An innovative horizontal directional drilling (HDD) project that succeeded in producing two world-firsts has won the 2017 Joop van Wamelen SASTT Award of Excellence.

The Temba Water Purification Plant in Hammanskraal is being upgraded to deliver water to thousands of residents in areas north of Pretoria. The upgrade will provide for additional on-site storage and included replacing an existing raw water pipeline. A 1 300 m section of 800 NB asbestos cement (AC) pipe required replacement underneath wooden electrical pylons and cables, which were to remain operational during the replacement works, prohibiting the use of large conventional construction equipment. Thus, a trenchless solution was sought.

Specialist contractor Trenchless Technologies explored a range of trenchless replacement and lining technologies, and pipe reaming proved to offer the most economical solution. Although pipe reaming is a pipe replacement methodology similar to pipe bursting, it offers some unique advantages, explains Marco Camarda, general manager, Trenchless Technologies. “Pipe reaming allows for extremely large upsizing of 100% and more, which is not available with displacement-type pipe-bursting techniques, both static and percussive, particularly at shallow depths. As such, pipe reaming can be a useful tool to expand the capacity of urban sewers and water pipes in dense urban areas.”

One for the history books
The existing 800 NB AC pipeline was reamed out and replaced with a new 800 mm OD PN 16 HDPE pipe, with a wall thickness of 76 mm supplied by Marley Pipe Systems. This marked the first of
what is believed to be two world firsts on this challenging project – the largest-diameter host pipe known to have been replaced by pipe-reaming technology.

To achieve this, a DD10 American Auger horizontal directional drilling (HDD) rig capable of pullback forces of 50 t and a rotation force of 18 982 Nm, was utilised, explains Camarda.

The rig’s 6.1 m long drill rods are threaded together by the HDD rig to form a long, continuous drill stem and pushed from the HDD rig through a receiving pit into the existing AC pipe up to the launch pit. The drill rods are then connected to a stabiliser and a pipe reamer with an extended shield, which is in turn connected via a swivel to a bull-nose. The bull-nose is attached to the new 800 mm PE 100 PN 16 pipe.

In order to reduce the number of butt-welds required, the 800 mm PN 16 HDPE pipe was delivered to site in 18 m lengths. These 18 m lengths were butt-welded into long continuous sections of approximately 150 m to be pulled into position in the reamed-out bore behind the reaming assembly.

The existing AC pipe was cut into smaller fragments, mixing the pipe cuttings into the surrounding soil and into the inflowing bentonite mud mix. The mixture of bentonite and water helps to maintain the integrity of the bore, in addition to lubricating and surrounding the new HDPE pipe during pull-in.

This brings us to the second world first – undertaking the pipe-reaming process and installation of the 800 mm HDPE pipe in a single pass, without first filling the host pipe void with bentonite and then reaming in stages to insert the HDPE pipe.

Electrofusion couplings
Connection between the 150 m lengths of installed HDPE was achieved by means of electrofusion couplings imported from Germany. According to Camarda, the process involved pre-warming the actual pipe through the coupling before welding, which proved to be extremely successful. Air valve systems were also connected by means of electrofusion saddles, vacuum held and strapped, to provide a complete HDPE solution.

Connection to end points and scour valve was achieved by HDPE stub-ends and backing flanges. The advantage
of this, says Camarda, is being able to position exactly where the highest points are. Only six stub-ends and backing flanges were used on the project.

**Safe asbestos removal**
A Department of Labour-approved asbestos removal plan for safe disposal of contaminated waste was integral. All launch, receiving and catchment pits were lined with 250 µm plastic sheeting to contain the bentonite, spoil, asbestos and water. This was removed using a Kosun KSMR-250 mud separation system. Once separated, the bentonite and water mix was reused in the pipe-reaming process, and later filtered and disposed of.

"An interesting facet of the AC removal works was that it became apparent that you are able to control the amount of AC that enters the bentonite mix by the design and selection of the pipe reamers cutting teeth, as well as the design of the bentonite mix itself, to significantly reduce the volumes of contaminated waste," explains Camarda.

**A global solution**
"The Temba project demonstrated the successful use of pipe-reaming technology to replace ageing AC pipeline infrastructure without disruption to the overhead powerlines," says Camarda. He believes this technology offers a relatively cost-effective and efficient trenchless alternative to the South African industry for both large- and small-diameter pipe replacements.

Internationally, many countries are not physically replacing their AC piping and are instead relining them. However, in this situation, the ability to utilise locally produced HDPE pipe results in pipe reaming being far more cost-effective than trenchless solutions that utilise any imported lining material.

"The pipe-reaming process undertaken on this project provides a possible upsizing solution to owners of AC water piping, and lays the foundation of an acceptable methodology for dealing safely with the AC material during replacement works. This could greatly aid South Africa and the international market by providing a viable solution to replace leaking AC water pipes in the future," says Camarda. 35

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