TU ELECTRIC

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Group Vice President

January 7, 1993

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES) - UNIT 2
DOCKET NO. 50-446
CRACKS IN THE CONTAINMENT SPRAY SYSTEM
SDAR: CP-92-010 (SUPPLEMENTAL REPORT)
SDAR: CP-92-020 (FINAL REPORT)

REF: 1) TU Electric letter to the NRC dated October 30, 1992 logged TXX-92509 (SDAR CP-92-010)
2) TU Electric letter to the NRC dated January 4, 1993 logged TXX-92636 (SDAR CP-92-020)

Gentlemen:

On July 22, 1992, via facsimile, TU Electric notified the NRC of a reportable defect in two welds on 3/4" containment spray pump suction vent piping. The evaluation was designated SDAR CP-92-010, and Reference 1 contains the final report.

On December 4, 1992, via facsimile, TU Electric notified the NRC of a reportable defect involving a 90 degree circumferential crack found in the base metal along the toe of a weld in the chemical eductor portion of the containment spray system. The evaluation was designated SDAR CP-92-020, and an interim report was submitted on January 4, 1993 (Reference 2).

Two additional cracks were discovered during investigations on November 17 and December 8, 1992.

In all, five TUE Forms (non-conformance reports) have been generated to document these cracks in welds and base metal. Because of the significance and repetitive nature of these deficiencies, TU Electric conducted a Root Cause Analysis in accordance with established site procedures.

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This letter serves as a supplemental report for SDAR CP-92-010; a final report for SDAR CP-92-020, satisfying the reporting requirements of 10CFR50.55(e); and, provides the results of the analysis of all five deficiencies as Attachment 1.

Sincerely,

William J. Cahill, Jr.

By: JS Marshall
J. S. Marshall
Generic Licensing Manager

CBC/grp
Attachment

c - Mr. J. L. Milhoan, Region IV
Mr. B. E. Holian, NRR
Resident Inspectors, CPSES (2)

Deficiency Identification

All of the deficiencies were identified in the Containment Spray System. The first crack which developed on this system (on June 14, 1992) was documented in TUE 92-5473. This crack occurred on a 3/4" diameter branch line weld off loop 3 while the loop was undergoing flushing prior to Hot Functional Testing (HFT). The defective weld and two adjacent piping sections were cut out, replaced, and forwarded to Engineering for review.

A second through-wall crack developed six days later, on June 20, 1992, on the same branch line. This crack, documented in TUE 92-5529, was a weld metal crack approximately 1" long at the sock-o-let (SOL) weld of the 3/4" branch line to the main header. The disposition of this TUE was the same as the previous one.

The deficient welds and piping sections were sent to a metallurgical laboratory for failure analysis. The lab issued a report dated August 11, 1992, which concluded that the cracks propagated due to vibration induced fatigue. This was not an unexpected conclusion since visual observations of the system in operation confirmed that there was significant vibration at a number of locations

No further incidents of this type occurred prior to or during HFT. During preoperational vibration testing on October 9, 1992, a circumferential crack developed on the 2" diameter eductor line on loop 4, as documented in TUE 92-6536. This particular line was not in formal preoperational testing at the time the crack developed, but the pump on loop 4 was running. The damaged sections of piping were replaced and the parts were forwarded to Engineering for evaluation. Metallurgical evaluation at the laboratory was also performed on this specimen. Engineering, using the lab report as input, issued their investigation report on November 11, 1992, which concluded:

o The crack in the eductor line was caused by excessive steady state vibration.

o The pump is the (primary) source of vibration.

o An added temporary tie-back support brought the vibration levels within allowable limits.

o Vibration prior to installation of the tie-back support did not cause any fatigue damage to the remaining piping.

o The steady state vibration testing program would have identified and corrected the excessive vibration during the normal course of pre-operational testing, in accordance with the Project procedures.

Prior to proceeding further with system testing, Engineering implemented two additional steps. First, a tie-back support was designed and issued at each of the two locations where the previous failures occurred. These tie-back supports would help to keep the branch piping in-phase with the header piping and thus not allow the vibration to amplify. Secondly, Engineering identified locations on all four loops which were susceptible to severe vibration. Accelerometers were placed on these lines and vibration levels which exceeded published allowable limits were reported to engineering. The accepted industry allowable velocity is 0.5 inches per second (ips) based on guidance in ANSI/ASME OM3 - 1982, "Requirements for Preoperational and Initial Start-up Testing of Nuclear Power Plant Piping Systems." This same allowable value also appears in site procedure 2PP-5.23, "Piping Vibration Test Guidelines." Based on these steps Engineering concluded that system configuration was adequate to begin the Integrated Testing Sequence (ITS).

During preoperational vibration testing and ITS, instrumented vibration data was collected and forwarded to Engineering whenever the velocity acceptance criterion of 0.5 ips was exceeded. Engineering performed a more detailed analysis for these cases and established higher acceptable velocities on a case-by-case basis. Near the end of ITS, on November 17, 1992, a through-wall crack developed in a SOL weld of a 3/4" branch connection to a main header on loop 1. This crack, documented in TUE 92-6856, was also repaired and the damaged parts were forwarded to Engineering for evaluation. Because of the frequency of occurrence and the similarity of conditions (i.e., system in a testing mode, high vibration present, locations at or near SOLs in branch piping, stainless steel piping), a programmatic/repetitive TUE form was initiated.

On December 8, 1992, a through-wall hole developed in the tubing just downstream of the root valve off the 3/4" SOL branch connection on loop 1 (described above). This hole was created by rubbing of the tubing inside a supporting clamp due to severe vibration. This incident reinforced the previous conclusions that fatigue due to high frequency vibration was a problem in the system and that actions were warranted to improve system performance.

Conclusions and Root Cause Identification

Each of the five piping or weld failures was caused by fatigue due to high frequency vibration of the piping system. Based on review of system and vibration data, it was concluded that the dominant contributor to the overall system vibration was the pump Vane Passing Interference (VPI) frequency of 120 Hz. The following contributing factors were noted:

1. Unsupported branch lines, whose out-of-phase motion tends to amplify the effect of the vibration, also contributed.

2. The 100 hour cumulative run time of the pumps, which is a requirement for system testing, introduces over 43 million cycles to the system. Thus, there is a significant accumulation of effect due to high frequency vibration.

Generic Implications

Since the cracks which developed were a result of fatigue induced by high frequency vibration, all susceptible configurations which experienced this type of vibration were examined. Susceptible configurations were identified as small bore socket-welded branch connections on stainless steel piping systems. The entire population of these configurations was found by reviewing all problem reports in which measured piping velocity exceeded 0.5 ips. Nine such configurations were identified.

Corrective Action

The nine unacceptable configurations identified in Unit 2 have been modified to preclude excessive vibration.

A large number of cycles have been introduced into the system. Since pre-operational and startup testing of the CT system is essentially complete, there will not be a significant number of additional new cycles added due to quarterly tests, etc. Since all susceptible connections have been strengthened, the accumulation of fatigue in these connections will be very slow. Therefore, no further actions are planned.