AFRO-ASIAN FORUM FOR INNOVATION & TECHNOLOGY

ROV

PARTICIPATE IT'S VERY EASY:

→ STUDY

→ Design

→ Compete

Professional &Ranger class

2024

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Contents

OVERVIEW

RUVs (Rescue Underwater Vehicles) play a crucial role in rescuing and preserving underwater life. These advanced robotic systems are designed to navigate and operate in the challenging underwater environment, enabling effective interventions and reducing risks to human divers. The importance of RUVs in underwater life rescue can be summarized in the following points:

- Accessibility: RUVs can reach depths and areas that are inaccessible or dangerous for human divers. They can explore underwater environments with precision and flexibility, allowing for targeted rescue operations.

- Search and Rescue: RUVs equipped with cameras and sensors can aid in locating and identifying distressed marine life, such as angled animals or injured species. They can cover large search areas efficiently, increasing the chances of successful rescues.

- Intervention and Assistance: RUVs can be equipped with specialized tools and manipulators to perform various underwater tasks, including untangling marine creatures from fishing nets or debris, removing pollutants, or providing life support measures.

- Data Collection and Monitoring: RUVs can gather valuable data about underwater ecosystems and species, contributing to scientific research and conservation efforts. They can capture high-resolution imagery, record videos, and collect samples for further analysis.

- Minimizing Human Interference: By utilizing RUVs, the need for direct human intervention in delicate or hazardous underwater environments is reduced, minimizing disturbance to the ecosystem and ensuring the safety of both divers and marine life.

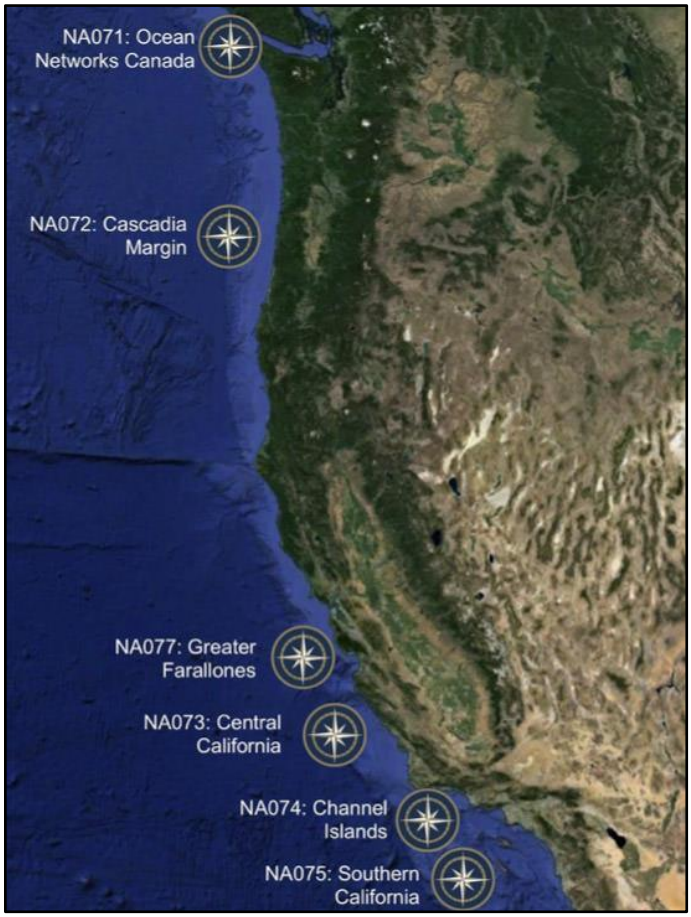
- Public Education and Awareness: RUV missions and footage can be shared with the public, raising awareness about the importance of ocean conservation and the challenges faced by underwater life. By showcasing the impact of human activities on marine ecosystems, RUVs can promote sustainable practices and foster a sense of responsibility toward preserving underwater habitats.

In conclusion, RUVs play a vital role in underwater life rescue by providing accessibility, conducting search and rescue operations, assisting in interventions, collecting data, and raising public awareness. Their versatility, precision, and ability to operate in challenging conditions make them indispensable tools in protecting and preserving underwater ecosystems and the diverse species that depend on them.

COMPETITION THEME

Throughout the summer of 2016, NOAA's Office of National Marine Sanctuaries teamed up with the Ocean Exploration Trust to explore the marine ecosystems of the West Coast. Working aboard the E/V *Nautilus* and utilizing remotely operated vehicles (ROVs), scientists mapped and explored targets throughout the U.S. West Coast, from Canada to southern California, including five national marine sanctuaries.

NOAA Office of Ocean Exploration and Research provides support for the complementary ocean exploration program of the *Nautilus*, which operates under a similar paradigm as NOAA Ship Okeanos Explorer.

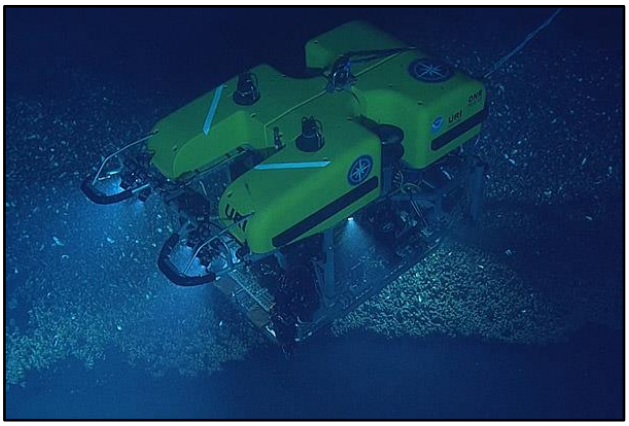


Nautilus *2016 expedition map. Credit: OET*

E/V Nautilus*. Credit: OET*

The E/V *Nautilus* is equipped with telepresence, which allowed scientists from around the world to participate and contribute to the success of this mission. Plus, telepresence brought national marine sanctuaries and ocean science to the classroom, as students across the country directly engaged with mission staff and operations.

