Effect of temperature distortion on HP turbine heat transfer and aerodynamics

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Detailed experimental investigations have been performed to understand the effect of turbine inlet temperature distortion on the aerodynamics and heat transfer of a full-scale high pressure turbine stage at flow conditions that are representative of those found in a modern gas turbine engine.

This paper discusses the time-mean rotor blade surface and over-tip casing heat transfer, with and without inlet temperature distortion. Experimental measurement of over-tip casing static pressure has also been performed. Full stage CFD simulations have also been conducted using the Rolls Royce code Hydra, and are compared to the experimental data.

The test turbine was the unshrouded MT1 turbine, installed in the transonic transient turbine test facility (Isentropic Light Piston Facility) at QinetiQ, Farnborough UK. This is a short duration facility, which simulates engine representative M, Re, Tu, $N/\sqrt{T}$ and T_g/T_w at the turbine inlet. The facility has recently been upgraded to incorporate an advanced second-generation inlet temperature distortion generator, capable of simulating well-defined, aggressive temperature distortion profile both in the radial and circumferential directions, at the turbine inlet.