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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO VALVES INSERVICE TESTING PROGRAM, RELIEF REQUESTS VR-4 AND VR-17

BRAIDWOOD NUCLEAR POWER STATION, UNITS 1 AND 2

DOCKET NOS. STN 50-456 AND STN 50-457

1.0 INTRODUCTION

The Code of Federal Regulations, 10 CFR 50.55a, requires that inservice testing (IST) of certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Class 1, 2, and 3 pumps and valves be performed in accordance with Section XI of the ASME Code and applicable addenda, except where specific written relief has been requested by the licensee and granted by the Commission pursuant to Sections (a)(3)(i), (a)(3)(ii), or (g)(6)(i) of 10 CFR 50.55a. In requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety; or (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for its facility. Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," provided alternatives to the Section XI requirements determined to be acceptable to the staff.

By letter dated June 25, 1992, Commonwealth Edison Company (CECo) submitted Revisions 5 and 5a of the IST program for Braidwood Nuclear Power Station, Units 1 and 2. This Safety Evaluation (SE) concerns relief requests VR-4 and VR-17 contained in this submittal.

2.0 DESCRIPTION AND EVALUATION OF RELIEF REQUESTS

2.1 Relief Request Number VR-4

The licensee requested relief from the exercising requirements of Section XI, IWV-3200 and -3522, for check valves 1(2)CS003A/B and 1(2)CS008A/B on the containment spray (CS) system. The licensee proposed to: (1) disassemble and inspect the valves on a sampling basis during refueling outages, (2) partial-stroke test the 1(2)CS003A/B valves quarterly and following reassembly, and (3) leak test the 1(2)CS008A/B valves following reassembly.

2.1.1 Licensee's Basis for Relief

The 1(2)CS003A/B check valves are on the discharge of the CS pumps and function in the open direction to allow flow from the refueling water storage tank (RWST) to the spray rings inside containment. They function in the closed direction to prevent water column separation and reverse rotation of the CS pumps. The 1(2)CS008A/B check valves are the inboard containment

isolation valves (CIVs) for the spray header piping and function in the open direction to allow flow. They function in the closed direction to provide for containment isolation, which is a redundant function to the outboard CIVs. These valves can not be full flow tested during unit operation or cold shutdown as water from the CS pumps would be discharged through the CS ring headers, causing undesirable effects on many critical components inside containment.

Additionally, the full flow testing of these check valves during periods of cold shutdown, using the CS pumps, would fill the reactor refueling cavity with borated water from the RWST. This would adversely affect the reactor head components (e.g., control rod drives). The filling of the cavity, via temporarily installed large bore piping, would require the removal of the reactor vessel head so as to preclude equipment damage from borated water. The erection of temporary piping from the CS line to the reactor cavity would take an estimated nine to twelve shifts, compared to one to two shifts for valve inspection. This estimate does not take into account the time required to drain and remove the piping from containment. Testing in this manner would also require overriding protective electrical interlocks in the pump start circuitry.

Full flow recirculation flow paths do not exist from the discharge of the CS pumps through these check valves to the RWST. The addition of such flow paths would require extensive modifications to existing plant design, including additional penetrations of the containment boundary, and electrical system changes to allow for pump start without the need of jumping protective interlocks.

Partial stroking of the 1(2)CS008A/B valves with air using existing local leak-rate test (LLRT) connections does not provide adequate flow to obtain any meaningful acoustic monitoring data relative to valve condition or its performance parameters. This acoustic testing was attempted at Byron Station per special process procedure, SPP 91-054.

The A and B train valves in each group are of the same design (manufacturer, size, model number, and materials of construction) and have the same service conditions, including orientation, therefore, they form a sample disassembly group.

UNIT 1

GROUP 1	GROUP 2
1CS003A 1CS003B	1CS008A 1CS008B

UNIT 2

GROUP 1	GROUP 2
2CS003A 2CS003B	2CS008A 2CS008B

One valve from each group, on a per unit basis, will be examined each refueling outage. If a disassembled valve is not capable of being manually full-stroke exercised or if there is binding or failure of internals, the remaining valve on the affected unit will be inspected.

