

Investigation on Unsteady Flow of a Turbine Stage with Negative Bowed Stator

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Abstract : Complicated unsteady flow in axial turbines produces high-frequency unsteady aerodynamic exciting force, which threatens the safe operation of turbines. This paper illustrates how negative-bowed stator reduces the rotor unsteady aerodynamic exciting force by unsteady flow field. With the support of three-dimensional viscous compressible Navier-Stokes equation, the single axial turbines with 0, -10 and -20 degree bowed stator are comparably investigated, aiming to identify the flow field structure difference caused by various negative-bowed degrees. The results show that negative-bowed stator strengthens the turbulence kinetic energy, which is further strengthened with the increase of negative-bowed degree. Meanwhile, the flow phenomenon including stator wakes and passage vortex is shown. In addition, the interaction of upstream negative-bowed wakes contributes to the reduction of unsteady blade load fluctuation. Furthermore, the aerodynamic exciting force decreases with the increasing negative bowed degree, while the efficiency is correspondingly reduced. This paper provides the reference for the alleviation of the harmful impact caused by unsteady interaction with the method of wake control.

Keywords : unsteady flow, axial turbine, wake, aerodynamic force, loss

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