

Rules of Participation In MWD SOLAR CUP



A High School Solar/Electric Boating Competition

Sponsored and Published by:

The Metropolitan Water District of Southern California
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1. Purpose of the MWD Solar Cup

Solar Cup™ is sponsored by The Metropolitan Water District of Southern California. Teams are entered and sponsored by MWD member agencies and local water utilities.

Solar Cup is an event where high school teams design a boat that runs on solar power. The team boat competes in two races, a sprint event and an endurance event. The different events test teams' ability to design their solar boats for maximum energy efficiency as well as speed. This year's event will be held **May 17-19, 2019** at Lake Skinner in Riverside County.

2. Program Administration

- 2.1 **Application of Rules** - The Rules shall apply to the **MWD SOLAR CUP Competition**, hereinafter referred to as the "Event".
- 2.2 **Effective Date of Rules** - The Rules become effective immediately and supersede all previous editions.
- 2.3 **Right to Revise Rules** - MWD 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 Event.
- 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 **Program Administrator** - The Solar Cup program and Event are administered and coordinated by the Metropolitan Water District of Southern California (MWD). MWD is located at 700 North Alameda Street, Los Angeles, CA 90012. All inquiries should be directed to:

Julie Miller Kalbacher, Solar Cup Coordinator
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- 2.6 **Sponsorship**-The program is conducted under the sponsorship of the Metropolitan Water District of Southern California and its participating member agencies. The following are specific requirements related to sponsorship of a team(s):
 - Rookie teams receive a grant from their sponsoring agency of \$4,000 to outfit their hull. Veteran teams receive a grant from their sponsoring agency of \$2,500 to outfit their hull.
 - Only MWD member agency and retail agencies identification will be allowed on the hull.
 - No additional funds may be spent for items used or needed for the boat. Teams must document and report all expenditures and provide an accounting of all monies expended on their boat.
 - Donated materials, not including solar panels and the motor, along with labor (particularly for work that cannot be done by the students, e.g., machining), are allowed, but must be fully documented. **Again, solar panels and the motor must be purchased with sponsorship grant funds only.**
 - **Solar Cup teams may borrow equipment from other Solar Cup teams. Please document all borrowed equipment.**
 - Prior to the event, outside money may be raised for items not related to the boat, such as for a trailer or truck rental to transport the boat to events. Other non-boat items may include, but are not limited to—food for meetings or work days and team apparel.

- 2.7 **Accidents** - All accidents must be reported to an Event official immediately. Failure to do so may affect a Team's standing in the Event. MWD assumes 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.
- 2.8 **Parent/Guardian Release and Waiver of Liability for *Solar cup Event***- Every adult and student participant must have the medical and liability release form **signed by a parent or guardian (if under 18 years of age) and turned into MWD by March 21, 2019.**
- 2.9 **“Statement of Swimming Ability” for Skippers** - There is a special form for skippers and anyone who will be out on the water, which must be carefully read and signed by each skipper's respective faculty advisor. See 4.2.2.
- 2.10 **Withdrawals** - Any Team which has agreed to participate shall fulfill its obligations unless excused by MWD. Any Team choosing to withdraw must notify MWD in writing. If a Team chooses to withdraw at the Event, MWD must be notified as soon as possible. Any Team choosing to withdraw must return all unused sponsorship funds to their sponsor and provide a detailed accounting of grant monies already expended on the construction of the Team's boat.

3. Definitions

- 3.1 **“Paddock”** - Is the Event 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, of the 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 loses control of the craft. This device should be wired to disconnect power to the motor when the switch is shorted. 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.

4. Student Services and Inspections

- 4.1 **Student Services Registration** - Each team must be registered and checked in with Student Services prior to participating. Student services will be open from at **8 a.m. to 4 p.m. each day of the event. Participants are to check in and check out at Student Services every day of the event. Teams who fail to check in and/or check out will lose points each day of the event.**
- 4.1.1 **Point of Contact** - One person, preferably the faculty advisor, must be designated as the primary point of contact for the team during the Event.
- 4.1.2 **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.

