

SOUTHERN CALIFORNIA EDISON COMPANY

SAN ONOFRE NUCLEAR GENERATING STATION

UNIT 1

REACTOR CONTAINMENT BUILDING

INTEGRATED LEAK RATE TEST

FINAL REPORT

JUNE, 1984 TEST

REVISION I

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1.0 INTRODUCTION

1.1 GENERAL

The Reactor Containment Building Integrated Leak Rate Test (Type A) was performed to demonstrate that the overall leakage rate through the primary reactor containment system does not exceed the allowable leakage rate as specified in Technical Specification 4.3.1. The ILRT was performed as part of the Unit 1 Return to Service.

The successful Type A and supplemental verification tests were performed in accordance with the requirements of San Onofre Nuclear Generating Station, Unit 1, Procedure SO1-V-1.3, Revision 11, "Sphere Integrated Leak Rate Test". The test method utilized is the absolute method described in ANSI/ANS-56.8-1981 & ANSI N45.4-1972, "Containment System Leakage Testing Requirements". The leakage rate was calculated using the Mass Point and Total Time formulae from these standards and Bechtel Topical Report, BN-TOP-1, Revision 1, "Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plants". The test results are reported in accordance with the requirements of 10CFR50, Appendix J, Section V.B.

1.2 TEST SYNOPSIS

The Integrated Leakage Rate Test (ILRT) was successfully completed on June 6, 1984, at San Onofre Nuclear Generating Station, Unit 1. All ILRT requirements of the Technical Specifications and ANSI N45.4-1972 were satisfied. The following is a test sequence of events summary:

* Pressurization Start	6/4/84 @ 1015
* Test Pressure of 51 psig	6/5/84 @ 0800
* Temperature Stabilization	6/5/84 @ 0830
* Mass Point Criteria for Upper 95% Confidence Met	6/5/84 @ 1745
* Total Time Criteria for Upper 95% confidence Met	6/6/84 @ 0830
* Verification Test Start	6/6/84 @ 1500
* Verification Test Completed	6/6/84 @ 2030

1.0 INTRODUCTION (Continued)

1.2 TEST SYNOPSIS (Continued)

Analysis of the measured data taken during the test resulted in a calculated leakage rate of 0.043%/day and a 95% probability upper confidence limit (UCL) leakage of 0.045%/day using the Mass Point calculation technique as recommended in ANSI/ANS 56.8-1981. The leakage rate at this upper confidence limit plus a 0.002%/day Local Leak Rate penalty yields an overall leakage rate of 0.047%/day which satisfies the Technical Specification acceptance criteria of being less than 0.090%/day.

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Analysis of the measured data taken during the test resulted in a calculated leakage rate of 0.042%/day and a 95% probability upper confidence limit (UCL) leakage of 0.048%/day using the Total Time calculation technique as recommended in ANSI/ANS-56.8-1981. The leakage rate at this upper confidence limit plus a 0.002%/day Local Leak Rate penalty yields an overall leakage rate of 0.050%/day which satisfies the Technical Specification acceptance criteria of being less than 0.090%/day.

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Following the completion of the ILRT measurements, a successful verification test was performed with an imposed leakage rate of 4.40 scfm which corresponds to La. The Mass Point calculated leakage rate of 0.146%/day established during the verification test, was within the allowable limits of 0.133%/day to 0.193%/day. The Total Time calculated leakage rate of 0.143%/day was within the allowable limits of 0.132%/day to 0.192%/day.

The calculated leakage rates for this Reactor Containment Building ILRT demonstrates that leakage through the primary reactor containment and systems and components penetrating primary containment do not exceed the allowable leakage rate specified in the SONGS 1 Technical Specification.

