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WORLD PIPELINES

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Lining up

United Pipeline Systems explains how the application of an HDPE liner helped to solve a persistent internal corrosion problem on a crude oil pipeline.

Figure 1. Tite Liner® installation.

Valero Energy Corp. knew it had a problem inside a decades-old crude oil pipeline operation in Perryton, Texas, USA.

Texas Gathering System, which Valero acquired through a merger in 2001, had been plagued with repair expenses since the 1960s. Just six years after construction, microbiological internal corrosion forced the replacement of 5000 ft of pipe. Then in 1971, another 15 000 ft was replaced. By the mid 1980s, more than 40 000 ft had been redone. During these maintenance periods, the pipeline had to be derated to prevent future leaks and maintenance questions, causing a decrease in production and an increase in expense. In 1992 and 1994, Texas Gathering System performed smart pigging operations, as it had done years before, and even substituted old pipe with epoxy coated pipe. But the corrosion problems did not cease; they merely moved farther downstream.

It was clear to Valero Energy that a permanent repair for the pipeline was critical, not only in a business

sense but in an ecological sense, too. Valero was committed to protecting the environment at each of the sites where it had operations, and the Perryton, Texas, site would be no different. Fixes of the past would no longer suffice.

The total solution

Technology employed by United Pipeline Systems (United) of Durango, Colorado, USA, ultimately helped Valero turn an inherited maintenance and environmental problem into an issue of the past.

To provide a long term solution for mitigating the internal corrosion, Valero chose an internal high density polyethylene (HDPE) lining for the pipeline. Although not a new technology, this was a first for Valero. It contracted with United to supply and install the HDPE liner. The company has been installing its proprietary Tite Liner® System since 1985, and has enjoyed a notable track record in rehabilitating pipelines.

The process brought with it several benefits. The HDPE liner provided a corrosion barrier with an estimated lifetime of over 50 years. The structural integrity of the liner enabled it to bridge internal corrosion issues in the pipeline, thus enabling Valero to operate the pipeline at full operating pressure. The liner caused a small reduction in internal diameter, but because of its low friction characteristics, the liner actually reduced the operating pressure of the pipeline. Because the system is a trenchless technology, excavations were only required every 2000 - 3000 ft. The process was economical and required minimal downtime for the pipeline.

The process

The Tite Liner® system utilises an HDPE liner that is inserted into carbon steel pipelines. The liner is custom extruded to be slightly larger than the inside diameter of the steel pipe. The process relies on a roller reduction box to reduce the liner to a diameter smaller than that of the inside of the steel pipe. United then uses a winch truck (wireline unit) to pull the liner through the roller reduction box and into the pipe itself. The elastic nature of the material causes it to expand tight against the pipe. Long pipeline projects, such as this one, are divided into sections to be lined and then flanged on both ends. After the liner is installed, HDPE flanges are attached to the ends of the liner, covering the steel flanges, and the pipeline is then bolted together. Once all the sections are combined, the resulting pipeline has a continuous pipe/liner that will protect the steel pipeline from internal corrosion.

Figure 2. Installation through roller reduction box.

Figure 3. Steel spacer ring for flange connection.

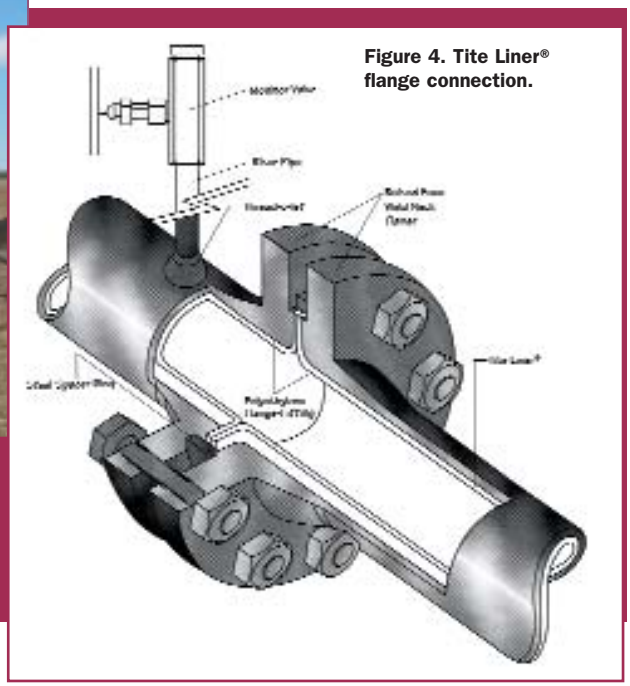

Figure 4. Tite Liner® flange connection.

