UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

Report Nos.: 50-325/91-38 and 50-324/91-38

Licensee: Carolina Power and Light Company
P. O. Box 1551
Raleigh, NC 27602

Docket Nos.: 50-325 and 50-324 License Nos.: DPR-71 and DPR-62

Facility Name: Brunswick 1 and 2

Inspection Conducted: November 26 - December 2, 1991

Inspector: H. F. Whitener 1-27-92
H. L. Whitener Date Signed

Approved by: Claudia Julian 1/27/92
F. Jape, Chief Date Signed
Test Programs Section
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope:

This routine, announced inspection was conducted in the areas of containment integrated leak rate testing, followup of pressure isolation valve testing, followup of reverse testing containment isolation valves and review of main steam valve leakage.

Results:

The licensee performed a successful "as left" integrated leak rate test on Unit 2. This is the first of two penalty tests per 10 CFR 50, Appendix J. Preparations for the Unit 2 test included turning around six butterfly valves in the CAC system to improve leakage characteristics and the replacement of feedwater check valves and HPCI steam supply isolation valves with an improved valve design. Also, the licensee has made modifications and/or revised test methods to perform local leak rate tests in a conservative manner (accident direction) and test pressure isolation valves at full pressure differential with the proper test medium.

Management involvement and allocation of resources for leak rate improvements indicates a continuing management commitment to a quality leak rate program.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*K. Ahern, Manager, Regulatory Compliance
*S. Callis, Licensing
*B. Cowen, Senior Engineer
*J. Crider, Manager, ISI Program
*M. Foss, Manager, NRC Compliance
R. Helme, Manager, Technical Support
*C. Robertson, Manager, Environmental and Radiological Controls
*J. Spencer, General Manager

Other licensee employees contacted during this inspection included technicians, and administrative personnel.

General Physics Corporation

Containment Leak Rate Consultants:

*R. Carey
R. Shirk
T. Vanschaick
G. VanWert

NRC Resident Inspectors

*P. Byran, Resident Inspector
D. Nelson, Resident Inspector

*Attended exit interview

2. Containment Integrated Leak Rate Test - Unit 2 (70307, 70313)

The inspector reviewed and witnessed test activities to determine that the primary containment integrated leak rate test was performed in accordance with the requirements of 10 CFR 50 Appendix J, Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors, ANSI-N45.4-1972, American National Standard Leakage - Rate Testing of Containment Structures for Nuclear Reactors, BN-TOP-1, Revision 1 - 1972, Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plants, and test procedure PT-20.5, Integrated Primary Containment Leak Rate Test (IPCLRT).

Selected sampling of the licensee's activities which were inspected included: (1) review of the test procedures to verify that the procedures were properly approved and conformed with the regulatory requirements;

(2) observation of test performance to determine that test prerequisites were completed, special equipment was installed, instrumentation was calibrated and appropriate data were recorded; and (3) preliminary evaluation of leakage rate test results to verify that leak rate limits were met.

Pertinent aspects are discussed in the following paragraphs.

a. General Observations

The inspector witnessed and reviewed portions of the test preparation, temperature stabilization and data processing during the period of November 26 - December 2, 1991. The inspector's observations included the following:

(1) The test was conducted in accordance with an approved procedure. Procedure changes and test discrepancies were properly documented in the procedure.

(2) Test prerequisites selected for review were found to be completed.

(3) Selected plant systems required to maintain test control were found to be operational.

(4) Special test instrumentation was reviewed and found to be installed and calibrated.

(5) Controls for preventing pressurized air sources inside containment or externally pressurized penetrations were established in the test procedure.

(6) Instructions and documentation for venting, draining, and isolation of systems were established in the test procedure.

(7) Problems encountered during the test were described in the test event log.

(8) A containment temperature survey was previously performed to determine representative locations of instruments.

(9) An in-situ check of CILRT instruments was performed prior to the test.

(10) Temperature, pressure, humidity, and flow data were recorded at 15-minute intervals. Data were assembled and retained for final evaluation and analysis by the licensee. A final leak rate test report will be submitted to the Office of Nuclear Reactor Regulation pursuant to Paragraph V of Appendix J to 10 CFR 50.

b. Procedure Review (70307) Units 1 and 2

Portions of PT 20.5, Revision 25, "Integrated Primary Containment Leak Rate Test", dated January 26, 1991 were reviewed to verify that test conditions, test controls, valve alignments and acceptance criteria were specified. The inspector concluded that test conditions and controls were specified in detail in the text; valve alignments and valve restoration were specified in detail in Table 2; and system venting and draining was specified in Table 1. Local leakage (Type C) measurements were identified for those penetrations whose alignment or venting were not in accordance with Appendix J requirements. Leakage savings (leakage correction due to valve repair) were required by procedure to correct the "as left" to the "as found" leak rate. The visual inspection of containment surfaces for structural deterioration is accomplished by reference to PT 20.5.1, Primary Containment Inspection. Instrumentation detailed information and location, and computer program verification are also incorporated into the test procedure.