- 4.1.3** Ballast - The official skipper weight for the competitive events shall be sixty (60) 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 60 kg., ballast will be added to make up the difference. If the weight of the skipper is over 60 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. See Rule 7.2.6 for total weight limitations of skipper and boat.
- 4.2** **Technical Inspections** - All craft will be inspected to verify compliance with the Rules. Technical Inspections will begin two weeks prior to the event on **May 4, 2019**.
- **Each team will have to present visual evidence to MWD that their boat has been operational on a body of water in a safe, seaworthy condition by the May 4, 2019 Technical Inspection.**
 - Each craft must also pass technical inspection prior to each race at the Event.
 - Event primary technical inspections will begin at **8 a.m., Friday, May 17, 2019**, and will end at **1 p.m.**
 - Any Team not passing Technical Inspections will be required to correct the deficiency prior 1 p.m. be reinspected before proceeding 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.
 - Crafts that do not pass qualifying will not be able to participate in the racing.
 - Craft will be weighed during Technical Inspections.
 - **Any changes made after Inspection require re-inspection.**
- 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. **Visual proof must be supplied to MWD by May 4, 2019 that the boat was operational in a safe, seaworthy condition.** (rule 4.2) All craft will also have to follow the guidelines supplied by MWD for the prevention of quagga mussel contamination.
- 4.2.2** Swimming Ability - Technical Inspections on **May 4, 2019** will include a brief test (50m or less and treading water for 1 minute) of the swimming ability of skippers and any other 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. There will be no other means of proving swimming ability.
- 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 two configurations of the boat, based on the same hull (fixed structure). The hull is that portion of the boat which provides flotation and stability. The hull must be used as built at the boat-building workshop and must conform to the assembly instructions; exception being the bow of the boat may be rounded and filled so the stem and two sides are even. The fill may not extend the length of boat. It can only be used to even the sides and stem. You may round the top edge of the bulkhead where it meets the boat side; you may not cut the bulkhead down. Gunwales may be rounded slightly. **Additions may be made to the interior but the only allowed removal of material will be holes in the bulkhead for wires; and holes in the hull for the drive train and steering, so long as they don't substantially affect the structural integrity of the craft, in the opinion of the judges.** The markings showing a current year hull on the stem, bulkhead and gunwales must be visible to judges and not painted over or disturbed. **In both configurations the skipper, steering, and instruments must be forward of the bulkhead, and the propulsion batteries and drive train must be aft. The master switch must be placed within the reach and visual sight line of the skipper during operation of the craft. The main sitting or kneeling area for the skipper must not be more than 40 inches from the bulkhead. The**

area will be measured and tested during pre-race inspections. A line will be placed on the outside of the hull as a visual marker to note the 40 inches. Boats that are found to be in violation will be disqualified.

Solar panels and mounting hardware may not project more than 36 cm beyond the gunwale measured perpendicular.

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 320 watts. This configuration will be used for Qualifying, including negotiating a fixed-distance obstacle course (maneuverability) in minimum time and an irregular course for a fixed time (Endurance Event).

The **Sprint configuration** is electric only and will be used for a straight line, fixed distance Sprint and a qualifying straight line sprint.

Motor Configuration: Boats must use the same motors in either endurance or sprint configuration. Motors may be regared but not removed from or added to the hull.

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 or her discretion.

- 4.2.4** Solar Array Output - All participants must have their solar collection devices checked to verify that the output does not exceed 320 watts under normal one-sun conditions.

5. Entries

- 5.1** **Team Member Eligibility** - Anyone who is currently attending the participating high school as a full-time student is eligible to serve as a team member.
- 5.2** **Skipper Eligibility** - The skipper must be a team member and must be at least 14 years old.
- 5.3** **Code Of Conduct** – Every person on the team will have a signed Code of Conduct on file with MWD prior to the event. Failure to follow the Code of Conduct will result in dismissal from Solar Cup (**see 11.6**).

6. Venue

- 6.1** **Site** - The site for **MWD SOLAR CUP** is Lake Skinner launch ramp 1, approximately 15 miles east of Temecula, California.
- 6.2** **Qualifying** - The course times and dimensions will be laid out as described in section 8, Competition Events. Teams must pass Technical Inspection and both Qualifying courses to participate in Sprint and Endurance events.
- 6.3** **Sprint Course** - The course will be laid out to be logistically convenient. The course will be around **200 meters** in length.
- 6.4** **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. Regulations

7.1 Classes – The entries will compete in two different configurations. Each configuration will have two different categories.