In addition to the above, the 1(2)CS003A/B valves will be partial-stroke tested during the quarterly pump surveillance and after maintenance in order to verify that they are installed correctly. The 1(2)CS008A/B are required to be leak tested before and after visual inspection per Appendix J requirements. The leakage test following reassembly of the valve into the system will serve as post-maintenance verification that the valve was installed correctly.

The 1(2)CS003A/B and 1(2)CS008A/B valves are removed from the system and visually examined per the strict detailed inspection requirements of the station check valve program. This inspection adequately verifies that the valves are maintained in a state of operational readiness and that the valve's performance parameters are adequately assessed. The valves are verified to be functional by performing a thorough visual inspection of the internals and by performing a manual full-stroke exercise of each disc. Previous inspections of these particular valves at both Byron and Braidwood Stations have repeatedly shown them to be in good condition.

The wafer type design of the valve body makes removal of these valves a simple process with little chance of damage to their internals. Also, there is no disassembly of internal parts required; all wear surfaces are accessible to visual examination. After inspection and stroke testing, the valve is reinstalled into the line and post maintenance testing is performed. The 1(2)CS008A/B valves are local leak rate tested per the requirements of 10 CFR 50, Appendix J; and the 1(2)CS003A/B valves are partial flow tested. These tests verify proper installation of the check valves. The valve inspection procedure requires post-inspection visual examination of the check valves to ensure that the pin is oriented properly and that the flow direction is correct.

The alternate test frequency is justifiable in that maintenance history and previous inspection of these valves at both Byron and Braidwood stations have shown no evidence of degradation or physical impairments. In addition, industry experience, as documented in nuclear plant reliability data system (NPRDS), shows no history of problems with these valves.

A company wide check valve evaluation addressing the "EPRI Application Guidelines for Check Valves in Nuclear Power Plants" revealed that the

location, orientation, and application are such that these valves are not conducive to the type of wear or degradation correlated with SOER 86-03 type problems. However, they still require some level of monitoring to detect hidden problems.

The alternate test method is sufficient to ensure operability of these valves and is consistent with GL 89-04. The hardship involved with full-stroke exercising these check valves, if the Section XI requirements were imposed, does not provide a compensating increase in safety of these CS system valves.

2.1.2 Evaluation

Using the containment spray pumps to full-stroke exercise valves 1(2)CS003A/B and 1(2)CS008A/B would result in containment spray down and equipment damage. The ASME Code required testing could only be performed after significant system modifications which would not be practical because of the excessive burden.

The licensee proposed to verify the full-stroke open capability of these check valves by sample disassembly and inspection. Following reassembly, 1(2)CS003A/B valves are partial-flow tested and the 1(2)CS008A/B valves are leak tested. Valves 1(2)CS003A/B are upstream of the motor-operated isolation valves which receive an engineered safeguards signal to open to allow flow to the CS nozzles. Valves 1(2)CS008A/B are downstream of the motor-operated isolation valves in a portion of piping that is isolated until the CS system actuates and the isolation valves open. Therefore, 1(2)CS003A/B are partial-flow exercised quarterly when the CS pumps run in a recirculation mode, but 1(2)CS008A/B are not. Byron Station partial-stroked 1(2)CS008A/B with air using existing LLRT connections, but the test did not appear to provide meaningful acoustic monitoring data because of inadequate flow. By adding test piping downstream of 1(2)CS008A/B to allow for recirculation of the fluid, the valves can be partial-stroke tested with water without resulting in a spray nozzle discharge; however, such a modification would be extensive and costly and impose an undue burden on the licensee.

The NRC staff position regarding check valve disassembly and inspection is explained in GL 89-04. The minutes of the public meetings on GL 89-04 regarding Position 2, "Alternative to Full Flow Testing of Check Valves," further stipulate that a partial-stroke exercise test using flow is expected to be performed before the valve is returned to service after disassembly and inspection. Full-stroke exercise using flow should be performed if possible. This post-inspection testing provides a degree of confidence that the disassembled valve has been reassembled properly and that the disk in the valve moves freely. Disassembly and inspection is considered by the NRC to be a maintenance procedure with inherent risks which make its use as a routine substitute for Section XI testing undesirable when other testing methods are possible. The licensee should actively pursue the use of non-intrusive diagnostic techniques to demonstrate that the disks in the valves fully open during partial-flow testing. If another method is developed to verify the

full-stroke capability of these check valves, this re: hould be revised or withdrawn.

