ESIS Summer 2005

[A work of fiction derived from http://www.darpa.mil/grandchallenge/Rules_8oct04.pdf 6/12/05 for student use only]

3. Lunar Circumnavigation Grand Challenge Vehicle Requirements

3.1 Autonomous Vehicle Behavior Requirement

Participating vehicles must demonstrate fully autonomous behavior and operation at all times during the PRE-LAUNCH QUALIFICATION EVENT and Lunar Circumnavigation Event. Vehicles must be unmanned, and no animals are permitted onboard.

3.2 Vehicle Limitations

The entry must be a ground vehicle that is propelled and steered principally by traction with the ground. The type of ground contact devices (such as tires, treads, and legs) is not restricted. The vehicle must not damage the environment or infrastructure at the PRE-LAUNCH QUALIFICATION EVENT or along the Lunar Circumnavigation route.

Maximum vehicle weight is 5000 pounds on earth.

3.3 Classified Data and Devices

No classified data or devices may be used by a team in preparation for or during the Lunar Circumnavigation.

3.4 Tethered Vehicle Systems

Only individual, independent, untethered ground vehicles are eligible to participate in the Lunar Circumnavigation.

A system comprising a single ground vehicle and one or more subsystems (such as sensors) that are physically tethered to that ground vehicle is permitted provided that the tethered subsystems are not propelled or maneuvered independently of the ground vehicle. Tethered subsystems that are specifically permitted include those that are rigid, telescoping, or on an articulating mast.

3.5 Vehicle Identification Number

Each semifinalist team will be assigned a unique identification number that shall be displayed on its vehicle at least 12 inches in height on its sides, front, back, and top. The number should be either black or white and have a solid background that extends at least 3 inches larger than the number. The color of the background should contrast with the number such that the number is clearly visible and distinguishable from other signage or symbols on the vehicle. A vehicle that can operate when flipped over shall also display the number on its underside.

Teams are allowed to obtain sponsorships and to display advertising if such advertisements are not considered inappropriate by the Officials The DARPA Lunar Circumnavigation 2005 logo may be displayed on each vehicle.

3.6 Vehicle Safety

DARPA makes no representation as to the safety of any vehicle entered in the Lunar Circumnavigation notwithstanding any rule or the acceptance by DARPA of any application document, vehicle specification sheet video demonstration, or any inspection or demonstration required as a condition of participating in the Lunar Circumnavigation.

3.6.1 Radiated Energy Safety Standards

3.6.1.1 Laser Safety Standards

All parties are directed to OSHA 29 CFR 1926.54 and OSHA Technical Manual (TED 1-0.15A), Section III - Chapter 6 (1999, January 20) for relevant laser safety standards. Challenge vehicles must comply with all applicable local, state, and federal laser safety regulations.

3.6.1.2 RF Radiation Standards

All parties are directed to OSHA 29 CFR 1910.97 (Non-ionizing Radiation) and Department of Defense Instruction 6055.11 (1995, February 21) for relevant RF safety standards. All Challenge vehicles must comply with all applicable local, state, and federal RF safety regulations.

3.6.2 Wireless Emergency Stop (E-stop) Units

DARPA will supply each semifinalist team one government-owned E-stop system consisting of a controller and a vehicle receiver. It is the sole responsibility of the team to properly install the E-stop system in its vehicle. Detailed specifications for the integration of the E-stop system will be provided on the Lunar Circumnavigation website. Limited technical assistance for this installation will be available. DARPA shall not, however, incur any liability from the semifinalist's use of this technical assistance. Use of this technical assistance is solely at the discretion of the team leader.

Semifinalists have 10 calendar days following receipt of the E-stop to notify DARPA that the unit is damaged or otherwise not in working condition. After that period, the semifinalist assumes responsibility for the E-stop, and DARPA will not be responsible for repairs to the E-stop or replacement of damaged units.

DARPA reserves the right, solely within its discretion and assuming equipment availability, to provide the team with a replacement unit. Each E-stop must be fully functional for the semifinalist to be eligible to participate in the PRE-LAUNCH QUALIFICATION EVENT and Lunar Circumnavigation Event.

Each team shall return its E-stop to DARPA within 24 hours from the date of any of the following events:

- The vehicle is eliminated from participation in the Lunar Circumnavigation
- The vehicle is disqualified from the Lunar Circumnavigation
- The vehicle is withdrawn from the Lunar Circumnavigation
- Completion of the Lunar Circumnavigation (return earth bound portion only)

If any of these events occur during the PRE-LAUNCH QUALIFICATION EVENT or Lunar Circumnavigation, the equipment shall be returned to the proper DARPA official on-site.

