UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING THE LOCAL LEAK RATE TESTING OF CONTAINMENT

ISOLATION VALVES IN THE REVERSE DIRECTION

CAROLINA POWER & LIGHT COMPANY

BRUNSWICK STEAM ELECTIC PLANT, UNITS 1 AND 2

DOCKET NOS. 50-325 AND 50-324

1.0 INTRODUCTION

1.1 Background - Generic

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 direction from the direction that would be expected under loss-of-coolant accident (LOCA) conditions or when the component 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.

1.2 Background - Plant Specific

In 1985, the NRC staff found during an inspection (See Inspection Reports 50-325/85-31 and 50-324/85-31) that four isolation valves at the Brunswick Steam Electric Plant, Units 1 and 2, were local leak rate tested (LLRT) in a non-LOCA (loss-of-coolant accident) direction. However, these valves were not included in the list of valves that the licensee established for this LLRT non-accident direction testing. In response to this finding, the licensee committed to submit a report to provide the staff with justification and evaluation of testing isolation valves in the reverse direction.

By letter dated August 13, 1987, the licensee informed the staff that test procedures for the above valves have been revised and have been successfully tested in the LOCA direction. With this letter, the licensee also included a report on the evaluation and justification for testing of certain isolation valves in the reverse direction.

By letter dated January 25, 1989, the licensee provided the staff with a revised report. The staff reviewed the revised report and performed an onsite inspection on August 6-10 and August 20-24, 1990.

The staff's review was focused on determining whether reverse testing meets the NRC criteria for a conservative test. Simply stated, the criteria require the following:

1. A test in the reverse direction must challenge all potential leakage paths challenged by a test in the accident direction.

2. Pressure applied in the reverse direction must tend to lift the valve disk (maximizing leakage) while pressure applied in the accident direction would tend to seat the disk (minimizing leakage).

2.0 EVALUATION

The following evaluation is based on the staff review of the licensee's submittals and the results of the staff inspection of the licensee's PIV (pressure isolation valve) inservice and surveillance testing activities that were conducted in August 1990 (see NRC Inspection Report 50-325/90-32 and 50/324-90-32).

Appendix J to 10 CFR Part 50, Paragraph III.C.1, allows the following reverse tests under certain conditions:

> Type C tests shall be performed by local pressurization. The pressure shall be applied in the same direction as that when the valve would be required to perform its safety function, unless it can be determined that the results from the tests for a pressure applied in a different direction will provide equivalent or more conservative results.

Also, ASME BPV Code, Section XI, Subsection IWV, Paragraph 3423, specifies the following containment isolation valve test conditions:

> Valve seat leakage tests shall be made with the pressure differential in the same direction as when the valve is performing its function, with the following exceptions:
>
> (a) Globe-type valves may be tested with pressure under the seat.
>
> (b) Butterfly valves may be tested in either direction, provided their seat construction is designed for sealing against pressure on either side.
>
> (c) Gate valves with two-piece disks may be tested by pressurizing them between the seats.

The following criteria are derived from the regulations and ASME BPV Code:

1. Test pressure applied in the reverse direction must challenge all potential leakage paths which would be challenged when pressure is applied in the accident direction.

2. Pressure applied in the reverse direction must tend to open the valve while pressure applied in the accident direction will tend to close the valve tighter.

3. Leakage through any untested leak path must be confined to the containment when pressure is applied from the accident direction.

These criteria dictate that the valve type, valve location, packing and bonnet seal orientation must be considered.

The above criteria applied to local pressurization of containment isolation valves reduces to the following positions:

A. Gate Valves (single or double wedge)

The gate valve has a seal on each side of the valve disk which forms the valve seat. For leakage consideration, bonnet seals and stem packing are between the seat seals. Consequently, when pressurized in the reverse direction the seal which is challenged by accident pressure is not tested. Further, if the seal tested in the reverse direction is tight, the bonnet seal and packing are not tested. These conditions yield the following two positions:

1. Reverse testing of a gate valve located inside containment is conservative. Potential leakage through the untested leak path is into containment and through-line leakage is tested.

2. Reverse testing of a gate valve located outside containment is non-conservative. Potential leakage through the untested leak path would be into the atmosphere.

B. Globe Valves

For a globe or plug valve, the seal is made by the disk or plug moving in a vertical direction to contact the seat. For leakage consideration, packing and bonnet seals are considered to be above the valve disk. With only one seating surface, leakage paths across the valve seat are the same from either direction. The concern is that pressure applied over the seat tends to assist the valve in sealing while pressure applied under the seat tends to lift the disk and reduce the sealing. Also, pressure applied above the seat will challenge the packing and bonnet seal. These conditions yield the following three positions:

1. Reverse testing a globe valve located inside the containment by applying pressure under the seat is conservative. Accident pressure would tend to seat the valve and potential leakage through the untested packing or bonnet seal boundary would be into containment.

