U.S. NUCLEAR REGULATORY COMMISSION
REGION III

Reports No. 50-456/91023(DRS); 50-457/91021(DRS)

Docket Nos. 50-456; 50-457 Licenses No. NPF-72; NPF-77

Licensee: Commonwealth Edison Company
Opus West III
1400 Opus Place
Downers Grove, IL 60515

Facility Name: Braidwood Nuclear Power Station, Units 1 and 2

Inspection At: Braidwood, IL

Inspection Conducted: September 19 through December 17, 1991

Inspector: V. P. Lougheed 1/28/92
V. P. Lougheed Date

Approved By: M. P. Phillips 1/29/92
M. P. Phillips, Chief Date
Operational Programs Section

Inspection Summary

Inspection on September 19 through December 17, 1991 (Inspection Reports No. 50-456/91023(DRS); No. 50-457/91021(DRS))
Areas Inspected: Routine announced safety inspection by regional based inspector of the Unit 2 containment integrated leak rate (Type A) test and a review of test results for the February 1991 Unit 1 Type A test. Inspection modules used during this inspection were 70307, 70313, and 70323.
Results: The September 1991 Unit 2 Type A test failed in the as-found condition due to leakage through the steam generator manways. The treatment of steam generator manway leakage has been referred to the Office of Nuclear Reactor Regulation for resolution. Should NRR determine that manway leakage may be excluded, the test failure will be revisited. A licensee strength was apparent in the approach used to identify, quantify, and isolate the steam generator leakage.

The February 1991 Unit 1 Type A test was determined to be a failure based on the excessive leakages observed during the Type A test. One violation was identified against the requirements of 10 CFR Part 50, Appendix J, Section III.A.1, for identification of excessive leakage paths during the test which interfered with satisfactory completion of the test. These paths were blocked without quantification of their leakage or their impact on the test results.

DETAILS

1. Persons Contacted

Commonwealth Edison

2,3,4	D. O'Brien, Technical Superintendent
1	G. Bal, Integrated Leak Rate Test Engineer
3	R. Bishop, Production Services Manager, NED
1,2,4,	E. Carroll, Regulatory Assurance, NRC Coordinator
1	A. Checca, Nuclear Licensing Administrator
2	R. Cozz, Nuclear Safety Offsite Review
4	A. J. D/Antonio, Nuclear Quality Program
1	R. Francoeur, Assistant Technical Staff Supervisor
1,2,3	J. Glover, Leak Rate Test Coordinator, NED
2	M. Gorski, Onsite Nuclear Safety
2,4	A. Haegger, Regulatory Assurance Supervisor
1,2,3,4	C. King, Integrated Leak Rate Test Engineer
2	F. Lesage, Nuclear Quality Programs
2	P. Maher, Assistant Technical Staff Supervisor
2	C. Melone, Technical Staff Group Leader
2,3,4	T. Simpkin, Nuclear Licensing Administrator
2,3,4	G. Vanderheyden, Technical Staff Supervisor
1,3,4	J. Zeszutek, Integrated Leak Rate Test Engineer

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2,4	S. DuPont, Senior Resident Inspector
4	D. Hartland, Reactor Engineer
1,2,	M. Huber, Resident Inspector
1	G. Nejfelt, Reactor Inspector
3	R. Landsman, Braidwood Project Engineer
3	G. Wright, Chief, Operations Branch

1 Attended meeting on Unit 1 test held September 25, 1991
2 Attended exit on November 22, 1991
3 Attended meeting on Unit 1 test held December 17, 1991
4 Participated in telephone exit on January 27, 1992

The inspector also interviewed other licensee employees during the course of the inspection.

2. Licensee Action on Previous Inspection Findings

(Closed) Unresolved Item 456/86023-01 "Treatment of Leak Chase Channels During Integrated Leak Rate Tests." This matter had been referred to the Office of Nuclear Reactor Regulation for resolution. By letter dated May 17, 1990, the NRC approved the licensee's plans for leaving the leak

chase channels vented during the integrated leak rate tests. The inspector verified that the licensee's procedure was in accordance with their commitment. This item is closed.

3. Containment Integrated Leak Rate (Type A) Test Procedure Review (70307)

The inspector reviewed surveillance procedure 2BwVS 6.1.2.a-1, "Primary Containment Type A Integrated Leakage Rate Test (ILRT)," in relation to the requirements of 10 CFR Part 50, Appendix J; ANSI N45.4-1972; and the licensee's Technical Specifications. The inspector determined that the procedure was in conformance with these regulatory documents.