The E-stop system has three modes: a RUN mode, a PAUSE mode, and a DISABLE mode. Teams must integrate the E-stop equipment so that the vehicle responds to the E-stop outputs as follows:

- E-stop RUN mode enables the vehicle for autonomous movement.
- E-stop PAUSE mode brings the motion of the vehicle to a prompt stop, with brakes applied to hold the vehicle even if it is on a slope. The vehicle should be ready to resume forward motion when the E-stop re-enters RUN mode.
- E-stop DISABLE mode brings the vehicle to a prompt halt and shuts down all propulsion systems while actively applying and maintaining the brakes.

Specifications regarding size, weight, power, output voltage, current, connectors, and other relevant details will be furnished to semifinalists.

The required integration of the E-stop system enables the E-stop PAUSE mode to be cycled on or off so that the vehicle can be stopped and resumed during the Challenge. The E-stop DISABLE mode should be latched so that its state cannot be changed after initiation except by a manual unlatch switch.

The vehicle and its systems must not interfere with the proper functioning of the E-stop device. A demonstration of the wireless E-stop capability is required as part of the PRE-LAUNCH QUALIFICATION EVENT.

Teams should anticipate that their vehicle may receive the E-stop PAUSE signal numerous times during the Lunar Circumnavigation Event, and that the duration of any individual E-stop PAUSE event may be as long as several hours. Teams should ensure that all electrical connections to the E-stop are ruggedized and tested to provide assured electrical connectivity after exposure to adverse (damp or dusty) environmental conditions and a high vibration environment.

3.6.3 Manual Emergency Stop Unit

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3.6.4 Warning Devices

Each vehicle shall be equipped with visual alarms that are activated according to the state of the E-stop system. The following is a summary of the required behavior of the alarms.

- E-stop RUN mode:. Visual alarm on.
- E-stop PAUSE mode:. Visual alarm on.
- E-stop DISABLE mode: No visual alarm.

3.6.4.1 Audible Warning–Vehicle Operating

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3.6.4.2 Visual Warning–Vehicle Operating

Each vehicle shall display one or more flashing amber warning lights, the combination of which results in visibility 360 degrees azimuthally around the vehicle. The warning light shall operate when, and only when, the vehicle is in E-stop RUN or E-stop PAUSE mode. The vehicle may not commence movement until the warning light has been in operation for 5 seconds.

The warning light(s) shall comply with SAE Class 1 standards for warning lights and shall not produce light(s) than can be confused with those of public safety vehicles such as law enforcement, fire, or ambulance.

3.6.4.3 Visual Warning–Vehicle Brake

Each vehicle shall display two or more steadily illuminated red warning lights on the rear of the vehicle and visible within a 90-degree cone that illuminates when, and only when, the vehicle's dynamic braking system (not the parking brake) is activated. The purpose of this light is to indicate that the vehicle is braking. The placement of this light should be mounted high and sufficiently distant from the flashing amber warning lights to permit rapid recognition.

3.7 Towing Requirements

Each vehicle must be designed to facilitate removal from the route should the vehicle be disabled. The vehicle must have tow points front and rear, or if the vehicle design precludes towing, the vehicle must have hoist points.

3.8 Position Determination Signals

Challenge vehicles may be equipped to receive and process electronic position-determination signals that are furnished by radio transmitters placed on the lunar surface by DARPA.

3.9 Wireless Signal Restrictions

All computing, intelligence, and sensor processing must be contained onboard the vehicle while on the PRE-LAUNCH QUALIFICATION EVENT course or the Challenge route. Apart from the control and tracking signals from DARPA-provided systems and DARPA provided navigation signals, the emission or reception of communication signals is prohibited.

On-board wireless connections are prohibited. A vehicle may emit and receive signals to sense the environment. Vehicles may record video or other data on-board for review after the conclusion of the event. Any data recorded on the PRE-LAUNCH QUALIFICATION EVENT course may not be shared among teams until the conclusion of the PRE-LAUNCH QUALIFICATION EVENT. Any data recorded during the Lunar

Circumnavigation Event may not be shared among teams until all vehicles have finished the route or have been disqualified.

Any wireless system used for vehicle movement or testing must be disconnected prior to the PRE-LAUNCH QUALIFICATION EVENT and Lunar Circumnavigation Event. The wireless hardware must be easily accessible and capable of being inspected. This includes systems for monitoring, control, or intra-vehicle communication.

3.10 Vehicle Cooperation

Cooperation of any kind among vehicles on the PRE-LAUNCH QUALIFICATION EVENT course or the Lunar Circumnavigation Event route is prohibited.

3.11 Environmental Impact

Any aspect of vehicle activity or operation that has an unacceptable impact on the earth or lunar environment is prohibited. These activities include destructive vehicle behavior, the use of abnormally hazardous substances or materials, and generally reckless operation. Potentially hazardous equipment or activities must be identified to DARPA for review in the vehicle specification sheet and at the site visit.

3.12 Pre-Challenge Testing

Testing of Challenge vehicles or components is the sole responsibility of each team. The use of public lands for this purpose is at the team’s own risk and must be in accordance with applicable local, state, and Federal guidelines.