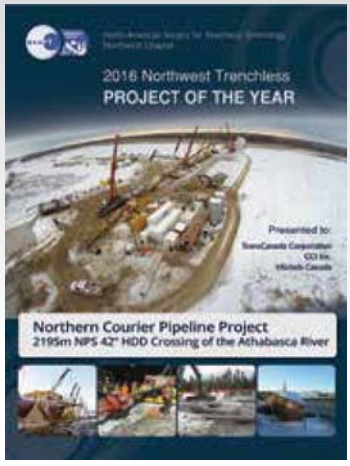
2016 NW Trenchless

Project of the Year



Congratulations to the TransCanada Corporation, CCI Inc., and Michels Canada on being awarded the 2016 Northwest Trenchless Project of the Year for the Northern Courier Pipeline Project!

About the project

TransCanada Corporation (TransCanada) proposed the design and construction of the Northern Courier Pipeline Project (NCP) to carry hot bitumen from the Fort Hills Terminal to the Suncor tank farm at the Voyageur East facility. The pipeline project included several large watercourse crossings, with the largest crossing identified being the Athabasca River, located north of Fort Mackay, Alberta. An NPS 42 x 1" wt. pipe was installed and is to be utilized as a casing for the internal 24" bitumen line.

The successful completion of this crossing considering the length and required finished borehole diameter, 2,195 m and 54", respectively, was a milestone for the HDD industry as this is the longest NPS 42 installation completed to date in North

America. The HDD construction required thorough planning and implementation of an approved preliminary construction plan and the ability to adapt to changing conditions as they presented themselves in a very remote region of Alberta, Canada. Utilizing sound HDD experience and a combination of cutting-edge installation tooling and techniques, such as pilot-hole intersect gyro steering, pipe thrusters, equipment winterization, and deployment of properly sized equipment for achievement of the installation which occurred during the winter of 2015.

Michels Canada was contracted by TransCanada to perform construction of the HDD as well as the pipe makeup and pullback support of the Athabasca NPS 42 HDD. The Athabasca River crossing was part of an overall program that included six HDDs and one Direct Pipe all installing NPS 42 casing. Preconstruction plans were submitted as part of the requirement by the owner following the TransCanada HDD specifications – TES PROJ HDD Rev 1.

Mobilization to the prepared HDD work pads started in August 2016 from a staging yard that was provided by TransCanada at a nearby site outside of Fort McKay, Alberta.

Surface casing was part of the initial proposed design that had 20 m specified at both the entry and exit sides of the crossing. Soft near surface formation common to the area quickly gave way to competent formation that only allowed for the 20 m installation as designed. The steel conductor casings were both installed using a pneumatic hammer, or were excavated at the required entry/exit angles to facilitate the given designed geometry.

Entry and exit sides were set up simultaneously with full spreads dedicated on each side in preparation for staging the 1,200,000 lb. HDDs as well as a full complement of mud cleaning and recycling equipment capable of pumping and cleaning 4m^3 per minute as would be expected during operations.

"This is the longest NPS 42 installation completed to date in North America."

The pilot hole was initially drilled to 12 ¼ inches with 4-radius curves to manage the entry angle of 12 degrees and exit angle of 11 degrees, which were critical in the overall project design. Due to specified grouting requirements, the installation needed to maintain precise gradients at critical points along the projected profile in order to adhere to the engineered grouting plan for installation of the grout in lifts for proper curing. Performing the pilot hole intersect was a major challenge in itself as it had to take place along a 0.75° slope designed for the tangent. A combination of guidance systems including gyroscope and Para-tracker systems were used during the pilot hole drilling due to the length, depth of 70 m (230 feet), and annular pressure monitoring requirements in the sensitive area.

Tackling the Challenges

Subsurface conditions proved formidable and inconsistent. Crews drilled and navigated through variable formations consisting of oil sands, sands and silts, hard limestone, sandstone and siltstone, while attempting to maintain control of mud properties efficient in holding the hole and carrying out drilled cuttings. Northstar Fluid Solutions provided the Engineer Designed Fluid Program that was approved by the owner before drilling and had managed it closely with regular checks to react to the changing formation. Cleaning the hole along a drill path of this length proved challenging with the flow of drill fluid cuttings going to both entry and exit sides unexpectedly. With both entry and exit having full and complementary mud cleaning and recycling equipment, the program was successful and finished with what both owner and contractor agreed was a cleaned hole.

