U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-237/91006(DRS); 50-249/91006(DRS)

Docket Nos. 50-237; 50-249 Licenses No. DPR-19; DPR-25

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

Facility Name: Dresden Nuclear Power Station, Units 2 and 3

Inspection At: Dresden Site, Morris, Illinois

Inspection Conducted: January 23-28, 1991

Inspectors: K. Saleni — Date: 2/6/91

V. P. Lougheed — Date: 2/6/91

F. A. Maura — Date: 2/6/91

Approved By: M. P. Phillips, Chief, Operations Branch — Date: 2/6/91

Inspection Summary

Inspection on January 23-28, 1991 (Reports No. 50-237/91006(DRS); No. 50-249/91006(DRS))

Areas Inspected: Special announced safety inspection by regional based inspectors of the licensee's containment integrated leak rate test (CILRT) and local leak rate test (LLRT) programs, including review of the events surrounding the failure of the flange on the Torus Purge Exhaust Containment Isolation Valve 2-1601-20A, and the data acquisition system failure during the verification portion of the CILRT.

Results: The inspection resulted in one apparent violation against Technical Specification 3/4.7.A.2 which requires that containment integrity be maintained at all times when the reactor is critical. Leakage from the flange, at accident pressure, was conservatively calculated to be 65 weight percent per day, which was 41 times the allowable. This apparent violation is described in section 6 of this report.

Dresden Unit 2 had been granted a waiver of compliance until the end of the Cycle 12 refueling outage in regard to testing of the Reactor Building Closed Cooling Water System (RBCCW). LLRT results during the refueling outage showed that this penetration was acceptable during the previous operating cycle.

The licensee is considered to have failed the CILRT in the as-found condition, due to leakage from the inboard flange on valve 2-1601-20A.

DETAILS

1. Persons Contacted

Commonwealth Edison

*E. Eenigenburg, Station Manager
*J. Geiger, Technical Staff, CILRT Lead Test Engineer
J. Glover, Nuclear Engineering Division, Corporate CILRT Lead
*L. Gerner, Technical Superintendent
*M. Horbaczewski, Technical Staff Group Leader
*G. Kusnik, Quality Control
*D. Lowenstein, Regulatory Assurance Analyst
*K. Peterman, Regulatory Assurance Supervisor
*R. Williams, Senior Quality Assurance Inspector
*K. Yates, Onsite Nuclear Safety Administrator

Illinois Department of Safety

*R. Zuffa, Resident Inspector

U.S. NRC

*D. Hills, Senior Resident Inspector
*M. Peck, Resident Inspector
*J. Monninger, Resident Inspector, NRR

*Attended exit on January 28, 1991.

The inspectors also interviewed other licensee employees during the course of the inspection, including members of the maintenance, quality control, and technical staff.

2. Licensee Action on Previously Identified Findings

a. (Closed) Violation 50-249/90005-01 "Failure to Include Service Air and Demineralized Water in Valve Lineups": The licensee revised the CILRT procedure to include the above systems in the valve lineups. The inspectors reviewed the revised procedure and the test results and had no further concerns. This item is considered closed.

b. (Closed) Unresolved Item 50-249/90005-02 "Status of Small Diameter Pneumatic Tubing Penetrating Drywell": The licensee has completed their evaluation of all containment isolation boundaries and is in the process of performing a final review prior to submittal to NRR. The particular lines in question were handled by cutting and capping them, under the licensee's minor design change program. The work was accomplished on Unit 2 during the Winter 1990 refueling outage, and

will be performed on Unit 3 during the Spring 1991 refueling outage. The inspectors reviewed the packages and discussed the post-modification testing requirements for Unit 3 with the licensee. (Post-modification testing for Unit 2 was accomplished through the CILRT.) The inspectors had no problems with the licensee's solution for the pneumatic lines. This item is considered closed.

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

The inspectors reviewed surveillance instruction DTS 1600-7, "Unit 2/3 Integrated Primary Containment Leak Rate Test," Revision 11, dated December 13, 1990, relative to the requirements of 10 CFR Part 50 Appendix J, ANSI N45.5-1972, and the licensee's Technical Specifications. The valve lineup problems and failure to require venting of some systems as described in Inspection Reports No. 50-237/90006(DRS); No. 50-249/90005(DRS) had been resolved in this revision. The inspectors did not identify any further problems with the procedure.