Several temporary changes to the test procedure were reviewed to confirm that minor procedure changes to accommodate system conditions did not affect test leakage boundaries.

The inspector concluded that the integrated leak rate test procedure contains the required information and level of detail to adequately address regulatory requirements.

c. Containment Integrated Leak Rate Test (CILRT) Performance - Unit 2 (70313)

(1) Method

The integrated leak rate test was performed at the calculated accident pressure (Pa) by the absolute test method. Acceptance criteria were included in the test procedure for Mass Point, Total Time and Short Duration testing in accordance with the specifications of ANSI/ANS-56.8-1981, "Containment System Leakage Testing Requirements"; ANSI-N45.4-1972, "Leakage-Rate testing of Containment Structures for Nuclear Reactors"; and, BN-TOP-1, Revision 1-1972, "Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plants", respectively.

The computer program for analysis of test data was provided by General Physics Corporation. The program included capability for analysis of test data according to the Mass Point, Total Time or Short Duration test methodologies. The test analysis was performed using the short duration (BN-TOP-1) Methodology. Test duration was 9.75 hours.

(2) Description

Values bounding the test conditions were as follows:

Containment Volume	294981 cubic feet
Accident Pressure (Pa)	49 psig
Maximum Allowable Leakage (La)	0.5 wt. percent per day

System conditions for performance of the integrated leak rate test were as follows:

Reactor Vessel	-	Vented to containment atmosphere: water level at about 240 inches.
RHR System	-	One loop operating in the shutdown cooling mode.
Containment Ventilation System	-	Fans tripped: No forced air flow.
Containment Isolation System	-	Vented, drained, and aligned per procedure PT 20.5

After the structural inspection, the containment was pressurized to 65 psia. The following table gives a brief description of test events extracted from the test log book.

Date	Time	Event
11/30	1857	Started pressurization of containment at about 7 psig hr.
12/1	0530	Pressurization complete at 50.93 psig. Begin minimum 4 hour temperature stabilization.
	0555	Preliminary leakage inspection revealed only minor packing leaks. No correction was taken.
	1100	Stabilization complete, first Type A test data point taken.
	2030	Type A test terminated at 9.75 hours duration. Total Time 95% UCL = .3265 wt. percent per day. A known containment leakage induced for verification test.
	2045	One hour stabilization per BN-TOP-1 started.

Date (cont'd)	Time	Event
	2145	One hour stabilization terminated. Verification test started.
	0245	Five hour verification test completed.
	0405	Containment depressurization started.

d. Test Analysis and Results

(1) Type A Test

The Technical Specification for Brunswick Unit 2 specifies the allowable containment leakage rate as 0.5 wt. percent per day of the containment volume of 294981 cu. ft. at the calculated accident pressure (Pa) of 49 psig. Therefore the acceptance limit for the integrated leak rate (Type A) test (0.75 La) is 0.375 wt. percent per day.

Analysis of 9.75 hours of data using a total time methodology for a short duration test shows that the calculated leak rate using a linear regression technique was 0.273 wt. percent per day with a 95 percent Upper Confidence Limit (UCL) of 0.327 wt. percent per day. An add-on leakage of 0.022 wt. percent per day was applied to compensate for valves not aligned and vented per Appendix J requirements. The resulting "as left" leakage rate was 0.349 wt. percent per day for the 95 percent UCL which meets the BN-TOP-1 acceptance criteria and the Appendix J Limit of 0.375 wt. percent per day. Mass point calculations for calculated leak rate of 0.266 wt. percent per day and a 95 percent UCL of 0.269 wt. percent per day were in reasonable agreement with Total Time Calculations. Also, the inspectors calculational checks were slightly higher but reasonably consistent with the licensees test results.

