RobotX 2026 | Team Handbook

Introduction & Table of Contents

Welcome to the frontlines of innovation at the 2026 Maritime RobotX Challenge!

This Team Handbook contains the information that teams will need to compete at the 2026 Maritime RobotX Challenge. It includes task descriptions, rules and requirements, specifications and other guidance. This document will provide teams with a comprehensive understanding of what will be necessary to compete effectively.

What is RobotX?

The Maritime RobotX Challenge is a biennial international competition hosted by RoboNation and was established to foster student interest in robotic and autonomous systems.

The 2026 edition of the Maritime RobotX Challenge represents a significant shift in emphasis and level of challenge for the competition. There is a greater emphasis on cooperative, multi-domain autonomous operation of teams of uncrewed systems. All mission elements require cooperation between systems in more than one maritime domain for successful execution. While the initial mission elements will be demonstrated individually during early rounds, all of the demonstrated capabilities will be needed to complete the full mission in the finals rounds.

Why RobotX?

The goal of the Maritime RobotX Challenge is to expand the community of researchers and innovators capable of substantive contributions to the emerging field of autonomous and uncrewed, multi-domain vehicles.

The nominal winners are teams that score the most points. The real winners are participants who learn lasting lessons about working collaboratively to create an autonomous System of Systems (SoS) to accomplish a challenging mission in a complex environment.

Why compete in RobotX?

Participants of the Maritime RobotX Challenge can expect to:

- Increase technical proficiency;
- Establish valuable professional connections; and
- Enjoy the satisfaction of learning and collaborating while competing at a world-class level.

The Maritime RobotX Challenge builds upon the successful implementation of other student robotics competitions, such as RoboBoat (Autonomous Surface Vehicle), RoboSub (Autonomous Underwater Vehicle), and SUAS (Student Uncrewed Aerial Systems). Teams are encouraged to learn from their participation in competitions such as these and apply their skills to the more advanced challenges presented in RobotX.

Maritime autonomous technology is critical to monitoring and healing our oceans, as well as applying that technology when dealing with post-disaster maritime scenarios. Developing the human resource to expand this effort is even more essential.

RobotX Organizers

The RobotX Program is brought to you by RoboNation, Inc. and the U.S. Office of Naval Research.

Table of Contents

Section 1: Competition Overview

1.1 Dates and Venue

1.2 Competition Structure

1.3 Competition Theme: Storm Response

1.4 Eligibility

1.5 Competition Schedule and Timeline

1.6 Points of Contact

1.7 RoboNation Code of Conduct

Section 2: Design Documentation

2.1 Technical Design Report

2.2 Team Website

2.3 Team Introduction Video

2.4 Design Strategy Presentation

2.5 System Assessment

Section 3: Autonomy Challenge

3.1 Proof of Readiness

3.2 Mandatory Activities

3.3 Mission Task Descriptions

3.4 Communications Protocol

3.5 Task Build Specifications

Section 4: Scoring & Awards

4.1 Design Documentation Scoring

4.2 Autonomy Challenge Scoring

4.3 Awards

Section 5: Rules & Requirements

5.1 Team Rules and Requirements

5.2 Safety Requirements

5.3 System Requirements

Section 6: How to Compete

6.1 Registration

6.2 Event Submissions

6.3 Design Documentation Submissions

6.4 Event Expectations

6.5 Team Communications

6.6 Data Sharing

Section 7: Glossary & Acronyms

7. Glossary & Acronyms

Change Log

Date	Section	Details
2026-03-30		Initial Release
2026-04-07	• Sections 3.1.2 and 3.1.3	Updated terminology to be consistent: "visual feedback system"
2026-04-14	• Section 3.3.2 and 3.3.3	Updates to Task 1 and 2 based on Team Time feedback and Requirements updates. Also standardized Capabilities demonstrated and a few formatting discrepancies.
2026-04-27	• Section 3.3.4 and 3.3.5	Updates to Task 3 and 4 based on Team Time feedback and Requirements updates.
2026-04-30	• Section 3.3.3 and 3.3.4	Updates to the UAV Resource Delivery details
2026-05-01	• Section 6.4	No overnight pool access
2026-05-16	• Section 5.2	UUV kill switch requirement updates
2026-06-17	• Section 3.5	Published new section for task build specifications.
2026-06-18	• Section 3.1 • Section 5.3 • Section 5.3.3	• Section 3.1: Removed requirement to submit mount point pictures for USV, UUV. • Section 5.3: Removed general requirement for water-activated light for all uncrewed systems.

		• Section 5.3.3: Added requirement for water-activated light for UAVs, along with link to Amazon and image capture of the device.

2026-06-25	• Section 3.1
	• Section 3.3.2
	• Section 3.5.8
		• Section 3.1: Proof of Readiness
		  ○ Added R/C block diagram details
		  ○ Added propeller shrouds
		• Section 3.3.2: Updated behavior
		• Section 3.5.8: UAV Landing Platforms

2026-06-26	• Section 1	• Updated Proof of Readiness deadlines and submission link.
2026-07-01	• Section 3.1.3	• Proof of Readiness - UUV/USV Tethered Pair Alternate Course
2026-07-11	• Section 5.3.2	• UUV Safety and Beacon Requirements
2026-07-27	• Section 3.1.2	• USV Proof of Readiness Requirements and Alternatives
	• Sections 3.3.1 / 5.3.3	• Updated UAV requirements and added UAV Proof of Readiness criteria based on latest inputs from host nation leads.

2026-08-06	• Section 3.3.2 • Section 3.3.3 • Section 3.3.4	• Updated Task 1 content to clarify based on team questions. This includes emphasizing the requirement to circle the flashing blue and solid blue lights at the start/end of the attempt. Also updated the task example image. • Updated Task 2 imagery and text based on questions and feedback from teams. • Updated Task 3 imagery and text to clarify bay numbering scheme.
2026-08-07	• Section 3.1.5 • Section 3.4 / Team ID List	• Published Communications Proof of Readiness requirements • Published Communications Protocol and Team ID List
2026-09-14	• Section 3.5.2	• Updated task build specifications for light beacon

2026-09-29	• Section 3.5
	• Section 5.3, 5.3.1, 5.3.2
		• Updated pinger timing image
		• Updated underwater pipeline node quantity
		• System requirements:
		  ○ RoboCommand
		  ○ General safety requirements

		◦ Commercial thrusters with integrated shrouds may be used as is. • Real-Time Kinematic positioning systems allowance
2026-10-15	• Section 4: Scoring & Awards	• Section Published

What's New for 2026

1. **One Cohesive Story:**

   RobotX is no longer a set of disconnected tasks, but a mission vignette simulating a real-world scenario in which maritime autonomy can provide capability to support recovery. This is a shift from isolated skill evaluation to holistic mission execution and evaluation.

2. **Cross-Domain Integrated Behaviors:**

   Teams must demonstrate multiple uncrewed systems operating across multiple domains in a dynamic, semi-structured environment representing real-world challenges. RobotX will increase focus on collaborative mission execution rather than linear, single-unit operation.

3. **Vehicle Requirements:**

   - Teams must prepare a System of Systems:
     - All teams must compete with at least one Uncrewed Surface Vessel (USV).
     - In addition to the USV, teams must incorporate an Uncrewed Underwater Vehicle (UUV) and/or an Uncrewed Aerial Vehicle (UAV).
     - Participation in all three domains is needed to complete the full mission.
   - Platforms may be team's own design or commercially available platforms, within the required size and weight restrictions (closely aligned with RoboNation's single-domain competitions: RoboBoat, RoboSub and SUAS).

4 **Capability Levels:**

Each mission task has capabilities divided by three levels:

- ***Core Capabilities***: Fundamental competencies required for safe and effective baseline autonomous operation.
- ***Advanced Capabilities***: Competencies that reflect growth in autonomy sophistication and real-world relevance.
- ***Disruptive Capabilities***: Transformative competencies pushing the boundary of autonomous systems - enabling novel or mission-critical applications.

5 **Team Collaboration:**

Teams may partner across disciplines, campuses, or borders and can formalize those partnerships up to (and during) the event. Joint teams will be treated as a single competition entry for scoring and awards.

6 **Granted Platform Application:**

To lower barriers for participation, teams can request a granted platform through our partnership with Blue Robotics. Platforms available include the BlueBoat and/or BlueROV2, or a stipend equivalent. Teams should prepare to submit an official signed letter of intent from their school/organization. More information can be found here: robotx.org/2026↗.

Section 1: Competition Overview

1.1 Dates & Venue

The 2026 Maritime RobotX Challenge (RobotX 2026) will take place the week of November 8, 2026, at the Promontory at Marina Bay ↗ in Singapore, Singapore.

1.2 Competition Structure

RobotX 2026 includes the Autonomy Challenge that demonstrates autonomous performance and safety; and Design Documentation that presents each team's work and system design.

> **Proof of Readiness:** New to RobotX this year is a requirement for teams to submit proof of readiness for each vehicle that verifies specific capabilities to guarantee approval to compete in the on-site events.

1.3 Competition Theme: Storm Response

Technology in Action for Recovery and Relief. Storm Response explores the power uncrewed systems play in recovery, resilience, and discovery in disaster relief efforts. This year's competition is framed as an opportunity, not just to restore what was lost, but to rebuild smarter and reimagine the future. This season's challenges reflect the real-world role of robotics in helping communities respond to and recover from storms and other natural events. Through hands-on missions grounded in post-disaster scenarios, teams will apply technology with purpose – restoring harbor operations, assessing underwater infrastructure, supporting exploration, and unlocking new possibilities.

A major storm has impacted a coastal port facility. Teams of autonomous system integrating AUVs, ASVs, and UAVs have been dispatched to coordinate across multiple domains in a real-time port recovery and resilience operation. Teams will autonomously execute a continuous mission that simulates assessment, clearance, and restoration of port operations.

This includes survey of the area from air and sea to determine safe passage areas for relief teams, survey and repair of undersea infrastructure (cables or pipeline), coordinated logistics delivery, and detection/ tracking of a rogue element (suspicious vessel, floating debris, etc.).

The integrated mission challenge emphasizes multi-vehicle collaboration, cross-domain data flow, and adaptive decision-making under evolving mission parameters.

Vehicles are deployed to demonstrate how coordinated action can turn disaster into recovery and resilience:

- **Assessment & Discovery:** Vehicles are deployed for rapid damage assessment to inspect the area and report environmental hazards, gathering the critical information needed to understand the scope of damage.
- **Recovery & Repair:** Vehicles work to search the debris field armed with supplies to restore safety and functionality. Yet recovery is not only about rebuilding what was lost; it's also about protecting the future.
- **Environmental & Public Safety:** Vehicles conduct surveying and data collection to coordinate with first responders, underscoring the responsibility to restore balance for both communities and ecosystems.

Find out more in Section 3: Autonomy Challenge for the task descriptions.

1.4 Eligibility

Student teams from anywhere in the world are eligible to participate. All teams must build a System of Systems, including an USV and one additional system (UUV and/or UAV) to compete.

1.4.1 Eligibility Details & Team Composition

- Teams must be comprised of 75% or more full-time students. Student members are expected to make significant contributions to the engineering development cycle of their systems.
- The majority of team members must be college or high school students. Teams may also include middle school students. Interdisciplinary teams are encouraged.
- Teams may be comprised of 25% or less alumni, industry, academic or government partners.
- A minimum of three (3) team members are required for safe operations on-site at RobotX.

1.5 Competition Schedule and Timeline

The event schedule is also available on the RobotX website ↗.

Date	Event	Location
Online		
01 November 2025 - 01 April 2026	Registration	Start Registration ↗ (Online)
31 August 2026	Proof of Readiness Submissions * 1st and 2nd domain	Submission Link ↗ (Online)
23 September 2026	**Event Submission Deadline:** • Team Member Registration • Team Demographics • Merchandise Order • Vehicle Information • On-Site Requirements **Design Documentation Deadline:** • Technical Design Report • Website • Team Introduction Video • Community & Outreach (optional)	Registration Portal ↗ (Online)
12 October 2026	Proof of Readiness * 3rd domain (optional)	Submission Link ↗ (Online)
In-Person Event (08-14 November)		
06-07 November 2026	UAV Pilot Tests	Multiple Locations
08 November 2026	Team Check-in / Orientation	Promontory at Marina Bay
09-11 November 2026	Practice Course Open Qualifying Round	Promontory at Marina Bay

	Design Presentations System Assessments	
12-13 November 2026	Scoring Round Begins	Promontory at Marina Bay
TBA November 2026	Finals Round Awards	Promontory at Marina Bay

1.5.1 Daily Team Meeting

Each competition day starts and ends with a mandatory team meeting conducted by the Technical Director. Team leads (or their designated team representative) are required to attend all meetings. All participants are strongly encouraged to attend.

The Technical Director summarizes the day's events, describes any course changes for the following day, and teams are encouraged to ask questions and provide feedback.

1.6 Points of Contact

RobotX Questions:	Registration Questions:	On-Site Logistics/Safety:
robotx.org/discord ↗ competitions@robonation.org	support@robonation.org	events@robonation.org +1 850.642.0536

1.7 RoboNation Code of Conduct

1. **All team members must abide by the RoboNation Code of Conduct while participating in the Competition.** Failure to abide by this Code of Conduct at any point during the competition season may result in the disqualification of the team and/or participants from the Competition, components of the competition, the full competition, and/or future competitions.

2. **Give your best effort.** Display honesty, integrity, and sportsmanship while engaging in friendly competition. Compete fairly. Team products are solely the creation of student participants' own efforts, ideas, and designs with supporting mentors providing only verbal advice.
3. **Respect others.** All participants and guests will display courtesy and respect toward officials, volunteers, other teams, and guests of the Competition.
4. **Act with integrity.** All participants and guests will behave in a responsible manner and follow the rules of the competition and host organization.
5. **Support each other.** All participants will embody the spirit of RoboNation and endeavor to engage with, learn from, and support one another.

Section 2: Design Documentation

This section includes detailed requirements and instructions for the design documentation portion of the competition.

Delivered Online Before On-Site Competition

The following design documentation are delivered online prior to the on-site competition according to the deadlines found in 1.5 Competition Schedule. Teams are encouraged to refer to the past top-scored deliverables: robobtx.org/past-programs↗.

- 2.1 Technical Design Report
- 2.2 Team Website
- 2.3 Team Introduction Video

> **Don't Forget!** The Proof of Readiness submissions are also required to submit before the on-site competition. More details can be found in Section 3.1 Proof of Readiness.

Delivered On-Site During Competition

The following design documentation are delivered on-site during the competition.

- 2.4 Design Strategy Presentation
- 2.5 System Assessment

2.1 Technical Design Report (TDR)

Each team is required to submit a TDR that describes the team's design principles and competition priorities. The report should address the rationale for which autonomy challenge tasks have been chosen to attempt and how this competition strategy influenced the design decisions for the hull, propulsion system, control systems, and autonomy system. Teams must follow the TDR instructions provided below. To be eligible for full points, teams must submit their TDR by the deadline found in Section 1.5.

A strong TDR provides a coherent narrative and addresses the elements of the rubric as much as possible, including citing references used. The competition strategy justifies the choices of autonomy challenge tasks and design decisions that trace back to those task choices. The report also identifies which software tools allow the team to accomplish the tasks chosen.

> **Top-Scored Report:** Get inspiration from Embry-Riddle Aeronautical University's first place report from RobotX 2024. View the report here ↗.

The technical design report is worth a total of **200 points**. The outline of each content section includes a scoring weight with guidance for scoring considerations that are provided to the judges during evaluations.

2.1.1 Deliverable Requirements

The content of the written paper shall include the following sections:

- Abstract
- Acknowledgements
- References
- Technical Content: Competition Strategy, Design Strategy, Testing Strategy
- Optional Appendix: Test Plan & Results

The format of the written paper shall adhere to the following guidelines:

- 10 page limit (excluding References and Appendices)
- 8.5 × 11 in. page size
- Margins ≥ 0.8 in.
- Font: Times New Roman 12pt
- Header on every page including team name and page number
- Submitted in .pdf format

Optional Formatting: Teams may choose to follow the two-column format, editorial style for IEEE Conference Proceedings: www.ieee.org/conferences/publishing/templates.html ↗.

> **RoboNation Tip:** It is recommended that papers be peer-reviewed prior to submission. For example, teams can utilize resources at their institution, fellow students, or professional editing services.

Formatting Scoring Metrics (5% of score)

Strong	Paper follows page limit, and all formatting guidelines are followed. The document is professionally organized. All required sections are included and easy to identify. All grammar, punctuation, and spelling are correct. The style follows that expected of a scientific paper submitted for publication.
Requirements Not Met	Formatting guidelines are not followed and the layout is unorganized.

2.1.2 Abstract

The abstract is a short summary of the main points in the paper. The abstract should summarize the linkage between overall competition strategy and system architecture, design, and engineering decisions.

RoboNation Tip: Find out more about how to best write an abstract here ↗. (University of Wisconsin–Madison: The Writing Center ↗)

Abstract Scoring Metrics (10% of score)

Outstanding	Abstract is engaging, lists the scope of the work, and provides a thorough summary of the paper.
Strong	Abstract provides a strong overview of the scope of work and a detailed summary of the paper.
Average	An adequate explanation of the scope of work is included with a brief summary of the paper.
Below Average	Abstract provides a basic summary of the paper.
Poor	Abstract section is included but does not serve the intent of an abstract. The abstract is treated as an introduction and provides no summary of the paper.
Requirements Not Met	No abstract is included.

2.1.3 Acknowledgements

Participating in the competition, as in all research projects, involves leveraging resources and support beyond the efforts of individual team members. This support can take many forms such as technical advice, labor, equipment, facilities, and monetary contributions. Acknowledging those who have supported efforts is important.

Acknowledgements Scoring Metrics (5% of score)

Strong	Acknowledgements detail supporting personnel and their contributions as well as resources. Sponsors and their contributions are acknowledged.
Average	Acknowledgements include a list of supporters and sponsors with little or no detail of the support provided.
Poor	Acknowledgements provide a general thank you but do not specify particular contributions.
Requirements Not Met	No acknowledgements are included.

2.1.4 References

As with any technical publication, original ideas and content not generated by the paper's authors should be properly cited. The references should follow the IEEE Conference Proceedings citation style ↗.

References Scoring Metrics (5% of score)

Strong	Sources include notable technical references including technical papers and articles. Use of the source materials are evident in the TDR. Sources are thoroughly documented. The IEEE citation style is correctly utilized.
Average	Sources are adequate and documented correctly with the IEEE citation style is utilized.
Poor	Limited sources are documented but there is no adherence to the IEEE citation style.
Requirements Not Met	No sources or citations are documented.

2.1.5 Competition Strategy

The paper must include details on the team’s strategy for the competition, including the plans for approaching the course and how the System of Systems (SoS) design relates to this approach. The course consists of multiple tasks with associated points for accomplished behaviors. Teams should cover their efforts to address the increased emphasis on autonomy and collaborative behaviors. The more tasks a SoS is designed and engineered to accomplish, the more complex the overall system will be.

Discuss the team's strategy on trade-offs between system complexity and reliability. For example, teams have a limited number of working hours to prepare for the competition; this time could be spent adding additional capabilities or testing and improving the reliability of an existing capability. As system complexity grows, changes in subsystems can propagate in unmanageable ways when time is limited. Based on history and the system engineering talents of the team, include a description the team’s strategic vision.

Competition Strategy Scoring Metrics (25% of score)

Outstanding	Detailed description of the team's strategic vision and how the system design compliments their goals. Detailed discussion on trade-off studies between system complexity and reliability during design development process.
Strong	The team's goals are clearly evident but not discussed in detail. Trade-off studies evident but lacking details.
Average	Brief mention of team’s strategic goals and/or trade-off studies.
Below Average	Document hints at a goal for competition and/or trade-off studies.
Poor	Discussion of the team’s vision is incoherent; rationale for competition goals is not discussed.
Requirements Not Met	No mention of competition goals.

