

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

February 13, 2006

NRC INFORMATION NOTICE 2006-04: DESIGN DEFICIENCY IN PRESSURIZER
HEATERS FOR PRESSURIZED-WATER
REACTORS

ADDRESSEES

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

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to inform addressees about pressurizer heaters that failed following replacement because the heater elements provided by the vendor did not match the licensees' design specification. 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 information notice are not NRC requirements; therefore, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

During the Fall 2004 refueling outage, the licensee at Palo Verde Generating Station, Unit 3, replaced all 36 pressurizer heaters with replacements supplied by Framatome that had heater internals manufactured by Thermocoax. From December 2004 through February 2005, four of the replaced heaters in the proportional heater banks failed. On May 23, 2005, with Palo Verde Unit 3 in Mode 5 (cold shutdown), the licensee replaced nine Framatome/Thermocoax heaters with General Electric (GE) heaters. During the subsequent reactor heatup, five Framatome/Thermocoax heaters in the backup heater banks failed. As a result of the continued heater failures, the licensee returned to Mode 5 to replace all remaining Framatome/Thermocoax pressurizer heaters with GE heaters. When the Framatome/Thermocoax heaters failed, all were grounded, and all but one tripped a circuit breaker to clear a ground fault. The licensee discovered one heater grounded while maintenance was being performed during the outage. There was no damage to any other equipment such as power cables as a result of the heater failures.

During the Spring 2005 refueling outage, Waterford Steam Electric Station, Unit 3, replaced 29 pressurizer heaters with replacements supplied by Framatome that had the heater internals manufactured by Thermocoax. During plant heatup but prior to reactor startup, two of the replaced heaters experienced partial ejection of the epoxy in the receptacle area due to heat

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transfer to electrical connections in the receptacle area, six experienced failure due to grounding, and several experienced partial melting of the silicon-type material used to seal the bottom end of the receptacles. The licensee replaced 23 Framatome/Thermocoax heaters with Watlow heaters and abandoned the remaining 6 Framatome/Thermocoax heaters in place by electrically disconnecting them. There was no damage to any other equipment such as power cables as a result of the heater failures.

The vendor subsequently inspected the failed heaters from the Palo Verde and Waterford plants and determined that the heaters had been incorrectly fabricated with a longer heating element than the licensees' design specification. The longer heating elements extended down into the heater sleeves and pressurizer shell thereby changing the location of the transition joint that separates the heated and unheated portion of the heater assembly. This resulted in a reduced ability to transfer that heat away from the heater and also allowed more heat transfer to electrical connections in the receptacle area.

DISCUSSION

Technical specifications for PWRs specify a minimum required available capacity of pressurizer heaters to ensure that the RCS pressure can be controlled to maintain subcooled conditions in the RCS. Plant operation with failed pressurizer heaters can affect a facility's ability to control reactor pressure. Following a reactor trip, unnecessary safety injection actuations could occur due to inability to maintain RCS system pressure above the actuation set point.

Additionally, the longer heating elements extended down into the heater sleeves and pressurizer shell resulted the potential to exceed the allowable temperature limits by the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code*.

The Palo Verde and Waterford licensees had each supplied Framatome the correct design specification regarding the location of the transition joint between the heated and unheated portions of the heater assembly. However, Framatome supplied pressurizer heater assemblies that did not match the design specification. The licensees did not obtain vendor specifications and drawings that were sufficiently detailed to allow them to identify that the replacement pressurizer heaters were not consistent with the licensees' design specification.

At Palo Verde Generating Station, Unit 3, one heater was discovered grounded while maintenance was being performed during the outage. Sensitive ground-fault protection on low voltage circuits such as 480 V pressurizer heater circuits, can help in the detection of a ground fault.

Additional information on this subject is available in a Title 10 of the *Code of Federal Regulations* Part 21 (10 CFR Part 21) report from Framatome dated July 28, 2005, which is accessible using NRC's document control system (Agencywide Documents Access and Management System (ADAMS), Accession No. ML052140277).

CONTACTS

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 (NRR) project manager.

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