(2) Supplemental Test

Appendix J requires that a supplemental test be performed to verify the accuracy of the Type A test and the ability of the CILRT instrumentation to measure a change in leak rate. An acceptable supplemental test method is described in Appendix C of ANSI-N45.4-1972, as follows:

> A known leak rate (Lo) is imposed on the containment and the measured composite leak rate (Lc) must equal, within ± 0.25 La, the sum of the measured Type A leak rate (Lam) plus the known leak rate (Lo).

The acceptance criteria is expressed as:

$$Lo + Lam - 0.25\ La < Lc < Lo + Lam + 0.25\ La$$

A five hour supplemental test was performed by the imposed leak rate method described in Appendix C to ANSI-N45.4-1972. The following values in units of wt. percent per day were obtained using Total Time analysis.

Total Time (wt. percent per day)

Lam	0.2735
Lo	0.4871
0.25 La	0.125
Lc	0.6922

Using these values in the acceptance criteria yields the following:

$0.6356 < 0.6922 < 0.8856$

Lc = 0.6922 satisfies the above inequality and therefore, the supplemental test is acceptable.

The inspector concluded that the "as left" containment leak rate meets the Appendix J and Technical Specification requirements.

3. Status of Containment Leak Rate Testing

a. Integrated Leak Rate Testing

Paragraph III.A.6(b) of Appendix J requires that if two consecutive periodic Type A tests fail to meet the applicable acceptance criteria in III.A.5(b), notwithstanding the periodic retest schedule for III.D, a Type A test shall be performed at each plant shutdown for refueling or approximately every 18 months, whichever occurs first, until two consecutive Type A tests meet the acceptance criteria in III.A.5(b), after which time the retest schedule specified in III.D may be resumed.

The acceptance limit specified III.A.5(b) is 0.75 La which for Brunswick is 0.375 wt. percent per day (24 hours).

The Unit 2 integrated leak rate test is the first of two penalty tests since previous tests in March 1988 and February 1990 were failed Type A tests. As discussed above the Calculated Total Time leak rate of 0.273 (0.277) wt. percent per day and 95 percent Upper Confidence Limit of 0.327 (0.342) wt. percent per day meet the acceptance limit of 0.375 wt. percent per day. The numbers in parentheses are the results of the NRC calculations. Since both the licensee and NRC calculations show that the "as left" leakage rate of

the containment meets the acceptance limit, there is no hold on plant startup. However, under the regulations currently applicable to the Brunswick plant the "as found" leakage rate exceeds the 0.375 wt. percent per day limit and represents another failed integrated leak rate test per Appendix J.

To determine the "as found" leakage the licensee added a penalty of 0.022 wt. percent per day for non-vented systems and a penalty of 0.05 wt. percent per day for leakage repaired prior to the Type A test. The Total Time 95 percent UCL becomes 0.399 (0.414) wt. percent per day which exceeds the 0.75 La limit of 0.375 wt. percent per day. Over the last hour of the Type A test the UCL was decreasing at a rate of .008 wt. percent per day each hour. To reduce the 0.399 wt. percent per day to the acceptance limit, a reduction of 0.024 wt. percent per day at a rate of change of 0.008, which was also decreasing, was estimated to require an additional five to ten hours of critical path test time. The options available to the licensee were to continue the Total Time methodology, run a 24 hour Mass Point test or terminate the test at 9.75 hours and petition for an exemption to the 0.75 La limit for "as found" leakage. The licensee elected the latter option on the following basis and with the understanding that failure to obtain an exemption would result in a failed "as found" Type A test:

- The NRC and industry recognize that the appropriate "as found" limit should be La (0.5 wt. percent per day for Brunswick).

- In a proposed revision to Appendix J now under review by the NRC the "as found" leakage limit has been changed to La.

- A number of plants including the CP&L H.B. Robinson plant have been granted the La limit.

The inspector advised the licensee that pending the outcome of the exemption request the NRC would reconsider the "failed test" classification.

b. Local Leak Rate Testing

Appendix J to 10 CFR Part 50 allows reverse testing under certain conditions. Reverse testing is applying the pressure differential across a component in the opposite directinn from the direction that would be expected under loss-of-coolant accident (LOCA) conditions or when the ccmponent is performing its intended functions.

Also, ASME Boiler and Pressure Vessel Code (ASME BPV Code) Section XI, Subsection IWV, Paragraph 3423, specifies containment isolation valve test conditions in the reverse directions for certain specific valve types.

The regulations and the ASME Code allow testing in the reverse direction when it can be shown that a test in the reverse direction is as conservative as a test in the accident direction. Therefore, it is the Nuclear Regulatory Commission (NRC) position that a licensee may perform reverse testing without prior NRC approval. However, the basis for considering a reverse test conservative, as required by the regulations, must be documented in plant records.

