



Omaha Public Power District
 444 South 16th Street Mall
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August 12, 1997
 LIC-97-0116

U.S. Nuclear Regulatory Commission
 Attn: Document Control Desk
 Mail Station P1-137
 Washington, D.C. 20555-0001

- References:
1. Docket No. 50-285
 2. LER-97-003 Manual Reactor Trip Due to a Steam Line Rupture
 3. Letter from OPPD (S. K. Gambhir) to NRC (Document Control Desk), dated June 4, 1997 (LIC-97-0087)

SUBJECT: Failure analyses of the ruptured elbow from the Extraction Steam Line Rupture of April 21, 1997

As committed in the May 5, 1997 Public Meeting, please find enclosed the failure analyses of the ruptured elbow completed in response to the extraction steam line rupture of April 21, 1997.

Two failure analysis reports have been issued. The first report, Enclosure 1, is the "Failure Investigation of the Fourth Stage Extraction Steam Line Rupture, Altran Corporation, Technical Report No. 97152-TR-01 Revision 0," and the second report, Enclosure 2, is the "Root Cause Evaluation of Fourth Stage Extraction Elbow, April 1997 at Ft. Calhoun Station, FPI Report FPI-97-905." Both of these reports support the preliminary conclusion that pipe wall thinning resulting from Flow Accelerated Corrosion (FAC) and water droplet/wet steam impingement erosion led to the failure. The information in these failure analysis reports provides the required documentation to address the physical cause of the rupture, and substantiate the "Apparent Root Cause" (i.e., FAC) that was stated in the Root Cause Analysis (RCA). Therefore, the RCA together with Enclosures 1 and 2 address the physical causes of the pipe rupture.

The RCA previously docketed in Reference 3, was issued prior to the completion of the failure analyses of the ruptured piping. This RCA provided a preliminary discussion of the apparent physical cause of the rupture, and indicated that a failure analysis would further analyze the physical cause of the rupture. The RCA identified FAC as an "Apparent Root Cause" of the event. Therefore, OPPD has reviewed the failure analyses and determined the results do not affect the previously identified causes in the RCA. In addition, a significant piece of maintenance history information has been located that was not addressed in the RCA. Specifically, Elbow S-28 in the fourth stage extraction steam line was replaced in 1985. This replacement was not reflected in modeling of this line. This elbow is a "long-radius" elbow,

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which has a shorter radius than the "sweep" elbow that failed (i.e., Elbow S-25).

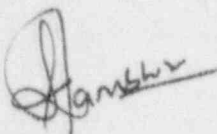
While the fact that Elbow S-28 was replaced was not recognized or discussed in the RCA, the event causes identified in the RCA are applicable. Specifically, as indicated in the RCA, it had been judged that the longer radius "sweep" elbows would have lower wear rates than shorter-radius elbows that had been inspected. Industry experience and information from the CHECWORKS model were consistent with the judgement that shorter-radius elbows generally experience higher wear rates than longer-radius elbows exposed to similar conditions. EPRI's CHECWORKS analytical model indicates that a "sweep" elbow (elbow bend radius = 5.0 D) is predicted to experience about a 30% lower rate of erosion/corrosion than a comparable "long-radius" elbow (elbow bend radius = 1.5 D) subjected to similar conditions. The apparent low rate of wear on Elbow S-28 (based on an inspection performed in 1987) was therefore taken as an indication that the "sweep" elbows in the line should be acceptable.

Since Elbow S-28 had been replaced in 1985 due to erosion FAC damage, the 1987 inspection data reflected wear that had occurred in less than 2 years, rather than wear over a period of about 14 years. All four of the 90 degree elbows and one "sweep" elbow in the fourth stage extraction steam line had been replaced between 1985 and 1990, leaving "sweep" elbows as the only remaining original 90 degree elbows in the line. The failure of "sweep" Elbow S-25 initially appeared anomalous when compared to the apparent low wear rate of Elbow S-28. Realization that Elbow S-28 had been replaced in 1985 would have enhanced the ability to predict potentially significant wear in the three remaining original 90 degree "sweep" elbows in the line. Knowledge of this information would likely have led to more aggressive inspections being performed on the fourth stage extraction steam line. This particularly emphasizes the applicability of RCA Contributing Cause 5.5, "Incomplete utilization of plant history data." As a result, Cause 5.5 is now considered to be a Root Cause, and Cause 5.2, "Over-reliance on elbow radius as a predictor of relative wear rate, with insufficient consideration of plant history and industry guidance," is now considered to be a Contributing Cause.

In summary, the two failure analysis reports and information regarding the replacement of Elbow S-28 have been reviewed against the RCA for the extraction steam line rupture. The "Apparent Root Cause" of FAC identified in the RCA is considered to be validated by the failure analysis reports.

Please contact me if you have any questions,

Sincerely,



S. K. Gambhir
Division Manager
Engineering and Operations Support

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- Enclosures
1. Failure Investigation of the Fourth Stage Extraction Steam Line Rupture, Altran Corporation, Technical Report No. 97152-TR-01 Revision 0
 2. Root Cause Evaluation of Fourth Stage Extraction Elbow at Ft. Calhoun Station, FPI Report 97-905, April 1997

SKG/ddd

c: Winston & Strawn
E. W. Merschhoff, NRC Regional Administrator, Region IV
L. R. Wharton, NRC Project Manager
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