

- 14.3** The craft will be operated by a skipper at all times. No remote control operation is permitted.
- 14.4** Boats must be removed from the water if extensive repair work is required. Only minor repairs will be allowed on the water and must be done outside the course area. Boats left in the water must be reinspected before they compete in the next event.
- 14.5** At no time during the competition will a swimmer be allowed in the water to assist a boat. Wading is permitted at the Launching Site – close-toed shoes are required (no sandals).
- 14.6** Protective eyewear must be worn at all times by anyone who is handling batteries. Footwear is recommended for all participants.
- 14.7** At the discretion of the officials, in order to give the media a good photo opportunity, the start of the Endurance heats may begin with a "Parade lap". There will be no passing until on the course.
- 14.8** Should there be a question regarding the meaning of Rules, the participating team will file their question in writing with the Registrar using a Rule Interpretation Form.
- 14.9** Teams are expected to be able to change configurations in one hour or less.

15. Paddock Area

This is the area that is under large tents, where each entry will have an area of approximately 300 square feet. This area may have to be adjusted, depending on the number of participants. The area is used to work on and store the craft and for the Visual Display. Participants are encouraged to have School Banners or other identification. The area immediately outside the tent may be used for recharging.

16. On-the-water testing

Because of restrictions at the Site, no on-the-water testing will be allowed.

Rules of SOLAR SPLASH[®] 2011

World Championship of Solar/Electric Boating Revised Edition: May 2011

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13. Prizes and Awards

The Sponsor and Organizer of the Event will recognize all Teams' participation. In addition, the following awards will be presented:

- 13.1 Daily Award** - Some awards may be presented at the Morning Meeting and some on Wednesday evening.
- 13.2 Overall and Runner-Up Awards** - For each competition, an award will be presented to the Team that demonstrates the best performance. Runner-up awards may also be presented. An Overall Winner will be determined by a formula which includes: Technical Report, Visual Presentation, Workmanship, Qualifying, Solar Slalom, Endurance, and Sprint. Runner-up awards may also be presented.
- 13.3 Other Awards** - Other awards may be presented at various times during the Event.
- 13.4 Award Ceremonies** - An awards ceremony will be held on Sunday following the day's competitions.

14. Procedures

To assure that all competitors are in compliance with the Rules during the competitions, an “on deck” area has been established. There are some safety concerns that will be checked, and are subject to penalty. This, along with the “staging” area, is intended to expedite the conduct of the competitions, especially the Sprint events. All Rules and procedures are written with the safety of the participants and spectators in mind.

- 14.1** All competitors must be in the “staging” area at least one hour before the competitions. Charging of the battery pack may occur during this time.
- 14.2** As boats are moved from the “staging” area to the “on deck” area there will be a brief reinspection. No work can be done on the boats once the boats are in the on deck area.

- 11.4.3 Striking a Buoy** - If a craft strikes a buoy, the craft must execute a 360° penalty turn on the inside of the course prior to the completion of the Event.
- 11.4.4 Failure to Yield the Right-of-Way** - Any Team failing to allow right-of-way when being overtaken by another craft will be penalized a minimum of 0.5 laps per infraction.
- 11.5 Paddling** - Using paddles or oars to power the craft during any competitive event (other than to avoid becoming a safety hazard) will result in automatic disqualification.
- 11.6 Failure to Attend Morning Meetings** - Any Team that fails to be properly represented at any Morning Meeting will be penalized and must receive a briefing before they can continue to compete.
- 11.7 Conduct** - Officials may assess penalties ranging from ten (10) points to total disqualification for improper conduct. Such conduct may include, but is not limited to, improper language and obscene gestures.
- 11.8 Failure to Comply with the Rules** - Officials may assess penalties ranging from ten (10) points to total disqualification for a Team's failure to comply with any Rule.

12. Advertising, Promotion and Publicity

All advertising, sales promotion, and publicity material produced by the Teams or their sponsors concerning or referring to the Event shall refer to the Event as “**SOLAR SPLASH 2011**”. By entering the Event, all teams shall agree to the use, without compensation, of their names and photographs in any publicity material that may be issued by the Event's Sponsor, the Organizer, and their associated companies.