2.1.6 Design Strategy

Given the strategy for success at the competition and the approach to managing complexity, the paper must include a description of the SoS design to meet the goals they established for the competition. Justification for design choices should be clear. Discuss how components and subsystems were selected and integrated on each system. For teams that are working with a previously designed system, discuss how the design meets the current competition strategy and any modifications needed at the component, subsystem, and/or integrated system levels. Describe the experience in making both architectural/design decisions and system engineering decisions. Describe how the team implemented inter-vehicle collaboration.

This section should not include detailed component descriptions and/or specifications not of original design. Instead, it should focus on WHY design decisions were made and HOW they were influenced by competition requirements.

Design Strategy Scoring Metrics (25% of score)

Outstanding	Provides in-depth explanations on design strategy and clearly identifies creative aspects of system. Creative design methodology is justified with required calculation steps and visual aids. Content clearly exhibits a Systems Engineering approach.
Strong	Provides explanations on design strategy and identifies creative aspects of system. Creative design methodology is justified with calculation steps and visual aids. Content hints at a Systems Engineering approach.
Average	Provides some information on design strategy and creative aspects of system. Creative design methodology is supported with a few calculations. Content could be justified as a Systems Engineering approach.
Below Average	Provides little information on design and creative design methodology. Little evidence to support applications of a Systems Engineering approach.
Poor	Provides limited information on the creative aspects of system. Creative design methodology is hypothesized. No evidence to support application of Systems Engineering principles.
Requirements Not Met	Creative aspects of design are not described.

2.1.7 Testing Strategy

Testing and experimentation is a crucial step to preparing and innovating a system design that strongly correlates with a competitive performance in the arena. The paper must include the approach to a testing strategy, including various test plans, both physically and in simulation.

Discuss considerations of the time needed to thoroughly test to meet the determined goals and the demands of design and engineering with those of testing and experimentation. Also including how much field testing was performed and the impacts on performance.

Testing Strategy Scoring Metrics (25% of score)

Outstanding	Testing approach is presented in great detail, to include test strategy and plans. Component testing, sensor and control systems testing done in accordance with a test plan.
Strong	Detailed testing approach, test strategy, and plans. Documentation shows good overview of components, sensors and control system testing.
Average	Testing approach is presented with sufficient detail, including mention of test strategy and plans. Documentation shows components, sensors and control system testing.
Below Average	Testing approach is presented with little to no detail. No mention of components or sensors testing.
Poor	Testing is done to a certain degree. No components and sensors are tested independently. There are no test plans.
Requirements Not Met	No mention of testing or connection with the system design.

2.1.8 Test Plan & Results (Optional Appendix)

Based off the testing approach outlined in the paper, this appendix showcases the test plan that was developed and the detailed results that came out of testing. Teams should present their plans for testing, including algorithm testing in a virtual environment, component testing in a laboratory setting, subsystem testing in a relevant environment, and full system testing in a pseudo-competition environment. Test set up should be included and results presented. Any design modifications or changes in competition strategy as a result of testing should be discussed.

While this appendix is not required, excellence seen in this section can be eligible for a special judges' award.

The appendix may include detailed documentation covering the following areas:

- *Scope:* Objectives and test cases (this may also specify what was not included in tests)
- *Schedule:* Start/end dates and deadlines
- *Resource and Tools:* Resources and tools needed to conduct tests and assess results
- *Environment:* Description of the test environment, configurations, and availability
- *Risk Management:* Outline potential risks that could occur throughout testing
- *Results:* Detailed outcomes of test cases

2.2 Team Website

Teams are required to submit a website in English that documents their team, vehicle design, and competition approach. To be eligible for full points, teams must submit their website by the deadline found in Section 1.5.

Top-Scored Website: Get inspiration from National University of Singapore's first place website from RobotX 2024. Visit the website here ↗.

2.2.1 Deliverable Requirements

1. Website Content: Layout and detailed contents of the website are left for the teams to develop; however, the team website must include:
   - Current team name and contact information
   - Vehicle photos and/or videos
   - Test event summaries showing time in the field (water time, air time, etc.), objectives, and results. This should include simulations and real-world testing.
   - Supporting media, which may include:
     - Instructional/Informative videos
     - Procedures (text, images)
     - Design decision documentation (text, images, videos)
     - Blogs for historical records of build progress
   - List of sponsors with logos
2. Website Quality: Websites are often the first impression of a project. Potential supporters such as supervisors, sponsors, or advisors must find the website visually appealing and easy to navigate. Development of the website should include careful consideration of user experience, including:
   - Written in English, or English translation provided
   - Clear prioritization of key content
   - Site search functionality

- Basic design elements: contrast, repetition, alignment and grouping to organize/highlight content
- User accessibility, as defined by the W3C Web Accessibility Initiative: www.w3.org/WAI↗
- Cross browser compatibility for modern web browsers (Chrome, Firefox, Safari, MS Edge)
- A mobile friendly display

2.2.2 Scoring Metrics

The website submission is worth a total of **180 points**. The scoring metrics include a scoring weight with guidance for scoring considerations that are provided to the judges during evaluations.

Team Information (20% of score)

Outstanding	Team website includes all required content: team's name and contact information, vehicle photos and test summaries, and a list of team members and sponsors. All mentions of the vehicle are relevant to the current competition year.
Strong	Team website provides a brief introduction to the team, team members and sponsors. There is supporting media on the vehicle.
Average	Team website introduces the team and/or team members.
Below Average	Team website provides little to no information on the team. There is no mention of the vehicle.
Requirements Not Met	The required team information is not included on the website.

Vehicle Design and Testing (40% of score)

Outstanding	Vehicle development and testing process is thoroughly documented with instructional and informative supporting media and historical recording. This could include photographs, diagrams, videos, procedures (text + images), design documentation (text + images + video), or blogs for historical records.
Strong	Good documentation on vehicle development and testing process is provided. Supporting media is accessible.
Average	Vehicle development and testing process is adequately presented with some evidence of supporting media.
Below Average	Few pictures or videos of the vehicle, but no instructional or informative documentation included.
Requirements Not Met	No visuals or documentation of the vehicle is available on the website.

Website Quality (40% of score)

Outstanding	Website is engaging and considers the user experience. Layout is visually appealing, easily maneuverable, and does an excellent job of drawing user's attention to relevant content.
Strong	Website considers user experience. Layout does a good job of drawing user's attention. Users can navigate the site easily and quickly.
Average	Website quality was adequate. Users can navigate the site to find most information.
Below Average	Layout and/or design makes it difficult to find information. Website does not have a user-friendly display.
Requirements Not Met	Website is busy and difficult to read; no guidance on maneuvering site.

2.3 Team Introduction Video

Teams are required to create a video introducing their team members and highlighting their team personality. This video is meant to be a creative showcase of what makes each team unique, such as the mission of the team or the team culture. Teams should consider this video as an “elevator pitch” or project proposal for an opportunity to earn additional funding or support. To be eligible for full points, teams must submit their video by the deadline found in Section 1.5.

Top-Scored Video: Get inspiration from National University of Singapore's first place video from RobotX 2024. Watch the video here ↗.

2.3.1 Deliverable Requirements

- Video must be conducted in English or include subtitles in English.
- Video must be no more than three (3) minutes in length.
- Video may include graphics, vehicle performance, and/or simulation.
- Videos must be hosted by team. Teams have the choice of hosting on YouTube, Vimeo, or on their Team Website. The video must follow YouTube Rules & Policies ↗, including appropriate music copyright management.

2.3.2 Scoring Metrics

The team video submission is worth a total of **120 points**. The scoring metrics include a scoring weight with guidance for scoring considerations that are provided to the judges during evaluations.

Formatting (10% of score)

Strong	All formatting guidelines are followed. Video is conducted in English or includes English subtitles, video is no more than 3 minutes in length, and video is hosted on the YouTube, Vimeo, or on their Team Website.
Requirements Not Met	Video does not follow formatting requirements.

Video Quality (20% of score)

Outstanding	Visuals immediately draws attention. Overall, the video is solid in frame (not shaky), correctly lighted, in precision focus, appropriately segmented, and visually clear in all respects. Transitions between segments are clear and smooth. The video is less than 3 minutes total runtime.
Strong	Good visual impression. Majority of video is clear, adequately lit, and places people and objects in recognizable scale and perspective. Video segments are generally of the appropriate length, transition well, and are related to each other. Use of video effects is good. Runtime is less than 3 minutes.
Average	Video quality is satisfactory.
Below Average	Frames and segments are shaky, distracting or poorly lit. Some segments are out of focus. Some heavy shadows are obscuring viewpoint. Visual effects are distracting rather than informative. Video exceeds 3 minutes in length.
Requirements Not Met	No focus on visual quality. Video exceeds 3 minutes in length.

Information Organization (25% of score)

Outstanding	Video is a complete introduction of the team makeup including team members, sub-teams, activities, mentors, and major sponsors. Organization of video information is logical and compelling.
Strong	The viewer is left with good understanding of the information shared in video.
Average	Video information is somewhat scattered throughout video, leaving the viewer lacking complete understanding of project.
Below Average	Video provides incomplete information regarding the team members, activities, or progress. The information presented is extraneous, confusing, or low quality.
Requirements Not Met	No organizational strategy is apparent.

Clear and Effective Communication (25% of score)

Outstanding	Effective and compelling use of video medium to communicate the introduction of the team. Easy for non-technical viewer to understand and support. [You're left wanting to learn more.]
Strong	Exhibits moderately compelling use of video medium to communicate the introduction of the team. Strong potential, moderately compelling, mostly understandable to non-technical viewer. [You're left strongly considering to learn more.]
Average	Adequately uses the video medium to introduce the team. Not difficult to understand, but not compelling either.
Below Average	Exhibits some ability to use video to attempt to introduce team and project overview. Difficult for viewer to understand and/or was not compelling. [You're left unenthused.]
Requirements Not Met	Poorly used video medium to convey team introduction. Information was as not clearly understood and was not compelling. [You're left with little information.]

Creativity (20% of score)

Outstanding	Team creativity and enthusiasm is clearly evident in the video. Appropriate use of humor is understated and well done. Video captures user's attention without diminishing or obscuring the information delivered. Effects of careful post-production editing are clear.
Strong	Some creativity has been used throughout video. The visual style and tone are consistent throughout video.
Average	Exhibits a moderate attempt at creativity.
Below Average	Little attempt made to include creative or imaginative ideas in video. Poor visual effects and enthusiasm for the project.
Requirements Not Met	Little imagination or creativity is evident in production. Information is presented lacking enthusiasm.

2.4 Design Strategy Presentation

Teams are required to give a design strategy presentation to a panel of subject matter expert judges. The goal of the presentation is to share the team's System of Systems (SoS) design approach to the challenges presented in the Autonomy Challenge, specifically the capabilities required for each task. The presentation should include:

- a concise description of the team's strategic vision, and
- how the SoS design compliments the team's goals.

2.4.1 Deliverable Requirements

This presentation must be conducted in English and may include visual aids (i.e. digital slides, poster board). If digital slides are used, teams must provide their own computer and adapters for an HDMI connecter to use the presentation display monitor. Teams receive an assigned 30-minute presentation time. The presentation schedule can be found on the RobotX Challenge webpage: robotx.org/2026↗.

This presentation includes:

- Team introduction video - 3 minutes
- Team presentation – 20 minutes
- Judges' question and answer – 5 minutes

2.4.2 Scoring Metrics

The design strategy presentation is worth a total of 180 points. The scoring metrics include a scoring weight with guidance for scoring considerations that are provided to the judges during evaluations.

Competition Strategy (30% of score)

Outstanding	Presentation includes a concise description of the team's strategic vision and how the system design compliments their goals. The team clearly explains how they developed their competition strategy.
Strong	Presentation describes their competition strategy and how their system design aligns with meeting their competition goals.
Average	Presentation includes a brief overview of how the system design aligns with the team’s competition strategy and goals.
Below Average	Team mentions a competition strategy but no additional details on how it was developed or how it led to their strategic vision.
Requirements Not Met	Team does not mention their competition strategy, vision or how their system design is aligned with vision.

Design Rationale (30% of score)

Outstanding	Team presents their design process and how their decisions relate to their overall competition strategy. Lessons learned from testing or previous competition experience are described, including application throughout the design process.
Strong	Presentation includes a description of the team's design process and includes narrative on how testing or previous experience influenced system design.
Average	Team describes the rationale behind the system design process.
Below Average	Presentation includes mention of the design process, lacking a clear rationale of design choices.
Requirements Not Met	No mention of the team's design process or the rationale behind the design process.

Effective Communication & Professionalism (20% of score)

Outstanding	Presentation materials and team members' knowledge are effective and support the team's message. Team members are engaging, respectful, and professional, while interacting positively with the judges and each other.
Strong	Presentation materials are presented in a professional manner and support the team's message. Presentation is well prepared and appears to be rehearsed in advance.
Average	Presentation materials are presented in a mostly professional manner and support the team's message.
Below Average	Presentation materials and styles are adequate but less than engaging.
Requirements Not Met	The message was not effective, and the presentation was not organized.

Judge Questions & Dialogue (20% of score)

Outstanding	The team effectively uses evidence, experience, and research from their project to inform responses to all questions and discussion posed by the judges.
Strong	The team responded professionally and knowledgeably to judges' questions.
Average	The team responded adequately to most or all of the judges' questions, mostly interacting with courtesy and professionalism.
Below Average	The team did not provide sufficient answers to the judges' questions and interacted with minimal courtesy and professionalism.
Requirements Not Met	Team members were not able to respond to many or all questions and did not take the initiative to engage in dialogue with the judges.

2.5 System Assessment

Judges inspect the team's System of Systems (SoS) and assess technical design, technical innovation, and craftsmanship of the design. Team members should be present to answer technical questions posed by the judges during this inspection and be prepared to explain their design strategy and how decisions made impacts on the technical design, functionality, and craftsmanship.

Teams receive an assigned 30-minute slot. The assessment schedule can be found on the RobotX Challenge webpage: robotx.org/2026 ↗.

2.5.1 Deliverable Requirements

Team members should be present to answer technical questions posed by the judges during this inspection and be prepared to explain their design strategy and how decisions made impacts on the technical design, functionality, and craftsmanship.

2.5.2 Scoring Metrics

The system assessment is worth a total of **180 points**. The scoring metrics include a scoring weight with guidance for scoring considerations that are provided to the judges during evaluations.

Technical Design (45% of score)

Outstanding	Design and implementation of systems and subsystems are well aligned with team's strategy, design decisions, and engineering principles. Clear and thoughtful design choices are evident in the technical functions, key decisions, and testing regimen.
Strong	Good and knowledgeable rationale and execution of design selections made, aligning with team's strategy, design decisions, and engineering principles.
Average	Adequate explanation of technical design decisions, equipment selections, and testing regimen, mostly evident in the system and subsystems.
Below Average	Rationale of technical design is briefly covered with minimal alignment with team's strategy, design decisions, and engineering principles.
Requirements Not Met	Design and implementation of systems and subsystems are not aligned with team's strategy, design decisions, and engineering principles.

Innovation (30% of score)

Outstanding	Full system demonstrates creative and innovative solutions by applying existing technology in novel ways within the system, using existing technology in a previously unintended way, or creating new technology or products incorporated into the system.
Strong	Clear evidence of innovative approaches across multiple sub-systems. Research and testing were conducted throughout the development process.
Average	There is moderate evidence that creative and innovative solutions were incorporated into system to improve performance.
Below Average	Little evidence of creativity or innovation in design choices throughout the system.
Requirements Not Met	No technical innovation noted.

Craftsmanship (25% of score)

Outstanding	System is assembled with exquisite care and thoughtful attention to detail and aesthetics. Construction and improvisations are neatly executed to maintain high levels of functionality, durability, and adherence to the team's design philosophy. Any system adornment demonstrates creativity, originality, etc.
Strong	System is assembled with care and attention to detail and aesthetics. Construction and improvisations maintain acceptable levels of functionality, durability, and adherence to the team's design philosophy.
Average	System is assembled to execute acceptable levels of functionality, durability and adherence to team’s design philosophy.
Below Average	Minimal evidence that system is assembled with care and attention to detail and aesthetics. Adherence to team’s design philosophy is vague and unclear.
Requirements Not Met	Evident hazards or potential hazards throughout the system. The system was assembled with minimal care and attention to detail. Little to no attention to aesthetics.

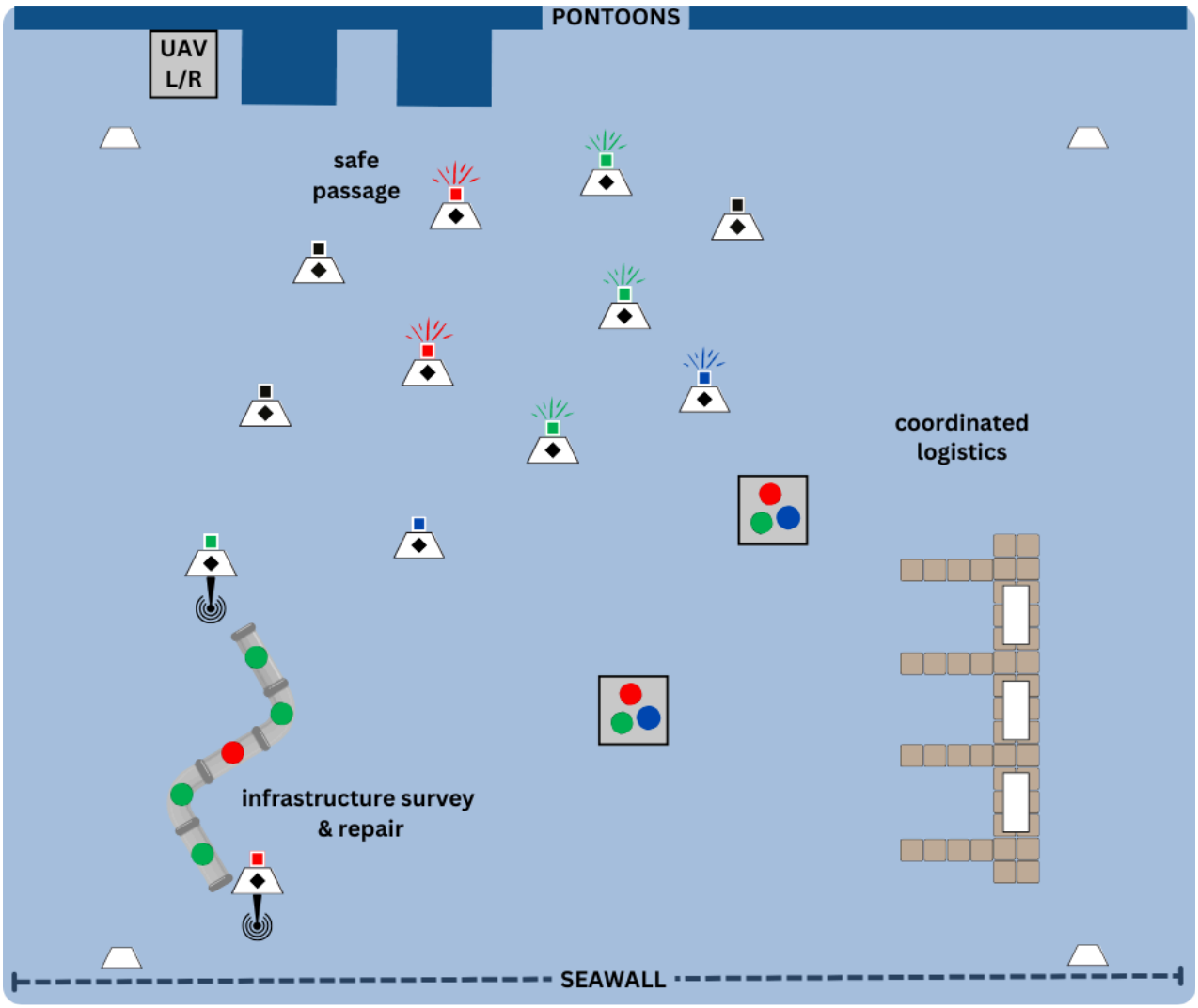
Section 3: Autonomy Challenge

This section includes detailed requirements and instructions for the autonomy challenge portion of the competition.

