APPENDIX D

THREE MILE ISLAND UNIT 1

1977 REFUELING

REACTOR BUILDING LOCAL LEAK RATE TESTING REPORT

SP 1303-11.18

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APPENDICES

REACTOR BUILDING LOCAL LEAK RATE TESTING NRC REPORT

1977 REFUELING

A. PURPOSE

1. To provide analysis to the Nuclear Regulatory Commission on the second periodic type B and type C leakage tests performed along with th first periodic integrated leak rate test of Three Mile Island Unit 1 reactor building.

   This is in accordance with "Primary Reactor Containment Leakage Testing for Water Cooled Power Reactors," Appendix J, Part 50, Title 10 Code of Federal Regulations which required the contents of this summary report to become part of the type A test report along with the details of any other type B and type C testing performed since the previous type A test. (Also required per technical specification 4.4.1.1.8)

2. To summarize the violation of the TMI-1 technical specifications, paragraph 4.4.1.2 in that the reactor building local leakage rate surveillance testing resulted in a combined leakage above the acceptance criteria of 0.6 L_a. This event was considered to be a reportable occurrence as defined in technical specification 6.9.2.A (9).

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SECTION B

SUMMARY

SECTION B SUMMARY OF WORK ACCOMPLISHED

1. Testing

Reactor building refueling frequency local leak rate testing was performed on the containment isolation valves and penetrations listed in the technical specifications and those additionally committed to be tested per Reference 2. See Appendix II for a description of the equipment tested. A total of approximately eighty three (83) seat and/or packing leak tests were performed, many as retests after repairs. Fifteen (15) of the fifty three (53) containment isolation valves had higher seat and/or packing leakage than the cognizant engineer could accept and repairs were performed:

AH-V1A/1B	CM-V2	NS-V4, 15, 35*	
CA-V4A/B	HP-V1*	RB-V7	*packing/gasket problems only
CA-V5A/5B	IC-V3,4	WDL-V4	

Twelve (12) of these valves were accepted after one (1) repair/retest two (2) after two (2) repairs/retests and the remaining valve after four (4) repairs/retests.

Five (5) valve leakages remain higher than desirable though further repairs were not considered worthwhile or parts were not available.

CA-V5B	IC-V4	MDG-V4
CF-V19A	RB-V7	

Note: All five (5) of these are gate valves.

2. VALVE REPAIRS

Three (3) gate valves (IC-V3, 4 and RB-V7) in cooling water systems required refinishing of seating surfaces. The most common repair was lapping and grinding of seats/wedges. The stem was replaced for RB-V7. The fluid block bonnet connection for NS-V15 was leaking and required seal welding.

Three (3) other gate valves (CA-V5A, 5B, &WDG-V4) were also re-seated to obtain more acceptable leak rate. CA-V5A had new seat rings and wedge installed and the seat rings were tack welded into both CA-V5A and 5B.

Two (2) large butterfly valves (AH-V1A/1B) were cleaned and lubricated and the seat and operator for AH-V1B was readjusted for optimum seatings. One small ball valve (CM-V2) required new teflon seats. The ball was also replaced. The packing was replaced in eight (8) valves (NS-V4, 15, 35, HP-V1, WDG-V4, CA-V4A, 4B & CA-V5B)

SECTION C METHODS OF TESTING

SECTION C METHODS OF TESTING

Testing was performed by use of TMI Unit 1 surveillance procedure SP 1303-11.18 Reactor Building Local Leak Rate Testing. This procedure gives detailed guidance on the test equipment and methods to be used for each penetration/valve.

The following general philosophy is contained in the surveillance procedure.

1. Use air or nitrogen at a pressure differential across the valve greater than P_a (Calculated accident pressure)
2. Assure that the pressure is exerted in the accident test direction unless it can be demonstrated that pressurizing in the opposite direction is as conservative.
3. Assure that the test volume is drained of liquid so that air or nitrogen test pressure is against valve seats.
4. Assure that the test verifies valve packing integrity.
5. Assure adequate time period for stabilization of test conditions.
6. Assure test equipment is calibrated and used in a manner consistent with the data accuracy desired. (Weekly meter standardization was performed to verify meters accurate within ± 5% full scale. MP 1430-Y-22)
7. Assure that the fluid blocking system is drained and vented during tests on the associated containment isolation valves to prevent any effects it might have on the test results. (The majority of the F. B. system is seismic 3)
8. Assure valves to be tested are closed by the normal method prior to testing.
9. Document as-found conditions (prior to adjustments/repairs) and as-left conditions.
10. Record test instrument <u>scale</u> readings prior to doing any data corrections.

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11. Perform test ring bypass valve tests weekly.

12. Assure that system drains and vents which could serve as containment isolation valves, are closed and capped and tagged after completion of the test program.

A training program prior to the refueling outage was also performed to help assure that the above philosophy was understood by the personnel involved in the testing.