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11.2 Solar Slalom

11.2.1 Striking a Buoy - If a craft strikes a buoy, a five (5) second penalty will be assessed.

11.3 Sprints

11.3.1 Disturbing Official Battery Markings - When batteries are inspected, they will be given official tags. These tags must not be disturbed. Competitors are allowed to use only the batteries inspected for their craft. Officials may assess penalties ranging from fifty (50) points to total disqualification.

11.3.2 Obstructive Boating - Any Team that operates their craft in a manner that impedes the progress of another craft or risks the safety of another craft or of their own will receive a minimum penalty of fifty (50) points or may be disqualified at the discretion of the Officials.

11.3.3 Striking a Buoy - If a craft strikes a buoy and remains in its lane, a five (5) second penalty will be assessed.

11.3.4 Leaving the Course - If a craft leaves its assigned lane, its run has ended and it must be shut down and may not re-enter the course or finish.

11.4 Endurance

11.4.1 Disturbing Official Battery Markings - When batteries are inspected, they will be given official tags. These tags must not be disturbed. Competitors are allowed to use only the batteries inspected for their craft. Officials may assess penalties ranging from fifty (50) points to total disqualification.

11.4.2 Obstructive Boating - Any Team that operates their craft in a manner that impedes the progress of another craft or risks the safety of another craft or of their own will receive a minimum penalty of one lap per infraction or may be disqualified at the discretion of the Officials.

10. Dates and Times

- 10.1 Registration** - Begins on Wednesday at 8:00 a.m. All boats must be registered by Thursday at 9:00 a.m.
- 10.2 Technical Inspections** - Mechanical and electrical inspections must be completed by Thursday at noon.
- 10.3 Swim Test** - Will be held on Wednesday afternoon, time to be announced.
- 10.4 Qualifying** - Begins Thursday at 9:00 a.m. Must be completed by Friday at 10:00 a.m.
- 10.5 Solar Slalom** - To coincide with Qualifying.
- 10.6 Endurance** - Scheduled for Saturday.
- 10.7 Sprint** - Scheduled for heats to begin on Friday afternoon and continue to completion on Sunday.
- 10.8 Weather** - The Sprint and Endurance competition days and times are at the discretion of the Organizer. Weather conditions may dictate competition days and times.

11. Penalties

Any Team failing to comply with the Rules, as stated herein, may be penalized. Officials are required to record all instances of unsafe conduct, and penalties will be assessed as follows:

11.1 Qualifying

- 11.1.1 Leaving the Course** - If a craft leaves the Qualifying course, as defined in Rule 8.3.1, the craft has not qualified.
- 11.1.2 Striking a Buoy** - If a craft strikes a buoy, a ten (10) second penalty will be assessed.

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1. Purpose of the SOLAR SPLASH

The **SOLAR SPLASH** has been established to promote interest in Science and Technology, Education, and Personal Interactive Skills. Established for collegians, it gives students an opportunity to apply theory to a practical project in a team environment. The **SOLAR SPLASH** itself serves as an opportunity for students to compete and showcase their accomplishments. Although it is an intercollegiate competition, high school teams who demonstrate competence may be included.

2. Administration

- 2.1 Application of Rules** - The Rules shall apply to the **SOLAR SPLASH**, hereinafter referred to as the “Event”. These Rules become effective immediately and supersede all previous editions.
- 2.2 Event Dates** – The Event will be held June 8-12, 2011.
- 2.3 Right to Revise Rules** - The Organizer, as defined in Rule 2.6 below, reserves the right to revise the Rules at any time by providing the participants notification of revisions in the form of Bulletins, revised editions of the Rules, or announcements at the Competition.
- 2.4 Acceptance of Rules** - All persons or groups selected to participate in the Event are expected to know and accept the Rules. Participation in the Event shall constitute acceptance of them.
- 2.5 Sponsors** - The Event is conducted and organized by the **IEEE Power Electronics Society**. The prime corporate sponsor is Johnson Controls Inc. Other sponsors are listed at www.solarsplash.com.

8.10 Seeding - Seeding for the first round of Sprints will be based on Sprint Qualifying times. All boats will run in the first two rounds. The three boats with the fastest times in the first two rounds will advance to the final round. All other boats will run a third time in a consolation round. The morning Endurance heats will be decided by random draw. The afternoon heats will be based on results of the morning heats.