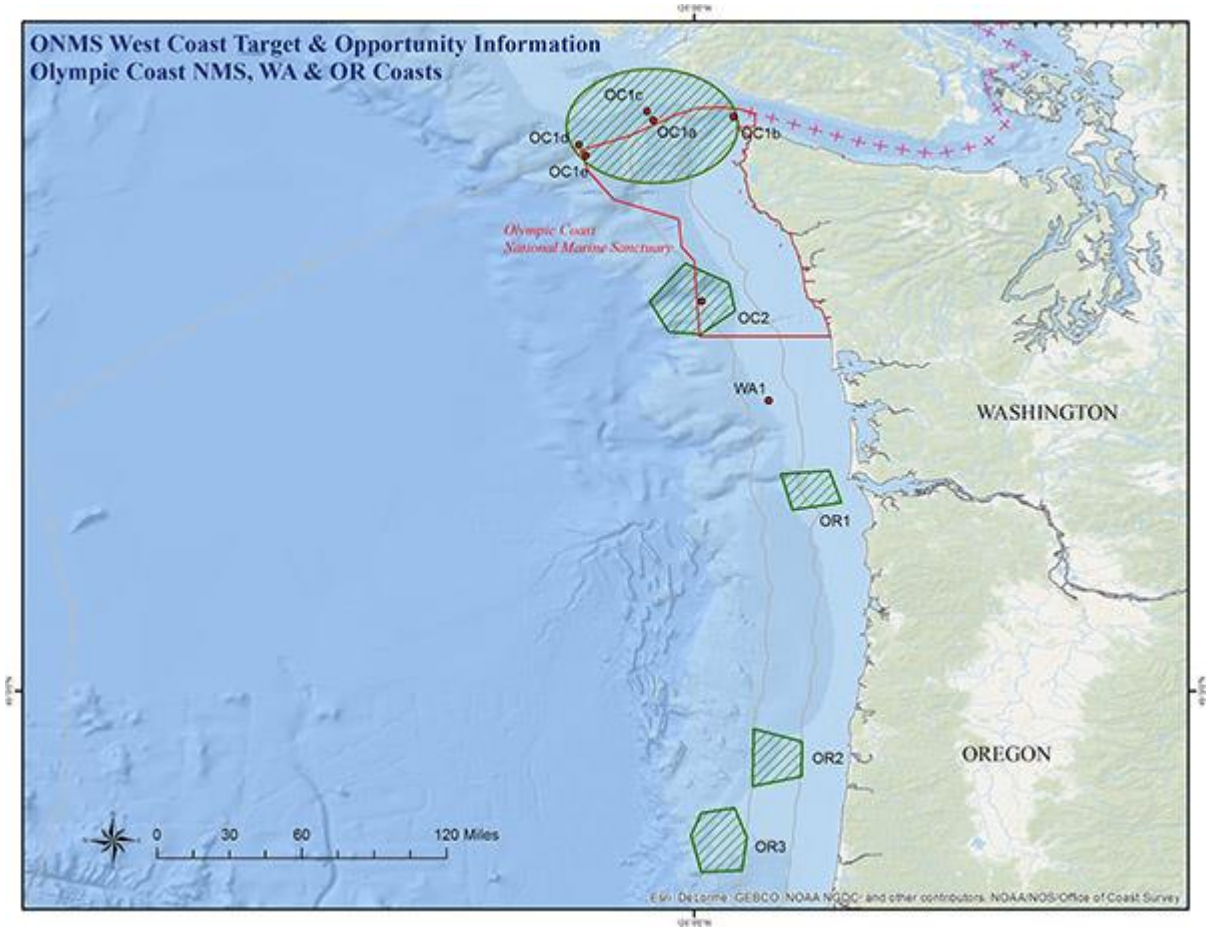
Details and photos from the 2016 expedition can be found below, and the archive from the expedition can be seen at nautiluslive.org.



ROV Hercules*. Credit: OET*

Control room. Credit: OET

Seeps and Ecosystems of the Cascadia Margin



Dates: June 1-19, 2016

Lead Scientists: Dr. Robert Embley and Dr. Stephen Hammond, NOAA Pacific Marine Environmental Laboratory

Area of Exploration: Washington state to San Francisco, California, including Olympic Coast National Marine Sanctuary

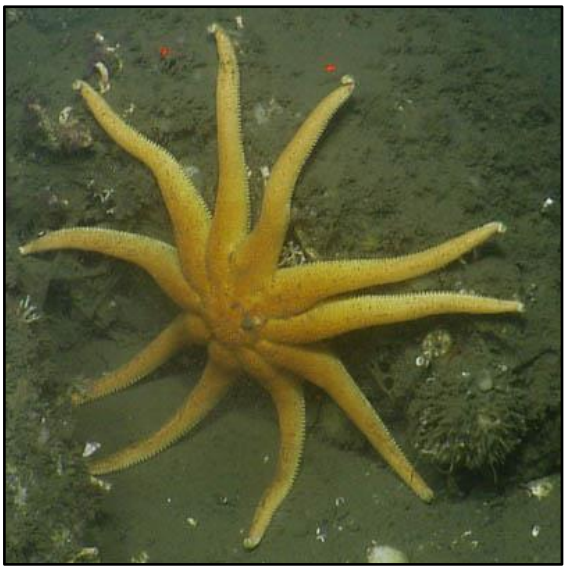
On this expedition, the scientists on board *Nautilus* will use mapping tools to survey the extent of methane seeps along the Pacific Northwest coastline. Methane is a powerful greenhouse gas and an important commercial resource that fuels many elements of our lives on land. Scientists are beginning to understand the complex and varied ways methane fuels life beneath the sea as well. As habitats are identified, the ROVs will dive on these targets to investigate the structure and communities they support. A well-explored baseline understanding of these dynamic ecosystems will be essential for understanding changes as they occur. During this cruise, *Nautilus* will also explore the wreck of the World War II freighter SS Coast Trader, located just outside Olympic Coast National Marine Sanctuary in Canadian Waters. The ROVs will conduct the first visual survey of this cultural heritage site as well as assess its condition and remaining vessel stability.

Scientists also plan to explore for the first time (by deep submergence vehicle), the unique geological features that define the jagged rim of Quinault Canyon within Olympic Coast National Marine Sanctuary on the Washington continental slope. Recent sonar mapping shows rock ridges, relict Pleistocene sediments, and reflectance from non-geologic formations that may indicate rich habitats for coral and sponge communities. Live underwater video will provide the first glimpse of the unexplored Quinault Canyon.