2.0 TEST DATA SUMMARY

2.1 Test Method Absolute Method

2.2 Data Analysis Techniques

1) Mass Point per ANSI/ANS 56.8-1981
& ANSI N45.4-19722) Total Time per ANSI/ANS 56.8-1981
& ANSI N45.4-1972

2.3 Calculated Peak Accident Pressure 49.4 psig

2.4 Test Pressure @ Start of Test 51.0 psig

2.5 Maximum Allowable Leakage Rate (La) 0.120%/day

2.6 75% of La 0.090%/day

2.7 ILRT Results Leakage Rate (wt. %/day)

Lam	95% UCL	95% UCL +LL
1) Mass Point	0.043	0.045
2) Total Time	0.042	0.048

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2.8 Instrument Selection Guide Per ANSI/ANS 56.8-1981

1) Required < 0.030 %/day

2) Actual	Start	End
	0.000297%/day	0.000297%/day

3) RTD'S 18 18

4) DEWCELL'S 4 4

5) PRESSURE SENSORS 2 2

3.0 VERIFICATION TEST DATA SUMMARY

3.1	Verification Test Imposed Leakage Rate	0.120%/day (4.40 scfm)
3.2	Verification Test Results	Leakage Rate (wt. %/day)
	1) Mass Point	0.146
	2) Total Time	0.143
3.3	Verification Test Acceptance Criteria	Test Limits (wt. %/day)
	1) Mass Point Analysis	
	Upper Limit (Lo+Lam+0.25La)	0.193
	Lower Limit (Lo+Lam-0.25La)	0.133
	2) Total Time Analysis	
	Upper Limit (Lo+Lam+0.25La)	0.192
	Lower Limit (Lo+Lam-0.25La)	0.132

4.0 LOCAL LEAK RATE TEST DATA SUMMARY

During the ILRT the penetrations listed below were not aligned to simulate the configuration after a postulated loss of coolant accident. The measured local leakage rates obtained from Test Procedure S01-V-1.12, "Containment Penetration Leak Rate Testing", are given below and were added to the ILRT results.

PEN_#	DESCRIPTION VALVE_#	LOCAL LEAKAGE RATE (SCCM)
B-16B	RCS SAMPLE SV-3303 (CAPPED DURING ILRT)	29
E-1	CTMT PURGE POV-10, CVS-313	2043
W-19	ILRT PRESS STS-320	1
W-19	ILRT FLOW STS-303	0
B-12	RHR SAMPLE CV-957, CV-962	21
B-12	PRT GAS SAMPLE CV-948, CV-949 (CAPPED)	0
LEAKAGE TOTAL (sccm)		2094
LLRT Penalty (wt. %/day)		0.002

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5.0 ANALYSIS AND INTERPRETATION

5.1 PRESSURIZATION

Pressurization started at 1015 June 4, 1984 and test pressure of 51.0 psig was achieved at 0200 June 5, 1984. The average pressurization rate was 3.24 psi/hr over the 15.75 hour period using a 4500 cfm diesel compressor system with one 1500 cfm diesel compressor as a backup.

5.2 CONTAINMENT ATMOSPHERE STABILIZATION

The acceptance criteria for containment atmosphere stabilization at test pressure is that the rate of change of the containment temperature (weighted average of RTD sensors) averaged over the last hour shall not deviate by more than 0.5 degrees F per hour from the rate of change averaged over the last four hours, and the containment atmosphere has been at test pressure for at least four hours.

Temperature stabilization commenced at 0200 and the criteria of 0.5 degrees F was met at 0830 (within 6.5 hours).

5.0 ANALYSIS AND INTERPRETATION (Continued)

5.3 ILRT (Mass Point)

The acceptance criteria for the ILRT is that the leakage rate determined using the 95% UCL value for Mass Point calculated leakage rate plus the sum of the measured LLRT rates for penetrations not included in the ILRT must be less than 75% of the allowable leakage rate (La) at the peak accident pressure (Pa).

- * The Mass Point Leakage Rate calculated at the 95% UCL is 0.045%/day.

$$95\% \text{ UCL} = 0.045\%/\text{day}$$

- * The LLRT for penetrations not included in the ILRT is 0.002%/day.

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$$LL = 0.002\%/\text{day}$$

- * 75% of the allowable leakage rate of 0.120%/day is 0.090%/day.

$$75\% \text{ La} = 0.090\%/\text{day}$$

The acceptance criteria for the ILRT leakage rate using the Mass Point technique is satisfied, i.e.,

$$\begin{array}{rcl} 95\% \text{ UCL} + LL & < & .75 \text{ La} \\ 0.045\%/\text{day} + 0.002\%/\text{day} & < & 0.090\%/\text{day} \\ 0.047\%/\text{day} & < & 0.090\%/\text{day} \end{array}$$

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5.0 ANALYSIS AND INTERPRETATION (Continued)

5.4 ILRT (Total Time)

The acceptance criteria for the ILRT is that the leakage rate determined using the 95% UCL value for Total Time calculated leakage rate plus the sum of the measured LLRT rates for penetrations not included in the ILRT must be less than 75% of the allowable leakage rate (La) at the peak accident pressure (Pa).

