TRENCHLESS Technology

Showcased as Solution for Modern Day Hydro Repairs at North American Conference

Laying out the pipe before it is pulled through the hole under the Fraser River.

By Tonia Jurbin, P. Eng.

Just a few weeks ago, Las Vegas Nevada was the exciting location for the 21st international No-Dig 2003 show. The North American Society for Trenchless Technology (NASTT) and the International Society for Trenchless Technology (ISTT), organizations that support "trenchless technology" for use by utilities, sponsored the conference.

Trenchless technology is a broad description of any method that is used to install or repair utilities without trenching, or cutting the ground from the top. Construction methods include horizontal directional drilling (HDD), microtunneling, pipe ramming, pipe jacking and conventional tunneling. Rehabilitation methods, more applicable to the water and sewer industry, include pipe bursting, pipe splitting and pipe lining. It is important to BC Hydro and its employees who deal with new installations, upgrades or repair work, because it offers alternatives to the disruption of digging up roads people's gardens to conduct repairs.

Although trenchless technologies have been around for about 30 years, these methods have only started to gain recognition and acceptance by major utility owners as a viable alternative to conventional construction methods. This type of work has become more popular in the Greater Vancouver area in the last decade. There is no single trenchless method that works well in all conditions, and new techniques are evolving to suit different situations.

Briefly, Horizontal Directional Drilling (HDD) is when a small pilot hole is drilled under an obstruction such as a busy highway or watercourse. Once the pilot hole is complete and the drill string has met its target at the exit point (and the contractor breathes a huge sigh of relief), a back reamer (a cutting tool with progressively larger diameters) is attached to the drill string. The initial pilot hole diameter is increased as the drill string pulls the reamer back to the entry point. Progressively, larger reamers are used until the desired diameter is achieved, at which point the conduit is finally pulled through the hole. During the drilling and back reaming, thick bentonite mud is used, which cools and lubricates the drill bit, and carries the 'cuttings' from the hole to either the entry or the exit point where the mud is screened and recycled.

There are risks and issues associated with HDD. This method does not work well in soils with lots of gravel, cobbles or boulders that can cause the drill bit to go off course, so collecting quality geotechnical information is important before choosing this method. Dealing with the bentonite slurry at the end of the job is also an issue for the project owners. There is also a risk of 'fracking out', which can occur if the mud pressures are too high and the mud finds somewhere else to escape. This can cause excessive heaving at the surface, or worse, the mud can frack out into an environmentally sensitive lake or river. Dozens of papers presented at the Las Vegas NoDig 2003 conference dealt with these issues. Most of the information about fracking out is based on case

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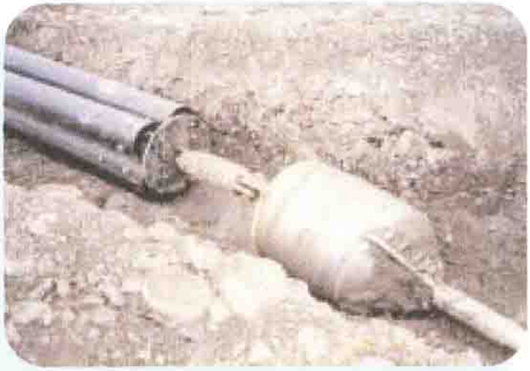

Four cables are getting ready to pull the conduit under the Fraser River from Kidd #1 substation to Mitchell Island (distribution line).

looking to the academic community for guidance. What should contractors vary to lower the risk of frack out? The drilling rate? The back reaming rate? The composition and/or the pressure of the drilling mud? Researchers and industry are working together to come up with guidelines but work procedures are still largely based on the operator's experience.

Conventional tunneling using a manned Tunnel Boring Machine (TBM) has been used very effectively in the Lower Mainland, where the glacial till is extremely hard and bouldery. Compared to other trenchless methods, the biggest risk with using a TBM is that there is a crew at the cutting face; therefore, safety issues arise. The TBM cannot effectively deal with unexpected inflows of groundwater, or flowing ground, like wet sand for example, especially if it is contaminated as that poses even a greater risk to the crews. However, the TBM can cut through almost anything and may be the only way to install large diameter (greater than 90 inches) tunnels.

Microtunneling uses a closed face remotely operated system and works very well in soft soils, or wet flowing soils. This method is not well suited to the Lower Mainland, except for perhaps Richmond, because of the consistency of the soils. It is a relatively expensive method, and since there is no microtunneling equipment available locally, it is rarely the first choice of local designers.