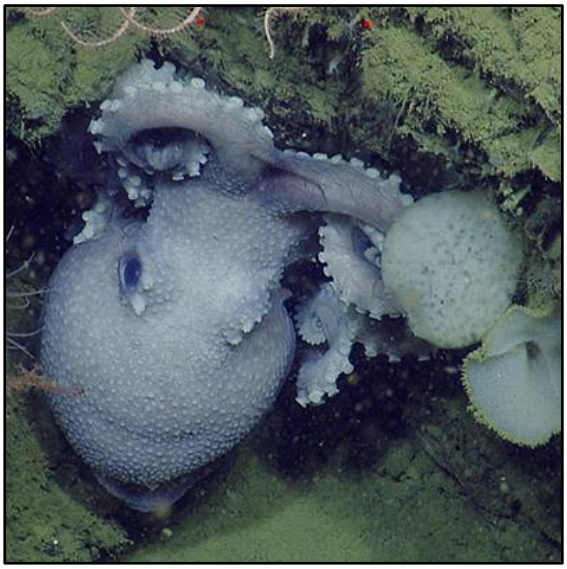
A fish hides in the wreck of the SS *Coast Trader,* an American merchant ship torpedoed by Japanese submarine *I-26* on June 7th, 1942 in what is now Olympic Coast National Marine Sanctuary. Photo: OET/NOAA

Quinault Canyon is the deepest submarine canyon within Olympic Coast National Marine Sanctuary. Many creatures, like rockfish and lingcod, call the canyon home. Photo: OET/NOAA

This sea star was spotted in the deep environments of Quinault Canyon in Olympic Coast National Marine Sanctuary. Photo: OET/NOAA



This octopus was spotted on an ROV dive near Olympic Coast National Marine Sanctuary. Photo: OET/NOAA



The *Nautilus* crew spotted this octopus while diving with an ROV in a canyon near Olympic Coast National Marine Sanctuary. Photo: OET/NOAA

Glass sponges are found in the deep waters of submarine canyons like Gray's Canyon, near Olympic Coast National Marine Sanctuary. These sponges are named for their integration of silica into the porous body. In collaboration with experts on shore, *Nautilus* researchers collected substrate and sponge samples in Grays' Canyon to give clues about the glass sponge's growing habits, morphology and species variety. Photo: OET/NOAA

SCORING

Underwater tasks – 350 points
Safety – 30 points
Technical report – 100 points
Presentation – 50 points

TIMELINE

Registration	9/3/2024 - 20/6/2024
Technical Report Submission Deadline	1/7/2024
Regional Finals	12-13/7/2024
International Finals	September 2024

REGESTERATION

- Registration will be open from 9 March 2024 to 20 June 2024.
- All data should be written in English.
- The team members cannot be less than 5 and not more than 25 including mentors.

Fees

10,000 EGP registration fees for Professional and Ranger categories teams in the regular registration period, for 10 team members in the team, 300 EGP will be added per each extra member.

For more information, please visit our website. www.Africaniat.com

Awards

Professional class:

Qualified teams will participate in the international competition in Saudi Arabia in Sep 24

- 1^{st} place in professionals wins 15000LE.
- 2^{nd} place in professionals wins 8000LE.
- 3^{rd} place in professionals wins 5000LE.

Ranger class:
Qualified teams will participate in the international competition in Saudi Arabia in Sep 24

- Free accommodation for the team members in the international competition.
- 2^{nd} place in professionals wins 2000 LE.
- 3^{rd} place in professionals wins 1000 LE.

UNDERWATER TASKS

Each team will have total time of 25 minutes allocated for the underwater tasks, which includes 15 minutes for the actual task completion, 5 minutes for preparation before the task, and 5 minutes for demobilization from the station.

TASK #1: SEA FLOOR MAPPING AND SEARCH AREA DEFINITION (140 Points)

- Conduct a scan of the area, from the North to South and East to West directions (autonomous or manual).
- Determine the dimensions of the area in square centimeters (autonomous or manual)
- Mark the boundaries of the identified area using four markers.
- Add a label with the date of the discovered data.

TASK #2: CONDUCT UNDERWATER HABITAT SURVEYS TO ASSESS THE HEALTH AND CONDITION OF MARINE ECOSYSTEMS. (120 POINTS)

- Install a basket in the designated area.
- Collect three pieces of dead coral and place them in the basket.
- Gather two samples of algae from the seafloor and add them to the basket.
- Collect a sediment sample.
- Lift the basket to the pool deck.

TASK #3: ARTIFICIAL REEF DEPLOYMENT (90 POINTS)

- There are three types of coral reefs.
  The first is in good health, The second has a disease, and the third has a disease that affects the health of the rest of the reef.
- There will be three clusters of these reefs. It is required for the team is to photograph these reefs and clarify the locations of each type of reef.
- There will only be one cluster of the three of the most dangerous type of reef, and the team will have to get rid of it and replace it with another artificial reef.
- Teams are tasked with deploying pre-fabricated artificial reef modules to a specified location on the ocean floor.
- RUVs must carefully position and secure the reef structures in accordance with environmental guidelines to ensure stability and longevity.

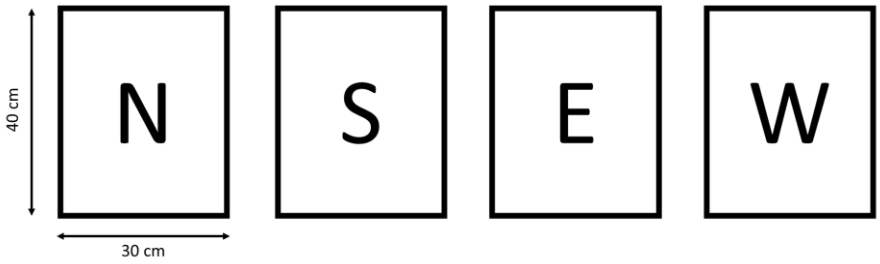
TASKS DETAILS

TASK #1: SEA FLOOR MAPPING AND SEARCH AREA DEFINITION (MUST BE IN ORDER)

1. **Conduct a scan of the area, from the North to South and East to West directions.**

(10 Points for each direction / 20 points in total) – Manual movement
(20 Points for each direction / 40 points in total) – Autonomous movement
The RUV should start from one side from the two sides of the pool, the first side will be the north/south and the RUV should reach to the end of the playground, or maybe start from the second side of the pool which will be the east/west then move the end of the playground to navigate and define correctly the search area.

