

UNITED STATES

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

February 24, 1995

NRC INFORMATION NOTICE 95-11: FAILURE OF CONDENSATE PIPING BECAUSE OF
EROSION/CORROSION AT A FLOW-STRAIGHTENING
DEVICE

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 possible piping failures caused by flow
disturbances that are not accounted for in erosion/corrosion programs. 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 November 29, 1994, the Sequoyah Unit 1 reactor tripped from 100-percent
power. Approximately 3 hours after the plant trip, Tennessee Valley Authority
(TVA, the licensee) observed water pouring from a 16 inch nominal size
diameter condensate line between the 1B4 and 1B3 feedwater heaters. A
licensee investigation found a 180 degree circumferential crack in the reduced
section of a nominal 14 inch pipe. This pipe section was part of a
Westinghouse flow-metering device that had been installed during the first
refueling cycle to test turbine performance.

The metering device consisted of three flanged sections of pipe: the first
section reduced the pipe diameter from 16 inch to 14 inch; the last section
expanded the diameter back to 16 inch; and the middle section contained a
flow-straightening device, a nozzle, and flow taps. The flow straightener
device consisted of three 0.95 cm [0.375 inch] thick, circular plates with
drilled flow holes. The plates were spaced about 0.3 meter [1 foot] apart and
held together by four 1.27 cm [0.5 inch] rods. The first circular plate fit
the pipe flange face and held the fixture in place. The other two plates fit
the machined, inside surface of the 14 inch diameter pipe section.

DOCKETED
USNRC

August 12, 2008 (11:00am)

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

U.S. NUCLEAR REGULATORY COMMISSION

In the Matter of Energy Nuclear Vermont Yankee LLC
Docket No. 50-271 Official Exhibit No. NEC-JH-50
OFFERED by: Applicant/Licensee (Intervenor) NEL
NRC Staff _____ Other _____
IDENTIFIED on 7/23/08 Witness/Panel Hagan/Ed
Action Taken: (ADMITTED) REJECTED WITHDRAWN
Reporter/Clerk MAC

Discussion

TVA found that the pipe failure occurred at the interface of the edge of the middle plate and the inner surface of the pipe wall. The failure resulted from bypass flow around the edge of the plate, which caused very localized erosion along a narrow band, approximately 1.27 cm [0.5 in] wide and 360 degrees around the pipe wall. A 7.6 cm [3 inch] wide, 0.32 cm [0.125 inch] deep machined surface, 360 degrees, on the outer surface of the pipe in the same area of the internal erosion may have contributed to the pipe failure. This surface had been machined to serve as a reference surface and the inner surface was machined to ensure a snug fit of the flow straightener inside the pipe. At the failure area, erosion had further thinned the pipe wall to approximately 0.127 cm [0.05 inch].

The condensate line containing the flow-metering device was in the erosion/corrosion program and modeled with CHECMATE, but it was modeled as a straight 16 inch pipe section without any diameter or thickness change. CHECMATE is a program used by a majority of licensees that predicts erosion/corrosion rates in piping components, ranks the components in order of damage potential, and calculates the time remaining before reaching a user defined acceptable wall thickness. The licensee personnel responsible for operations and engineering were aware that the flow-metering device was installed; however, ambiguities in drawings prompted the personnel responsible for the erosion/corrosion program to assume that these sections had been removed. The pipe configuration had not been visually inspected and it had been modelled as a straight section.

After the pipe failure, the CHECMATE model, including the condensate line with the flow-metering devices, was re-analyzed. The CHECMATE program did not include a model for the flow straightener; the closest model for this device was a straight pipe section. The CHECMATE model would have indicated a high rank for erosion downstream of the nozzle, which would have been modelled as an orifice. Therefore, knowledge that the metering device was installed still may not have prompted an inspection of the area of piping that failed (the area of the flow straightener). Even if the area had been inspected, the band of erosion was so localized that it could have been missed since only grid intersections are inspected.

The licensee determined that the parallel condensate lines still had the temporary metering devices installed and replaced those sections with straight 16 inch sections of pipe. The licensee also determined that the heater drain system had two of these temporary metering sections but decided to leave the lines in service because the flow straighteners had been removed in an outage and present thickness measurements indicated no unacceptable erosion.

The root cause of the failure was the bypass flow around the middle plate of the flow straightener. This bypass flow was not anticipated and the NRC staff is not aware of any previous industry experience that would have demonstrated a need to have the CHECMATE program indicate a high rank for flow straighteners. This example is an indication of how flow disturbances not accounted for by modelling tools can affect the reliability of licensee erosion/corrosion programs..

Related Generic Communications

In NRC Bulletin 87-01, "Thinning of Pipe Walls in Nuclear Power Plants," July 9, 1987, the staff requested licensees and applicants to inform NRC about their programs for monitoring the wall thickness of carbon steel piping.

By NRC Generic Letter (GL) 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning," May 2, 1989, the staff requested licensees and applicants to implement long term erosion/corrosion monitoring programs.

The NRC also issued several information notices on erosion and corrosion.

This information notice requires no specific action or written response. 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.

/s/'d by BKGrimes

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Attachment:

List of Recently Issued NRC Information Notices