MITIGATION OF PRESSURE PULSATIONS FROM THE CONICAL DIFFUSER USING THE PULSATING JET DEVICE

Goal of the project

The aim of this project is to focus on the influence of the pulsating jet on the dynamic and energetic performances of the conical diffuser, when the hydraulic turbines operate on a wide range of regimes. Thus the purpose of the initiative is: the safe extension of the operating regime of turbines or pump-turbines, by reducing or eliminating the self-induced non-stationarity of the flow with rotation, with the associated effects - noise, vibration, mechanical and dynamic loads. The project does not necessarily address the method itself, but rather its fundamentals, for a better understanding of the mechanism and effects of the pulsating water jet, in turbines and turbine pumps.

Short description of the project

The fundamental problem to which this project is addressed is the study at several operating regimes of a new method of controlling the decelerated swrling flow, with helical swirl. The new method consists of axial injection of a pulsating water jet along the axis of the suction tube of the hydraulic turbines, in order to reduce the pressure oscillations due to the swirling flow that appears at operating regimes far from the optimum one.

Implementation period

01.02.2020 - 15.06.2020

Budget

47.600 RON (10000 EUR)

Main activities

- O1. Experimental investigations with and without pulsating jet.

A.1.1. Implementation of the variable speed system, for obtaining different operating regimes of rotational flow

A.1.2. Testing the pulsed jet method at 5 operating modes

- O2. 3D numerical analysis of the swirling flow at different operating regimes with and without a pulsating jet

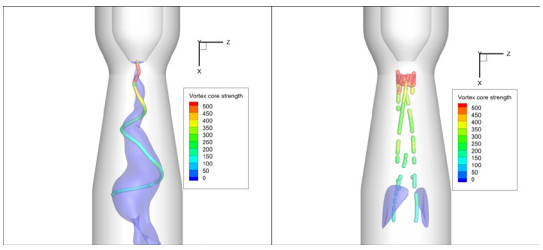
A 2.1. 3D numerical analysis at 5 operating modes with pulsed jet

A. 2.2. Comparison of numerical data with experimental data.

Results

Thus, during the first phase of the project, the numerical analysis of the 3D flow at different operating points of the turbine was analyzed, with and without the technique of water injection with pulsating jet. The numerical analysis was performed using the FLEUNT expert software from ANSYS 16.2. The qualitative images of the velocity field below, obtained from the numerical simulation, show clearly that, with the introduction of the pulsating water jet along the axis of the conical diffuser, the helical vortex disappears, including the pressure pulsations associated with it, which damages the turbine.

- All the results can be found published in articles:
- C. TANASA, A. Bosioc, A. Stuparu and R. Susan-Resiga, "Numerical Analysis of Pulsating Water Jet Method in a Conical Diffuser at Different Operating Regimes", CIEM 2019, published IEEE.
- C. TANASA Adrian STUPARU, Catalin STROITA, Constantin POPESCU and Romeo SUSAN-RESIGA, (2019), 3D Numerical Analysis of Pulsating Water Jet in the Draft Tube Cone of Hydraulic Machinery, ICCMSE, Rhodos, Greece, AIP conference Proceedings, 2186.
- A. Bosioc, C. Tanasa*, 2020, Experimental study of swirling flow from conical diffusers using the water jet control method, Renewable Energy, 152, p.385-398. https://doi.org/10.1016/j.renene.2020.01.08
- C. Tanasa, A. Bosioc, S. Muntean, R. Susan-Resiga, 2019, A Novel Passive Method to Control the Swirling Flow with Vortex Rope from the Conical Diffuser of Hydraulic Turbines with Fixed Blades, Appl.Scienc., 9 (4910).



Applicability and transferability of the results:

The method to be tested on the experimental stand will be proposed for use on real hydroelectric power plants from the national electricity company SC Hidroelectrica SA Romania, which is a partner of UPT in different contracts in the field of hydraulic machines.

Research team

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