EXPERIMENTAL STUDY OF SEPARATION AND TRANSITION CONTROL ON VERY-HIGH LIFT LOW PRESSURE TURBINE BLADES AT LOW Re AND HIGH SUBSONIC CONDITIONS

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The development and use of very-high lift turbine blades in modern turbo gas engines allows reducing the number of blades in a row, bringing to a reduction of the weight, maintenance and production costs. On the other hand, these blades working at low Re and pressure level are characterized by a laminar separation that may result in high losses and power drop.

The present work deals with an experimental investigation of the effect of the free-stream turbulence intensity on the boundary layer development, i.e. the separation and transition phenomena, and its impact on the blade performance.
The blade in object is the mid-loaded T106C profile, tested in the S-1/C high-speed variable density cascade tunnel in the "Jacques Chauvin" Laboratory of the VKI.

A turbulence generator grid has been designed and manufactured in order to vary the turbulence level of the flow entering the cascade. It consists of a set of parallel horizontal bars which can be moved and fixed at different positions relatively to the cascade. The turbulence grid has been characterized in terms of turbulence level and pressure drop.

Upstream and downstream measurements have been performed respectively by means of a 3-hole and a 5-hole pressure probes. Pressure taps along the blade suction side were used to determine the flow behaviour along the profile. Finally, the turbulence intensity was measured using a single hot wire. The influence of the Reynolds number and the turbulence intensity has been investigated. In particular, their effect on the losses, the mean outlet flow angle and the velocity distribution has been stressed out. The comparison between the effect of free-stream turbulence intensity and artificial roughness on the blade surface has been carried out.

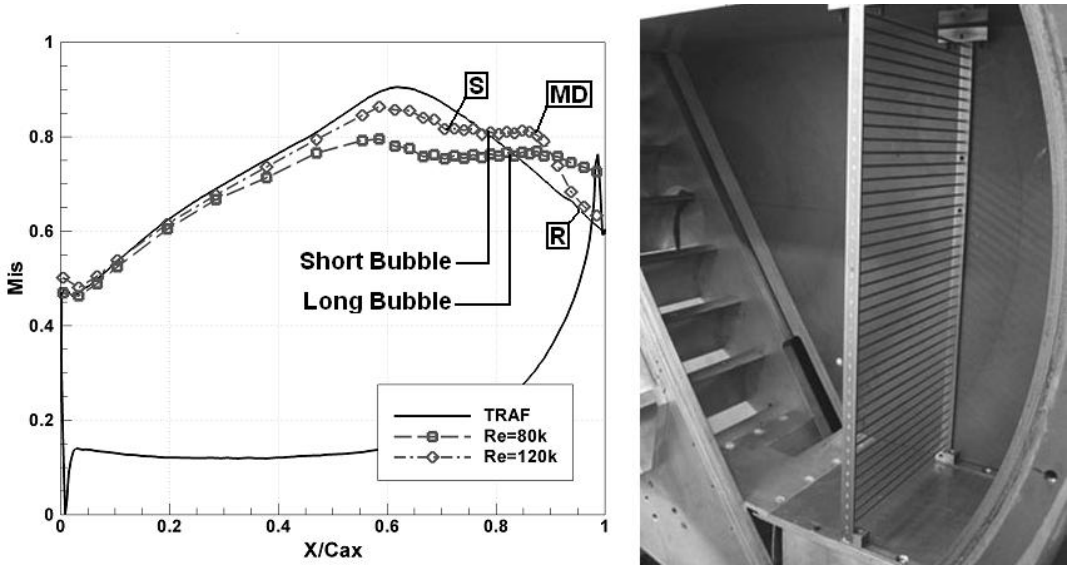

Figure 1: Left: Isentropic Mach number distribution along the T106 blade suction side, with the two types of separation bubble (S: separation; MD: maximum displacement; R: reattachment). Right: View of the turbulence grid inside the S-1 cascade test section.