4. Test Results Evaluation (70323)

a. Review of Data Acquisition Problems Encountered During the CILRT

During the pressurization phase the licensee experienced a failure of their Data Acquisition System (DAS) due to the loss of incoming data information. The licensee attributed this to wetting of the amphenol connector to the DAS computer. This same failure also occurred during the verification portion of the CILRT, causing the licensee to terminate the supplemental test. The inspectors discussed the cause of the failure with the licensee. The apparent root cause was due to a soap-water solution used to identify leaks wetting the connector and causing it to short out. The soap-water solution was used to check the fittings on the CILRT instrumentation penetrations. These penetrations, which exit containment through the personnel airlock, were a source of leakage during the last Unit 3 CILRT. In order to ensure that a similar leak did not occur during the Unit 2 test, the licensee used a new Conax fitting, which provided a tighter seal, and then checked for leakage using the soap-water mixture. The licensee stated that excess solution ran down the cable from the fitting to the connector. Since the connector was not designed to be water-proof, the accumulated moisture caused the connector to fail. Although the licensee carefully dried the cable and connector when the failure first occurred during containment pressurization, the licensee speculated

that sufficient moisture again collected to cause the failure during the supplemental test. The inspectors also discussed with the licensee the intended preventative measures to ensure that similar problems did not occur in the future. The inspectors reviewed the collected data during both failures and verified that it was not isolated sensor failures, but a complete failure of all sensors during that time period. The licensee stated that they were considering tighter controls on the use of soap-water solutions on electrical connections as well as providing a water-proof connector. The inspectors had no further questions in this area.

b. CILRT Data Evaluation

A six hour and ten minute CILRT was performed on Unit 2 on December 17 and 18, 1990 at a test pressure of 64.4 psia following satisfactory completion of the required temperature stabilization period. During the pressurization phase, the licensee experienced excessive leakage from the inboard flange of the Torus Purge Exhaust Containment Isolation Valve, 2-1601-20A. An evaluation of this leakage is described in section 6 of this report. Data were collected every 10 minutes. The inspectors independently evaluated leak rate data using total time (BN-TOP-1) formulas to verify the licensee's calculations of the leak rate and instrument performance. There was good agreement between the inspectors' and licensee's results as indicated by the following summary (units are in weight percent per day).

Measurement	Licensee	Inspector
Measured leak rate during CILRT (Lam)	0.500	0.500
Lam at 95 percent Upper Confidence Level (95% UCL)	0.743	0.746

The Appendix J acceptance criterion is that Lam, at the 95% upper confidence level (UCL), be less than 0.75 La (1.2 wt%/day). The test met this criterion.

c. Supplemental Test Data Evaluation

After satisfactory completion of the CILRT, a known leakage rate of 13 scfm, equivalent to 1.53 wt%/day was induced. The inspectors noted that the licensee corrected the leakage rate for containment temperature and volume changes at the time of the test. These corrections were conservative in nature and resulted

in a higher flowrate than the methodology used by the inspectors. Since both the inspectors' and the licensee's calculated induced leakage rates were within the band specified by Appendix J, the method was considered acceptable.

The Bechtel test method, described in BN-TOP-1, requires a one hour stabilization period between the time when the known flowrate is induced and when the supplemental test is started. It also requires that the supplemental test be at least half of the main test in length. The licensee commenced the supplemental test following the one hour stabilization period required by BN-TOP-1. Data were collected and analyzed by the licensee every 10 minutes. After approximately two and a half hours, the licensee's instrumentation malfunctioned. The cause of this malfunction is described in section 4.a above. In order to obtain the required three hour verification period, the licensee requested from Region III that they be allowed to include the one hour stabilization period in the supplemental test data. The inspectors calculated the supplemental test leakage rate, both with and without the stabilization period data. All data units are in weight percent per day (wt%/day).

