Old before their time

Cal Chapman, P. E., Chapman Engineering, Inc., USA, asks: who really wants to install a liability?

Chapman Engineering, Inc. works on pipelines and other industry assets that are sometimes 70 years old, maybe older. The company also works on some assets – be they related to oil and gas, petrochemical production, water and wastewater, transportation or even the electric utility industry – that are historically young, but appear so 'aged'. Just in the last seven years, these asset examples have become old before their time.

Gathering pipeline

Oil gathering pipelines in a Texas (USA) shale region were hustled into the ground with terrible 'in the field' coating work, and no cathodic protection (CP) was applied until 30 months later (Figure 1). How was trouble identified? Three liquid product leaks were found in a local river crossing area within a 45 day span, with threat of environmental consequences. Alignment sheets generally showed reasonable materials specified, bored crossings of roads and creeks laid out well in design documents. Construction inspectors had been on the pipeline installation work full time. Chapman Engineering, Inc. reviewed files of inspection worksheets, photos etc., but none of the problems were documented. Evaluation, based in part on the company's field work, strongly suggested that company representatives, the contract inspectors and pipeline contractor were all motivated to simply hurry up and get product flowing through the line. In 2011, everybody thought this field might pay back for 10 - 15 years. The industry now knows the shale play is likely to give 25 - 35 years of production. But the pipelines had grave issues at two years and onwards.

Transmission pipeline

A major oil and gas transmission pipeline company had a new, large diameter pipeline designed by reputable engineering group. Right-of-way was acquired and the pipeline was constructed with a budget of hundreds of millions of dollars. Before this line could be commissioned to flow product, several points failed under a hydrotest and the high voltage alternating current power line interaction with the pipeline was identified as a major issue. This was completely missed during design work. The pipeline had to be replaced or rehabilitated for many miles of length before any product ever flowed or any income was realised.

International pipeline

A 200 mile long pipeline was constructed of pipe that was purchased 8000 miles away, shipped that long distance and transferred several times during transit by methods that damaged external coatings. Once in the field, the pipe was then treated by field bending at certain positions, with the bending carried out by inexperienced contractors using substandard methods. The pipeline coating was damaged severely in hundreds of locations. Field inspection during construction failed to catch and properly remediate these issues. With the pipeline backfilled and offered for commissioning, the CP requirement was found to be 75 times greater than design estimates. The reason for this was because resultant coating quality on the entire pipeline length was greatly compromised. This set of concerns led to months of discussion and disagreement among the pipeline owner, its engineering design group and the contractor. Final decision? All decided to only install the CP called out in the original design, and then monitor going forward. This choice was probably made because no one wanted to shine light on the significantly changed economics for the capital project costs. Long-term, this pipeline is at much greater risk for external corrosion, at many locations. It also has significant integrity risks now in place, both from stresses introduced by the field bending processes used and by external corrosion. It is true, too, that corrosion may occur even more rapidly in high stress regions of the pipe.

Figure 1. A 0.3 in. wall, 6 in. elbow with field coating. Pits were not evident until the removal of never-adhered (but intact) field-applied coating in the shop; corrosion product still partially fills both pits, one of which was 0.24 in. deep (80% wall loss). Note that coating had not cured before backfilling began. A through-wall external corrosion pit was found several inches to the right, at a girth weld.

Asset example outcomes

What does one conclude from this review? Each case involves installation of an asset, certainly. In every case, the asset owner/operator created a project plan, a budget and a desired service life. But what actual cost was incurred, and what useful life was really purchased and installed? Worse yet, what risks were worsened and future costs 'built in'? In every one of these matters, the predicted capital economics and financial operating plan for each asset were changed for the worse, thanks to design choices or omissions, poor contractor experience and construction methods, poor construction inspection and generally poor project management.

The result? Liabilities got installed. Yes, there is an asset that has been constructed. But it is compromised from day one and the risk of failure is much greater. The new structure suffers from premature old age, with terrible effect on the service life. On top of all that, the costs to operate the asset are much larger, because of remediation needs early in the service life. What happens when failures occur? Public and personnel safety threats are real and visible. Environmental responses may be needed with significant costs and, again, visible consequences. Public relations 'negatives' are almost always involved, along with the threat of legal actions. Every failure causes reduction in company profitability/return on capital. Admittedly, these risks are always present. But how are they escalated when poor quality work is performed and accepted?

Certainly, there are different perspectives for creating a new physical asset, depending on the owner and industry. A crude oil or gas transmission pipeline company, a natural gas distribution company or an electric utility building transmission towers out of steel structures, for instance, will probably design for a service window of 50 years, and possibly longer. This should mean that all the design, construction and inspection work is done more deliberately and with good quality achieved. Obviously, that is also the outcome desired by a corporation's board and its shareholders/investors.

Contrast this with an oil and gas production company's new onshore or offshore lease area. The well field is making product, or will soon be. The new network of pipelines and facilities is needed as soon as possible. Yes, it gets designed, but for what service life? Does the company's process pay attention to qualifications and experience of the design engineering company and their on-staff project managers available now? Does this operating company choose a thinner pipe wall? Does it choose a less expensive steel type for the line? Does it scrimp on the quality of other equipment and materials to make overall project economics look more desirable? Is a low bid approach used for hiring the contractor bringing on contract inspectors? How about qualifications and experience of the contractor or inspection group? Always taking the low bidder, without screening of qualifications and experience, is a risk-increasing approach.

Conclusion

What are the lessons to be learned? First, integrity management of the asset(s) really starts before the assets are built. A project must be designed and managed using technically sound judgment with good co-operation among financial planners, the internal engineering group and the contracted design engineers. Once the design package is built and vetted, contractors and material providers along with their products should be heavily screened before they are chosen. To know that quality work will be done, assure that these vendors have consistently provided quality in the past before they are brought into the new project.

Field inspection is prescribed by job specifications and, in some ways, by state and federal law and rule. Assure that inspection work is done not just to meet specifications, but to clearly meet integrity requirements, long-term. An experienced and qualified inspector, when reviewing work done by an experienced and qualified welder, is probably going to drive the processes to a result – an asset – that can last 50 years.

Should the project be done right the first time? That is the desired outcome. But the following is also heard: 'if you cannot do it right the first time, you had better get it right the second time'. And what happens to the person or the team who did not get it right the first time?

Chapman Engineering, Inc. wonders too about the pride and professionalism that, most would think, should be put into these projects. As the President of Chapman Engineering, Inc., there are some physical monuments to which I can point, in which I've had a small hand. So, these physical assets represent legacy and pieces of the world that are in better shape now than when I arrived. Is this a motivating factor for good work to be done? I certainly hope so.

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Company Profile

Chapman Engineering, Inc., a Texas USA corporation founded in 1989, offers corrosion control and engineering, environmental engineering, subsurface environmental assessment and corrective action, ground-water availability studies, and specialty construction and survey related to corrosion control. Starting in underground fuel storage tank (UST) release detection and cathodic protection of steel USTs, Chapman Engineering has worked in the corrosion protection marketplace since the mid-1990s. It designs, constructs and manages cathodic protection systems for water, sewer and
electrical utilities and infrastructure, oil and gas production and transportation systems, and refining/petrochemical complexes.
The firm's multifaceted engineering team has over three decades of experience in corrosion control design, installation of cathodic protection (CP), coating quality and AC power interaction evaluations with pipelines, and review of existing asset integrity, as well as CP system commissioning,
testing and optimizing across the industries. Our team has a proven track record of effectively mitigating the corrosion risk for steel, ductile iron, concrete pressure pipe, storage tanks, and other metal assets across North America.