Cooperation, Geotech Data Smooth Way For Fraser River Crossing

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Installing a 24-inch diameter steel pipe by horizontal directional drilling (HDD) under a major river in a populated area takes careful planning, a realistic design, experienced contractors and a leap of faith (or reliable geotechnical data).

Terasen Pipelines of Calgary, Alberta, Canada, needed to replace a section of vintage 1953 pipeline that carries crude oil and refined products from Alberta to markets along the West Coast and offshore. The segment under the Fraser River in Coquitlam, BC, about 15 miles east of Vancouver, was being upgraded to withstand a 7.2 magnitude earthquake. The C$5.2 million job took about 18 months to prepare, but only six weeks to assemble and install.

Everything was planned to the last detail and, fortunately, there were no surprises. Terasen Pipelines was fortunate at the outset when they negotiated an area large enough to lay out and assemble the 4,250 feet of 24-inch pipe prior to the pull-in with only temporary, short duration road closures. The contract for the pipeline construction was awarded to Ledcor Pipeline Limited of Edmonton, Alberta. The C$2.1 million subcontract for the HDD work went to Mears/HDD, Rosebush, MI. The HDD portion of the project included all the drilling activity, the entry and exit pit construction and mud handling.

In addition to horizontal drilling, the tie-ins required at each end presented Ledcor with challenges. About 500 feet of road and sidewalk excavation was required. Hydro vacuum excavation was the primary method for locating the existing water, phone and sewer services. Environmental work included diverting a fish bearing stream, meeting the sediment control requirements and preparing a strategy to deal with the presence of methane. Much of the river in Coquitlam is built on inactive landfills that, when excavated, could release methane gas.

Risks

"On this project, it was appropriate to share the risks," explains Peter Cocciolo, senior pipeline engineer, Terasen Pipelines. "A geotechnical base line report was part of the contract, and we stood by everything in our reports."

Top: Pull-back operations begin at the exit pit. Bottom: Bob Zelany (left), geotechnical engineer and Bob Vergette, vice president of operations for Terasen Pipelines, view the entry point of the Fraser River Crossing.

Because contractors' innovations are often what lead the industry, it makes sense for contracts to be performance based, but owners cannot reasonably penalize contractors for a job that is delayed because of unforeseen circumstances. The geotechnical baseline report uses definitive language and is issued without a changed condition disclaimer.

"This gives the contractor a baseline that he can use to cost out the job without adding in a huge contingency. By doing this, we spread the risk fairly so we get more reasonable bids," points out Cocciolo.

The geotechnical data for this crossing included six land-based Standard Penetration Tests (SPT) bore holes (three on each side of the river), and six Cone Penetration Tests (CPT). SPTs and CPTs deliver detailed information on the subsurface layers that is critical when evaluating installation methods. There also were three bores made in the river in water depths up to 52 feet. These holes were extended about 100 feet below the mud-line. The investigation indicated drilling conditions of silts and sands with a river gravel layer well below the final pipe alignment.

The 4,250-foot long, 1/2-inch thick pipe had entry and exit angles of 14 degrees; the average depth of pipe below the mud line was about 90 feet where the pipe would run horizontal for about 2,570 feet. In preparation for pullback, the pipe was supported by four 165-ton cranes, four 583 Caterpillar sidebooms and two 25-foot lattice steel towers with a capacity of 23,300 pounds to suspend the pipe across a four-lane trucking route. Because the lay down area was large enough, the 40-foot sections were welded on site in one continuous string. The welds were radiographed and coated with a 40-mil layer of SPC3888; the pipe itself had a tough, dual powder epoxy coating of Scotchkote 6233 for corrosion and 6253 for abrasion resistance.

Extra 'insurance'

The entry pit had an interesting feature. Inside the 8-foot deep pit, a 40-foot section of 48-inch diameter, ½-inch thick casing was set at the 14 degree entry angle. A 15,000 pound hammer from TT Technologies was used to drive the casing into the soil, adding 40-foot sections until the casing was 200-feet long and about 42- feet deep. The casing provided a sure and easy route for drilling the pilot hole through any possible cobbles, boulders or buried woodwaste that is typically encountered on the Fraser River and has stopped the progress on more than one project along its banks.

Starting with an 8 3/4-inch pilot hole using high pressure mud, the hole was first reamed up to 24-inches and finally to 38-inches. The drilling mud pressures were carefully monitored from the drill shack, and because of the quality of the information and the expertise of the crews, there were no hole failures, nor were there any frac-outs of drilling mud into the river.

"The most difficult part of the job was the side curve at the end and the tight area that we had at the exit, but for the most part we had perfect drilling conditions, we didn't even have to add anything to our drilling solution," reported Ted Foltz, Mears/HDD.

In fact, Foltz said that even though it was a fairly long pipe pull, it went smoothly. "We were really impressed with Ledcor. They were a great general contactor to work with, and they really taught our crews a thing or two about laying out pipe on a job like this."

The mud specifications were also challenging as the intention was to keep the hole as clean as possible, and to provide a caking around the hole that would help prevent hole collapse. A smooth wall also makes for an easier pull. Dealing with the huge volume of mud did present some logistical challenges for Mears. With about 60 tons of dry bentonite necessary for the job, handling costs could add up, especially in British Columbia where there are stiff regulatory requirements. Eveready Industrial Western Ltd. of Burnaby, BC, was contracted to deal with mud handling and disposal needs.

"We had the capacity to move about 2,000 gallons of mud from one side to the other, and about 80,000 gallons of storage between the two sites. When we pulled the pipe, we displaced about 103,000 gallons of mud, about half of which came out of the exit hole as the first half of the pipe was pulled, the rest of the mud came out of the entry hole during the second half of the pull. Of course, we cleaned and recirculated the mud throughout the operation; we could clean about 600 gpm. In other jurisdictions we could have just dumped the material on private property providing we had a letter from the owner.

"All of the cuttings and drilling fluids were tested for contamination and found to be clean," said Foltz. Even so, the cuttings and fluid had to be hauled 11 miles to a specially licensed landfill. "It cost us about C$100,000 in trucking and disposal fees."

The project was a success for Terasen and the contractors.

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