ESTIMATED STUDY OF SPATIAL FLOW IN THE FLOW PART OF THE HIGH-PRESSURE FRANCIS TURBINE

Mironov K.A., Oleksenko Yu.Yu., Mironov V.K.
National Technical University
«Kharkiv Polytechnic Institute»,
Kharkiv

Improving the flow parts of the hydro turbine is based on conducting extensive numerical investigations, during which the search for the most rational variants. The basis of this research is the multivariate numerical analysis of the influence of geometric and operating parameters on the energy performance of the hydro turbine. To solve this problem, both simplified flow models and a more complex kinematic flow description using quasi-three-dimensional and three-dimensional fluid flow models are used.

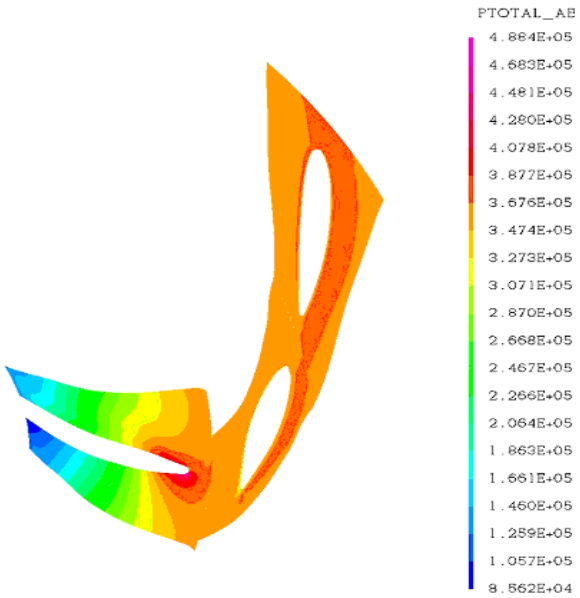

Fig. 1. Isolines of total pressure in the middle part of blade systems

Numerical simulation of the flow in the flow parts of the hydro turbine Fr500 was carried out for the design area, including the intervene channel formed by stator columns, shoulder guide vanes, runner blades and draft tube for a model with a diameter runner D_1=500 mm.

The obtained results of the calculation of the spatial flow are presented in the form of averaged values of the total and static pressures of flow, averaged flow angles in relative and absolute motion, and values of losses in individual elements of the flow parts. For runner at a mode point with minimal total losses close to optimal, a static and total pressure field in the computational domain, the distribution of the components of the meridional and peripheral components of the full velocity before entering and output the runner, as well as the trajectory of fluid particles in draft tube.

The pressure continuously decreases along the meridional direction from the entrance to the stator to the exit from runner, as can be seen from fig. 1. The pressure becomes negative at the exit from the runner due to the influence of the draft tube.

Analysis of losses in the supply shows that the greatest energy losses occur in the guide vanes. Losses in the spiral case and in the stator constitute no more than one third of the losses of the guide vanes. The total losses in the supply change smoothly with increasing flow and have a minimum, in absolute values up to 65% of all hydraulic losses in the flow parts, which is a characteristic feature of high-pressure Francis turbine.