Swagelining Renews Potable Water Transmission Lines

By Daniel F. Moore, P.E., Water Systems Engineer, Water and Sewer Department, City of Greeley, CO

The city of Greeley, CO, depends upon two parallel 27” steel transmission lines to supply it with potable water from a source 33 miles away. The pipelines are about 50 years old and a significant corrosion problem had developed in an 8,000’ section of each pipe. To make matters worse, rapid development around and over these water mains severely limited access to them.

A sacrificial anode cathodic protection system was installed when the pipelines were new, but it had been neglected for the next 40 years. During that time, corrosion found its way through damaged and misapplied coatings and weakened the pipes. In 1988 a new cathodic protection system was installed to replace the old one and the incidence of new leaks dropped dramatically, but serious damage had already been done. Prior to installing the new cathodic protection system, as many as ten leaks per year developed in the most seriously damaged section. Since these leaks developed under normal working pressures, planned pressure increases would create even more leaks.

The Water and Sewer Department wanted to be proactive and replace the pipelines, but found the lines were now covered with residential and commercial development. Homes had been built within a few feet of the pipelines, and a trailer park, state highway, railroad, other utilities, and even a cemetery had been built over them. It would be extremely difficult, costly, and disruptive to dig the pipelines up and replace them.

The severity of the problem became apparent in the middle of July, 1995, one of the hottest days of the year. A leak was reported near a railroad track in the troublesome area. This was very serious because the pipe was not in a casing and the owner of the railroad would not allow an excavation through the tracks to find the leak.

Leaks are normally easy to find from the exterior of an exposed, pressurized pipe and can be repaired quickly, with the pipe in service, by inserting a gasketed tapping screw in the hole. However, without access to the exterior of the pipe, the line would have to be taken out of service, and an attempt made to find the leak from the inside without benefit of water pressure.

Opening the pipe would deprive the city of a much-needed 10 million gallons of water every day the line was out of service, and the odds of a quick repair were not very good. As it turned out, the leak was found to be accessible and was repaired without any major incident. However, the leak did motivate the city to find a long-term solution for this high-risk section of pipeline. It was decided that one pipe could be taken out of service and replaced or repaired during the winter months. The other pipe would remain in service to supply Greeley with potable water. That pipe could be replaced or repaired the following winter.

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Several proposals were made and each was evaluated on how well it met the specified criteria. The first proposal was for an open-cut, total replacement. This proposal was attractive because the pipe could be up-sized, but the total cost, in terms of money, time, and social disruption, was considered to be too high. The estimated monetary cost was at least $200 per linear foot.

The second proposal was for slippining a polyethylene (PE) pipe capable of withstanding 80 psi without any dependence upon the host pipe. In order to withstand that 80 psi, the wall of the liner would have to be 1.5” thick. The installation method required annular space between the host pipe and liner so the liner would not bind when it was pulled through the host pipe. It was decided that the combination of liner thickness and annular space would result in too great a reduction in flow capacity. This method would have cost about $75 per linear foot.

Two proposals were received for inserting a tight-fitting, high-density polyethylene (HDPE) liner into the old pipeline. Both methods would take advantage of the remaining structural strength of the host pipe. This would allow a relatively thin-walled SDR-40 liner to be used. The smoothness of the HDPE appeared to offset the small reduction in inside diameter, resulting in very little, if any, reduction in flow capacity. The decision was made to

Solution criteria

In order to find the best solution to the problem, a performance specification outlining the desired result was given to interested contractors. The criteria specified the solution should:

- be NSF approved for potable water;
- remain leakproof for at least 50 years;
- minimize excavations and couplings;
- maintain existing flow capacity as much as possible;
- be installed during the winter months when demand is lowest;
- withstand 200 pounds pressure while spanning a 2.5” hole;
- be economical and maintenance-free;
- and, install in compliance with OSHA’s safe construction practices.

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A 20’ to 25’ spool section of the original steel pipe was removed from the line in each entry/exit pit. This would allow sufficient room for the liner to be pulled into the relatively straight sections of host pipe. When straight sections of pipe were removed, they were lined with the PE pipe above ground and reinserted to close the pipeline after the rest of the host pipe had been lined. When curved sections which could not be lined were removed, they were epoxy coated on the inside before they were used again. After two adjacent pipeline sections and the spool pieces had been lined, the pieces were joined with special connectors designed and manufactured by ARB and Greeley’s Water and Sewer Department. Epoxy-coated steel sleeves were inserted into the ends of the PE liners to reinforce them enough to withstand the exterior pressure of 4-piece shell clamps. Dresser couplings were also used to finish the connections. After the pipe was completely connected, the line was pressure tested at 150 psi. When no leaks were found, the line was chlorinated and flushed before it was put back in service. The line was pigged a year later to be sure there were no leaks due to liner shrinkage or loose reinforcement rings. The first 8,000’ of one of the two parallel pipes was lined in the 1996-97 winter and the same section of the other pipe was lined in the winter of ‘97-’98. There have been no leaks on either of these two pipes since the PE liner was installed. The standard design life of the PE liner is 50 years, but it may last longer. As long as the outside pipe holds up, there is no known reason for the PE liner to fail. The remainder of the pipeline is in good enough shape that no rehabilitation is pending.

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