The playground will have four signs with N, S, E and W each one refers to the North, South, East and West.



Notes

- The RUV must start in each direction movement from the side of the pool then move by the thrusters to navigate the required area.
- The teams may finish this step manual or autonomous
- The team could do one direction manual and the other direction autonomous.
- Fully autonomous means the RUV move without any control by the pilot member.

2. **Determine the dimensions of the area in square centimeters**

20 points – Manual calculation / 40 points – Autonomous calculation

Notes

- In the manual calculation the teams may use any method to calculate the area in square centimeters
- In the autonomous calculations a ready-made method or tool must be calculated the area automatic and explain the method to the station judge
- The total area should be calculated with reference to the four directions signs N, S, E and W.

3. **Mark the boundaries of the identified area using four markers.**
   (10 Points for each marker, 40 points in total)

The RUV should locate four markers from the station to the four designated areas around the playground.

Notes

- The RUV may take the four markers at one time or take them one by one.

4. **Add a label indicating the discovered data.** **(20 Points)**

The RUV should take the label which hold the date of the discovery from the station and locate it in the designated area in the middle of the playground, the label must be settled in a right way and to be read easily from the up side.

TASK #2: CONDUCT UNDERWATER HABITAT SURVEYS TO ASSESS THE HEALTH AND CONDITION OF MARINE ECOSYSTEMS (May done in any order)

1. **Install a basket in the designated area.** **(20 Points)**

The team should take the PVC basket from the station then locate it by the RUV in the designated area, the RUV should hold the basket completely not throw it in the water.

Notes

- if the basket falls down in the water the teams have the advantage to catch it and deliver it to the designated area.

2. **Collect three pieces of dead coral and place them in the basket.** **(10 points each, 30 points in total)**

The teams should collect three dead coral pieces indicated by brown color then transfer it to the basket.

The pieces should locate completely in the basket.

3. **Gather two samples of algae from the seafloor and add them to the basket.** **(10 points each, 20 points in total)**

There will be four samples of algae in the playground and the teams have to collect two only and transfer them to the basket.

4. **Collect a sediment sample.** **(10 Points)**

The teams have to catch the bottle and transfer it to the basket.

5. **Lift the basket to the pool deck.** **(40 Points)**

The teams should lift the basket to the pool station by the RUV own thrusters, lift bag or any lift method to be created by the team, pulling the basket by the tether man is not permitted in the professional class.

The basket can only be retrieved if the RUV has successfully completed any two of the following points: 2, 3, or 4.

TASK #3: ARTIFICIAL REEF DEPLOYMENT (MUST BE IN ORDER)

Objective

Exploring and photographing coral reefs, determining their health, eliminating danger from them, and installing other structures to maintain the health of the reefs and enhance marine biodiversity.

Description

- There are three types of coral reefs
- The first is in good health Its color is green
- The second has a disease its color is yellow
- The third has a disease that affects the health of the rest of the reef its color is red.
- There will be three clusters of these reefs. What is required of the team is to photograph these reefs and clarify the locations of each type of reef
- There will only be one clusters of the three of the most dangerous type of reef, and the team will have to get rid of it and replace it with another artificial reef.

Team Action

1. The team must photograph each one of them separately and determine the proportion of each type of reefs in this cluster. **(60 Points)**

Note: The grades are equal for each one, and a 5% error is allowed.

2. Identify the gathering for the most dangerous people, replace it with another, and place it in the same place designated for it **(30 Points)**

SAFETY

Safety is of paramount importance in RUV competition. These competitions bring together teams of participants who design, build, and operate underwater robots, showcasing their skills and innovation. Ensuring a safe environment throughout the event is crucial, and the following points highlight the importance of safety in RUV competitions:

- Participant Well-being: The safety of all participants, including team members, event organizers, and spectators, is the top priority. Implementing safety protocols and guidelines helps minimize the risk of accidents or injuries during the competition.

- Equipment Safety: RUVs are complex machines with various electrical, mechanical, and hydraulic components. Ensuring that all equipment is properly tested, maintained, and operated according to safety standards reduces the likelihood of equipment failure or malfunctions that could lead to accidents.

- Risk Mitigation: Identifying potential risks and hazards associated with RUV operations is crucial. Conducting thorough risk assessments and implementing appropriate safety measures, such as wearing personal protective equipment (PPE), establishing restricted areas, and implementing emergency response plans, helps mitigate risks and prevent accidents.

- Electrical and Water Safety: RUV competitions involve the use of electrical equipment in close proximity to water. Ensuring proper insulation, grounding, and adherence to electrical safety guidelines minimizes the risk of electrical shocks or short circuits. Additionally, implementing safety measures to protect against water-related hazards.

- Operational Safety: Establishing clear operational guidelines and protocols for RUV testing, deployment, and retrieval is crucial for maintaining safety. This includes proper handling of RUVs, adherence to weight and size restrictions, and following operational procedures to prevent entanglement or collision hazards.

- Learning and Education: RUV competitions provide valuable opportunities for participants to learn about engineering, underwater technology, and teamwork. Integrating safety education and promoting a safety-conscious culture among participants fosters responsible and informed practices in the field of robotics and underwater operations.

In summary, safety is a fundamental aspect of RUV competitions. Prioritizing participant well-being, implementing equipment and operational safety measures, and being prepared for emergencies contribute to a safe and successful event. By emphasizing safety, RUV competitions create an environment conducive to learning, innovation, and the responsible application of robotics technology in underwater exploration and research.

SAFETY NOTES

- The teams must explain to the safety judge the fuse calculation.
- The team which uses a pneumatic must show to the judge pneumatic SID.
- There are two trials for the safety inspection, the score at the first trial is 30 points and 20 points for the second trial.

