Dependable water delivery pipe system crucial to protecting U.S. nuclear weapons stockpile from fire

AMARILLO, Texas – The high-pressure fire loop system engineer is responsible for maintaining the water supply for fire suppression at the U.S. Department of Energy/National Nuclear Security Administration's Pantex Plant near Amarillo, Texas.

And because Pantex is responsible for maintaining the nation's nuclear weapons stockpile, that particular engineer becomes a pretty important person. Failures to the piping system that carries the water used to extinguish a fire in such a facility are unacceptable.

Over time, a pattern of such failures was occurring, said Melvin Suttle, the high pressure fire loop system engineer at BWXT Pantex, the management and operating contractor at the plant. The plant operates under the highest levels of safety and security and requires a dependable piping system.

Suttle was reporting pipe breaks due to corrosion of the cast and ductile iron system; a system that was first installed in the late 1940s. The 79,000-foot long high-pressure fire loop is a dedicated water distribution system feeding fire suppression systems and fire hydrants. A break in the distribution pipe can seriously compromise the fire suppression system function.

So Suttle decided to change the way things had been done in the past. He discovered the benefits of smooth wall high-density polyethylene (HDPE) pipe for industrial water applications. In August of 2001, he purchased 60 feet of pipe — three 20-foot lengths — as a test case for Pantex.

This initial HDPE use was for an extension of the system that required 5,000 gallons per minute capacity and 40 pounds of residual pressure. "We had several design options, however, HDPE offered solutions to all the issues," Suttle said.

"Back then, the product was brand new to us," Suttle said. "It's performing very well. And knowing what I know about HDPE pipe now, I'm sure that we'll never have to see that 60-foot section of pipe again."

Today, Pantex has about 3,900 feet of HDPE installed for the high-pressure fire loop. A couple of thousand additional feet of small diameter (2-to 4-inch) pipe is used on the natural gas distribution system but it does not share the safety-class scrutiny of the fire loop and did not require qualification. Pantex has a phased plan to replace 50,000 more feet of the fire loop with HDPE pipe — preliminary drawings for the next phase were reviewed in September 2004.

Getting approval for HDPE

Suttle expands on the steps and hurdles that were involved to get approvals to change to the HDPE.

"My impression is that HDPE pipe was viewed by some site engineers (both BWXT and the DOE) as low quality material to be used for temporary service," Suttle said. "I worked with my management to have vendor demonstrations on site. This was no small task due to site security. I also collected all the vendor data I could find using the Internet

extensively, conducted visits to municipalities and observed PVC, iron and steel installations, and talked to several installers."

He said the high-pressure fire loop is termed a "safety-class" system, meaning the configuration of the pipe, valves, pumps, etc., are governed under a management process. "This configuration management process is defined by our operating permit, known as the Authorization Basis," Suttle said. "This is a high level agreement between BWXT and the U.S. Department of Energy for operation of the site.

"Any proposed changes to the high-pressure fire loop must be defined, described and proven to meet the operating requirements of the system," he continued. "This process, known as a design change proposal, is reviewed by numerous groups each with the privilege of challenging the rationale, including the Department of Energy."

A DOE engineer did object to the use of HDPE pipe before Suttle proved that the material was listed in the NFPA Standard (24). Suttle reports that the DOE engineer is now fully supportive of using HDPE pipe.

Broadening the market

Rich Gottwald, president of the Plastics Pipe Institute, reports that municipal and industrial applications for HDPE pipe are trending up.

"We're seeing other applications taking the lead of the natural gas industry," Gottwald said. "More than 90 percent of our country's natural gas distribution lines are made of polyethylene pipe. What engineers and contractors are realizing is that if PE pipe is safe and reliable enough to carry natural gas, it certainly is also for water."

System engineers like Suttle are touting the fusion process for HDPE water pipe. When two sections of HDPE pipe are butt fused using heat, the resulting pipe joint actually becomes as strong as the pipe itself. The result is a virtually leak-free system. And because polyethylene is a nonconductor, the material is physically unable to corrode.

Passing the environmental test

Using those first 60 feet of HDPE pipe as a test case three years ago convinced Suttle and his colleagues to continue to use HDPE pipe at BWXT Pantex. The most satisfying part was making the case for HDPE as the environmentally-positive choice, Suttle said.

He said that was the sticking point with the initial designs, due primarily to the risk of contaminants leaching into the water supply. HDPE is also ideally suited to horizontal directional drilling installation (HDD), which was an additional job requirement. The original 18-inch HDPE pipe was installed under two railroad tracks, a roadway, and a security corridor using HDD.

"I documented that first project as much as I possibly could," Suttle said. "I visually inspected every piece of pipe personally and every fused joint to everyone's satisfaction."

The result was a system that delivered the required capacity with 46 pounds of residual pressure.