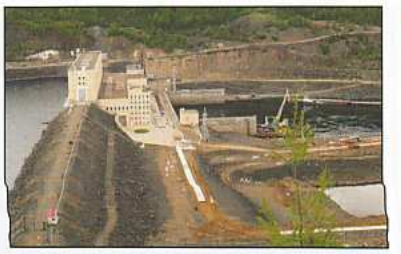
A touch of frost

A Comacchio MC 3000 rig was chosen to install a sheet-pile retaining wall on a hydropower plant in Siberia



Overall view of the Svetlinskaya HPP site

Extraction of the core after diamond drilling

"This area is characterised by extremely cold winters from -32°C to -39°C"

The Svetlinskaya HPP is the only hydroelectric plant in the world built on permafrost instead of rocky ground, on the banks of the Vilyuy River, in the Sakha Republic in the far east of Russia. This subarctic area is characterised by extremely cold winters with average temperatures ranging from -32°C to -39°C in January.

The design of the plant, which started in the late 1970s, required a series of innovative technological solutions and was carried out by the Lenhydroproject research institute (part of RusHydro).

In 2008 the station was officially commissioned with three (out of four) generators. The planned output of the plant is 360MW with an average annual production of 1.2 billion kWh. The capacity is currently estimated at 270MW.

DAMAGE CONTROL

The composition of the hydropower plant includes a left-bank dam (112m long; max. height 50m), right-bank dam (273m long; max. height 50m), inlet and outlet channels and the combined riverbed powerhouse.

A design feature of the bottom of the outlet waterway is the covering of the channel soils with reinforced concrete plates across the entire width of the channel (about 135m), with a special elevated 'apron' at a distance of 53-100m from the edge of the hydroelectric dam.

During the operation of the hydroelectric power station, due to the strong turbulent flow of the water, the apron slabs situated farthest from the wall of the dam collapsed. The remainder of the apron was under threat of under-washing and destruction.

To prevent further destruction of the reinforced concrete plates composing the apron, St Peters-

The Comacchio MC 3000 is equipped with a DTH hammer and loaded onto the barge

burg-based company Stroitelnoe Upravlenie N. 299 was commissioned to construct a sheet-pile wall over the entire section of the outlet waterway.

The design was developed by the Hydroproject design institute, with participation from the contracting organisation, and includes the installation of 155 pipes with 720mm diameter into the soil beneath the concrete plates of the apron to a depth of 11.5m.

ON SITE

"Carrying out of the work is planned for two summer/autumn seasons (2013-2014), when the load on the power units of the plant is reduced to 40-50MW, the head water race drops to 8-8.5m, and the flow velocity of water in the outlet waterway is 0.5-1m/s, thus allowing us to perform diving operations," explains V. Klimov, academic consultant and development director at Stroitelnoe Upravlenie N. 299, one of the leaders of the project, which is managed by project director V. Korshunov.

Accordingly, part of the project was completed last summer and autumn. The work process was organised in four stages:

- Creating a groove through each concrete plate of the apron by diamond drilling;
- Installation of the 11.5m-long sheet-pile pipes along the groove axis;
- Installation of reinforcement in the inner cavity of the pipes and underwater concreting;
- Underwater concreting of the clearance between the concrete plates' walls and the sheet piles.

The diamond drilling involved in the first stage was performed using two concrete-drilling machines mounted on a concrete base and equipped with underwater lighting and video surveillance systems. Drilling was performed with underwater positioning of the machine by a diver using a floating crane. The hydraulic power pack on a barge was connected with the rig through high-pressure hoses. The machine was controlled by an operator on the barge with help from the images transmitted by the cameras.

The next stage involved the installation of sheet piles by means of rotary-percussive drilling through the grooves created.

The installation of the sheet-piling pipes, with 720mm outer diameter and 10mm wall thickness, was performed by means of an 18in (45.7cm) down-the-hole (DTH) hammer using an overburden drilling system. Three-metre-long canned rods of 273/530mm diameter, weighing 1,052kg each, have been specifically designed and manufactured for this project in the Czech Republic.

A drilling rig to carry out this project had to fulfil specific requirements, including:

- up to 45t weight, to ensure secure placement on a barge with a displacement of 200t;
- pull-up force able to work with a complete drilling assembly weighing 9.5t;
- low rotation speed;
- increased torque for the rotation of the bit with 785mm diameter;
- swivel with a passage no less than 3in (7.6cm) to reduce pressure losses;
- availability of lubricator; and
- availability of hydraulic jacks to hold the drill assembly suspended during tripping.

"We found the machine that best met these requirements was the Comacchio MC 3000. With 42t weight, the machine features 15t feed/retract force and was equipped with a rotary head with 7800daNm torque at 22rpm," says Klimov.

Comacchio's area manager, Alessandro Comacchio, explains: "We had to equip the machine with a special rotary head able to perform DTH drilling at such a large diameter. Also, we developed a special automatic lubricator with the possibility of regulating hammer lubrication."

The work on the banks of the Vilyuy River will be continued during the summer/autumn season of 2014.

"We found the machine that best met our requirements was the Comacchio MC 3000"

Centre column: sheet-pile installation and drilling operations

Near left: the project also involved the work of a team of divers