Due to being in a remote and secluded location, having a large variety of downhole tooling available was important to facilitate as little downtime as possible. After review of the available geotechnical data Michels had source or redesigned the required tooling early to insure continuous optimal production. Sizes and types of tooling ranged from 12 ¼" pilot bits to 54" reamers/fly-cutters all capable of soft displaceable formation up to hard rock. Due to the length, diameter, and elevation change of the borehole, added flow capacity was needed to remove cuttings and maintain a clean hole. Bitumen zones proved most challenging as equipment wear was substantial requiring continual monitoring and maintenance.

The finished hole was reamed to a final diameter of 54" in multiple stages to accommodate installation of the 42" x 1.00" wt. steel casing.

"THIS PROCESS WAS BY MICHELS' ESTIMATION A SUCCESS DUE TO MINIMIZING TRAFFIC AND MAINTAINING PRODUCTION ON SITE."

Michels and the owner had agreed to implement a water recycling system unique to large-diameter HDDs, which had success in the earlier stages of the program but challenges through the later, larger ream stages due to the large volumes required for processing. The high concentrations of bitumen made the recycling and drying process challenging. The overall implementation of this type of program has recognizable benefits, however further refinements for large diameter HDD will need to be studied and addressed.

Drill fluid and cuttings disposal was managed by the owner with Michels utilizing local sumps on site to maintain production. This process was by Michels' estimation a success due to minimizing traffic and maintaining production on site.

Michels Canada mobilized, assembled, and managed the massive pipe string. The NPS 42 pullback was designed to extend 2,195 m back from the exit location. Due to available workspace before a ravine and waterbody, a 2,000-meter radius horizontal curve was required to avoid a protected area. The section was prepared in one continuous string to minimize the stops during pullback. The pipe string was strategically placed on rollers to conform to points on a curve for the access road. The curve encompassed almost 70% of the laydown length as pull rollers were strategically placed along the curve under the string for the pullback.

The exit angle required a detailed and comprehensive pullback plan to be prepared with precise pick points as pipe-handling crews had to carefully hoist the pipe section 14.3 meters into the air to form the over-bend radius.

The assembled 42-inch pipe string weighed upwards of 1,000,000 lbs.

"The Athabasca HDD installation was completed without lost-time injuries."

To handle the pipe during pullback safely and efficiently, Michels used 10 cranes, five side booms, and three excavators.

As an added contingency, Michels' 750-ton Herrenknecht Pipe Thruster™ was set up at the exit location to engage if pull loads during HDD pullback exceeded a set limit, ensuring the stress on the downhole tooling was minimized during pullback operations. Due to this addition of a surface-staged Pipe Thruster, a modified plan was developed at the last minute between Michels and the engineering firm to accommodate the additional equipment that added height to the pipe section design during the pullback phase. The maximum pullback force that the rig faced was 650,000 lbs., while the thruster supplied a maximum of 300,000 lbs. of thrust and was initiated primarily during the radius portion of the pull along the profile to get the pipe moving.

During pipe pullback operations, the buoyancy plan was key to a smooth pullback; special attention was paid to the calculated buoyancy program that had staged frac tanks and used 15 water trucks to continuously supply the massive section during critical pulling operations to minimize the required force.

Safety as always is of paramount importance as with all TransCanada projects. The Athabasca HDD installation was completed without lost-time injuries. Crews worked two shifts 24 hours per day, six days a week for the duration of the project. They encountered all the typical Canadian weather for fall and into the winter months ranging from 30 degrees Celsius to -25 degree Celsius, which required boilers to be added to the contingency of entry and exit side equipment. Michels' schedule started in August and ended mid-November of 2015.

An exceptional accomplishment

Michels constructed the crossing without any inadvertent fluid releases along the environmentally sensitive and highly visible alignment. Constant monitoring of the drill path as well as the river channel was carried out by Michels as well as TransCanada inspection.

Athabasca River HDD *– in addition to being one of the longest large-diameter crossings successfully completed in North America, this crossing included several innovative components such as thruster assist, EDFP in bitumen and on grade intersect, which has established the Athabasca River HDD as an exceptional accomplishment for the industry. We would like to recognize the entire team for combining their efforts and utilizing their experience and expertise. All components from engineering to HDD and pipeline support did a solid job of installing the Athabasca crossing without any lost time incidents or environmental issues.*