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Francis Design and Prediction Technology for Flexible Operation

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Abstract:

Traditionally, hydro power plants have been operated close to the best efficiency point, the more stable operating condition for which they have been designed. However, because of changes in the electricity market, many hydro power plant operators wish to operate or already operate their machines differently to fulfil new market needs. New operating conditions can include the whole 0 to 100% range of operation, numerous start/stops, extensive low load operation, synchronous condenser mode and power/frequency regulation. In order to design reliable 0-100% Francis™ runners for these new challenging operating scenarios, Andritz Hydro has developed various proprietary tools and design rules. These are used within Andritz Hydro to design mechanically robust Francis runners for the operating scenarios fulfilling customer's specifications. Hydraulic development and mechanical verifications are done conjointly to converge toward an optimal solution. Francis runner dynamic stresses on the complete operating range from 0-100% load can be predicted and compare well with prototype strain measurements. In addition to operation under a wider operating range, the number of start-ups has also a significant impact on Francis runner fatigue life. In our paper, we will present details of the design considerations required for operating Francis turbines from 0 to 100% power.