

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION  
WASHINGTON, DC 20555-0001

June 18, 2008

NRC INFORMATION NOTICE 2008-11: SERVICE WATER SYSTEM DEGRADATION AT  
BRUNSWICK STEAM ELECTRIC PLANT UNIT 1

**ADDRESSEES**

All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

**PURPOSE**

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of recent service water problems experienced at the Brunswick Steam Electric Plant (Brunswick) Unit 1. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

**DESCRIPTION OF CIRCUMSTANCES**

The licensee at Brunswick Unit 1 recently encountered problems with the service water system, including failure of one of the supply valves to the residual heat removal (RHR) service water system, an RHR service water pump that was rendered inoperable by foreign material, and flow degradation to a safety-related room cooler.

RHR Service Water Supply Valve Failure

On July 26, 2007, the 1B loop RHR service water supply motor-operated butterfly valve failed to open while operators were attempting to place the B loop RHR service water pumps in service. This caused the 1B and 1D RHR service water pumps to trip on low suction pressure. The failure of this 24-inch Fisher Series 7600 butterfly valve was due to the loss of two taper pins used to connect the valve stem to the valve disc. Taper pins are impact-driven into holes in the valve stem and disc and are intended to hold them together through an interference fit. The licensee determined that the most likely cause of the failure was that the taper pins had not been completely driven into the holes during valve refurbishment, which allowed the pins to become displaced during operation.

The licensee had previously reviewed operating experience, including NRC IN 2005-23, "Vibration-Induced Degradation of Butterfly Valves," dated August 1, 2005, which showed that vibration could cause these pins to come loose over time, and had determined that no action was necessary based on different operating conditions, periodic valve inspections, and valve

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assembly conducted in accordance with vendor recommendations. In light of the July 26, 2007, valve failure, licensee corrective actions included welding or staking any service water valve taper pin that was vulnerable to loss (i.e., becoming dislodged and carried downstream). In addition, the licensee revised their valve maintenance procedures to specify staking or welding taper pins on these valves during refurbishment.

#### RHR Service Water Pump Failure

Following identification of the two missing taper pins from the loop B RHR service water supply valve, the licensee attempted to find and retrieve both pins, but could only locate one. The licensee's operability evaluation concluded the system was operable based on their determination that the pin had passed through the RHR service water pumps to the 1B RHR heat exchanger, where it would remain in the heat exchanger's service water inlet endbell. The licensee based this conclusion, in part, on bench testing they conducted which consisted of dropping a spare taper pin through a stationary pump impeller.

On August 21, 2007, the 1D RHR service water pump seized during a start attempt. The licensee's investigation identified that the pump failure was the result of the missing taper pin from the loop B RHR service water supply motor-operated valve becoming lodged between the pump casing and impeller. During their evaluation of the missing taper pin, the licensee had not contacted the vendor to assist in determining whether the taper pin would pass through an operating pump. During subsequent discussions, the vendor indicated that based on the pump's internal clearances, they could not predict if a taper pin would pass through. Licensee corrective actions included replacing the rotating element for the 1D RHR service water pump.

#### Service Water Flow Decrease to RHR Room Cooler

On August 2, 2007, operators identified that service water cooling flow through the 1B RHR room cooler had decreased from a normal value of 380 gallons per minute (1438 liters per minute) to 250 gallons per minute (946 liters per minute). Flow continued to decrease, and the cooler and the B RHR loop were declared inoperable on August 16, 2007. The licensee opened the cooler for inspection and found foreign material in the cooler inlet piping consisting of rubber lining material from a Fisher Model 9100 butterfly valve. Because there was only one valve of this type upstream of the affected cooler, the licensee concluded that all the material came from this valve and had been removed during cooler cleaning. The valve was tagged closed to prevent the release of additional material and an operability evaluation was completed. The licensee's operability evaluation concluded that the service water system was operable but degraded, and that normal system monitoring would be effective at discovering any unrecovered foreign material.

At Brunswick, there have been a number of failures of Fisher Model 9100 butterfly valve rubber liners dating back to 1985 and most recently at Unit 1 in 2004. The valve believed to be the source of the material had not been internally inspected, and the NRC inspectors questioned the licensee's operability conclusion, given the possibility that the foreign material could have come from historical valve lining failures and that additional foreign material from these previous failures could remain in the system. On September 9, 2007, the licensee decided to shut down

Unit 1 to inspect portions of the service water system. This decision was based on the failure of the 1D RHR service water pump and inoperability of the 1B RHR room cooler. The licensee inspected the valve believed to be the source of the foreign material and found that its rubber lining was intact. Additional foreign material, in the form of rubber valve lining, oyster shells, and two pieces of service water strainer tie rod with retaining nuts, was identified during these inspections. The licensee removed the foreign material and completed a subsequent operability determination to demonstrate that the service water system was operable prior to plant restart.

An NRC special inspection team reviewed the circumstances surrounding these issues. The team identified that the service water system problems experienced at Brunswick occurred because the licensee did not take adequate corrective actions to remove foreign material from the system and did not perform an adequate loose parts analysis and operability evaluation once foreign material was identified. Additional information is available in NRC Special Inspection Report 05000324/2007-011 and 05000325/2007-011, dated November 16, 2007, and can be found on the NRC's public website in the Agencywide Documents Access and Management System (ADAMS), under Accession No. ML073200779.

## **BACKGROUND**

### Related NRC Generic Communications

NRC IN 2005-23, "Vibration-Induced Degradation of Butterfly Valves," dated August 1, 2005 (ADAMS Accession No. ML051740299). This IN was written to alert addressees to failure of Fisher butterfly valves in the component cooling water system at San Onofre Nuclear Generating Station. Two of the taper pins used to hold the stem to the disc came loose, preventing valve operation. Similar failures had been reported at Davis-Besse Nuclear Power Station and Turkey Point Nuclear Power Plant with valves manufactured by Flowserve and Henry Pratt Company, respectively.

## **DISCUSSION**

Licensees are required to have an operable service water system as specified in plant technical specifications. The Brunswick Unit 1 service water problems were the result of the loss of two taper pins from a Fisher service water system butterfly valve, historical degradation of Fisher butterfly valve lining material, and failure to adequately assess the impact of foreign material in the system.

## CONTACT

This information notice requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation project manager.

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Note: NRC generic communications may be found on the NRC public Web site, <http://www.nrc.gov>, by going to the Electronic Reading Room and then to Document Collections.

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