INVESTIGATIONS ON NON-STEADY BEHAVIOUR OF ROTORS DUE TO LIGHT RUBBING TO BRUSH SEALS

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Abstract. *One option to increase efficiency of turbomachines is the reduction of leakage losses by using and improving sealing concepts with minimized clearance, accepting the risk of rub of rotors to the seals under operational conditions. Beside wear and subsequently increased leakage losses, rub affects rotordynamics of turbomachines with reaction to fluid dynamics again. Brush seals consider these issues and combine excellent leakage characteristics with compliant behaviour under rub conditions. While brush seal related topics like leakage characteristics, fluid dynamics, design issues and wear were investigated in detail during the last decades; publications concerning impact of brush seals on rotordynamics are more or less rare. The following paper deals with the influence of light rub of rotors to brush seals on rotordynamics. Light rub implies frictional heat, partly entering the shaft and leading to thermal expansion. A not uniform heat distribution of the shaft through eccentric rub can lead to thermal bending of the shaft causing further growth of shaft deflection. This phenomenon is known as Newkirk-Effect also referred to as Spiral Vibrations because of the spirally shaped shaft orbit in rotating coordinates. Depending on thermal parameters and damping in particular, stable and unstable operating areas can be identified. In extension to existing steady state descriptions this paper pursues a transient consideration of spiral vibrations due to rub to brush seals. The objective is a better understanding of the magnitude and implications of spiral vibration and its possible prediction during run-up and rundown. For that purpose the power loss due to rub is taken into account and a rotordynamic analysis is conducted for a simple rotor model consisting of a bulky shaft rubbing to a brush seal supported by rigid bearings. In a first step a run-up with a constant low drive torque is considered with focus on behaviour at stability limit near first eigenfrequency.*