3rd World Conference on Mechanical Engineering

Vienna, Austria 21 - 23 June

Computational Study of the Effect of the Slot Width on the Aerothermal Performance of a High-Pressure Gas Turbine

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ABSTRACT

In today's gas turbines, the purge flow plays a critical role in enhancing turbine performance by limiting the ingestion of hot gases into the cavity located at the stator / rotor interface. The aerothermal efficiency of this method is fundamentally affected by various geometric and physical parameters. This study presents a 3D CFD simulation that investigates the influence of the slot width (E) on the cooling performance and aerodynamic losses of a high-pressure transonic gas turbine, in which four geometries are studied by using the commercial software ANSYS Fluent (two uniform slot geometries with E= 2 mm and 3 mm, and two converging slot geometries $E2/E1 = 0.5$ and $E2/E1 = 0.75$), setting the slot inclination angle ($\boldsymbol{\phi}$) to 30° and the purge flow rate to 1%. The Reynolds-averaged Navier-Stokes (RANS) equations for steady flow are solved using the k-ω SST turbulence model. The results obtained indicate that the converging slot configuration with $E2/E1 = 0.5$ is the most adequate choice.

Keywords: Gas turbine; purge flow; slot width; aerothermal; 3D CFD simulation