8-1981.

6.6 Containment System Leakage Testing Requirements, American Nuclear Society, LaGrange Park, IL: N274, Draft No. 2, Revision 3, November 15, 1978.

6.7 Daniels and Aberty, Physical Chemistry, John Wiley & Sons, New York, 1955.

6.8 J.H. Keenan, F.G. Keyes, P.C. Hill and J.G. Moore, Steam Tables, John Wiley & Sons, New York, 1969.

6.9 Integrated Leak Rate Test Analysis, Washington Public Power Supply System, February 1984.

6.10 R.C. Reid, J.M. Prauznitz and T.K. Sherwood, The Properties of Gas and Liquids, 3rd Edition, 1977, McGraw Hill Book Company.

SUPPLEMENT #2

TYPE B & C TESTING PROGRAM

CONTAINMENT PENETRATION TESTING SCHEDULE

Washington Public Power Supply System
Nuclear Plant No. 2
September 1987

On April 29, 1987, the NRC granted an exemption to a provision of Appendix J to WNP-2 (issued by the NRC with Ammendment No. 41 to Facility Operating License NPF-2). This exemption allowed containment isolation boundaries to be tested at a frequency of every 24 months rather than every refueling outage as required by Appendix J.

Certain conditions were agreed upon between the NRC and WNP-2 Plant Staff regarding the exceptions to the 24 month duration between leak rate tests. Of greatest significance is the requirement to establish leakage limits for each containment barrier. Barriers which exceed this leakage limit are required to be retested during the next refueling outage.

One of the conditions of the granted exemption is that the reporting requirements of Appendix J be augmented to include the information associated with the unique aspects of the WNP-2 Type B & C testing program. In particular, a tabulation of leakage limits established for each barrier is required. This tabulation must also indicate those barriers which were tested during the 1987 outage, those which exceeded their leakage limits and must be retested during the 1988 outage, and those penetrations/valves not tested in 1987 and thus being scheduled for testing during the 1988 refueling outage.

The table that follows includes the information required under the conditions of the granted exemption to Appendix J.

TEST ID NUMBER PENETRATION	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-000	Drywell Head	50	X			X	X	
X-1A	Inspection Port	50	X		X			
X-1B	Inspection Port	50	X		X			
X-1C	Inspection Port	50	X		X			
X-1D	Inspection Port	50	X		X			
X-1E	Inspection Port	50	X		X			
X-1F	Inspection Port	50	X			X	X	
X-1G	Inspection Port	50	X		X			
X-1H	Inspection Port	50	X		X			
X-15	Equipment Hatch	50	X		X			3
X-16	Personnel Airlock leakage from PPM 7.4.6.1.3.2	5664	X		X			2
X-27A-1	Tip Drive Flange and Bulkhead Union	50	X		X			
X-27B-1	Tip Drive Flange and Bulkhead Union	50	X			X	X	
X-27C-1	Tip Drive Flange and Bulkhead Union	50	X			X	X	
X-27D-1	Tip Drive Flange and Bulkhead Union	50	X		X			
X-27E-1	Tip Drive Flange and Bulkhead Union	50	X		X			

TEST ID NUMBER PENETRATION	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-27F-1	Tip Purge Flange	50	X		X			
X-28	CRD Removal Hatch	50	X		X			3
X-51	Suppression Chamber Access Hatch	50	X		X			3
X-100A	Neutron Monitoring	50	X		X			
X-100B	Neutron Monitoring	50	X		X			
X-100C	Neutron Monitoring	50	X		X			
X-100D	Neutron Monitoring	50	X		X			
X-101A	Control Rod Position Indicator	50	X		X			
X-101B	Thermocouple and RTD	50	X		X			
X-101C	Thermocouple and RTD	50	X		X			
X-101D	Thermocouple and RTD	50	X		X			
X-102A	Thermocouple and RTD	50	X		X			
X-102B	Thermocouple and RTD	50	X		X			
X-103A	Medium Voltage Power	50	X		X			
X-103B	Medium Voltage Power	50	X		X			
X-103C	Medium Voltage Power	50	X		X			

TEST ID NUMBER PENETRATION	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-103D	Medium Voltage Power	50	X		X			
X-104A	Low Voltage Power	50	X		X			
X-104B	Low Voltage Power	50	X		X			
X-104C	Low Voltage Power	50	X		X			
X-104D	Low Voltage Power	50	X		X			
X-105A	Control and Indication	50	X		X			
X-105B	Control and Indication	50	X		X			
X-105C	Control and Indication	50	X		X			
X-105D	Control and Indication	50	X		X			
X-106C	Wide Range Neutron Monitoring System	50	X		X			
X-106D	Wide Range Neutron Monitoring System	50	X		X			
X-107A	Low Voltage Power and Control Indication	50	X		X			
X-107B	Low Voltage Power and Control Indication	50	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-3	7.4.6.1.8.3	From last surveillance per PPM 7.4.6.1.8.3: CEP-V-1A, CEP-V-1B, CEP-V-2A, CEP-V-2B	5660	X		X			1
		CEP-V-800-3							
		CEP-V-800-2							
		CEP-V-800-1							
X-4	X-4-1	RCIC-V-122	110	X			X	X	
	X-4-2	RCIC-V-121	110	X		X			
	X-4-3	RCIC-V-41	110	X		X			
	X-4-4	RCIC-V-601, RCIC-V-68, RCIC-V-40	1475	X		X			
	X-4-5	RCIC-V-124	110	X		X			
X-5	X-5-1	RCC-V-95	110	X		X			
	X-5-2	RCC-V-93	110		X			X	
	X-5-3	RCC-V-107	110		X			X	
	X-5-4	RCC-V-5, RCC-V-104	1475		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-11A	X-11A-1	RHR-V-17A, RHR-V-16A	1415		X			X	
	X-11A-2	RHR-V-154B	110		X			X	
	X-11A-3	RHR-V-154A	110	X		X			
	X-11A-4	RHR-V-10A	110		X			X	
X-11B	X-11B-1	RHR-V-16B, RHR-V-17B, RHR-V-609	1415		X			X	
	X-11B-2	RHR-V-10B	110		X			X	
X-13	X-13-1	SLC-V-7	221	X			X	X	
	X-13-2	SLC-V-26, 606, 601, 602, 4A, 4B	221	X		X			
	X-13-3	SLC-V-45	110	X		X			
X-14	X-14-1	RWCU-V-1, RWCU-V-4, RWCU-V-607	885		X			X	
	X-14-2	RWCU-V-612	110	X			X	X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-17A	X-17A-1	RFW-V-10A	2125	X		X		X	4
	X-17A-2	RFW-V-70, 123, 30B, 65B RFW-V-65A, RHCV-V-40	2125	X			X	X	
	X-17A-3	RFW-V-30A	110	X		X			
	X-17A-4	RFW-V-32A	2125	X		X		X	4
	X-17A-5	RFW-V-66	110	X		X			
X-17B	X-17B-1	RFW-V-10B	2125	X		X		X	4
	X-17B-2	RFW-V-32B	2125	X		X		X	4
	X-17B-3	RFW-V-69	110	X		X			
		NOTE: Some values associated with X-17B were tested in X-17A-2							
X-21	X-21-1	RCIC-V-64, 63, 76, 36, 8, 602, 624, 625	1475	X		X			
	X-21-2	RCIC-V-72	110	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-22	X-22-1	MS-V-16, MS-V-19, MS-V-17	442	X		X			
	X-22-2	MS-V-604	110	X		X			
X-23	X-23-1	EDR-V-625, EDR-V-618, EDR-V-20	442	X		X			
	X-23-2	EDR-V-19	442	X		X			
	X-23-3	EDR-V-619	110	X		X			
	X-23-4	EDR-V-661	110	X		X			
X-24	X-24-1	FDR-V-570 FDR-V-4	442	X			X	X	
	X-24-2	FDR-V-3	442	X			X	X	
	X-24-3	FDR-V-614	110	X		X			
	X-24-4	FDR-V-647	110	X		X			
X-25A	X-25A-1	RHR-V-27A	885		X			X	
	X-25A-2	RHR-V-175A	110		X			X	
	X-25A-3	"TEST DELETED"							
	X-25A-4	RHR-V-241	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-25A-5	RHR-V-254	110		X			X	
	X-25A-6	Flange between RHR-V-130A RHR-V-241	50		X			X	
X-25B	X-25B-1	RHR-V-130B	442		X			X	
	X-25B-2	RHR-V-242	110		X			X	
	X-25B-3	RHR-V-27B	885	X		X			
	X-25B-4	RHR-V-175B	110		X			X	
X-26	X-26-1	RHR-FCV-64C, RHR-V-195, RHR-V-196, RHR-V-197	442		X			X	
	X-26-2	RHR-V-145C	110		X			X	
	X-26-3	RHR-V-21, RHR-V-148	1595		X			X	
	X-26-4	RHR-V-194	110		X			X	
	X-26-5	RHR-V-740	110		X	—		X	
X-27A	X-27A-2	TIP-V-1	50		X			X	
X-27B	X-27B-2	TIP-V-2	50		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-27C	X-27C-2	TIP-V-3	50		X			X	
X-27D	X-27D-2	TIP-V-4	50		X			X	
X-27E	X-27E-2	TIP-V-5	50		X			X	
X-27F	X-27F-2	TIP-V-15 and THREADED UNION	148	X			X	X	
X-27F	X-27F-3	TIP-V-6	74	X		X			
X-27F	X-27F-4	TIP-V-13	74	X		X			
X-29 a & c	X-29 a/c-1	PI-VX-257	148	X		X			
	X-29 a/c-2	PI-VX-256 PI-VX-258	148	X		X			
X-42d	X-42d-1	PI-VX-42d PI-VX-216	148	X		X			
	X-42d-2	PI-VX-224	148	X		X			
X-43A	X-43A-1	RRC-V-13A	110		X			X	
	X-43A-2	RRC-V-16A	110		X			X	
	X-43A-3	RRC-V-87A	110	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-43B	X-43B-1	RRC-V-16B	110		X			X	
	X-43B-2	RRC-V-87B	110		X			X	
	X-43B-3	RRC-V-13B	110		X			X	
X-46	X-46-1	RCC-V-40, RCC-V-21	1475		X			X	
	X-46-2	RCC-V-97	110		X			X	
X-47	X-47-1	RHR-V-134A	295		X			X	
	X-47-2	RHR-V-178A	110		X			X	
	X-47-3	RHR-FCV-64A, RHR-V-192, RHR-V-190	442		X			X	
	X-47-4	RHR-V-145A	110		X			X	
	X-47-5	RHR-V-191	110		X			X	
	X-47-6	RHR-V-121, RHR-V-120	885		X			X	
	X-47-7	RHR-V-147	110		X			X	
	X-47-8	RHR-V-146	110		X			X	
	X-47-9	RHR-V-24A, RHR-V-11A	1595		X			X	
	X-47-10	RHR-V-152A	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-47-11	RHR-V-73A	295		X			X	
	X-47-12	RHR-V-135A	110		X			X	
	X-47-13	RHR-V-180A	110		X			X	
	X-47-14	RHR-V-181A	110		X			X	
	X-47-15	RHR-V-239	110		X			X	
X-48	X-48-1	RHR-V-181B	110		X			X	
	X-48-2	RHR-V-180B	110		X			X	
	X-48-3	RHR-V-145B	110		X			X	
	X-48-4	RHR-V-11B, RHR-V-24B	1595		X			X	
	X-48-5	RHR-V-202, RHR-FCV-64B	442		X			X	
	X-48-6	RHR-V-134B	295		X			X	
	X-48-7	RHR-V-178B	110		X			X	
	X-48-8	RHR-V-73B	295		X			X	
	X-48-9	RHR-V-135B	110		X			X	
	X-48-10	RHR-V-152B	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-49	X-49-1	HPCS-V-23 HPCS-V-74	1062	X		X			
	X-49-2	HPCS-V-36	110	X			X	X	
	X-49-3	HPCS-V-12 HPCS-V-72	590	X		X			
	X-49-4	HPCS-V-83	110	X		X			
	X-49-5	HPCS-V-84	110	X		X			
	X-49-6	HPCS-V-73	110	X		X			
	X-49-7	HPCS-V-71	110	X		X			
	X-49-8	HPCS-V-63	110	X		X			
X-53	X-53-1	CSP-V-96	148	X		X			
	X-53-2	CSP-V-97	148	X		X			
	X-53-3	CSP-V-800-2	110	X		X			
	X-53-4	CSP-V-800-24	110	X		X			
		LEAKAGE FROM PPM 7.4.6.1.8.3	5660 TOTAL	X		X			1
	X-53-5	CSP-V-1, CSP-V-2							
	X-53-6	CSP-V-800-3							

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-54Aa	X-54Aa-1	RCIC-V-184 RCIC-V-740	148	X		X			
	X-54Aa-2	RCIC-V-185	110	X		X			
X-54Bf	X-54Bf-1	PI-VX-54Bf PI-VX-218	148	X		X			
	X-54Bf-2	PI-VX-226	148	X		X			
X-56	X-56-1	CIA-V-21	110	X			X	X	
	X-56-2	CIA-V-44	110	X		X			
	X-56-3	CIA-V-20	110	X		X			
X-61f	X-61f-1	PI-VX-219 PI-VX-61f	148	X		X			
	X-61f-2	PI-VX-227	148	X		X			
X-62f	X-62f-1	PI-VX-62f PI-VX-220	148	X		X			
	X-62f-2	PI-VX-228	148	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-63	X-63-1	LPCS-V-12	1062		X			X	
	X-63-2	LPCS-V-58	110		X			X	
	X-63-3	LPCS-V-36	110		X			X	
	X-63-4	LPCS-V-57 LPCS-FCV-11	442		X			X	
	X-63-5	LPCS-V-69	110		X			X	
X-64	X-64-1	RCIC-V-69 RCIC-V-28	221	X			X	X	
	X-64-2	RCIC-V-55	110	X		X			
	X-64-3	RCIC-V-125	110	X		X			
X-65	X-65-1	RCIC-V-19	295	X		X			
	X-65-2	RCIC-V-120	110	X			X	X	
X-66	X-66-1	CSP-V-98	148	X		X			
	X-66-2	CSP-V-93	148	X		X			
	X-66-3	CSP-V-5 CSP-V-7	2124	X			X	X	
	X-66-4	CSP-V-800-17	110	X			X	X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-66-5	CSP-V-800-11	110	X		X			
	X-66-6	CSP-V-800-23	110	X		X			
	X-66-7	TEST DELETED							5
	X-66-8	TEST DELETED							5
	7.4.6.1.8.2	CSP-V-3, CSP-V-4 CSP-V-800-9	5660 MAX	X		X			1
X-67	X-67-1	CSP-V-6 CSP-V-8	2124	X			X	X	
	X-67-2	CSP-V-800-22	110	X		X			
	X-67-3	TEST DELETED							5
	X-67-4	TEST DELETED							5
	7.4.6.1.8.2	CEP-V-3A, 3B, 4A, 4B, CEP-V-800-9	5660 MAX	X			X		1
	X-67-5	CEP-V-800-11	110	X		X			
	X-67-6	CEP-V-800-12	110	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-69c	X-69c-1	PI-VX-69c PI-VX-221	148	X		X			
	X-69c-2	PI-VX-229	148	X		X			
X-72f	X-72f-1	PI-VX-253 PI-VX-254	148	X		X			
	X-72f-2	PI-EFCX-72f	148	X		X			
X-73e	X-73e-1	PI-VX-259 PI-VX-260	148	X		X			
	X-73e-2	PI-EFCX-73e	148	X		X			
X-73f	X-73f-1	PSR-V-X73-1	148	X		X			
	X-73f-2	PSR-V-X73-2	148	X		X			
X-77Aa	X-77Aa-1	RRC-V-20	148	X			X	X	
	X-77Aa-2	RRC-V-19	148	X		X			
X-77Ac	X-77Ac-1	PSR-V-X77A-1	148	X		X			
	X-77Ac-2	PSR-V-X77A-2	148	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-77Ad	X-77Ad-1	PSR-V-X77A-3	148	X		X			
	X-77Ad-2	PSR-V-X77A-4	148	X		X			
X-78d	X-78d-1	LPCS-V-66 LPCS-V-67	148		X			X	
	X-78d-2	LPCS-V-68	110		X			X	
X-78e	X-78e-1	HPCS-V-65 HPCS-V-68	148	X		X			
	X-78e-2	HPCS-V-69	110	X		X			
X-80b	X-80b-1	PSR-V-X80-1	148	X		X			
	X-80b-2	PSR-V-X80-2	148	X		X			
X-82b	X-82b-1	TEST DELETED							5
	X-82b-2	TEST DELETED							5
X-82d	X-82d-1	PSR-V-X82-1	148	X		X			
	X-82d-2	PSR-V-X82-2 PSR-V-10-3	148	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-82d-3	PSR-V-10-2	148	X		X			
	X-82d-4	PSR-V-10-1	148	X		X			
X-82e	X-82e-1	CAS-VX-82e CAS-V-730	148	X		X			
	X-82e-2	CAS-V-455	110	X		X			
X-82f	X-82f-1	PSR-V-X82-7	148	X		X			
	X-82f-2	PSR-V-143	110	X		X			
	X-82f-3	PSR-V-144	110	X		X			
	X-82f-4	PSR-V-24-1 PSR-V-X82-8	148	X		X			
X-83a	X-83a-1	PSR-V-X83-1	148	X		X			
	X-83a-2	PSR-V-146	110	X		X			
	X-83a-3	PSR-V-147	110	X		X			
	X-83a-4	PSR-V-X83-2 PSR-V-22-1	148	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-84a	X-84a-1	TEST DELETED							5
	X-84a-2	TEST DELETED							5
X-84f	X-84f-1	PSR-V-X84-1	148	X		X			
	X-84f-2	PSR-V-149	110	X		X			
	X-84f-3	PSR-V-150	110	X		X			
	X-84f-4	PSR-V-X84-2 PSR-V-23-1	148	X		X			
X-85a/c	X-85a/c-1	PI-VX-251	148	X		X			
	X-85a/c-2	PI-VX-250 PI-V-252	148	X		X			
X-86A	X-86A-1	TEST DELETED							5
	X-86A-2	TEST DELETED							5
X-87A	X-87A-1	TEST DELETED							5
	X-87A-2	TEST DELETED							5

