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Modelling of the multiple Francis turbine by velocity diagram for speed control application

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Abstract.Hydro power is one of the oldest and extensively used renewable sources of energy. Requirement of the electrical energy increased due to recent development of the technologies rapidly. Environmental impact by non renewable source of power generation and awareness of the use of green energy various researches reported to improve the performance of the renewable energy sector. Green power generation unit like, non inertial solar power and wind power also presently connected to grid, which cause of fluctuation of the frequency of generated power. To improve the existing frequency control system to generate stable quality power become essential due to intermittent of the non inertial power generation system. In the present study velocity diagram based Francis turbine mathematical model has been developed. The velocity diagram based turbine model can capture the dynamics of the water flow through turbine IGV due to variation of the IGV angle. The variation of the turbine mechanical power generation due to the change of flow direction cause of IGV angle variation can be capture better with the consideration of velocity diagram based modelling inspite of orifice flow formulation reported by the other researcher. Instead of a big turbine installation multiple small turbine installation has advantages like less maintenance cost, no need to shut down whole power generating unit at a time, less material cost in piping etc. In this paper three Francis turbine sharing a common tunnel for water flow has been considered. As the multiple turbine connected to the common conduit has shown more complex configuration suitable controller design important for the same. In the present study a fuzzy PI controller has been employed for the speed control of the turbine system. Simulation study has been performed using Matlab Simulink environment. The proposed controller performance has been found satisfactory.