8.11 Technical Report - A technical report is required. A PDF copy must be received by Headquarters by 5 p.m. EDT on **May 19, 2011**. The boat number must be displayed on the cover in a minimum 36 pt. type. The names of all students and faculty advisors involved with the project must appear on the cover. Reports will be made available for participants of future **SOLAR SPLASH** Events. Requirements for the technical report are detailed on www.solarsplash.com.

9. Graphics

- 9.1 Boat Number Signs** - Each craft will have a “boat number” assigned by the Organizer. Each team will be provided with a base and an “L” bracket for their “boat number” sign. The base, or a satisfactory substitute, must be mounted in a manner which will allow for the proper display of the sign. All participants will be provided physically similar signs. These signs and “L” brackets may not be modified. The sign will not be included in the dimensions of the craft.
- 9.2 Event Logo** - The Event identification and logo must be displayed at all times. These are part of the boat number sign.
- 9.3 School Name** - School names on the craft are optional.
- 9.4 Team Sponsor Identification** - A maximum of three (3) advertising spots per sponsor will be allowed. No team sponsorship graphics will be added after Technical Inspection without the Organizer's approval.
- 9.5 Inappropriate Graphics** - The Organizer reserves the right to disapprove any graphics it deems inappropriate or offensive. The decisions of the Organizer are final.

Qualifying - 100 points. Your Time will be the sum of your Maneuverability time plus five times your Sprint Qualifying time. The fastest qualifier will receive 100 points. All other qualifiers will be scored by the formula:

$$\text{Your Points} = \frac{\text{Winner's Time}}{\text{Your Time}} \times 100$$

If multiple attempts must be made in order to qualify, your qualifying time on that course will be multiplied by the number of attempts. **Failure to complete the Maneuverability course prevents an entry from competing in the Endurance Event. Your Time will then be twenty times your Sprint Qualifying time multiplied by the number of Sprint Qualifying attempts. Failure to complete the Sprint Qualifying course prevents an entry from competing in the Sprint Event. Your Time will then be four times your Maneuverability time multiplied by the number of Maneuverability attempts.**

Workmanship - 20 points. Points awarded will be based on quality of workmanship as determined by a panel of judges.

Solar Slalom - 100 points. The same scoring formula that is used for Qualifying will apply. If a competitor fails their first attempt, additional attempts may be allowed, time permitting. If multiple attempts are made, Your Time will be multiplied by the number of attempts.

Sprint - 250 points. Your Time will be the sum of your two best Sprint times. **If a competitor completes just one Sprint heat, Your Time will be four times the time of the completed heat.** If a competitor completes no heats, they will receive zero points in the Sprint.

$$\text{Your Points} = \frac{\text{Winner's Time}}{\text{Your Time}} \times 250$$

Endurance Event - 400 points. The purpose is to go as far as possible in 2 hours. Total distance traveled will be recorded to the nearest 0.25 lap completed.

$$\text{Your Points} = \frac{\text{Your total distance (2 heats)}}{\text{Winner's total distance (2 heats)}} \times 400$$

2.6 Organizer and Address - The Event is organized and produced by Dr. Jeffrey Morehouse (the "Organizer") located at the Mechanical Engineering Department, University of South Carolina, Columbia, SC 29208. This location shall serve as Event Headquarters.

Business hours are generally 9-6 Eastern weekdays
(803) 777-3017, Fax (803) 777-0106 E-mail: hq@solarsplash.com

2.7 Event Officials - The Organizer will select and announce the list of Officials for the Event. These Officials are generally known as "Red Shirts" because of their distinctive red shirts worn at the Event. The Event Officials will be instructed in and responsible for specific duties pertaining to the operation of the Event. The Event Officials shall have the authority and responsibility to ensure compliance with the Rules.

2.8 Insurance - Each participating Team is required to provide proof of general liability insurance from their educational institution or written proof that, as a state institution, they are self-insured. Proof of insurance must be supplied with the Technical Report. Failure to do so will result in a **10 point penalty** applied to the Technical Report score.

2.9 Accidents - All accidents must be reported to an Event Official and the Organizer immediately. Failure to do so may affect a Team's standing in the Event. The Organizer and the Sponsors assume no liability for accidents that occur as the result of poor craft design and construction, unsafe or improper boating procedures, or any form of negligence on the part of the competitors and spectators.

