THE AUTOMOTIVE ISSUE

May 2015

FFJournal

The magazine for today's metal fabricating & forming technologies

A TREND Publication

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BY NICK WRIGHT, EXECUTIVE EDITOR

A weld runs through it

Using the weld-after-backfill method, crews keep Colorado waterline project on track

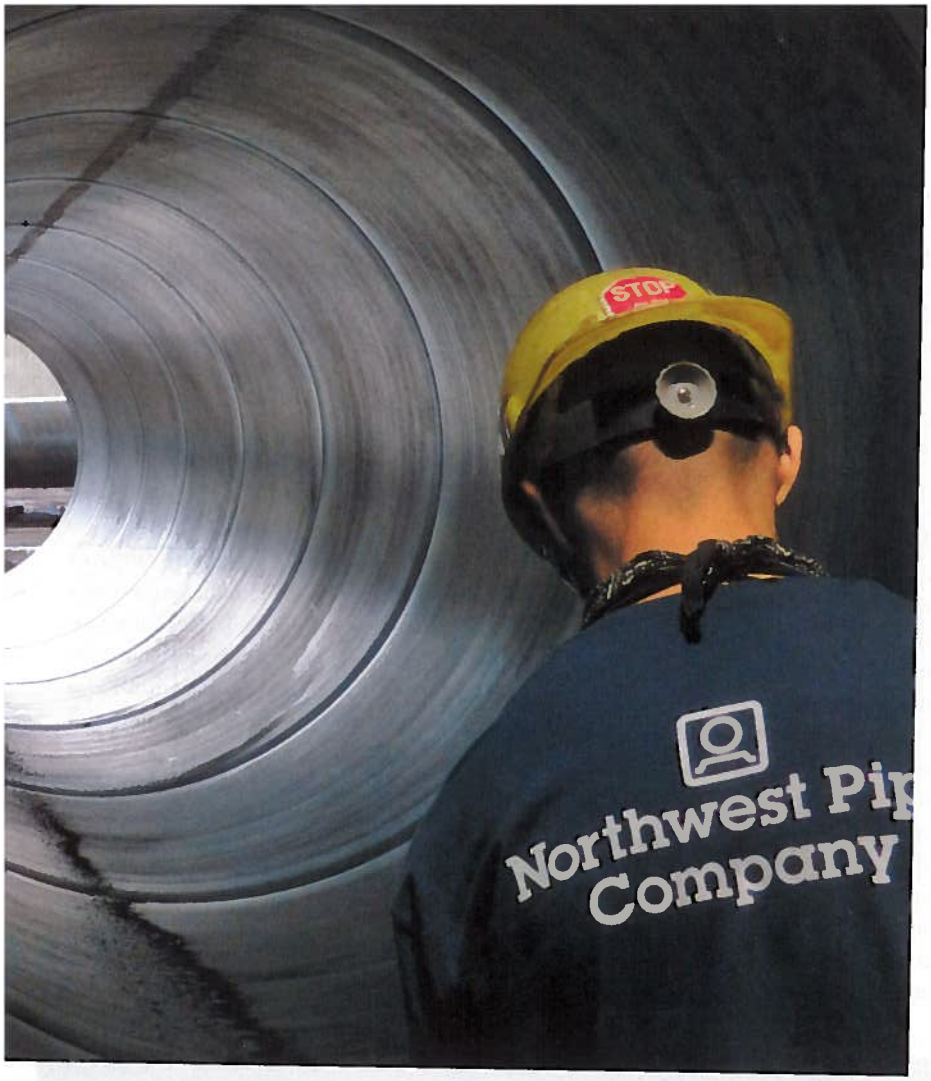
A piece of pipe moves through production at Northwest Pipe Co. in Denver.

The Arkansas River, one of the main tributaries of the Mississippi River, winds 1,469 miles from the Rocky Mountains in Colorado to Arkansas, providing drinking water for some of the communities along the way. As of March, Colorado Springs, Colorado, joined those communities that are increasingly using the watershed as crews finished a 50-mile pipeline that brings water to the growing area.