- * The test duration was 30.5 hours.
- * 123 data points were used in the calculations.
- * Data was collected at fifteen (15) minute intervals.
- * The Total Time Leakage Rate calculated at the 95% UCL is 0.048%/day.

$$95\% \text{ UCL} = 0.048\%/\text{day}$$

- * The LLRT for penetrations not included in the ILRT is 0.002%/day.

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$$\text{LL} = 0.002\%/\text{day}$$

- * 75% of the allowable leakage rate of 0.120%/day is 0.090%/day.

$$75\% \text{ La} = 0.090\%/\text{day}$$

The acceptance criteria for the ILRT leakage rate using the Total Time technique is satisfied, i.e.,

$$\begin{array}{rcl} 95\% \text{ UCL} + \text{LL} & < & .75 \text{ La} \\ 0.048\%/\text{day} + 0.002\%/\text{day} & < & 0.090\%/\text{day} \\ 0.050\%/\text{day} & < & 0.090\%/\text{day} \end{array}$$

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5.0 ANALYSIS AND INTERPRETATION (Continued)

5.5 Imposed Leakage Rate Verification Test (Mass Point)

The acceptance criteria for the imposed leakage verification test is as follows:

$$* \quad L_o + L_{calc} - .25 L_o < L_{ver} < L_o + L_{calc} + .25 L_o$$

where, L_o = Imposed leakage rate in the range
 $.75 L_a \leq L_o \leq 1.25 L_a$
 L_{calc} = ILRT calculated leakage rate
 L_{ver} = Verification test calculated leakage rate

The imposed leakage rate shall be between 0.75 and 1.25 of the maximum allowed leakage rate of 0.120%/day. The calculations shall utilize at least 10 data points, recorded over a time span of at least 4 hours. Actual test data is as follows:

- * L_o = 0.120%/day (4.40 scfm)
- * $.25 L_o$ = 0.030%/day
- * L_{calc} = 0.043%/day
- * L_{ver} = 0.146%/day (Mass Point)
- * Data Points = 17

The acceptance criteria for the Mass Point technique of determining the imposed leakage rate is satisfied, i.e.,

$$L_o + L_{calc} - .25 L_o < L_{ver} < L_o + L_{calc} + .25 L_o$$

$$0.120 + 0.043 - 0.030 < 0.146 < 0.120 + 0.043 + 0.030$$

$$0.133 < 0.146 < 0.193$$

5.0 ANALYSIS AND INTERPRETATION (Continued)

5.6 Imposed Leakage Rate Verification Test (Total Time)

The acceptance criteria for the imposed leakage verification test is as follows:

$$* \quad L_o + L_{calc} - .25 L_o < L_{ver} < L_o + L_{calc} + .25 L_o$$

where, L_o = Imposed leakage rate in the range
 $.75 L_a \leq L_o \leq 1.25 L_a$

L_{calc} = ILRT calculated leakage rate

L_{ver} = Verification test calculated leakage rate

The imposed leakage rate shall be between 0.75 and 1.25 of the maximum allowed leakage rate of 0.120%/day. The calculations shall utilize at least 10 data points, recorded over a time span of at least 4 hours. Actual test data is as follows:

$$\begin{aligned} * \quad L_o &= 0.120\%/day \quad (4.40 \text{ scfm}) \\ * \quad .25 L_o &= 0.030\%/day \\ * \quad L_{calc} &= 0.042\%/day \\ * \quad L_{ver} &= 0.143\%/day \quad (\text{Total Time}) \\ * \quad \text{Data Points} &= 17 \end{aligned}$$

The acceptance criteria for the Total Time technique of determining the imposed leakage rate is satisfied, i.e.,

$$L_o + L_{calc} - .25 L_o < L_{ver} < L_o + L_{calc} + .25 L_o$$

$$0.120 + 0.042 - 0.030 < 0.143 < 0.120 + 0.042 + 0.030$$

$$0.132 < 0.143 < 0.192$$

6.0 RESULTS OF LOCAL LEAK RATE TESTS CONDUCTED SINCE THE LAST LLRT (May 20, 1981)

Penetration (Type B and C) testing was accomplished in accordance with the requirements of 10CFR50, Appendix J, Technical Specification 4.3.II and Procedure SD1-V-1.12. The penetrations were tested by the pressure decay method using local panels.

