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DYNAMIC BEHAVIOR OF GTU ROTOR-BEARINGS-CASING SYSTEM

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ABSTRACT

Dynamic behavior and response to possible seismic loading of GTU rotor-bearing casing system are investigated. Power turbine rotor is supported by two fluid film bearings with four and six tilting pads. Finite element (FE) model of rotor with nonlinear supports and rotor-bearing casing system model are developed. The problems of eigenvalues and eigenmodes determination, rotor dynamics investigation with usage of Newmark direct integration method and spectral analysis of the structural response to seismic loading are solved at different steps of investigation.

Rotor finite element model, comprising special finite elements, that consider fluid film bearing nonlinear stiffness and damping are used for dynamic behavior analysis at the step of the structural design. Titling pad and multilobe bearing models are developed for determination of special finite element stiffness and damping matrices. These models assume coupled solution of incompressible lubrication flow problem in clearance between shaft journal and pad surfaces and problem of each pad stable position definition with working surfaces compliance taken into account. Rotor orbits in bearings and spectrum cascade plots, corresponding to them are obtained for turbine startup. Bearing malfunctions affection on rotor dynamic behavior is investigated.

Finite element model of rotor-bearings casing system is developed for structural response analysis under the action of up to 9 balls earthquake. Evaluation of dynamic reactions in supports and attachment elements is carried out. It is shown, that the action of rotor gyroscopic moments may cause changes in natural frequencies of the structure and leads to considerable rotor and casing relative displacements, that have an influence on gasdynamic route gap values.

Keywords: gas turbine power unit, rotor dynamics, tilting pad bearing, elastohydrodynamic contact problem, seismic response