*Refer to Appendix (A)

TECHNICAL REPORT

- Teams are required to submit a technical report that showcases their vehicle's features and highlights the advantages of their team structure. The report should be must be no less than 15 pages and no more than 25 pages (**100 points**).
- The report will be sent at the pre-determined date according to the competition schedule to the following email:
- The team should send their technical report in PDF format by naming it [Challenge Name_ Category_TeamName_TechnicalReport_2024]
- If the team is one day late in delivering on the specified date, **(10 points**) will be deducted from the grades allocated to the report, If the team is late for more than a day, all grades allocated to the report will be deducted.
- The team can use any required visuals to support your report

*Refer to Appendix (B)

PRESENTATION

- The teams are required to deliver a well-prepared presentation in 15 minutes that effectively demonstrates the features of their vehicle as a product to be sold to the committee. The teams should emphasize the value of their vehicle in relation to its cost.
- The presentation evaluates teams' ability to effectively communicate their project, strategies, and results to judges and audience members.
- The goal of the presentation is to effectively market the vehicle and convince the judges of its value and potential success in the market.
- The actual time for the visual presentation is **25 minutes**, **15 minutes** are allocated for the team to present their project and explain their ideas in the way they see fit, **10 minutes** are allocated for the judges to present any questions or inquiries to the team

Note:

Teams are required to deliver their presentations verbally and directly on the vehicle without the use of laptops, TVs, or any other devices.

*Refer to Appendix (C)

POWER SOURCE

The competition provides a power supply of 48 volts and up to 30 amperes for the teams. Alternatively, teams can use their own power supply, but only after passing a safety inspection.

Teams have the flexibility to use any power connector between the RUV and the power supply. However, direct wire connections are not allowed.

It's important to note that the competition power supply is the only permissible power source, and the use of other power sources, such as batteries, is not allowed.

GENERAL RULES

- Only team members are allowed to work on the vehicle not mentors or supervisors.
- During the Underwater Mission, only five members are allowed to be in the station (a pilot, two co-pilots and two tether-men).
- Direct communication during the Underwater Mission is only allowed between the pilot and the co-pilots in the team.
- The tether-man can communicate with one of the co-pilots to know what task to do, to attach the required devices to the vehicle.
- The tether-man cannot throw the devices or mechanisms used in mission to the water, the vehicle should carry it and deliver it down.
- The time given is 5 minutes for setup, 15 minutes for the Underwater Mission tasks to do and 5 minutes to leave the station.
- The tether-man is not allowed to pull the vehicle from its tether, and the vehicle must go back to the surface under its own power.

- Any debris must be returned to the surface before the mission time ends.

- **Note**: In the event of non-compliance with these rules, 5 marks will be deducted from the team each time

PENALTIES

The competition aims to foster a strong challenge among innovators and discover new applicable ideas, necessitating the enforcement of strict rules. The following scenarios will result in disqualification of teams:

- Disrespect towards judges or organizers.
- Engaging in cheating or fraudulent activities.
- Involvement of mentors or individuals outside the team members.
- Failure to pass the safety inspection.

In addition, the following actions will result in a deduction of 5 points from the team's score:

- Communication between the pilot and the tether man to indicate the direction of the RUV or provide assistance during tasks.
- Leaving any part of the RUV in the water.
- Delayed demobilization, beyond the allocated 5 minutes.

These measures ensure fair competition and adherence to the rules, promoting a level playing field for all participants.

APENDICES

Appendix (A): SAFETY CHECK LIST

All motors are insulated properly?	□ Yes	□ No
All wires are secured in the RUV and control box?	□ Yes	□ No
The tether is completely sealed?	□ Yes	□ No
The power conversion inside the RUV?	□ Yes	□ No
All components attached to RUV are secure?	□ Yes	□ No
Minimal use for chemical insulation like epoxy?	□ Yes	□ No
The tether has one end to connect to the power source?	□ Yes	□ No
There are a sharp edges or elements of the RUV design that could cause injury?	□ Yes	□ No
A suitable fuse is used at the nearest point in the power supply connection side?	□ Yes	□ No
Fluid power used? If yes, the pneumatic SID must be submitted.	□ Yes	□ No

Appendix (B): Technical Report

The document should demonstrate:

Technical Report (Maximum Points: 100)	
1. Introduction	• Cover page • Table of contents • Clarity in introducing the team, including objectives and scope. • Concise summary of the report structure and key findings
2. Design Specifications	A clear explanation of the design in all its aspects, including: • Photos of design and real RUV • Vehicle Design • manipulators • Drag force calculations • Mobility
3. Electrical systems (Hardware & Software)	• Vehicle components • Station components • Movement techniques • Stability techniques • Autonomous system • Image recognition techniques
4. Electric power	• Fuses • Power conversions • Power distribution
5. Fluid power	• Software and hardware components
6. Mission tools	• Additional devices • software and hardware components • The methods used to solve the competition tasks
7. SIDs	• Electrical SID • Fluid SID • Additional devices SID
8. Safety	• electrical and mechanical safety precautions
9. R&D plan	• The plans that the team is seeking to do.
10. Project timeline	• The timeline that the team went through during the season
11. Cost Analysis	• Clarifying the team's total budget for all items during the season in terms of the project budget itself or the team's general expenses that serve on the project.
12. Team members hierarchy	• Clarifying the responsibilities of each individual within the team and distributing tasks
13. Acknowledgments	• Acknowledgments for the team supporters.
14. References	• Show the references of presented info.

Appendix (C): Presentation

- The team can use any required visuals to support your report

Presentation Content (Maximum Points: 50)	
1. Introduction	• Clarity in introducing the team and their project. • Clear explanation of the problem statement and objectives. • Explanation of the core value of the product
2. Project Overview	• Comprehensive overview of the RUV design, features, and capabilities. • Explanation of how the RUV was constructed or modified to meet the competition tasks.
3. Strategy and Approach	• Clear articulation of the team's strategy for tackling the competition tasks. • Explanation of the decision-making process behind task prioritization and execution.
4. Results and Achievements	• Presentation of quantitative and qualitative results achieved during task execution. • Discussion of challenges faced and innovative solutions implemented.
5. Depth of Knowledge	• Demonstrated understanding of technical concepts related to RUV design and operation. • Ability to address detailed questions about the project from judges and audience members.
6. Carrying out tasks	• clearly explaining how to perform the required tasks
7. Time Management	• Adherence to the allotted presentation time. • Ability to convey key points succinctly without rushing or exceeding time limits.
8. Clarity and Organization	• Clear and logical flow of information throughout the presentation. • Effective use of visual aids, such as slides or demonstrations, to enhance understanding.
9. (R&D) plan	• Overview of the research and development Plan

