Frequencies in the Vibration Induced by the Rotor Stator Interaction in a Centrifugal Pump Turbine - DTU Orbit (17/11/2019)

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The highest vibration levels in large pump turbines are, in general, originated in the rotor stator interaction (RSI). This vibration has specific characteristics that can be clearly observed in the frequency domain: harmonics of the moving blade passing frequency and a particular relationship among their amplitudes. It is valuable for the design and condition monitoring to count on these characteristics. A CFD model is an appropriate tool to determine the force and its characteristics. However, it is time-consuming and needs highly qualified human resources while usually these results are needed immediately and in situ. Then, it is useful to determine these characteristics in a simple, quick, and accurate method. At present, the most suitable method indicates a large amount of possible harmonics to appear without indicating the relative importance of them. This paper carries out a theoretical analysis to predict and explain in a qualitative way these frequencies and amplitudes: The theoretical analysis incorporates the number of blades, the number of guide vanes, the RSI nonuniform fluid force, and the sequence of interaction. This analysis is compared with the method currently in use, and both methods are applied to a practical case. The theoretical analysis gives a resulting force over the pump turbine, which corresponds well to the measured behavior of a pump turbine in terms of its frequencies and the relationship between their amplitudes. A corrective action is proposed as a result of the analysis and after it is carried out in one of the units, the vibration levels are reduced.

The vibration induced by the RSI is predicted considering the sequence of interaction and different amplitudes in the interactions between the same moving blade and different stationary blades, giving a different and original interpretation about the source of the vibration characteristics. A successful corrective action is proposed as a consequence of this new interpretation.

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