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-88	X-88-1	PSR-V-X88-1	148		X			X	
	X-88-2	PSR-V-4-1	110		X			X	
	X-88-3	PSR-V-4-2	110		X			X	
	X-88-4	PSR-V-4-3 PSR-V-X88-2	148		X			X	
X-89B	X-89B-1	CIA-V-30A	74	X			X	X	
	X-89B-2	CIA-V-31A	74	X		X			
	X-89B-3	CIA-V-47A	74	X		X			
X-91	X-91-1	CIA-V-30B	74	X		X			
	X-91-2	CIA-V-47B	74	X		X			
	X-91-3	CIA-V-31B	74	X			X	X	
X-92	X-92-1	DW-V-156 DW-V-157	295	X		X			
	X-92-2	DW-V-158	110	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-93	X-93-1	SA-V-109 and Pipe CAP	295	X		X			
	X-93-2	SA-V-200	110	X		X			
X-94	X-94-1	MWR-V-124	110	X		X			
	X-94-2	X-94 Pipe Cap	50	X		X			
X-95	X-95-1	MWR-V-125	110	X		X			
	X-95-2	X-95 Pipe Cap	50	X		X			
X-96	X-96-1	CAC-V-2 CAC-FCV-2A	590		X			X	
	X-96-2	CAC-V-800-39	110		X			X	
	X-96-3	CAC-V-800-37	110		X			X	
	X-96-4	CAC-V-800-38	110		X			X	
X-97	X-97-1	CAC-V-15 CAC-FCV-1B	590		X			X	
	X-97-2	CAC-V-800-21	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-97-3	CAC-V-800-19	110		X			X	
	X-97-4	CAC-V-800-20	110		X			X	
X-98	X-98-1	CAC-V-11 CAC-FCV-28	590		X			X	
	X-98-2	CAC-V-800-15	110		X			X	
	X-98-3	CAC-V-800-13	110		X			X	
	X-98-4	CAC-V-800-14	110		X			X	
X-99	X-99-1	CAC-V-6 CAC-FCV-1A	590		X			X	
	X-99-2	CAC-V-800-45	110		X			X	
	X-99-3	CAC-V-800-44	110		X			X	
	X-99-4	CAC-V-800-43	110		X			X	
X-101	X-101-1	FPC-V-156 FPC-V-161 FPC-V-149	885	X			X	X	
	X-101-2	FPC-V-182	110	X		X			
	X-103-3	FPC-V-160	110	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-102	X-102-1	CAC-V-4 CAC-FCV-4A	590		X			X	
	X-102-2	CAC-V-800-33	110		X			X	
	X-102-3	CAC-V-800-35	110		X			X	
	X-102-4	CAC-V-800-36	110		X			X	
X-103	X-103-1	CAC-V-13 CAC-FCV-4B	590		X			X	
	X-103-2	CAC-V-800-9	110		X			X	
	X-103-3	CAC-V-800-11	110		X			X	
	X-103-4	CAC-V-800-12	110		X			X	
X-104	X-104-1	CAC-V-17 CAC-FCV-3B	590		X			X	
	X-104-2	CAC-V-800-5	110		X			X	
	X-104-3	CAC-V-800-1	110		X			X	
	X-104-4	CAC-V-800-2	110		X			X	
X-105	X-105-1	CAC-V-8 CAC-FCV-3A	590		X			X	
	X-105-2	CAC-V-800-29	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-105-3	CAC-V-800-27	110		X			X	
	X-105-4	CAC-V-800-28	110		X			X	
X-116	X-116-1	RCIC-V-85	110	X		X			
	X-116-2	RCIC-V-84	110	X		X			
	X-116-3	RCIC-V-183	110	X		X			
X-117	X-117-1	RHR-V-124A RHR-V-124B	221		X			X	
	X-117-2	RHR-V-139B	110		X			X	
	X-117-3	RHR-V-139A	110		X			X	
	X-117-4	RHR-V-620B	110		X			X	
X-118	X-118-1	RHR-V-125A RHR-V-125B	221		X			X	
	X-118-2	RHR-V-619C	110		X			X	
	X-118-3	RHR-V-141B	110		X			X	
	X-118-4	RHR-V-141A	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-119	X-119-1	CSP-V-9 CSP-V-10	2124	X			X	X	
	X-119-2	CSP-V-800-14	110	X		X			
	X-119-3	CSP-V-800-16	110	X		X			
	X-119-4	CSP-V-800-15	110	X		X			

Notes:

1. Containment Purge butterfly valves; tested every 6 months per Plant Technical Specifications. Leakage limit defined by Technical Specifications.
2. Airlock tested every 6 months per Plant Technical Specifications. Leakage limit defined by Technical Specifications.
3. Hatch will be leak tested if opened during the 1988 outage.
4. Feedwater check valve with soft seat. Tested every refueling outage per conditions of granted exemption.
5. Test connection for excess flow check valve. Deleted from Type C testing per FSAR Table 6.2.6 Note 27.

REACTOR CONTAINMENT BUILDING
INTEGRATED LEAK RATE TEST

Washington Nuclear Plant Number Two (WNP-2)
Washington Public Power Supply System
Richland, Washington

September, 1987

PCILRT FINAL REPORT

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1.0 INTRODUCTION

This report documents the periodic Type A, B, and C testing performed on the Primary Reactor Containment of Washington Nuclear Plant Number Two (WNP-2) from February 1984 to June 1987. The plant consists of a GE BWR/5 NSSS System housed within a Mark II Over/ Under Containment.

Chronologically, the Preoperational Type A test, the "Preoperational Primary Contaminant Integrated Leak Rate Test" (PCILRT) (Ref. 5.11) was conducted from February 3, 1984 to February 16, 1984, various Type B&C tests were conducted, mostly occurring during the spring outages of 1985, 1986, and 1987, the second Type A Test was conducted from June 3, 1987 to June 17, 1987, then non-Type A tested penetration leak rates were summed with the calculated Type A test leak rate to arrive at the corrected "as-left" Type A test result.

This report is organized into three broad topics: SUMMARY, DISCUSSION, and CONCLUSION. Each topic consists of an appropriate level of information pertaining to the Type B & C Tests and the Type A Test. Finally, supporting information is provided in the ATTACHMENTS in sufficient detail to justify the CONCLUSIONS and to comply with regulatory and plant requirements (Ref. 5.1, 5.2 and 5.3).

Acronyms used in this report are listed in Attachment IV.

2.0 SUMMARY

2.1 Type B & C Tests

Type B&C local leak rate testing was performed during each of three annual spring outages since the pre-operational Integrated Leak Rate Test (ILRT), with the last testing period occurring just prior to the 1987 ILRT. The leakage rates listed below represent a summation of as-left maximum pathway penetration leakages applying single failure criteria to active containment boundary valves. The allowable leakage rate for the sum of each Type B&C test sequence was 67,920 sccm (0.6La). The summation of the as-found maximum pathway leakage rates exceeded 0.6La. An analysis and interpretation of the as-found test results is included in a supplement to this report.

2.1.1 Spring 1985 Outage

The measured leak rate for the sum of the as-left Type B&C tests was 54,859 sccm (0.485La).

2.1.2 Spring 1986 Outage

The measured leak rate for the sum of the as-left Type B&C tests was 36,741 sccm (0.325La).

2.1.3 Spring 1987 Outage

The measured leak rate for the sum of the as-left Type B&C tests was 21,616 sccm (0.191La).

2.2 Type A Test

The plant systems were lined up consistent with the requirements of references 5.1 and 5.2. Emergency Core Cooling Systems (RHR, LPCS and HPCS) were filled and available to perform their safety functions, with RHR Loops A and B used to maintain Reactor Pressure Vessel temperature within Technical Specification (Ref. 5.1) limits. SLC, RWCU, RFW, and the normally water filled portions of the PSR, RCIC, and FPC systems were also filled and, as in the case of RHR, LPCS and HPCS, were vented to see Pa via the head vent. The RCC, RWCU, and CRD systems, as well as the RRC seal injection and sample lines were filled and operating; therefore, the CIVs in these systems were not exposed to Pa. The remaining systems were drained and vented to both the Primary Reactor Containment (PRC) Atmosphere as well as outside the outermost CIV to the Reactor Building atmosphere.

The 23-hour Primary Containment Integrated Leak Rate Test (PCILRT) quantified the Overall Integrated Leakage Rate (OILR) of the PRC. The PCILRT was followed by the Leakage Rate Verification Test (LRVT), which was a four hour and 40 minute supplemental test using a constant-rate superimposed leak.

The recorded 95% Upper Confidence Level (UCL) leakage rate (LR) for the PCILRT was 0.2837 weight percent per day (w/o/day) (based on Total Time Calculated method) which was then corrected for valve lineup exceptions and drywell sumps water level increases to give 0.3241 w/o/day. Since 0.75 L_a is 0.375 w/o/day, the leakage rate is less than the acceptance criterion. For the LRVT, the corrected acceptance criterion, (based on a superimposed constant leakage rate of 0.4987 w/o/day, the measured Total Time PCILRT LR of 0.1615 w/o/day, and a correction factor), was 0.6629 w/o/day $\pm$ 0.125 w/o/day. The Total Time Calculated Leakage Rate, corrected for valve lineup test exceptions, was 0.6924 w/o/day; thus, the LRVT substantiated the validity of the PCILRT results.

3.0 DISCUSSION

3.1 Type B&C Tests

3.1.1 Methods

The penumatic Type B&C tests were performed utilizing the Pressure Decay and Makeup Flowrate methods. Hydrostatic Type C testing on water sealed valves was accomplished using the Makeup Flow Rate Method.

3.1.2 Specific Testing Categories, Acceptance Criteria, and Results

The first category consists of air and nitrogen - tested Type B&C penetrations. The measured Type B&C Leakage rate summations are tablulated in Table 1.

Outage Year	$\leq$ Type B	$\leq$ Type C	$\leq$ B&C	Allowable Limit
1985	5587 sccm	49,272 sccm	54,859 sccm	67,920 sccm
1986	411 sccm	36,330 sccm	36,741 sccm	67,920 sccm
1987[1]	397 sccm	21,219 sccm	21,616 sccm	67,920 sccm

TABLE 1
LLRT RESULTS FOR TYPE B&C TESTING PERFORMED
SINCE PRE-OPERATIONAL ILRT

NOTE: 1 During the 1987 outage, all Type B penetrations were local leak rate tested. Type C testing was performed as allowed by the Exemption to Appendix J Testing issued by the NRC with Amendment No. 41 to Facility Operating License NPF-21. This allowed testing of approximately half of the Type C penetrations at each shutdown for refueling. During the 1987 outage, 46 of 75 Type C penetrations were tested. For those not tested, the leakage rates from the 1986 outage were used to calculate the total Type C Leakage rate listed in Table 1.

The second category is a subset of the above Type C tests, being the measured leakage rates on the secondary containment bypass lines that must be included in the sum of the Type B&C tests. The allowable leakage rate from these secondary containment bypass sources is 349.2 sccm. The measured leakage rates are tabulated in Table 2.

PENETRATION	SERVICE	LEAKAGE RATES (sccm) 1985	1986	1987
X-14	RWCU from RPV	16.24	98.8	98.8
X-22	MS Drain	2.14	13.0	133.4
X-77Aa	RRC Sample	11.44	176.7	81.2
X-92	DW Service to Drywell	2.4	0.0	4.0
	TOTALS	32.22	288.5	317.4

TABLE 2
LLRT Results for Secondary Bypass Leakage Sources

A special case of the above category makes up the third category and applies to the Main Steam Isolation Valves (MSIVs). They are similar to the second category in that any process line leakage passes directly from the PRC to the Turbine Building, thereby "bypassing" the SGT System. The line leakage is not added to the sum of the Type C leakage rates because the Main Steam Leakage Control System intercepts all leakage past the inboard CIV up to the allowable limit (See Ref. 5.1). The allowable leakage rate is 5428 sccm per valve and the test results are tabulated in Table 4.3. Testing was performed at a test pressure of 25 psig (per Ref. 5.1).

PENETRATION	LEAKAGE RATES (sccm) 1,2 1985	1986	1987
X-18A	3634	425	675
X-18B	1133	330	4932
X-18C	708	4955	589
X-18D	3964	142	411

TABLE 3
LLRT Results for the MSIV's

NOTES: 1 Pressure decay test performed between the inboard MSIV and the outboard MSIV; therefore, the LRs assigned to the penetrations are conservative with respect to the acceptance criteria.

2 Measured Leakage rates shown are as-left values. As-found leakage rates in excess of 5428 sccm are discussed in the Supplemental Report.

The fourth and last category pertains to Containment Isolation Valves (CIV) sealed with fluid from a seal system (Ref. 5.2). Hydrostatic tests were performed on 64 valves sealed by water during an accident event requiring Primary Reactor Coolant integrity. Leak rate testing was performed at a pressure equal to 1.1 Pa using the make-up flowrate method with water. The maximum allowable leakage rate per Reference 5.1 is 1.0 gpm per valve. The total measured leakage from all 64 valves was 0.069 gpm for the 1985 outage, 0.032 gpm for the 1986 outage, and 0.039 gpm for the 1987 outage. These values are not required to be included in the sum of the Type B&C leakage rates (see Refs. 5.1 and 5.2).

3.2 Type A Test

3.2.1 Methods

The absolute method of pressure decay testing was used for the PCILRT and the LRVT.

3.2.2 Data Collection and Reduction

The Data Acquisition System consisted of 17 drybulb temperature probes, 4 dew cells and 2 pressure sensors. Reference 5.13 indicated the location of each sensor and the volume of each containment subvolume. The only significant changes made to the sensors or their utilization since that documented in Ref. 5.13 for the preoperational PCICRT were the programmatic deletion of the output from the installed wetwell drybulb sensor TE-17 (it failed just prior to the PCICRT, necessitating the ignoring of its output and rearrangement of Wetwell subvolume assignments) and the physical deletion of ME-5 & 6 (these Wetwell dew cells were not installed because the Suppression Chamber atmosphere is essentially saturated under equilibrium conditions; hence, the program below was tailored to process the drybulb data as if it were reading water-saturated air). The sensors were connected to a Volumetrics Integrated Leak Rate Monitoring System (ILRMS), model 14629LC (Ref. 5.4), which printed out the measured value of each drybulb sensor and dew cell every 15 minutes. The quartz crystal pressure transducer outputs were continuously displayed on a digital readout panel and were likewise printed out every 15 minutes. The

raw data were then automatically transmitted to a computer located in the Main Control Room for the plant into which the ILRT computer program (Ref. 5.12) had been loaded. The pressure data were individually corrected for calibration inaccuracies by a subroutine in the program. The data were then accessed and the computer was directed to process same periodically by a terminal at the Test Center in the Reactor Building. The data printout tapes were simply a hard-copy backup of the data. Hardcopy printouts of the data and the attendant analyses were then obtained.

The computer program printouts consisted of individual sensor data, averaged sensor data, air partial pressure, calculated dry air mass and leakage rate. The program also allows determination of temperature stabilization based on Reference 5.6. The program allows the operator to examine and correct any data at any point in time. Plots of average temperature, dew point, pressure and calculated air mass may be displayed on the terminal and can be printed at any time. The program was developed in-house and was verified against data and results accepted for a prior ILRT at another plant. The same basic program was used for the preoperational PCILRT.

Reference 5.1 committed WNP-2 to using Reference 5.3 as the basic document for PRC leakage rate testing; therefore, there are two possible calculation methods that could be used for the reduction of the data for the PCILRT and the LRVT: The Total Time method and the Point to Point method. Of the two, the Total Time method has heen chosen as the basic method used at WNP-2. References 5.5 and 5.6 present the superior Mass Point method, which was also used for data reduction, the results of which are included for information only.

3.2.3 Plant Status During Tests

The systems were placed in the following four broad categories:

A. Systems filled with water and not vented to the Primary Reactor Containment atmosphere.

   1. Reactor Closed Cooling (RCC)

   2. Control Rod Drive (CRD)

   3. Reactor Recirculation (RRC), Seal Injection

B. Systems filled with water but vented to the Primary Reactor Containment atmosphere.

1. Residual Heat Removal (RHR)
2. High Pressure Core Spray (HPCS)
3. Low Pressure Core Spray (LPCS)
4. Standby Liquid Control (SLC)
5. Reactor Water Cleanup (RWCU)
6. Reactor Feed Water (RFW)
7. Reactor Core Isolation Cooling (RCIC), water-filled portions
8. Post Accident Sampling (PSR), Water-filled Portions
9. Fuel Pool Cooling (FPC), Supply

C. Systems On-Line

1. Control Rod Drive (CRD)
2. Reactor Recirculation (RRC), Seal Injection
3. Residual Heat Removal (RHR), A and B Loops
4. Reactor Water Cleanup (RWCU)
5. Containment Atmosphere Control (CAC)*
6. Sample Handling Equipment Hydrogen Oxygen Monitors
7. Reactor Closed Cooling (RCC)

*CIV's open but air pumps not running

D. All other systems penetrating the PRC were drained and vented to the PRC atmosphere as well as to the Reactor Building atmosphere.

In the above listing all of the CIVs and Boundary Valves were closed except those used for specific purposes (e.g. X-53: dual series Boundary Valves opened to give a flow path during the LRVT).