These challenges showcase System of Systems (SoS) performance through autonomous completion of a range of tasks designed to represent research and real-world applications.

> Specifications for each task are still under development and will continue to be updated and released as plans are finalized. Keep a close eye on the RobotX Discord ↗ for updates and answered questions.

- 3.1 Proof of Readiness
- 3.2 Mandatory Activities
- 3.3 Mission Task Descriptions
- 3.4 Communications Protocol
  - Team ID List
- 3.5 Task Build Specifications
- 3.6 Scoring Rounds *(coming soon)*


PONTOONS
UAV
L/R
safe
passage
coordinated
logistics
infrastructure survey
& repair
SEAWALL

3.1 Proof of Readiness

- 3.1.1 Submission Requirements
- 3.1.2 USV Proof of Readiness Criteria
- 3.1.3 UUV Proof of Readiness Criteria
- 3.1.4 UAV and Pilot Proof of Readiness Criteria
- 3.1.5 Communications Proof of Readiness Criteria

Click here to get started on your Proof of Readiness submission. ↗

Teams must submit the required proof of readiness materials outlined below for each of the domains in which they will compete and for each system which will be used during the event. These submissions will be reviewed to determine whether teams and their systems are eligible to deploy at competition.

If a system is deemed ineligible, teams will not be permitted to deploy the system at competition. Submissions will be reviewed on a rolling basis during the window defined in Competition Schedule and Timeline, with responses provided in a timely manner. Teams will receive a pass/fail, including any necessary follow-up questions. Teams who receive a fail are permitted to keep submitting attempts up until the close of the submission windows. Submission windows are as follows:

- **01 April 1 - 31 August 2026**
  - Submission window for Communications Proof of Readiness.
  - Submission window for mandatory two (2) systems, consisting of a USV and at least one (1) other uncrewed system. If you intend to use a UAV in November, the second system MUST be your UAV.
- **01 April - 12 October 2026 |** Submission window for teams who plan to use a third uncrewed system.

Eligibility for Travel Stipend: Registered teams must successfully pass the mandatory proof of readiness requirements to be eligible to receive a travel/shipping stipend. These stipends are not guaranteed, and will be determined at a later date.

3.1.1 Submission Requirements

The submitted video and file uploads must meet the following requirements:

- The entire demonstration must be recorded from start to finish with no breaks in the video.
- Videos and text must be conducted in English or include subtitles in English.
- Videos must be no more than 5 minutes in length.
- Videos and text must include school/organization and team name at the beginning.
- Videos and text must include all required content, outlined in the sections below.

3.1.2 USV Proof of Readiness Criteria

Criteria for the required **Uncrewed Surface Vehicle (USV)** proof of readiness submission includes:

- **Autonomous Navigation Demonstration (Video Submission) -** In a fully autonomous run, the USV must start 3m behind the Gate, and pass through both sets of Gates.
  - USV must not strike any buoys.
  - USV must demonstrate good autonomous control throughout the run.
- **Safety Systems (Photo/Video Submission)**
  - File Upload Submission:
    - Drawings detailing how the kill switches are wired into the system.
    - Pictures of clearly marked tow points with proper tow harness.
    - Pictures of clearly marked lift points and lift harness.
    - Pictures of propeller shrouds.
    - Functional Block Diagram and pictures of R/C (manual control) approach demonstrating operation independent of laptop connection.
  - Video Submission:

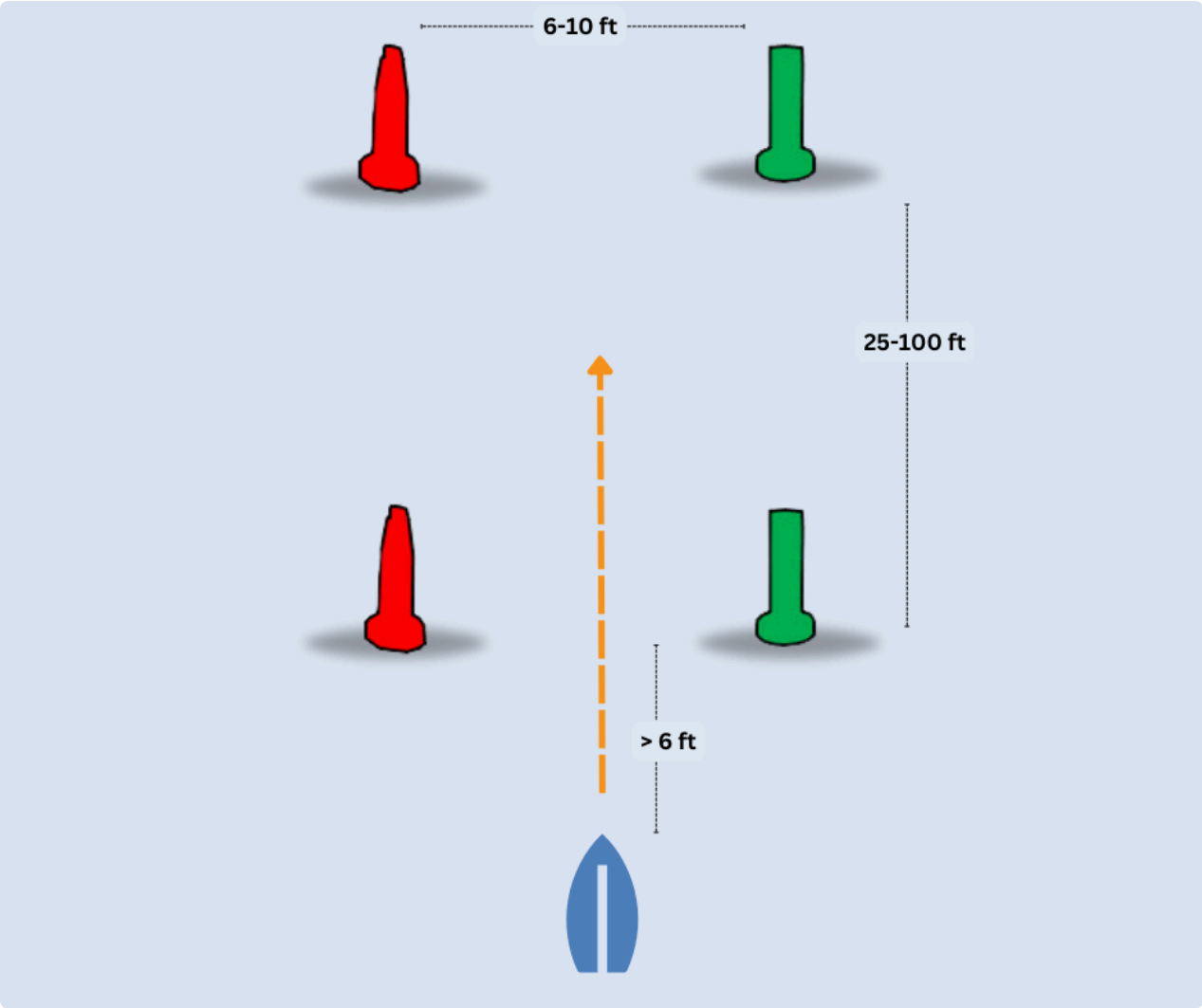
- Demonstrate onboard and remote kill switch operating correctly.
- Demonstrate functionality of the visual feedback system (auto, manual, kill).

Working Concept: Teams may be required to submit proof that the USV can send properly formatted RoboCommand messages. (details forthcoming)

How to Build: USV Proof of Readiness Course

The autonomous navigation demonstration course consists of buoys arranged as shown below. The USV must successfully navigate autonomously between two pairs of red and green buoys.

If a team is unable to build a course to meet these specifications, notify RoboNation for alternative instructions to attempt proof of readiness.



USV Proof of Readiness: Dynamic Navigation Demonstration

Course Elements

Teams may use ANY RED and GREEN buoys to construct the course for this demonstration of autonomous navigation. Buoys should extend approximately 1m above the surface of the water so that they are easily seen in your submission.

> Previous RobotX competitions used buoys from Taylor Made (www.taylormadeproducts.com ↗) and Marine Buoys Australia (www.marinebuoysaustralia.com ↗) but these are **NOT** mandated for the Proof of Readiness course.

3.1.3 UUV Proof of Readiness Criteria

Criteria for the **Uncrewed Underwater Vehicle (UUV)** proof of readiness submission includes:

- **Autonomous Demonstration (Video Submission) -** In a fully autonomous run, the UUV must start 3m behind the Gate, submerge, pass through the Gate, circle around the Marker, and then pass back through the Gate.
  - Everything attached to the UUV must submerge with the vehicle (nothing floating on the surface).
  - UUV must not breach the surface.
  - UUV must not strike any buoys.
  - UUV must demonstrate good autonomous control throughout the run.
- **Safety Systems (Photo/Video Submission)**
  - File Upload Submission:
    - Drawings detailing how the kill switches are wired into the system.
    - Pictures of clearly marked tow points with proper tow harness.
    - Pictures of clearly marked lift points and lift harness.
    - Pictures of propeller shrouds.
    - Picture of mounting area for locator beacon.
    - Functional Block Diagram and pictures of R/C (manual control) approach demonstrating operation independent of laptop connection.
  - Video Submission:
    - Demonstrate onboard kill switch operating correctly.
    - Demonstrate functionality of the visual feedback system (auto, manual, kill).
    - Demonstrate proof the system is positively buoyant.

How to Build: UUV Proof of Readiness Course

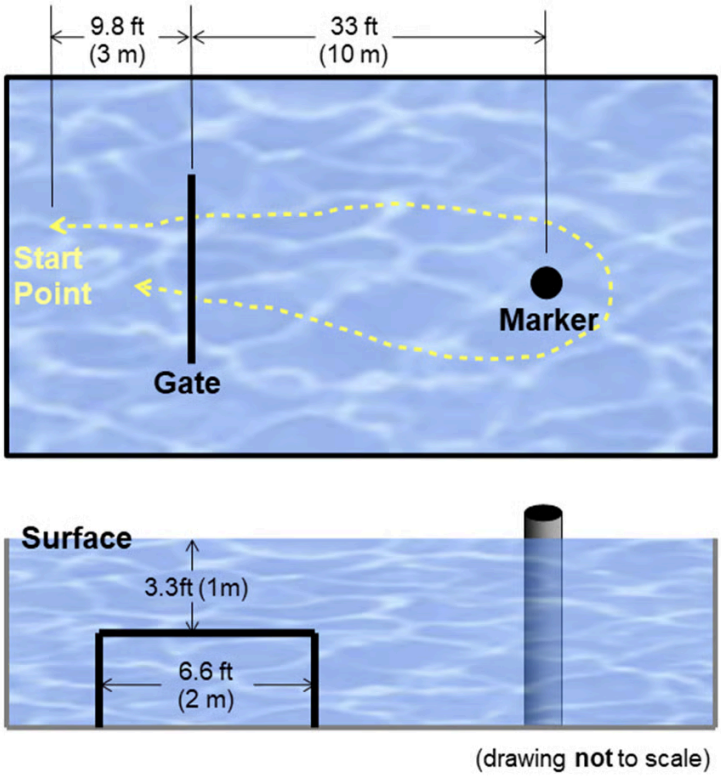
The autonomous demonstration course consists of a Horizontal Gate and a Vertical Marker arranged as shown below.

- Horizontal Gate must be:
  - 2m wide.
  - positioned 1m below the surface of the water.
  - made of materials of any diameter and any color the team chooses.
  - anchored to the floor by any means necessary (ex. using PVC elbows to create two vertical legs, with a line on each end to moor the gate to the floor, etc.).

- Vertical Marker must be:
  - positioned 10m beyond the gate.
  - made of materials of any diameter and any color the team chooses.

Video must make it clear that the vehicle has maneuvered around the marker.

> If a team is unable to build a course to meet these specifications, notify RoboNation for alternative instructions to attempt proof of readiness.



Alternate Course for USV/UUV Tethered Pair

For teams who will have a USV tethered to their UUV, the UUV Proof of Readiness may be completed by following the alternate specifications listed below:

- In order to avoid tangling of the tether with the underwater gate and marker buoy, teams may construct an alternate course configuration:
  - Gate: pair of buoys placed approximately 2m apart.
  - Marker Buoy: must be clearly indicated and placed at least 10m beyond the gate.
  - Both the gate and marker buoys must extend sufficiently below the surface that it is reasonable for the UUV to perceive and navigate using these as reference points.
- In order to demonstrate autonomous capability as specified for the UAV/UUV tethered pair (Section 5.3.2), the submission must comply with the following requirements, at a minimum:
  - The UUV must remain submerged throughout the run.

- Both the UUV and USV must been seen to be operating autonomously for the full duration of the proof of readiness demonstration; we will be looking for both the visual mode indicator on the system and for hands off controllers by your team members.
- The USV may autonomously follow the UUV through the course.

3.1.4 UAV and Pilot Proof of Readiness Criteria

Gaining approval for pilots and UAVs to operate at RobotX 2026 is a multi-step process. UAV Proof of Readiness submissions are intended to provide organizers with sufficient Objective Quality Evidence (OQE) to increase the likelihood of obtaining approvals for teams to operate during the event.

Criteria for the UAV proof of readiness submission include the elements listed below:

- **RobotX UAV Information package (electronic submission)**
  - Teams must complete and submit the UAV and Pilot information package to the best of their ability and work with the organizing team to provide sufficient detail on their aircraft in accordance with requirements set by the Civil Aviation Authority of Singapore (CAAS).
  - For the purposes of this submission, teams should consider the following when describing UAV configurations:
    - The UAV airframe and core functional flight elements are considered one configuration.
    - Addition of payload handling equipment (with or without the associated payload) is considered a second configuration.

Click here to download the UAV Information Package ↗ requirements and examples.

- **Flight Demonstration (Video Submission)**
  - Teams must submit a video demonstrating that the UAV is ready for on-site final evaluation of flight readiness. The video must contain at a minimum the following content:

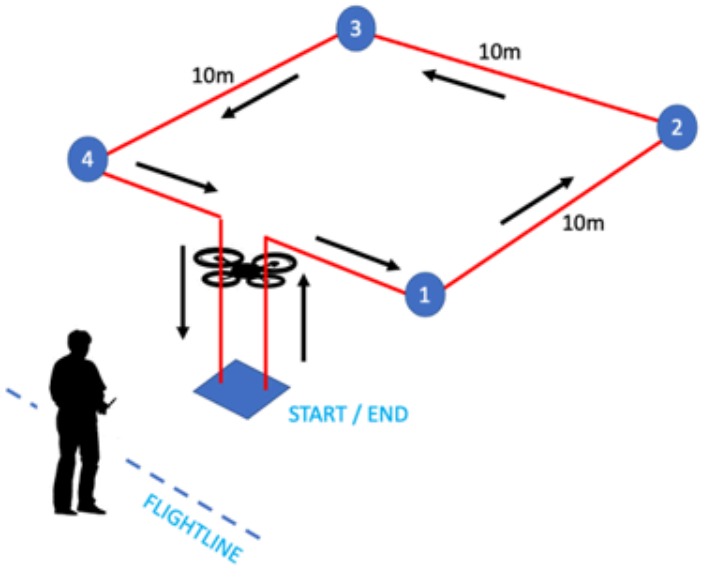
        - **Introduction (≈ 30 Seconds)**: This section must include a visual and verbal identification of the School and Team name.
        - **Safety, Risks, and Mitigations**: This section should describe the potential safety risks and the steps taken to mitigate them. It should include risks during the development process and during the mission.
        - **Proof of Readiness for Flight**: This section must show the UAV from takeoff to landing with the following characteristics:
            - Manual Operation
                - Proof the system is in manual mode.
                - Piloted Takeoff to Above 3m AGL
                - Flight pattern as shown in the UAV Flight Patterns section below.
                - Proof that the system remains within the published geofence even when commanded to exceed the boundary.
                - Proof that the system does not exceed the maximum allowable altitude, even when commanded to exceed this limit.
                - Piloted Landing
            - Autonomous Operation
                - Proof the system is in autonomous flight.
                - Autonomous Takeoff to Above 3m AGL
                - Flight pattern as shown in the UAV Flight Patterns section below.
                - Proof that the system remains within the published geofence, even when commanded to exceed the boundary.
                - Proof that the system does not exceed the maximum allowable altitude even when commanded to exceed this limit.
                - Autonomous Landing
- **Safety Systems (File/Photo/Video Submission)**
    - Teams must submit the following:
        - File Upload Submission
            - Picture(s) showing the mounting area for the emergency recovery light.
            - Picture(s) showing clearly marked safe handling areas for recovery.

        - Documentation detailing the UAV behaviors in each of the following scenarios:
            - Loss of link with remote controller
            - Low battery
            - Task/Mission abort
            - Geofence boundary reached
    - Video Submission (These may be incorporated into the Proof of Flight video)
        - Video demonstrating proper operation of the following emergency conditions:
        - Loss of link with remote controller.
        - Proof of compliance with geofence boundaries.
        - Proof that the system is positively buoyant.
- **Remote Controller Compliance (File/Photo/Video Submission)**
    - Documentation of remote controller approach demonstrating compliance with UAV requirements.
    - Image/video of dedicated remote controller.

