



January 28, 2004

DARPA GRAND CHALLENGE TEAM NEWSLETTER #3

The following is updated information on the DARPA Grand Challenge:

A. Challenge Vehicle Preparation

1. Route Definition Data File (RDDF): DARPA is making the attached sample RDDF available to help all teams develop their vehicles' RDDF parsing and navigation control software. The file is illustrative of waypoint density and spacing, speed restrictions, lateral boundaries, and course curvature that will be in the RDDF given to the teams at the QID and for the Challenge route on March 13, 2004.

Waypoint density refers to the number of waypoints for a given segment of the route. *Waypoint spacing* refers to the distance between waypoints. The waypoints on portions of the Challenge route are separated by only a few feet. *Course curvature* refers to the types of turns on the route. Some turns are very tight, requiring vehicles to navigate a 180-degree turn within a very short distance. Teams should pay particular attention to the radius of the turns in the sample RDDF.

DARPA recommends all teams give careful consideration to their vehicles' navigation control software ability to cope with the types of data in the sample RDDF. The control software should be designed to not be confused by waypoint density, waypoint spacing, and sharp turns—at all speeds and with GPS errors. DARPA has seen instances where a robotic vehicle was confused by tight waypoint spacing, and the vehicle failed to recognize that it had successfully passed a waypoint and kept trying to return to the passed waypoint.

It is not necessary to design the control software so the vehicle passes exactly over each waypoint, but rather that the vehicle stays within the lateral boundary distance for that portion of the route.

2. Vehicle Testing: The terrain in the Grand Challenge course will test your vehicle's systems and ruggedness. All vehicles that start the Grand Challenge must have the potential to complete the course. The QID course was designed to ensure the entrants' vehicles have the ability to tackle the Grand Challenge route. DARPA urges all teams to thoroughly test their vehicles prior to the QID, with a particular emphasis on the ability of the vehicles' subsystems and electrical wire connections to withstand vibrations while traveling 200+ miles of rough terrain.

3. Mounting the E-stop Receiver: Instructions have been provided for mounting the tracking device and E-stop receiver on the Challenge vehicles. It is imperative that the E-stop receiver be installed such that the LED readout on the side of the receiver is visible from outside the vehicles

when enabled for autonomous operation. This LED display will be used as part of the procedure for timing the vehicle, and readings will be taken at both the start and finish of the course.

4. E-stop Testing: DARPA will thoroughly test E-stop operation at the QID and again immediately prior to the start of the Grand Challenge. All teams are urged to extensively test their E-stop systems prior to arriving at the QID. It is imperative that the E-stop be installed according to the instructions provided and that it functions correctly 100 percent of the time. Whenever the E-stop is activated, the vehicle must be brought to a stop, even if the command occurs while the vehicle is on a hill or a downward slope. As part of the E-stop testing, DARPA will closely evaluate each vehicle's overall braking system for its ability to stop the vehicle within a reasonable distance and that the system is rugged enough to remain effective for the entire event. All vehicles must respond immediately whenever a pause or disable command is issued—whether at the beginning, during, or at the end of the event. Team vehicles will be disqualified if they do not demonstrate the proper response to E-stop signals or if DARPA believes the braking system is ineffective or not sufficiently robust to be effective throughout the entire event.

5. E-stop System Integrity: Given the ruggedness of the Grand Challenge route, teams should take extra precautions to ensure all wire connections to the E-stop are secure, and all wires and components are stowed in such a manner that they will not be cut or destroyed from abrasion, snagging, overheating, and other perils from traveling long distances over rugged terrain. If you have any problems or questions with the installation or operation of the E-stop unit, contact OMNITECH at the main office (303-922-7773, ext. 159), or Mr. David Parish at 303-725-7171.

6. The Start: Challenge vehicles should be designed so they begin moving promptly upon receiving the “run” signal (from the E-stop unit) at their assigned start times. Once the run signal is given, the elapsed time count for the Challenge vehicle will begin. It is in each team's interest to begin movement to the first waypoints as quickly as possible. Rule changes are under consideration whereby a Challenge vehicle will forfeit its pole position if it does not expeditiously begin movement onto the Challenge route.

