Russia pumped hydro storage

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The designs of both pumped storage projects were completed by Institute Hydroproject, which is part of the Rushydro Group, one of the largest generating companies in Russia. Zagorsk PSP-2 is an unusual project in that it is being constructed entirely on a soft base and without suspension of activities at the first pumped storage project. The main parameters of the project are as follows:

* Capacity in generator mode 840MW, in power consumption mode - 1000 MW.

* Annual energy output -1000MkWh, annul power consumption 1350MkWh.

Institute Hydroproject examined 18 sites to discover the most optimum location for the project. The most promising proved to be in the Moscow Region where the deficit of load-following regulating capacity is about 1.5MkW. The most feasible solution was to build the project near the existing pumped storage project on the river Kunya at Bogorodskoye township. The site already had the necessary transport infrastructure, and some parts of the construction plant still existed. This, together with the absence of ecological limitations, enabled the construction of the project to begin quickly. However, the site was not without its problems. Investigations by Institute Hydroproject uncovered some issues that had to be addressed in the project design.

Hydrological and geological features

Considering the fact the soft base of the main hydraulic units of Zagorsk PSP-2 have not been studied thoroughly using traditional methods, it would be reasonable to specify the physical and mechanical characteristics of the soils which form the base of the main units. The new way to calculate this is based on the new method elaborated for design definition of the physical and mechanical characteristics of the base, taking into consideration data on settlement of the buildings and deformation of the soft base.

For this purpose, the design of constantly active mathematical models of systems "structure-foundation" for the main hydro units is required, as well as for the water intake structure which is one of the most important facilities in the water retaining structure.

Using the series of iterative calculations with field data of settlement of the buildings and deformation of their foundations, it may be possible to define the physical and mechanical characteristics of the soils forming the base of the main units of Zagorsk PSP-2.

Zagorsk PSP-2 includes the following structures: upper pool; reverse intake incorporated into the body of the retaining dike of the upper pool; four lines of steel reinforced concrete open penstocks of inner diameter 7.5m;

station block consisting of the powerhouse and assembly bay, transformer workshop, the rooms of start-up thyristor devices, reverse channel, service building; lower storage pool created through the expansion of the existing lower pool of Zagorsk; and transmission structures.

This is designed to hold 11.9Mm3 of water. The pool stability is provided by its special geometry. The dike has a maximum height of 40m, minimum height of 14m, the width of water area is 1090m, and it is 1870m long. The wide spread profile of the pool enables soil balance to be optimized due to the large excavation volume of the lower pool arrangment. Of interest is the procedure for first filling. During the flood, the first to be filled is the lower common pool, from there part of the water which flows through the units of the existing Zagorsk project is pumped into the upper pool up to elevation 255m. To compensate for any anthropogenic hydrodynamic effect, the intermorainal aquifer will be drained. This will help dewater sandy and sandy-gravel-pebble materials.

The upstream slopes have ratios of 1:3.5 (protected by reinforced concrete) and 1:7 (protected by sandy-gravel mixed with stone). The downstream slope is 1:2.5 protected by grass sowing and drainage.