Appendix (D): Presentation Penalties

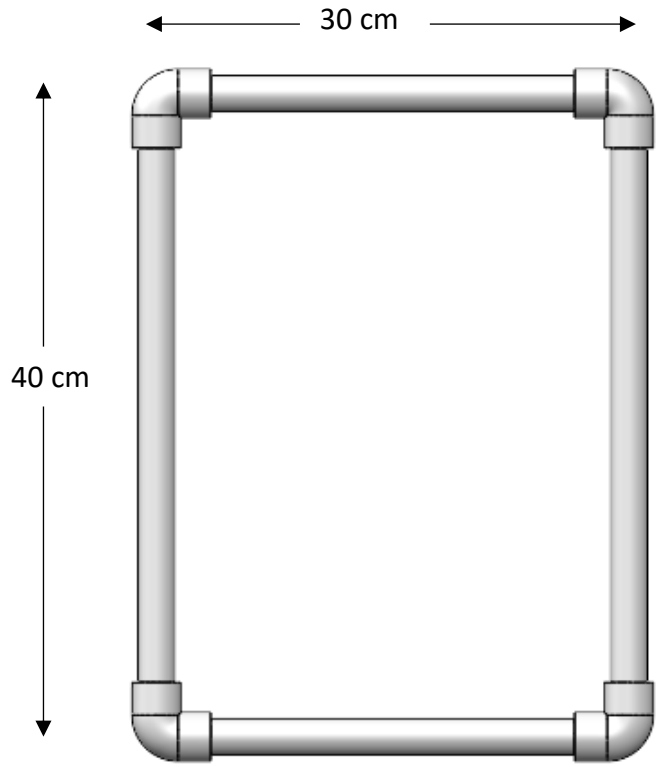
These penalties ensure that teams adhere to the rules and maintain professionalism throughout their presentations.

Late Start	Deduct 3 points if the team begins the presentation after the allotted start time.
Exceeding Time Limit	Deduct 3 points if the presentation exceeds the allotted time limit by more than 1 minute.
Unprofessional Behavior	Deduct 5 points for behavior deemed disrespectful, inappropriate, or unprofessional during the presentation or Q&A session

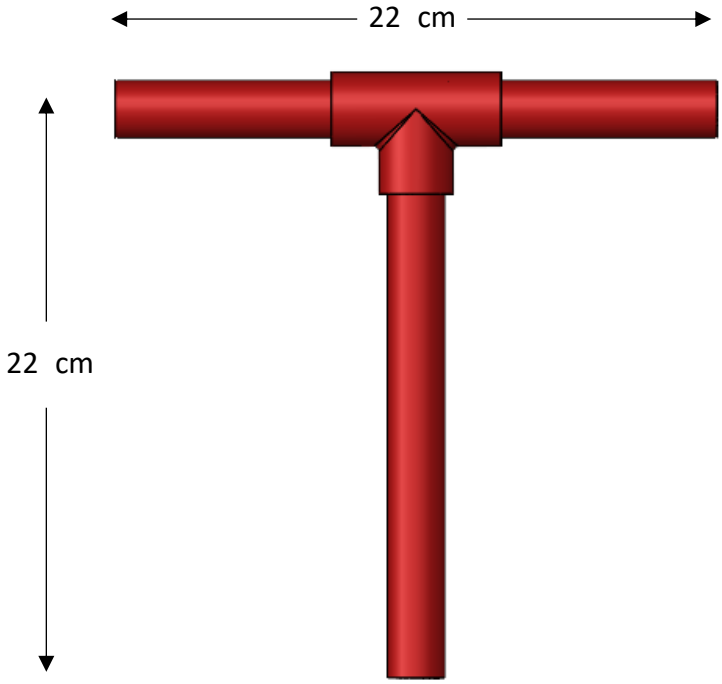
Appendix (E): Underwater tasks

Task (1)