2.10 Release of Liability and Image Release - Everyone involved with the Event – Participants, Faculty Advisors, Officials and official visitors – are required to sign this release upon arriving on-site. The Release is available at Registration.

2.11 Waiver for Skippers - There is a special waiver form for skippers and anyone who will be out on the water, which must be carefully read and signed by the skipper.

- 2.12 Waiver for Minors** - Anyone under the age of 18 is required to have this waiver signed and notarized by a parent or guardian in advance of the Event.
- 2.13 Withdrawals** - Any team which has agreed to participate shall fulfill such obligation unless excused by the Organizer. Any Team wishing to withdraw must notify the Organizer in writing. If a Team wishes to withdraw at the Event, the Organizer must be notified as soon as possible.

3. Definitions

- 3.1 “Paddock”** - Is the area where participants prepare their craft and store their boat and equipment.
- 3.2 “Staging” Area** - Is the area between the paddock area and the “On Deck” area.
- 3.3 “On Deck” Area** - Is the area between the staging area and the Launching Site.
- 3.4 “Launching Site”** - Is the area which extends 10 meters back from the shoreline and extends outward from the shoreline 15 meters. Access to this area is restricted.
- 3.5 “System Voltage”** - Is the voltage measured with a VOA meter between the system ground and any point in the electrical system.
- 3.6 “Source Voltage”** - Is the nominal value, e.g. 24 VDC or 36 VDC, output voltage of the battery pack.
- 3.7 “Dead-man’s Switch”** - Is any device that cuts off power to the motor if the skipper leaves the craft.

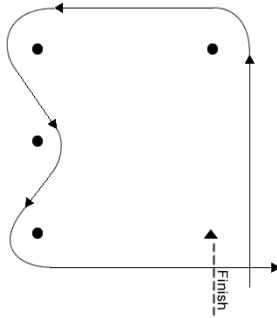
- 8.4 Overtaking** - Once an overtaking craft establishes overlap (the bow breaks an imaginary perpendicular plane across the stern of the overtaken craft), the overtaking craft has the right-of-way.
- 8.5 Buoys** - The first craft to reach a buoy has the right-of-way until the stern of the craft has cleared the buoy. If a craft strikes a buoy, a penalty will be assessed (see Rule 11).
- 8.6 Leaving the Course** - In the Solar Slalom and Endurance Events, if a boat leaves the course for any reason, it must re-enter at the same point or further back.
- 8.7 Support Craft** - No support craft will be allowed.
- 8.8 Scoring and Results** - The results of each day’s events will be available no later than the following day’s Morning Meeting. The results of the final day’s events will be announced and posted at the final awards ceremony.
- 8.9 Overall Scoring** - In order to determine an overall World Champion, the following overall scoring system is used:

Technical Report - 90 points. The report judged as the best will receive 90 points. Others will receive fewer points as judged by a panel of technical reviewers. See Rule 8.11 for Technical Report format and criteria.

Visual Presentation - 40 points. The presentation should be targeted to both a general audience and the **SOLAR SPLASH** judges. The topic of the Visual Display should directly relate to significant and/or new features of the team’s boat. Points awarded will be based on overall visual appeal, clarity of message, and ease of understanding. The display should be resistant to wind and water and must be set up from 9 a.m. to 5 p.m. Friday and Saturday; and from 9 a.m. Sunday until 1 p.m.

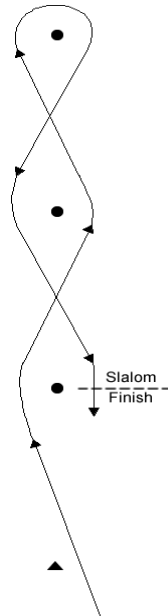
8.3 Course - Courses for the on-the-water events are defined as follows:

8.3.1 Qualifying - The primary purpose of Qualifying is to determine the eligibility of Teams to participate in the Event. Qualifying will be used to test the safety, seaworthiness, handling, maneuverability, and “qualifying time” of each craft. The track of the boat through the Maneuverability course must generally conform to the diagram and may not vary by more than 15 meters from the prescribed path. A 70-meter straight line Sprint course will be set up and timed to demonstrate the ability of the skipper to control the boat from a standing start in a straight line under full power.