UAV Flight Patterns (Manual and Autonomous)

Teams should fly the following flight patterns in their video submissions:

PILOT SAFETY CHECK – ELEMENT # 1



INSTRUCTIONS

a) Take-off and establish a hover at an altitude of 2 - 3 metres

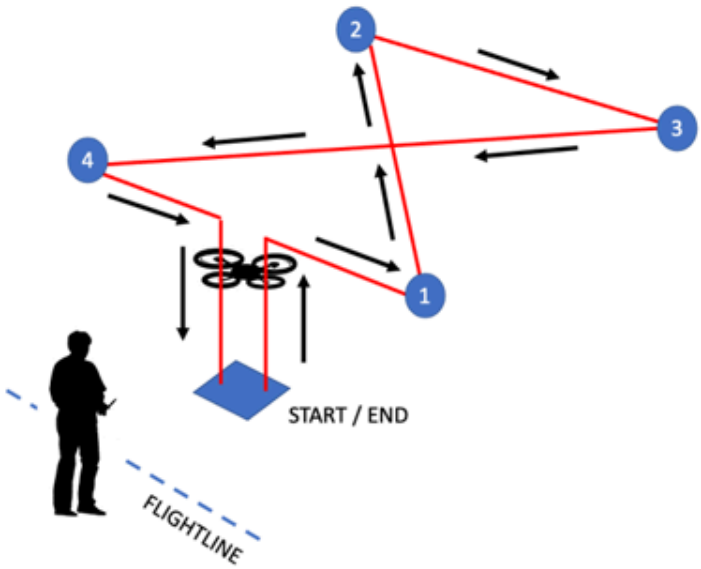
b) Maintain this altitude for the entirety of the course.

c) With the done facing AWAY from the pilot, complete a square circuit in either direction through each point 1-2-3-4 (or 4-3-2-1).

d) Return to the take-off position, hover and land.

e) Render the Drone / Aircraft SAFE

PILOT SAFETY CHECK – ELEMENT # 2



INSTRUCTIONS

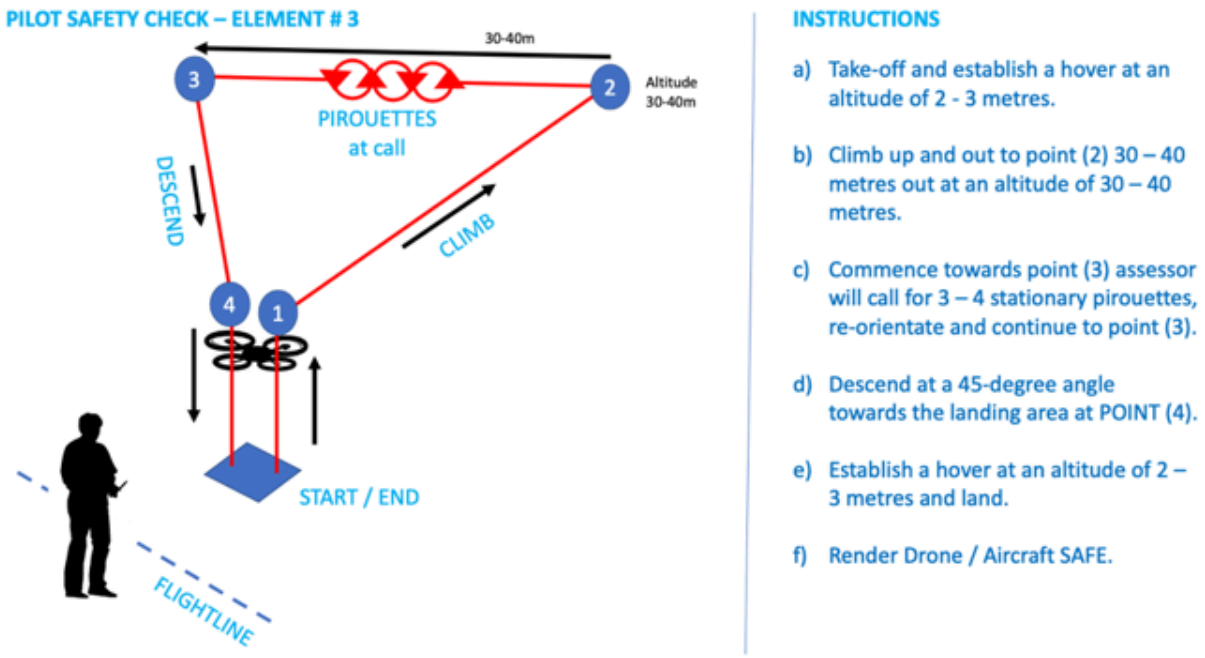
a) Take-off and establish a hover at an altitude of 2 - 3 metres.

b) Maintain this altitude for the entirety of the course.

c) With the done facing AWAY from the pilot, commence hour glass flight in either direction to each point 1-2-3-4 (or 4-3-2-1).

d) On return to the take-off position, hover and land.

e) Render Drone / Aircraft SAFE.



3.1.5 Communications Proof of Readiness Criteria

Radio Frequency Transmitters

All Radio Frequency (RF) equipment must be operated within the rules and regulations of the host country. This includes, but is not limited to frequency, transmitting power, antenna, etc. The organizing team is coordinating broad spectrum clearances with the appropriate authorities. To support these efforts teams must submit radio usage information for the equipment they plan to use on site using the provided template. This information includes the following:

- Radio Function
- Radio Information: Manufacturer, Model Number, Frequency Range, Center Frequency, Bandwidth, Transmit Power
- Antenna Information: Manufacturer, Model Number, Type (Omni, Sector, etc.), Gain

ⓘ Click here to download the RF Emitter ↗ submisison template.

RoboCommand Compliance

Teams must demonstrate their ability to send and receive messages in compliance with the Communications Protocol prior to arrival on site.

This is accomplished by submitting *rc-test* logs that show a run start sequence as detailed in Section 3.4.10. The run start sequence must be performed with at least two vehicles in the *run_declaration* message.

3.2 Mandatory Activities

Prior to being permitted to operate in any competition areas (on land or in water), each autonomous system must pass basic functionality and safety checks. These include verification that the systems meet vehicle requirements as specified in Section 5.3 System Requirements, as well as demonstration of the operation of all safety systems.

Vehicles are weighed before each scoring run. Teams transport the vehicle on their cart to the scale for weight measurement.

Any system operating in autonomy courses must report status and other required data via the RoboCommand system as specified in Section 3.4 Communications Protocol.

3.2.1 Static Safety Inspection

Prior to deploying at the competition, all systems must meet all safety requirements and pass a safety inspection, as outlined in 5.2 Safety Requirements. Any system that is deemed unsafe may be disqualified. At a minimum, the following requirements are checked:

- Emergency Stop System (location of switches, on-board and remote functionality).
- Tow points and tow line are installed and clearly marked (forward/aft).
- Lift points are clearly marked and lifting harness is sufficient.
- Safety requirements for propellors, including propeller guards.
- All components or subsystems are properly secured.
- Mount points and compatibility to carry emergency recovery light.
- Cart meets published transport requirements.

More details on safety and system requirements are available in 5.2 Safety Requirements and 5.3 System Requirements.

USV Functionality and Safety Checks

Teams must demonstrate that each USV adheres to the system requirements outlined in 5.3.1 USV Requirements and pass the static safety inspection and weight measurement.

UUV Functionality and Safety

Teams must demonstrate that each UUV adheres to the system requirements outlined in 5.3.2 UUV Requirements and pass the static safety inspection and weight measurement.

UAV Functionality and Safety

The Civil Aviation Authority of Singapore (CAAS) ↗ serves as Singapore's national aviation authority, responsible for safety and air traffic management. Teams must meet all requirements mandated by the CAAS for their UAV. Compliance with CAAS regulations will be collected in the UAV Proof of Readiness, required of teams prior to competition.

UAV Airworthiness Safety Inspection

Prior to being cleared for flight, the UAV must pass the airworthiness safety inspection. At a minimum, the following requirements will be checked:

- Meets the limitations for size and weight.
- Safety issues related to, but not limited to, propellers, motor mounts, general airframe and wiring integrity, battery security, and battery capacity checks.
- All sub-systems are properly secured.
- Autonomous flight control disconnected to enable manual flight control mode.
- Mount points and compatibility to carry emergency recovery light.

More details on system requirements are available in Section 5.3.3 UAV Requirements.

> The requirements for UAV Functionality and Safety are still being finalized and will be provided at a later date.

3.2.2 Weight Measurement

Systems are weighed at the start of competition to ensure compliance with the system requirements. Teams transport the vehicle on their cart to the scale (similar to a veterinary scale, available at scaleline.com ↗) for weight measurement. The stable scale reading weight is recorded.

During scored runs, the systems must be re-weighed every time it is launched into the water. If the system stays in the water between scored runs, teams may forgo the weight test a second time. However, if a team is observed to be switching significant components or making modifications on their boat, the team may be asked for a new measurement.

Weight & Size Requirements

Weight and size requirements can be found in the following sections:

- 5.3.1 USV Requirements
- 5.3.2 UUV Requirements
- 5.3.3 UAV Requirements

3.3 Mission Task Descriptions

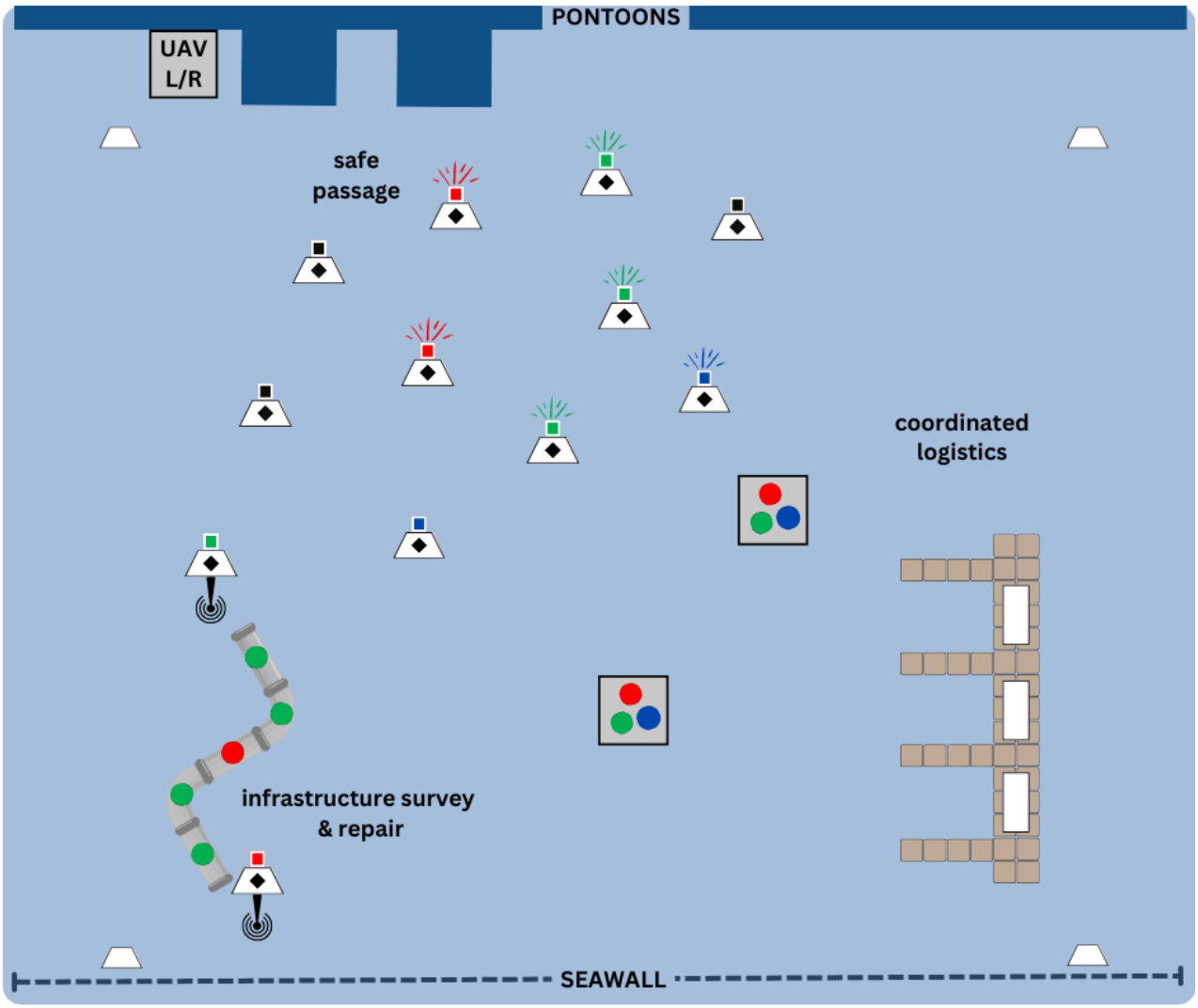
This section provides details of the RobotX 2026 Autonomy Challenge tasks and the proficiency requirements for each round of competition. Teams are encouraged to develop a strategy to approach these tasks that best suits their SoS.

All uncrewed systems must be switched to autonomous mode to initiate start of any collaborative autonomous run in the courses.

Capability Levels

Each mission task has capabilities divided by three levels:

- ***Core Capabilities***: Fundamental competencies required for safe and effective baseline autonomous operation.
- ***Advanced Capabilities***: Competencies that reflect growth in autonomy sophistication and real-world relevance.
- ***Disruptive Capabilities***: Transformative competencies pushing the boundary of autonomous systems - enabling novel or mission-critical applications.



Preliminary Course Layout

3.3.1 Cross-cutting Tasks

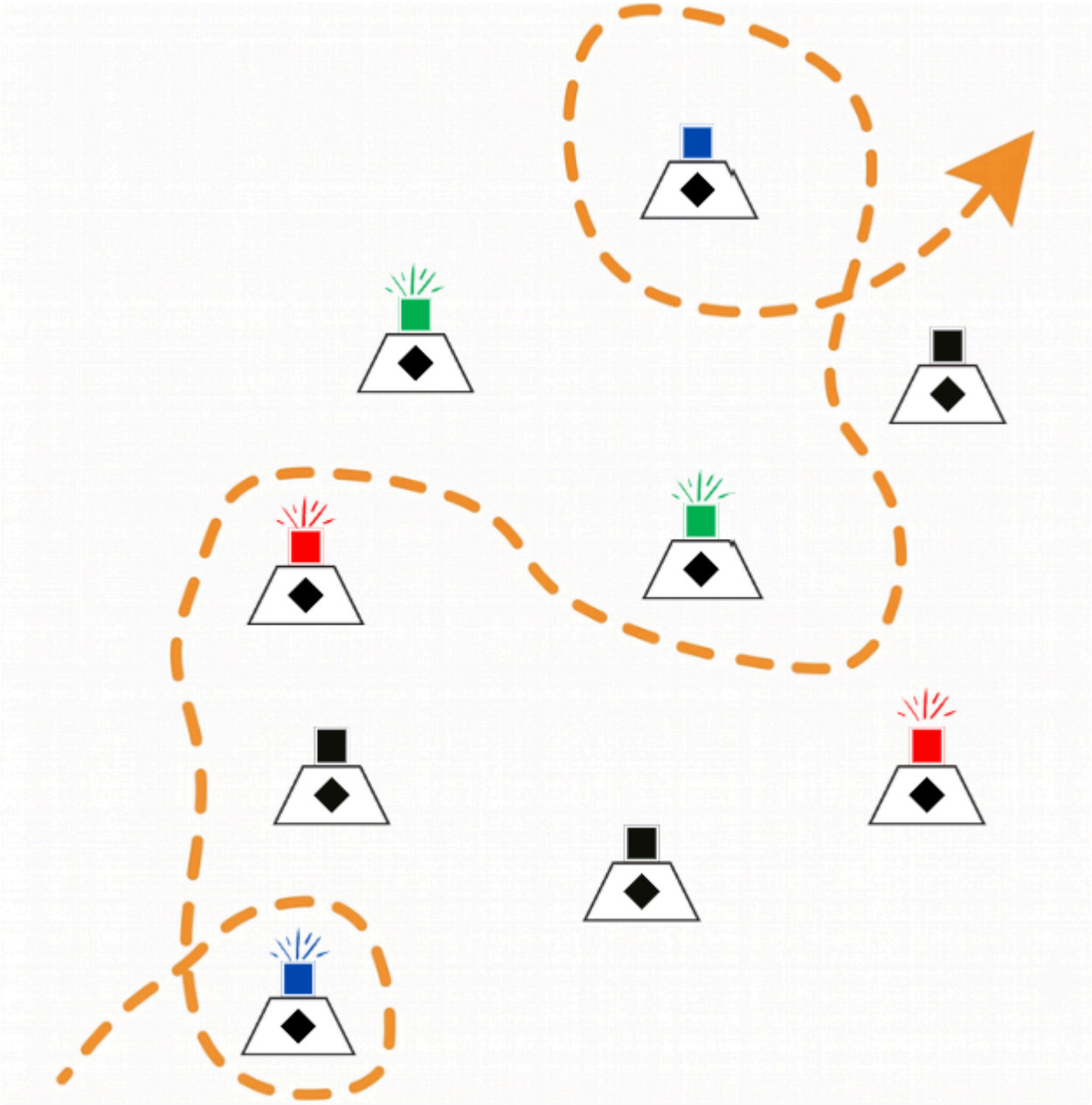
All uncrewed systems are required to autonomously perform basic functions as part of mission execution and safe operation. These functions cut across all aspects of autonomous mission execution.

- **RoboCommand:** The System of Systems (SoS) must provide updates and reporting for each vehicle operating during any run in the autonomy challenge courses via the RoboCommand system. This is to allow competition organizers, technical teams, and judges to have good situational awareness of the SoS and to evaluate performance against the challenges.
- **Obstacle Avoidance:** The ability to avoid obstacles is a critical capability for safe operation of uncrewed systems. Every course element is an object to be avoided or approached safely in some way. In addition, obstacle buoys may be placed throughout the operating areas in an effort to provide a more representative real-world challenge.
- **Inter-Vehicle Communication:** Inter-vehicle communication is a central component to multi-vehicle collaborative execution of the tasks as required by Advanced and Disruptive Tiers. Teams are encouraged to provide clear and easily understandable demonstration of this capability for judges to understand.
- **Dynamic Adaptability:** In real-world scenarios, uncrewed systems must be able to adapt to changes in the operating environment or other mission priority changes. Mission Task 4 represents these conditions through use of the RoboCommand system to transmit dynamic changes to the mission priorities or operating environment.

3.3.2 Mission Task 1: Safe Passage

Minimum Systems Required: USV (or surfaced UUV), UAV

The maritime systems must safely enter the recovery area in order to begin survey and relief efforts. There are hazards to surface and underwater vessels, represented by buoys topped with light beacons in the transit area.



Example Task 1 Layout and USV Path

This task consists of a group of ten (10) buoys with LED light beacons that will be in one of five states: OFF, flashing **RED**, flashing **GREEN**, flashing **BLUE**, and steady **BLUE**. The flashing lights will repeatedly cycle on for 1 second and off for 1 second. These represent objects on the water that must be approached and avoided as described below.

The buoys will have two light beacons, one visible from the side (for surface systems), and one visible only from above (for the UAV). Only one of these beacons will be active at any time.

Each buoy will have lights visible from the side (for surface systems) or only from above (for the UAV). Depending on the tier to be attempted, one or both of these beacons will be activated to show a safe path through the area.

When a System of Systems (SoS) reports that it is attempting an autonomous passage, the task will activate light beacons in a random configuration based on the tier to be attempted. The task will remain active for as long as a system continues to report attempts at the task.

A surface system (USV or UUV) must autonomously transit on the water surface from the correct ENTRY point to the correct EXIT point while avoiding obstacles and passing the **RED** and **GREEN** buoys on the appropriate side of the surface system.

- A **FLASHING RED** light must be passed on the surface system's starboard side.
- A **FLASHING GREEN** light must be passed on the surface system's port side.
- A **FLASHING BLUE** light indicates the safe ENTRY point for the surface system.
- A **SOLID BLUE** light indicates the safe EXIT point for the surface system.
- A **BLACK** indicator refers to one in which the light beacon is not active; this is an obstacle to transit and may be passed to any side.

In the Advanced and Disruptive Tiers the UAV must complete an overfly of the start area and report via the RoboCommand system to determine a safe passage before the USV can transit into the field to attempt safe passage. Light beacons visible only from above will be placed atop buoys to indicate a safe route. The USV will then be required to transit the course identified by the UAV. Safe route changes in a random pattern for each run.

Core Tier

The System of Systems (SoS) must identify and report the correct start and end points for the transit, as well as the **RED**, **GREEN**, and **BLACK** (OFF) buoys as detected and classified. The USV or UUV must approach and fully circle around the ENTRY buoy with the **FLASHING BLUE** light in a **clockwise direction** before beginning transit of the buoy field.

The USV or UUV must transit through the area on the surface after circling the ENTRY buoy and exiting near the correct EXIT marker while passing the **RED**/**GREEN** buoys on the correct side. The **RED**/**GREEN** buoys will have lights visible from the side at the Core Tier.

Once the USV or UUV has completed transit, the craft must fully circle around the EXIT buoy with the **SOLID BLUE** light in a **counterclockwise direction** to complete this task.

Capabilities Demonstrated:

- UAV (optional): Autonomous search, detect, localize, and ID light beacons, Report to RoboCommand, Communicate with other systems.
- USV/UUV: Detect, localize, and ID light beacons, Autonomous path planning, Autonomous path following, Avoid obstacles, Report to RoboCommand.

Advanced Tier

At the Advanced Tier, the safe passage is only detectable by the UAV, which must relay the ENTRY and EXIT points, as well as the location of **RED** and **GREEN** markers, to the surface system and to RoboCommand. The USV or UUV must use the data from the UAV to safely transit the field. The path will be randomized for each run, but will remain constant for the duration of a single attempt. Thus, the UAV is not required to remain on station tracking passage of the surface system.