3.2.4 Major Test Events

This section discusses the testing, which and consisted of the following three major phases:

1. Temperature and Pressure Stabilization

2. 23 Hour PCILRT

3. 4+ Hour (Induced) LRVT

Temperature and Pressure Stabilization

Pressurization of the containment began at 1532 on June 7, 1987. The ILRT test pressure, P_a, was reached at about 2315 on June 7. Data were continuously collected from this time up to the conclusion of the ILRT testing sequence at 1244 on June 9. The stabilization period was started at 2334 on June 7 and was considered satisfactorily completed at 0334 on June 8.

Primary Containment Integrated Leakage Rate Test

The ILRT test was initiated at 0619 on June 8. The total containment pressure at this time was 50.459 psia (36.067 psig). Data were collected at 15 minute intervals for the next 23 hours.

Leakage Rate Verification Test

A four hour and 40 minute flow verification test was run immediately following the ILRT test. The verification test provides a method for assuring that systematic error or bias is given adequate consideration. This test consisted of superimposing a known leakage rate upon the existing leakage rate.

The verification test was started at 0804 on June 9 with an average superimposed LR of 3.94 scfm, which corresponds to a LR of 0.4987 w/o/day (see Attachment I.C). The data collection interval was reduced to ten minutes.

3.2.5 Acceptance Criteria and Results

Temperature Stabilization

The acceptance criterion used for the PCILRT was:

$$\left| \frac{(T_t - T_{t4})}{4\ \text{hrs}} - \frac{(T_t - T_{t1})}{1\ \text{hr}} \right| \leq 0.5°F/\text{hr}$$

where:

T_t = weighted average containment temperature at time, t

T_{t4} = weighted average containment temperature 4 hours prior to time, t

T_{t1} = containment temperature 1 hour prior to time, t

This method requires that the absolute average temperature change per hour over the last 4 hours minus the absolute average temperature change per hour over the last hour be less than 0.5°F. The result of using this analysis method, gleaned from Reference 5.6, is given in Attachment II, Table II.1, which presents the average dry bulb temperature, the 1 hour, 4 hour, and 4 hour minus 1 hour calculations for the time period of 2334 on June 7 to 0334 on June 8. As can be seen, the 4 hours minus 1 hour differential was only -0.0837°F, which meets the requirements of Ref. 5.14.

Primary Containment Integrated Leakage Rate Test

The acceptance criteria for the PCILRT is that the calculated 95 percent UCL leakage rate, L_{am} 95%, be less than 75 percent of the maximum allowable leakage rate, L_a. L_a is 0.5 weight percent per day and 75 percent of L_a is 0.375 weight percent per day. Therefore, the 95 percent UCL leakage rate, L_{am}, 95%, must be less than 0.375 weight percent per day.

The average temperature, pressure and air mass for the 23 hour ILRT are presented in Attachment II, Tables II.2 and II.3. Figure III presents the time history of the air mass in graphical form and is included for information only.

Attachment II, Table II.4 presents the summary of the leakage rate calculation based on the Total Time method. The Total Time L_{am}, 95% for the 23 hour test was 0.2837 percent per day, which is well below the acceptance criterion of 0.375 weight percent per day. The column labeled Calculated Leakage Rate is the calculated mean leakage rate.

The leakage rate calculated by the mass point method is presented in Table II.5. L_{am}, 95% based on the mass point method was 0.2080 weight percent per day, which is well below the acceptance criterion of 0.375 weight percent per day.

The PCILRT calculated result was corrected for the effects of improper valve lineup and water inventory changes, which are discussed below.

The effects caused by the improper valve lineup used during the PCILRT (and the LRVT) are tabulated in Table 1.

Penetration Number	Valve Numbers	Exception Discussion	Leakage Rate[1] (SCCM)
X-5	RCC-V-5 RCC-V-104	Note 4	86.1
X-14	RWCU-V-1 RWCU-V-4	Note 4	49.4
X-17A/17B	RFW-V-10A RFW-V-10B RFW-V-32A RFW-V-32B RFW-V-65A RFW-V-65B	Note 5	193.5
X-18B	MS-V-22B MS-V-28B MS-V-67B MSLC-V-3B	MS-V-67B manually blocked during PCILRT and LRVT	89.0
X-23	EDR-V-19 EDR-V-20	Note 5	18.0
X-24	FDR-V-3 FDR-V-4	Note 5	10.8
X-46	RCC-V-40 RCC-V-21	Note 4	10.1
X-533	CSP-V-800-2 CSP-V-800-24	Used for LRVT flow path	3.2
X-662	PI-V-X66-1 PI-V-X66-2	Used for PI-1 tap (wetwell pressure)	25.0[6]
X-77Aa	RRC-V-19 RRC-V-20	Note 4	6.3
X-93	SA-V-109 Pipe Cap	Pressurization path (pipe cap removed during PCILRT and LRVT)	0.0

Penetration Number	Valve Numbers	Exception Discussion	Leakage Rate[1] (SCCM)
X-95	MWR-V-125 Pipe Cap	Pressurization path (valve and cap removed; temporary valve and cap in place during PCILRT and LRVT)	0.0

TABLE 4

Valve Lineup Exceptions During the PCILRT and the LRVT

NOTES: 1. Obtained from LLRT Program.

2. Used in lieu of an instrument line.

3. Used only during the LRVT.

4. Line filled with water and CIVs open during both the PCILRT and the LRVT.

5. Line filled with water and CIVs closed but accident fluid is considered to be a gas.

6. These are small instrumentation test connections that are normally closed and capped and only tested during the PCILRT. The value given was simply assigned and was conservatively based on historic response of this type of valve to LLRTing.

Combining all of the factors of table 4 except for the LRVT-related penetration but adding an additonal factor for statiscial uncertainty adds 610.2 sccm to the PCILRT leakage rate, which is equivalent to 0.00272 w/o/day (see Attachment I.A). All of the factors were summed to add 614.2 sccm to the LRVT result (discussed later). This is equivalent to 0.00274 w/o/day (see Attachment I.B).

Two other correction factors were applied to the PCILRT results:

1) The drywell floor sump collected 20 inches of water during the course of the PCILRT and LRVT, and

2) The equipment drain sump collected eight inches of water during the course of the tests.

These two events added the equivalent of 0.0376 w/o/day to the PCILRT leakage rate (see Attachment I.A). Thus, the correction factor that was applied to the 95% UCL PCILRT LR was 0.0404 w/o/day (see Attachment I.A), which resulted in a total time 95% UCL PCILRT LR of 0.3241 w/o/day.

Leakage Rate Verification Test

The acceptance criteria for the Leakage Rate Verification test is:

$(L_o + L_{am} - 0.25\ L_a) \leq L_c \leq (L_o + L_{am} + 0.25\ L_a)$

where: L_o = Known superimposed leakage rate, w/o/day

L_{am} = Previously measured leakage rate, w/o/day

L_a = Maximum allowable leakage rate, w/o/day

L_c = Measured composite leakage rate, w/o/day

The superimposed leakage rate should be between 75 to 125 percent of L_a.

Data were collected at 10 minute intervals. Attachment II, Tables II.6 and II.7 present the data summary for the test. Attachment II, Table II.8 presents the leakage rate calculation based on the Total Time method. The measured composite leakage rate, L_c, was 0.6897 weight percent per day. The leakage rate based on a Mass Point calculation is given, for information only, in Attachment II, Table II.9.

Correcting L_c for the valve lineup factor previously presented (614.2sccm, or 0.00274 w/o/day) gives 0.6924 w/o/day.

Based on corrected lower and upper band limits of 0.5379 w/o/day and 0.7879 w/o/day, respectively, it is apparent that the instrumentation accurately tracked actual PRC atmospheric parameters.

Therefore, the LRVT was successfully passed and the agreement between the expected and measured LRs indicates that systematic errors were not a factor in the performance of the PCILRT.

Comparison of Results with Acceptance Criteria

The acceptance criteria and results for all tests are presented in Table 5.

Test	Date Completed	Acceptance Criteria (w/o/day)	Results		Corrections (w/o/day)	Corrected Results (Total Time) (w/o/day)
			Total Time (w/o/day)	Mass Point (w/o/day)		
PCILRT	6-09-87	0.375[3]	0.2837[1]	0.2080[1]	0.0404	0.3241[1]
LRVT	6-09-87	0.6629 ± 0.125[4]	0.6897[2]	0.6897[2]	0.0027	0.6924[2]

TABLE 5

Tabulation of the PCILRT and LRVT Results with Corrections

NOTES:

1. 95% UCL Value
2. Measured Value
3. Based on 0.75 La, where La = 0.5 w/o/day
4. Based on an induced leakage rate of 0.4987 w/o/day, a measured Primary Containment integrated Leakage Rate of 0.1615 w/o/day, and a correction factor of 0.0027 w/o/day.

4.0 CONCLUSION

The as-left Type B&C tests performed since the completion of the Pre-Operational Type A test were in compliance with the acceptance criterion (67,920 sccm). Specifically, the 1985 outage result was 54,859 sccm, the 1986 outage result was 36,741 sccm, and the 1987 outage result was 21,616 sccm; thus, the respective Type B&C test sequences are considered to be successful.

The Type A test performed for this Report was the first Operational PCILRT. It commenced on June 8, 1987 at 0619 and was successfully completed on June 9, 1987 at 0519. This was followed by a successful LRVT on the same date between the hours of 0804 and 1244. Quantitatively, the Total Time 95% UCL PCILRT LR was 0.2837 w/o/day, uncorrected, and 0.3241 w/o/day when corrected for valve alignment and other irregularities. The Total Time measured LRVT LR, uncorrected, was 0.6897 w/o/day, with an induced LR of 0.4987 w/o/day, and a corrected LR of 0.6924 w/o/day. Since the acceptance criteria were 0.375 w/o/day and 0.6629 w/o/day +0.125 w/o/day, respectively, the former was considered successful and the latter adequately verified instrumentation and methodology veracity for the former.

5.0 REFERENCES

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5.4 ILRT Console Operation, Volumetrics, Inc., for Model 14629-LC.

5.5 Containment System Leakage Testing Requirements, American Nuclear Society, LaGrange Park, IL; ANSI/ANS-56.8-1981.

5.6 Containment System Leakage Testing Requirements, American Nuclear Society, LaGrange Park, IL; N274, Draft No. 2, Revision 3, November 15, 1978.

5.7 Daniels and Aberty, Physical Chemistry, John Wiley & Sons, New York, 1955.

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5.9 J.H. Keenan, F.G. Keyes, P.C. Hill and J.G. Moore, Steam Tables, John Wiley & Sons, New York, 1969.

5.10 O.A. Hougen, K.M. Watson and R.A. Ragatz, Chemical Process Principles, Part 1, 2nd Edition, McGraw Hill Book Company, 1956.

5.11 Primary Containment Integrated Leak Rate Test, WNP-2 Pre-Operational Test Number PT 201.0-A, Revision 1, with Two Test Change Notices, February 2, 1984.

5.12 Integrated Leak Rate Test Analysis, Washington Public Power Supply System, February 1984.

5.13 Reactor Containment Building Integrated Leak Rate Test, WNP-2, May 1984.

5.14 Primary Containment Integrated Leak Rate Test, WNP-2 Plant Procedure Manual Number 7.4.6.1.2.1, Revision 0, with one Procedure Deviation, June 2, 1987.

ATTACHMENT I

LEAKAGE RATE CALCULATIONS

A. Corrections to the PCILRT Calculated Result.

1. LLRT Correction (Refer to Table 4)

a. $\Sigma LR = 86.1 + 49.4 + 193.5 + 89.0 + 18.0 + 10.8 + 10.1 + 25.0 + 6.3 + 0.0 + 0.0 + 122.0$ sccm
(25% of 488.2 included for statistical variance)
$= 610.2$ sccm

b. Conversion

$$\text{Correction} = \frac{(610.2)(60)(24)(100)\left(\frac{14.696}{50.414}\right)\left(\frac{76.948 + 459.69}{519.69}\right)}{(30.48)^3\ (343{,}040)}$$

$= 0.002723$ w/o/day

2. Floor Drain, Radioactive (FDR) Sump Level change correction.

a. Level change: + 20 inches
(equivalent to 94.2 ft ^{3})

b. $\text{Correction} = \frac{94.2}{343{,}040}\ (100)$

$= 0.02746$ w/o/day

3. Equipment Drain, Radioactive (EDR) sump level change correction.

a. Level change: +8 inches (equivalent to 34.9 ft3)

b. $\text{Correction} = \frac{34.9}{343{,}040}\ (100)$

$= 0.01017$ w/o/day

4. Overall correction

$\text{Correction} = 0.00272 + 0.02746 + 0.01017$
$= 0.04035$ w/o/day

NOTE: No correction performed for an observed Suppression Pool level decrease of 0.85 inches because it was an assumed loss out of ECCS loops to other systems via Boundary Valves.

B. Correction to the LRVT measured result

NOTE: Liquid level changes were wholly incorporated into the PCILRT correction, this Attachment, Section A; therefore, this correction shall deal only with penetration corrections.

1. LLRT Correction (Refer to Table 4 and Section A.1, this Attachment)

a. $\leq$ LR = 488.2 + 3.2 + 122.8 sccm
[25% of 491.4 included for statistical variance]
= 614.2 sccm

b. conversion

$$\text{Correction} = \frac{(614.2)(60)(24)(100)\left(\frac{14.696}{50.279}\right)\left(\frac{76.405 + 459.69}{519.69}\right)}{(30.48)^3\ (343{,}040)}$$

$$= 0.002745 \text{ w/o/day}$$

C. LRVT CALCULATIONS

The superimposed leakage was 3.94 scfm. The average containment temperature and pressure were 76.405°F and 50.279 psia, respectively. The total containment volume was 343,040 ft^3. Therefore the superimposed leakage rate, L_o was:

$$L_o = (100\%)\ \frac{3.94 \text{ scfm}\left(\frac{14.696 \text{ psia}}{50.279 \text{ psia}}\right)\left(\frac{76.405 + 459.69 \text{ R}}{60 + 459.69 \text{ R}}\right)}{343{,}040 \text{ Ft}^3}\left(60 \frac{\text{min}}{\text{hr}}\right)\left(\frac{24 \text{ hr}}{\text{Day}}\right)$$

= 0.49868 weight percent per day

The following values are therefore used to demonstrate compliance with the acceptance criteria.

L_o = 0.4987 weight percent per day

L_{am} = 0.1615 weight percent per day (measured)

L_a = 0.5 weight percent per day

L_c = 0.6897 weight percent per day (measured)

Using these values in the acceptance criteria equation:

$$(L_o + L_{am} - .25\ L_a) \leq L_c \leq (L_o + L_{am} + .25\ L_a)$$

$$[0.4987 + 0.1615 - .25(.5) \leq 0.6897 \leq [0.4987 + 0.1615 + .25(.5)]$$
$$0.5352 \leq 0.6897 \leq 0.7852$$

Incorporating the LRVT correction factor (This Attachment, Section B.1.b) produces:

$$0.5379 \text{ w/o/d} \leq 0.6924 \text{ w/o/d} \leq 0.7879 \text{ w/o/d}$$

ATTACHMENT II
DATA SUMMARIES

Table of Contents

TABLE II.1

ILRT, REFUELING OUTAGE 1987
TEST STARTED AT 2334 ON 6/ 7/87
TEMPERATURE STABILIZATION

DATA SET #	TIME (HR)	TEMP R	DELTA T 4-HR	DELTA T 1-HR	DELTA
1	23.57	537.1425			
5	0.57	536.8621			
9	1.57	536.8708			
13	2.57	536.8356			
17	3.57	536.9640	0.0446	0.1283	-0.0837

TABLE II.2

ILRT, REFUELING OUTAGE 1987
TEST STARTED AT 619 ON 6/ 8/87

AVERAGED MEASURED DATA

DATA SET #	TIME (HR)	TEMP (F)	DEWPT (F)	PRESSURE (PSI)
1	619	76.913	72.933	50.459
2	634	76.914	72.889	50.458
3	649	76.918	72.791	50.458
4	704	76.933	72.776	50.455
5	719	76.928	72.918	50.456
6	734	76.897	72.981	50.456
7	749	76.896	72.867	50.457
8	804	76.935	72.894	50.457
9	819	76.962	73.028	50.457
10	834	76.954	73.131	50.458
11	849	76.969	73.165	50.459
12	904	76.987	73.216	50.458
13	919	76.978	73.095	50.458
14	934	76.969	73.174	50.459
15	949	77.038	73.236	50.458
16	1004	77.011	72.880	50.456
17	1019	76.997	72.965	50.453
18	1034	76.955	73.204	50.450
19	1049	76.954	73.196	50.448
20	1104	76.944	73.217	50.447
21	1119	76.964	73.215	50.446
22	1149	76.959	73.121	50.440
23	1204	76.948	72.977	50.436
24	1219	76.900	72.973	50.430
25	1234	76.852	72.773	50.425
26	1249	76.856	72.630	50.422
27	1304	76.837	72.663	50.417
28	1319	76.831	72.631	50.415
29	1334	76.801	72.648	50.415
30	1349	76.810	72.615	50.416

TABLE II.2 (CONT'D)

DATA SET #	TIME (HR)	AVERAGED MEASURED DATA TEMP (F)	DEWPT (F)	PRESSURE (PSI)
31	1404	76.822	72.742	50.420
32	1419	76.871	72.725	50.424
33	1434	76.888	72.755	50.428
34	1449	76.920	72.795	50.433
35	1504	76.920	72.993	50.437
36	1519	76.987	73.017	50.441
37	1534	76.981	73.037	50.444
38	1549	77.017	73.051	50.445
39	1604	77.057	72.955	50.448
40	1619	77.090	73.155	50.452
41	1634	77.132	73.071	50.452
42	1649	77.132	72.795	50.453
43	1704	77.166	73.091	50.451
44	1719	77.179	73.288	50.449
45	1734	77.116	72.951	50.445
46	1749	77.158	72.198	50.441
47	1804	77.107	73.101	50.438
48	1819	77.109	73.039	50.435
49	1834	77.124	73.184	50.433
50	1849	77.088	72.917	50.429
51	1904	77.044	73.140	50.426
52	1919	77.052	73.230	50.423
53	1934	77.102	73.344	50.420
54	1949	77.037	73.110	50.419
55	2004	77.090	73.235	50.417
56	2019	77.051	73.425	50.415
57	2034	77.027	73.408	50.413
58	2049	77.037	73.421	50.412
59	2104	77.039	73.190	50.410
60	2119	77.021	73.010	50.409