SECTION D TEST EQUIPMENT

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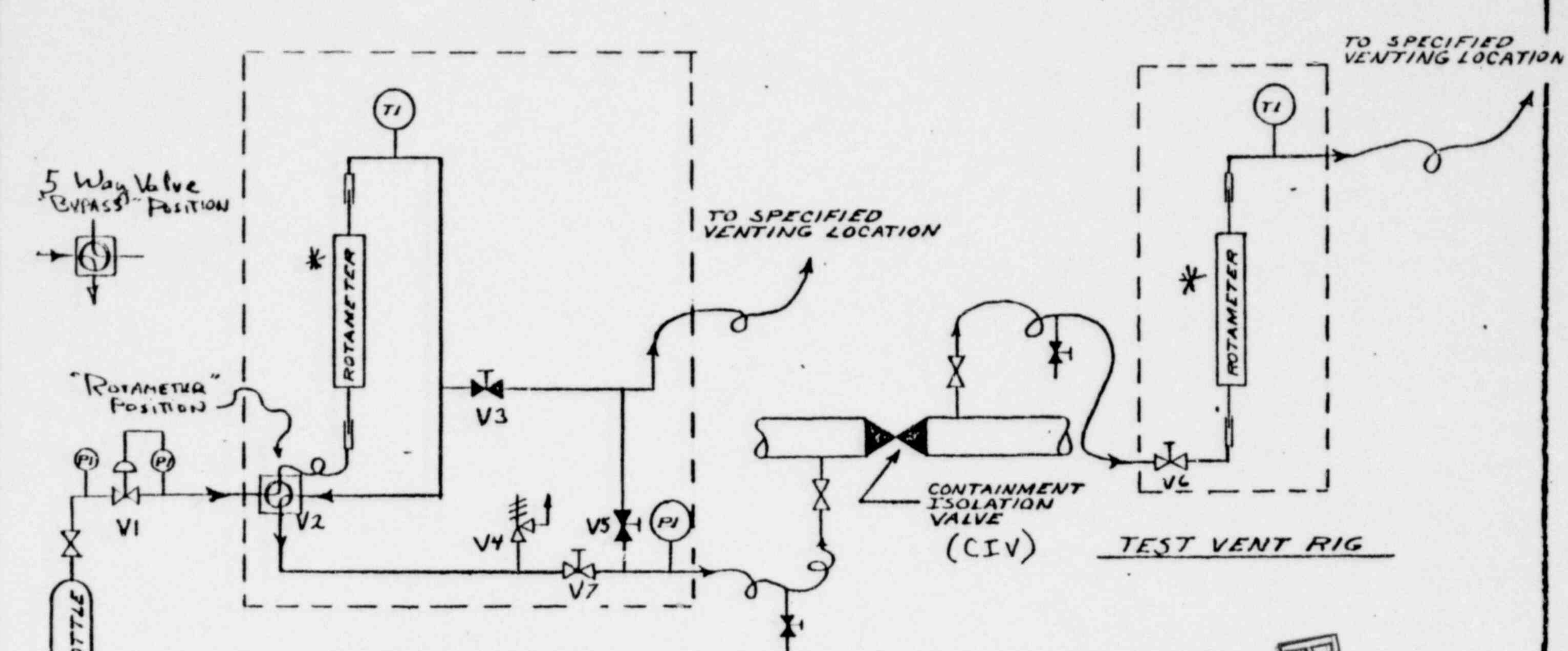
SECTION D TEST EQUIPMENT (See Figure 1)

Brooks Model 1114 01F1A1A rotometers were used to measure the supply and/or vent flow rate for each valve and penetration (except for the purge valves which were tested by pressure drop methods). These flow meters are fitted with 0 - 150 mm scales and have quick-disconnect couplings to allow switching meters for proper scale. The range of the meters for both zero and fifty five psig metering conditions is given on Figure #1, which also shows the valving, tubing and other controls for the testing apparatus. The flow rotometers were standardized once a week against identical lab meters which had been factory calibrated prior to the outage. (See Reference 1)

The testing apparatus also included calibrated pressure gages for regulation of proper test pressure and thermometers to allow correction of readings for significant variations from calibration conditions.

FIGURE 0[illegible]



TEST PRESSURIZATION RIG

Equipment

Reactor plant grade N_2 supply

Pressure gage 0-100 psi ± 1 psi accuracy

Temperature Indicators 25-125°F ±1°F accuracy

* Test Rotameters (Note: these rotameters are fitted with quick-connect fittings at inlet and outlet)

Brooks R-2-15-AA / Tantalum	@ 0 psi 10-480 SCCM	@ 55 psi 140-1430 SCCM
R-2-15-C / Saphire	100-5300 SCCM	200-12,200 SCCM
R-6-15-B / Carboloy	1000-61000 SCCM	2000-142000 SCCM
Fisher & Porter 035-1/16-56	10-80 SCCM	
118-1/8-55	150-1500 SCCM	
324-1/4-55	1000-32000 SCCM	

ISOLATION VALVE TEST RIG

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FIGURE # 1 N_2 TEST RIG

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SECTION E ANALYSIS OF RESULTS AS-FOUND/AS-LEFT

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SECTION E

ANALYSIS OF RESULTS AS-FOUND/AS-LEFT (See Appendix III for data)

"As-found" leakage data were recorded on an individual data sheet for each each valve/penetration tested. The data sheet was signed by the Test Foreman and a Cognizant Engineer. The safety analysis for the excessive leakage as-found is included in the NRC Reportable Occurrence Report (See Appendix I).

