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

June 23, 1999

NRC INFORMATION NOTICE 99-19: RUPTURE OF THE SHELL SIDE OF A FEEDWATER HEATER AT THE POINT BEACH NUCLEAR PLANT

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the recent rupture of the shell side of a feedwater heater at the Point Beach Nuclear Plant. The reactor was manually tripped because of the steam leak that resulted from the failed heater shell. 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

On May 14, 1999, at 7:13 a.m. (CST), Point Beach Unit 1 was manually tripped from 100-percent power because of a steam leak from the 4B feedwater heater. The steam leak resulted when the shell side of the feedwater heater ruptured. Shortly after the reactor trip, reactor operators manually actuated the safety injection system because of a decreasing pressurizer level. However, no water was injected, and pressurizer level was restored through normal charging. Plant equipment responded appropriately. No one was injured during this event because no personnel were in the vicinity of the ruptured heater. The fish-mouth rupture was approximately 27 inches long and .75 inch at its widest point. The rupture was located adjacent to the extraction steam pipe inlet.

Discussion

The feedwater heaters at Point Beach are low-pressure, horizontal, shell and U-tube heat exchangers. Each heater consists of a hemispherical channelhead welded to the tubesheet, which is then welded to the shell. The heater that failed was manufactured by Struthers Wells, Inc., and was installed in 1984. The heater had operated for 97,000 hours. The channelhead of the heater contains feedwater inlet and outlet nozzles. Extraction steam enters through the top of the shell, where it is deflected by a stainless steel diffuser plate directly under the extraction steam inlet nozzle. The purpose of the diffuser plate is to protect the heater tube

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bundle from the direct impact of the extraction steam. The source of the extraction steam is the discharge nozzles of the high pressure turbine. The moisture/steam mixture from the high pressure turbine passes through a preseparator tank and then into the feedwater heater. The licensee's experience has been that the preseparator tank has not been entirely effective in removing all moisture from the extraction steam. Therefore, the quality of the extraction steam entering the feedwater heater has not been optimal.

When the extraction steam enters the feedwater heater it is deflected by the diffuser plate. The deflected steam impinges on the carbon steel shell of the feedwater heater adjacent to the extraction steam inlet nozzle. The area of steam impingement is the area where the rupture occurred. The thickness of the heater wall in the area of the rupture was determined to be as little as .05 inch (nominal wall thickness is .5 inch). The degraded area extended approximately 4 feet along the length of the feedwater heater. An inspection of the second feedwater heater in the same stage of feedwater heating found similar shell wall degradation; however, no failure was experienced.

The licensee cut out the degraded sections of the feedwater heater and replaced them with 0.625- inch carbon steel plate. Following a recommendation from Struthers Wells, the licensee also removed the six tube bundle guide bars in an attempt to reduce the turbulent flow that may have contributed to the wall thinning. The licensee sent the sections of heater shell that were removed to a materials laboratory for analysis. The licensee's root-cause investigation is continuing. The feedwater heat exchangers at Point Beach Unit 2 were also inspected and no degradation was found.

The licensee stated that the feedwater heaters were not included in any periodic inspection program. As part of their corrective actions, the licensee intends to develop an inspection program for all feedwater heaters at the plant. Similar failures of feedwater heaters had previously occurred at the Dresden Nuclear Power Station in 1983 and as recently as January 18, 1999, at the Susquehanna Steam Electric Station and April 28, 1999, at the Pilgrim Station.

On March 7, 1983, the licensee for Dresden Unit 3 found a steam leak from the shell of the number 3C3 low-pressure feedwater heater near the extraction steam inlet nozzle. The cause of the leak was attributed to erosion of the heater shell by deflected extraction steam.

Nine days before a refueling outage, the licensee for the Pilgrim Station found two holes in one of the low-pressure feedwater heaters at the plant. One of the holes was 0.5 by 1 inch. The other was approximately 1 inch in diameter. The holes were in the heater wall opposite the 24-inch extraction steam inlet.

Similarly, the Susquehanna licensee observed a steam leak from the shell of the Unit 2, number 3C feedwater heater. The shell-side rupture was approximately 0.5 inch by 1.5 inches and was located 90 degrees from the extraction steam inlet pipe and slightly above the center line of the feedwater heater.

The licensees in the above described events did not have in place an inspection program for examining the thickness of the walls of feedwater heaters. Failures of these and similar components can result in undesirable challenges to plant safety systems required for safe shutdown and accident mitigation. Such failures can result in complex challenges to operating staff. Also, injury to, and death of, personnel can result from failures of high energy components or piping.

This information notice requires no specific action or written response. However, recipients are reminded that they are required by 10 CFR 50.65 to take industry-wide operating experience (including information presented in NRC information notices) into consideration, when practical, when setting goals and performing periodic evaluations. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

LBMarsh

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LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

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99-17	Problems Associated with Post-Fire Safe-Shutdown Circuit Analyses	6/3/99	All holders of OL for nuclear power reactors, except those who have permanently ceased operations and have certified that the fuel has been permanently removed from the reactor
99-15	Misapplication of 10 CFR Part 71 Transportation Shipping Cask Licensing Basis to 10 CFR Part 50 Design Basis	5/27/99	All holders of operating licenses or construction permits for nuclear power reactors
99-14	Unanticipated Reactor Water Draindown at Quad Cities Unit 2, Arkansas Nuclear One Unit 2 and Fitzpatrick	5/5/99	All holders of licenses for nuclear power, test, and research reactors
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OL = Operating License
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