Called the Southern Delivery System (SDS), the pipeline originates from the Pueblo Reservoir in Pueblo, Colorado, where the Arkansas River flows through the Pueblo Dam. From there, the SDS runs north to Colorado Springs, roughly parallel to Interstate 25 between the two cities. The completed pipeline, which began in 2010, is phase one of two; the second is intended to add reservoirs and pumping capacity as needed long term. It'll serve the communities of Fountain, Security and Pueblo West as well. The project is one of about a dozen water infrastructure projects either in planning or under construction in the Southwest.

On the ground level, crews assembled the pipe from more than 7,000 individual

An excavator from Garney Construction moves a 50 ft. stick of pipe after delivery from Northwest Pipe Co.



pieces of mostly 66-in. diameter pipe supplied by Northwest Pipe Co., which is headquartered in Vancouver, Washington, and has a fabrication facility in Denver. Other inner diameters of the pipeline include 36-, 42-, 54-, 72- and 90-in. clear after cement mortar lining. The steel for the pipe was formed through a continuous cast process, says Neal Keleman, sales representative for Northwest Pipe Co.

Pipe is cut into smaller pieces after steel is spiral welded during fabrication at Northwest Pipe Co.'s factory in Denver.

PLENTY OF PIPE

NORTHWEST PIPE CO. FORMS the steel for the pipe through continuous casting, a fully kilned, fine-grained practice. It conforms to physical, manufacturing and testing requirements of ASTM A1018/A1018M, structural steel (SS) Grade 36, Type 2, modified with required minimum yield strength of 42,000 psi and 63,000 psi tensile. The 50-ft. lengths are made to American Water Work Association (AWWA) C-200 and other industry standards.

"The pipe with thicker steel is placed at the high pressure reaches of the pipeline, and the low pressure reaches can accommodate a slightly thinner steel thickness," says Neal Kelemen, a sales representative from the company. For the SDS pipeline, the steel ranges from 0.187-in. to 0.734-in-thick. "For example, six different wall thicknesses were used alone on one 6-mi. long segment of pipeline and the pressure decreases from south to north as you get further from the pump station," Kelemen explains.

Sheet or plate is rolled into a coil, spiral welded and fabricated into individual pipe lengths, generally 50 ft. to conform to American Water Works Association (AWWA) C-200 standards. The wall thickness varies based on the internal pressure in the pipeline, as well as other design considerations.

While there are different technical standards for water pipelines than, say, crude oil, there are still water sustainability and projected water demand challenges. But the project, which has thus far come in under budget, is expected to serve about three quarters of a million residents by 2040. The short- and long-term jobs created, combined with low interest rates for project financing, are expected to give SDS a return on investment after 2020—as well as a supply of drinking water.

"Colorado Springs Utilities and our project partners estimate completing SDS on time and forecast a savings of about $150 million, reducing the final project cost from almost $1 billion to $841 million," says John Fredell, SDS program director.