7. Restarting: Teams should expect their Challenge vehicles to be paused through the E-stop system numerous times while the vehicle is on the Grand Challenge route. Vehicles will be paused to avoid congestion, prevent a collision, wait for a safe road crossing, or wait for the correction of a mechanical failure in the assigned manned chase vehicle. Teams are advised to ensure their Challenge vehicles will reliably and promptly resume forward motion upon restoration of the run signal.

8. GPS Outages: Teams should expect their vehicles to lose GPS signals at points along the route, especially when going through the several underpasses on the route. The underpasses can be as long as 75 feet and as narrow as 10 feet. Experience shows that some GPS systems (such as Starfire) can take as long as 60 seconds to regain the GPS signal upon exiting an underpass. Teams should design their vehicle control software so the vehicle does not come to a complete stop waiting to re-acquire the GPS signal.

B. E-Stop Recall Process

The E-stop recall process requires all teams ship their units no later than February 6, 2004, to ensure arrival at OMNITECH by February 9, 2004. To expedite the mailing process, "Grand Challenge" must be included as the internal billing reference on the Federal Express airbill. The Federal Express account number is 110004966.

Use the boxes in which the units were shipped to you. Return both units (transmitter and receiver), the GPS antennas (CA19), power cables (CA20), safety interlock cable (CA21), and the 900-MHz antenna with the antenna cable.

The equipment should be returned via Federal Express to:

Omnitech Robotics
Attn: Steve Cunningham (303-922-7773)
2630 South Raritan Circle
Englewood, CO 80110

Once the equipment is shipped, please send an e-mail note to the Grand Challenge mailbox confirming shipment to Omnitech and provide the Federal Express tracking number.

DARPA will return E-stop units as soon as possible, but no later than February 17, 2004. We apologize for the inconvenience.

In addition to the E-stop units, teams will receive tracking systems by February 17. These tracking systems need to be installed on the robot. The tracking systems will be:

- In an enclosure exactly the same size as the E-stop unit;
- Mounted in exactly the same manner as the E-stop unit;
- Supplied with a 2-foot cable that will need to interconnect the E-stop and tracking systems. Power for the tracking systems is supplied by the E-stop unit.
- Supplied with a GPS antenna identical to the E-stop unit that will need to be mounted similar to the E-stop units; and
- Supplied with an iridium antenna, which will need to be mounted with clear line of sight to the sky above the vehicle.

You should have already received the tracking system manual. Please let us know if additional copies are needed.

C. Two-Day Grand Challenge Event Saturday–Sunday, March 13–14, 2004

For safety reasons, the Grand Challenge event can be run only during daylight hours. While the Grand Challenge is planned as a 1-day event, there is a possibility that the vehicles will have to stop at sunset and resume the trial the next morning (March 14). This may occur if the route is blocked for an extensive time and an entrant's vehicle has the potential to finish the course

within the 10-hour limit. If this happens, the Control Vehicle Team in the chase vehicle will command the Challenge vehicle to stop at darkness. The Challenge vehicles will remain at their respective stopped locations overnight. The three members of each Control Vehicle Team will stay with their vehicle. DARPA is further refining plans for this eventuality and will publish procedures before the event.

Since the Challenge vehicle will be disabled and turned off for the night, the Control Vehicle Team must know how to start the Challenge vehicle the next morning. Please prepare written, step-by-step vehicle start procedures. During the QID or at the start of the event, the Control Vehicle Team must have an opportunity to accomplish a practice start of the Challenge vehicle. The practice start should mimic likely restart scenarios (e.g., as a result of a disable command or a morning start when the engine is cold).

D. Award Ceremony Schedule Change

The Sunday, March 14, Award Ceremony in Primm has been changed from a luncheon to a dinner. **The new time is 6:30 to 8:30 PM.** Since all team participants are invited to the award ceremony, you are encouraged to stay until Monday, March 15.