Qualifying Time will be calculated from the times on the Maneuverability and Sprint courses and will be used in determining points towards the overall winner.

8.3.2 Solar Slalom - The course will utilize the first two marks for the Maneuverability course and two additional marks at 50m intervals in the manner shown.



8.3.3 Sprints - Sprints will be held over a 300-meter straight-a-way course. Boats are not required to carry their arrays or energy conversion devices during the Sprint event (7.1.3). **Boats are required to get to the start line and return to the Launching Site by motoring or paddling.**

8.3.4 Endurance - The event will be held over a closed course not exceeding 2 km in length. There will be two, 2-hour heats, one in the morning and one in the afternoon. All entries must carry their solar energy conversion device(s), as inspected, on board during the Event. Any changes in the solar energy conversion devices must be reinspected and reapproved before competing.

4. Registration and Inspections

4.1 Registration - The Organizer will require all persons participating or officiating at the Event to Register on Wednesday starting at 8 am. Registrants will be divided into the following categories:

- A. Participants (Skippers and Crew)
- B. Officials
- C. Volunteers
- D. Sponsors and VIP's

4.1.1 Badging - All Registrants will be badged by category when they register to make them easily identifiable at the Event. Badges will be issued after all necessary waivers have been signed, signifying eligibility to participate in the Event. Badges must be worn at all times during the Event, except by the swimmers (4.2.2).

4.1.2 Point of Contact - One person, preferably the Faculty Advisor, must be designated as the primary point of contact for the team during the Event.

4.1.3 Faculty and Guests - The number of faculty at the Event is not limited. Alumni, family, and friends are all welcome, but may not be team members for insurance purposes.

4.1.4 Ballast - The official skipper weight for the competitive events shall be seventy (70) kg. Each skipper will be weighed when he or she registers. Skippers will be weighed in their bathing suits and life jackets only. If a skipper's weight, including life jacket, is less than 70 kg., ballast will be added to make up the difference. If the weight of the skipper is over 70 kg., no credit will be given. Skipper, life jacket, and ballast will be identified with unique tags. The ballast corresponding to the skipper must be carried in the boat when it is on the water.

4.2 Technical Inspections - All craft will be inspected to verify compliance with the Rules. Technical Inspections will begin at 9 a.m. Wednesday and must be completed by noon on Thursday. Any Team not passing Technical Inspections will be required to correct the deficiency prior to Qualifying. Any craft not in compliance with the Rules will not be allowed to compete until it has passed Technical Inspections and Qualifying has been completed. Craft may be weighed during Technical Inspections. Each team will have a copy of its Technical Report available at Inspection time. Any changes made after Inspection require reinspection.

4.2.1 Safety - Each team is responsible for the seaworthiness of their craft. Passing Technical Inspections does not relieve the Team of any liability. All craft must be maintained in a safe, seaworthy condition at all times.

4.2.2 Swimming Ability - Technical Inspections will include a brief test (50m or less and treading water for 1 minute) of the swimming ability of all team members who may skipper the craft. Participants will not be allowed to use any flotation equipment or any propulsion device such as “flippers” to assist them.

4.2.3 Configuration - All entries (referred to as boats or craft) must conform to the following definitions. The boat will have a skipper who will be the sole occupant. There will be a maximum of three configurations of the boat, based on the same hull (fixed structure). The hull is that portion of the boat that provides flotation and stability.

In the **Endurance configuration**, solar panels must be in place and have a minimum one sun output of 100 watts and a maximum output of 480 watts. This configuration will be used during part of the Qualifying Event, which involves negotiating a fixed distance obstacle course (Maneuverability course) in minimum time, and the Endurance Event, which involves an irregular course for a fixed time.

7.14.5 Paddle - A paddle, no less than 60 cm (23.6 in) long with a blade at least 13 cm (5.1 in) wide, must be on board at all times. The skipper will be required to propel the craft with the paddle during Technical Inspections.

7.14.6 Fire Extinguisher - A U.S. Coast Guard approved fire extinguisher with a minimum capacity of one pound must be carried on board.