4. Type A Test Witnessing (Unit 2 Test, September 1991) (70313)

a. Calibration Data

The inspector determined that all the instruments used during the Type A test were properly calibrated and that the correct weighting factors were placed into the licensee's computer program. The licensee used 25 temperature sensors, 10 humidity sensors, 2 pressure detectors and 1 flow detector throughout the test.

b. Temperature Survey

The inspector reviewed the results of the Unit 2 temperature survey performed prior to pressurization. The inspector noted that the temperatures measured in subvolume 6 were approximately 5 degrees higher than those recorded by the test temperature instrumentation during the same time period. This discrepancy was discussed with the licensee, and no immediate cause for the discrepancy could be found. The licensee agreed to investigate the cause of this discrepancy prior to the next Type A test. No other problems were identified.

c. Valve Walkdowns

The inspector walked down the outside containment isolation valves and vent paths. All systems required to be vented outside of containment, per the licensee's safety analysis report, were in the proper position.

d. Steam Generator Manway Leakage

During the required stabilization period, the licensee identified leakage through main steam line B. This leakage was too large to enable them to pass the Type A test without isolating. After completion of proper

procedural changes, the licensee added an air source to maintain a constant pressure, approximately one pound below containment pressure, through the vent valve in steam line B for the duration of the Type A test.

During the above process, the licensee performed an approximate quantification of the leakage through the steam generators and concluded that it accounted for the excessive leakage monitored by the Type A test instrumentation. The licensee informed the inspector that the leaks would be repaired, and that the steam line would be pressurized with a zero leakage acceptance criteria, prior to returning the plant to operation. The inspector found these corrective actions to be acceptable.

The inspector considered the systematic, methodical process that the licensee used to identify, quantify, and isolate the steam generator leakage during performance of the test to be a strength.

5. Test Results Evaluation - Unit 2 September 1991 Test (70323)

a. Type A Test

Following the satisfactory isolation of the steam generator leak, the licensee began the Type A test. A 25-hour full-pressure Type A test was performed on September 15 and 16, 1991 at a test pressure of 59.7 psia. Data was collected every 10 minutes. The inspector independently calculated the leakage rates using the mass point methodology, with results as indicated below (all units in weight percent per day (wt%/day)). The acceptance criterion was that Lam, at the 95% UCL, be less than 0.75 La or 0.075 wt%/day. The test data met this criteria.

Measurement	Licensee	Inspector
Measured leak rate during Type A test (Lam)	0.053	0.053
Lam at 95 percent Upper Confidence Level (UCL)	0.054	0.054

b. Supplemental Test (Unit 2)

After satisfactory completion of the Type A test, a known leakage rate of 7.65 scfm was induced. The licensee stabilized for a one hour period, as required by their procedure, and then collected and analyzed

test data every 10 minutes, for a 2.8 hour test period. There was acceptable agreement between the licensee's and the inspector's calculations (units in wt%/day). The supplemental test results were within the acceptance criteria band of [Lc - (Lo + Lam)] ± 0.025.

Measurement	Licensee	Inspector
Measured leakage rate (Lc) during supplemental test	0.147	0.147
Induced Leakage Rate (Lo)	0.099	0.097
Results from 2? hour test (Lam)	0.053	0.053
Lc - (Lo + Lam)	0.005	0.003

6. Additional Corrections to the Type A Test

a. Type A Test Valve Lineup Penalties

The licensee was required to take a penalty for the following penetrations which were not in their post-accident configuration: (1) the shaft seals on the inner doors of both the personnel and emergency airlocks were sealed with a silicone sealant to eliminate leakage during the test, rather than closing the outer doors; and (2) several penetrations were in use during the test to provide paths for pressurizing containment, inducing the supplemental test leak, and for final depressurization.

The final local leak rate minimum pathway penalties for these penetrations, following all repairs, had not been calculated at the end of the inspection. The licensee was cognizant that these penalties needed to be determined and added to the Type A test results, and that the final value had to remain below 0.075 wt%/day. These penalties will be documented in the licensee's test report.

c. As-Found Condition of Containment

The as-found condition is the condition of the containment prior to any repairs or adjustments to the containment boundary. As described in paragraph 4.d, above, the licensee had to maintain a pressure source on main steam line B in order to pass the Type A test. Based on this leakage, the containment failed in the as-found condition. The issue of steam generator manway leakage has been referred to the Office of

Nuclear Reactor Regulation for resolution. Should NRR determine that leakage through the manways need not be included in calculating Type A as-found leakage, the Unit 2 failure will be revisited.

7. Test Results Evaluation - Unit 1 1991 Test (70323)

A. Leakage During 38 Hour Stabilization Phase

The licensee began the first periodic Type A test on Unit 1 on February 11, 1991. After reaching test pressure, the licensee commenced stabilization, as noted in the sequence-of-events log, at 12 midnight on February 12th. Although the reactor building fan coolers were isolated after three and a half hours of stabilization, resulting in destabilization of containment temperatures, the containment met the required temperature stabilization requirements of Appendix J at approximately 7:35 a.m. on February 13, 1991. At this time, by the inspector's calculations, the containment leakage rate was approximately 0.28 weight percent per day (wt%/d), as compared to a maximum allowable of 0.075 wt%/d.