If you have already purchased your ticket(s) for the Award Ceremony and plan to attend at the new time, no further action is required. If you are unable to attend the evening Award Ceremony and would like a refund, please contact Ms. Anne Landers at alanders@sainc.com before February 20, 2004.

E. Website Registration

Registration deadline is February 2, 2004, and includes activating your team website, completing your team roster, disseminating information to all team members listed on the roster, and purchasing any desired tickets for social events.

The Team Registration Website is at www.sainc.com/dgc/tcams/teamMain.asp (password protected). Logistical information available on this website includes the events schedule, hotel and transportation information, maps and driving directions, and social event information.

The following teams have activated their registration websites (as of January 26):

- Axion Racing
- The Blue Team
- Digital Auto Drive (Team DAD)
- The Golem Group
- Palos Verdes High School RoadWarriors
- Red Team
- Rob Meyer Productions
- Rover Systems
- SciAutonics

SciAutonics II
 Team Arctic Tortoise
 Team Caltech
 Team ENSCO
 Team LoGHIQ
 Team Overbot
 Team TerraMax
 Terra Engineering

Teams not included in the above list are reminded that the registration website activation deadline is February 2, 2004.

F. January 16, 2004, Team Drawing Results

QID Team Lineup

QID Team #*	Team	Team Lead
01	Team Phantasm	Warren Williams
02	Team CajunBot	Charles Cavanaugh
03	Team Arctic Tortoise	Richard Ruhkick
04	Center for Intelligent Machines and Robotics (CIMAR)	Carl Crane
05	Team Caltech	David van Gogh
06	A.I. Motorvators	CJ Pedersen
07	Digital Auto Drive (Team DAD)	David Hall
08	Insight Racing	Grayson Randall
09	The Golem Group	Richard Mason
10	Palos Verdes High School RoadWarriors	Chris Bowles
11	CyberRider	Ivar Schoenmeyr
12	Rob Meyer Productions	Robert Meyer
13	Team ENSCO	Gary Carr
14	Team Spirit of Las Vegas (TSOLV)	Kent Tiffany
15	Terra Engineering	Todd Mendenhall
16	The Blue Team	Anthony Levandowski
17	SciAutonics	John Porter
18	Rover Systems	Ted Copperthite
19	Team LoGHIQ	Seth Cabe
20	Team TerraMax	Jim Fravert
21	SciAutonics II	Paul Gunthner
22	Red Team	Red Whitaker
23	Axion Racing	Bill Kehaly
24	Team Overbot	John Nagle
25	Virginia Tech	Charles Reinholtz

*The team number represents the QID pole position, vehicle number, technical inspection number, and garage/pit number.

QID Time Slots

	MARCH 8	MARCH 9	MARCH 10	MARCH 11	MARCH 12
9:00 AM		Team 09	Team 23	Team 12	Reserve
9:30 AM		Team 10	Team 24	Team 13	Reserve
10:00 AM		Team 11	Team 25	Team 14	Reserve
10:30 AM		Team 12	Team 01	Team 15	Reserve
11:00 AM		Team 13	Team 02	Team 16	Reserve
11:30 AM		Team 14	Team 03	Team 17	Reserve
12:00 PM	BREAK				
12:30 PM	BREAK				
1:00 PM	Team 01	Team 15	Team 04	Team 18	Reserve
1:30 PM	Team 02	Team 16	Team 05	Team 19	Reserve
2:00 PM	Team 03	Team 17	Team 06	Team 20	Reserve
2:30 PM	Team 04	Team 18	Team 07	Team 21	Reserve
3:00 PM	Team 05	Team 19	Team 08	Team 22	Reserve
3:30 PM	Team 06	Team 20	Team 09	Team 23	Reserve
4:00 PM	Team 07	Team 21	Team 10	Team 24	Reserve
4:30 PM	Team 08	Team 22	Team 11	Team 25	Reserve