TABLE II. 2 (CONT'D)

DATA SET #	TIME (HR)	AVERAGED MEASURED DATA TEMP (F)	DEWPT (F)	PRESSURE (PSI)
61	2134	77.075	73.338	50.408
62	2149	77.038	73.112	50.407
63	2204	77.047	73.470	50.407
64	2219	77.061	73.411	50.406
65	2234	77.091	73.325	50.404
66	2249	77.073	73.326	50.403
67	2304	77.057	73.543	50.403
68	2319	77.060	73.297	50.403
69	2334	77.077	73.264	50.404
70	2349	77.123	73.464	50.404
71	4	77.090	73.124	50.404
72	19	77.078	73.043	50.403
73	34	77.113	73.077	50.401
74	49	77.103	73.124	50.400
75	104	77.086	73.067	50.399
76	119	77.085	73.189	50.397
77	134	77.067	72.913	50.395
78	149	77.041	72.935	50.391
79	204	77.081	73.024	50.389
80	219	77.034	72.968	50.386
81	234	77.003	72.892	50.383
82	249	76.996	72.741	50.380
83	304	76.954	72.691	50.376
84	319	76.913	72.531	50.372
85	334	76.918	72.257	50.368
86	349	76.879	72.372	50.364
87	404	76.855	72.106	50.359
88	419	76.813	72.334	50.355
89	434	76.783	71.729	50.351
90	449	76.722	71.736	50.347
91	504	76.723	71.620	50.343
92	519	76.650	71.537	50.339

TABLE II.3

ILRT, REFUELING OUTAGE 1987
TEST STARTED AT 619 ON 6/ 8/87
CORRECTED DATA SUMMARY

DATA SET #	TIME (HRS)	TEMP (F)	PRESSURE AIR (PSI)	AIR MASS (LB)	PRESSURE TOTAL (PSI)
1	619	76.913	50.0578	86361.86	50.4590
2	634	76.914	50.0577	86361.55	50.4583
3	649	76.918	50.0585	86362.24	50.4578
4	704	76.933	50.0562	86355.86	50.4553
5	719	76.928	50.0548	86354.23	50.4558
6	734	76.897	50.0545	86358.62	50.4563
7	749	76.896	50.0565	86362.27	50.4568
8	804	76.935	50.0562	86355.40	50.4568
9	819	76.962	50.0549	86348.77	50.4573
10	834	76.954	50.0545	86349.47	50.4583
11	849	76.969	50.0552	86348.38	50.4595
12	904	76.987	50.0535	86342.47	50.4585
13	919	76.978	50.0544	86345.52	50.4578
14	934	76.969	50.0547	86347.80	50.4593
15	949	77.038	50.0530	86333.53	50.4583
16	1004	77.011	50.0553	86341.76	50.4558
17	1019	76.997	50.0512	86336.89	50.4528
18	1034	76.955	50.0450	86332.82	50.4498
19	1049	76.954	50.0430	86329.83	50.4478
20	1104	76.944	50.0417	86329.20	50.4468
21	1119	76.964	50.0408	86324.28	50.4458
22	1149	76.959	50.0365	86317.74	50.4403
23	1204	76.948	50.0340	86315.06	50.4357
24	1219	76.900	50.0285	86313.48	50.4302
25	1234	76.852	50.0262	86317.10	50.4252
26	1249	76.856	50.0246	86313.80	50.4217
27	1304	76.837	50.0195	86307.88	50.4170
28	1319	76.831	50.0184	86306.96	50.4155
29	1334	76.801	50.0177	86310.64	50.4150
30	1349	76.810	50.0193	86312.03	50.4162
31	1404	76.822	50.0216	86314.08	50.4202
32	1419	76.871	50.0254	86312.57	50.4237
33	1434	76.888	50.0295	86316.97	50.4282
34	1449	76.920	50.0339	86319.60	50.4332
35	1504	76.920	50.0348	86320.92	50.4368
36	1519	76.987	50.0385	86316.57	50.4408
37	1534	76.981	50.0412	86322.20	50.4438
~~38~~	~~1549~~	~~77.017~~	~~50.0425~~	~~86318.65~~	~~50.4453~~
39	1604	77.057	50.0463	86318.75	50.4478
40	1619	77.090	50.0476	86315.79	50.4518

TABLE II.3 (CONT'D)

DATA SET #	TIME (HRS)	TEMP (F)	PRESSURE AIR (PSI)	AIR MASS (LB)	PRESSURE TOTAL (PSI)
41	1634	77.132	50.0492	86311.89	50.4523
42	1649	77.132	50.0535	86319.19	50.4528
43	1704	77.166	50.0482	86304.57	50.4515
44	1719	77.179	50.0430	86293.53	50.4490
45	1734	77.116	50.0434	86304.29	50.4448
46	1749	77.158	50.0497	86308.42	50.4410
47	1804	77.107	50.0346	86290.56	50.4380
48	1819	77.109	50.0321	86286.08	50.4348
49	1834	77.124	50.0282	86276.73	50.4327
50	1849	77.088	50.0278	86281.82	50.4287
51	1904	77.044	50.0217	86278.63	50.4257
52	1919	77.052	50.0175	86270.04	50.4227
53	1934	77.102	50.0135	86255.00	50.4202
54	1949	77.037	50.0151	86268.32	50.4187
55	2004	77.090	50.0119	86254.25	50.4172
56	2019	77.051	50.0073	86252.54	50.4152
57	2034	77.027	50.0051	86252.54	50.4127
58	2049	77.037	50.0039	86248.92	50.4117
59	2104	77.039	50.0050	86250.51	50.4097
60	2119	77.021	50.0065	86255.89	50.4087

TABLE II.3 (CONT'D)

DATA SET #	TIME (HRS)	TEMP (F)	PRESSURE AIR (PSI)	AIR MASS (LB)	PRESSURE TOTAL (PSI)
61	2134	77.075	50.0010	86237.84	50.4077
62	2149	77.038	50.0036	86248.21	50.4072
63	2204	77.047	49.9987	86238.38	50.4072
64	2219	77.061	49.9980	86234.92	50.4057
65	2234	77.091	49.9972	86228.72	50.4037
66	2249	77.073	49.9967	86230.61	50.4032
67	2304	77.057	49.9937	86228.08	50.4032
68	2319	77.060	49.9971	86233.42	50.4032
69	2334	77.077	49.9980	86232.37	50.4037
70	2349	77.123	49.9958	86221.10	50.4042
71	4	77.090	50.0004	86234.47	50.4042
72	19	77.078	50.0005	86236.56	50.4032
73	34	77.113	49.9981	86226.69	50.4012
74	49	77.103	49.9964	86225.45	50.4002
75	104	77.086	49.9962	86227.75	50.3992
76	119	77.085	49.9925	86221.59	50.3972
77	134	77.067	49.9942	86227.48	50.3951
78	149	77.041	49.9899	86224.18	50.3911
79	204	77.081	49.9868	86212.39	50.3892
80	219	77.034	49.9845	86215.86	50.3861
81	234	77.003	49.9825	86217.45	50.3831
82	249	76.996	49.9811	86216.05	50.3796
83	304	76.954	49.9782	86217.93	50.3761
84	319	76.913	49.9764	86221.28	50.3721
85	334	76.918	49.9755	86219.00	50.3676
86	349	76.879	49.9700	86215.76	50.3636
87	404	76.855	49.9690	86217.88	50.3591
88	419	76.813	49.9620	86212.44	50.3551
89	434	76.783	49.9659	86224.15	50.3511
90	449	76.722	49.9618	86226.83	50.3471
91	504	76.723	49.9588	86221.55	50.3426
92	519	76.650	49.9559	86228.17	50.3386

TABLE II.4

ILRT, REFUELING OUTAGE 1987
TEST STARTED AT 619 ON 6/ 8/87
TOTAL TIME LEAK RATE
ELAPSED TIME = 23.00

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
2	0.26	76.9140	50.0577	0.03434	0.14533
3	0.51	76.9184	50.0585	-0.02050	0.14604
4	0.76	76.9333	50.0562	0.22042	0.14675
5	1.01	76.9283	50.0548	0.21078	0.14747
6	1.26	76.8974	50.0545	0.07170	0.14818
7	1.51	76.8964	50.0565	-0.00742	0.14889
8	1.76	76.9353	50.0562	0.10227	0.14961
9	2.01	76.9625	50.0549	0.18134	0.15032
10	2.26	76.9538	50.0545	0.15260	0.15103
11	2.51	76.9685	50.0552	0.14951	0.15175
12	2.76	76.9870	50.0535	0.19548	0.15246
13	3.01	76.9782	50.0544	0.15110	0.15317
14	3.26	76.9686	50.0549	0.12001	0.15389
15	3.51	77.0376	50.0530	0.22454	0.15460
16	3.76	77.0113	50.0553	0.14872	0.15531
17	4.01	76.9971	50.0512	0.17324	0.15603
18	4.26	76.9555	50.0450	0.18960	0.15674
19	4.51	76.9535	50.0430	0.19752	0.15745
20	4.76	76.9436	50.0417	0.19082	0.15817
21	5.01	76.9638	50.0408	0.20859	0.15888
22	5.51	76.9591	50.0365	0.22266	0.16031
23	5.75	76.9482	50.0340	0.22621	0.16100
24	6.01	76.8996	50.0285	0.22384	0.16173
25	6.26	76.8524	50.0262	0.19885	0.16245
26	6.51	76.8558	50.0246	0.20530	0.16316
27	6.76	76.8372	50.0195	0.22203	0.16387
28	7.01	76.8314	50.0184	0.21778	0.16459
29	7.26	76.8006	50.0177	0.19616	0.16530
30	7.51	76.8099	50.0193	0.18451	0.16601

TABLE II.4 (CONT'D)

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
31	7.76	76.8219	50.0216	0.17122	0.16673
32	8.01	76.8714	50.0254	0.17109	0.16744
33	8.26	76.8881	50.0295	0.15111	0.16815
34	8.51	76.9195	50.0339	0.13808	0.16887
35	8.76	76.9203	50.0348	0.12995	0.16958
36	9.01	76.9868	50.0385	0.13975	0.17029
37	9.26	76.9812	50.0412	0.11909	0.17101
38	9.51	77.0174	50.0425	0.12632	0.17172
39	9.76	77.0575	50.0463	0.12280	0.17243
40	10.01	77.0899	50.0476	0.12797	0.17315
41	10.26	77.1317	50.0492	0.13542	0.17386
42	10.51	77.1317	50.0535	0.11288	0.17457
43	10.76	77.1659	50.0482	0.14803	0.17529
44	11.00	77.1789	50.0430	0.17264	0.17598
45	11.25	77.1161	50.0434	0.14221	0.17669
46	11.50	77.1576	50.0497	0.12914	0.17741
47	11.75	77.1068	50.0346	0.16863	0.17812
48	12.01	77.1088	50.0321	0.17541	0.17885
49	12.26	77.1244	50.0282	0.19304	0.17957
50	12.51	77.0884	50.0278	0.17787	0.18028
51	12.75	77.0435	50.0217	0.18140	0.18098
52	13.00	77.0516	50.0175	0.19628	0.18169
53	13.25	77.1017	50.0135	0.22411	0.18240
54	13.50	77.0369	50.0151	0.19256	0.18312
55	13.75	77.0900	50.0119	0.21749	0.18383
56	14.00	77.0512	50.0073	0.21699	0.18454
57	14.25	77.0269	50.0051	0.21319	0.18526
58	14.50	77.0368	50.0039	0.21645	0.18597
59	14.75	77.0393	50.0050	0.20979	0.18668
60	15.00	77.0212	50.0065	0.19632	0.18740

TABLE II.4 (CONT'D)

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
61	15.25	77.0748	50.0010	0.22599	0.18811
62	15.50	77.0381	50.0036	0.20376	0.18882
63	15.75	77.0468	49.9987	0.21787	0.18954
64	16.00	77.0608	49.9980	0.22047	0.19025
65	16.25	77.0905	49.9972	0.22768	0.19096
66	16.50	77.0733	49.9967	0.22106	0.19168
67	16.75	77.0571	49.9937	0.22194	0.19239
68	17.00	77.0601	49.9971	0.20996	0.19310
69	17.25	77.0767	49.9980	0.20860	0.19382
70	17.50	77.1229	49.9958	0.22353	0.19453
71	17.75	77.0897	50.0004	0.19944	0.19524
72	18.00	77.0777	50.0005	0.19345	0.19596
73	18.25	77.1125	49.9981	0.20582	0.19667
74	18.50	77.1026	49.9964	0.20491	0.19738
75	18.75	77.0859	49.9962	0.19877	0.19810
76	19.00	77.0849	49.9925	0.20516	0.19881
77	19.25	77.0667	49.9942	0.19400	0.19952
78	19.50	77.0411	49.9899	0.19621	0.20024
79	19.75	77.0806	49.9868	0.21031	0.20095
80	20.00	77.0345	49.9845	0.20287	0.20166
81	20.25	77.0032	49.9825	0.19817	0.20238
82	20.50	76.9962	49.9811	0.19766	0.20309
83	20.75	76.9540	49.9782	0.19276	0.20380
84	21.00	76.9132	49.9764	0.18603	0.20452
85	21.25	76.9181	49.9755	0.18683	0.20523
86	21.50	76.8789	49.9700	0.18884	0.20594
87	21.75	76.8550	49.9690	0.18396	0.20666
88	22.00	76.8135	49.9620	0.18874	0.20737
89	22.25	76.7831	49.9659	0.17199	0.20808
90	22.50	76.7224	49.9618	0.16678	0.20880
91	22.75	76.7230	49.9588	0.17139	0.20951
92	23.00	76.6503	49.9559	0.16153	0.21022

TOTAL TIME LEAK RATE = 0.210222
ESTIMATE OF STANDARD DEVIATION = 0.0433
95% UPPER CONFIDENCE LIMIT LEAK RATE = 0.2837
MAXIMUM ALLOWABLE LEAK RATE = 0.375

TABLE II.5

ILRT, REFUELING OUTAGE 1987
TEST STARTED AT 619 ON 6/ 8/87
MASS POINT LEAK RATE
ELAPSED TIME = 23.00

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
3	0.51	76.9184	50.0585	-0.02050	0.19966
4	0.76	76.9333	50.0562	0.22042	0.19966
5	1.01	76.9283	50.0548	0.21078	0.19966
6	1.26	76.8974	50.0545	0.07170	0.19966
7	1.51	76.8964	50.0565	-0.00742	0.19966
8	1.76	76.9353	50.0562	0.10227	0.19966
9	2.01	76.9625	50.0549	0.18134	0.19966
10	2.26	76.9538	50.0545	0.15260	0.19966
11	2.51	76.9685	50.0552	0.14951	0.19966
12	2.76	76.9870	50.0535	0.19548	0.19966
13	3.01	76.9782	50.0544	0.15110	0.19966
14	3.26	76.9686	50.0549	0.12001	0.19966
15	3.51	77.0376	50.0530	0.22454	0.19966
16	3.76	77.0113	50.0553	0.14872	0.19966
17	4.01	76.9971	50.0512	0.17324	0.19966
18	4.26	76.9555	50.0450	0.18960	0.19966
19	4.51	76.9535	50.0430	0.19752	0.19966
20	4.76	76.9436	50.0417	0.19082	0.19966
21	5.01	76.9638	50.0408	0.20859	0.19966
22	5.51	76.9591	50.0365	0.22266	0.19966
23	5.75	76.9482	50.0340	0.22621	0.19966
24	6.01	76.8996	50.0285	0.22384	0.19966
25	6.26	76.8524	50.0262	0.19885	0.19966

TABLE II-5 (CONT'D)

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
26	6.51	76.8558	50.0246	0.20530	0.19966
27	6.76	76.8372	50.0195	0.22203	0.19966
28	7.01	76.8314	50.0184	0.21778	0.19966
29	7.26	76.8006	50.0177	0.19616	0.19966
30	7.51	76.8099	50.0193	0.18451	0.19966
31	7.76	76.8219	50.0216	0.17122	0.19966
32	8.01	76.8714	50.0254	0.17109	0.19966
33	8.26	76.8881	50.0295	0.15111	0.19966
34	8.51	76.9195	50.0339	0.13808	0.19966
35	8.76	76.9203	50.0348	0.12995	0.19966
36	9.01	76.9868	50.0385	0.13975	0.19966
37	9.26	76.9812	50.0412	0.11909	0.19966
38	9.51	77.0174	50.0425	0.12632	0.19966
39	9.76	77.0575	50.0463	0.12280	0.19966
40	10.01	77.0899	50.0476	0.12797	0.19966
41	10.26	77.1317	50.0492	0.13542	0.19966
42	10.51	77.1317	50.0535	0.11288	0.19966
43	10.76	77.1659	50.0482	0.14803	0.19966
44	11.00	77.1789	50.0430	0.17264	0.19966
45	11.25	77.1161	50.0434	0.14221	0.19966
46	11.50	77.1576	50.0497	0.12914	0.19966
47	11.75	77.1068	50.0346	0.16863	0.19966
48	12.01	77.1088	50.0321	0.17541	0.19966
49	12.26	77.1244	50.0282	0.19304	0.19966
50	12.51	77.0884	50.0278	0.17787	0.19966
51	12.75	77.0435	50.0217	0.18140	0.19966
52	13.00	77.0516	50.0175	0.19628	0.19966
53	13.25	77.1017	50.0135	0.22411	0.19966
54	13.50	77.0369	50.0151	0.19256	0.19966
55	13.75	77.0900	50.0119	0.21749	0.19966
56	14.00	77.0512	50.0073	0.21699	0.19966

