



## **Ocean Engineering Robot Design Competition**

e-Biome's Ocean Engineering Robot Design competition provides a unique and excellent opportunity for students to showcase their ability to design and build a robot. The competition is great learning ground for participants to experience the challenges of AUV system engineering and develop skills in the related fields of mechanical, electrical and software engineering.

### **Overview**

Ocean robots, also known as autonomous underwater vehicles, or AUVs, are self-propelled, unmanned, untethered submersible vehicles that can execute simple tasks with little or no real-time input or control from a human operator or driver and so operates autonomously. AUVs are pre-programmed robotic vehicles that are being sent into the water with mission parameters. AUVs can drift, glide, or accelerate themselves through the water, depending on their design. They are commonly utilized as survey platforms for mapping the seabed or characterizing physical, chemical, or biological aspects of water. They are enhancing our understanding of how the world's oceans behaves and our capacity to do science at sea, even in the most inhospitable conditions. Such research is critical, but the complex dynamics of the ocean environment (e.g., wind, waves, and currents) provide a significant challenge for correctly managing these vehicles. Researchers are using advanced control approaches to improve the robustness and reliability of autonomous marine vehicles in a variety of aquatic conditions.

The challenge presented by the competition requires contestants to construct an AUV capable of performing specific tasks. These challenges are simulations of what operational AUVs must be capable of. The competition takes place in a swimming pool, and each team's AUV must complete four challenges. The speed and precision with which the AUV completes tasks will be utilized to determine the competition winner. The tasks encompass four common underwater challenges: AUV navigation, visual recognition, acoustic localization, and robotic manipulation.

For the Purpose of this competition, *“A robot is an electromechanical, autonomous device capable of detecting its surroundings, doing calculations to make decisions, and acting in the physical world. A robot should be able to move about, operate a mechanical connection, detect and modify their surroundings, and demonstrate cognitive behavior, such as mimicking people or other animals.”*

**Objective:**

The aim is for each team to create an Autonomous Underwater Vehicle (AUV) that can complete the tasks in the allotted time.

**Entry Rules:**

1. This competition is open to students from secondary/high schools only
2. Designed for students with limited coursework in programming and microprocessors or who are new to the competition
3. Maximum of two teams per institution
4. Limit of one robot per team
5. Robots must start and end each time trial at specified locations
6. Robot size must fit the specifications as stated below

**Video Submission:**

All teams have to submit a video of their AUV prior to the competition. The video HAS TO be maximum 1 minute long, be submitted before the allotted deadline, showcase the tether-less operation of AUV swimming underwater for at least 30 seconds, showcase the operation of the Kill Switch; pressing the Kill Switch should stop all thrusters immediately.

Videos will be reviewed by the organizing committee and 30 teams with the best vehicles will be short-listed to attend the competition.

The organizers reserve the right to publish the video submissions after the competition.

**Structure of the Team:**

A team may consist of up to 10 participants including faculty supervisors. Student participants must be non-professionals at the time of registration.

**Robot Specifications:**

1. Size and Weight

The weight of the vehicle shall not exceed 30 kg (weight in air). If the weight is below 30kg, corresponding bonus points will be applied; if the weight exceeds 30kg, points will be deducted for overweight. Vehicles weighing 50 kg or more are not allowed to compete.

The vehicle must fit into a cube size of 1000mm\*1000mm\*2000mm.

The team can use 2 vehicles if their total mass and dimensions do not exceed the specified limits.



## 2. Power Supply

The power supply can only be rechargeable battery, with the voltage not exceeding 72V. It is forbidden to use a 220V AC power supply.

## 3. Emergency Switch

Each vehicle must have a reliable security (emergency) switch to shut down the system and stop all propellers during an emergency. The switch should be placed in a prominent position on the surface of the vehicle, which can be easily operated by the diver in case of emergency.