The licensee states in the relief request that the alternate test method is c.nsistent with GL 89-04 and that this relief request is granted per GL 89-04.

Based on the determination that compliance with the ASME Code requirements is impractical, and considering the burden on the licensee if the ASME Code requirements were imposed, relief should be granted pursuant to 10 CFR 50.55a(g)(6)(i) provided the valves are disassembled and inspected in accordance with the position of GL 89-04.

2.2 Relief Request Number VR-17

The licensee requested relief from testing valves 1(2)SX101A on the essential service water system (SX) in accordance with the requirements of Section XI, Paragraph IWV-3413, -3415, and -3417, and proposed to verify the capability of the valve to stroke during quarterly auxiliary feedwater pump surveillance testing and to monitor the valves using acoustic techniques prior to each refueling outage.

2.2.1 Licensee's Basis for Relief

The 1(2)SX101A valves are the essential service water cooling outlet isolation valves for the motor driven auxiliary feedwater (AFW) pump lube oil coolers. These solenoid valves are completely encapsulated per design (valve stem not visible) and do not have any type of remote position indication or limit/reed switches that can be used to trigger a change in the valve stem position. These valves are energized closed when the pump is not in operation. On pump start, the valve's coil is de-energized; the valve then opens by means of spring force against the plunger and differential pressure across the main disk caused by the pilot disk opening.

These valves cannot be stroke timed using conventional ASME Code stroke timing techniques without a system modification to add position indicating switches. These valves change position in a matter of milliseconds; and because there is no means to control the differential pressure across the valve, establishing a repeatable stroke-time test to meet the ASME Code requirements is not practical or possible. GL 89-04, Position 6, for rapid-acting valves is not applicable because these valves stroke in the 70 to 250 millisecond range.

It is possible to monitor certain valve characteristics by analyzing the acoustical signature trace that is based on capturing structural-borne noise caused by the movement of the valve internals. The acoustical trace is obtained by mounting an accelerometer to the valve body at pre-selected location and recording the opening event. These accelerometers are very similar to those used in the loose parts monitoring system. By converting the analog-to-digital card in a computer, the data can be stored in a file. The non-safety-related software program is used for data analysis.

The acoustic trace of impacts and rubbing of internals can be evaluated using techniques similar to those developed for check valve acoustical monitoring. The full-stroke time that can be obtained from the acoustic trace is often difficult to analyze for a specific value. This is due to the variations in the differential pressure across the main disk that can cause the valve to stroke slowly, resulting in a small magnitude impact event which cannot be distinguished from the flow noise. By understanding the principles of valve operation and construction, the acoustical events provide a signature of the valve that can be used to evaluate valve performance and condition by comparison with previous traces and changes in key events within the valve.

The 1(2)SX101A valves will be verified to open during each quarterly ASME surveillance of the motor driven AFW pumps by observing that the temperature upstream of the valve changes when the pump starts. This is indirect evidence of flow through the valve, and is considered to be an acceptable method of verifying that the valve opens. In addition, observing that proper AFW pump lube oil temperatures are able to be maintained during the test run serves as more indirect evidence to substantiate the valve's opening capability. These valves are also stroke tested in the same manner during the AFW pump operability run required by Braidwood Technical Specifications, on a monthly basis.

In addition to the above, these valves will be tested using acoustic monitoring techniques prior to each refueling outage. Based on test results, additional maintenance activities may need to be initiated to investigate anomalies (electrical or mechanical), or to require internal inspection and repair, as required. The temperature indicator on the cooling water outlet also serves to help determine valve seating condition, this will also be used in evaluating the valve's condition.