By letters dated August 13, 1987, and January 25, 1990, Carolina Power and Light Company, submitted information related to pressure testing of isolation valves in the reverse (non-accident) direction at Brunswick Steam Electric Plant, Units 1 and 2.

The staff review, supported by an on-site inspection in August 1990 (NRC Report 50-325,324/90-32) concludes that of the 51 containment isolation valves submitted, 35 are acceptably conservative when they are locally leak rate tested by applying pressure in the reverse direction. These valves are identified in Table 1 of the Staff Safety Evaluation. The staff also concludes that local leak rate testing in the reverse direction for the remaining 16 valves is not as conservative as tests in the accident direction. These 16 valves are identified in Table 2 of the Safety Evaluation. The staff requested that the licensee submit a proposed corrective action plan and schedule to correct testing of these valves. Such a plan may include revised test methods, plant modifications, or a request for exemption from Appendix J requirements based on justification of acceptable risks or some other defined basis.

The inspector reviewed the local leak rate test procedure, results, and valve alignments for 12 of the 16 valves (eight valves in each unit) which were considered non-conservative. The test procedures indicate that six of these valves in Unit 2 were tested in the accident direction. A one time exemption was obtained for the other two valves in Unit 2. The revised procedures will be fully implemented in Unit 1 at the next refueling outage.

Procedures reviewed for Unit 2 included:

PT 20.3-118B	E11-F027A
	E11-F027B
PT 20.3-153A	E41-F079
PT 20.3-161A	E51-F066
PT 20.3-168	RNA-SV-5262
PT 20.3-169	RNA-SV-5261

The inspector concluded that the licensee has taken responsible action to correct the reverse testing of containment isolation valves. The disposition of resources also indicate management commitment toward obtaining a quality leak rate test program.

4. Main Steam Isolation Valves

On November 12, 1991, the licensee reported that the Main Steam Isolation Valves (MSIVs) on the C and D main steam lines (MSLs) had failed the local leak rate test. The inspector reviewed the test procedures and results and discussed the cause and significance of this event with licensee personnel. The licensee stated that the root cause investigation is still on-going but the cause and safety significance will be reported in an LER.

The offsite boundary dose calculations were performed considering the MSIVs as a separate leakage source from the other containment isolation valves. Consequently, the technical specifications exclude MSIV leakage from the leakage limits for local leak rate tests (Type B and C tests) and from the integrated leak rate limit (Type A test). However, it is obvious that MSIV leakage would contribute to post accident containment leakage. At the exit interview the inspector requested that the management consider this leakage in evaluating the safety significance of the event.

In reviewing the test results the inspector determined that for the C and D MSLs the test volume could not be pressurized. The test is performed by pressurizing the piping between the inboard and outboard isolation valves. The inboard valves were sealed by filling the MSLs with water and the test repeated. Again the test volume could not be pressurized indicating excessive outboard valve leakage. The outboard MSIVs for C and D MSLs were repaired and tested with the inboard valves sealed. The leakage was reduced to 0.053 scfh and 0.01 scfh for the C and D MSL outboard valves respectively. A test between the valves without the inboard valves sealed showed that the inboard valve on C line was leaking 33 scfh: the test volume on D line could not be pressurized. The inboard valves were repaired and the leakage was left at 0.173 scfh for the C MSL and 0.266 scfh for the D MSL when tested by pressurizing between the inboard and outboard isolation valves.

These results show that there was a leakage path through both isolation valves for the C and D MSLs which would have resulted in excessive leakage of containment atmosphere post accident. As indicated above, the licensee will provide an analysis of this condition to the NRC for review.

5. Pressure Isolation Valves

PIVs are defined as two normally closed valves in series that isolate the RCS from an attached low pressure system. PIVs are located at all RCS/low pressure system interfaces.

The licensee provided the NRC with a description of the PIV test program in a letter (NLS-87-125) dated June 11, 1987. Twelve valves were identified as PIVs for the following systems: RHR loop suction lines, RHR emergency core cooling injection lines, RHR head spray lines, and CS emergency core cooling injection lines.

Four of the 12 valves (check valves E11-F050 A and B and E21-F006A and B) interface directly with the RCS and function only as PIVs.