TABLE II.5 (CONT'D)

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
57	14.25	77.0269	50.0051	0.21319	0.19966
58	14.50	77.0368	50.0039	0.21645	0.19966
59	14.75	77.0393	50.0050	0.20979	0.19966
60	15.00	77.0212	50.0065	0.19632	0.19966
61	15.25	77.0748	50.0010	0.22599	0.19966
62	15.50	77.0381	50.0036	0.20376	0.19966
63	15.75	77.0468	49.9987	0.21787	0.19966
64	16.00	77.0608	49.9980	0.22047	0.19966
65	16.25	77.0905	49.9972	0.22768	0.19966
66	16.50	77.0733	49.9967	0.22106	0.19966
67	16.75	77.0571	49.9937	0.22194	0.19966
68	17.00	77.0601	49.9971	0.20996	0.19966
69	17.25	77.0767	49.9980	0.20860	0.19966
70	17.50	77.1229	49.9958	0.22353	0.19966
71	17.75	77.0897	50.0004	0.19944	0.19966
72	18.00	77.0777	50.0005	0.19345	0.19966
73	18.25	77.1125	49.9981	0.20582	0.19966
74	18.50	77.1026	49.9964	0.20491	0.19966
75	18.75	77.0859	49.9962	0.19877	0.19966
76	19.00	77.0849	49.9925	0.20516	0.19966
77	19.25	77.0667	49.9942	0.19400	0.19966
78	19.50	77.0411	49.9899	0.19621	0.19966
79	19.75	77.0806	49.9868	0.21031	0.19966
80	20.00	77.0345	49.9845	0.20287	0.19966
81	20.25	77.0032	49.9825	0.19817	0.19966
82	20.50	76.9962	49.9811	0.19766	0.19966
83	20.75	76.9540	49.9782	0.19276	0.19966
84	21.00	76.9132	49.9764	0.18603	0.19966
85	21.25	76.9181	49.9755	0.18683	0.19966
86	21.50	76.8789	49.9700	0.18884	0.19966
87	21.75	76.8550	49.9690	0.18396	0.19966
88	22.00	76.8135	49.9620	0.18874	0.19966
89	22.25	76.7831	49.9659	0.17199	0.19966
90	22.50	76.7224	49.9618	0.16678	0.19966
91	22.75	76.7230	49.9588	0.17139	0.19966
92	23.00	76.6503	49.9559	0.16153	0.19966

MASS POINT LEAK RATE = 0.199657
ESTIMATE OF STANDARD DEVIATION = 11.6535
STANDARD DEVIATION OF SLOPE = 0.181
STANDARD ESTIMATE OF INTERCEPT = 2.4210
COVARIANCE OF SLOPE AND INTERCEPT = -0.3790
95% UPPER CONFIDENCE LIMIT LEAK RATE = 0.2080
MAXIMUM ALLOWABLE LEAK RATE = 0.375

TABLE II.6

ILRT, INDUCED LEAK VERIFICATION 1987
TEST STARTED AT 804 ON 6/ 9/87

AVERAGED MEASURED DATA

DATA SET #	TIME (HR)	TEMP (F)	DEWPT (F)	PRESSURE (PSI)
1	804	76.309	71.030	50.296
2	814	76.309	71.181	50.295
3	824	76.327	71.329	50.293
4	834	76.303	71.339	50.290
5	844	76.316	71.263	50.289
6	854	76.277	71.222	50.288
7	904	76.325	71.277	50.287
8	914	76.280	71.135	50.284
9	924	76.313	71.338	50.283
10	934	76.299	71.260	50.283
11	944	76.304	71.264	50.282
12	954	76.366	71.493	50.281
13	1004	76.352	71.572	50.277
14	1014	76.325	71.678	50.276
15	1024	76.357	71.390	50.276
16	1034	76.403	71.533	50.275
17	1044	76.404	71.446	50.275
18	1054	76.410	71.585	50.274
19	1104	76.398	71.431	50.274
20	1114	76.442	71.707	50.274
21	1124	76.479	71.623	50.273
22	1134	76.464	71.709	50.273
23	1144	76.502	71.717	50.272
24	1154	76.478	71.944	50.272
25	1204	76.479	71.728	50.267
26	1214	76.482	71.843	50.267
27	1224	76.504	71.932	50.267
28	1234	76.527	71.797	50.267
29	1244	76.570	72.042	50.267

TABLE II.7

ILRT, INDUCED LEAK VERIFICATION 1987
TEST STARTED AT 804 ON 6/ 9/87
CORRECTED DATA SUMMARY

DATA SET #	TIME (HRS)	TEMP (F)	PRESSURE AIR (PSI)	AIR MASS (LB)	PRESSURE TOTAL (PSI)
1	804	76.309	49.9203	86221.67	50.2965
2	814	76.309	49.9174	86216.53	50.2955
3	824	76.327	49.9135	86206.96	50.2935
4	834	76.303	49.9103	86205.36	50.2905
5	844	76.316	49.9103	86203.24	50.2895
6	854	76.277	49.9099	86208.71	50.2885
7	904	76.325	49.9082	86198.06	50.2875
8	914	76.280	49.9065	86202.41	50.2840
9	924	76.313	49.9034	86191.71	50.2835
10	934	76.299	49.9039	86194.82	50.2830
11	944	76.304	49.9028	86192.28	50.2820
12	954	76.366	49.8994	86176.39	50.2815
13	1004	76.352	49.8943	86167.76	50.2774
14	1014	76.325	49.8919	86170.10	50.2764
15	1024	76.357	49.8952	86170.52	50.2760
16	1034	76.403	49.8928	86159.05	50.2755
17	1044	76.404	49.8935	86160.02	50.2750
18	1054	76.410	49.8912	86155.09	50.2745
19	1104	76.398	49.8932	86160.46	50.2745
20	1114	76.442	49.8891	86146.31	50.2740
21	1124	76.479	49.8897	86141.44	50.2735
22	1134	76.464	49.8886	86141.89	50.2735
23	1144	76.502	49.8875	86133.94	50.2725
24	1154	76.478	49.8845	86132.68	50.2725
25	1204	76.479	49.8817	86127.72	50.2669
26	1214	76.482	49.8802	86124.59	50.2669
27	1224	76.504	49.8791	86119.16	50.2669
28	1234	76.527	49.8808	86118.48	50.2669
29	1244	76.570	49.8776	86106.04	50.2669

TABLE II.8

ILRT, INDUCED LEAK VERIFICATION 1987
TEST STARTED AT 804. ON 6/ 9/87
TOTAL TIME LEAK RATE
ELAPSED TIME = 4.67

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
2	0.17	76.3095	49.9174	0.85783	0.73597
3	0.33	76.3272	49.9135	1.22819	0.73103
4	0.50	76.3032	49.9103	0.90788	0.72609
5	0.67	76.3162	49.9103	0.76937	0.72115
6	0.83	76.2773	49.9099	0.43277	0.71621
7	1.00	76.3252	49.9082	0.65706	0.71128
8	1.17	76.2800	49.9065	0.45945	0.70634
9	1.33	76.3132	49.9034	0.62546	0.70140
10	1.50	76.2993	49.9039	0.49826	0.69646
11	1.67	76.3040	49.9028	0.49085	0.69152
12	1.83	76.3657	49.8994	0.68742	0.68658
13	2.00	76.3524	49.8943	0.72243	0.68164
14	2.17	76.3249	49.8919	0.66256	0.67670
15	2.33	76.3571	49.8952	0.61020	0.67177
16	2.50	76.4033	49.8928	0.69719	0.66683
17	2.67	76.4040	49.8935	0.64348	0.66189
18	2.83	76.4099	49.8912	0.65407	0.65695
19	3.00	76.3980	49.8932	0.56796	0.65201
20	3.17	76.4423	49.8891	0.66241	0.64707
21	3.33	76.4790	49.8897	0.67000	0.64213
22	3.50	76.4641	49.8886	0.63448	0.63719
23	3.67	76.5020	49.8875	0.66601	0.63226
24	3.83	76.4778	49.8845	0.64617	0.62732
25	4.00	76.4791	49.8817	0.65379	0.62238
26	4.17	76.4824	49.8802	0.64854	0.61744
27	4.33	76.5037	49.8791	0.65849	0.61250
28	4.50	76.5269	49.8808	0.63830	0.60756
29	4.67	76.5698	49.8776	0.68967	0.60262

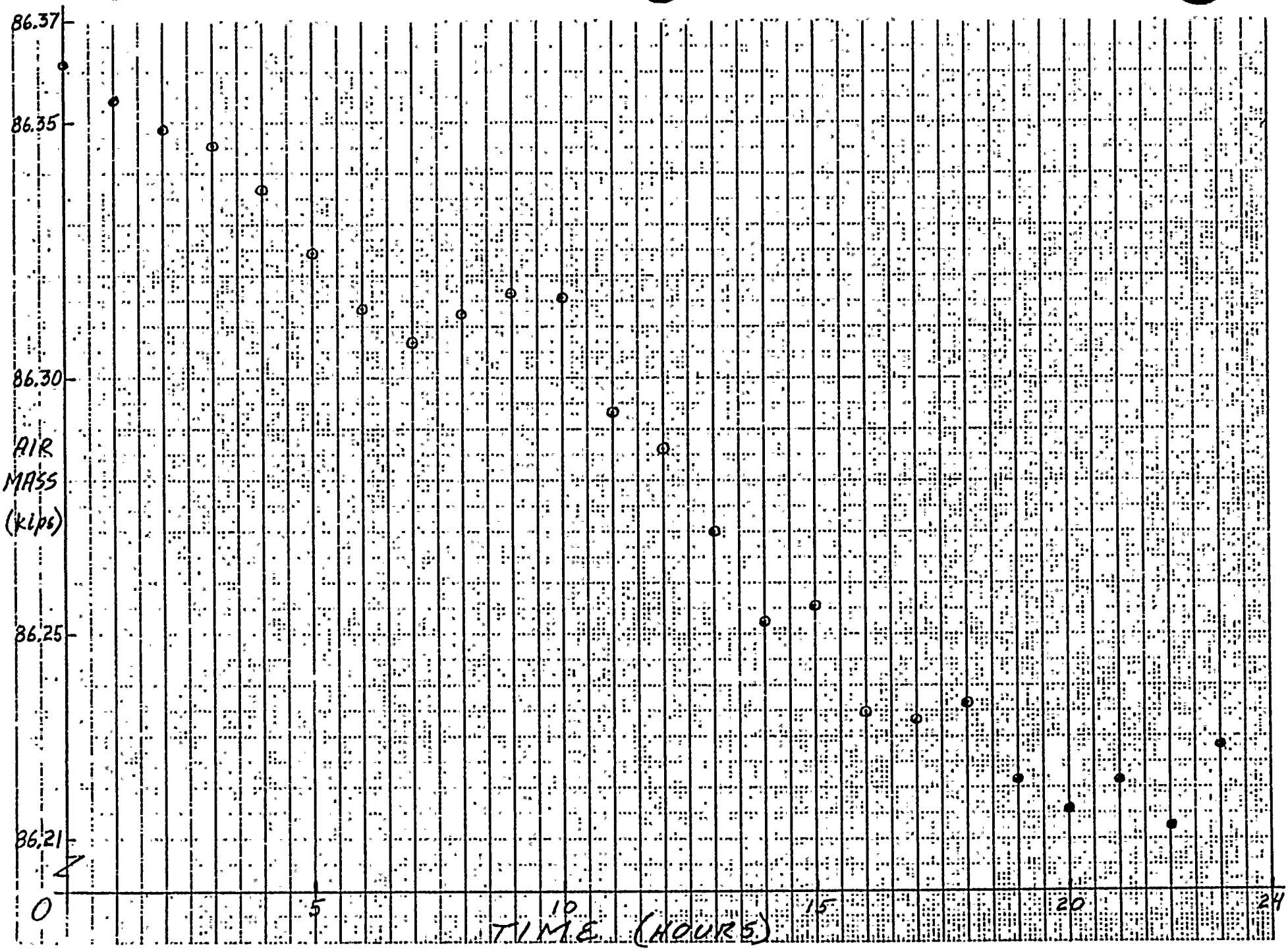
TOTAL TIME LEAK RATE = 0.602624
ESTIMATE OF STANDARD DEVIATION = 0.1462
95% UPPER CONFIDENCE LIMIT LEAK RATE = 0.8684
MAXIMUM ALLOWABLE LEAK RATE = 0.375

TABLE II.9

ILRT, INDUCED LEAK VERIFICATION 1987
TEST STARTED AT 804 ON 6/ 9/87
MASS POINT LEAK RATE
ELAPSED TIME = 4.67

DATA SET #	ELAPSED TIME (HR)	TEMP AVG (F)	PRESSURE (PSIA)	LEAK RATE MEASURED	LEAK RATE CALCULATED
3	0.33	76.3272	49.9135	1.22819	0.65634
4	0.50	76.3032	49.9103	0.90788	0.65634
5	0.67	76.3162	49.9103	0.76937	0.65634
6	0.83	76.2773	49.9099	0.43277	0.65634
7	1.00	76.3252	49.9082	0.65706	0.65634
8	1.17	76.2800	49.9065	0.45945	0.65634
9	1.33	76.3132	49.9034	0.62546	0.65634
10	1.50	76.2993	49.9039	0.49826	0.65634
11	1.67	76.3040	49.9028	0.49085	0.65634
12	1.83	76.3657	49.8994	0.68742	0.65634
13	2.00	76.3524	49.8943	0.72243	0.65634
14	2.17	76.3249	49.8919	0.66256	0.65634
15	2.33	76.3571	49.8952	0.61020	0.65634
16	2.50	76.4033	49.8928	0.69719	0.65634
17	2.67	76.4040	49.8935	0.64348	0.65634
18	2.83	76.4099	49.8932	0.65407	0.65634
19	3.00	76.3980	49.8932	0.56796	0.65634
20	3.17	76.4423	49.8891	0.66241	0.65634
21	3.33	76.4790	49.8897	0.67000	0.65634
22	3.50	76.4641	49.8886	0.63448	0.65634
23	3.67	76.5020	49.8875	0.66601	0.65634
24	3.83	76.4778	49.8845	0.64617	0.65634
25	4.00	76.4791	49.8817	0.65379	0.65634
26	4.17	76.4824	49.8802	0.64854	0.65634
27	4.33	76.5037	49.8791	0.65849	0.65634
28	4.50	76.5269	49.8808	0.63830	0.65634
29	4.67	76.5698	49.8776	0.68967	0.65634

MASS POINT LEAK RATE = 0.656335
ESTIMATE OF STANDARD DEVIATION = 4.5042
STANDARD DEVIATION OF SLOPE = 0.600
STANDARD ESTIMATE OF INTERCEPT = 1.6305
COVARIANCE OF SLOPE AND INTERCEPT = -0.8395
95% UPPER CONFIDENCE LIMIT LEAK RATE = 0.6847
MAXIMUM ALLOWABLE LEAK RATE = 0.375



ATTACHMENT III

ATTACHMENT IV
GLOSSARY

CIV - Containment Isolation Valve

DAS - Data Acquisition System

DF - Drywell Floor (horizontal concrete slab separating the Drywell from the Wetwell)

FVM - Flow Verification Monitor (part of ILRMS)

ILRMS - Integrated Leak Rate Monitoring System

ILRT - Same as PCILRT

ILRTA - Integrated leak Rate Test Analysis (Ref. 5.12)

La - Maximum Allowable PRC LR, in w/o/d (=0.5 w/o/d for WNP-2)

Lam Measured PRC LR, in w/o/d

Lc - Measured composite LR, in w/o/d (= value obtained by performance of the LRVT)

LLRT - Local Leakage Rate Test (Type B or C test)

LR - Leakage Rate

LRVT - Leakage Rate Verification Test (the supplemental test performed just after the Type A test)

MSIV - Main Steam Isolation Valve (CIVs in Main Steam Lines)

OILR - Overall Integrated Leakage Rate

Pa - Peak Accident Pressure (34.7 psig)

PCILRT - Primary Containment Integrated Leakage Rate Test (Type A Test)

Pd - PRC Design Pressure (45 psig)

PRC - Primary Reactor Containment

RB - Reactor Building

RPV - Reactor Pressure Vessel

SCCM - Standard Cubic Centimeters per Minute

UCL - Upper Confidence Limit

w/o/d - Weight Percent Per Day

X -____- PRC Penetration (Blank filled in with the specific identifying numeral)

SUPPLEMENTAL SUMMARY REPORT
APPENDIX J - TYPE A, B & C
AS-FOUND TEST RESULTS

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PLANT NO. 2

September 1987

PCILRT SUPPLEMENTAL SUMMARY REPORT
AS-FOUND TEST ANALYSIS

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PCILRT SUPPLEMENTAL SUMMARY REPORT

LIST OF TABLES

1.0 INTRODUCTION

During each annual spring outage in 1985, 1986 and 1987, Type B and C local leak rate testing was performed on Primary Containment Isolation Valves as prescribed by Appendix J, WNP-2 FSAR and Plant Technical Specifications. Leak testing is initially performed with valves in their "as-found" condition, i.e., prior to any adjustments or repairs which would affect a valve's leakage characteristics. Each Type C penetration is analyzed for total leakage using single failure criteria to arrive at the 'maximum pathway' leakage rate total for that containment penetration. The total penetration leakage reported is the greatest leak rate calculated from considering all possible single failures of active isolation boundaries.

The Primary Containment Integrated Leak Rate Test (PCILRT) was conducted at the end of the 1987 outage, after Type B & C testing was complete. Several isolation valves were repaired prior to the PCILRT due to excessive leakage detected from LLRT's or due to scheduled maintenance on resilient seals. The ILRT results (as-left) are adjusted by the difference in minimum pathway leakage rates before and after repairs or maintenance activities to arrive at the Type A "as-found" value.

