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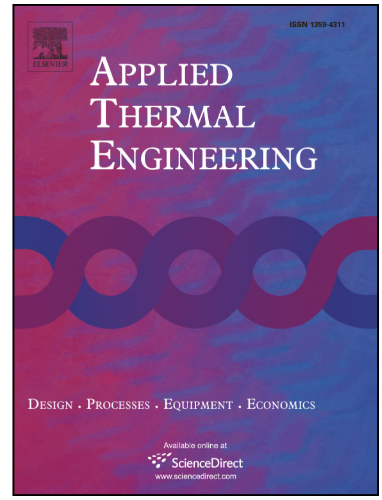

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Unsteady Behaviour of a Twin Entry Radial Turbine under Engine Like Inlet Flow Conditions

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ABSTRACT

The aim of this numerical study is to characterize the flows of a twin-entry radial turbine and the development of Dean vortices in its asymmetrical volute, as well as to examine the hysteresis-like behaviour under engine like inlet flow conditions. In pulsating flow conditions, there is a typical dissymmetrical behaviour characterized by high non-uniformities in the spanwise and circumferential directions at the rotor entry. Accordingly the isentropic total-to-static efficiency deviates noticeably from the steady state and the shaft power tend to follow the inlet total pressure. The flow in the spiral part of volute is characterized by the secondary flows in the form of counter-rotating Dean vortices formed practically within the hub side of volute. This swirling flow leaves the volute before an azimuthal position of 180 deg from the tongue and is convected to the rotor entry to influence the flow in interspaces and upstream rotor entry. The modification to the reference volute, keeping the circumferential distribution of global geometrical ratio (A/R) constant whereas that of the hub-entry side is chosen greater than that of shroud side, has led to new flow structures in the volute characterized by the disappearance of secondary flows.

Keywords: Radial inflow turbine; Twin-entry volute; CFD; Flow structures; Dean vortices; Pulsatile flow, Unsteady performance

I. INTRODUCTION

Twin-entry radial turbines allow a better recovery of energy inducted alternatively and intermittently into the hub and shroud sides of a volute, and hence the dynamic pressure of gas pulses is used effectively. Further understanding of the aerodynamic behaviour of a twin-entry radial turbine is of prime importance as it affects the global performance of a turbocharger. Thus, an attention has to be paid to both the inlet and spiral parts of volute which collect and distribute the gases all around the rotor periphery at a prescribed flow angle with minimum losses. Many researchers have concluded that the engine exhaust pulsatile flows significantly affect the turbine performance of a turbocharger, hence increasing the

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