The remaining eight PIVs, E11-F008, E11-F009, E11-F015A, E11-F015B, E11-F022, E11-F023, E21-F005A and E21-F005B, are motor operated gate valves. These valves have dual functions as pressure isolation valves and containment isolation valves.

In a previous inspection (NRC Report 50-324/90-32 and 50-325/90-32) the inspector questioned the licensees interpretation that Relief Request VR-27 granted relief from Section XI IWV 3420 and specifically 3423(e), 3423(f) and 3427(b) for the pressure isolation function of these valves.

In review of Relief Request VR-27 NRR determined that the relief granted applied to the containment isolation function only for the eight valves with both pressure isolation and containment isolation functions. Because tests performed per Appendix J have not been shown by the licensee, in an IST relief request, to be equivalent to leakage testing requirements for the pressure isolation function, relief to use the alternative method specifically addressing the pressure isolation function is required. Until relief has been granted, the pressure isolation function should be verified per Section XI, IWV-3420. Testing should include all requirements, and specifically the requirements of IWV-3423(e) and (f) relative to maximum pressure differential for all the PIVs and IWV-3427(b), Corrective Action, for the PIVs six inches and larger.

This position was transmitted to the licensee by letter dated September 18, 1991.

The inspector discussed the NRC position with licensee personnel and determined that six of the eight valves on Unit 2 with dual functions had been tested at full system differential pressure using water as the test medium. Review of test procedures and results indicated that the valves tested satisfactorily. The two remaining valves E11-F022 and E11-F023 are in the RHR Head Spray system which has been deactivated and the lines blind flanged between the valve and the pressure vessel. The tests will be performed on Unit 1 at the next refueling outage.

6. Exit Interview

The inspection scope and results were summarized on December 2, 1991, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results. Proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

7. Acronyms and Initialisms

CAC	Containment Air Control
CIV	Containment Isolation Valve

CILRT	Containment Integrated Leak Rate Test (Type A)
CS	Core Spray
HPCI	High Pressure Coolant Injection
IWV	Subsection of ASME Boiler and Pressure Vessel Code, Section XI, pertaining to valve testing
MSIV	Main Steam Isolation Valve
MSL	Main Steam Line
NRR	Nuclear Reactor Regulation
PIV	Pressure Isolation Valve
RCS	Reactor Coolant System
RHR	Residual Heat Removal
SCFH	Standard Cubic Feet Per Hour
UCL	Upper Confidence Limit

U.S. NUCLEAR REGULATORY COMMISSION

NRC FORM 766

INSPECTOR'S REPORT

Office of Inspection and Enforcement

INSPECTOR: H.L. WHITENER

LICENSEE/VENDOR: CP&L

TRANSACTION TYPE: [X] I - INSERT; M - MODIFY; D - DELETE; R - REPLACE

DOCKET NO. OR LICENSE NO. BY PRODUCT	REPORT NO.
05000324	91-38
05000325	91-38

INSPECTION PERFORMED BY: [X] 1 - REGIONAL OFFICE STAFF; 2 - RESIDENT INSPECTOR; 3 - PERFORMANCE APPRAISAL TEAM; OTHER

PERIOD OF INVESTIGATION/INSPECTION: FROM 11/26/91 TO 12/02/91

REGIONAL ACTION: 1 - NRC FORM 591; [X] 2 - REGIONAL OFFICE LETTER

TYPE OF ACTIVITY CONDUCTED: [X] 02 - SAFETY; 03 - INCIDENT; 04 - ENFORCEMENT; 05 - MGMT AUDIT; 06 - MGMT VISIT; 07 - SPECIAL; 08 - VENDOR; 09 - MAT ACCT; 10 - PLANT SEC; 11 - INVENT VER; 12 - SHIPMENT EXPORT; 13 - IMPORT; 14 - INQUIRY; 15 - INVESTIGATION

INSPECTION FINDINGS: A [X] 1 - CLEAR; B [X] 1 - CLEAR; 2 - VIOLATION; 3 - DEVIATION; 4 - VIOLATION & DEVIATION

TOTAL NUMBER OF VIOLATIONS AND DEVIATIONS: 0000

LETTER OR REPORT TRANSMITTAL DATE: NRC FORM 591 OR REG LETTER ISSUED: 01/28/92

MODULE INFORMATION

Type	Module Number	Direct Inspection Effort (Staff Hours)	Module Req Follow-up
0	70307	14	
0	70313	26	
0	92701	10	73756
0	92701	10	61720

* CIRCLE SEQUENCE IF VIOLATION OR DEVIATION