## 4. Others

- A. During the competition, except the balls for competition, no parts or accessories can be separated from the vehicle and nothing can be thrown into the pool. There should also be no leakage of oil or other pollution.
- B. During the competition, once the AUV (or one of the AUVs) floats onto the surface, the attempt ends.
- C. The AUVs must autonomously pass all tests. Teams are prohibited from touching the water in pool with any device or using any wireless device to remotely control the vehicles.
- D. Total attempt time for each team is 30 minutes. The AUV should pass the gate within 10 minutes after the starting of the race. The attempt ends when the AUV floats.
- E. If the participants consider that the result of the first attempt is unsatisfactory, then a second attempt may be made. The time spent in the previous attempt will be deducted from the total time of 30 minute. The AUV shall pass the qualification gate in 5 minutes in the second attempt to obtain the qualification for follow-up competitions. The result of the first attempt will not be calculated. The maximum chances of attempt for each team is 2.
- F. A captain for each team can be appointed to contact the judge, participate in the draw and stop the attempt, if necessary.
- G. Only if all the four tasks have been completed with scores at the end of the competition, additional points can be awarded for the remaining time.

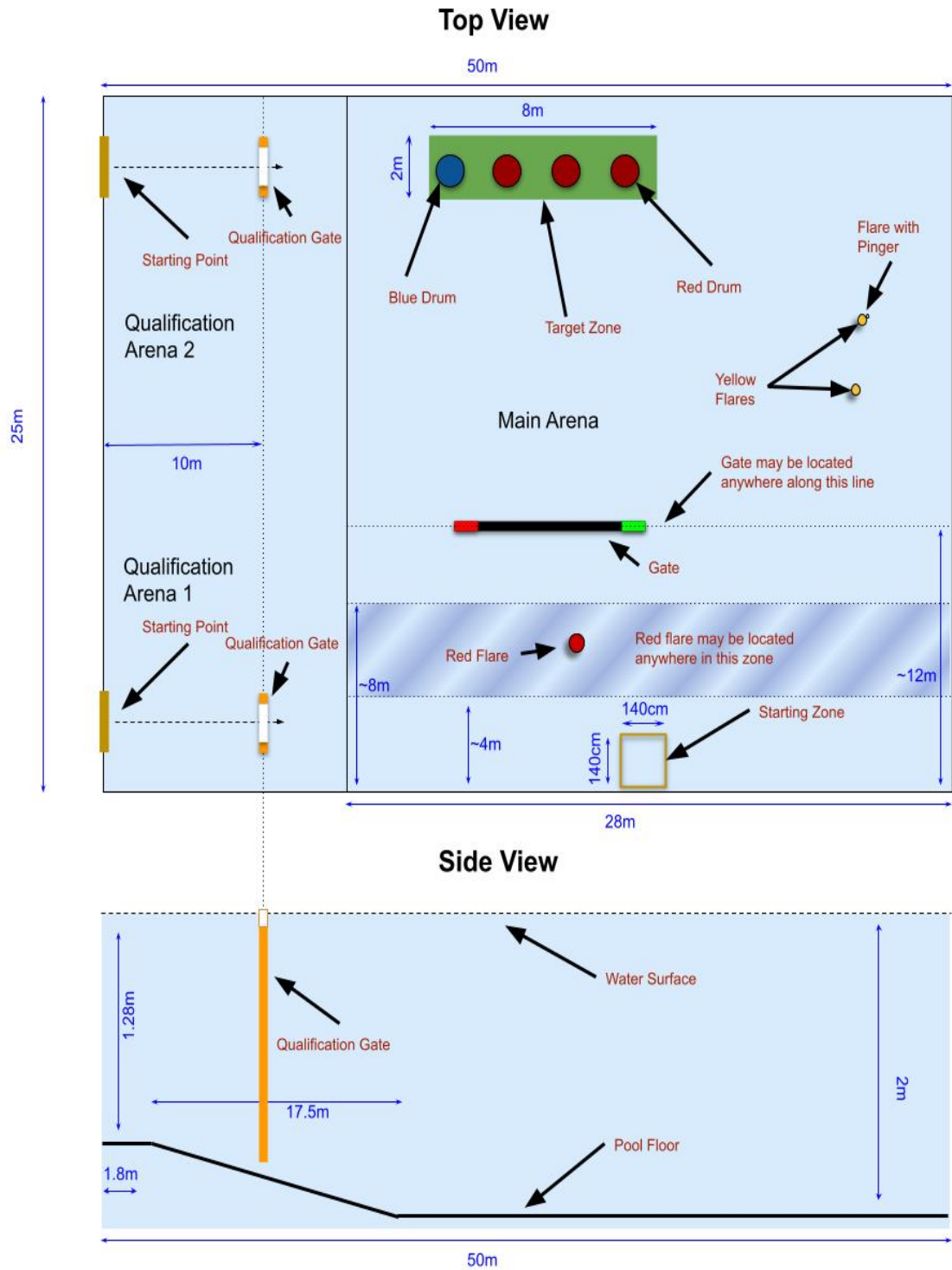


### **The Qualifying Round:**

- AUVs have to pass a qualifying round before they can participate in the main arena.
- To qualify, an AUV has to swim from qualification starting line and pass through the qualification gate without surfacing, touching the bottom/wall or the qualification gate.
- The time taken for the last part of the AUV to pass through the qualification gate will be counted towards the qualification time.
- Teams will be allocated a time slot for the qualification round. Teams may attempt multiple qualifying runs during the qualifying slot.
- If multiple qualifying runs are attempted during the qualifying slot, the fastest successful run will be considered for the final round.
- Only the top 10 qualified teams, with the fastest time for the qualifying round, will advance to the final round.
- The time taken to pass the qualifier round decides the sequence in which the teams will participate in the final round of the competition. The team that finished the last in the qualifying round would participate first in the final round.

## Venue and Site

The arena where the challenge will be held in an olympic sized swimming pool (50m x 25m).





## **Qualification Arena(s)**

The qualification rounds would be held on the side of the main arena. The qualification starting line is a marked 1m wide section of the pool wall from where the AUV should be deployed from. The AUV has to touch the wall at the beginning of the run. At approximately 10m from the starting line the qualification gate is hanging from the surface of the water. The AUV has to go through the gate to qualify.

## **Timing**

- I. The competition will consist of two or three rounds (will be decided later based on the number of entries) of time trials. Each team will complete one time trial per round.
- II. The order in which teams will complete their time trial will be announced prior to each round.