Retesting was performed for those valves which were repaired.

1. Interpretation of Data

1.1 As-found leakage Results

The "as-found" total Reactor Building local leakage for both nitrogen/air and fluid block testing is shown in the below table along with a comparison to Technical Specifications criteria.

AS-FOUND TOTAL REACTOR BUILDING LOCAL LEAKAGE

Type Test	Total Leakage	Tech. Spec/ FSAR Limit	Percent Tech. Spec./FSAR Limit	Remarks
N2/Air	171,024	111,899 sccm	152.8%	

NOTES: (1) The cumulative is taken from raw data, i.e., error analysis not included.

(2) The totals shown are cumulative by penetration and not the total of all valves, i.e., highest valve(s) on penetrations added.

Example: Penetration XYZ has one containment isolation valve inside the reactor building and one outside the reactor building. One valve leaks 500 sccm and the other leaks 1,000 sccm. The leakage for the penetration is 1,000 sccm not 1,500 sccm. The maximum leakage which can be forced through the worst valves at a pressure of Pa is still 1,000 sccm.

ROUGH DRAFT

The exact "as-found" leakage wa s not ascertainable in that two (2) of the nitrogen/air tested valves exceeded the flow capabilities of the pressurization equipment and thus could not be pressurized to the required test pressure.

1.2 As-left Leakage Results

(Subsequent to repair/maintenance) The existing combined reactor building local leakage is shown below. Comparison to FSAR limit is also given.

AS-LEFT REACTOR BUILDING LOCAL LEAKAGE

Type Test	Total Leakage	Tech. Spec. Limit	Percent Tech. Spec. Limit	Remarks
N2/Air	43,507	111,899 sccm	38.9%	

NOTES: (1) The cumulative total does not have the error analysis factor included.

(2) The total shown is cumulative by penetration and not the total of all valves tested. (See discussion note 2 of section 1.1)

(3) The as-left leakages on containment isolation valves/penetrations are listed in Appendix III.

If the error analysis is included in the data, the as-left leakage becomes 49,017 or 43.8 % of the Tech. Spec. Limit (See Section E2 "Error Analysis" for discussion.

2. Error Analysis

The flowmeters used in the field have normal industrial accuracies of ± 2% full scale in the 10-100% scale range. However, weekly comparisons of these meters with lab meters were done to verify better than ± 5% full scale accuracy. The lab meters were certified as ± 1% full scale accuracy from 10-100% F.S. by the manufacturer. See Appendix V for the meter Standardization Procedure.

The usable scale range for the field meters and the lab meters was 15-150 millimeters.

The relationship used to determine meter accuracy from standardization data was as follows:

$$\%\ \text{Field Meter Accuracy} = \sqrt{(\text{Lab meter accuracy})^2 + (\text{Largest deviation})^2}$$

or $(\text{Industrial Accuracy})^2$ whichever is largest

In cases where this calculated value exceeded 5%, (it was normally approximately 3%) or where the meter float did not move freely when the meter was turned alternately upside down and then right side up, the meter was dissasembled, cleaned, repaired, and then reassembled and retested.

In all cases temperature effects on the test results were considered to be insignificant.

To determine the leakage, corrected for meter accuracy on each individual leak test, 5% was added to the recorded data sheet scale readings. If this corrected value still did not exceed the minimum usable (10%) value for meter reading the flow rate corresponding to 10% full scale (15mm) was used as the corrected leakage value.

Example:

For CM-V3
Data sheet recorded scale reading = 5 mm
Add 5% F.S. 5 + (0.05x150) = 12.5 mm
Which is less than 10% F.S. therefore the corrected leakage value was taken as the flow rate corresponding to 15 mm.

For pressure drop tests the value for pressure gage resolution was used to make error corrections. i.e., the gage resolution was added to the intial pressure and subtracted from the final reading.

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SECTION F

REFERENCES

1. 1430-[illegible]-23 Standardization of Flow Rotometers
2. Met-Ed to NRC Licensing Letter 9/17/75 - Comparison of TMI 1 Tech. Spec. with Appendix J - 10 CFR 50
3. SP 1303-11.18 Reactor Building Local Leak Rate Testing
4. Three Mile Island Unit 1 Technical Specification 4.4.1
5. TMI Surveillance File (for Data Sheets)