7.14.7 Automatic Bilge Pump - an automatic electric bilge pump that is powered by a supplemental battery is required. The pump must have a minimum rating of 360 GPH, such as a model #24-35 pump made by Rule or equivalent. The discharge hose may not be smaller than the outlet on the pump. The hose must be secured to the hull to ensure that the discharge goes overboard.

7.14.8 Covers and Shields - The craft's revolving parts must be suitably covered to prevent accidental contact. All steering linkage must be shielded from contact with the skipper. If a flywheel is used, an NHRA approved scatter shield must cover it.

7.15 Boat Impound - Once a boat is brought to the competition site, it must remain on site throughout the competition.

7.16 Paddock Closure - The paddock area will be closed daily from 9 p.m. to 7 a.m. On-site security will be provided.

8. Competition Events

8.1 Morning Meetings - An open meeting will be held each morning, at **8 a.m.**, unless otherwise posted, before the day's events. Attendance by a skipper and the Team Leader is mandatory. Failure to do so will result in a penalty and team representative(s) must be briefed and sign a waiver.

8.2 Start and Finish - All on-the-water events will commence from a standing start. Each Event's finish is indicated by the bow crossing the appropriate mark.

7.13.3 Solar Panels - Each panel, with or without a frame, must be attached with a mechanical fastening to the hull. The design should take into account the possibility of gusty winds during the events. In addition, a lanyard must be attached from each solar panel to a secure member of the hull or a frame that attaches to the hull. The lanyard must be strong enough that it will not break if the panel should go into the water while the boat is moving.

7.14 Safety Equipment

7.14.1 Life Preservers - A life preserver, USCG approved Type I, II, or III, must be worn by all craft occupants and safety craft occupants at all times.

7.14.2 Buoyancy of Craft - Sufficient flotation must be provided on board so that the craft cannot sink, even when filled with water. A 20% safety factor must be included in the calculations. Verification calculations must be included in the Technical Report. Failure to do so will result in a **5-point penalty**. Revised calculations must be presented at Inspection if significant changes have been made since submission of the Technical Report.

7.14.3 Towing - A fitting for emergency towing must be attached at the bow. Its hole diameter must be at least 14 mm (0.56 in). All boats must carry a minimum of 5 meters of towing line, which will be provided at Registration. The towing line must be attached to the fitting and must be made easily accessible for emergency towing.

7.14.4 Signal Devices - Two signal devices must be carried on board the craft at all times. They are:

- A. Audible - a sound-producing device (a pressurized air can is acceptable).
- B. Visual - an orange ("skier in the water") warning flag. This flag must be displayed in the event of a breakdown. A socket for the flag must be provided to allow the skipper to paddle the craft.

The **Sprint configuration** is electric only and will be used for the qualifying straight-line sprint as part of the Qualifying Event, and the straight line, fixed distance Sprint Event.

For the **Solar Slalom**, either configuration may be modified to permit better handling at higher speed, but no components which change the buoyancy or stability can be removed. Any combination of parts such as motor(s), props, drive train components, and rudder from the Endurance and Sprint configurations may be used.

All craft will be inspected with their solar array or energy conversion devices in place. All components used in any configuration must be inspected along with the craft. All craft will have their configuration verified in the staging area before competing. The Technical Manager may perform inspections at any time at his discretion.

4.2.4 Solar Array Output - All participants must have their solar collection devices checked to verify that the output does not exceed 480 watts under normal one sun conditions. This will be "normalized" by a comparison to a calibrated standard cell.

5. Entries

5.1 Entry Date - Any 2 year or 4 year college, university, vocational school, or high school is eligible to compete. Any team entering a boat must submit an entry form **by April 25, 2011**.

5.2 Team Member Eligibility - Anyone who has attended the participating educational institution as a full time student in one of the past two semesters or two of the past four quarters, or part-time for the past year, is eligible to serve as a team member.

5.3 Skipper Eligibility - The skipper must be a team member, at least 14 years old, and may not be a graduate student.

- 5.4 Entry Forms and Fees** - An entry form and fee of \$400 (\$500 if after the January 17, 2011, early registration deadline) payable to “**SOLAR SPLASH**” must be submitted for each craft. Each participating institution will be limited to two entries. Each entry must be in the name of the School and signed by a Dean or Principal.