The totals for Type B & C testing for the 1985, 1986 and 1987 outages yielded as-found values greater than 0.6 La. The deficiencies which led to the excessive leakages and the corrective actions taken to reduce the total leakage to below 0.6 La are included in the discussion section of this report.

The adjusted Type A As-Found leakage results, corrected for the differences in minimum pathway leakage rates before and after repairs on Type C valves, exceeded the maximum allowable rate of 0.75 La. The factors contributing to the as-found failure are detailed below in the discussion section of this report.

2.0 DISCUSSION

2.1 Type B & C Testing

During the 1985, 1986 and 1987 testing sequences, the total Type B & C As-Found leakage rates exceed 0.6 La (67,920 sccm). Several valves had leakage rates in excess of the measuring capabilities of the testing instruments used or could not be pressurized to the required test pressure (Pa). For these valves, the as-found leakage rate is conservatively reported as greater than 0.6 La.

During the 1987 outage testing sequence, significant efforts were made to establish the leakage quantity of each isolation valve in series when tested simultaneously by pressurizing between the two valves. In this way, the as-found minimum pathway leakage rate for a given penetration could be established for use in arriving at the As-Found Type A leakage rate.

Tables 1, 2 & 3 list the isolation valves repaired or otherwise adjusted due to excessive as-found leakage and includes a description of the deficiency which caused the excessive leakage and the corrective action taken to reduce the leakage, thus lowering the overall Type B and C leak rate below 0.6 La.

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-5	RCC-V-107	3/4"	Test Connection	327	4.2	Damaged Seat/Disassembled and Machined Seats
X-5	RCC-V-5	10"	Closed Cooling Isolation	10,313.5	8.8	Torque Switch Set Too Low/Reset Torque Switch
X-17A	RFW-V-32A	24"	Feedwater Check Valve	>0.6 La	176	Soft Seat Damaged/Replaced Seat
X-17A	RFW-V-65A	24"	Feedwater Manual Remote Isolation	25,066.3	5746	Defect Unknown/Disassembled and Cleaned
X-17B	RFW-V-10B	24"	Feedwater Check Valve	>0.6 La	0	Soft Seat Damaged/Replaced Seat
X-17B	RFW-V-32B	24"	Feedwater Check Valve	>0.6 La	579	Soft Seat Damaged/Replaced Seat
X-22	MS-V-16	3"	Main Steam Drains Isolation	170.6	2.14	Debris Under Seat/Flushed and Stroked
X-23	EDR-V-20	3"	Equipment Drains Isolation	254	4.44	Debris on Seats/Flushed with Water
X-24	FDR-V-3	3"	Floor Drains Isolation	>0.6 La	920	Debris on Seats/Disassembled and Lapped
X-24	FDR-V-4	3"	Floor Drains Isolation	548.4	521	Debris on Seats/Disassembled and Lapped
X-25A	RHR-V-27A	6"	Spray Header Isolation	2330	0.08	Debris under Seat/Disassembled and Cleaned
X-25A	RHR-V-130A	3"	Spray Header Test Line Isolation	>0.6 La	2.9	Seat Damaged/Valve Locked Shut & Added Valve Downstream

TABLE 1
1985 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-25B	RHR-V-27B	6"	Spray Header Isolation	>0.6 La	4360	Debris under Seat/Flushed with Water
X-46	RCC-V-21	10"	Closed Cooling Isolation	3566	24.88	Damaged Seat/Disassembled and Lapped
X-49	HPCS-V-12	4"	Min Flow Line Isolation	>0.6 La	2044	Torque Switch Malfunction/Replaced Torque Switch
X-56	CIA-V-21	3/4"	Instrument Air Isolation	1686.3	89.1	Debris under Seat/Flushed with air
X-63	LPCS-V-57	3/4"	Test Connection	117.8	14.34	Debris under Seat/Flushed with water
X-64	RCIC-V-28	1.5"	RCIC Vacuum Pump Return	868	219.95	Damaged Seat/Disassembled and Lapped
X-89B	CIA-V-31A	1/2"	Instrument Air Isolation	4385.9	64.06	Debris under Seat/Disassembled and Cleaned
X-102	CAC-V-4	4"	H_2 Recombiner Isolation	>0.6 La	1067.2	Torque Switch set too Low/Increased Switch Setting
X-103	CAC-V-13	4"	H_2 Recombiner Isolation	>0.6 La	492	Debris under Seat/Disassembled and Cleaned
X-119	CSP-V-10	24"	Containment Purge Isolation Vacuum Breaker	>0.6 La	25.5	Worn Seal/Replaced Seal
X-119	CSP-V-9	24"	Containment Purge Isolation	>0.6 La	25.5	Worn Seal Ring and Packing Leak/Replaced Seal Ring

TABLE 1 (Cont'd)
1985 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-3	CEP-V-800-2	3/4"	Test Connection	1490	20	Seat Damage/Disassembled, Machined and Lapped
X-4	RCIC-V-40	10"	RCIC Turbine Exhaust Return	10,360	188.9	Seat Damage/Disassembled and Lapped Seat
X-11A	RHR-V-154A	3/4"	Test Connection	355	0	Debris Underseat/Disassembled Machined and Lapped
X-21	RCIC-V-76	1"	Min. Flow Bypass Isolaton	13,970	0	Valve Packing Leak/Repacked Valve Stem
X-24	FDR-V-3	3"	Floor Drains Isolation	>0.6 La	1.1	Debris on Seats/Disassembled, Cleaned, Lapped
X-24	FDR-V-4	3"	Floor Drains Isolation	>0.6 La	420	Debris on Seats/Disassembled, Clean, Lapped
X-25B	RHR-V-27B	6"	Spray Header Isolation	>0.6 La	9	Damaged Seats/Disassembled and Lapped
X-49	HPCS-V-12	4"	Min. Flow Line Isolation	>0.6 La	93.7	Seat Damage/Disassembled and Lapped Seats
X-49	HPCS-V-36	3/4"	Test Connection	588	302	Debris under Seat/Flushed with Water
X-49	HPCS-V-72	3/4"	Test Connection	>0.6 La	0.7	Seat Damage/Disassembled Lapped Seat
X-56	CIA-V-21	3/4"	Instrument Air Isolation	>0.6 La	378	Seat Damaged/Installed New Valve
X-64	RCIC-V-28	1.5"	RCIC Vacuum Pump Return	679	447	Debris under Seat/Disassembled and Cleaned

TABLE 2
1986 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-77Aa	RRC-V-19	1"	Sample Line Isolation	>0.6 La	176.7	Seat Damage/Disassembled and Lapped Seats
X-77Aa	RRC-V-20	1"	Sample Line Isolation	>0.6 La	35.9	Stem Binding and Worn O-Rings/ Disassembled, Straightened Stem and Replaced O-Rings
X-89B	CIA-V-31A	1/2"	Instrument Air Isolation	1107	129	Debris under Seat/Flushed with Air
X-98	CAC-V-800-13	3/4"	Test Connection	1130	0	Damaged Seat/Disassembled, Machined and Lapped
X-101	FPC-V-161	3/4"	Test Connection	796	38.3	Damaged Seat/Disassembled, Machined and Lapped
X-102	CAC-V-4	4"	H_2 Recombiner Isolation	>0.6 La	1529	Deficiency Unknown/Valve Replaced with New Valve
X-103	CAC-V-13	4"	H_2 Recombiner Isolation	859	149	Debris under Seat/Flushed with Air
X-103	CAC-V-800-11	3/4"	Test Connection	8260	16	Debris under Seat/Flushed with Air
X-103	CAC-V-800-12	3/4"	Test Connection	1800	377	Debris under Seat/Flushed with Air
X-119	CSP-V-10	24"	Containment Purge Vacuum Breaker	>0.6 La	32	Limit Switch Holding Vacuum Breaker Open/Reset Limit Switch

TABLE 2 (Cont'd)
1986 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-4	RCIC-V-68	10"	RCIC Turbine Exhaust	591	383	Closing Torque too High/Decreased Torque Setting
X-4	RCIC-V-122	3/4"	Test Connection	509	2.7	Debris under Seat/Flushed with Air
X-14	RWCU-V-612	3/4"	RWCU Test Connection	12,220	6.46	Distorted Seat/Lapped Seat
X-17A/B	RFW-V-65A/B	24"	Feedwater Isolation (Remote Manual Operation)	10,550	7439	Deficiency Unknown/Stroked Valves
X-24	FDR-V-3/4	3"	Floor Drains Isolation Valves	27,000	16.5	Debris under Seat/Flushed with Water
X-49	HPCS-V-23	12"	Test Line Isolation	18.4	78.2	Torque Switch Setting too High/ Decreased Torque Setting
X-49	HPCS-V-36	3/4"	Test Connection	612	3.3	Scored Seats/Lapped Seats
X-56	CIA-V-21	3/4"	Instrument Air Isolation	7380	4.4	Debris under Seat/Disassembled, Cleaned and Lapped
X-65	RCIC-V-120	3/4"	Test Connection	556	0.1	Seat Damage/Lapped Seats
X-66	CSP-V-7	24"	Containment Purge Vacuum Breaker	3720	0	Debris on Seating Surface/Cleaned Seat
X-67	CEP-V-3A	24"	Containment Purge Exhaust Isolation	>0.6 La	59.5	Replaced Resilient Seat

TABLE 3
1987 OUTAGE - ISOLATION VALVES REPAIRED/ADJUSTED

Penetration No.	Valve No.	Size	Function	As-Found SCCM	As-Left SCCM	Deficiency/Corrective Action
X-67	CSP-V-8	24"	Containment Purge Vacuum Breaker	>0.6 La	0	Debris on Seating Surface/Cleaned Seat
X-77Aa	RRC-V-20	1"	RRC Sample Point Isolation	859	81.2	Defective Resilient Seals/Replaced Valve
X-91	CIA-V-31B	1/2"	Instrument Air Isolation	1950	39.6	Debris under Seat/Cleaned and Lapped
X-101	FPC-V-156	6"	Effluent Return Line Isolation	9820	20.4	Deficiency Unknown/Stroked Valve
X-119	CSP-V-9	24"	Containment Purge Isolation	3130	43.2	Worn Seat/Replaced Resilient Seat

TABLE 3 (Cont'd)
1987 OUTAGE - ISOLATION VALVES. REPAIRED/ADJUSTED

2.2 Main Steam Isolation Valves (MSIV's)

The as-found leak rates for the MSIV's are shown in Table 4. These valves are tested @ 25 psig in accordance with Plant Technical Specifications and are not included in the sum of Type B and C testing. However, these isolation boundaries are subject to the Type A test and as such, their leak rates are reflected in the total Type A results. The allowable leak rate per Technical Specifications is 5427 sccm per valve.

Penetration No.	Valve No.	As-Found Leakage Rates (SCCM) 1985	1986	1987
18A	MS-V-22A	3631	12,460[1]	675
	MS-V-28A		895	
18B	MS-V-22B	10,021[1]	397	10,088[1]
	MS-V-28B	493		2,768
18C	MS-V-22C	697	4,965	37,356[1]
	MS-V-28C			2,568
18D	MS-V-22D	3,957	14,158[1]	411
	MS-V-28D		1,488	

Note 1. Valve repaired and subsequently retested.

TABLE 4
AS-FOUND LEAK RATES FOR MSIV's

2.3 Type A Testing

The as-left Type A test results were corrected to include the minimum pathway leak rate differential for Type B and C containment isolation boundaries which were repaired or otherwise adjusted during the refueling outage just prior to the 1987 PCILRT. This corrected value is referred to as the As-Found Type A leak rate. The containment boundaries which were repaired or adjusted during the 1987 outage and their as-found and as-left minimum pathway leak rates are listed in Table 5.

The total adjustment for repaired or adjusted Type B & C penetrations from Table 4 was 17,627.47 sccm. Adding 25% to this for statistical uncertainty yields a total correction of 0.0983 w/o/day (22,034.33 sccm). Adding this figure to the as-left Type A leak rate (total time 95% UCL value, per Ref. 6.1) of 0.3241 w/o/day, yields a total as-found Type A leak rate of 0.4224 w/o/day. This does not exceed the maximum allowable leakage rate (La) of 0.5 w/o/day (Ref. 6.2) but does exceed the As-Found acceptance criteria set forth in the NRC I.E., Information Notice 85-71 of 0.75 La.

The major contributing factor to the As Found correction value was Penetration X-24 which is the floor drain line exiting containment. This penetration yielded a delta minimum pathway leak rate (As-Found vs. as-left) of 13,491.75 sccm which constitutes 76% of the total delta leak rate. The isolation valves are 3" Ø air operated gate valves. Due to the inherent characteristics of the floor drain water, debris is trapped on the seating surfaces of the valves upon closing. This is evident in that vigorous water flushing of the line corrected the as-found excessive leak rate measured during Type C testing of these isolation valves. This is a reoccurring problem as evidenced in Tables 1, 2, 3. WNP-2 Plant Staff is pursuing design changes to eliminate this source of excessive as-found leakage.

Consistent with the Type C Testing Program as outlined in Reference 6.3, penetration X-24 isolation valves along with all other isolation valves which exhibited excessive leak rates during the 1987 outage testing period will be leak tested yearly during the annual spring refueling outage. This yearly testing will continue until such time that the isolation valves exhibit acceptable leak rates in the as-found condition.

Penetration No.	Test Type	Component Replaced/ Repaired/Adjusted	As-Found Min. Pathway (SCCM)	As-Left Min. Pathway (SCCM)	△Min. Pathway For As-Found ILRT (SCCM)
X-000	B	Containment Head O-Rings Replaced	1527.07	11.6	1515.47
X-4	C	RCIC-V-68 Repaired RCIC-V-122 Repaired	302.9	194.2	108.7
X-13	C	SLC-V-4A Replaced Internals (Squib Valve)	1.4	2.4	-1.0
X-14	C	RWCU-V-612 Repaired	98.8	49.4	49.4
X-15	B	Equipment Hatch	1.49	1.17	.32
X-18B	Note 1	MS-V-22B Repaired MS-V-67B Repaired	2768	2466	302
X-18C	Note 1	MS-V-22C Repaired	2568	294.5	2273.5
X-24	C	FDR-V-3 Adjusted FDR-V-4 Adjusted	13,502.6	10.85	13491.5
X-27F-1	B	TIP Purge Flange - Replaced	24.38	0	24.38
X-28	B	CRD Hatch - Replaced O-Rings	4.67	0	4.67
X-51	B	Wetwell Hatch - Replaced O-Rings	6.33	4.15	2.18
X-56	C	CIA-V-21 Repaired	24.9	4.4	20.5

TABLE 5
MINIMUM PATHWAY LEAK RATES
FOR AS-FOUND TYPE A ADJUSTMENT

Penetration No.	Test Type	Component Replaced/ Repaired/Adjusted	As-Found Min. Pathway (SCCM)	As-Left Min. Pathway (SCCM)	△Min. Pathway For As-Found ILRT (SCCM)
X-66	C	CSP-V-5 Replaced Seat CSP-V-7 Adjusted	2099.7	391.9	1707.8
X-67	C	CEP-V-3A Replaced Seat CEP-V-4A Replaced Seat CSP-V-6 Replaced Seat CSP-V-8 Adjusted	917.6	2878.5	-1960.9
X-91	C	CIA-V-31B	64.1	39.6	24.5
X-101	C	FPC-V-156 Adjusted	20.4	0	20.4
X-119	C	CSP-V-9 Replaced Seat	135.7	91.9	43.8

Total Adjustment 17627.47 sccm

NOTE 1 Main Steam Isolation Valve (MSIV) testing per Technical Specifications. MISV's are tested at each refueling outage but the leak rate is not included in the sum of Type B & C tests. MISV's are subject to Type A test pressure.

TABLE 5 (Cont'd)
MINIMUM PATHWAY LEAK RATES
FOR AS-FOUND TYPE A ADJUSTMENT

3.0 ILRT LEAKAGE RATE CALCULATIONS

A. PRESSURE DECAY ANALYSIS METHODS

There are several methods available for analysis of containment integrated leak rate data. The most commonly used methods are:

1. Mass point analysis
2. Total time analysis
3. Point to point analysis

A computer program was developed for the purpose of computing the containment leakage rate by all three methods (Ref. 6.9).

The mass point method consists of calculating the mass of air in the containment from the volume averaged temperature, dewpoint and pressure data by application of the perfect gas law. The test data consists of a time series of independent values of air mass. Assuming the leak rate is constant with time, the data lends itself to analysis by the method of linear regression. The slope of the regression line represents the rate of change of air mass with time, or leak rate. Because of its independent nature, any error in a data set does not materially affect the test results. This is the most accurate method of analysis and is recommended in References 6.5 and 6.6.

The total time method is base on comparing the most recent data with the data taken at the start of the test. Thus each successive calculation is based on a longer time period. The leak in percent per day is determined by applying linear regression analysis to the leakage rate calculated at each time point (1).

The point to point method is similar to the total time method except that the leakage rate at each time point is determined using the most recent data and the data immediately preceeding. The leakage rate is determined for each data time interval and the overall leak rate is obtained by application of linear regression to the leakage rate at each time point.

This section presents the theoretical basis, justification and derivations of formulae used in the computer program. The WPPSS ILRT program can calculate the leakage rate by all three methods.

(1) This is one of the methods approved by Reference 6.4 and is the one chosen by WPPSS as the primary reporting methods.

1. Mass Point Method

The individual temperature and dewpoint readings are volume averaged according to a volume fraction assigned to each sensor. This averaging process is the same for all three methods of calculating leak rate.

The average containment drybulb temperature, T_{aj}, at time j is:

$$T_{aj} = \sum_{i=1}^{n} f_i \, T_{i,j}$$

where:

f_i = Volume fraction of containment associated drybulb sensor i

$T_{i,j}$ = Drybulb sensor i reading at time j

The average dewpoint temperature at time j, $T_{DP,j}$ is:

$$T_{DP,j} = \sum f_i \, T_{dp\ i,j}$$

where:

f_i = Volume fraction of containment associated drybulb sensor i

$T_{i,j}$ = Dewpoint reading of sensor i at time j

If two pressure sensors are used, the averaged pressure is simply:

$$P_{Total} = 0.5\ (P_A + P_B)$$

where:

P_A and P_B are the two pressure readings

The mass of air is calculated from the ideal gas law.