◆ *Solar Endurance*
--Veteran
--Rookie

◆ *Sprint*
--Veteran
--Rookie

7.1.1 Solar Endurance - All craft will be powered by direct and stored solar energy. The maximum output of the solar array under normal one-sun conditions will be 320 watts. The minimum output under normal one-sun conditions is 100 watts. **A maximum of two sets of batteries will be inspected and permitted for use in the Endurance Event.** The craft will be operated only by a skipper at all times, remote control operation is not allowed.

7.1.2 Sprint - All craft will be considered “electric” for the Sprint, the solar panel(s) may be removed. **A maximum of two sets of batteries will be inspected and permitted for use in the Sprint Event.** The craft will be operated only by a skipper at all times, remote control operation is not allowed.

7.2 Technical Specifications

7.2.0 If a boat does not meet any of the technical specifications penalties will be assessed by the event officials.

7.2.1 Length - The length of the craft will be approximately 4.6 meters (15 ft, 1 in). **Nothing** may extend forward beyond the bow of the boat. **Only** the boat sign provided at the Event and the rudder may extend beyond the stern of the craft.

7.2.2 Width - Nothing may extend more than 36 cm (14.2 in) to the boat center line beyond the deck edge of the craft at any point.

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.

7.2.6 Weight - The maximum allowable combined weight for the boat plus skipper and ballast in any configuration is 205 kg (451 lb). Refer to Rule 4.1.4 for additional restrictions on skipper weight. A penalty of 10 points per pound over will be applied, up to max of 15 pounds. (150 points).

7.2.7 All means of generating thrust (propellers, treads, paddles, etc, etc.) must be 100% submerged.

7.2.1 Materials - Teams are not allowed to use materials that would pollute the water.

7.3.1 Shafts must be constructed from materials of sufficient mechanical and fatigue strength. Hollow shafts are discouraged. If employed hollow shafts must be approved by the technical staff. Hollow shafts should have sufficient wall thickness. Hollow shafts may need to be reinforced at points of contact.

- 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 photovoltaic panels) or may be stored in approved batteries. Batteries can be charged only from the inspected solar panels, which may not have a one-sun output greater than 320 watts. At no time during the Event may competition batteries be charged with any source other than the approved solar panels.
- 7.4.1 Teams interested in constructing their own solar panels must have designs approved by the Solar Cup Technical Team twice: 1) prior to construction and 2) post construction, prior to utilization. Designs will be evaluated for safety and power generation.**
- 7.4.2 Storage of Solar Radiation** - All craft 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. Battery chargers are NOT to be used on propulsion batteries after they are inspected, but may be used on the supplemental batteries. See 7.4.2(3).
- 7.4.3 Supplemental Batteries (Auxiliary Batteries)** - Supplemental batteries are required for safety reasons. These batteries may not provide propulsion nor directly enhance performance. The bilge pump must be powered by its own supplemental battery. Other acceptable uses include: relays, radio, telemetry, stability control, and memory devices. At Technical Inspection, such batteries and the devices they are in will be checked to assure that no possibility exists to convert the power into propulsion for the craft. The batteries are not limited to lead-acid technology and must be securely fastened to the hull.
- 7.4.4 “System Voltage”** - May not exceed 52 VDC or AC RMS.
- 7.4.5 “Source Voltage”** - May not exceed 24 VDC nominal value (usually 2 batteries). A maximum open circuit voltage of 52 VDC for the photovoltaic charging devices is allowed.
- 7.5 Visibility** - The skipper must have unobstructed vision forward and at least 100° to either side.
- 7.6 Stability** - Due to time constraints, it may be necessary to conduct events in less than ideal conditions. Since safety is vital, 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 Throttle** - In all Events, the throttle mechanism on the craft must be free moving and when released, must return to the zero current position. When the throttle returns to the zero position, it must also activate a switch which opens the electrical circuit going to the main motor controller. Additionally, the speed of the boat shall be controlled with a single Curtis PB6 (or similar) manual throttle. There will be no secondary throttle, either in series with, parallel with, replacing or somehow modifying the functionality of the single unmodified Curtis PB6 throttle, which acts as a “cruise control” and allows the motor speed to be regulated independently or in conjunction with the single Curtis PB6 throttle.
- A “**dead-man**” switch must be incorporated in addition to the spring loaded throttle. This “**dead-man**” switch should be wired to disconnect power to the motor controller when the switch is shorted. One does not replace the other, both are required. In addition, a secondary function of the “**dead-man**” switch shall be to short the primary coil of the solenoid to prevent the solenoid from turning on.
- 7.8 Ballast Carrier** - The ballast container must be designed 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.
- 7.9 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 500 GPH, such as a model #500 pump made by West Marine or equivalent. The bilge pump must be located aft of the bulkhead, and 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. The battery for the bilge pump must be of sufficient capacity to power the pump for a minimum of two hours and may not be used to power any other devices. The bilge pump shall have a “float switch” to automatically activate the pump when water enters the boat.

