Paper No. 26

ON THE USE OF STATIC AND ROTATING COORDINATE MEASUREMENTS TO UNDERSTAND TRANSIENT BEHAVIOURS IN HYDROELECTRIC TURBINES

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ABSTRACT

Transient events could contribute significantly to the fatigue damage sustained by hydroelectric turbines during operation. This paper details the case of the transient event following a load rejection. During a load rejection, the power generated by the turbine runner when the generator is connected to the electrical grid is transformed into angular acceleration as soon as the synchronization is lost. The runner then goes into overspeed and the protection system closes the wicket gates at a specific rate limiting the water hammer overpressure build-up in the penstock and stopping the runner rotation. The runner dynamic strain response during this transient depends on both the runner geometry defined during the design phase and the governing system protection. Our results show that the configuration of the protection system could be optimized during commissioning in order to improve the vibration response of the runner. In this paper, the dynamic responses of three hydroelectric turbines of similar design are compared. For the first two cases, measurements taken on both static and rotating coordinate systems were available. However, for the third turbine, we had access only to static coordinate measurement. In that last case, a methodology developed from the measurements of the first two fully instrumented runners makes possible to adjust the governor parameters to control the runner response and thus limiting potential damage caused by load rejections. Notice that, even if the runners have similar design, differences in the dynamic behaviour have been observed between the turbine runners. Furthermore, some measurements were under-sampled but the aliased signal could be corrected in order to obtain signals suitable for analysis. The paper presents the methodology used and an overview of the results obtained.