(1) $PV = NRT$

where:

P = air pressure, psia

V = volume, ft^3

N = lb moles of air

R = ideal gas law constant

$$10.731 \ \frac{\text{Psi} - \text{Ft}^3}{\text{lb mole} - {}^\circ\text{R}}$$

T = absolute containment temperature (°R)

Rearranging equation (1) gives:

$$(2) \quad N = \frac{PV}{RT}$$

The mass of air is simply the product of the number of lb moles and the molecular weight of air.

$$(3) \quad W = N\,(MW) = \frac{PV}{RT}.(MW)$$

The molecular weight of air is 28.96 $\frac{\text{lb mass}}{\text{lb mole}}$

Therefore the weight of air at any time is:

$$(4) \quad W = \frac{PV\,(28.96)}{10.731\,(T)}$$

It is important to note that P is the partial pressure of air not the total containment pressure as measured by the pressure sensors. The partial pressure of air is the total pressure minus the partial pressure of water vapor, P_{H_2O}.

$$P_{air} = P_{Total} - P_{H_2O}.$$

One of the widely used correlations for vapor pressure is the Antoine correction (Ref. 6.10) which is of the form:

$$\ln P = A - \frac{B}{T-C}$$

If C = 0, this equation reverts to the Clapeyron equation (Ref. 6.7). Rather than use published constants which cover a wide temperature range for water vapor in the Antoine equation, constants were determined to more accurately cover a narrow temperature range by utilizing data from Keenan & Keyes (Ref. 6.8). Two sets of constants were generated; one set for dew points less than 100°F and the second set for the temperature range of 100 to 120°F. The correlations agree with data in Keenan & Keyes to within 0.0001 psia. This functional form gives more accurate results than linear interpolation between the data points.

The correlations developed and used in the ILRTA computer program (Ref. 6.9) are:

$$\ln P = 14.940404 - \frac{4144.18422}{T-34.5}$$

for $60 < T < 100$

where T is in °K

and

$$\ln P = 14.643483 - \frac{3984.9582}{T-39.75}$$

for $100 < T < 120$

where T is in °K

P is in psia

With the equations listed above, the mass of air can be calculated for each data set. Next, a linear regression of the air mass is performed to obtain an estimate of the leak rate. This is done to provide a criteria for obtaining the best fit of the data, assuming a linear relation between air mass and time (i.e. a constant leak rate).

Linear regression or least mean square curve fit is given by:

$$\bar{W} = A + Bt$$

Where the slope, B, and intercept, A, are given by:

$$B = \frac{n(\Sigma t_i W_i) - (\Sigma W_i)\ (\Sigma t_i)}{n\ (\Sigma t_i^2) - (\Sigma t_i)^2}$$

and

$$A = \frac{(\Sigma W_i)\ (\Sigma t_i^2) - (\Sigma t_i W_i)\ (\Sigma t_i)}{n\ (\Sigma t_i^2) - (\Sigma t_i)^2}$$

Each t_1 is the elapsed time between a clock time at which the initial reading is taken and the clock time at which the i th reading is taken. Thus $t_1 = 0$ for all the test durations and the t_2 is the elapsed time before the next reading and so on. In most test applications the time intervals between collected data sets will be essentially constant, but the equations for the slope, B, and intercept, A, do not impose this as a limitation.

The leakage rate for nuclear power plant containments is expressed as the ratio of the rate of change of air mass to the air mass in the containment at the beginning of the test. Since t_i is expressed in hours and percentage daily leakage rates are desired, the mass point leakage rate is expressed as a positive number, as:

$$L_{am} = -2400\ B/A$$

It should be noted that A, the best estimate of the initial air mass, not W_o, is used as the denominator of L_{am}. The units of L_{am} are percent per day.

The uncertainty in the estimated value of L_{am} is assessed in terms of the standard deviations of A and B and their covariance followed by the computation of the 95th confidence level for L_{am}.

The estimate of the common standard deviation of the air mass with respect to the regression line is given by:

$$S = \left[\frac{\Sigma(W - \bar{W})^2}{n - 2}\right]^{1/2}$$

where: W_i = measured air mass at time t_i

$\bar{W}$ = estimated air mass at time t_i

(i.e. $\bar{W} = A + Bt_i$)

The standard deviations of the slope and intercept are:

$$S_B = Kn^{1/2}$$

$$S_A = K(\Sigma t_i^2)^{1/2}$$

where:

$$K = \frac{S}{[n(\Sigma t_i^2) - (\Sigma t_i)^2]^{1/2}}$$

and the covariance of the slope and intercept is:

$$S_{BA} = K^2\ (-\Sigma t_i)$$

The above equations are presented in Reference 6.6 and can be found in most elementary statistical texts.

The exact upper one-sided limit of a 95 percent confidence level for the leakage rate is given by:

$$UCL\ (L_{exact}) = -\ 2400\ [b - (b^2 - ac)^{1/2}]/a$$

where:

$$a = A^2 - t^2_{.95}\, S^2_A$$

$$b = AB - t^2_{.95}\, S_{AB}$$

$$c = B^2 - t^2_{.95}\, S^2_B$$

$t_{.95}$ is the 95th percentile of the "student's t distribution", which is tabulated in Reference 6.6 and most texts on statistics as a function of the number of degrees of freedom. The number of degrees of freedom is (n - 2) where n is the number of observations. If the number of degrees of freedom is equal to or greater than 5, the value of $t_{.95}$ can be calculated from the following equation:

$$t_{.95} = 1.654 + \frac{1.576}{n-2} - \frac{2.4}{(n-2)^2} + \frac{57.6}{(n-2)^3}$$

The equations presented above for calculating the mass point leak rate and appropriate statistical treatment have been programmed into a flexible easy to use computer program.

2. Total Time Method

The mass point method of computing leak rate is the preferred method and is recommended by References 6.5 and 6.6. However, in the past, the total time and point to point leak rate analyses were used to calculate the containment leak rate and are the acceptable methods recognized by Reference 6.4, which is the basic document for this test. Therefore, these methods of computing leak rate were included in the computer program.

The equation for calculating the leak rate by the total time method is taken from Reference 6.4. The formula is:

$$LR_{ni} = \left(\frac{2400}{H_i}\right)\left[1 - \frac{T_o}{T_i}\,\frac{(P_i - P_{vi})}{(P_o - P_{vo})}\right]$$

where:

LR_{ni} = measured leak rate of time i, in weight percent per day

H_i = Elapsed time in hours at time i

T_o = Mean containment absolute temperature at start of test

T_i = Mean containment absolute temperature at time i

P_o = Mean total pressure of containment atmosphere at start of test, psia

P_i = Mean total pressure of containment atmosphere at time i, psia

P_{vo} = Mean containment atmosphere water vapor pressure at start of test

P_{vi} = Mean containment atmosphere water vapor pressure at time i

The calculated leak rate is obtained by performing a linear regression of 3 or more sets of measured leak rate. The regression line is given by:

$$LR_c = A + Bt_i$$

The variance of the measured leak rate (LR_m) from the calculated leak rate (LR_i) is:

$$S = \left\{ \frac{[LR_{ni} - (A + Bt_i)]^2}{n-2} \right\}^{1/2}$$

where:

n = the number of measured data sets

The 95 percent upper confidence limit of the leak rate is:

$$UCL - LR_c + \sigma T$$

where:

T = Student T distribution of n-2 degrees of freedom

$$\sigma = S \left[1 + \frac{1}{n} + \frac{(tp - \bar{t})^2}{(ti - \bar{t},^2} \right]^{1/2}$$

tp = Time after start of test or total elapsed time

$$\bar{t} = \frac{\sum t_i}{n}$$

The above equations have been included in the program.

3. Point to Point Method

The point to point method is essentially the same as the total time method, except rather than referencing the calculations to the values of pressure and temperature at the start of the test, the pressure and temperature at any time i, are referenced to time i - 1. Thus, the measured leak rate equation is:

$$LR_{mi} = \left(\frac{2400}{h}\right)\left[1 - \frac{T_1 (P_2 - P_{v2})}{T_2 (P_1 - P_{v1})}\right]$$

where:

P_i = Mean absolute containment pressure, psia, at time i
T_i = Mean containment atmosphere absolute temperature at time i
h = time interval between time i and i -1

The regression line, variance and 95 percent upper confidence level are in the same manner for the total time method. The equations for the point to point method have been incorporated in the program.

4.0 ILRT INSTRUMENT ERROR ANALYSIS

Referenced 6.6 developes the following formulas:

Overall Instrumentation System Error ("ISG")

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

where,

$$e_p = \frac{(E_p^2 + \epsilon_p^2)^{1/2}}{(\#\ P\ Sensors)^{1/2}}$$

$$e_{pv} = \frac{(E_{pv}^2 + \epsilon_{pv}^2)^{1/2}}{(\#\ Dew\ Elements)^{1/2}}$$

$$e_T = \frac{(E_T^2 + \epsilon_T^2)^{1/2}}{(\#\ Drybulb\ Elements)^{1/2}}$$

where, (Refer to Instrumentation Data, Table 6)
E_p = Pressure sensor error = 0.001 psia
ϵ_p = Pressure system error = 0.0005 psia
E_{pv} = vapor pressure sensor error

$$= (0.5°F)\left(\frac{0.5073\ psia - 0.3632\ psia}{80°F - 70°F}\right) = 0.007205\ psia$$

ϵ_{pv} = vapor pressure system error

$$\epsilon_{pv} = (0.01°F)\left(\frac{0.5073\ psia - 0.3632\ psia}{80°F - 70°F}\right) = 0.0001441\ psia$$

E_T = Drybulb temperature sensor error = 0.036°F
ϵ_T = Drybulb temperature system error = 0.01°F

thus:
e_p = 0.0007906 psia
e_{pv} = 0.003603 psia
e_T = 0.009062 R

Resulting in:
Overall Instrumentation System Error = $\pm$0.0111 w/o/day

TABLE 6 - INSTRUMENTATION DATA

Instrument	Make	Model	Accuracy	Cal Range	Cal Date	Sensitivity[2] $(E)^3$	Repeatability[2] or Resolution $(\epsilon)^3$
Drybulb Temp[1]	Rosemount	78-65-17	± 0.5°F	32-120°F	02-19-87	0.036°F	0.01°F
Dewpoint[1]	Foxboro	2711AG	± 2.0°F	35-90°F	05-04-87	0.5°F	0.01°F
Pressure[1]	Mensor	10100-001	± 0.002% FS ± 0.010% RDG	0-100 PSI	04-01-87	0.001 PSIA	0.0005 PSIA

Notes: 1. Primary sensors.

2. Instrumentation was tested specifically for sensor sensitivity and readout repeatability.

3. Symbols defined for ISG formula (see this Attachment and Refs. 6.5 and 6.6).

5.0 CONCLUSION

The As-Found Type A Leak Rate for the 1987 ILRT was less than the allowable limit for containment leakage (La) but exceeded the as-found acceptance criteria clarified in I.E. Notice 85-71 of 0.75 La. The excessive as-found leak rate was not due to any structural deficiencies in the containment vessel but rather to the isolation valves in the floor drain (FDR) system. A design change is being pursued to correct the problem of trapping debris in these isolation valve upon closing.

The Type B and C isolation boundaries which exceeded their leakage limits thus contributing to the excessive as-found Type B & C leak rate will be leak tested yearly during each refueling outage until acceptable leak rates are obtained as outlined in Reference 6.3.

6.0 REFERENCES

6.1 Reactor Containment Building Integrated Leak Rate Test, WNP-2, September 1987.

6.2 Primary Reactor Containment Leakage Testing for Water Cooling Power Reactors, Code of Federal Regulations, Title 10, Part 50, Appendix J, January 1983.

6.3 Exemption to Appendix J Testing, issued by the NRC with Amendment No. 41 to Facility Operating License NPF-2, dated April 29, 1987.

6.4 Leakage Rate Testing of Containment Structures for Nuclear Reactors, American National Standards Institute, Inc., N.Y., NY; ANSI N45.4, 1972.

6.5 Containment System Leakage Testing Requirements, American Nuclear Society, LaGrange Park, IL; ANSI/ANS-56.8-1981.

6.6 Containment System Leakage Testing Requirements, American Nuclear Society, LaGrange Park, IL: N274, Draft No. 2, Revision 3, November 15, 1978.

6.7 Daniels and Aberty, Physical Chemistry, John Wiley & Sons, New York, 1955.

6.8 J.H. Keenan, F.G. Keyes, P.C. Hill and J.G. Moore, Steam Tables, John Wiley & Sons, New York, 1969.

6.9 Integrated Leak Rate Test Analysis, Washington Public Power Supply System, February 1984.

6.10 R.C. Reid, J.M.-Prauznitz and T.K. Sherwood, The Properties of Gas and Liquids, 3rd Edition, 1977, McGraw Hill Book Company.

SUPPLEMENT #2

TYPE B & C TESTING PROGRAM

CONTAINMENT PENETRATION TESTING SCHEDULE

Washington Public Power Supply System
Nuclear Plant No. 2
September 1987

On April 29, 1987, the NRC granted an exemption to a provision of Appendix J to WNP-2 (issued by the NRC with Ammendment No. 41 to Facility Operating License NPF-2). This exemption allowed containment isolation boundaries to be tested at a frequency of every 24 months rather than every refueling outage as required by Appendix J.

Certain conditions were agreed upon between the NRC and WNP-2 Plant Staff regarding the exceptions to the 24 month duration between leak rate tests. Of greatest significance is the requirement to establish leakage limits for each containment barrier. Barriers which exceed this leakage limit are required to be retested during the next refueling outage.

One of the conditions of the granted exemption is that the reporting requirements of Appendix J be augmented to include the information associated with the unique aspects of the WNP-2 Type B & C testing program. In particular, a tabulation of leakage limits established for each barrier is required. This tabulation must also indicate those barriers which were tested during the 1987 outage, those which exceeded their leakage limits and must be retested during the 1988 outage, and those penetrations/valves not tested in 1987 and thus being scheduled for testing during the 1988 refueling outage.

The table that follows includes the information required under the conditions of the granted exemption to Appendix J.

TEST ID NUMBER PENETRATION	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-000	Drywell Head	50	X			X	X	
X-1A	Inspection Port	50	X		X			
X-1B	Inspection Port	50	X		X			
X-1C	Inspection Port	50	X		X			
X-1D	Inspection Port	50	X		X			
X-1E	Inspection Port	50	X		X			
X-1F	Inspection Port	50	X			X	X	
X-1G	Inspection Port	50	X		X			
X-1H	Inspection Port	50	X		X			
X-15	Equipment Hatch	50	X		X			3
X-16	Personnel Airlock leakage from PPM 7.4.6.1.3.2	5664	X		X			2
X-27A-1	Tip Drive Flange and Bulkhead Union	50	X		X			
X-27B-1	Tip Drive Flange and Bulkhead Union	50	X			X	X	
X-27C-1	Tip Drive Flange and Bulkhead Union	50	X			X	X	
X-27D-1	Tip Drive Flange and Bulkhead Union	50	X		X			
X-27E-1	Tip Drive Flange and Bulkhead Union	50	X		X			

TEST ID NUMBER PENETRATION	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-27F-1	Tip Purge Flange	50	X		X			
X-28	CRD Removal Hatch	50	X		X			3
X-51	Suppression Chamber Access Hatch	50	X		X			3
X-100A	Neutron Monitoring	50	X		X			
X-100B	Neutron Monitoring	50	X		X			
X-100C	Neutron Monitoring	50	X		X			
X-100D	Neutron Monitoring	50	X		X			
X-101A	Control Rod Position Indicator	50	X		X			
X-101B	Thermocouple and RTD	50	X		X			
X-101C	Thermocouple and RTD	50	X		X			
X-101D	Thermocouple and RTD	50	X		X			
X-102A	Thermocouple and RTD	50	X		X			
X-102B	Thermocouple and RTD	50	X		X			
X-103A	Medium Voltage Power	50	X		X			
X-103B	Medium Voltage Power	50	X		X			
X-103C	Medium Voltage Power	50	X		X			

