

APPLICATION OF ROTOR DYNAMIC ANALYSIS FOR EVALUATION OF SYNCHRONOUS SPEED INSTABILITY AND AMPLITUDE HYSTERESIS AT 2ND MODE FOR A GENERATOR ROTOR IN A HIGH-SPEED BALANCING FACILITY

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ABSTRACT

The paper presents a high speed balancing facility case history of a generator rotor with a long turbine end overhang. This turbine had experienced rapid increase in vibration at 3600 RPM and amplitude hysteresis at the 2nd mode between run-up and run-down during shop balancing. This behavior raised concerns about the possibility of excessive generator rotor vibration on site.

A rotor-bearing-support system model was created to study the observed generator behavior in the balance facility. Critical speed, unbalance response, and damped eigenvalue analyses were performed. Examination of the rotor kinetic and potential energies for the 2nd mode showed that over 78% of the rotor 2nd mode kinetic energy was associated with the overhang. The analysis indicated that when the rotor operated at 3600 RPM, between the 2nd and 3rd modes, the overhang motion increased due to amplification of both modes and very little damping. As a result, vibration at the bearings increased and when the rotor decelerated through the 2nd mode the increased motion on the coupling generated excessive vibration.

The model was modified by adding coupling constraints to represent operating conditions of this rotor in the unit. The 2nd mode was shifted out of operating speed range, which was confirmed by the field operation.

The rotor was balanced and now operates with vibration levels under 1.5 mils at full load. This paper illustrates how rotor dynamics analysis help to explain unusual rotor behavior and provided assurance that vibration performance of this rotor on site will not be affected. Vibration plots from the balancing facility, DyRoBes models, critical speed analysis, unbalance response plots, and field vibration data are included as illustrations.

Keywords: High speed balancing, rotor dynamics, mode shape, critical speed analysis, unbalance response