Entries by a club or individuals not formally affiliated with the school will not be accepted. Entries must be sent to:

SOLAR SPLASH Headquarters
c/o Jeffrey Morehouse, PhD, PE
Mechanical Engineering Dept.
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6. Venue

- 6.1 Site** - The site for **SOLAR SPLASH 2011** is George Wyth Lake in George Wyth State Park, Cedar Falls/Waterloo, IA. Site pictures can be seen on www.solarsplash.com.
- 6.2 Qualifying** - The course will be laid out as described in section 8, Competition Events.
- 6.3 Solar Slalom** - The course will be laid out as described in section 8, Competition Events.
- 6.4 Sprint Course** - The course will be laid out to be logistically convenient. The course will be 300 meters in length.
- 6.5 Endurance Course** - The course will be a closed loop, not exceeding 2 km in length, and is likely to be irregular in shape due to the shoreline and spectator areas.

- 7.10.5 Main Fuse** - A separate fuse (not a circuit breaker) must be in series with the main battery and the rating must not exceed two hundred percent (200%) of the maximum expected current.

- 7.11 Radios** – During all events radio communication between the skipper and a team member on shore is required. There is no restriction on the type or frequency of voice or telemetry radio communication. Radios will be checked during technical inspection, and channels will be assigned. A team member must be in the Scorekeeper area with a radio any time their boat is on the water.

- 7.12 Skipper Cockpit** - The skipper’s cockpit must provide for the skipper’s unassisted exit within 5 seconds in case of emergency. The five (5) second exit, as well as the function of the dead-man’s switch, will be checked during Technical Inspections.

- 7.12.1 Harnesses** - No harnesses or restraints to hold the skipper in place will be allowed.

- 7.12.2 Safety** - The cockpit area will be inspected for hazards and compliance with the Rules during the Technical Inspections and in the Staging and/or On Deck areas.

7.13 Fasteners

- 7.13.1 Drive Train** - All fasteners associated with the craft’s drive train must be equipped with locking nuts, double nuts, or nuts secured with safety wire or cotter pins. Loctite may be used in areas of difficult accessibility, but must be accompanied by a written statement of application by the Team’s Faculty Advisor.

- 7.13.2 Batteries** - Batteries must be secured to the hull. This must be done with a strap not less than 1¼" in width, or other hold-down device, that will not allow the battery to come loose if the boat capsizes. Velcro is not acceptable.

7.10.2 Battery Type - Only secondary (electrically rechargeable) batteries are permitted. Fuel cells, primary batteries, or mechanically rechargeable batteries will not be approved. Each team is responsible for supplying their own batteries. The batteries must be commercially available, lead-acid, unmodified with their weight consistent with the Rules. Batteries must be absolutely stock (as manufactured) in every sense. The battery modules may not be modified in any manner, including the addition of electrolyte additives, case modification; or plate addition, removal, or modification. Manufacturer's data, specification information, and MSDS sheets must be supplied with the Technical Report. Failure to do so for the batteries you plan to use will result in a **10 point penalty** applied to the Technical Report score.

If you do not supply literature in the Report, you will be penalized, your batteries will be weighed on site, and no tolerance beyond the prescribed weight will be allowed. If you decide to use batteries different from those in your Technical Report, you may do so with no penalty by bringing the new batteries and Manufacturer's data, specification information, and MSDS sheets to Inspection on site.

7.10.3 Battery Safety - Batteries must be enclosed in one or more battery boxes or a portion of the hull to separate them from the skipper. Battery containment shall not be sealed and must allow for ventilation. Battery containment must protect the skipper from battery explosion and leakage, and may be plastic, fiberglass, or similar materials that will not chemically react rapidly to battery acid. The batteries must be secured in such a manner that they remain in place if the boat capsizes (see 7.14.2). All electrical cables must be properly sized to expected system currents.

7.10.4 Motor Switch - All craft must have a switch wired to disconnect all power to the motor. The device must be able to interrupt full load current. It must be clearly marked in 10 mm high letters as the "Motor Switch" and be plainly marked with "ON" and "OFF" positions in 10 mm high letters. A relay may be used for the switch function.

7. Regulations

7.1 Classes - The 2011 entries will compete only in the Open Class.

The "**Open**" **Class** competition events will include:

◆ Solar Endurance ◆ Sprint ◆ Solar Slalom

7.1.1 Solar Slalom - All craft will be considered "electric" for the Slalom. Allowed battery capacity will be the same as for the Sprint configuration (see Rule 7.1.3).

