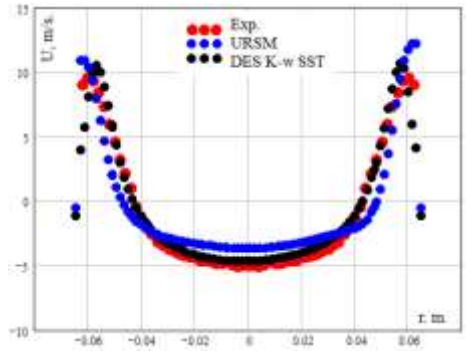

Fig. 4 Axial velocity in the draft tube in aerodynamic turbine

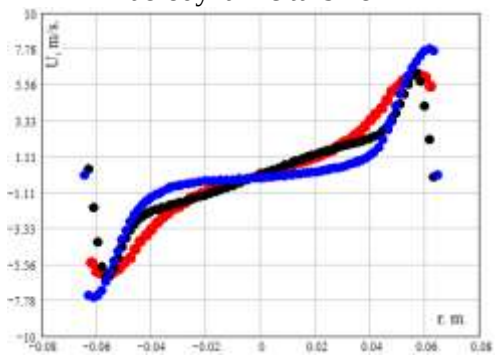

Fig. 5 Tangential velocity in the draft tube in aerodynamic turbine

5 Conclusion

The paper proposed and tested a numerical method for the simulation of flow in hydraulic turbines.

Designed and assembled a unique aerodynamic stand, which is a miniature copy of the actual hydroelectric power. At the booth, a series of experiments simulating different modes of hydroelectric works. We measure the velocity components and the pressure pulsation in the draft tube diffuser.

Using numerical simulation technique of carrying current in the aerodynamic stand. The comparison of the calculated and experimental data. Good coordination of the calculated and experimental data suggests the possibility of the use of numerical methods for the application of engineering problems. Moreover, use the aerodynamic stand for construct the structural elements Designing and testing of numerical methods.

Acknowledgements

We thank Russian Science Foundation for financial support (project No. 16-19-00138).

References:

[1] Doerfler P. System dynamics of the Francis turbine half load surge. 1982, Proc. IAHR Symp. on Hydraulic Machinery and Systems, Amsterdam, Netherlands.

[2] Alligne S., Maruzewski P., Dinh T., Wang B., Fedorov A., Iosfin J. and Avellan F., 2010, Prediction of a Francis turbine prototype full load instability from investigations on the reduced scale model. Proc. IAHR Symp. on Hydraulic Machinery and Systems, Timisoara, Romania.

[3] Kuznetsov I., Zakharov, A., Orekhov, G., Minakov, A., Dekterev, A., Platonov, D. Investigation of free discharge through the hydro units of high head Francis turbine. IOP Conference Series: Earth and Environmental Science 15 (PART 5). 2012. doi: 10.1088/1755-1315/15/5/052002

[4] Litvinov I. V., Shtork S.I., Kuibin P.A., Alekseenko S. V., Hanjalic K., 2013, Experimental study and analytical reconstruction of precessing vortex in a tangential swirler, Int. J. Heat Fluid Flow 42: 251–264.

[5] A.V. Minakov, A.V. Sentyabov, D.V. Platonov, A.A. Dekterev, A.V. Zakharov The numerical simulation of low frequency pressure pulsations in the high-head Francis turbine, Computer and fluids, Vol. pp. 197-205

[6] A.V. Minakov, A.V. Sentyabov, D.V. Platonov, A.A. Dekterev, A.V. Zakharov, The analysis of unsteady flow structure and low frequency pressure pulsations in the high-head Francis turbines, International Journal of Heat and Fluid Flow, Vol. 53, pp. 183–194

[7] Spalart P.R., Jou W.-H., Strelets M., Allmaras S.R. Comments on the feasibility of LES for wings and on a hybrid, RANS/LES approach / In Lue, C. and Lue, Z., (eds)// Advances in DNS/LES, Proceedings of 1st AFOSR International Conference on DNS/LES, Ruston, LA, August, 4-8, Greyden Press, Columbus, OH. – 1997. – pp. 137-147.

[8] Gavrilov A., Dekterev A., Sentyabov A., Minakov A., Platonov D. Application of hybrid methods to calculations of vortex precession in swirling flows // Notes on Numerical Fluid Mechanics. 2012. T. 117. P. 449-459.

[9] Cervantes M.J., Engstrom T.F., Gustavsson L.H., 2005, Proc. The third IAHR/ ERCOFTAC workshop on draft tube flows Turbine 99. Sweden, Porjus,. 193 p.

[10] Minakov, A.V. Sentyabov, D.V. Platonov, A.A. Dekterev, A.A. Gavrilov, 2014, Numerical modeling of flow in the Francis-99 turbine with Reynolds stress model and detached eddy simulation method. Journal of Physics: Conference Series Volume 579, doi:10.1088/1742-6596/579/1/012004.