STERN rocket firing completed

September 26 2008

(PhysOrg.com) -- The performance of unpiloted, reuseable spaceplanes could be significantly improved thanks to the completion of the Static Test Expansion/Deflection Rocket Nozzle (STERN) engine test programme.

A team of engineers from Bristol University finished the test programme last week [Friday 19 September] with 12 hot firings successfully completed. In each experiment the engine was held down on a heavily instrumented test stand providing data on pressures, temperature, flow rates and thrust.

The results will be presented by Dr Neil Taylor, Lecturer in Aerodynamics in the University's Department of Aerospace Engineering at the International Astronautical Congress in Glasgow next week [29 September to 3 October].

The objective of the test programme was to explore the flow stability and behaviour in an unusual rocket nozzle known as an Expansion Deflection Nozzle. In theory these should allow very large expansion nozzles suitable for operating in the vacuum of space to also perform stably and efficiently within an atmosphere. If so, then the performance of single stage to orbit launch vehicles like Skylon could be significantly improved.

Dr Taylor said: “Test programmes like this usually take years and costs hundreds of thousands of pounds, but we’ve done this in 18 months and on a relative shoestring, the whole team has done a really good job but the guys from Airborne Engineering who designed, manufactured and assembled the test rig have worked near miracles. I’m looking forward to getting all the data back to the lab and seeing how it compares to my predictions.”

The STERN engine burns hydrogen and air, the same as Skylon’s Sabre engines when in air breathing mode. To maximise the engine’s life the test firings were held below the engine design values with measured thrust between 1500 and 2000 Newtons (1/5 tonne). Each firing was restricted to less than a second, as any longer and the (un-cooled) chamber walls could start to melt. This still provided sufficient time for the flow to stabilise, and all the required data to be obtained.

The initial results have confirmed that the flow within Expansion Deflection nozzles is stable across a very wide range of pressure ratios. In addition, broad agreement with computer simulations of their behaviour has also been achieved.

Although the basic principles of Expansion Deflection nozzles are now better understood, as anticipated by the research team the complex processes within the flow meant that optimum performance was not achieved by this first attempt. The ongoing analysis of the data produced

by STERN will lead to a better understanding of the flow, enabling improved and optimised designs to be produced. It is expected this in turn will lead to future experimental work in a wider long-term project aimed at maximising the benefit Expansion Deflection Nozzles offer.

The STERN project is a collaboration between the University of Bristol, Reaction Engines Ltd, and Airborne Engineering Ltd. The final test firing has taken less than 18 months after a suggestion by Alan Bond, Director of Reaction Engines Ltd, over coffee at a conference.

Provided by University of Bristol