QID Technical Inspections Schedule

	BAY 1	BAY 2
10:00 AM	Team 01	Team 02
10:30 AM	Team 03	Team 04
11:00 AM	Team 05	Team 06
11:30 AM	Team 07	Team 08
12:00 PM	Team 09	Team 10
12:30 PM	Team 11	Team 12
1:00 PM	Team 13	Team 14
1:30 PM	Team 15	Team 16
2:00 PM	Team 17	Team 18
2:30 PM	Team 19	Team 20
3:00 PM	Team 21	Team 22
3:30 PM	Team 23	Team 24
4:00 PM	Team 25	

G. Vehicle Information: Each team has received an information package containing updated rules, QID information/slides, the environmental report, and a questionnaire to be returned to DARPA. The questionnaire includes specific questions regarding the operation of the Challenge vehicles. To date, DARPA has received responses from 17 of the 25 teams. If you have not already done so, please return the requested information to DARPA by February 2, 2004.

H. Grand Challenge Mailbox Questions

1. Do I have to sign the California Speedway liability form to participate in the QID?

Yes. The DARPA Grand Challenge registration staff recently sent team members the California Speedway Consent and Release of Liability Form. All participant team members are required to sign and return a copy of the form. We want to ensure that team members understand the following points:

- The release form is a California Speedway requirement. All individuals—Government employees, contractors and participants—who may enter a restricted area in the Speedway are required to sign the form.
- The Bailment Agreements executed between DARPA and the Grand Challenge teams include a liability protection provision for the teams that states, “The Government will assume the risk of liability to third parties, up to and including a combined total of \$300,000 for all events, for loss or damage to property or for death and bodily injury caused by the challenge vehicle during the bailment periods identified in Article 4.0.”
- DARPA will purchase a \$5 million insurance policy to cover the QID event.

The bailment periods include both the QID and the field-testing event. The bailment periods begin when a participant physically hands the E-stop single transmitter to the DARPA judge or monitor and terminates when the E-stop single transmitter is returned to the team representative.

The Bailment Agreement provides for the relationship between DARPA and the Grand Challenge participants. Because the Grand Challenge is using the California Speedway for the QID event, it is subject to specific conditions, including the California Speedway requirement that participant team members sign the Consent and Release of Liability Form

2. Will the moving obstacle have all the properties of a car? (Thermal and ferrous) It looked like it might be a cardboard outline of a car in the document.

To the extent possible, all obstacles will have similar characteristics to the obstacles or obstructions likely to be on the route. For this specific test, thermal will not be tested.

3. For security purposes, can a team member sit in a chair by their robot 24/7 for the week of the QID?

No. Team members can only be at the Speedway, and near their vehicles, during the Speedway's operational hours, from 7:00 AM to 10:00 PM.

4. Will spectators be required to sign a Liability Waiver for the California Speedway?

No. Only those individuals entering the Speedway infield, garage areas, and other restricted areas—as designated by the Speedway or DARPA—are required to sign waivers. The waivers are a California Motor Speedway requirement and must be signed before individuals are provided clearance to enter restricted areas. In addition, all minors must have a signed parental or guardian consent form to enter any restricted areas. The form is on the Grand Challenge web site. .

5. Where on the website does it layout information specifically for spectators: where, when and how?


Information applicable to Grand Challenge spectators is available at www.darpa.mil/grandchallenge/spectators.htm.

6. Clarification on NLT time for robots to arrive for inspection on Monday, March 8. Is NLT time affected by when that robot is to run the QID? Will there be anymore details about the QID course released in the coming weeks?

The deadline for entrants' vehicles to arrive at the Speedway is 7:00 AM, Monday, March 8. This time is set to allow all vehicles to be on display at the Opening Ceremony, which begins at 9:00 AM. The NLT times are to give teams enough time to complete the inspection and demonstration run. DARPA will continue to provide updates as they become available.

7. Do we have to register on Sunday, March 7? Our team is local (Los Angeles), and we are looking into driving there daily.

A mandatory team meeting will be held at 9:00 PM, Sunday, March 7 at the Speedway. QID activities will be discussed at this meeting, and two representatives from each team must attend. Other team members may register as they arrive at the Speedway.


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