Capabilities Demonstrated:

- UAV: Autonomous search, detect, localize, and ID light beacons, Report to RoboCommand, Communicate with other systems.
- USV/UUV: Detect buoys, Path planning/execution based on UAV shared data, Avoid obstacles, Receive tasking from UAV.

Disruptive Tier

The disruptive tier builds on the Advanced Tier by adding the possibility that the safe passage may change during the surface system transit through the field of buoys. This represents detection by the UAV of a previously not seen hazard to navigation.

Changes in the hazards will be visible only to the UAV, which means that the UAV will need to remain on station to provide updates to the surface system in real time, demonstrating the ability of the SoS to communicate and adapt to the changing environment.

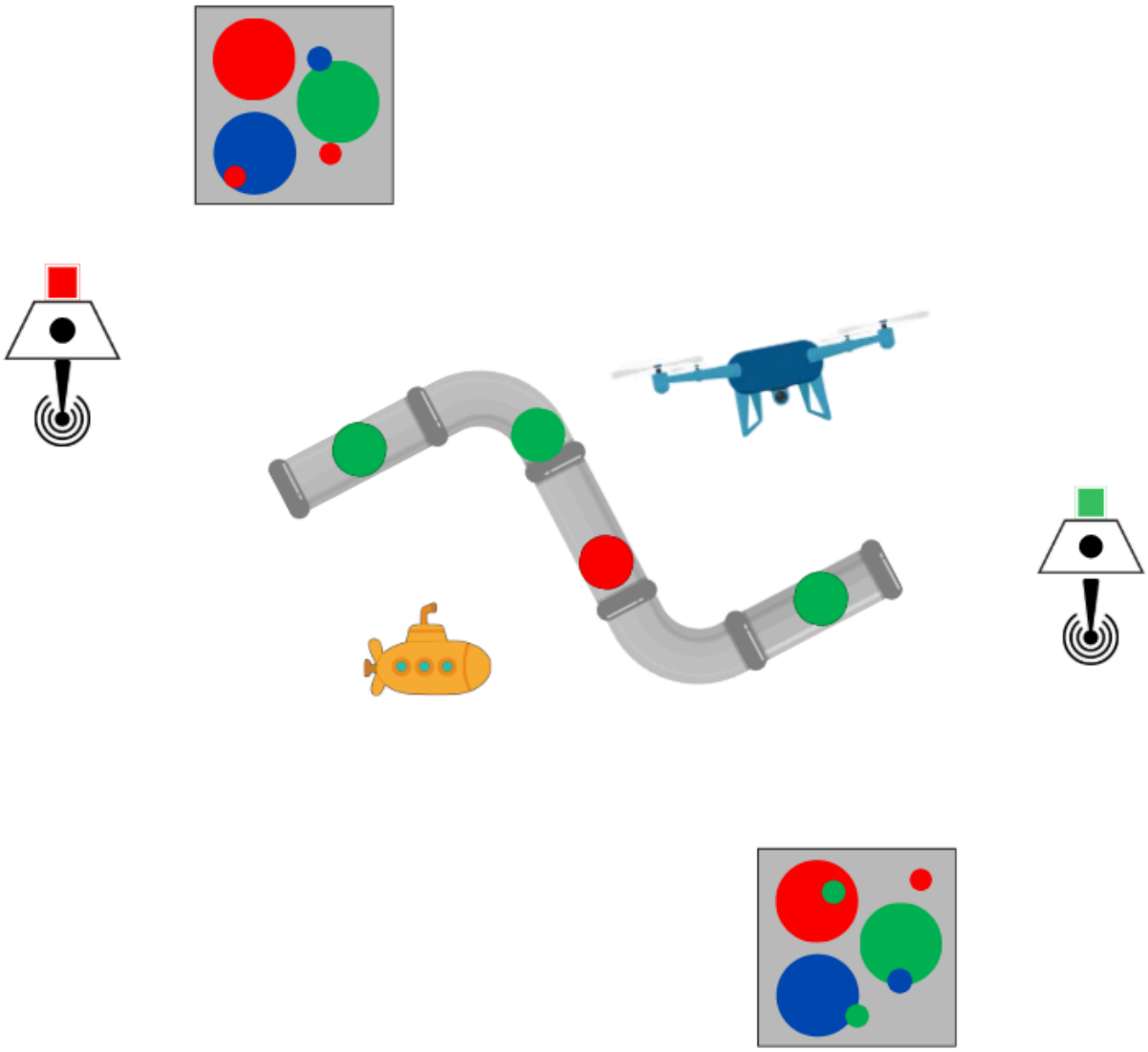
Capabilities Demonstrated:

- UAV: Autonomous search, detect, localize, and ID light beacons, Persistent surveillance, Detect changes, Report to RoboCommand (detections and changes), Communicate with other systems.
- USV/UUV: Detect buoys, Path planning/execution based on UAV shared data, Avoid obstacles, Receive tasking and re-tasking from UAV.

3.3.3 Mission Task 2: Infrastructure Survey and Repair

Minimum Systems Required: UUV, UAV

An underwater pipeline is indicating signs of damage in the harbor. It must be surveyed for damage and repaired. The area to be surveyed will be indicated on the surface by a pair of buoys.

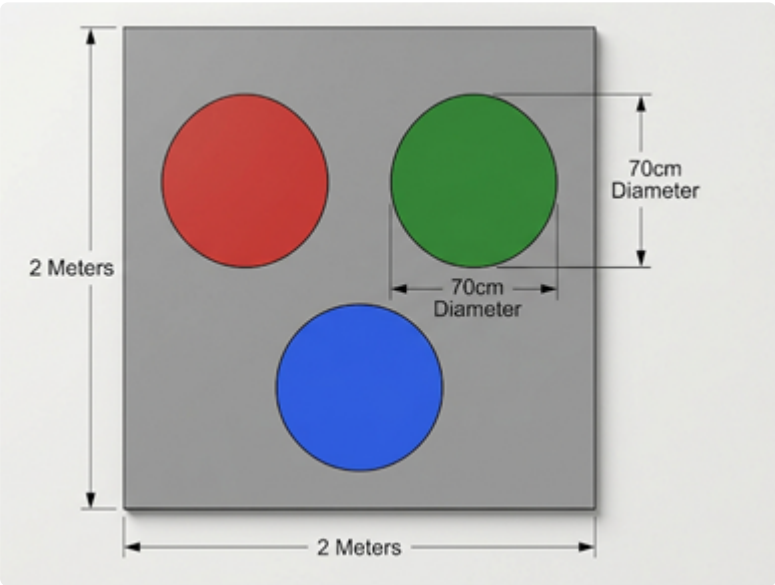


Mission Task 2: Infrastructure Survey and Repair

The task will consist of surface and underwater course elements. A pipeline will be suspended underwater approximately 1-2 meters above the seafloor. The pipeline will be equipped with LED ring lights that change between **GREEN** and **RED** to indicate functional and damaged areas, respectively. At the center of each light ring will be a magnetic switch that turns the **RED** light to **GREEN**.

Two buoys will be placed near the ends of the pipeline. Each buoy will have a color indicator on top and an underwater acoustic pinger suspended below. The color indicators will change between **RED** and **GREEN**. Only the acoustic pinger suspended below **GREEN** buoy will be actively pinging.

There will also be two floating platforms within the course boundary that contain **RED**, **GREEN**, and **BLUE** tins. Each of the floating platforms will be approximately 2 meters square, covered with a grey background with **RED**, **GREEN**, and **BLUE** circles on it. The circles will be 60-70cm in diameter. These platforms are also used in Task 3.



Example UAV Delivery Platform

The colors for the background and colored circles will be as near as we are able to produce to those listed in the table below.

Platform Element	Hex Code	Pantone Color
Background Color (Benjamin Moore Sidewalk Grey ↗)	#CCCED0	179-3 C
Red Circle	#E8282B	1788 C
Green Circle	#089404	355 C
Blue Circle	#0072CE	285 C

Tins colored **RED**, **GREEN**, and **BLUE** will be used to represent the resources to be delivered by UAVs. The tins will be weighted to approximately 40-50 grams and coated using a spray Plasti-Dip to help maintain their watertightness and durability. The components in the table below will be used to make the resource tins.

Uncoated Aluminum Tin Dimensions

Task Element	Description	Source
Metal Tins (~40-50 grams)	Aluminum Round Cans	https://a.co/d/03wsKktP ↗
Red Plastic Coating	Plasti-Dip Spray - Red	https://a.co/d/0iZDJoFA ↗
Green Plastic Coating	Plasti-Dip Spray - Blaze Green	https://a.co/d/01smaPAH ↗
Blue Plastic Coating	Plasti-Dip Spray - Blaze Blue	https://a.co/d/04vVGhNe ↗

When the challenge activates, one of the color indicators on the buoys will turn **GREEN** and the acoustic pinger on the same buoy will begin pinging. The UUV should begin its survey to locate the pipeline at this active buoy.

Simultaneously, the underwater pipeline will activate, illuminating one of the lights **RED** while the remaining lights turn **GREEN**. The **RED** light indicates the section in need of repair, and it will also indicate the area where the UUV must hold a magnetic probe to represent performing a repair of the damaged section.

Core Tier

The UUV must transit to the survey area start point to begin execution of the challenge. This start point is identified by a **GREEN** color indicator on the buoy. Once the UUV reaches the search area, it must find the underwater pipeline and follow it, noting whether each segment is intact (**GREEN**) or damaged (**RED**).

The minimum response at the Core Tier is a report of the pipeline status to the RoboCommand system. The order of reporting begins with the part of the pipeline closest to the active buoy. The UUV may surface to complete this reporting.

For additional points the UUV may “repair” the damaged segment by holding a magnetic probe in the area indicated near the light. Once the marker is held in place long enough, the pipeline will notify RoboCommand and change the light to **GREEN**.

Capabilities Demonstrated:

- UAV: Identify and localize the **GREEN** indicator, communicate start point to UUV for task execution.
- USV: Identify and localize the **GREEN** indicator or localize the active acoustic pinger, communicate start point to UUV for task execution.
- UUV: Identify **GREEN** indicator or home to acoustic pinger, Locate underwater pipeline, follow pipeline, report light pattern, precisely position probe to "repair" pipeline segment, report to RoboCommand.

Advanced Tier

The Advanced Tier builds on the Core Tier by requiring the UUV to request a supply delivery by the UAV after completing the repair of the pipeline segment. Once the UUV is on site, it conducts the Core Tier mission by surveying AND repairing the pipeline segment.

After the UUV has successfully completed its repair of the pipeline segment, the **RED** light will change to **GREEN** for five (5) seconds, it will then flash RED, GREEN, or BLUE to indicate where a resource needs to be delivered on one of the floating platforms. The flashing light will be on for one (1) second, then off for one (1) second, repeating this pattern for 30 seconds before turning off.

The UUV must transmit this resource request to the UAV and report successful task completion to RoboCommand.

The UAV must acknowledge the re-tasking by reporting a tasking change to RoboCommand and then deliver ANY colored tin to the correct circle on the floating platform. At this tier, the UAV may be pre-loaded with a tin, but must already be in autonomous mode when the UUV sends its message.

In order to help judges understand what is happening, the UUV and UAV must report their status and progress in accordance with the RoboCommand messages described in Section 3.4 Communications Protocol.

Capabilities Demonstrated:

- UAV: Receive tasking from UUV, Report to RoboCommand, Deliver payload, Identify and localize the **GREEN** indicator, communicate start point to UUV for task execution.
- USV: Identify and localize the **GREEN** indicator or localize the active acoustic pinger, communicate start point to UUV for task execution.
- UUV: Identify **GREEN** indicator or home to acoustic pinger, Locate underwater pipeline, follow pipeline, report light pattern, precisely position probe to "repair" pipeline segment, report to RoboCommand, communicate with UAV.

Disruptive Tier

The Disruptive Tier builds on the Advanced Tier by adding an extra flash of the lights on the pipeline, telling the UUV both what resource is needed and to which area it should be delivered.

After the UUV has successfully completed its repair of the pipeline segment, the **RED** light will change to **GREEN** for five (5) seconds, then flash two colors, **RED**, **GREEN**, or **BLUE** to indicate which resource is needed and to which color it should be delivered. This randomly generated a two-color sequence will show the 1st color for one (1) second, then the off for one (1) second, then the 2nd color for one (1) second, the off (**BLACK**) for 2 seconds. The same pattern is repeated continuously for 30 seconds.

The first color indicates which color tin is needed and the second color indicates to which colored circle the tin should be delivered.

Once the UUV completes its repair and receives the resource request, it may surface to report to RoboCommand and transmit the request to the UAV for completion. The UAV must then locate and retrieve the correct colored tin and successfully deliver it to the correct resource circle.

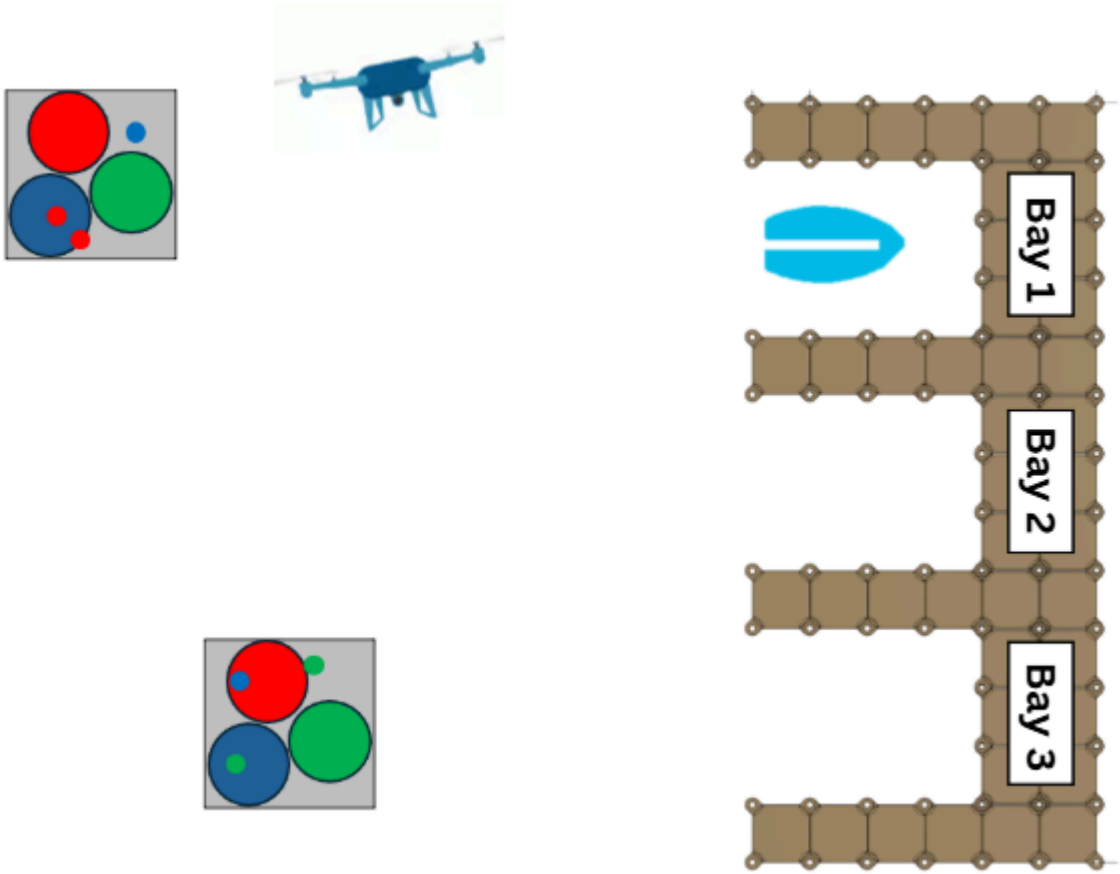
Capabilities Demonstrated:

- UAV: Receive tasking from UUV, Report to RoboCommand, Retrieve and deliver payload, Identify and localize the **GREEN** indicator, communicate start point to UUV for task execution.
- USV: Identify and localize the **GREEN** indicator or localize the active acoustic pinger, communicate start point to UUV for task execution.
- UUV: Identify **GREEN** indicator or home to acoustic pinger, Locate underwater pipeline, follow pipeline, report light pattern, precisely position probe to "repair" pipeline segment, report to RoboCommand, communicate with UAV.

3.3.4 Mission Task 3: Coordinated Logistics

Minimum Systems Required: USV (or surfaced UUV), UAV

This task represents multiple scenarios that may exist after a natural disaster: (a) the USV must find the safe docking bay, (b) complete a "firefighting task", and (c) request resources such as food, medical, or other supplies be delivered. The uncrewed systems can work as a team to quickly complete these challenges.



Example of the Task3 Docking Bays and Delivery Platforms

The task will consist of floating docks assembled to provide three docking bays, with bay numbers referenced left-to-right when facing the bays (as shown). Within each bay there will be a small, white structure that represents a building. Each structure will have two 25cm square target holes with black borders, and at the base of the face there will be a color indicator showing either **RED** or **GREEN** to indicate which bay is available for docking.

This task will also use the two floating platforms and resource tins described in Task 2. The UAV will be required to specify for which task it is executing the resource delivery in order to be eligible to score points for the Advanced and Disruptive tiers.

The surface craft must locate and dock in the available docking bay, indicated by a **GREEN** color indicator, then report a successful docking to the RoboCommand system. The bays with the **RED** color indicator are not safe bays in which to dock. When the USV reports successful docking, the rest of the challenge will activate as described in the sections below. The USV will be required to communicate with the UAV to enable the air delivery portion of the task (Advanced and Disruptive Tiers).

In the Advanced and Disruptive Tiers one of three (3) resources, represented by **RED**, **GREEN**, and **BLUE** tins, must be delivered from one location to another. The UAV launch area and one or two floating platforms on the water will be the origin points for resources (depending on challenge tier), and the delivery area will be at one of the floating platforms.

Core Tier

The USV must locate the floating docking platform, fully dock in the correct bay, identified by the **GREEN** indicator, then report to the RoboCommand system that it has successfully docked.

When the USV reports to RoboCommand that it has successfully docked, a **RED** light inside one of the windows within that bay will activate, indicating the active target area. The USV must then spray water into the correct window until the light turns **GREEN**. The **GREEN** light will stay on for five (5) seconds before turning off. When this is complete, the USV must report successful completion of the Core Tier challenge.

Capabilities Demonstrated:

- UAV: No tasking.
- USV: Detect safe docking bay, Detect correct window, Deliver water to correct window, Detect successful water delivery, Report to RoboCommand.

- UUV: No tasking.

Advanced Tier

The USV must complete the Core Tier by successfully docking and "putting out the fire" as described in the Core Tier. The light will turn **GREEN** for five (5) seconds as in the Core Tier, then begin flashing (1 second on, 1 second off) the color of the circle to which the UAV should deliver its "relief supply" payload (**RED**, **GREEN**, or **BLUE**). The flashing will continue for 60 seconds, after which the light will turn off.

The USV must relay the delivery destination to the UAV for fulfillment and report this information to RoboCommand for maximum points.

The UAV earns points by delivering ANY tin to the correct colored circle on the delivery platforms. The UAV may be pre-loaded with a tin at this tier, but will earn more points for retrieving and delivering a tin autonomously.

The USV does NOT need to remain in the dock while the UAV completes its part of the task.

Capabilities Demonstrated:

- UAV: Respond to tasking from USV, Locate and retrieve any resource, Deliver resource to correct target area.
- USV: Detect safe docking bay, Report to RoboCommand, Interpret resource request, Communicate with UAV.
- UUV: No Tasking.