The project

The main concern for the rehabilitation of the line was the length of time the system would be out of service. This was a primary production trunkline for Valero, and downtime would result in lost revenue. It was determined that the crude oil would have to be trucked during the installation process, so the contractor was told to minimise downtime.

The project was divided into six working crews: excavation; welding; HDPE fusion; installation; flanging/bolt-up; and cleanup. The installation process required that the pipeline be divided into section lengths to be lined, averaging approximately 2400 ft per section. The excavation and HDPE fusion crews started before the pipeline shutdown. Each excavation exposed approximately 80 ft of the pipeline, and a new excavation would continue down the pipeline ROW for the next section. Certain sections were shortened or lengthened to accommodate landowner or rough terrain issues. The fusion crews fused the liner into section lengths equal to the sections to be lined. Once the excavation crews and fusion crews were well ahead, the pipeline was shutdown and pigged of all crude oil with nitrogen.

Trucks were set up to transport the crude from one end of the pipeline to the other. The welding crew then cut and welded steel flanges into the pipeline, making way for the installation crew. The installation crew consisted of the wireline unit on one end of the section to be lined and the roller reduction box on the other end. This crew would work its way down the pipeline, pulling section after section of liner into the pipeline. After the liner was installed, it was allowed to relax and grow tight overnight, permitting the flanging/bolt up crew to complete the Tite Liner® System. The flanging/bolt-up crew installed the HDPE flanges or stubends at each end, and the steel flanges were then bolted together. Next, the lined sections were air tested to verify the integrity of the liner. This process was repeated for each section until the pipeline was fully lined. The installation process averaged approximately 1.2 miles per day, with as much as two miles completed in a single day, resulting in minimal shutdown time. Upon completion of the lining, the cleanup crew followed and backfilled the excavations, mended fences and cleaned up the light impact on the right of way. With the lining complete, the pipeline was placed back in service for the transportation of crude oil.

The system provides a continuous HDPE liner that protects the pipeline from all internal corrosive elements. It also reduces the friction and operating pressures in the pipeline and provides a substantial cost savings compared to replacement. The system provides the capability of bridging internal corrosion anomalies, preventing future leaks that would have been associated with the continued operation of the system.

The benefits

This project identified several key advantages for Valero, the primary being protection of the environment and the reduction of risk associated with the leaking pipeline. Prior to lining the pipeline, each leak would have delivered unknown environmental and production impact: two areas where Valero was unwilling to compromise.

According to a representative from Valero, the technology allowed Valero to achieve its environmental and safety objectives. Since the new liner's installation, the operation has experienced no recurrence of corrosion.

The Tite Liner® is also able to monitor the integrity of the liners after installation. It utilises a port in the pipeline that can report on the liner at each flange location. If the liner were to have a leak, the production fluid would migrate to the monitoring point and could be checked at the valve. A regular maintenance schedule ensures that the liner is functioning properly, and that leaks, if any, are discovered before they can harm the environment.

Conclusion

Since 1996, Valero (with refining, marketing and pipeline operations throughout the USA, Canada and the Caribbean) has utilised the Tite Liner® on five different projects totalling over 100 miles. On the first project, it invested a substantial amount of money on smart pigging and spot repair prior to installing the HDPE liner. For the next four projects, and with notable results, it was decided that skipping the 'investigation and upgrade' stage and proceeding straight to the 'total solution' was a smarter and more economical choice. The system stopped the corrosion, provided a structural solution to the internal corrosion problem and allowed for future monitoring of the integrity of the pipeline. The company is now reviewing future options in lining the remainder of the system in 2005.