2. Reverse testing a globe valve located outside the containment by applying pressure under the seat is non-conservative. Potential leakage through the untested packing or bonnet seal would be into the atmosphere.

3. Reverse testing a globe valve by applying pressure over the seat is non-conservative. Test pressure would tend to seat the valve disk while accident pressure would tend to lift the valve disk.

C. Butterfly Valves

In a butterfly valve, the disk rotates on a center mounted shaft to form the seal. The seat construction is the controlling factor. Where the seat is a flat resilient seal, the valve is considered bi-directional. Where the seat is a tapered ring and the ring or disk are subject to movement under pressure, the valve is considered one-directional.

Applying the foregoing criteria, the staff evaluated the 51 isolation valves submitted by the licensee.

3.0 CONCLUSION

Based on the criteria described above, the staff concludes that the 35 valves in Table 1 are conservatively tested by applying pressure in the reverse direction and require no further review. The staff concludes that local leak rate tests in the reverse direction are considered to be not as conservative as tests in the accident direction for the remaining 16 valves in Table 2.

The staff requests that the licensee submit a proposed corrective action plan and schedule to correct the 16 non-conservatively tested valves. Such a plan may include revised test methods, plant modifications, or a request for exemption from Appendix J requirements with appropriate justification.

Dated: January 28, 1991

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TABLE 1

ACCEPTANCE LOCAL LEAK RATE REVERSE DIRECTION TESTABLE VALVES

LLRT in the reverse direction is considered as conservative as in the accident direction for the following valves. Valve numbers refer to a valve in each unit (2 valves) unless indicated for Unit 1 only.

Valve	Size	Type	Location
B21-F016 (Unit 1)	3"	GA	Main steam Line Drain Inboard Isolation Valve
B21-F022A	24"	GL	Inboard MSIV
B21-F022B	24"	GL	Inboard MSIV
B21-F022C	24"	GL	Inboard MSIV
B21-F022D	24"	GL	Inboard MSIV
B32-F019	3/4"	GL	Recirculation Sample Line Inboard Isolation Valve
CAC-V5	20"	BF	Suppression Pool Nitrogen Inlet Valve
CAC-V6	18"	BF	Drywell Nitrogen Inlet Valve
CAC-V7	20"	BF	Inboard Suppression Pool Purge Exhaust Valve
CAC-V9	18"	BF	Inboard Drywell Purge Exhaust Valve
CAC-V16	20"	BF	Reactor Building to Suppression Pool Vacuum Breaker Valve
CAC-V17	20"	BF	Reactor Building to Suppression Pool Vacuum Breaker Valve
E11-F009	20"	GA	RHR Shutdown Cooling Inboard Suction Throttle Valve
E11-F002	4"	GA	RHR Reactor Vessel Head Spray Inboard Isolation Valve
E41-F002	10"	GA	HPCI Steam Supply Inboard Isolation Valve

Valves	Size	Type	Location
E51-F007 (Unit 1)	3"	GA	RCIC Steam Supply Inboard Isolation Valve
G31-F001 (Unit 1)	6"	GA	RWCU Inlet Inboard Isolation Valve
G16-F003	3"	GA	Drywell Floor Drain Inboard Isolation Valve
G16-F019	3"	GA	Drywell Equipment Drain Inboard Isolation Valve

GA - Gate Valve
GL - Globe Valve
BF - Butterfly Valve

TABLE 2

VALVES REQUIRING ADDITIONAL SUPPORTING EVALUATION/JUSTIFICATION

LLRT in the reverse direction is considered not as conservative as tests in the accident direction for the following valves. Valve numbers refer to a valve in each unit unless specifically indicated for one unit only.

Valves	Size	Type	Location
B32-V22	3/4"	GA	Recirculation Pump A Seal Injection Valve
B32-V30	3/4"	GL	Recirculation Pump B Seal Injection Valve
E11-F027A	6"	GL	RHR Suppression Pool Spray Isolation Valve
E11-F027B	6"	GL	RHR Suppression Pool Spray Isolation Valve
E41-F079 (Unit 1)	2"	GL	HPCI Turbine Exhaust Vacuum Breaker Valve
E41-F079 (Unit 2)	2"	GA	HPCI Turbine Exhaust Vacuum Breaker Valve
E51-F066 (Unit 1)	2"	GL	RCIC Turbine Exhaust Vacuum Breaker Valve
E51-F066 (Unit 2)	2"	GA	RCIC Turbine Exhaust Vacuum Breaker Valve
RNA-SV-5261	2"	S	Non-Interruptible Reactor Instrument Air Isolation Valve
RNA-SV-5262	2"	S	Non-Interruptible Reactor Instrument Air Isolation Valve

GA - Gate Valve
GL - Globe Valve
S - Solenoid Valve

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