MODELING LEAKAGE IN A FUEL TRANSFER PIPELINE USING COMPUTATIONAL FLUID DYNAMICS TECHNIQUES

Chris Alexander - Stress Engineering Services, Inc.
Harbi Pordal - Stress Engineering Services, Inc.

Proceedings of PVP2005
2005 ASME Pressure Vessels and Piping Division Conference
July 17-21, 2005, Denver, Colorado USA

ABSTRACT

Stress Engineering Services, Inc. (SES) performed an assessment of leaks for an insurance company that occurred in a fuel transfer pipeline at a tank storage facility. Of specific interest were the duration and timing of the leaks, which occurred from a 30 foot section that entered an earthen containment berm. It was originally estimated that 28,900 gallons of gasoline and ethanol leaked periodically from two (2) pin holes in the pipeline during a two month period.

Early analysis efforts were not able to estimate the conditions that were necessary to cause the leaking fluid to break through the surface of the earthen berm (a phenomenon known as *daylighting*). Consequently, SES performed a more rigorous investigation to determine what conditions were required to produce daylighting, the significance of which involved quantifying the estimates of leak duration and the petroleum volumes.

This effort integrated assumptions and data from prior analyses to assess the effects of time-dependency using computational fluid dynamics (CFD) modeling techniques. The intent was to take the existing calculations and provide a more technically-defensible model to predict the timing and volume released using reasonable conditions. SES used soil permeability and actual pipe pressure data to simulate the pipeline leak and soil conditions. The results of the CFD analysis showed that it is possible for daylighting to occur within a two-month period. However, a specific combination of conditions associated with leak rates, leak duration, and soil permeability are required to generate daylighting in a relatively short period of time. The predominant observation is that there must be extended periods of continuous leaking involving leak rates of sufficient magnitude.

The significance of this work is that it presents a proven analytical method for modeling leaks in pipelines and addressing the effects of specific variables on the amount of released products and the time required to achieve specific leak volumes.

Alexander, C.R., Pordal, H., (July 2005), "Modeling Leakage In A Fuel Transfer Pipeline Using Computational Fluid Dynamics Techniques," 2005 ASME Pressure Vessels and Piping Division Conference, July 17-21, 2005, Denver, Colorado.