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to: Basil Hassan, Org. 1515, MS0825

from: Dave Kuntz, Org. 1515, MS0825

subject: One Page Descriptions of STAR Efforts to Date

Attached as pages 2 and 3 of this memo are one page descriptions in word and powerpoint formats of our efforts to date on the AFOSR-sponsored STAR (Stability Analysis for Reentry) program. These descriptions are intended to be combined with inputs from other STAR team members to form an unlimited-release presentation for the Lockheed-Martin FALCON team. No details of either vehicle are provided in this presentation, and no sensitive material is included.

Sandia National Laboratories Contributions to the STAR Program

David W. Kuntz

Sandia National Laboratories' contributions to the efforts of the STAR team have primarily centered on the computation of the boundary conditions for boundary layer stability analyses of ballistic flight vehicles. These boundary conditions are being used in the development and validation of the STABL code. To date, two ballistic flight vehicles have been analyzed, one unclassified vehicle, Reentry F, and one classified flight vehicle. The computed boundary conditions have included nosetip shapes, nosetip surface temperature distributions, nosetip surface blowing rate distributions, heatshield surface temperature distributions, and heatshield surface blowing rate distributions.

For both vehicles, the trajectories and atmospheres reported in postflight reports were used for the analyses. The nosetip solutions for the two flight vehicles were obtained using the ABRES Shape Change Code (ASCC 86). This code uses engineering/correlation methods combined with the Momentum/Energy Integral Technique (MEIT) to compute the aerodynamic heating and material thermal response, including ablation, of standard sphere-cone nosetips. The extremely small nosetip radius on the Reentry F vehicle resulted in the need for additional nosetip analyses using the ablating version of the COYOTE code. This code is a generalized finite element conduction code to which aeroheating and ablating boundary conditions have been added.

The flowfield and aeroheating environments for the heatshield calculations were computed with the 2IT-SANDIAC-HIBLARG set of codes. The 2IT code solves for the inviscid flowfield on the spherical portion of the nosetip, the SANDIAC code solves for the inviscid flowfield over the remainder of the vehicle, and HIBLARG solves the integral boundary layer equations over the complete vehicle. The Charring Materials Ablation code (CMA) was used to compute the heatshield temperatures and blowing rates assuming one-dimensional conduction using the boundary conditions obtained from the 2IT-SANDIAC-HIBLARG codes.

The results from the analyses of these two flight vehicles were provided to STAR team members running the STABL code. These results, along with the in-flight measured transition conditions, are being used to evaluate the STABL code and determine flight-based transition n-factors for use in subsequent analyses.

Sandia National Laboratories
STAR Efforts

- **SNL's STAR efforts have centered on the computation of sample boundary conditions for the STABL code**
- **Two reentry vehicles have been analyzed to date, one unclassified vehicle (Reentry F) and one classified vehicle**
- **Additional classified vehicle analyses are planned**
- **Computed quantities include:**
  - **Nosetip shapes**
  - **Nosetip surface temperature distributions**
  - **Nosetip blowing rate distributions**
  - **Heatshield surface temperature distributions**
  - **Heatshield blowing rate distributions**
- **Results passed on to STAR team members for use in determining flight-based transition n factors**