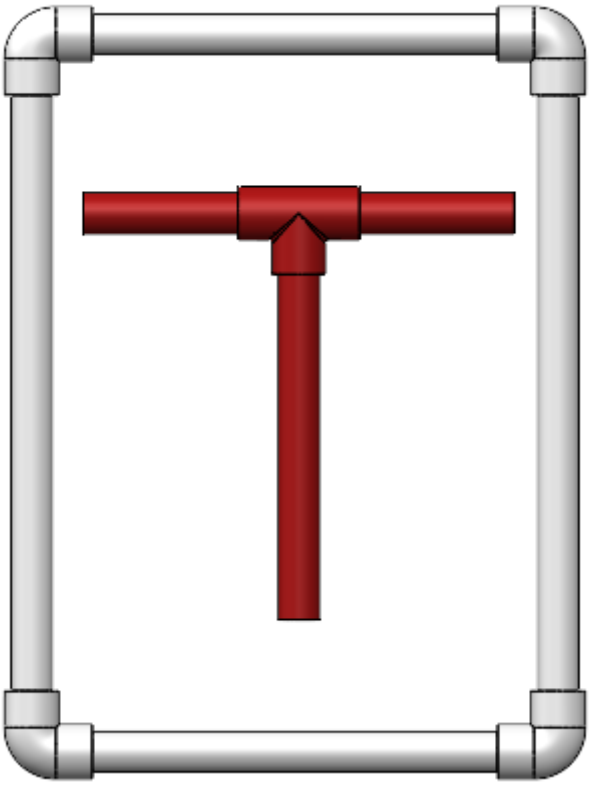
½" PVC pipe for the frame



¾" for the markers

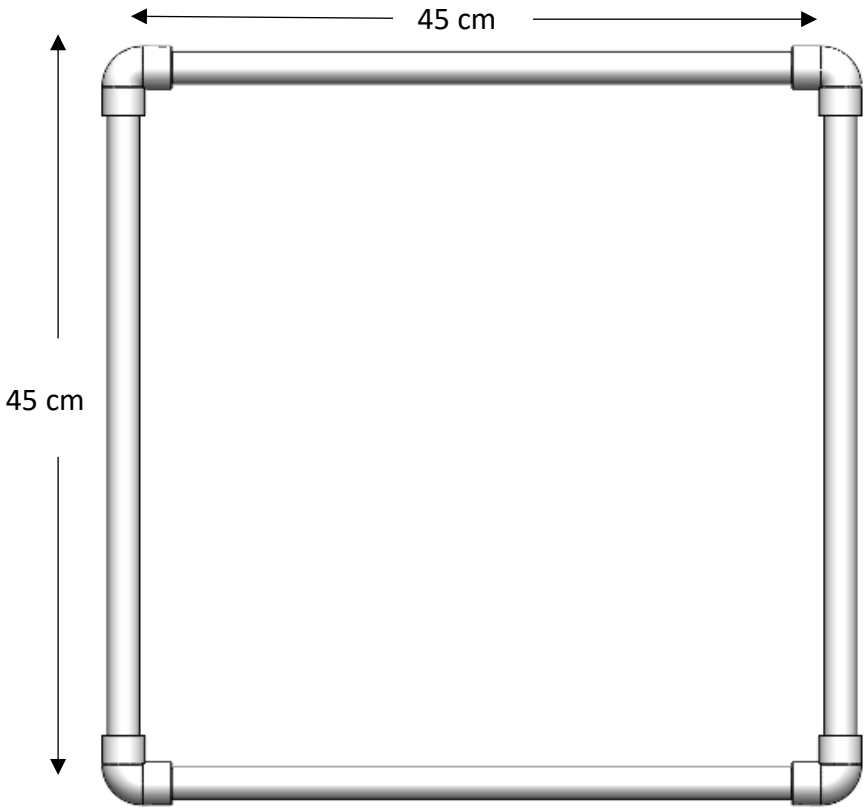


The marker inside the designed frame

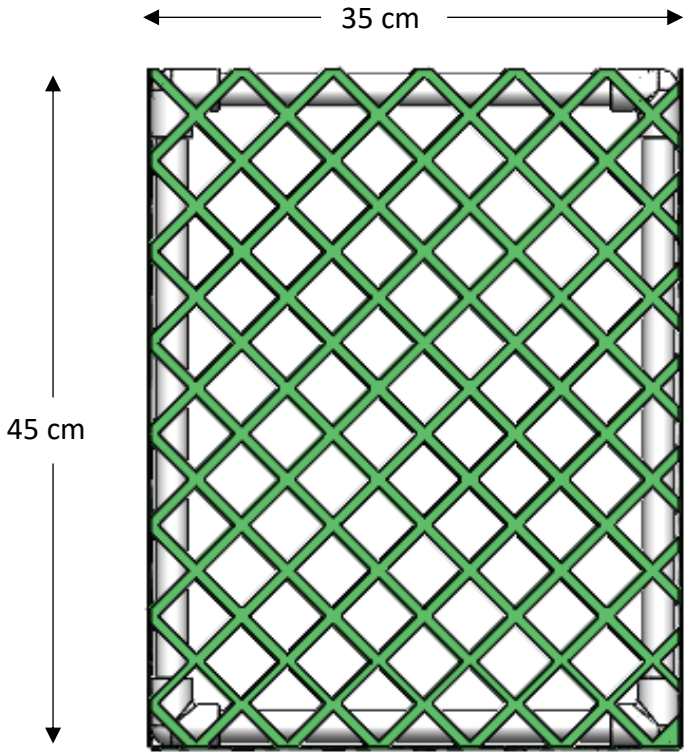


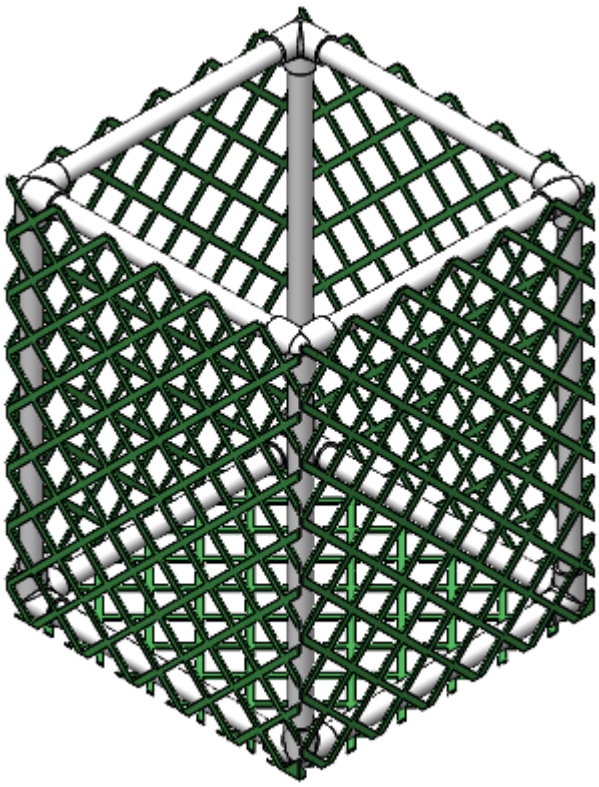
Task (2)