7.10 Covers and Shields - All steering linkage must be shielded from contact with the skipper. Chain guards must be used wherever there is potential injury to skipper. Skippers whose hair is longer than shoulder length must have it secured in a ponytail or under a hat.

7.11 Electrical

7.11.1 Shock Hazards - All exposed conductors operating at greater than thirty-six (36) volts must be properly insulated.

7.11.2 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.** Craft are allowed to carry a total battery weight of not more than 25 kg (55 lb). 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, which includes battery weight and MSDS sheets, must be available at Inspection time.** Batteries will be weighed during Inspection. MWD scales will be used as the final determination of official total battery weight.

7.11.3 Battery System - Batteries must be enclosed in battery boxes and securely anchored to the hull aft of the bulkhead. This must be done in such a manner that the battery boxes and their batteries remain in place if the boat capsizes (see 7.15.2). All electrical cables must be properly sized to expected system currents.

7.11.4 Motor Switch - All craft must have a switch wired to disconnect all power to the motor. The switch must be placed within reach and **visual line of sight of the skipper during operation of the craft.** The switch must be able to interrupt full-load current. The switch must have a minimum rating of 310 A continuous, such as the Cole Hersee model M-750.

7.11.5 Main Fuse - A separate fuse (not a circuit breaker) must be in series with the main battery connection at all times and the rating must not exceed 350 A.

7.11.6 Kill Switch - A kill switch, or “deadman’s switch”, is a switch that will cut power to the motor in the event of an emergency. Typically, one end of a lanyard is connected to the switch, and the other end is connected to the skipper—either to the skipper’s arm or life vest. **The kill switch is required to cut all power to the motor through the contactor relay when engaged or short circuited.** Refer to circuit diagram in Chapter 5.

7.11.7 Contactor Relay - Contactor relays with the appropriate current rating are required for all boats. The relays must be connected to the deadman switch and serve as direct disconnects to the electrical motor along the high-current line. The contactor relay must be rated for 24 V and continuous duty rating of at least 400 Amps. Example contactor relays include Altrax part # SOL-24V-400A, MZJ-400D or Ametek 24144.

7.11.8 All boats are required to use motor controllers rated for the amperage greater than the main fuse. All power to the motor must be regulated by a motor controller. The motor controller must not be bypassed.

7.12 Radios - There is no restriction on the type or frequency of voice or telemetry radio communication with the on-shore team and the competition craft but voice radio communications from the Launching Site is required. This will be the responsibility of each Team. **A team member must be in the Headquarters area, with or without a radio, any time their boat is on the water.**

7.13 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 Qualifying.

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

7.13.2 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.

7.14 Fasteners

7.14.1 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.

7.14.2 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.

7.14.3 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.

7.14.4 Charge Controllers - All solar panels will be connected to the batteries through a Solar Charge Controller which regulates the voltage/current flowing into the batteries. The charge controller is required when charging the batteries both in the boat and when charging the batteries off the boat in the paddock area.

7.15 Safety Equipment

7.15.1 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.

7.15.2 Buoyancy of Craft - Sufficient flotation must be provided on board so that the craft cannot sink. **Verification calculations must be provided at the Tech Inspection and submitted in writing at Registration.** A 20% safety factor must be included in the calculations.

7.15.3 Towing - A bow eye has been provided to each team and must be used. All boats must carry a minimum of 5 meters of towing line, **which will be provided at the event near the Tech Team area**

7.15.4 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.

7.15.5 Paddle - A paddle, no less than 60 cm long with a blade at least 13 cm wide, must be on board at all

times. The skipper will be required to propel the craft with the paddle during Technical Inspections.