Measurement	Licensee	Inspector
Measured leakage rate (Lc) during supplemental test, stabilization data not included	1.756	1.754
Measured leakage rate (Lc') during supplemental test, stabilization data included	1.814	1.812
Induced Leakage Rate (Lo)	1.556	1.533
Results from main test (Lam)	0.500	0.500
Lc - (Lo + Lam)	-0.300	-0.279
Lc' - (Lo + Lam)	-0.242	-0.221

The Appendix J acceptance criterion is that the value of [Lc - (Lo + Lam)] be within a band of $\pm$ 25 % of La. For Dresden, this results in an acceptance criterion of $-0.400 < [Lc - (Lo + Lam)] < 0.400$. The supplemental test results fell within the band, for both the cases using the stabilization data and those without.

The inspectors noted that the last five data points during the supplemental test showed a decreasing trend. Normally, the NRC expects the verification results to stabilize within the band before the test is terminated. In this case, since the test was terminated due to equipment malfunction, the inspectors agreed, for this supplemental test only, to accept the results as valid as long as all of the points remained within the acceptance band.

d. CILRT Volume Change Corrections

At the completion of the CILRT and the supplemental test, the licensee was required to make corrections to the calculated Lam at the 95% UCL due to changes in volume of various water sources inside containment. The following corrections to Lam were recorded and calculated by the licensee, with the calculations being verified by the inspectors:

Water Source	Change in Volume
Equipment Drain Sump	48 cubic feet
Floor Drain Sump	48 cubic feet
Drywell Floor	146 cubic feet

The level at the beginning of the CILRT was 2.67 feet in both sumps, and at the end of the test both sumps were full, with an additional inch of water on the drywell basement floor. The sumps are six feet by six feet by four feet deep. The drywell basement has a radius of 23.6 feet. The licensee had not identified the source of the water at the time of the inspection.

The total volume change due to water inleakage was 242 cubic feet which corresponds to 0.020 wt%/day. This results in a total leakage, at the 95% UCL, of 0.766 wt%/day, which is under the maximum allowable of 1.2 wt%/day.

e. CILRT Valve Lineup Penalties

Due to valve configurations which deviated from the ideal penetration valve lineups for the CILRT, the

results of LLRTs for such penetrations must be added as a penalty to Lam at the 95% UCL, per Appendix J. The licensee had the following penetrations in a configuration which differed from that which would be experienced post accident:

X-101	X-107A,B	X-109A,B	X-111A,B	X-113
X-116A,B	X-119	X-122	X-138	X-145A,B
X-149A,B	X-150A	X-310A,B	X-311A,B	

Addition of the as-left minimum pathway LLRT result for the non-vented penetrations added a penalty of 25.9 scfh to the 95% UCL limit. This leakage was equivalent to 0.051 wt%/day, resulting in a final as-left limit of 0.817 wt%/day. This value was within the acceptance criterion (Lam < 1.2 wt%/day). The licensee added an additional 2 scfm penalty to its calculations. This was due to the CILRT procedure listing service air as a non-vented penetration. Service air was properly vented during the CILRT, however the licensee failed to remove it from the table, and decided to take the additional penalty as a conservative measure. This penalty added approximately 0.004 wt%/day to the total and was negligible.

f. As-Found Condition of Containment

The as-found condition is the condition of the containment at the beginning of the outage prior to any repairs or adjustments to the containment boundary. This is calculated by reviewing the summary of the LLRTs and calculating the amount of leakage rate improvement due to repairs or adjustments using the minimum pathway methodology. The inspectors reviewed the licensee's local leak rate results to ensure that the minimum pathway repairs and adjustment calculations were correctly performed. The inspectors determined that these corrections were worth 140 scfh which corresponds to 0.275 wt%/day. Adding this to the final as-left total would have resulted in an as-found leak rate of 1.092 wt%/day, exclusive of the 2-1601-20A flange leakage. However, due to the excessive leakage from the flange, the CILRT was considered to have failed in the as-found condition.