Disruptive Tier

As in the Core and Advanced Tiers, the USV must first locate and dock in the safe bay and report readiness to receive the next task from RoboCommand. The USV must put out the fire, causing the target window light to change from **RED** to **GREEN**.

The light will remain **GREEN** for five (5) seconds, turn off for one (1) second before it begins flashing the color of the needed resource AND the color of the receiving bay where it needs to be delivered (**RED**, **GREEN**, or **BLUE**). This randomly generated two-color sequence will show the 1st color for one (1) second, then off for one (1) second, then the 2nd color for one (1) second, then off (BLACK) for 2 seconds. The same pattern is repeated continuously for 60 seconds.

The USV must report the detected pattern to RoboCommand and relay the resource request to the UAV for maximum points.

The UAV must either launch from the start point or divert from its current tasking, locate the platform with the correct resource (colored tin), retrieve the resource, and deliver it to the appropriate colored circle on the other platform.

Capabilities Demonstrated:

- UAV: Respond to tasking from USV, Locate and retrieve CORRECT resource, Deliver resource to correct target area.
- USV: Detect safe docking bay, Report to RoboCommand, Interpret resource request, Communicate with UAV.
- UUV: No Tasking.

3.3.5 Mission Task 4: Dynamic Incident Response

Minimum Systems Required: USV, surfaced UUV, UAV

In real-world scenarios, uncrewed systems must be able to adapt to changes in the operating environment or other mission priority changes. These conditions will be represented through use of the RoboCommand system to broadcast a new task

Core Tier

The RoboCommand system will transmit a request for assistance at a specific GPS position for a specific domain (air or surface). The uncrewed system operating in that domain must acknowledge receipt and intent to support via the appropriate RoboCommand message.

The specified system must immediately acknowledge re-tasking, break off of its current task, transit to the requested area, loiter, and report readiness for further tasking. The RoboCommand system will respond to the readiness message indicating receipt of the message from the uncrewed system and clearance to return to normal operations.

In the core tier, the system may resume normal operation after receiving confirmation from RoboCommand.

Capabilities Demonstrated:

- Systems must demonstrate the ability to break off from current tasking, travel to the requested location, and then resume overall mission tasking.
- Systems must effectively communicate within the SoS, as well as to operators and judges to provide sufficient situational awareness of the changes in tasking.

Advanced Tier

The RoboCommand system will transmit a static keep out area representing a detected hazard and the impacted domain. Any uncrewed systems operating in the affected domain must acknowledge receipt of this message and avoid the area for the duration of the run or until an *All Clear* message is transmitted by RoboCommand and acknowledgement sent in response by the uncrewed system.

Capabilities Demonstrated:

- Systems must demonstrate the ability to receive and act on messages from RoboCommand while continuing to execute their mission.

Disruptive Tier

The most challenging scenario is an unexpected moving object within the field of operations. During a run, the RoboCommand system will transmit a report of a moving surface object within the operational area and the domain(s) impacted.

All uncrewed systems operating in the impacted domains must avoid approaching within 10m of this object (as visible on the tracking display) based on its current and projected travel. The RoboCommand message will include (at a minimum) GPS location, heading, speed, and system type.

Capabilities Demonstrated:

- The uncrewed system of systems must adapt their mission execution to account for the virtual moving object reported in the area.

3.4 Communications Protocol

This section explains how a team's Operator Control Station (OCS) connects to and communicates with RoboCommand during RobotX 2026.

RoboCommand exchanges course information, run-control commands, vehicle status, and task reports with the OCS. The OCS is responsible for exchanging the relevant information with the team's vehicles through the team's own communications system.

> **Only the OCS connects to RoboCommand.** Team vehicles must not connect directly to the RoboCommand network or MQTT broker.

3.4.1 Communications Architecture

The team communications path is:

```
Team vehicles ⇄ Team OCS ⇄ RoboCommand
```

- The **OCS** is the team's network endpoint and MQTT client.
- The **OCS publishes** requests and vehicle-attributed reports to RoboCommand.
- The **OCS subscribes** to course configuration and team-addressed commands from RoboCommand.
- A `vehicle_id` identifies the vehicle represented by a message; it does not identify a separate RoboCommand network connection.
- The team determines how its OCS communicates with its USV, UUV, UAV, and other systems.
- Additional OCS interfaces and all OCS-to-vehicle networking are outside the scope of this guide.

3.4.2 Competition and Demonstration Networks

RobotX provides four isolated competition course networks: Alpha, Bravo, Charlie, and Delta. Each course has a dedicated RoboCommand computer.

Only one team is active on a course at a time. That team's OCS is the only team system permitted to connect to the course's RoboCommand network.

Team Village provides a separate Demo RoboCommand system for integration testing. Multiple teams may connect to the demo environment at the same time. Teams must therefore use their assigned `team_id` in every topic and message so their traffic remains distinguishable.

Location	Team network	OCS address assignment	RoboCommand address
Course Alpha	`192.168.65.0/24`	DHCP: `192.168.65.15–192.168.65.254`	`192.168.65.2`
Course Bravo	`192.168.66.0/24`	DHCP: `192.168.66.15–192.168.66.254`	`192.168.66.2`
Course Charlie	`192.168.67.0/24`	DHCP: `192.168.67.15–192.168.67.254`	`192.168.67.2`
Course Delta	`192.168.68.0/24`	DHCP: `192.168.68.15–192.168.68.254`	`192.168.68.2`
Team Village demo	Demo network, VLAN 70	DHCP	Provided with the demo connection instructions

Course networks carry course data only and do not provide Internet access.

3.4.3 Configure the OCS Network Interface

The Ethernet interface connected to the RoboCommand network must be configured as a DHCP client.

1. Select the physical Ethernet interface that will connect to the provided RJ-45 cable.
2. Enable automatic IPv4 address assignment using DHCP.
3. Enable automatic gateway and DNS assignment.
4. Disable Internet-connection sharing, network bridging, and DHCP-server functions on that interface.
5. Connect the provided RJ-45 cable.
6. Confirm that the OCS receives an address in the subnet for the assigned course.
7. Confirm that the assigned default gateway is the course RoboCommand address shown in the table above.
8. Start the team's RoboCommand communications application on the OCS.

> ⚠ Do not configure a static course address. DHCP allows the same OCS configuration to operate on Alpha, Bravo, Charlie, Delta, and the Team Village demo network.

An OCS may use other interfaces for vehicle links or team systems. Their configuration is the team's responsibility and must not route, bridge, or expose those networks through the RoboCommand-facing interface.

3.4.4 MQTT and Protocol Buffers

The message definitions and test server are available in the RoboCommand Repo ↗

RoboCommand messages are transported using MQTT. Each MQTT payload is a binary message serialized using Protocol Buffers (protobuf).

Protocol Buffers provide a language-neutral message definition:

1. RoboNation supplies versioned `.proto` schema files.
2. The team runs the Protocol Buffers compiler, `protoc`, or uses the supplied generated classes.
3. The OCS application creates a message using the generated class.
4. The application serializes the message to bytes.
5. The OCS publishes those bytes to the required MQTT topic.
6. For received messages, the OCS selects the correct generated class and parses the MQTT payload.

The current repository contains schemas for:

- Common position, robot-state, and task-tier values
- RobotX task, vehicle-type, beacon, pipeline, resource-color, and flight-phase values
- Course configuration
- Team requests
- RoboCommand commands
- Vehicle-attributed status and task reports

> Use the competition-provided schema release without changing package names, field numbers, enum values, or MQTT topic names. Protocol Buffer field numbers are part of the wire format.

3.4.5 MQTT Connection

The OCS connects to the RoboCommand MQTT broker using the address for its current course. The current RobotX communications package uses MQTT over TCP port `1883`.

The team should maintain one OCS connection and use it for all required subscriptions and publications. If the connection is interrupted, the OCS should reconnect automatically and restore its subscriptions.

The team should publish no more than five(5) messages per second per system unless otherwise specified.

The OCS should not assume that it will retain the same DHCP address after moving to another course or reconnecting. The application should use the configured RoboCommand address rather than binding its logic to the OCS address.

3.4.6 MQTT Topics

All RobotX 2026 topics use the root:

```
robocommand/robotx
```

Purpose	MQTT topic	Direction
Course configuration	`robocommand/robotx/course`	RoboCommand → OCS
Vehicle-attributed report	`robocommand/robotx/<team_id>/<vehicle_id>/report`	OCS → RoboCommand
Team request	`robocommand/robotx/<team_id>/request`	OCS → RoboCommand
Team command	`robocommand/robotx/<team_id>/command`	RoboCommand → OCS

Replace:

- `<team_id>` with the team identifier assigned by RoboNation.
- `<vehicle_id>` with the unique identifier declared for the represented vehicle.

For example, a report attributed to vehicle `USV1` for team `RNRX` is published to:

```
robocommand/robotx/RNRX/USV1/report
```

The OCS should subscribe to:

```
robocommand/robotx/course
robocommand/robotx/<team_id>/command
```

The OCS must not subscribe to or act on another team's topic namespace.

3.4.7 Message Envelopes

RobotX messages use four top-level protobuf envelopes.

Envelope	Purpose	Publisher
`RxCourse`	Current course identifier, boundary, and pinger frequency	RoboCommand
`RxRequest`	Team-level requests, including `RunDeclaration`	OCS
`RxCommand`	Run start and Task 4 commands	RoboCommand
`RxReport`	Heartbeats and task reports attributed to a vehicle	OCS

`RxRequest`, `RxCommand`, and `RxReport` contain a `oneof body`. Only one body type is valid in each envelope instance.

Every published message must use the correct topic, envelope type, `team_id`, sequence number, timestamp, and—where applicable—`vehicle_id`.

3.4.8 Identifiers, Sequence Numbers, and Time

Team and vehicle identifiers

- Use the assigned `team_id` exactly as issued.
- Use stable, unique vehicle identifiers throughout a run.
- Include every participating vehicle ID in `RunDeclaration`.

- Use the same vehicle ID in the MQTT report topic and the `RxReport.vehicle_id` field.

Sequence numbers

- `RxRequest.seq` is a monotonically increasing team-request sequence.
- `RxCommand.seq` is maintained by RoboCommand for the addressed team.
- `RxReport.seq` is scoped per vehicle; each represented vehicle has its own increasing report sequence.
- Acknowledgments and confirmations must reference the sequence number specified by their message definitions.

Timestamps

Set `sent_at` to the time the OCS publishes the message. Use the protobuf `google.protobuf.Timestamp` type and keep the OCS clock synchronized.

3.4.9 Course Configuration

RoboCommand publishes `RxCourse` on:

```
robocommand/robotx/course
```

The message is retained by the MQTT broker. After the OCS subscribes, it should receive the current course configuration without waiting for a new publication.

`RxCourse` includes:

- `course_id`
- Acoustic pinger frequency in hertz
- Ordered latitude/longitude corners of the course boundary
- Publication timestamp

The first and last boundary points are the same, closing the polygon.

The OCS should validate the course identifier and configuration before beginning a run. The team determines how the OCS distributes relevant course information to its vehicles.

3.4.10 Pre-Run Declaration and Run Start

Before a run begins, the OCS publishes one `RxRequest` containing `RunDeclaration`.

The declaration identifies:

- Every vehicle participating in the run
- The tier attempted for Task 1
- The tier attempted for Task 2
- The tier attempted for Task 3
- The tier attempted for Task 4
- The UAV geofence polygon

Use `TIER_NONE` when the team is not attempting a task. Do not use `TIER_UNKNOWN` as a substitute for `TIER_NONE`.

The UAV geofence must be a closed polygon whose first and last points are identical. RoboCommand validates the geofence against the course boundary.

The normal start sequence is:

1. The OCS connects to the course RoboCommand broker.
2. The OCS subscribes to `RxCourse` and its team command topic.
3. The OCS receives and validates `RxCourse`.
4. The OCS publishes `RunDeclaration`.
5. The OCS publishes heartbeats for all declared vehicles.
6. Each declared vehicle's heartbeat reports `STATE_AUTO` when that vehicle is autonomous and ready.
7. RoboCommand publishes `RunStart` after the run-start conditions are satisfied.

8. The OCS verifies that `RunStart.declaration_seq` matches the declaration it sent.
9. The OCS records the assigned `run_id` and begins official run processing.

> All vehicles should position-hold after switching into Autonomous Mode. Only when the OCS receives and verifies the RunStart should any vehicle begin their run.

3.4.11 Heartbeats and Task State

The OCS publishes a separate `RxReport` heartbeat on behalf of each active vehicle at 2Hz

A heartbeat contains:

- Robot state: killed, manual, or autonomous
- Position
- Speed and heading
- Roll, pitch and altitude/depth (where applicable)
- Current task
- Vehicle type
- UAV flight phase where applicable

`Heartbeat.current_task` is the authoritative indication that a vehicle has begun or moved on from a task attempt:

- A transition into a task value begins that vehicle's task attempt.
- A transition to `TASK_NONE` signals the end of the task attempt and the transition to the next.
- `TASK_UNKNOWN` means unset and should not be used. It must not be interpreted as transitioning between tasks.

> Relevant telemetry from the heartbeat reports for UAVs will be relayed to Garuda Robotics to meet the Network Remote ID requirements in Singapore. It is critical that these messages are complete and reliable.

3.4.12 Task Reports and Commands

The OCS publishes task reports on behalf of the appropriate vehicle. Message requirements depend on the task and declared tier.

Task 1 — Safe Passage

`SafePassageReport` communicates the identified entry position, exit position, and detected buoy states. The report is attributed to the vehicle performing the reporting role. Send an updated report when new buoys are detected or the mapped buoy state changes.

Task 2 — Infrastructure Survey and Repair

`PipelineSurveyReport` communicates the active buoy position and the ordered condition of pipeline segments.

At Advanced and Disruptive tiers, `ResourceDeliveryRequest` identifies the task, requested resource color, and delivery-circle color. The detecting vehicle reports the request, and the UAV echoes the request when delivery begins.

Task 3 — Coordinated Logistics

`DockingReport` identifies successful docking in a bay. `FirefightingReport` signals a successful water delivery attempt to the indicated window (as perceived by the vehicle).

At Advanced and Disruptive tiers, `ResourceDeliveryRequest` is used for the delivery requirement and identifies Task 3 in its `task` field.

Task 4 — Dynamic Incident Response

Task 4 uses RoboCommand commands and vehicle-attributed responses routed through the OCS.

- **Core:** `AssistanceRequest` → `IncidentAck` → `ReadinessReport` → `ReadinessConfirm`
- **Advanced:** `KeepOutZone` → `IncidentAck` → `AllClear` → `IncidentAck`
- **Disruptive:** `MovingObjectAlert` identifies the moving object and affected vehicle types. It has no separate acknowledgment or all-clear message.

The OCS must preserve the command and report sequence references required by these response chains.

3.4.13 Application Behavior

Teams should design their OCS communications application to:

- Connect automatically after receiving a DHCP configuration
- Restore subscriptions after reconnecting
- Reject malformed or unexpected protobuf payloads without stopping the application
- Confirm that the topic team and vehicle identifiers match the decoded message
- Maintain independent report sequence counters for each vehicle
- Prevent messages from a previous run from being reused in a new run
- Log connection changes, publications, received commands, sequence numbers, and parsing errors
- Display the current RoboCommand connection state to the operator
- Make command receipt and response state visible to the operator
- Avoid blocking vehicle control if logging or visualization fails

3.4.14 Team Village Testing

Use the Demo RoboCommand system to test the same OCS application and protobuf classes that will be used on the competition courses.

Recommended test sequence:

1. Configure the RoboCommand-facing interface for DHCP.

2. Connect to the Team Village demo network.
3. Confirm that the OCS receives a valid demo-network address.
4. Connect the MQTT client using the demo connection information.
5. Subscribe to the course and team command topics.
6. Confirm that `RxCourse` can be received and decoded.
7. Publish a `RunDeclaration` using the assigned `team_id`.
8. Publish one heartbeat for each declared vehicle.
9. Verify that RoboCommand identifies the team and each represented vehicle correctly.
10. Exercise the task reports and Task 4 command-response chains supported by the demo system.
11. Disconnect and reconnect to confirm automatic recovery.

Multiple teams may be connected in Team Village. Never use another team's identifier for testing.

3.4.15 Troubleshooting

The OCS does not receive an IP address

- Confirm that the correct Ethernet interface is connected.
- Confirm that IPv4 is set to DHCP.
- Disable any DHCP server, bridge, or Internet-sharing function on that interface.
- Replace the cable or ask course staff to verify the connection.

The OCS receives an address but cannot connect to RoboCommand

- Confirm that the address belongs to the assigned course subnet.
- Confirm that the default gateway matches the course RoboCommand address.
- Confirm that the application is using the RoboCommand address for the current course.
- Confirm that local firewall rules allow the configured MQTT connection.

- Do not use Internet connectivity as a network test; course networks intentionally provide no Internet access.

RoboCommand does not recognize a publication

- Confirm the MQTT topic spelling and capitalization.
- Confirm that the topic contains the assigned `team_id`.
- For a report, confirm that the topic `vehicle_id` matches `RxReport.vehicle_id`.
- Confirm that the correct top-level protobuf envelope was serialized.
- Confirm that exactly one `oneof body` field is populated.
- Confirm that the application is using the competition-approved schema version.

A command is received but the response is rejected

- Confirm that the response references the correct command sequence.
- Confirm that the response is attributed to the intended vehicle.
- For `ReadinessConfirm`, use both the report sequence and vehicle ID to identify the readiness report.
- Confirm that sequence counters were not reset during the active run.

3.4.16 Pre-Run Checklist

- [ ] RoboCommand-facing OCS interface is configured for DHCP.
- [ ] Network bridging and Internet sharing are disabled.
- [ ] The OCS received an address in the assigned course subnet.
- [ ] The default gateway matches the course RoboCommand address.
- [ ] The MQTT client is connected.
- [ ] The OCS subscribed to `robocommand/robotx/course`.
- [ ] The OCS subscribed to `robocommand/robotx/<team_id>/command`.
- [ ] The retained `RxCourse` message was received and decoded.
- [ ] The course identifier and boundary were checked.
- [ ] The application is using the approved protobuf schema release.

- [ ] The assigned `team_id` is configured correctly.
- [ ] All participating vehicle IDs are unique and configured consistently.
- [ ] Independent report sequence counters are operating for every vehicle.
- [ ] The UAV geofence is closed and within the received course boundary.
- [ ] The intended tier for every task is correct in `RunDeclaration`.
- [ ] Operators can see the RoboCommand connection and command-response status.
- [ ] Logging is enabled for the run.

3.4.17 Scope Boundary

This protocol governs communication between the team OCS and RoboCommand. It does not prescribe:

- Vehicle-to-OCS radios or network protocols
- The number or configuration of other OCS network interfaces
- Internal team message formats
- Vehicle control architecture
- How the OCS distributes course data or RoboCommand commands internally

Regardless of the team's internal design, all required RoboCommand messages must enter and leave the team system through the connected OCS.