7.1.2 Solar Endurance - All craft will be powered by direct and stored solar energy. If photovoltaic conversion of solar energy is employed, the maximum output of the solar array under normal one sun conditions will be 480 watts. The minimum output under normal one sun conditions is 100 watts. Solar Endurance craft are allowed to carry 31 kg (68.2 lb) of lead acid batteries, and the approved solar array for the Endurance competition. A maximum of two sets of batteries will be inspected and permitted for use in the Endurance Event. Only one set of batteries may be used for one Endurance Heat. Batteries cannot be changed during the heat.

7.1.3 Sprint - All craft will be considered "electric" for the Sprint, the solar energy conversion device(s) may be removed. Craft are allowed to carry 45.5 kg (100 lb) of lead acid batteries for the Sprint competition. A maximum of two sets of batteries will be inspected and permitted for use in the Sprint Event.

7.2 Technical Specifications

7.2.1 Length - The overall length of the craft may not exceed 6 meters (19 ft, 8 in). This **does not** include the boat number sign.

7.2.2 Width - The maximum allowable width, including the solar array, is 2.4 meters (7 ft, 10.5 in).

- 7.2.3 Height - The maximum allowable height above the waterline is 1.5 meters (4 ft, 11 in). This height can never be exceeded during the events. This does not include the boat number sign.
- 7.2.4 Depth - No restriction. An excessive depth may make the craft awkward to handle near shore and may increase the likelihood of encountering underwater obstacles.
- 7.2.5 Cross Sectional Area - In profile, the fixed area (such as the hull) is unrestricted. The solar array may be fixed or may be in the form of one or more movable panels.
- 7.3 **Materials** - Teams are encouraged to be creative in the selection of materials. The only restrictions are 1) flexible materials are not allowed to create a sail, 2) any materials that would pollute the water are not allowed.
- 7.4 **Power** - Sunlight is the only power source that shall be used for propulsion. Wind and human power are not allowed. The sunlight may be direct (received onboard during the Event using energy conversion devices) or may be stored in batteries or in other approved energy storage devices. Batteries can be charged only from the inspected energy conversion devices. At no time during the Event may competition batteries be charged with any source other than the approved devices.
 - 7.4.1 Storage of Solar Radiation - All crafts in the Event will be allowed to store solar energy in their batteries at any time during daylight hours from the time of registration to the completion of the last competition.
 - 7.4.2 Supplemental Batteries - **The bilge pump and skipper's radio must be powered by supplemental batteries. Any other devices requiring electric power must use the energy storage as defined in Rule 7.4.** The batteries are not limited to lead-acid technology, and the bilge pump battery must be securely fastened to the hull.

- 7.4.3 "System Voltage" - May not exceed 52 VDC or AC RMS.
- 7.4.4 "Source Voltage" - May not exceed 36 VDC nominal value (usually 3 batteries). A maximum open circuit voltage of 52 VDC for the photovoltaic charging devices is allowed.
- 7.4.5 Energy Storage Devices - In addition to the storage of solar energy in batteries (7.4.1), energy may be stored using other devices such as capacitors or flywheels. Storage of energy may begin at the "on deck" time.
- 7.5 **Visibility** - The skipper must have unobstructed vision forward and at least 100° to either side.
- 7.6 **Stability** - The stability of the craft will be tested by placing 10 kg at the sheer line (outer edge at the beam) with the skipper stationary in the normal operating position. Craft must not heel more than 15°. Skipper must remain centered with hands/feet in normal position.
- 7.7 **Dead-man's Switch** - It must be functional at all times when the skipper is in the boat and must be demonstrated in an egress test during Technical Inspection.
- 7.8 **Circulation** - Fresh air must be provided for the skipper if the cockpit is enclosed.
- 7.9 **Ballast** - The ballast must be placed in a manner such that the ballast will fall out of the craft if it capsizes (turns over 180°) or adequate flotation must be provided for the ballast.
- 7.10 **Electrical**
 - 7.10.1 Shock Hazards - All exposed conductors operating at greater than thirty-six (36) volts must be properly insulated.