5. Review of Local Leak Rate Test Results (61720)

a. Review of Proposed Dresden Primary Containment Pathways Document

The inspectors performed a cursory review of the licensee's proposed Dresden primary containment

pathways document issued by the corporate (Nuclear Engineering Division) office on November 19, 1990. The licensee stated that the current status of the document was that it was being reviewed by the on-site technical staff. Following this review, the document would be reviewed and approved by the Onsite Review Group. It would then be submitted to NRC - NRR for review and approval concurrently with the Quad Cities document. The inspectors noted that this document failed to identify the requirement to test the inboard flanges of the purge valves. No other problems were noted.

b. Review of Local Leak Rate Test Results

The inspectors reviewed the licensee's LLRT procedure, DTS 1600-1, "Local Leak Rate Testing of Primary Containment Isolation Valves," Revision 14 dated September 24, 1990. The inspectors noted that the licensee had completely revised the document to resolve the concerns discussed in Inspection Report 50-237/90006(DRS); 50-249/90005(DRS). The inspectors also reviewed the licensee's LLRT data. The licensee performed the majority of the LLRTs by using the flow makeup method. This allowed for more accurate representation of the actual penetration leakage rates. The inspectors noted that the licensee still tended to pressurize the penetrations in excess of Pa (48 psig). This was especially true when the licensee had to account for a water head on one side of the penetration and was using an increased test pressure to overcome the water pressure, which often resulted in a differential pressure of greater than Pa on the penetration. This was discussed with the licensee, and the licensee agreed to keep future tests closer to Pa. The inspectors particularly reviewed the results for penetrations X-123 and X-124 for the Reactor Building Closed Cooling Water (RBCCW) system. The licensee had obtained a Waiver of Compliance for the previous outage from including these penetrations in calculating their 0.6 La total. The inspectors noted that these penetrations had acceptable LLRT results (0.4 and 14.6 scfh, respectively, in the as-found condition.) The inspectors had no further problems in this area.

6. Review of Events Surrounding the Failure of Valve 2-1601-20A (93702)

On December 17, 1990, the licensee began the pressurization of containment in order to perform the CILRT. A review of the test log and discussions with test personnel indicated that at approximately 6:30 on the morning of the 17th, with the containment pressure at approximately 15 psig, a loud "pop" was heard, followed by a "siren-like sound". Upon

further inspection, the licensee found the leakage to be occurring past the inboard flange on the Torus Purge Exhaust Containment Isolation Valve 2-1601-20A. The licensee stopped the air compressors, obtained approximately ten data points prior to tightening the flange bolts thereby eliminating the leak, and recommenced the CILRT pressurization. The licensee subsequently completed the CILRT with satisfactory results as discussed in section 4.0, above. The inspectors had no concern with these short-term corrective actions.

On December 18, 1990, the licensee reviewed the maintenance history on the 2-1601-20A valve and determined that the valve had not been worked on since the last refueling outage, at which time the valve was replaced. Upon making this determination, the licensee reported the event to the NRC under 10 CFR 50.72(b)(2)(i). This was subsequently followed by Licensee Event Report LER-90-018 which was issued on January 14, 1991.

The inspectors reviewed the work history of the valve and flange. The valve was replaced under nuclear work request 67528 in February 1989. Following replacement of the valve, a LLRT was performed by pressurizing between the 2-1601-20A valve and check valve 2-1601-31A. This test, which was the licensee's normal LLRT method, tested the 2-1601-20A valve seat, packing, and outboard flange as well as operation of the check valve. However, it failed to test the inboard flange as required by paragraph IV.A of 10 CFR Part 50, Appendix J. This testing omission was not recognized by any of the licensee personnel involved in development of the work package, maintenance work activities, or conduct of the post-maintenance test. Following satisfactory completion of the LLRT, as well as other required valve surveillances, the valve was returned to operation. On February 19, 1989, Dresden Unit 2 went critical following completion of their refueling outage. The plant remained basically in operation until they shutdown for refueling in September 1990.

