

## **HDD Intersect in Calgary**

Bradley Kramer — Oct 01, 2007

Engineering Technology Inc. (Entec), of Calgary, faced rugged terrain and complicated logistics when formulating the HDD design and execution plan for one of the most difficult intersect-drilling projects ever attempted. For Conoco Phillips Canada and Shell Canada, the Chinook Ridge Pipeline had been an ambition for many years, but its construction would require overcoming significant technical challenges posed by the severe valley slopes and banks of the Wapiti River.

After reviewing the scope of the project, the team selected HDD as the solution. Although doable, completing the project with one long bore (9,000 ft) was deemed too risky because of the geology. The project was split into two intersect bores.

The installation featured two 14-in. pipe sections that were drilled from the same location with each drill requiring an intersect that would take place hundreds of feet above drill rig elevation. Altogether, four HDD rigs worked simultaneously to complete the intersect in a region where HDD had not been considered an option before.

Crossing the Wapiti River required the contractors to bore almost 4,700 ft from the flood plain to the top of the southern bank of the Wapiti River, in the Elsworth region of the Rocky Mountain foothills near Grande Prairie, Alberta, Canada. The intersect point was about 650 ft above the lower drill rig pit, which is approximate to the height of some skyscrapers — 100 ft more and the bore could have cleared Boston's Prudential Tower. The second bore required a 2,700-ft drill from the flood plain to the top of the north river bank.

A satellite-serviced command and control center was constructed to allow for the collaboration of the various parties, including: Mears Canada (the HDD contractor), Entec's drilling management team, the ConocoPhillips pipeline construction and support team and the Entec Environmental Monitoring Team, including Gardner Lee Ltd. Jarett McInenly of Entec, one of the four principles within the company, took the construction management leadership role. Entec directed the HDD engineering, design and construction management functions.

As part of a feasibility study, a thorough geotechnical program identified varying layers of sandstone, clay and shale along with numerous horizontal fracture planes, underground aquifers and thick gravel overburdens that would impact the design of a drilling solution. Other factors included inaccessible river banks, the nearly 9,000 ft between the top of the banks — the proposed HDD bore needed to traverse from bank to bank — a 1,148-ft total vertical depth requirement and the fact that the drive from one bank to the other takes five hours.

The first drilling program was from the river flood plain to the southern bank. Elevation change from the entry point (valley) to the exit point (top of the bank) was more than 850 ft. Gravel overburden at entry and exit required the installation of surface casings at both points and necessitated an intersect point nearly 650 ft above the lower rig. Drilling rigs were specified to require a minimum of a 300,000-plus lb drill on the lower side and a 140,000-lb rig at the top. The second was from the flood plain to the northern river bank.

Due to the difficulty of the bores, the remote location of the site and the scarcity of roads, the project would need to start at the beginning of freeze-up in order to be completed ahead of the spring break-up. Mobilization started at the end of October 2006, coinciding with a blizzard that dropped 4 ft of snow.

The start of the drilling program brought about the manifestation of the geotechnical investigation. Sticky,

swelling clays, unstable shale and the influx of sand and sediments from underground aquifers demanded the constant attention of the drilling fluid management team. Round-the-clock annular pressure monitoring and fluid rheology monitoring were instrumental in successfully meeting the challenge. There were no frac-to-surface and returns were never lost.

In early January 2007, the two drill strings touched bits on the first bore, at a height of 650 ft above the lower drill rig. Having that much drill stem above the rig produces safety issues and limited steering control, a problem that must be accounted for in design and managed onsite to within inches to successfully meet the intersect requirements.

In mid-February, drilling commenced on the northern bank bore finding the same geologic conditions as encountered on the first bore. As the end of the construction season approached, the project team, lead by Entec, instituted a number of options that enabled the project to be safely completed on time.

The second bore was completed during the midnight hour of March 19 and the 14-in. concrete coated pipeline was pulled into place. On March 21, the 4,620-ft section of 14-in. epoxy coated pipeline was pulled in. Mark Kappelhoff, ConocoPhillips operations engineer, Deep Basin — Elsworth said: "Jarett McInerly poured his heart and soul into this critical project that has recently allowed Shell and ConocoPhillips to move large additional (trapped) gas volumes to sales. In the face of multiple expected and unexpected challenges, Jarett consistently displayed a tremendous and contagious work ethic and encouraging attitude that was ultimately necessary to successfully complete the project. We feel very fortunate to have had Jarett's talents along with field and office support from both John Jameson and Grant Jameson and the rest of the ENTEC staff."

Bradley Kramer is an assistant editor of Trenchless Technology.