

PROJECT

## METRO WARSAW GROUND FREEZING



### PROJECT NAME

Second Warsaw metro Line. Mixed method ground freezing at station C13 Powisle underneath the Wislostrada Tunnel

### CLIENT

Capital City of Warsaw

### ENGINEER

Studio Balossi Milan

### GENERAL CONTRACTOR

Joint Venture AGP: ASTALDI GÜLERMAK PBDIM

### SUBCONTRACTOR

RODIO GmbH Spezialtiefbau

### CONTRACT VALUE

EURO 8,0 Mio CHF 9,8 Mio

### BEGINNING OF WORKS

OCTOBER 2013

### END OF WORKS

MARCH 2014

### JOB DESCRIPTION

The freezing of soil with the mix method (combination of liquid nitrogen and brine freezing) has been carried out to create a temporary support structure for four tunnels excavated at the new underground station C13 in Warsaw. The tunnels lay in fine silty sands overlying a clay layer and are located 20 m below the ground water level. The two semi-tunnels from the West shaft are partially embedded in very plastic clays, whereas the two from the East shaft are embedded in a sandy clay layer only in the invert zone. The holes for the installation of pipes freezing and thermometers were drilled against water pressure using special Preventers (BOP) to avoid uncontrolled water and soil losses. The first stage of freezing was made using Liquid Nitrogen (LN) in order to reach quickly the required frozen wall thickness whereas the maintenance stage was performed using brine. For both phases the same freezing pipes, with high resilience steel, with the use of an additional copper pipe, have been used.

### WORK QUANTITIES

670 drilled holes, drill depth: 5 to 20 m. Total drilled length: 10.500 m

Total Volume of frozen ground: 3.000 m<sup>3</sup>

610 freezing pipes, 60 Thermometer Strings with a total quantity of 380 measuring points.

### MAIN EQUIPMENT

5 Drill rigs: EGT 710 SM14 MC1200 DB100 EGT FM315

1 Mixing and Grouting plant

2 Brine Freezing plants with a power of 370 KW each at -35 °C

5 LN Tanks plants with a total capacity of 260m<sup>3</sup>

Drilling Parameter Recording by means of LUTZ LT3 system

Online monitoring and control of temperatures and plants



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Liquid nitrogen installations - West Shaft



Frozen body seen from the tunnel



Liquid Nitrogen Tanks



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