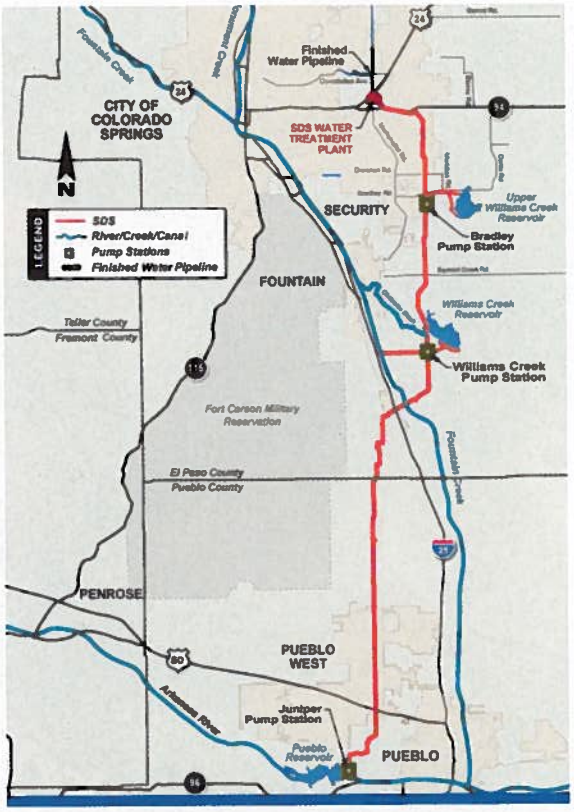
Weld-after-backfill

Among the permits needed to install such a pipeline is the Pueblo County 1041 Land Use Permit, which concerns land disturbance for big municipal water and sewage systems. What that meant for laying and welding pipe was sequencing its installation. Because crews could not leave more than 400 feet of trench open in one day, they had to carefully sequence work. This made digging a trench, laying the pipe, and backfilling a challenge to maintain schedule. To help meet this 1041 requirement, they would join the pipe with a heat shrink sleeve, then go back and weld the pipes from the inside later on.

This method of welding pipe from the inside is called weld-after-backfill (WAB). From an access point, a welder would return to pre-installed sections fit together via bell and spigot ends, and weld them. Because the pipe is already backfilled and the joints covered with a shrink wrap sleeve, the heat dissipates into the ground and with it goes the risk of warping around the heat-affected zone. The whole process lets crews backfill the pipe and weld separately from the open trench installation—a key method for satisfying rules of the permit.

WAB is the go-to method for lap-welded joints, the most common for water pipelines. The SDS pipeline incorporates single- and double-lap joints as well as full penetration butt-welded joints, according to Colorado Springs Utilities Project Manager Joseph Rasmussen.

The ends of each joint have no factory lining or coating on the interior of the pipe—that's where the weld takes place. "Hand-applied cement mortar completes the interior lining of the joint area" once



The SDS spans 50 miles from Pueblo Dam to Colorado Springs and serves the communities of Pueblo West, Fountain and Security.

welding is done, says Rasmussen.

The cement mortar lining conforms to AWWA C-205 and National Sanitation Foundation 61 standards, according to Kelemen.

Welders on the pipeline trained on WAB procedures before starting on site; that included field demonstrations with welders performing WAB jobs similar to the SDS job.

"The demonstration had to account for variables including multiple pipe wall thicknesses, different welders and weld methods, as well as the use of native and controlled low-strength backfill materials," says Rasmussen. Also known as flowable fill, controlled low-strength material is any variation of a runny concrete mix.

As far as how deep the pipe is buried, the minimum cover for the pipeline is 5 ft.; in some cases, it's 25 ft. Garney Construction, Kansas City, Missouri, one of three contractors on the SDS, used a Caterpillar 390 to dig the trenches. The CAT 390 is one of the biggest excavation machines that Caterpillar makes. Garney used three of them at the site. Because it was bigger and more powerful than other available equipment, the 390 helped them maintain schedule.

But there are some places where the pipe is even deeper, such as the Fountain Creek tunnel crossing, where the pipeline runs underneath I-25 for about one mile. There, it's about 85 ft. underground, and was constructed using trenchless technology (tunnel boring). The WAB method was used in lower pressure reaches of the pipeline, not at deep tunnel segments.

Moving water

Harnessing Arkansas River water and moving it 50 mi. north is no small feat. According to the SDS, among the biggest challenges was sequencing the work activities. At the height of pipeline installation, about one mile of pipe was being installed per week, with multiple contractors active in separate areas along the pipe.

"Since there was a limited supply of approved welders that had gone through the WAB training, the construction teams collaborated to share resources and shift work activities to allow welding to catch up to pipe laying production," says Rasmussen. "Welding of the pipe is fairly standard, with