Team ID List

Team ID	School/Organization	Team Name
ADEL	Adelaide University	RoboSeals
ASTA	Advancing Science Technology and Art	Team Inspiration
BNGU	Bangladesh University of Engineering and Technology	Team Black Pearl
ERAU	Embry-Riddle Aeronautical University	Team Minion
FLIN	Flinders University	Flinders Robotics Team
FLAU	Florida Atlantic University	Team Owltonomous
GTEC	Georgia Institute of Technology	Marine Robotics Group
ITSN	INSTITUT TEKNOLOGI SEPULUH NOPEMBER	Barunastra ITS
KMOU	Korea Maritime & Ocean University	KMOU MACRO
KYUT	Kyushu Institute of Technology	OUXT-Polaris
LSSU	Lake Superior State University	Team AMORE
NYTU1	Nanyang Technological University	Archimedes Autonomous Vehicles
NYTU2	Nanyang Technological University	Mecatron
NUSB	National University of Singapore	Bumblebee Autonomous Systems
PUCC	Pontificia Universidad Católica de Chile	Caleuche
PUCP	Pontificia Universidad Católica del Perú	Tumi Robotics

REPP	Republic Polytechnic	circle
SGIT	Singapore Institute of Technology	OptiPrime
SUTD	Singapore University of Technology and Design	MARVL
SRMU	SRM University	SRM_ASV
STUP	STEAMUP ECUADOR	STEAMUPEC
TONG	Tongji University	Tongji MRL
UFLO	University of Florida	Machine Intelligence Lab
ULLY	University of Louisiana at Lafayette	Bayou Bot Krewe
UNEW	University of Newcastle Australia	NU Marine

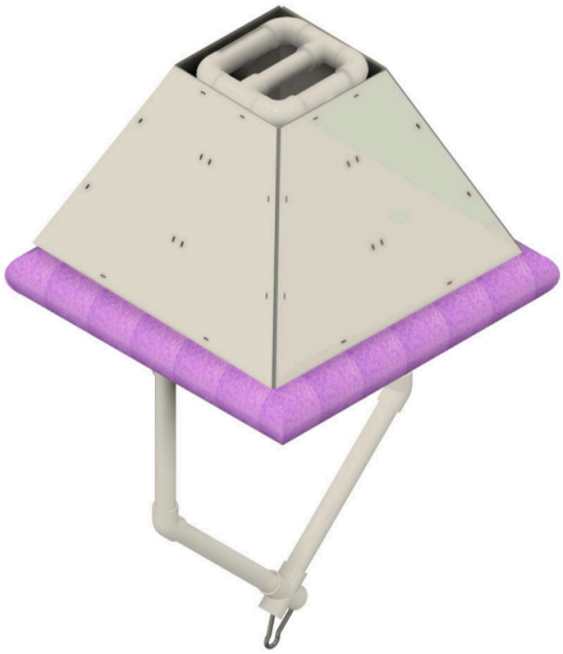
3.5 Task Build Specifications

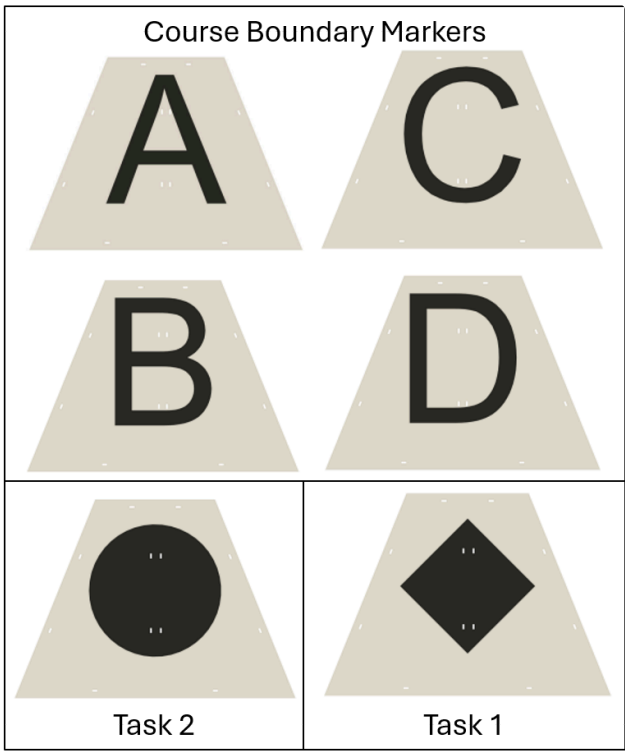
Details of task hardware for RobotX

This section contains high-level information about the specifications for the task elements. Detailed build guides can be found here. ↗

3.5.1 RoboBuoys

RoboNation has designed custom buoys to provide visual indication of course boundaries, as well as on Task 1 to support the Light Beacons and in Task 2 to support the Color Indicator and Acoustic Pingers.

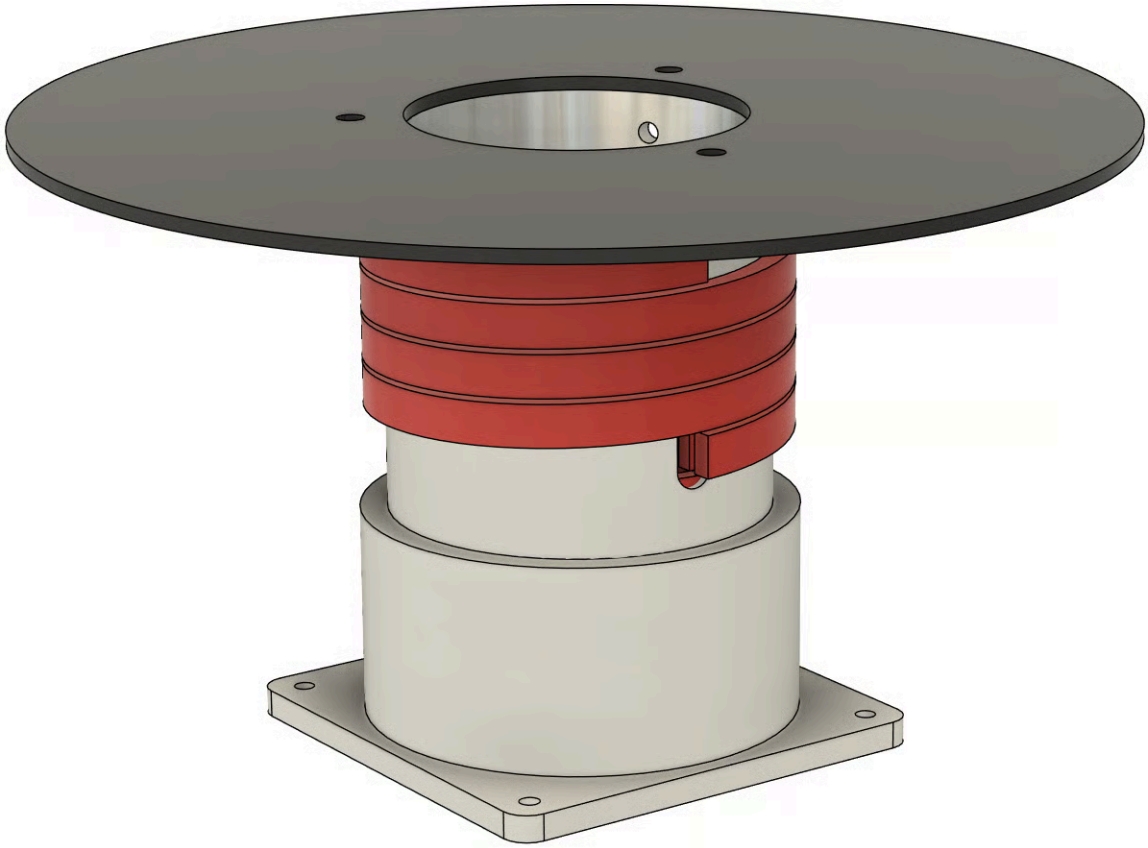




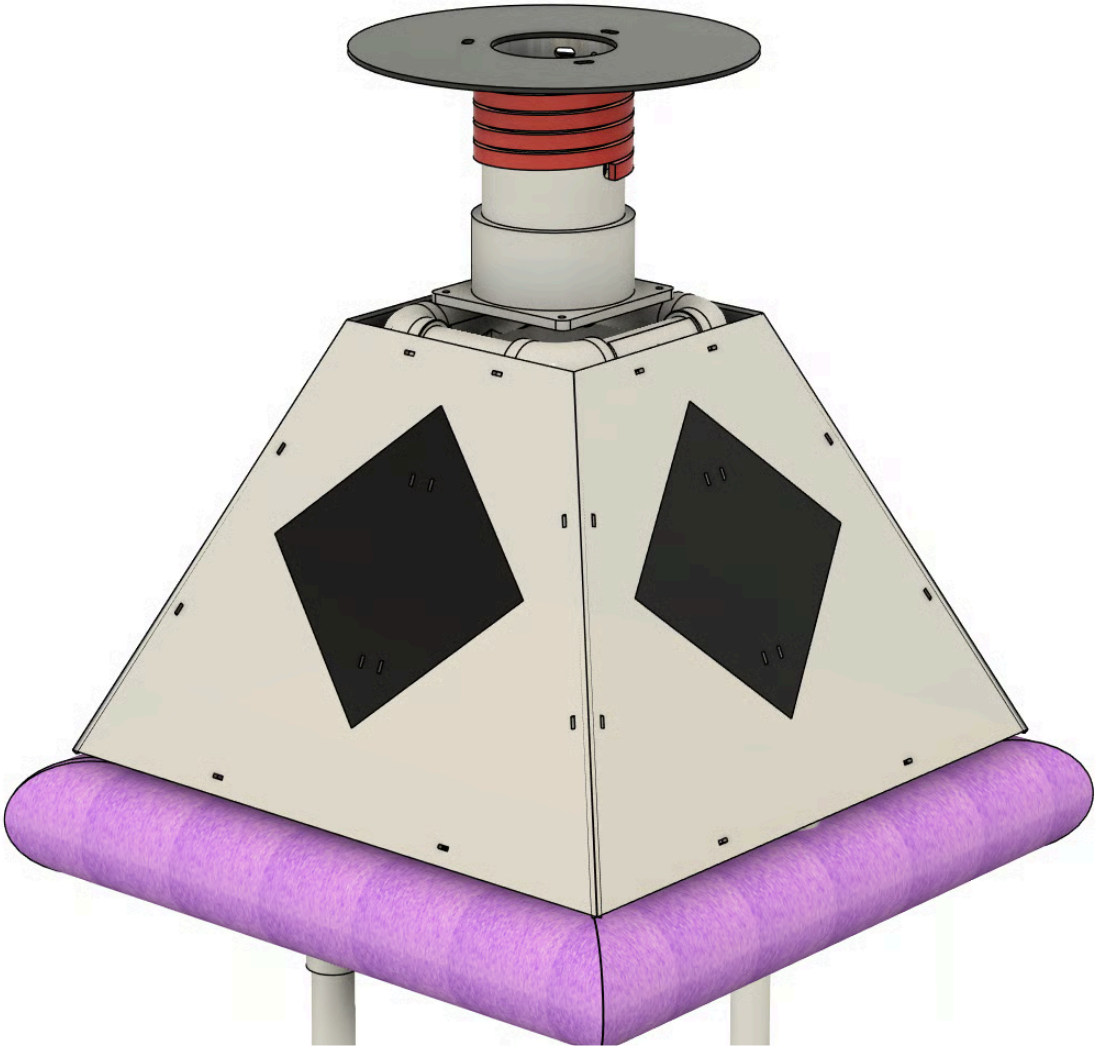
Example RoboBuoy and side panel images

3.5.2 Light Beacons

The Light Beacons used in Task 1 consist of RGB LEDs wrapped around the outside of a 3.5" OD PVC pipe for the side-facing light beacon and wrapped inside with a reflector cone for the upward-facing light beacon. These will be mounted on top of standard RoboBuoys.



Rendering of Light Beacon

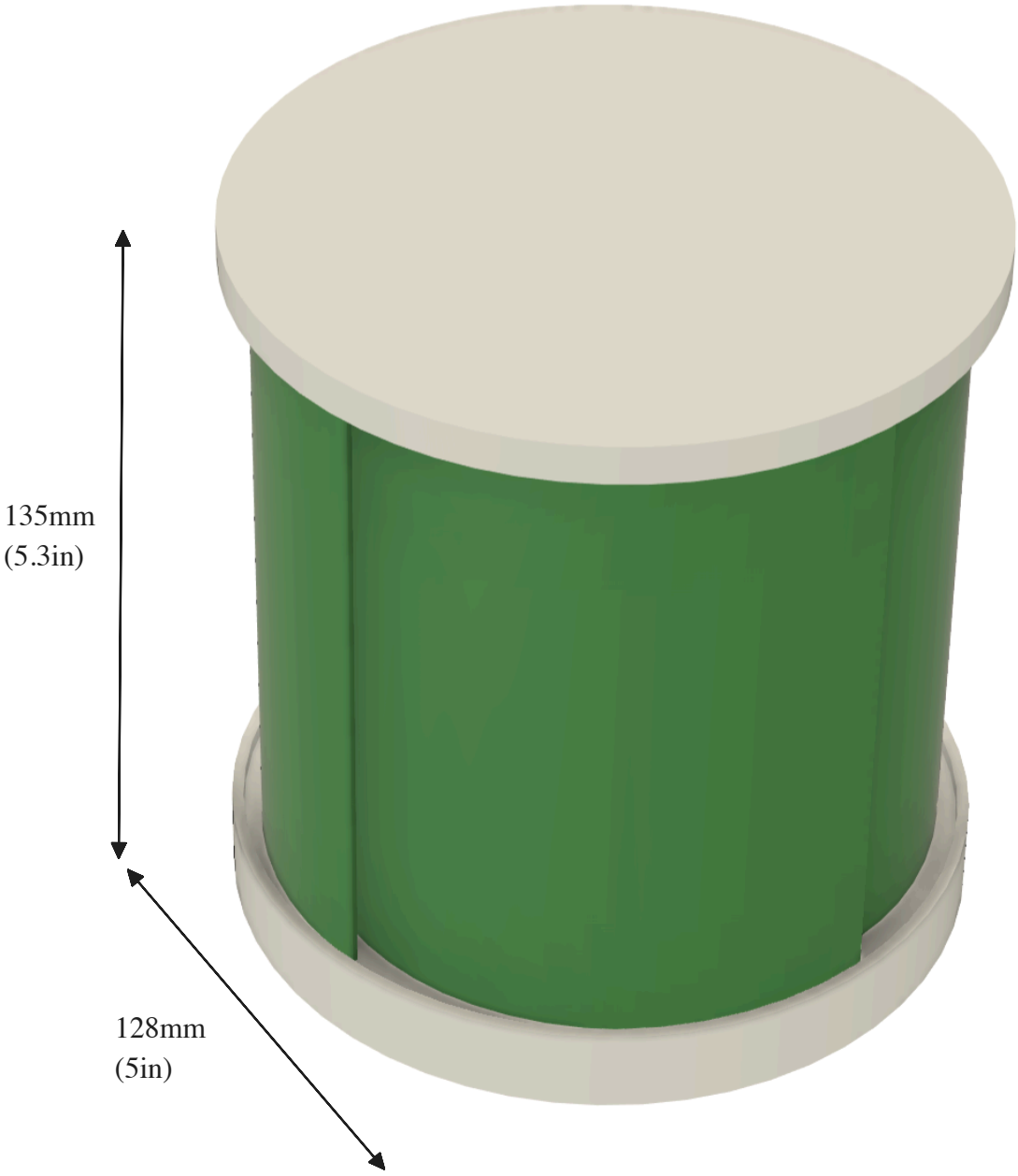


Light Beacon mounted on top of RoboBuoy

3.5.3 Color Indicators

Custom color indicators will be used in Task 2 and Task 3 to indicate the start point for the underwater survey and the safe docking bay, respectively.

These color indicators are 3D-printed cylinders that are actuated to change the color between **RED** and **GREEN**. This single colored indicator is visible 360° radially on a horizontal plane only. A single Color Indicator will be mounted atop each RoboBuoy for Task 2 and at the base of the Docking Bay Structure for Task 3.



Color Indicator Render

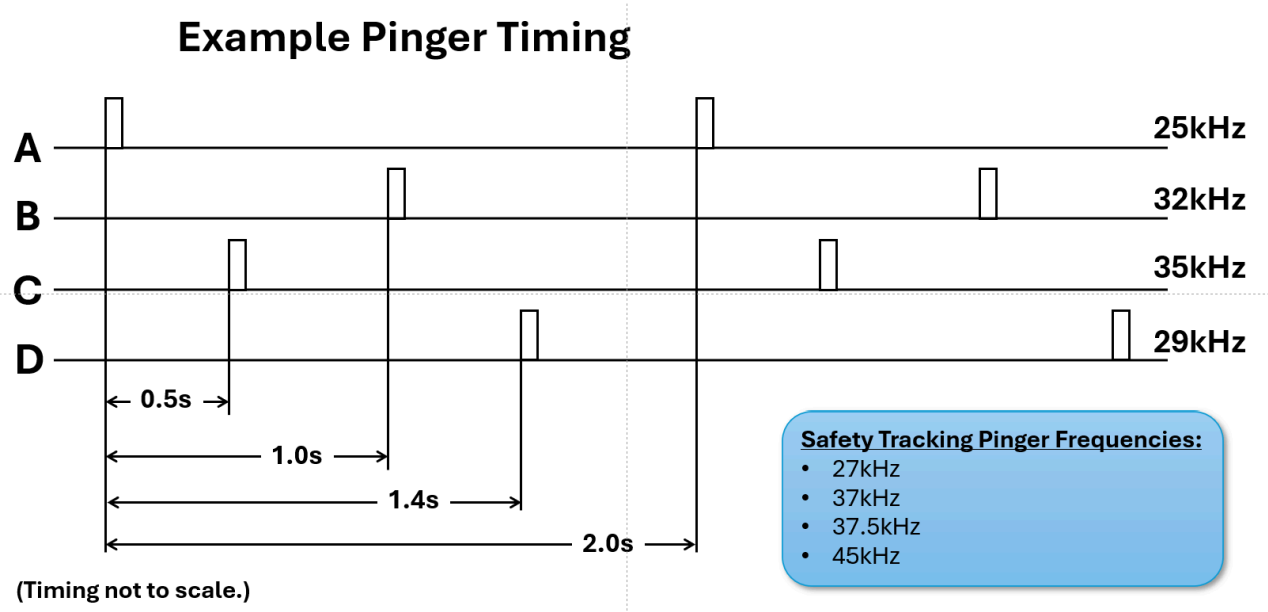
3.5.4 Acoustic Pingers

Pingers will be used as outlined in Task 2. The frequency and pulse rate will be made available to teams on site, and may change daily. The full range of frequencies (25 – 40 kHz) and pulse rate (0.5 Hz to 2 Hz) can be used throughout the competition.

At any time during the competition, multiple pingers are active, with at least one in each course. To mitigate interference issues, each active pinger is separated by at least 2 kHz in frequency. The pingers are controlled such that they send out a pulse at time intervals in sequence with the other courses.

Each course will have a set of pingers, with only one active pinger active at a time. Each course will use a different frequency for the set of pingers. The ping for each course deconflicts with the pings in other courses, such that only one pinger pings at a time.

> For example: the two pingers in Course A both operate at the same frequency, and the two pingers in Course B both operate at the same frequency, but differ from the frequency used in Course A pingers.



Example Pinger Timing Across Courses

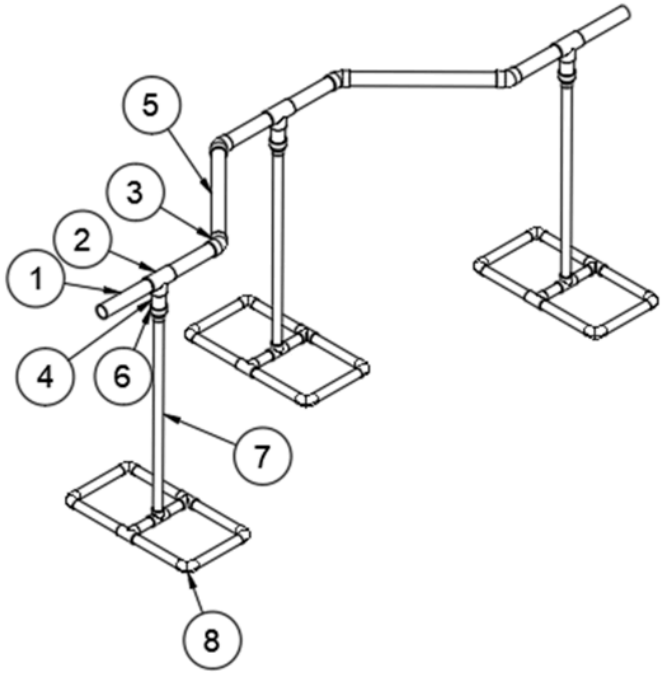
Example pinger specifications can be found at: robonation.org/benthos-locator ↗

.

