Engineering Design and Rapid Prototyping

January 14, 2007

Deliverable A

Requirements and Interface Document

System: VDS Assisted Human Powered Vehicle

Component or Subsystem: Shell Design (Ingress/Egress System, Windshield System)

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1. Component Description

Designed and constructed during six weeks of the VDS summit in Summer 2006, the Assisted Human Powered Vehicle (AHPV) is a concept of a human-solar car hybrid. Due to the tight and rigid deadlines involved, the AHPV was left unfinished, with no means of egress/ingress, and problems with visibility due to the lack of a proper windshield.

Our task is to design and implement a method for the driver to enter and exit the vehicle, and to create a windshield that affords the driver more visibility. These systems can be treated either as two separate systems or one integrated system. As well as the important practical aspects of the design, we must also pay special attention to the aesthetics of the vehicle; in four weeks, it will be presented by the CEO of Solidworks at a major conference. Further in the future, the AHPV will compete in the Shell Eco Marathon in California.

2. Functional Requirements

2.1. The ingress/egress system must allow a middle-aged person, well built, 170 cm to enter or leave the vehicle unaided, in no more than 30 seconds.

2.2. The visibility in the seated driving position must be at least 150° in the horizontal direction, with maximum visibility in the vertical direction (below horizontal line of sight.)

2.3. Windshield should resist a force of $550N/m^2$ without deformation. (Based on drag force at 100km/h.)

2.4. Weight of the windshield system should be minimized, with a weight per unit area less than twice that of the shell (i.e. less than $5kg/m^2$).

2.5. Completed shell must be aesthetically pleasing (unquantifiable criteria).

3. Constraints

3.1. The ingress/egress and windshield systems must mount to the AHPV steel frame or composite shell. If mounted to the composite shell, the shell must be sufficiently reinforced in the mounting zone to prevent deformation of shell shape at vehicle operating speeds (up to 100km/h).

3.2. The ingress/egress system cannot be able to come into contact with the rear solar panel array in any configuration.

3.3. If vehicle controls are to be moved to accommodate ingress/egress system, they must stay within arms length (0.75 meters) of any drivers in the specified size range.

3.4. Total cost of the project should not exceed $1800, including materials, outside contracting, etc.

3.5. Deadline for completion, including testing is Jan 30th 2007.

4. Interface Definition

4.1. The external dimensions of the ingress/egress and windshield systems will maintain the shape of the existing shell.

4.2. The ingress/egress and windshield systems will be integrated within the existing steel structure.
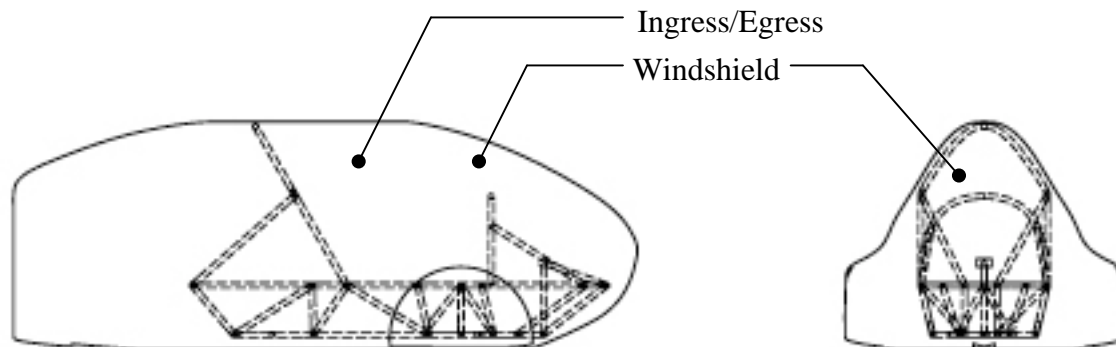
5. Verification

The geometry of the system will be modeled using CAD software (e.g. Solidworks). CAE (e.g. Cosmosworks) will be used to verify load distribution, deformations under loading, etc.

Rapid prototypes will then be created, for better visualization of digital mockups, and human tests will be carried out after fabrication.