In order to obtain an estimate of the leakage through the flange, the inspectors calculated the leakage rate at 15 psig using the ten data points supplied by the licensee. Using point to point test methodology, the inspectors calculated that the leakage rate through the flange was within the range of 23.8 to 24.6 wt%/day at a test pressure of 15 psig. The inspectors then corrected the leak rate to the design pressure (48 psig). This involved both a correction to the test mass and pressure. In regard to the mass change, the calculation was based on the ideal gas law. This result was then utilized in the pressure correction calculation. In this case, calculations were performed using both a formula described in the licensee's local leak rate procedures, which yielded a result of 31 wt%/day; and a formula developed by the Franklin Research Institute for the

NRC, which yielded a result of 65 wt%/day. The later formula assumes a capillary, or non-orifice, type leakage, such as would be the case for leakage through a flange, and the former case is based on flow through an orifice. Neither calculation assumed that the size of the opening would enlarge due to increasing pressure, although that might be physically realistic, if the gasket material was displaced due to the increased air flow at higher pressures.

At the conclusion of the inspection, the licensee was in the process of performing calculations to better quantify the leakage at design pressures. The inspectors noted that all of these values were considerably in excess of the design allowable of 1.6 wt%/day and that either method of extrapolating the leakage rate to design pressure resulted in undesirable leakage rates.

At the time of the inspection, the licensee had not completed its evaluation of the effect of these leakage rates upon the dose releases following a design basis loss of coolant accident. Although direct linear interpolations are not necessarily accurate, the inspectors noted that the flange leakage rates were five to ten times greater than those utilized in the dose calculations presented by the licensee during an enforcement conference concerning opening of sampling valves held on October 12, 1990 (EA 90-168). Those results are contained as attachments to Dresden Inspection Reports No. 50-237/90025(DRP); No. 50-249/90024(DRP).

The inspectors conducted numerous interviews to determine the root cause of the failure. This event appeared to originate in the maintenance program involving installation of flanged valves. The inspectors noted that there were no acceptance criteria for tightening of the flange bolts as they were replaced. The licensee had considered this activity to be within the realm of "skill of the craft." Discussions with the maintenance department indicated that the bolts were tightened through use of a slugging wrench. This involved tightening the bolts by hammering the wrench until the bolts would not turn any further. A maintenance worker also indicated that there was not a good fit between the pipe and the valve at the time of installation that may have contributed to the problem. In addition, as discussed above, the post-maintenance test did not challenge the flange so that the failure to completely tighten the flange was not identified subsequent to the valve installation and prior to its being returned to service. Although the licensee installed eight similar valves with sixteen similar flanges during the prior refueling outage, this was the only flange that leaked.

The inspectors noted that the licensee, at the Quad Cities Nuclear Station, had previously been notified that the inside flanges of the purge valves were part of the containment boundary and that Type C testing between the containment isolation valves did not challenge these flanges. (See Inspection Reports No. 50-254/89024(DRS); No. 50-265/89024(DRS) issued on June 15, 1990). Since Quad Cities was on an accelerated test program such that it performed a CILRT every outage, no action was required at that site. During the Dresden inspection, the inspectors specifically discussed with the licensee the Appendix J requirement to test the flanges was similar to that for other containment isolation valves and needed to be performed every refueling outage rather than just following maintenance. The licensee acknowledged this requirement and stated that the flanges would be properly tested during future outages.

Technical Specification 3.7.A.2 requires, in part, that primary containment integrity be maintained whenever the reactor is critical. Section 3.7.A.2.a.(3) defines the maximum allowable leakage rate (La), at a pressure of Pa, as equal to 1.6 percent by weight of the containment air per 24 hours at 48 psig. Technical Specification section 3.7.A.2.b states, in part, that, when containment integrity is required, primary leakage rates will be limited to an overall integrated leakage rate of less than or equal to 75 percent of La. Operation of Dresden Unit 2 over a complete operating cycle from February 1989 until September 1990, with the inboard flange of containment isolation valve 2-1601-20A having a calculated leakage of approximately 65 wt%/day at 48 psig, is an apparent violation of Technical Specification 3.7.A.2 (50-237/91006-01(DRS)).

7. Exit Interviews

The inspectors met with licensee representatives (denoted in section 1) throughout the inspection. An exit meeting was held prior to leaving the site on January 28, 1991. The inspectors summarized the scope of the inspection and the apparent findings. The licensee acknowledged these findings. The inspectors also discussed the likely informational content of the inspection report with regards to documents or processes reviewed by the inspectors during the inspection. The licensee did not identify any such documents or processes as proprietary.