- III. Each team will be given a 4-minute heads-up before placing their robot on the board.
- IV. Time trials will begin at the specified times whether robot(s) are present or not. Judges will NOT wait for teams that are making last-minute changes to start their time trial.
- V. Teams will have a total of 10 minutes to prepare their robot on the board, complete each time trial, and score as many points as possible. Touching the robot after it starts navigating the course is considered as intervention.
- VI. No bonus points will be awarded for time remaining. In the event there is a draw, the time will be used as the tie-breaker.

## **RESOURCES**

Teams may use any materials they choose as long as they are safe, do not harm or otherwise degrade the competition environment, and adhere to the design and building standards. Teams are urged to concentrate on building a vehicle to fulfill the product demonstration tasks; when considering design options, teams should ask themselves which one allows them to tackle the challenge the most quickly and effectively. It is permissible to reuse components produced by prior team members as long as the current team members analyze, understand, and can explain their technical and operational concepts. Commercial components may be used or re-used as long as team members analyze, comprehend, and can explain their technical and operating principles. Teams will be questioned extensively on their overall design and component selections during their technical sales presentations.



### **General Restrictions**

- Team members are not allowed inside the swimming pool at any point during the game.
- Team members may not disturb the water surface once the game starts.
- Members of other teams are not allowed in the game area.
- Nobody is allowed to wear any footwear near the pool area.
- The Judges may suspend the challenge if weather turns unfavorable.
- The pool area must be evacuated in case of lightning.

### **Disqualification**

Teams may be disqualified if :

- Oil or lubrication leaks causing the pollution of pool.
- Battery leak causing the pollution of pool.
- The AUV damages or tries to damage the arena, facilities or equipment.
- The team performs any acts that are not in the spirit of fair play.
- The team fails to obey instructions or warnings issued by the Judges or Game Master.
- If the team does not abide by the the general restrictions.

### **Others**

The legitimacy of any actions not provided in this rulebook will be subject to discretion of the Judges. The dimensions, weights, etc. of the field, facilities and equipments stated in this rulebook have a margin of error of  $\pm 5\%$  unless otherwise stated. However the dimensions and weights of the AUVs as stated in the rule book are the maximum and cannot be deviated. The Judges may demand additional explanations on safety issues when the safety of a vehicle is deemed to be in question.

### **Contact**

The complete competition manual will be released soon; teams have from that date until the regional event to construct their vehicles and prepare the engineering and communication components (technical documentation, product presentations, and marketing displays). Visit the e-Biome web site at [www.e-biome.com](http://www.e-biome.com) or if you have any questions regarding the competition rules, please summarize and submit to the email: [biolifeja@gmail.com](mailto:biolifeja@gmail.com).