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

8. Competition Events

8.1 Start – Sprint events will commence from a standing start. Endurance events will commence from a parade start.

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

8.2.1 Qualifying - The primary purpose of Qualifying is to determine the eligibility of Teams to participate in the Event. Teams must pass Technical Inspection prior to attempting to Qualify. Qualifying will be used to test the safety, seaworthiness, handling, and “qualifying time” of each craft. The track of the boat through the Qualifying course must generally conform to the diagram posted at the event. A 200-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. Failure to complete a Qualifying course disqualifies the team from the event they didn’t pass. If they fail to pass both courses, they cannot continue to participate in on-the-water activities.

Qualifying Time will be the sum of the times on the Maneuverability and Sprint courses and will be used in determining points towards the overall winner. The time for Qualifying will be used to determine heat position for the Sprint and Endurance Events.

8.2.2 Sprints - Sprints will be held over a 200-meter straight-a-way course. Boats are not required to carry their solar arrays during the Sprint event (7.1.3). **Boats will be required to return to the Launching Site without being towed. Paddling is allowed.**

8.2.3 Endurance - The event will be held over a closed course not exceeding 2 km in length. The course will be run in a clockwise direction. All entries must carry their solar panels, as inspected, on board during the Event. Any changes in the solar panels must be re-inspected and re-approved before competing.

8.3 Skippers’ Meetings - An open meeting will be held Saturday morning, May 19, and Sunday, May 20, at 7:30 a.m., unless otherwise posted, before the day’s events. **Attendance by a skipper or Team leader is mandatory. Failure to do so will result in a penalty which can range from missing a heat to missing the day of racing.**

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 Endurance Event, if a boat leaves the course for any reason, it must re-enter at the same point or further back.

8.7 Overnight Impound - All craft will be impounded overnight on Friday, **May 17** and Saturday, **May 18** in the paddock area to prevent “all-nighters”, which could cause safety concerns. Impound will begin after qualifying on Friday, **May 17**, and will be from 5 p.m. to 7 a.m. daily. **No components may be taken from Lake Skinner Launch Ramp parking lot area.** If a new component is acquired during the impound time, it must be inspected before being installed in the craft.

- 8.8 Support Craft** - No support craft will be allowed.
- 8.9 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.
- 8.10 Overall Scoring – Total possible points is 1000.** In order to determine an overall MWD Solar Cup Champion, the following overall scoring system is used:

Technical Reports - 50 points. Two progress reports will be required at specific dates (see 8.13).

Outreach Project - 250 total points. The Public Service Message (PSM) has two parts; the Final Outreach Project (PSM) is worth 220 points and the Outreach Project draft outline worth 30 points. **If a team fails to submit a draft outline, they CANNOT submit a final Outreach Project.** The draft outline must be received at MWD headquarters by 5:00 pm on **February 21, 2019.**

The final Outreach Project will be judged on: Creative use of theme and format; content that is accurate and consistent with the published topic, appeal of design and messages that clearly articulate the theme. The final Outreach Project is due on **April 12, 2019.** **All final PSA's must be sent to MWD via Hightail address detailed in the brochure.** **Late entries will be penalized 20% or 44 points.**

Outreach Project

Students will be asked to create a conservation themed piece, see Outreach Project workshop handouts and brochure for specific theme and more details.

Outreach Project Draft Outline

The written draft (outline) should be no longer than one page, double-spaced in 10 to 12 point font (see 8.12 for the due date). Up to two additional pages with the same format requirements will be accepted as an attachment to the outline to share feedback from your testing or evaluation. It will include highlights of the method for testing, the feedback received and how it was used (if at all) to modify the final product.

Outreach Project Scoring

Scoring will be based on the total points awarded to the project by the review panel. The panel will award points based on how well the project followed the criteria detailed in the Outreach Project Brochure. The points awarded on the draft will be added to the final Outreach Project points for the total points awarded. The project that receives the most points will receive 250 points, the maximum award. **Points will descend by two (2) per place.** There may be ties. If so, equal points will be awarded.