The licensee identified potentially excessive leaks on the chilled water, containment purge, containment spray, and safety injection systems, and began isolating the vent paths for these systems. The chilled water vent path was isolated prior to restabilization of containment following the fan cooler termination. Therefore, the effect of its isolation on containment leakage could not be determined and was excluded from the remainder of the inspector's calculations. Although each isolation decreased the leakage rate, the leakage did not approach the allowable until an airlock shaft seal leak was identified and blocked. Concurrently, with blockage of the shaft seal leakage, pressurized air was injected and maintained between the containment purge valves and down stream of the containment spray valves. Following these actions, the leakage rate approached the allowable. The licensee then declared the stabilization period comp.ete, and began the official Type A test. Following completion of the test and containment depressurization, the containment purge and spray penetrations were depressurized, then repressurized to perform the local Type C tests. The results of the Type C tests were satisfactory, showing only minimal leakage. Therefore the licensee concluded

that all the leakage experienced during the test was due to leakage through the shaft seals and that the Type A test was acceptable in both the as-found and as-left conditions.

The licensee's conclusions that the airlock accounted for all the containment leakage could not be reproduced, as discussed below. Therefore, the inspector concluded that the Type A test was an as-found failure as the initial containment leakage rate exceeded the maximum allowable.

The inspector noted that pressurized air was continuously added to the space between the containment purge valves and downstream of the containment spray valves. Those air sources were added within a half hour of the airlock shaft seal leakage being blocked. The licensee did not monitor the amount of air being added. As these pressurizations occurred concurrently with the airlock blockage, the inspector could not determine which action resulted in the leakage rate decrease.

The inspector also noted that the licensee originally pressurized between the containment purge valves at 12:15 pm on February 12, 1991. During the December 17, 1991, meeting, the licensee stated that, to the best of their knowledge, this penetration had depressurized by the time the decision was made to add a continuous air source. Using a worst case assumption that the penetration decayed from 43 psig to atmospheric conditions within an hour, this would have resulted in a leakage rate of 0.181 wt%/day. If it was assumed that it took 21 hours to depressurize (the time between the pressurizations), the leakage could have been as little as 0.008 wt%/day. In either case, these leakages were considerably above the measured Type C leakage of 0.001 wt%/day.

The inspector reviewed approximately eight previous Type A test reports where shaft seal leakage had occurred. In every case, the containment leakage was initially within the allowable and dramatically increased upon shaft seal failure. The inspector concluded that the most likely failure mechanism for the shaft seal during this test was to catastrophically fail just prior to being discovered. This explained why the shaft seal leakage was not identified during the hourly checks done over the previous 33 hours.

The inspector performed a statistical analysis of licensee data, which showed an overall steady decrease in leakage rate when each penetration was isolated, with the largest decrease coming after the first pressurization of the purge valves. This conflicted with the licensee's report "Reactor Containment Building Integrated Leak Rate Test, Braidwood Unit 1 (February 2 to March 5, 1991)", which stated "isolation of the first four [chilled water, containment purge, containment spray, and safety injection] leakage paths had a noticeable but small effect upon the total containment leakage. It was only after isolation of the fifth leakage path...did the total leakage rate sharply drop to a value under 0.75La".

10 CFR Part 50, Appendix J, Section III.A.1 requires that, if during a Type A test, potentially excessive leakage paths are identified which will interfere with satisfactory completion of the test, the Type A test shall be terminated and the leakage through such paths shall be measured using local leakage testing methods. The corrective action taken and the change in leakage rate determined from the tests and overall integrated leakage determined from the local leak and Type A tests shall be included in the test report.

During the Unit 1 Type A test, potentially excessive leakage paths existed which interfered with the satisfactory completion of the test. The change in leakage rate due to isolation of these paths was not determined. This is a violation of Appendix J requirements. (246/91026-01(DRS))

B. <u>As-Left Type A Test Results</u>

After sealing the airlock shaft seal leak and adding the continuous air source to block leakage from the containment purge valve and containment spray valves, the licensee noted that the Type A test leakage had dropped below the maximum allowable, and the Type A test was started. Data was collected for 25 hours, with a final leakage rate of 0.053, including the results from the local leak rate tests on the isolated penetrations. The inspector independently calculated the official test leakage rates and found acceptable agreement with the licensee's values. Therefore, the Unit 1 Type A was acceptable in the as-left condition.

8. Airlock Leakage

The licensee has previously experienced leaks in the airlock shaft seals at the Braidwood stations, including the initial preoperational containment integrated leak rate test on Braidwood Unit 1 (May 1986), and the first periodic tests on both units, as described in sections 6 and 7, above. Shaft seal failures were also experienced at the licensee's Byron station. The licensee implemented an improved installation procedure in May 1991 to eliminate the repetitive failure of the shaft seals.

9. Exit Interview

The inspector met with licensee representatives (denoted in Paragraph 1) throughout the inspection. Meetings on the Unit 1 test results were held on September 25, 1991, and on December 17, 1991. A meeting to discuss the conclusions on Unit 2, as well as the initial analyses of the Unit 1 list, was held November 22, 1991. A final exit was held via telephone on January 27, 1992. During this meeting, the inspector summarized the conclusions for both units and the resultant findings. The inspector also discussed the likely informational content of the inspection report with regards to documents or processes reviewed by the inspector during the inspection. The licensee did not identify any items as proprietary.