Monitoring the temperature of the SX cooling water exiting the lube oil cooler just upstream of the SX101A valve provides information regarding both seating and opening capabilities. Normally, the water temperature just upstream of the closed SX101A valve is approximately equal to the air temperature of the auxiliary building. When the AFW pump starts and the valve opens, the temperature at this point should change, approaching that of the intake lake water temperature. In addition to monitoring the SX water temperature, an acoustic type diagnostic test is used to monitor valve condition. The alternate testing will adequately maintain the AFW system in a state of operational readiness, while not sacrificing the safety of the plant or imposing undue hardships associated with a valve position indication modification.

2.2.2 Evaluation

The 1(2)SX101A valves can be verified to open by monitoring the temperature of the service water just upstream of these valves following actuation, but stroke timing using conventional techniques is not practical because of the encapsulated design without a position indication and the rapid stroke time

(less than about 1/4 second). System modification would be needed to directly measure the stroke time of these valves and would be burdensome to the licensee. The licensee proposed using acoustic techniques to monitor valve condition on a refueling outage frequency in addition to monitoring the SX temperature. This testing, however, does not meet the condition of the NRC Safety Evaluation dated October 15, 1991, which called for measuring the stroke time of these valves. Also, the proposal did not justify the refueling outage test frequency, which is not consistent with the quarterly test frequency specified in the ASME Code.

With regard to meeting the 50% increase in stroke time corrective action criterion of Section XI, Paragraph IWV-3417(a), the licensee states that establishing repeatable stroke times is not possible because of the varying pressure differentials across the valve. The design of the valves is such that the stroke time is a function of the pressure differential across the main disk. Since the valves stroke in the 70 to 250 millisecond range, the difference in normal stroke times from one test to the next could exceed the 50% limit specified in Paragraph IWV-3417(a). Compliance in this case would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety, since it would unnecessarily require an increased test frequency until corrective action is taken when the variation in stroke times is normal. The licensee, however, should establish a limiting value of full stroke time that is a reasonable deviation from the range expected when the valve is known to be operating properly. The limiting value should be conservative enough so that corrective action would be taken for a valve that may not perform its intended function.

Based on the determination that compliance with the ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety, relief should be granted from Section XI, Paragraph IWV-3417(a), pursuant to 10 CFR 50.55a(a)(3)(ii).

With the exception noted for Section XI, Paragraph IWV-3417(a), the licensee should be capable of developing a non-intrusive method of measuring the stroke time of these valves in accordance with the applicable GL 89-04 guidelines and ASME Code requirements. Immediate imposition of ASME Code requirements is not practical since compliance involves the development of unconventional test methods. The licensee's proposal to verify that the valves are stroking quarterly during pump surveillance tests and to perform acoustic type diagnostic testing on a refueling outage frequency should be acceptable on an interim basis.

Based on the determination that immediate compliance with the ASME Code requirements is impractical and considering the licensee's proposal, relief may be granted as requested from Section XI, Paragraphs IWV-3413, -3415, and -3417(b), pursuant to 10 CFR 50.55a(g)(6)(i) for an interim period of one year from the date of issuance of this SE, or the next refueling outage, whichever is later, while the licensee develops a test method that will stroke time

these valves quarterly in accordance with applicable GL 89-04 guidelines and ASME Code requirements.

3.0 CONCLUSION

Valve relief request VR-4 is granted, provided that the subject valves are disassembled and inspected in accordance with Position 2 of GL 89-04. For valve relief request VR-17, relief is granted from the requirements of ASME Section XI, Paragraph IWV-3417(a); interim relief is granted from the requirements of Paragraphs IWV-3413, -3415, and -3417(b) for a period of one year from the date of this SE, or until the next refueling outage, whichever is later. The implementation of the program commitments is subject to inspection by NRC. The Commission concludes that granting these reliefs will not compromise the reasonable assurance of the operational readiness of the valves to perform their safety-related functions. The Commission has determined that granting relief pursuant to 10 CFR 50.55a(a)(3)(ii) and (g)(6)(i) is authorized by law and will not endanger life or property, or the common defense and security and is otherwise in the public interest. In making this determination the staff addressed the hardship of compliance without a compensating increase in safety and the impracticality of performing the required testing considering the burden if the requirements were imposed. The granting of relief is based upon the fulfillment of any commitments made by the licensee in its basis for each relief request and the proposed alternate testing.

Principal Contributor: K. Dempsey

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