HydroFlex Peer-Reviewed Publications and Conference Proceedings

HydroFlex

Increasing the value of hydropower through increased flexibility

Deliverable 6.18 Peer review publications and proceedings from conferences 1

Work package	WP6 Communication, dissemination and exploitation
Task	Task 6.4 Publications and presentations
Lead beneficiary	Multiconsult
Authors	
Due date of deliverable	30.06.2019
Actual Submission date	24.06.2019
Type of deliverable	Websites, patents filling, etc.
Dissemination level	Public

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1 Introduction

Peer-reviewed scientific publications in journals and conference proceedings is a core part of disseminating the results of the HydroFlex project. The project has stated the quantitative target of more than 32 peer-reviewed publications. This deliverable lists the peer-reviewed HydroFlex publications from the first 14 project months. Open access to all publications will be ensured.

2 List of peer-reviewed journal publications and conference proceedings

Felicetti, R, Abrahamsson J & Lundin, U (2019): *Experimentally validated model of a fast switched salient pole rotor winding*. Forthcoming in Proceedings of the IEEE WEMDCD 19. Greece.

> Abstract: The article proposes a model of a salient pole synchronous machine field winding based on a single transmission line model. An experimental method to derive the parameters is also presented and validated. Finally the measured voltage distribution in the winding is compared to the model voltage distribution and the results match, demonstrating the model capabilities. The model describes the intrinsic resonance phenomena and accurately determines the voltage amplification factor.

Foti, P & Berto, F (2019) Evaluation of the strain energy density value for welded joints typical of turbine runner blades. Forthcoming in Journal of Physics: Conference Series. Francis-99 workshop 3.

> Abstract: The main aim of this work is to investigate the fatigue behavior of welded joints through an energetic approach based on the Strain Energy Density failure criteria. The geometrics, taken from the literature, are typical of turbine runner blades. The results of the fatigue tests on these details were summarised through the Strain Energy Density approach. The application of this method to these geometries is the first step of a wider research with the aim to provide a suitable tool in FEM code for the lifetime estimation of components characterized by complex geometrics.

Juarez, A, Adeva-Bustos, A, Alfredsen, K & Dønnum, B (2019): *Performance of A Two-Dimensional Hydraulic Model for the Evaluation of Stranding Areas and Characterization of Rapid Fluctuations in Hydropeaking Rivers.* Water 11(2), doi:10.3390/w11020201

> Abstract: Extreme, short-duration fluctuations caused by hydropeaking occurs when hydropower is regulated to cover demand peaks in the electricity market. Such rapid dewatering processes may have a high impact on the downstream biological conditions, particularly related to stranding of fish and other species. The present work analyzes these fluctuations using a two-dimensional unsteady hydraulic modelling approach for quantification of two important hydro-morphological factors on fish stranding risk: the variation in wetted area and the dewatering ramping rate. This approach was applied on the two-kilometer-long reach of Storåne downstream of the Hol 1 power plant, where topo bathymetric LiDAR (Light Detection and Ranging) data was available providing a high-resolution digital elevation model. Based on this model, hydraulic conditions could be simulated in high detail allowing for an accurate assessment of the hydro morphological factors. Results show the dried area

distribution at different flows and dewatering ramping rates. The attenuation of the water level fluctuation due to the damping effect along the river reach controls the dewatering rate. We recommend an alternative scenario operation which can reduce the impact of the peaking operation and estimate the operational mitigation cost. We find that the modelling based on the fine resolution grid provides new opportunities in assessing effects of hydropower regulations on the ecosystem.

Lazarevikj, M., Stojkovski, F., Iliev, I & Markov, Z. (2019) Influence of the guide vanes design on stress parameters of Francis-99 turbine. Forthcoming in Journal of Physics: Conference Series. Francis-99 workshop 3.

Abstract: The frequencies with predominant amplitudes in low specific speed Francis turbines are related to rotor-stator interaction and they are calculated on the basis of the runner speed and the number of guide vanes and runner blades. Pressure pulsations in the blade channels can be a reason for noise and vibration in the turbine above allowed level. High pressure pulsations can be caused by certain combination of runner blades and guide vanes and their modifications are analysed in this paper. The main aim is to determine the impact of the geometry modification (thinner for increased efficiency) of the guide vanes on the Francis turbine stresses by performing numerical simulations. The original Francis-99 turbine guide vane geometry and three modifications consisting of new guide vane shapes are being considered. The numerical investigation of the flow field is based on the k-ω SST turbulence model with 'frozen rotor' approach selected, constituting a quasi-steady state analysis, without taking into account the physical rotation of the runner to obtain Rotor-Stator-Interaction (RSI). Pressure distribution on one guide vane determined by a Computational Fluid Dynamics (CFD) simulation of the turbine is coupled to a Finite Element Method (FEM) simulation in order to analyse the stresses. The results from the one-way fluid-structure interaction analysis give the stresses distribution and deformations of the guide vanes. Moreover, modal-acoustics analysis is conducted to obtain the natural frequencies of the guide vanes in water and comparison is made with the calculated vortex shedding frequencies to estimate the risk of resonance.

Markov, Z, Stojkovski, F, Lazarevikj, M & Iliev, I (2018): *Investigation of the possibilities for development of a variable speed hydraulic turbine*. Energetics 2018 Conference Proceedings Book, pp. 333-341. https://www.h2020hydroflex.eu/wp-content/uploads/2018/11/Markov-et-al.-Investigation-of-the-possibilities-for-development-of-a-variable-speed-hydraulic-turbine.pdf

Abstract: The need of hydropower, as a renewable energy resource, nowadays is increasing more and more. The goal is to obtain more efficient and more reliable power generating equipment for rational and long-term harnessing energy from water. Following the Horizon 2020 goals in the field of renewable energy, the need for development of a variable speed hydraulic turbine was exploited. The potential benefits of developing such as hydraulic generation unit with variable speed are described in

this paper along with the theoretical background used as a starting condition to be taken into account for the further development processes. The “Ss. Cyril and Methodius” University is a partner is a project called HydroFlex, with the aim of developing a variable speed high pressure Francis Turbine, with particular goal to develop the stay/guide vanes cascade to be suitable for such hydraulic turbines.