C32 When Stronger is Weaker: A Dynamic Failure of an 8-Inch Natural Gas Transmission Line Coupling System

James F. Lane, MS, Applied Technical Services, Inc., 1190 Atlanta Industrial Drive, Marietta, GA 30066*

The goal of this presentation is to both inform and instruct the attendee about the potential hazards of unknowingly bypassing or disabling the proper operating mechanisms of a designed component.

As forensic investigators, participants invariably encounter situations where installers, maintenance personnel and/or end users have made improvements to mechanical systems that have unwittingly created dangerous situations. This presentation will impact the forensic community and/or humanity by providing a concrete example of how well intentioned installation personnel created a potentially deadly condition by providing external reinforcement that prevented the engineer-designed mechanism from properly seating.

The intent of this presentation is to both inform and instruct the attendee about the potential hazards of unknowingly bypassing or disabling the proper operating mechanisms of a designed component. As forensic investigators, participants invariably encounter situations where installers, maintenance personnel and/or end users have made *improvements* to mechanical systems that have unwittingly created dangerous situations. The case outlined in this presentation will provide a concrete example of how well intentioned installation personnel created a potentially deadly condition by providing external reinforcement that prevented the engineerdesigned mechanism from properly seating.

When natural gas transmission lines are moved or bypassed, the original line is generally left in place, but closed off to gas flow. Often times, the original line is partially removed, with a short stub section remaining at both ends of the transition from the old to the new. When this is accomplished, the short stub sections have to be capped. Traditionally, the end cap has been welded to the stub section, requiring significant installation time and manpower. Recently, within the past 10 to 15 years, a coupling device that utilizes a mechanical gripping mechanism has been introduced to the industry, which greatly reduces the manpower and manhours necessary to achieve capping.

One such device was installed on an 8-inch natural gas transmission line, operating at approximately 300 psi, used to service the inhabitants of two affluent island communities. The installation of the coupling devices was made when the line was moved from beneath the accessing street to underneath the sidewalk area. A catastrophic failure of one of the installed couplings occurred on the Friday of a holiday weekend during the late fall, excavating a large crater in the center of the street and cutting off gas service to both islands.

A complete metallurgical analysis was performed on both the coupling and pipe sections. The results of the analysis indicated that both the materials of construction and the fabrication were in accordance with the manufacturer's design requirements. Anomalistic features associated with the gripping mechanism within the coupling were inconsistent with anticipated results. Thus, mechanical and full-scale testing of the devices was conducted.

A systematic series of statically loaded tests and experiments yielded data that was not consistent with the observed findings in the failed coupling. The discrepancy in data led to the performance of dynamic full-scale testing. The results of the dynamic loading indicated that the use of external reinforcement of the coupling prevented proper seating of the gripping mechanism. When the external support failed, the sudden application of load associated with the 300-psi line pressure did not allow sufficient time for the gripping mechanism to seat, propelling the end cap and coupling off the end of the short stub section. The cavity created under the road quickly filled with gas until the asphalt failed and a large crater was formed in the middle of the street.

Immediate memoranda, followed by additional training, were provided to the installation crews. The use of external reinforcement was explicitly forbidden, and similar conditions at other locations were excavated and repaired to prevent additional incidents.

Metallurgical Failure Analysis, Natural Gas Transmission Line, Explosion

 ** Presenting Author*