

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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## VENUS - CONCEPTUAL DESIGN FOR VEGA NEW UPPER STAGE

**Abstract**

With the first launch of Vega approaching, the European launch vehicle family will soon be completed. VEGA aims at transporting small research- and earth observation satellites to Low Earth Orbit (LEO).

Ongoing investigations show the opportunity for a performance improvement of the launcher to cope with the evolution of P/L mass. Therefore, studies to enhance the capabilities of the launch vehicle were started.

The German National Agency (DLR) sponsors the ongoing VENUS (VEGA New Upper Stage) study with Astrium Space Transportation as Prime Contractor and the DLR institute SART (System Analyse RaumTransport) as subcontractor. The second slice of the study, the so-called VENUS-II study, was started in July 2009 and will be finalized mid 2011 through the Förderkennzeichen FKZ50RL0910. VENUS-II aims at investigating possible evolutions of the VEGA launcher. In particular, conceptual lay-outs for new storable propellant upper stages are prepared including also design studies on Engines.

The VENUS-II study is divided into three study phases. Phase 1 work was focused on conceiving and analysing different new upper stage architectural concept candidates and selecting reference concepts on the basis of trade-offs and by optimization of overall launcher P/L performance. After this phase the main parameters were frozen. This paper presents these phases 2 (Conceptual Design of the two frozen 3-stage and 4-stage configurations) and 3 (Programmatic File). Dedicated stage mechanical designs and trade offs are presented, as well as thermal studies on the thermal behaviour of the stages, lay-outs of the functional propulsion systems, propellant and helium budgets on the basis of more detailed analyses, needed electrical interfaces between upper stage and avionics equipment, trade-offs for the separation systems, dedicated designs for the engines AESTUS-II and BERTA, resulting mass budgets, and adapted launcher performance characteristics in order to update the maximum payload mass. Further, Phase 3 development logics and plans and assessments of related development cost are presented.

The content of this paper is new and was hence not presented at previous conferences. Also the attendance of the authors in Cape Town, South Africa to deliver the paper is assured.