Deadlines—55 points. Each team is asked to meet deadlines throughout the Solar Cup program. Failure to meet deadlines will cause the team to lose points in various categories. Teams are now responsible for submitting the following items on time to earn the points in this new point category:

- Submit the team liability forms by **5 p.m., March 21, 2019 (30 pts)**
- Submit the final boat expenditure sheet by **5 p.m., April 26, 2019 (5 pts)**
- Submit a photo showing boat was on the water and seaworthy by **May 4, 2019 (5 pts)**
- Pass Technical Inspection on **May 4.** Boat must pass 85% of items on Tech Sheets **(15 pts)**

Qualifying - 50 points. Teams that pass Inspection by the posted time and are within the hours posted for Qualifying may be given the opportunity to run the Qualifying courses for score. The times from the two courses will be added. (No practice will be permitted). The fastest qualifier will receive 50 points. All other qualifiers will be scored by the formula:

$$\text{Your points} = \frac{\text{Winner's time}}{\text{Your time}} \times 50$$

If multiple attempts must be made in order to qualify, your qualifying time on that course will be multiplied by the number of attempts to determine your time.

Sprint - 250 points. The same formula will be used for the Sprint as is used for Qualifying with the modification that it will be based on the best two times. If a competitor fails to complete either of their first two heats, they will be assigned the time of the slowest competitor in that round +5 seconds.

Endurance Event - 345 points. The purpose is to go as far as possible in 1.5 hours. Total distance traveled will be recorded to the nearest .25 lap completed.

$$\text{Your points} = \frac{\text{Your total distance (two heats)}}{\text{Winner's total distance (two heats)}} \times 345$$

- 8.11 Seeding** - All entrants will be seeded for the Sprint based on their sprint qualifying time.
- 8.12** The Outreach Project has two due dates that must be met. **Components will only be accepted up to one week late.**
- Draft Outreach Project is due no later than **5:00 p.m., February 21, 2019**
 - Final Outreach Project is due no later than **5:00 p.m., April 12, 2019** for two items listed below:
 - **Final PSA—must be submitted to MWD via Hightail address detailed in the brochure.**
 - **Outreach Project Team Participation Form (send via email).**
- 8.13 Technical Reports** - Progress reports are due at Metropolitan Water District Headquarters at the times below (see 2.5). A penalty of 5 points will be assessed for any late reports. Reports will only be accepted up to one week late. Reports must be turned in electronically or if too large to send electronically, via cd or dvd.
- Drive Train and Steering Report is due via email no later than **5:00 p.m., January 7, 2019.**
 - Solar Array and Electrical System Design Report is due via email no later than **5:00 p.m., February 14, 2019.**

9. Graphics

- 9.1 Boat Number Signs** - Each craft will have a “boat number”. Each team will be provided with a base and an “L” bracket for their “boat number” sign. It, 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. In addition, all materials produced by teams, which use the MWD logo, seal or Solar Cup logo, **must be approved by MWD** before being printed and distributed.
- 9.3 School Name** - School names on the craft are optional, but recommended.
- 9.4 Sponsor Identification** – All boats are must have Metropolitan Water District and their sponsoring MWD Member Agency and retail agency if applicable stickers displayed on each side of the craft, above the waterline, at all times. MWD will furnish sponsor decals in white, black, or blue. No other sponsoring agency or business logos may be displayed on the hull. The participant must provide an

area to apply decals of at least 24 inches in length aft of the bow stem and forward of the stern stem. This area will be a solid color that will contrast with the logos provided. (This allows approximately 9' in the center area on each side for your school name.)

9.5 Inappropriate Graphics - MWD reserves the right to disapprove any graphics.

10. Dates and Times

- 10.1 Technical Inspections** – Saturday, **May 4, 2019**, 9:00 a.m. to 3 pm. During the event weekend, Technical Inspection will occur on Friday, **May 17, 2019** from 8:00 a.m. to 1:00 p.m. Re-inspections will take place at the event prior to each race on Saturday and Sunday.
- 10.3 Swim Test** - Saturday, **May 4**, 10 a.m.- 3 p.m.; location to be announced
- 10.4 Qualifying** - Friday, **May 17**, 9 a.m. to 4 p.m.; Event site, Lake Skinner
- 10.5 Endurance** - Begins Saturday, **May 18**, 10 a.m.; Event site, Lake Skinner
- 10.6 Sprint** - Begins Sunday, **May 19**, 10 a.m.; Event site, Lake Skinner
- 10.7 Weather** - The Sprint and Endurance competition days and times are at the discretion of the MWD. 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:

- 11.0 Failure to Comply with the Regulations** - Officials may assess penalties ranging from ten (10) points to total disqualification for a Team's failure to comply with any Regulation.
- 11.1 Qualifying**
 - 11.1.1 Leaving the Course** - If a craft leaves the Qualifying course, as defined in Rule 8.2.1, 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.
 - 11.1.3 Failure to pass Technical Inspection** on Friday, **May 17, 2019 by 1:00 p.m** disqualifies teams from further on-the-water events.
 - 11.1.4 Failure to pass Qualifying courses** disqualifies teams from participating in the event that they failed to qualify.
- 11.2 Sprints**
 - 11.2.1 Disturbing Official Battery Markings** - When batteries are inspected, they will be given official tags. These markings 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.
 - 11.2.2 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.

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

11.2.4 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. See 8.10 for scoring.

11.3 Endurance

11.3.1 Disturbing Official Battery Markings - When batteries are inspected, they will be given official tags. These markings 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 one lap per infraction or may be disqualified at the discretion of the officials.

11.3.3 Striking a buoy - If a craft strikes a buoy, the craft will be penalized a minimum of .5 laps per infraction.

11.3.4 Failure to Yield to Right-of-Way - Any Team failing to allow right-of-way when being overtaken by another craft will be penalized a minimum of .5 laps per infraction.

11.4 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.

11.5 Failure to Attend Skippers' Meetings - Any team that fails to be properly represented at any Skippers' meeting will be penalized in the form of missing a heat or missing the day's race and must receive a briefing before they can continue to compete.

11.6 Code of Conduct - Officials may assess penalties ranging from ten (10) points to total disqualification for improper conduct that does not uphold the spirit and educational intent of Solar Cup. Such conduct may include, but is not limited to, improper or demeaning language, failure to listen to officials during any workshops and/or event (including at campground area) and obscene gestures.

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 **MWD SOLAR CUP**. By entering the Event, all teams shall agree to the use of, without compensation, their names and photographs in any publicity material that may be issued by MWD.

13. Prizes and Awards

MWD will recognize all Teams' participation. In addition, the following awards will be presented:

13.1 Daily Award - Daily awards may be presented.

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 will also be presented. An Overall Winner will be determined by a formula which includes: Progress Reports, PSA, Deadlines, Qualifying, Endurance, and Sprint.

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, **May 19**, following the final competition.

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 fairness and 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 via the sun 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.
- 14.3 Only one set of batteries may be used for one Endurance Heat. Batteries can not be changed during the heat.
- 14.4 At no time during qualifying or the competitions will a swimmer be allowed in the water to assist a boat in any manner.
- 14.5 Protective eyewear must be worn at all times by anyone who is handling batteries. Footwear is recommended for all participants.
- 14.6 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.

15. Paddock Area

This is the area that is under large tents, where each entry will have an area of approximately 20' x 20'. The area is used to work on and store the craft. 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 at Lake Skinner during the Event starting at 6 a.m., **Friday, May 17** through **Sunday, May 19, 2019**.

17. Amendments

17.1 Skeg Rule Amendment

Ruling Background:

In the past Solar Cup teams have inquired about the use of a keel, skeg or fin attachment(s) to the bottom of their boats. In this context a keel, skeg or fin attachment(s) is a vertical attachment to the bottom of the boat designed to aid in the directional stability or steering of the boat. **Rule 4.2.3**, see below, was applied to not allow modifications to the hull structure based upon the following specific wording:

... The hull must be used as built at the boat-building workshop and must conform to the assembly instructions. Additions may be made to the interior but the only allowed removal of material will be holes in the bulkhead for wires; and holes in the hull for the drive train and steering, so long as they don't substantially affect the structural integrity of the craft, in the opinion of the judges.

Although it is somewhat questionable how significant such a attachment would “aid in the directional stability or steering” of the “6 hour canoe” boat design as compared to a conventional rudder, in keeping with the competition goal of safety it was felt by the MWD and the technical team that if such

a structure could aid in the directional stability of the boat some allowance or ruling for such a structure should be made.

Current Applicable Rules

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 two configurations of the boat, based on the same hull (fixed structure). The hull is that portion of the boat which provides flotation and stability. The hull must be used as built at the boat-building workshop and must conform to the assembly instructions. Additions may be made to the interior but the only allowed removal of material will be holes in the bulkhead for wires; and holes in the hull for the drive train and steering, so long as they don't substantially affect the structural integrity of the craft, in the opinion of the judges.