Pipe ramming and pipe jacking are used typically under railway crossings; however, this method is being used to install the concrete tunnel under Highway 1 for the 2L33 construction. These can be manned or unmanned depending on the soil conditions and the contractor's equipment. Tunneling, microtunneling, pipe ramming and pipe jacking all require the construction of sometimes very deep entry and exit pits. Occasionally when things don't go according to plans, intermediate rescue pits have to be installedor the equipment may have to be accessed from the exit pit.

Naresh Koirala, a Senior Geotechnical Engineer with EBA Consultants Limited, designed the first one metre diameter, 400 metre long trenchless installation in B.C. in 1999. He has been working on trenchless projects worldwide since the mid-1980s. For the last seven years, he has been working exclusively on trenchless installations, including the 175 metre long tunnel that was built under Highway 1 a few years ago during the 2L39/40 upgrade. He has been a director of the North West chapter of NASTT and a director of TTBC. He offers these insights into the growing importance of trenchless technology below:

Pipe jacking under Highway No.1 for the 2L33 job.

"There seems to be a preconception amongst

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our clients that these technologies are high risk, and while it is true that there are risks, the risks are manageable and the benefits are great," Naresh says. "Clients generally don't consider the 'social costs' when carrying out their risk benefit analysis, they don't look at environmental costs or the disruption costs to the travelling public".

Researchers in the U.S. have attempted to put a dollar figure on the productivity that is lost for every minute a vehicle is delayed by a road closure that includes the costs of lost business, cars idling, fuel consumption and environmental costs. If these vaguely defined costs are included in the risk/benefit analysis, which is difficult to do, trenchless installations in many cases would work out to be more economical. At any rate, according to Naresh, even without taking the social costs into account, at about five metres or deeper, some trenchless technologies will offer a cost advantage over conventional construction techniques.

Trenchless technologies, particularly HDD, are gaining popularity around the Lower Mainland for installing small diameter (under 30 centimetre) services. The local industry is seeing about 15 kilometres per year in small service installations. To date, there has only been a small handful, about a dozen large diameter installations in the last 10 years, two of which have been tunnels under Highway No. 1 for BC Hydro. (The tunnel under Highway No. 1 in Burnaby for the 2L39/40 upgrade, completed in 2001, and the tunnel currently being constructed under Highway No. 1 at William Avenue in Vancouver for the new 2L33 transmission cable). A ground breaking 914mm, 1023 metre installation was drilled under the Fraser River for BC Gas in 2000. Several other large diameter pipes have been drilled under the Fraser River, with another one being planned for construction this summer by Trans Mountain. Contrast this with the 300 or so kilometres per year that are being placed in the Netherlands, a small country with many waterways and built up areas.

What does all this mean to BC Hydro and how will trenchless technology change the way our engineers design new plant and upgrades? Most municipalities in the Greater Vancouver Regional District (GVRD), while they have not for the most part put by-laws in place, are making it increasingly difficult to obtain approvals for any new overhead construction, especially for high voltage circuits.

"Trenchless technologies have made our work much more challenging," says Blain Good, a Senior Geotechnical engineer in Transmission. "There are many more unknowns, higher risks and more expense

Horizontal Directional Drill rig at Kidd #1 substation.

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compared to cut and cover. Not only that, but layout of the circuits is more difficult because you cannot turn a 90-degree angle in a tunnel or a horizontal borehole the same way that you can if you are trenching."

Much larger turning radii, 10 to 20 metres, are required for pulling the cables in both the vertical and horizontal planes. (This challenge is specific to the electric industry.) Most of the trenchless methods require large entry and exit pits which often puts us in conflict with other nearby services. Safety issues must be carefully addressed because tunneling for large civil projects falls somewhere between the jurisdiction of the Worker's Compensation Board (WCB) and the BC Mining Act. When you are working on a trenchless project, you have to be ready to respond to soil conditions that you did not expect to encounter – whether it is dewatering, wall stability or safety issues.

The drill rig, drill string and mud bath.

Occasionally, whole projects have to be abandoned because the method chosen simply is not compatible with the soil. However, there are times when an installation would be impossible using traditional methods.

As our existing infrastructure ages and our system grows to meet new loads, BC Hydro, like other utilities, is facing a world where trenchless technologies may be the only way to work in heavily built up or environmentally sensitive areas. The NASTT, the ISTT, and the local chapter, British Columbia Trenchless Technology (BCTT) are committed to the education process, as they understand that the only way to grow the industry is to teach others about the innovative options of trenchless technologies.