HDD eases Sino-Russian links

Wu Yiquan, Yang Nan, Liu Rui and Zhang Yu report on a special bentonite blend and UV-curing used on a crude oil HDD installation beneath a river

THE Heilongjiang River Crossing project is located on the Sino-Russian border, about 2,000km northeast of Beijing. The crossing forms a critical component of the entire Sino-Russian crude oil pipeline project, linking the Skovorodino pump station in Russia with the Mohe pump station in China.

Two equal-sized crossings, spaced 25m apart, have been installed in parallel; one as the main line, the other as back-up. With a total curved crossing length of 1,100m, the 812mm-diameter pipeline enters at 12º and exits at 10º.

Russia's National Oil Pipeline Co and China's National Petroleum Corp are the owners of the project, and the general contractor is China Petroleum Pipeline Bureau (CPP).

GEOLOGY

Cobble layers are found at both entry and exit sides. The horizontal stretch of the bore contains sandstone formations embedded with fine-to-medium and medium-to-coarse feldspar gravels. Due to their poor integrity, the formations have been graded as 'heavily to completely fractured', and defined as a 'no-go' zone for HDD work by the owner on the Russian side.

Pilot-hole drilling began in August 2009, and was successfully completed on the main and back-up lines using the intersection technique. Product pipes were successfully installed in April and June 2010, respectively, after four reaming passes, one hole-cleaning pass and one pull-back test pass.

PROJECT CHARACTERISTICS

To simplify customs procedures and ensure building continuity, designated zones were set up on either side of the river for equipment, facilities and crew living areas; both sides were supervised by the respective military border authorities. Temporary customs and immigration offices were set up to process the entry and exit of personnel, equipment and materials, simplifying the customs procedures on both sides.

To ensure the success of HDD during the cold winter, large enclosures were built, one for each of the designated areas, with heating provided by diesel-powered tube heaters and an engine exhaust, steel-pipe heating system. Air-monitoring devices in each enclosure ensured healthy working conditions.

Drilling pilot holes for both lines entailed using a ParaTrack II guidance system with intersection capability. A self-developed, hole-repair reamer

Above: temporary border checkpoint on Heilong River. The building just visible on the other side of the river (Russia side) is for the exit pit
Right: granite cuttings, 20-40mm diameter

was used for the very first time to smooth the intersection location, following the completion of the mainline pilot hole. The reamer helped to improve the smoothness of the intersection point of the back-up line pilot hole. Data from the steering software indicates a misalignment of only 40mm horizontally and 90mm vertically.

CETCO's high-viscosity bentonite/MMH (mixed-metal hydroxide) drilling-fluid system was used to carry out a large number of 50-60mm OD cuttings, reducing the possibility of 'stuck pipe'. With extensive experience in all types of HDD operations, CETCO China's drilling products staff anticipated that conditions would require a specific type of fluid to control borehole stability and remove the large material encountered.

Based in Suzhou, CETCO China's laboratory developed a special blend of bentonite drilling fluid for use with MMH additives for suspension characteristics or enhanced gel strength. Many hours of testing were performed to ensure the special blend would perform as needed. During reaming, an innovative technique of injecting mud from both sides was used, which greatly increased mud flow and cuttings removal.

Inside the entrance pit building with HDD rig and mud plant

UV-curing was used to protect the pipeline's PE coating and improve its impact resistance, thus minimising the possibility of mechanical damage to the coating from either the borehole wall or the cuttings inside.

Pull-back testing with a product line of three joints was conducted to verify the quality of the reamed borehole. For final pullback, balanced dynamic water injection was used to reduce the buoyancy of the pipeline in the borehole, thus reducing frictional resistance.

Drilling-fluid recycling technology was used to reduce the amount of waste drilling fluid and environmental pollution. Waste fluid from drilling rigs at the Russian and Chinese locations was taken to a Chinese EPA-designated disposal site for environmentally responsible treatment.

PROJECT IMPACT

The successful completion of the Helongjiang project has helped intersection and dog-leg repair techniques gain greater acceptance in the global HDD industry. It has also, to a certain degree, expanded the application of HDD technology in the trenchless sector.

The successful application of high-viscosity bentonite/MMH drilling fluid provides greater security for future HDD projects in rock and fractured rock. For China's HDD sector, the project also constitutes a significant advance in the application of drilling fluid technology.

For the very first time in China's HDD sector, the Heilongjiang River Crossing project used UV-cured, protective coating technology, showing good performance in reducing the possibility of a pipeline coating being damaged by the internal surface of a borehole and cuttings. UV-cured coating technology is therefore a further measure in improving the success rate and quality of HDD projects in rock formations.

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