The ruling:

A skeg, fin or keel, here after referred to as the structure(s), **will be allowed provided it meets the following requirements:**

- a. The structure must be mounted vertical with respect to the bottom of the boat. In this configuration the structure will be **perpendicular to the surface of the water** when the boat is at rest. **No horizontal components such as wings or foils** which attempt to provide lift or thrust to the boat will be allowed as part of the structure.
- b. The maximum **length** of the structure will be **less than 10 inches** measured from the boat hull.
- c. The total square inches of all such attachment(s) will be **limited to 30 square inches in profile** (i.e. from the side view). Because these structures often have unique curvatures¹ it is up to each team to prove that its design is less than the prescribed amount.²
- d. The number of structure attachments will be limited to a **maximum of three**, however the total square inches of all must be 30 square inches or less, so if three equal size structures are proposed each must be less than 10 square inches.
- e. The structure must be **planar or flat** in nature with the thickest part of the structure attached to the bottom of the boat with the structure tapering as it extends away from the boat. Structures such as a "bulb keel"³ or "tunnel fin"⁴ which dramatically vary the thickness or cross-sectional area of the structure will not be allowed.

Resources used in the development of this ruling were:

MWD Solar Cup Rules

<http://en.wikipedia.org/wiki/Skeg>

http://en.wikipedia.org/wiki/Surfboard_fin

Final notes: As a modification to the current rules any team considering the addition of such a structure should contact MWD early in the design process to clarify their design before any construction takes place on their boat.

¹ <http://islandfindesign.com/finstore/templatepage.htm>

² The profile or side view area can probably be determined easiest by tracing the profile of the structure onto graph paper, for example ¼ inch or finer and then adding up the amount of square inches contained within the profile.

³ http://www.lhyb.com/yacht_images/tenacious/keel.jpg

⁴ See example at <http://www.tactics.com/turbo-tunnel/95-turbo-tunnel-fin>

17.2 Battery Amendment

Rule Advisory

7.11.2 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 its own batteries. The batteries must be commercially available, lead-acid, unmodified with their weight consistent with the Rules. Craft are allowed to carry a total battery weight of not more than 25 kg (55 lb). 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, which includes battery weight and MSDS sheets, must be available at Inspection time. Batteries will be weighted during Inspection. MWD scales will be used as the final determination of official total battery weight. ***The manufacturer's data: make and model must be fully specified not just generic battery information that might be in a sales flyer. Batteries that meet the 55 lbs limit will be allowed. Batteries that are specified as 55 lbs or less but weigh up to 57 lbs (a total of 2 lbs over) will incur a penalty of 10 points per pound. Batteries that weigh over 55 lbs and are specified over 55 lbs will not be allowed. Any batteries over a total of 57 lbs, 2 lbs over, will be disallowed even if the manufactures data sheets say they should meet the 55 lbs limit.***

17.3 Rule clarification on the rudder supporting structure: rules that apply 7.2.1 and 4.2.3

Rule: 7.2.1 Length - The length of the craft will be approximately 4.6 meters (15 ft, 1 in). Nothing may extend forward beyond the bow of the boat. Only the boat sign and the rudder may extend beyond the stern of the craft.

Rule 4.2.3, portion listed below, has been applied to not allow modifications to the hull structure based upon the following wording:

... The hull must be used as built at the boat-building workshop and must conform to the assembly instructions. Additions may be made to the interior but the only allowed removal of material will be holes in the bulkhead for wires; and holes in the hull for the drive train and steering, so long as they don't substantially affect the structural integrity of the craft, in the opinion of the judges.

Because the above two rules are somewhat contradictory and especially because of the difficulty in mounting the rudder supporting structure to the narrow portion of the stern (which must also allow for the boat sign mount) teams which attach anything to the outside of their boats in conjunction with the rudder structure must have the design pre-approved by MWD before the Technical Inspection date **(May 4, 2019)**.

In general, small supporting structures near the gunwale (From Wikipedia: The gunwale, nautical term describing the top edge of the side of a boat.) maybe granted waivers but should be designed such that they will not be in the water during either the sprint or endurance competition. This will most likely limit any rudder supporting structure to within a few inches of the gunwale.