TEST ID NUMBER PENETRATION	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-103D	Medium Voltage Power	50	X		X			
X-104A	Low Voltage Power	50	X		X			
X-104B	Low Voltage Power	50	X		X			
X-104C	Low Voltage Power	50	X		X			
X-104D	Low Voltage Power	50	X		X			
X-105A	Control and Indication	50	X		X			
X-105B	Control and Indication	50	X		X			
X-105C	Control and Indication	50	X		X			
X-105D	Control and Indication	50	X		X			
X-106C	Wide Range Neutron Monitoring System	50	X		X			
X-106D	Wide Range Neutron Monitoring System	50	X		X			
X-107A	Low Voltage Power and Control Indication	50	X		X			
X-107B	Low Voltage Power and Control Indication	50	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-3	7.4.6.1.8.3	From last surveillance per PPM 7.4.6.1.8.3: CEP-V-1A, CEP-V-1B, CEP-V-2A, CEP-V-2B	5660	X		X			1
		CEP-V-800-3							
		CEP-V-800-2							
		CEP-V-800-1							
X-4	X-4-1	RCIC-V-122	110	X			X	X	
	X-4-2	RCIC-V-121	110	X		X			
	X-4-3	RCIC-V-41	110	X		X			
	X-4-4	RCIC-V-601, RCIC-V-68, RCIC-V-40	1475	X		X			
	X-4-5	RCIC-V-124	110	X		X			
X-5	X-5-1	RCC-V-95	110	X		X			
	X-5-2	RCC-V-93	110		X			X	
	X-5-3	RCC-V-107	110		X			X	
	X-5-4	RCC-V-5, RCC-V-104	1475		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-11A	X-11A-1	RHR-V-17A, RHR-V-16A	1415		X			X	
	X-11A-2	RHR-V-154B	110		X			X	
	X-11A-3	RHR-V-154A	110	X		X			
	X-11A-4	RHR-V-10A	110		X			X	
X-11B	X-11B-1	RHR-V-16B, RHR-V-17B, RHR-V-609	1415		X			X	
	X-11B-2	RHR-V-10B	110		X			X	
X-13	X-13-1	SLC-V-7	221	X			X	X	
	X-13-2	SLC-V-26, 606, 601, 602, 4A, 4B	221	X		X			
	X-13-3	SLC-V-45	110	X		X			
X-14	X-14-1	RWCU-V-1, RWCU-V-4, RWCU-V-607	885		X			X	
	X-14-2	RWCU-V-612	110	X			X	X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-17A	X-17A-1	RFW-V-10A	2125	X		X		X	4
	X-17A-2	RFW-V-70, 123, 30B, 65B RFW-V-65A, RWCV-V-40	2125	X			X	X	
	X-17A-3	RFW-V-30A	110	X		X			
	X-17A-4	RFW-V-32A	2125	X		X		X	4
	X-17A-5	RFW-V-66	110	X		X			
X-17B	X-17B-1	RFW-V-10B	2125	X		X		X	4
	X-17B-2	RFW-V-32B	2125	X		X		X	4
	X-17B-3	RFW-V-69	110	X		X			
		NOTE: Some values associated with X-17B were tested in X-17A-2							
X-21	X-21-1	RCIC-V-64, 63, 76, 36, 8, 602, 624, 625	1475	X		X			
	X-21-2	RCIC-V-72	110	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-22	X-22-1	MS-V-16, MS-V-19, MS-V-17	442	X		X			
	X-22-2	MS-V-604	110	X		X			
X-23	X-23-1	EDR-V-625, EDR-V-618, EDR-V-20	442	X		X			
	X-23-2	EDR-V-19	442	X		X			
	X-23-3	EDR-V-619	110	X		X			
	X-23-4	EDR-V-661	110	X		X			
X-24	X-24-1	FDR-V-570 FDR-V-4	442	X			X	X	
	X-24-2	FDR-V-3	442	X			X	X	
	X-24-3	FDR-V-614	110	X		X			
	X-24-4	FDR-V-647	110	X		X			
X-25A	X-25A-1	RHR-V-27A	885		X			X	
	X-25A-2	RHR-V-175A	110		X			X	
	X-25A-3	"TEST DELETED"							
	X-25A-4	RHR-V-241	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-25A-5	RHR-V-254	110		X			X	
	X-25A-6	Flange between RHR-V-130A RHR-V-241	50		X			X	
X-25B	X-25B-1	RHR-V-130B	442		X			X	
	X-25B-2	RHR-V-242	110		X			X	
	X-25B-3	RHR-V-27B	885	X		X			
	X-25B-4	RHR-V-175B	110		X			X	
X-26	X-26-1	RHR-FCV-64C, RHR-V-195, RHR-V-196, RHR-V-197	442		X			X	
	X-26-2	RHR-V-145C	110		X			X	
	X-26-3	RHR-V-21, RHR-V-148	1595		X			X	
	X-26-4	RHR-V-194	110		X			X	
	X-26-5	RHR-V-740	110		X	—		X	
X-27A	X-27A-2	TIP-V-1	50		X			X	
X-27B	X-27B-2	TIP-V-2	50		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-27C	X-27C-2	TIP-V-3	50		X			X	
X-27D	X-27D-2	TIP-V-4	50		X			X	
X-27E	X-27E-2	TIP-V-5	50		X			X	
X-27F	X-27F-2	TIP-V-15 and THREADED UNION	148	X			X	X	
X-27F	X-27F-3	TIP-V-6	74	X		X			
X-27F	X-27F-4	TIP-V-13	74	X		X			
X-29 a & c	X-29 a/c-1	PI-VX-257	148	X		X			
	X-29 a/c-2	PI-VX-256 PI-VX-258	148	X		X			
X-42d	X-42d-1	PI-VX-42d PI-VX-216	148	X		X			
	X-42d-2	PI-VX-224	148	X		X			
X-43A	X-43A-1	RRC-V-13A	110		X			X	
	X-43A-2	RRC-V-16A	110		X			X	
	X-43A-3	RRC-V-87A	110	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-43B	X-43B-1	RRC-V-16B	110		X			X	
	X-43B-2	RRC-V-87B	110		X			X	
	X-43B-3	RRC-V-13B	110		X			X	
X-46	X-46-1	RCC-V-40, RCC-V-21	1475		X			X	
	X-46-2	RCC-V-97	110		X			X	
X-47	X-47-1	RHR-V-134A	295		X			X	
	X-47-2	RHR-V-178A	110		X			X	
	X-47-3	RHR-FCV-64A, RHR-V-192, RHR-V-190	442		X			X	
	X-47-4	RHR-V-145A	110		X			X	
	X-47-5	RHR-V-191	110		X			X	
	X-47-6	RHR-V-121, RHR-V-120	885		X			X	
	X-47-7	RHR-V-147	110		X			X	
	X-47-8	RHR-V-146	110		X			X	
	X-47-9	RHR-V-24A, RHR-V-11A	1595		X			X	
	X-47-10	RHR-V-152A	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-47-11	RHR-V-73A	295		X			X	
	X-47-12	RHR-V-135A	110		X			X	
	X-47-13	RHR-V-180A	110		X			X	
	X-47-14	RHR-V-181A	110		X			X	
	X-47-15	RHR-V-239	110		X			X	
X-48	X-48-1	RHR-V-181B	110		X			X	
	X-48-2	RHR-V-180B	110		X			X	
	X-48-3	RHR-V-145B	110		X			X	
	X-48-4	RHR-V-11B, RHR-V-24B	1595		X			X	
	X-48-5	RHR-V-202, RHR-FCV-64B	442		X			X	
	X-48-6	RHR-V-134B	295		X			X	
	X-48-7	RHR-V-178B	110		X			X	
	X-48-8	RHR-V-73B	295		X			X	
	X-48-9	RHR-V-135B	110		X			X	
	X-48-10	RHR-V-152B	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-49	X-49-1	HPCS-V-23 HPCS-V-74	1062	X		X			
	X-49-2	HPCS-V-36	110	X			X	X	
	X-49-3	HPCS-V-12 HPCS-V-72	590	X		X			
	X-49-4	HPCS-V-83	110	X		X			
	X-49-5	HPCS-V-84	110	X		X			
	X-49-6	HPCS-V-73	110	X		X			
	X-49-7	HPCS-V-71	110	X		X			
	X-49-8	HPCS-V-63	110	X		X			
X-53	X-53-1	CSP-V-96	148	X		X			
	X-53-2	CSP-V-97	148	X		X			
	X-53-3	CSP-V-800-2	110	X		X			
	X-53-4	CSP-V-800-24	110	X		X			
		LEAKAGE FROM PPM 7.4.6.1.8.3	5660 TOTAL	X		X			1
	X-53-5	CSP-V-1, CSP-V-2							
	X-53-6	CSP-V-800-3							

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-54Aa	X-54Aa-1	RCIC-V-184 RCIC-V-740	148	X		X			
	X-54Aa-2	RCIC-V-185	110	X		X			
X-54Bf	X-54Bf-1	PI-VX-54Bf PI-VX-218	148	X		X			
	X-54Bf-2	PI-VX-226	148	X		X			
X-56	X-56-1	CIA-V-21	110	X			X	X	
	X-56-2	CIA-V-44	110	X		X			
	X-56-3	CIA-V-20	110	X		X			
X-61f	X-61f-1	PI-VX-219 PI-VX-61f	148	X		X			
	X-61f-2	PI-VX-227	148	X		X			
X-62f	X-62f-1	PI-VX-62f PI-VX-220	148	X		X			
	X-62f-2	PI-VX-228	148	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-63	X-63-1	LPCS-V-12	1062		X			X	
	X-63-2	LPCS-V-58	110		X			X	
	X-63-3	LPCS-V-36	110		X			X	
	X-63-4	LPCS-V-57 LPCS-FCV-11	442		X			X	
	X-63-5	LPCS-V-69	110		X			X	
X-64	X-64-1	RCIC-V-69 RCIC-V-28	221	X			X	X	
	X-64-2	RCIC-V-55	110	X		X			
	X-64-3	RCIC-V-125	110	X		X			
X-65	X-65-1	RCIC-V-19	295	X		X			
	X-65-2	RCIC-V-120	110	X			X	X	
X-66	X-66-1	CSP-V-98	148	X		X			
	X-66-2	CSP-V-93	148	X		X			
	X-66-3	CSP-V-5 CSP-V-7	2124	X			X	X	
	X-66-4	CSP-V-800-17	110	X			X	X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-66-5	CSP-V-800-11	110	X		X			
	X-66-6	CSP-V-800-23	110	X		X			
	X-66-7	TEST DELETED							5
	X-66-8	TEST DELETED							5
	7.4.6.1.8.2	CSP-V-3, CSP-V-4 CSP-V-800-9	5660 MAX	X		X			1
X-67	X-67-1	CSP-V-6 CSP-V-8	2124	X			X	X	
	X-67-2	CSP-V-800-22	110	X		X			
	X-67-3	TEST DELETED							5
	X-67-4	TEST DELETED							5
	7.4.6.1.8.2	CEP-V-3A, 3B, 4A, 4B, CEP-V-800-9	5660 MAX	X			X		1
	X-67-5	CEP-V-800-11	110	X		X			
	X-67-6	CEP-V-800-12	110	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-69c	X-69c-1	PI-VX-69c PI-VX-221	148	X		X			
	X-69c-2	PI-VX-229	148	X		X			
X-72f	X-72f-1	PI-VX-253 PI-VX-254	148	X		X			
	X-72f-2	PI-EFCX-72f	148	X		X			
X-73e	X-73e-1	PI-VX-259 PI-VX-260	148	X		X			
	X-73e-2	PI-EFCX-73e	148	X		X			
X-73f	X-73f-1	PSR-V-X73-1	148	X		X			
	X-73f-2	PSR-V-X73-2	148	X		X			
X-77Aa	X-77Aa-1	RRC-V-20	148	X			X	X	
	X-77Aa-2	RRC-V-19	148	X		X			
X-77Ac	X-77Ac-1	PSR-V-X77A-1	148	X		X			
	X-77Ac-2	PSR-V-X77A-2	148	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-77Ad	X-77Ad-1	PSR-V-X77A-3	148	X		X			
	X-77Ad-2	PSR-V-X77A-4	148	X		X			
X-78d	X-78d-1	LPCS-V-66 LPCS-V-67	148		X			X	
	X-78d-2	LPCS-V-68	110		X			X	
X-78e	X-78e-1	HPCS-V-65 HPCS-V-68	148	X		X			
	X-78e-2	HPCS-V-69	110	X		X			
X-80b	X-80b-1	PSR-V-X80-1	148	X		X			
	X-80b-2	PSR-V-X80-2	148	X		X			
X-82b	X-82b-1	TEST DELETED							5
	X-82b-2	TEST DELETED							5
X-82d	X-82d-1	PSR-V-X82-1	148	X		X			
	X-82d-2	PSR-V-X82-2 PSR-V-10-3	148	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-82d-3	PSR-V-10-2	148	X		X			
	X-82d-4	PSR-V-10-1	148	X		X			
X-82e	X-82e-1	CAS-VX-82e CAS-V-730	148	X		X			
	X-82e-2	CAS-V-455	110	X		X			
X-82f	X-82f-1	PSR-V-X82-7	148	X		X			
	X-82f-2	PSR-V-143	110	X		X			
	X-82f-3	PSR-V-144	110	X		X			
	X-82f-4	PSR-V-24-1 PSR-V-X82-8	148	X		X			
X-83a	X-83a-1	PSR-V-X83-1	148	X		X			
	X-83a-2	PSR-V-146	110	X		X			
	X-83a-3	PSR-V-147	110	X		X			
	X-83a-4	PSR-V-X83-2 PSR-V-22-1	148	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-84a	X-84a-1	TEST DELETED							5
	X-84a-2	TEST DELETED							5
X-84f	X-84f-1	PSR-V-X84-1	148	X		X			
	X-84f-2	PSR-V-149	110	X		X			
	X-84f-3	PSR-V-150	110	X		X			
	X-84f-4	PSR-V-X84-2 PSR-V-23-1	148	X		X			
X-85a/c	X-85a/c-1	PI-VX-251	148	X		X			
	X-85a/c-2	PI-VX-250 PI-V-252	148	X		X			
X-86A	X-86A-1	TEST DELETED							5
	X-86A-2	TEST DELETED							5
X-87A	X-87A-1	TEST DELETED							5
	X-87A-2	TEST DELETED							5

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-88	X-88-1	PSR-V-X88-1	148		X			X	
	X-88-2	PSR-V-4-1	110		X			X	
	X-88-3	PSR-V-4-2	110		X			X	
	X-88-4	PSR-V-4-3 PSR-V-X88-2	148		X			X	
X-89B	X-89B-1	CIA-V-30A	74	X			X	X	
	X-89B-2	CIA-V-31A	74	X		X			
	X-89B-3	CIA-V-47A	74	X		X			
X-91	X-91-1	CIA-V-30B	74	X		X			
	X-91-2	CIA-V-47B	74	X		X			
	X-91-3	CIA-V-31B	74	X			X	X	
X-92	X-92-1	DW-V-156 DW-V-157	295	X		X			
	X-92-2	DW-V-158	110	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-93	X-93-1	SA-V-109 and Pipe CAP	295	X		X			
	X-93-2	SA-V-200	110	X		X			
X-94	X-94-1	MMR-V-124	110	X		X			
	X-94-2	X-94 Pipe Cap	50	X		X			
X-95	X-95-1	MMR-V-125	110	X		X			
	X-95-2	X-95 Pipe Cap	50	X		X			
X-96	X-96-1	CAC-V-2 CAC-FCV-2A	590		X			X	
	X-96-2	CAC-V-800-39	110		X			X	
	X-96-3	CAC-V-800-37	110		X			X	
	X-96-4	CAC-V-800-38	110		X			X	
X-97	X-97-1	CAC-V-15 CAC-FCV-1B	590		X			X	
	X-97-2	CAC-V-800-21	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-97-3	CAC-V-800-19	110		X			X	
	X-97-4	CAC-V-800-20	110		X			X	
X-98	X-98-1	CAC-V-11 CAC-FCV-2B	590		X			X	
	X-98-2	CAC-V-800-15	110		X			X	
	X-98-3	CAC-V-800-13	110		X			X	
	X-98-4	CAC-V-800-14	110		X			X	
X-99	X-99-1	CAC-V-6 CAC-FCV-1A	590		X			X	
	X-99-2	CAC-V-800-45	110		X			X	
	X-99-3	CAC-V-800-44	110		X			X	
	X-99-4	CAC-V-800-43	110		X			X	
X-101	X-101-1	FPC-V-156 FPC-V-161 FPC-V-149	885	X			X	X	
	X-101-2	FPC-V-182	110	X		X			
	X-103-3	FPC-V-160	110	X		X			

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-102	X-102-1	CAC-V-4 CAC-FCV-4A	590		X			X	
	X-102-2	CAC-V-800-33	110		X			X	
	X-102-3	CAC-V-800-35	110		X			X	
	X-102-4	CAC-V-800-36	110		X			X	
X-103	X-103-1	CAC-V-13 CAC-FCV-4B	590		X			X	
	X-103-2	CAC-V-800-9	110		X			X	
	X-103-3	CAC-V-800-11	110		X			X	
	X-103-4	CAC-V-800-12	110		X			X	
X-104	X-104-1	CAC-V-17 CAC-FCV-3B	590		X			X	
	X-104-2	CAC-V-800-5	110		X			X	
	X-104-3	CAC-V-800-1	110		X			X	
	X-104-4	CAC-V-800-2	110		X			X	
X-105	X-105-1	CAC-V-8 CAC-FCV-3A	590		X			X	
	X-105-2	CAC-V-800-29	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
	X-105-3	CAC-V-800-27	110		X			X	
	X-105-4	CAC-V-800-28	110		X			X	
X-116	X-116-1	RCIC-V-85	110	X		X			
	X-116-2	RCIC-V-84	110	X		X			
	X-116-3	RCIC-V-183	110	X		X			
X-117	X-117-1	RHR-V-124A RHR-V-124B	221		X			X	
	X-117-2	RHR-V-139B	110		X			X	
	X-117-3	RHR-V-139A	110		X			X	
	X-117-4	RHR-V-620B	110		X			X	
X-118	X-118-1	RHR-V-125A RHR-V-125B	221		X			X	
	X-118-2	RHR-V-619C	110		X			X	
	X-118-3	RHR-V-141B	110		X			X	
	X-118-4	RHR-V-141A	110		X			X	

PENE-TRATION NUMBER	TEST ID NUMBER	DESCRIPTION	LEAKAGE LIMIT (sccm)	TESTED IN 1987 YES	NO	PASSED	FAILED	TEST IN 1988	NOTES
X-119	X-119-1	CSP-V-9 CSP-V-10	2124	X			X	X	
	X-119-2	CSP-V-800-14	110	X		X			
	X-119-3	CSP-V-800-16	110	X		X			
	X-119-4	CSP-V-800-15	110	X		X			

Notes:

1. Containment Purge butterfly valves; tested every 6 months per Plant Technical Specifications. Leakage limit defined by Technical Specifications.
2. Airlock tested every 6 months per Plant Technical Specifications. Leakage limit defined by Technical Specifications.
3. Hatch will be leak tested if opened during the 1988 outage.
4. Feedwater check valve with soft seat. Tested every refueling outage per conditions of granted exemption.
5. Test connection for excess flow check valve. Deleted from Type C testing per FSAR Table 6.2.6 Note 27.