The allowable leakage for all penetrations is 0.072%/day (0.60La) of the mass of air in the containment at 49.4 psig. A summary of the results of all penetration testing accomplished between May 20, 1981, and June 4, 1984, is provided below. The results are expressed as a percentage of the maximum allowable leakage for all penetrations.

The test result shown for June 4, 1984, is the final test result obtained after repairs were made to penetrations that failed to meet the acceptance criteria of .072%/day. Section 7.0 contains an analysis and interpretation of test results for the penetrations that failed to meet the acceptance criteria.

<u>Test Date</u>	<u>Leakage</u> <u>(% of Allowable)</u>
5/28/81	57.74
6/ 1/81	60.08
6/ 9/81	60.08
6/10/81	57.71
8/15/81	57.75
10/13/81	56.91
10/22/81	65.46
11/ 4/81	78.23
11/ 4/81	65.69
11/30/81	93.13
12/ 1/81	62.70
2/10/82	62.71
6/ 4/84	53.00

7.0 RESULTS OF PENETRATION TESTS WHICH FAILED TO MEET ACCEPTANCE CRITERIA OF 0.6La (.072%/day)

7.1 Containment Purge & Exhaust Valves (POV10 & CVS-313)

During the initial test on these valves test pressure could not be attained due to valve seat leakage. Since the penetration design requires that these valves be tested in parallel, it was not possible to determine the actual through penetration leakage. During the ILRT, this penetration was blank flanged since repairs could not be completed in time to support the ILRT start date. After the ILRT, POV-10 was replaced and the present leakage is 2.74% of allowable.

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7.2 RCDT Discharge Valves (CV-104 & CV-105)

During the initial test on CV-104, inside containment isolation valve, a leakage rate of approximately 3.5 times the allowable was obtained. The outside containment isolation valve (CV-105) test results indicated zero leakage. After CV-104 seat repairs and stroke adjustment were completed, a final leakage rate of approximately 0.38% of allowable was obtained.

7.3 Pressurizer Samole (CV-953 & CV-992)

During the initial test of CV-953 test pressure could not be attained. CV-953 is the inside containment isolation valve for this penetration. The outside containment isolation valve (CV-992) was tested at the same time and had leakage of approximately 0.95 % of allowable. After seat repairs and stroke adjustment were completed, a final leakage of approximately 0.28% of allowable was obtained for CV-953.

7.0 RESULTS OF PENETRATION TESTS WHICH FAILED TO MEET ACCEPTANCE CRITERIA OF 0.6La (Continued)

7.4 Nitrogen to POV's (CV-532 & GNI-102)

During the initial test of check valve GNI-102, test pressure could not be attained. GNI-102 is the inside containment isolation check valve for this penetration. The outside containment isolation valve (CV-532) test results indicated zero leakage. After lapping of the valve seat, a leak rate of approximately 0.06% of allowable was obtained.

7.5 RC Sample Penetration (SV-3303)

This penetration was installed during the current outage as part of the Post Accident Sampling System. Attempts to measure the leak rate on the outside containment isolation valve (SV-3303) failed when test pressure could not be attained. An investigation revealed that the valve was not correctly designed for containment isolation purposes. As a result, the penetration was capped and the leakage rate added to the ILRT results. After the ILRT, the cap was removed and SV-3303 was replaced. The present leakage is 0.039% of allowable.

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7.6 RHR Sample (CV-957 & CV-962)

During the initial test of CV-962 test pressure could not be attained. The leak test on the outside containment isolation valve (CV-957) indicated a leak rate of approximately 15% of allowable. The seats on both valves were lapped and a final leakage rate of approximately 0.028% and 0% of allowable was obtained for CV-962 and CV-957 respectively.

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