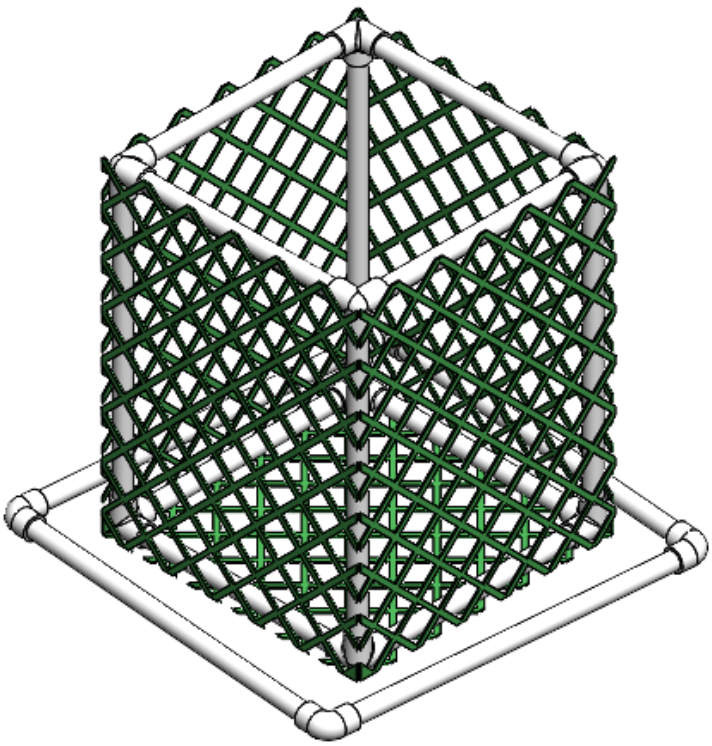
½” PVC pipe for the frame



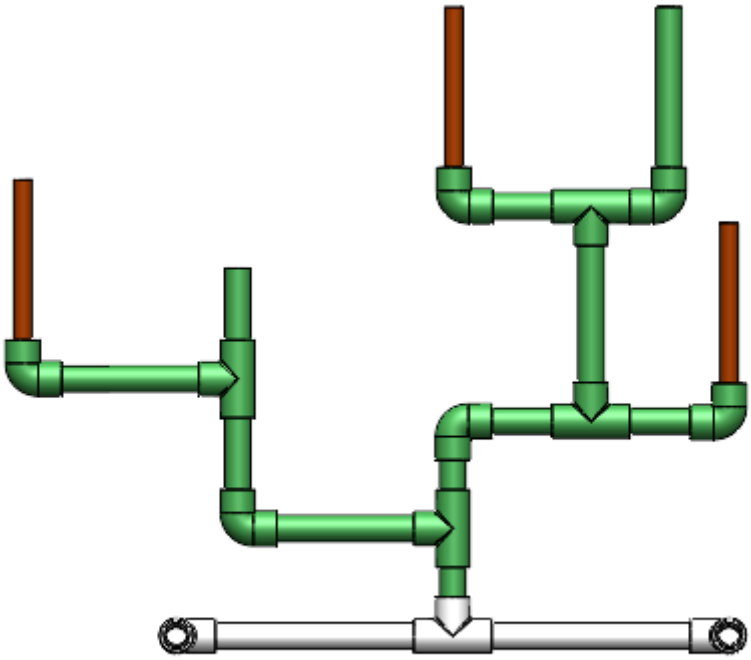
½” PVC pipe for the basket and covered with plastic mesh from the 5 faces

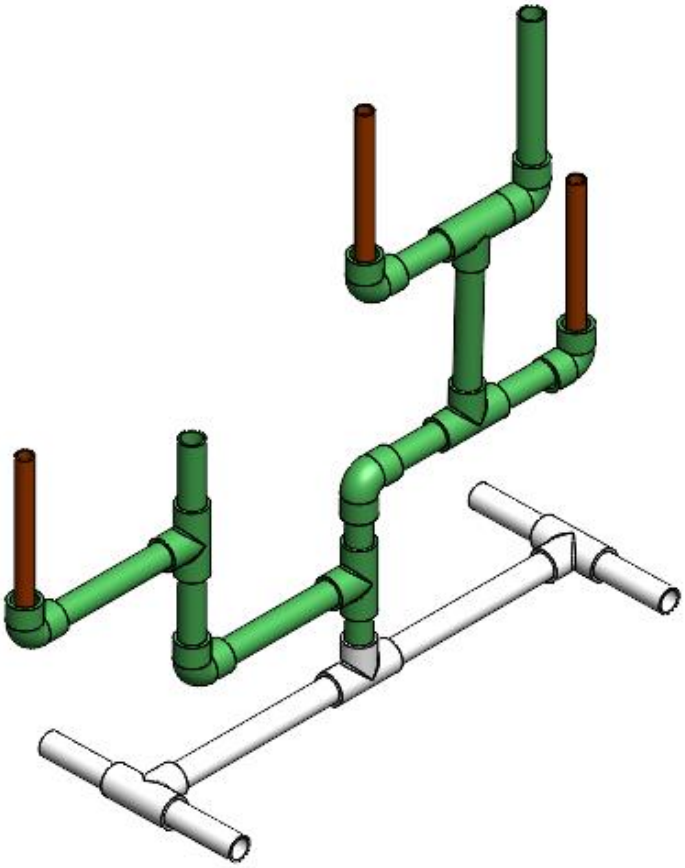






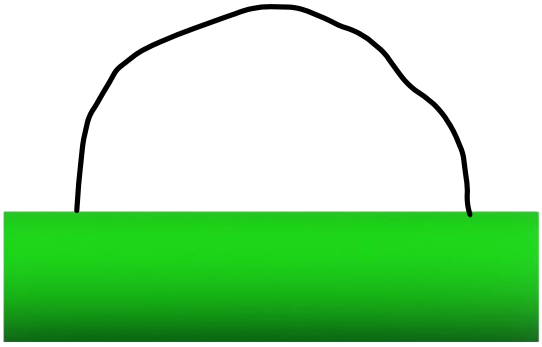
Alive coral ¾” PVC pipe – dead coral ½”





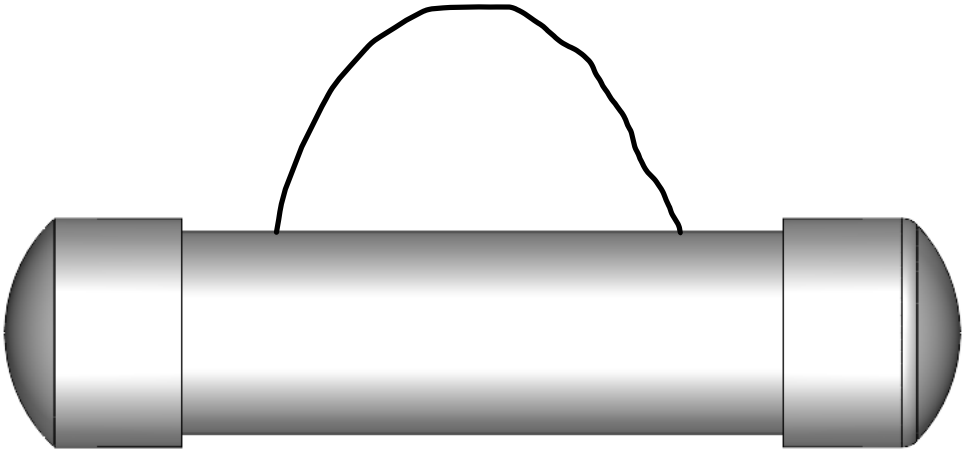
Algae

3/4” PVC pipe – 15 cm – Plastic rope



Sediment sample

2” PVC pipe -25 cm – Plastic rope



Task (3)

¾” for the markers

- Three coral reefs with the same shape, but in different colors