



HERRENKNECHT Project Report

6. April 2011

**Warsaw: Major pipe jacking process successfully completed.
Clean water for the Vistula river.**

The underground connection to the new "Czajka" wastewater treatment plant in Warsaw has been completed successfully and on time. Two Herrenknecht AVND micromachines handled the difficult drives with a total of 5,860 meters with bravura. Apart from pipe jacking with extraordinarily large diameters of 3 meters, the extreme winter conditions and a high groundwater level demanded top performance by everyone involved. With performances of up to 36 meters a day, the Herrenknecht machines blazed the trail for an efficient new wastewater system in the Polish capital fast and efficiently.

Warsaw, Poland / Schwanau, Germany, 6. April 2011. Wastewater systems in many large cities have already reached their limits requiring modernization or expansion in order to avoid overflowing into nearby rivers. For this reason, the city of Warsaw is investing in the construction of a state-of-the-art wastewater treatment system. This will treat the wastewater produced by 80 percent of Warsaw's inhabitants, thereby improving the quality of water and life along the banks of the Vistula over the long term. Hydrobudowa 9 S.A., PRG Metro Sp.z.o.o. and KWG (PBG Group) have been commissioned to connect the plant with the underground wastewater network.

The Polish contractors selected the pipe jacking method for their tunnel project and relied on the two AVND2000AB (with Extension Kit, Ø 3,025mm) and AVND2400AB (Ø 3,025mm) hydroshields from Herrenknecht. This type of machine is worldwide in use in the construction of supply and disposal tunnels; they master tunnelling through groundwater and can penetrate a wide range of heterogeneous soils. In Warsaw, the machines tunnelled at depths of 10 to 14 meters reaching their final targets after boring through 5,860 meters of soil comprising coarse and fine sand, clay, loam, gravel and boulders.

Apart from the unusually large diameter of 3 meters for the pipe jacking method, another challenge was represented by a high groundwater level which in some places reached up to 8 meters above the top of the pipes. The site teams were therefore obliged to dewater and seal the requisite construction shafts prior to tunnelling. The Herrenknecht AVND pipe jacking machines proved its worth during this tunnelling process. Where required, these machines secure the tunnel face using a support fluid (bentonite and water mixture) and an additional compressed air cushion in the split excavation chamber, allowing safe tunnelling under water pressure. The separation of solids of the excavated material from fluids was realized with the Herrenknecht Separation Plant HSP500, providing a capacity of 400 to 500 m³/h depending on the particle size distribution.

During the particularly cold winter months of 2010, the site team continued tunnelling work despite some extremely low temperatures and a lengthy period of frost. The Herrenknecht micromachines completed a total of 16 drives, some with short distances starting at 80 meters, but also including long-distance sections of 800 meters and more. The longest individual drive was 930 meters. The hydroshields safely underpassed a six-lane highway without having any negative impact on the flow of traffic. Hydraulic intermediate jacking stations serve to reduce the

friction forces prevailing in such long-distance tunnelling projects. Herrenknecht had already adapted these interjack stations exactly to the thin walls of the Hobas GRP pipes installed in Warsaw. The longest section revealed yet another particular feature: two underground curves with a radius of 450m and 900m had to be realized. Thanks to the Herrenknecht SLS RV navigation system the cutterhead is guided exactly with millimeter precision, the machine operators also mastered this task in a precise and safe manner.

December 14, 2010 saw completion of the last section representing a significant milestone for this wastewater project in Warsaw. During the construction project, the Herrenknecht equipment achieved impressive advance rates of up to 36 meters a day (double shift) and an average of 20 meters per day. To complete the entire sewer system and connect it with "Czajka" wastewater treatment plant (WWTP), PRG Metro Sp.z.o.o. and Hydrobudowa 9 S.A. are additionally realizing the 1,300m long Vistula River Crossing tunnel with a Herrenknecht large diameter tunnel boring machine. The Mixshield S-642 with a diameter of 5.35m was successfully accepted in February 2011 in the Schwanau/Germany plant of Herrenknecht. Once this tunnel is completed the Czajka WWTP could go into operation.

Project data

Wastewater tunnel in Warsaw, Poland

Geology: 70% coarse and fine sand, 30% clay and loam, gravel, boulders

Tunnel lengths: total of 5,860 m, 16 drives of 80 to 930 meters

Particular features: high groundwater level, long-distance driving, curve drives

Machine data

Herrenknecht M-1083M, AVND2000AB with Extension Kit, excavation diameter 3,025mm

Herrenknecht M-1363M, AVND2400AB, excavation diameter 3,025mm

Cutterhead: mixed-soil cutterheads fitted with disc cutters and cutting knives

Max. torque: 780kNm, 1,200kNm

Tunnel lining: Pipe Jacking

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The graphics for publication are attached as printable files. They include:

Fig. 1:



Ready to go: the Herrenknecht AVND2400AB for the underground connection of a new wastewater treatment plant in Warsaw, Poland.

Fig. 2:



The jobsite teams realized in total 16 tunnel sections with lengths up to 930 meters with pipe jacking.

Fig. 3:



To connect the sewer system with the "Czajka" wastewater treatment plant, the Herrenknecht Mixshield S-642 (Ø 5.35m) will be used for the 1,300m long Vistula River Crossing tunnel.