> ***NOTE:*** *These pingers are no longer in production and are unavailable for purchase. RoboNation is working to replace the pinger system and will release more information.*

3.5.5 Underwater Pipeline

Task 2 requires a UUV to survey underwater pipeline to look for areas that may need repair. The pipeline is made using five (5) straight sections of PVC Pipe, using 2″ - 3″ diameter pipe and pipe fittings. Each segment will be connected together via PVC elbows, but each segment will not necessarily be planar with other segments. The pipeline will be suspended from the seafloor on a rigid structure, notionally similar to what is shown in the figure below.



Item	Qty	Description
1	6	3" Sch 40 PVC Pipe x 17.7" (450mm) Long
2	3	3" Sch 40 PVC Tee
3	4	3" Sch 40 45 Deg Elbow
4	3	3" Sch 40 PVC Pipe x 7.9" (200mm) Long
5	2	3" Sch 40 PVC Pipe x 39.4" (1000mm) Long
6	3	3" to 2" Sch 40 PVC Straight Reducing Coupler
7	3	2" Sch 40 PVC Pipe 50.1" (1500mm) Long
8	3	Pipeline - 2" Sch 40 PVC Base Assembly

NOTE: Pipelines were designed using US Sch 40 PVC pipe. US Sch 40 pipe typically has the following specifications:

Pipe Size	Outer Diameter (OD)	Inner Diameter (ID)
2" Pipe	2.375" OD	2.047" Average ID
3" Pipe	3.500"OD	3.042" Average ID

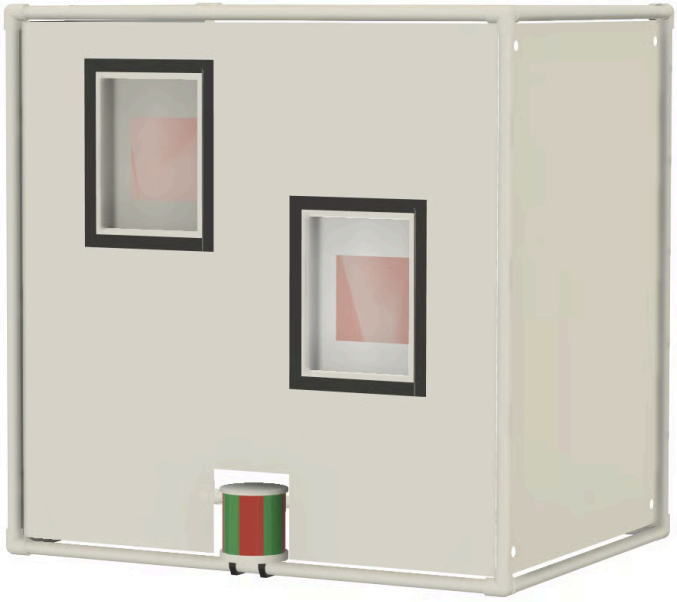
3.5.6 Underwater Magnetically Activated Light

Light Nodes will be attached to the underwater pipeline to indicate damaged or working sections of the pipe for the UUV to survey and "repair" as described in Section 3.3.3.

Render of Underwater Underwater Magnetically Activated Light

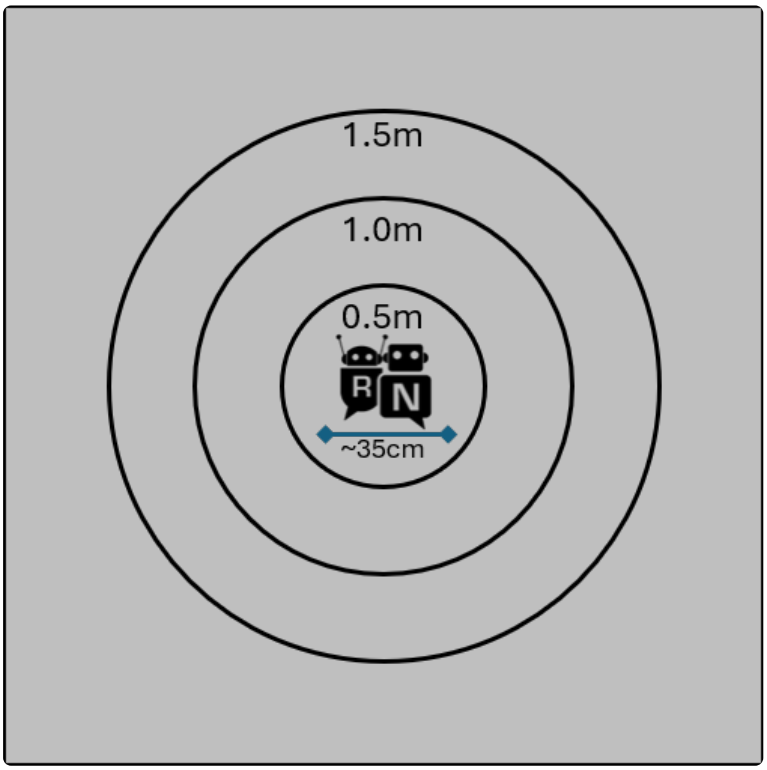
3.5.7 Docking Bay Structure

Each docking bay in Task 3 contains a structure representing a building with two windows. The USV will interact with this structure when it has successfully docked in the correct bay.



3.5.8 UAV Launch and Landing Platform

Each course will have a dedicated UAV launch and landing platform. These platforms will be 2m x 2m squares painted with a grey background, a RoboNation logo centered within the square, and three black concentric circles around the logo.



Section 4: Scoring & Awards

This section includes a detailed overview of the competition scoring.

Scores are calculated by the judges' evaluation and observation. All decisions of the judges are final.

4.1 Design Documentation Scoring

Design documentation must be submitted in accordance with the requirements outlined in Section 2: Design Documentation and the deadlines listed in Section 1.5: Competition Schedule and Timeline, to be eligible for full points. After the competition, the judges will issue overall standings in the design documentation portion of the competition.

Design Documentation	Potential Points
Technical Design Report	200
Website	180
Team Introduction Video	120
Design Presentation	180
System Assessment	180
Total Potential Points	**860**

4.2 Autonomy Challenge Scoring

The Autonomy Challenge consists of three (3) parts: Practice, Scoring, Finals. During the first days of the competition, teams will be able to practice and work on the in-water courses. After the first few days, judges will begin scoring the systems based on the performance criteria listed below.

Upon completion of the Scoring Round, the judges will announce the top-scoring teams who will progress to the Finals Round. The judges have the discretion to select the number of teams advancing to the Finals Round.

After the competition, RoboNation will issue Autonomy Challenge overall standings. Any team accepted into the Finals Round will be ranked ahead of all teams that did not participate in the Finals Round.

During the Scoring Round, judges will observe and record performance of the System of Systems in water and using the RoboCommand Course Display.

Cross-Cutting Capabilities

There are several capabilities that span the scope of the individual Mission Tasks, and points are assigned independently from individual task performance.

Action Required or Observed	Points Possible
SoS must successfully start a run.	25
UAV must autonomously take off and enter the course boundaries (awarded only once per run)	25
UAV must autonomously leave the course boundaries and land on the correct landing platform (awarded only once per run).	25
Uncrewed system strikes any course element.	-10
Maximum Possible points for Cross-cutting Challenges	**75**

Safe Passage

The tables below contain the point breakdowns for the Safe Passage challenge at the various tiers of difficulty. If a UUV is used for this challenge, it is scored as a USV. Only one vehicle can earn points on this challenge per scoring attempt.

Core Tier

Action Required or Observed	Points Possible
SoS activates challenge by sending successful heartbeat messages (once per run).	25
USV reports correct ENTRY buoy.	10
USV reports correct EXIT buoy.	10
USV circles correct ENTRY buoy in clockwise direction.	25
USV circles correct EXIT buoy in counter-clockwise direction.	25
USV reports correct locations for detected **FLASHING GREEN** buoys. Points are awarded per correctly reported buoy (up to 4).	40
USV reports correct locations for detected **FLASHING RED** buoys. Points are awarded per correctly reported buoy (up to 4).	40
USV must successfully navigate the buoy field after correctly circling the ENTRY buoy, passing with the **GREEN** buoys to PORT of the vessel.	25
USV must successfully navigate the buoy field after correctly circling the ENTRY buoy, passing with the **RED** buoys to STARBOARD of the vessel.	25
USV is granted a bonus for correctly completing ALL aspects of the challenge successfully (reporting all buoys and completing all behaviors).	100
Maximum Possible Points for Safe Passage at the Core Tier	**325**

Advanced Tier

At the Advanced Tier the USV and UAV work together to complete the challenges. The USV behaviors are similar to those at the Core Tier, but point rewards are higher because the uncrewed systems must collaborate to complete the tasks.

Action Required or Observed	Points Possible
SoS activates challenge by sending successful heartbeat messages (once per run).	25
UAV reports correct ENTRY buoy.	25
UAV reports correct EXIT buoy.	25
USV circles correct ENTRY buoy in clockwise direction.	100
USV circles correct EXIT buoy in counter-clockwise direction.	100
UAV reports correct locations and states for detected buoys. Points are awarded per correctly reported buoy (up to 8).	200
After correctly circling the ENTRY buoy, if the USV successfully passes ANY of the **GREEN** buoys to PORT of the vessel it will be awarded partial credit for attempting the challenge.	25
If the USV successfully navigates the buoy field after correctly circling the ENTRY buoy, passing **ALL GREEN** buoys to PORT of the vessel, it is awarded an additional points.	100
After correctly circling the ENTRY buoy, if the USV successfully passes ANY of the **RED** buoys to STARBOARD of the vessel it will be awarded partial credit for attempting the challenge.	25
If the USV successfully navigates the buoy field after correctly circling the ENTRY buoy, passing **ALL RED** buoys to STARBOARD of the vessel, it is awarded an additional points.	100

The SoS is granted a bonus for correctly completing ALL aspects of the challenge successfully (reporting all buoys and completing all behaviors).	200
Maximum Possible Points for Safe Passage at the Advanced Tier	**925**

Disruptive Tier

The Disruptive Tier requires the SoS to complete the Advanced Tier tasking, as well as to detect and respond to changes during the attempt. The points at this tier are identical to the Advanced Tier, with the addition of an extra bonus for full completion of the challenge.

Action Required or Observed	Points Possible
Complete ALL Advanced Tier Tasks	925
UAV is awarded points for each correctly reported buoy state change (up to 2).	100
The SoS is granted an additional bonus for correctly completing ALL aspects of the challenge successfully AND adapting to changes in RED/GREEN buoys.	200
Maximum Possible Points for Safe Passage at the Disruptive Tier	**1225**

Infrastructure Survey and Repair

The tables below contain the point breakdowns for the Infrastructure Survey and Repair challenge at the various tiers of difficulty. If a UUV is used for this challenge, it is scored as a USV. Only one vehicle can earn points on this challenge per scoring attempt.

Core Tier

The Core Tier can be completed with only a UUV.

Action Required or Observed	Points Possible
SoS activates challenge by sending successful heartbeat messages (once per run).	25
The SoS must report the correct starting point for the survey, indicated by the buoy with the GREEN color indicator and active acoustic pinger.	25
UUV must survey the pipeline and report the light sequence in the CORRECT order.	150
The UUV must demonstrate the ability to change the color of the "damaged" segment from RED to GREEN.	250
Maximum Possible Points for Infrastructure Survey and Repair at the Core Tier	**450**

Advanced Tier

The Advanced Tier requires collaboration between multiple uncrewed systems.

Action Required or Observed	Points Possible
Complete all parts of the Core Tier	450
The UUV is awarded points if it reports the CORRECT resource delivery location AFTER completing the pipeline repair.	25
The UAV must demonstrate receipt of tasking via Heartbeat message indicating CORRECT delivery location.	25
The UAV earns partial credit for successfully delivering a resource canister to ANY colored circle.	50
The UAV earns additional points for successfully delivering a resource canister to the CORRECT colored circle.	150
Maximum Possible Points for Infrastructure Survey and Repair at the Advanced Tier	**700**

Disruptive Tier

In addition to collaboration between two uncrewed systems, the UAV must also locate and retrieve the correct resource to successfully complete the challenge at the Disruptive Tier.

Action Required or Observed	Points Possible
Complete all parts of the Core Tier.	450
The UUV is awarded points if it reports the CORRECT resource color request AFTER completing the pipeline repair.	25
The UUV is awarded points if it reports the CORRECT resource delivery location AFTER completing the pipeline repair.	25
The UAV must demonstrate receipt of tasking via Heartbeat message indicating CORRECT resource request color.	25
The UAV must demonstrate receipt of tasking via Heartbeat message indicating CORRECT delivery location.	25
The UAV earns partial credit for successfully retrieving ANY COLOR resource canister.	50
The UAV earns additional points for successfully retrieving the CORRECT color resource canister.	100
The UAV earns partial credit for successfully delivering a resource canister to ANY colored circle on a different UAV delivery platform from which it retrieved the canister.	50
The UAV earns additional points for successfully delivering the CORRECT color resource canister to the CORRECT colored circle on a different UAV delivery platform from which it retrieved the canister.	300
Maximum Possible Points for Infrastructure Survey and Repair at the Disruptive Tier	**1050**

Coordinated Logistics

Core Tier

The Core Tier of the Coordinated Logistics task requires only an uncrewed system operating on the water surface. If a UUV is used for this challenge, it is scored as a USV. Only one vehicle can earn points on this challenge per scoring attempt.

Action Required or Observed	Points Possible
SoS activates challenge by sending successful heartbeat messages (once per run).	25
The USV earns partial credit for successfully docking in any one of the docking bays as determined by the judges.	50
The USV earns additional points if the bay in which it docked was the correct one as identified by the **GREEN** color indicator.	100
The USV is awarded points for reporting it has successfully docked. These points are only awarded if the USV has actually docked in the reported bay.	25
The USUV must spray water into the RED window until the light changes to GREEN.	150
Maximum Possible Points for Coordinated Logistics at the Core Tier	**350**

Advanced Tier

The Advanced Tier requires collaboration between multiple uncrewed systems.

Action Required or Observed	Points Possible
Complete all parts of the Core Tier.	350
The USV is awarded points if it reports the CORRECT resource delivery location AFTER completing the firefighting task.	25
The UAV must demonstrate receipt of tasking via Heartbeat message indicating CORRECT delivery location.	25
The UAV earns partial credit for successfully delivering a resource canister to ANY colored circle.	50
The UAV earns additional points for successfully delivering a resource canister to the CORRECT colored circle.	150
Maximum Possible Points for Coordinated Logistics at the Advanced Tier	**600**

Disruptive Tier

In addition to collaboration between two uncrewed systems, the UAV must also locate and retrieve the correct resource to successfully complete the challenge at the Disruptive Tier.

Action Required or Observed	Points Possible
Complete all parts of the Core Tier.	350
The USV is awarded points if it reports the CORRECT resource color request AFTER completing the firefighting task.	25
The USV is awarded points if it reports the CORRECT resource delivery location AFTER completing the firefighting task.	25
The UAV must demonstrate receipt of tasking via Heartbeat message indicating CORRECT resource request color.	25
The UAV must demonstrate receipt of tasking via Heartbeat message indicating CORRECT delivery location.	25
The UAV earns partial credit for successfully retrieving ANY COLOR resource canister.	50
The UAV earns additional points for successfully retrieving the CORRECT color resource canister.	100
The UAV earns partial credit for successfully delivering a resource canister to ANY colored circle on a different UAV delivery platform from which it retrieved the canister.	50
The UAV earns additional points for successfully delivering the CORRECT color resource canister to the CORRECT colored circle on a different UAV delivery platform from which it retrieved the canister.	300
Maximum Possible Points for Coordinated Logistics at the Disruptive Tier	**950**

Dynamic Incident Response

Core Tier

The tasked system (USV or UAV) must interrupt its current tasking and transit to the tasked location as soon as safely possible. Judges will determine if the system is responding within a reasonable time. A UUV operating on the surface for the duration of this task will be treated as a USV.

Action Required or Observed	Points Possible
The CORRECT system as requested by RoboCommand must acknowledge receipt of the message and break off current tasking.	25
The CORRECT system must transit to the specified location, report arrival to RoboCommand and wait for the "all clear" message from RoboCommand.	100
The CORRECT system must resume mission tasking after receiving the ALL CLEAR message from RoboCommand. The system is not required to resume the exact same tasking; if the SoS determines another mission task is higher priority, the redirected system may proceed to another task.	25
Maximum Possible Points for Coordinated Logistics at the Core Tier	**150**

Advanced Tier

The static keep out area is virtual, so there will be no visible indicators on the water. The Course Display Judge will determine if the system crosses into the keep out area at any time during the run.

Action Required or Observed	Points Possible
The CORRECT system must respond to RoboCommand acknowledging receipt of the keep out zone.	25
The CORRECT system must complete the run without entering into the keep out area to earn points.	225
If the system enters into the keep out zone at any time during the run, the system is no longer eligible to earn points and will be penalized for entering the space.	-25
Maximum Possible Points for Coordinated Logistics at the Core Tier	**250**

Disruptive Tier

The moving keep out area is virtual, so there will be no visible indicators on the water. The Course Display Judge will determine if the system crosses into the keep out area at any time during the run.

Action Required or Observed	Points Possible
The CORRECT system must respond to RoboCommand acknowledging receipt of the keep out zone.	25
The CORRECT system must complete the run without entering into the keep out area to earn points.	425
If the system enters into the keep out zone at any time during the run, the system is no longer eligible to earn points and will be penalized for entering the space.	-25
Maximum Possible Points for Coordinated Logistics at the Core Tier	**450**

Summary

The table below summarizes the maximum points that a System of Systems can earn at each tier.

Task Name	Max COR	Max ADV	Max DIS
Cross-cutting	75	75	75
Safe Passage	325	925	1225
Infrastructure Survey and Repair	450	700	1050
Coordinated Logistics	350	600	950
Dynamic Incident Response	150	250	450
Design Documentation	860		
Maximum Possible Points	**2210**	**3410**	**4610**

4.3 Awards

Awards are provided in three categories: Autonomy Challenge standings, Design Documentation standings, and Special Awards. Teams must be present to collect their awards, and award money will be issued within 4-6 weeks after the competition.

4.3.1 Autonomy Challenge Ranking

Teams are awarded prize money reflective of their autonomy challenge ranking after scores are calculated. The first-place teams receive a RoboNation champion banner.

4.3.2 Design Documentation Ranking

Teams are awarded prize money reflective of their design documentation ranking after scores are calculated.

4.3.3 Special Awards

Throughout the competition, teams, judges, and staff are asked to be on the lookout for exemplary behavior from teams to acknowledge with special awards. A digital nomination form will be shared on-site to nominate teams for special awards. Nominations are collected at the following link, until the day before finals: robotx.org/award-nomination ↗.

Section 5: Rules & Requirements

This section includes detailed rules and requirements for the systems developed to enter into the competition.

5.1 Team Rules and Requirements

5.2 Safety Requirements

5.3 System Requirements

5.1 Team Rules and Requirements

1. **Code of Conduct:** All team members must abide by the RoboNation Code of Conduct while participating in the Competition. Failure to abide by this Code of Conduct at any point during the competition season may result in the disqualification of the team and/or participants from the Competition, components of the competition, the full competition, and/or future competitions. (Section 1.7: RoboNation Code of Conduct)
2. **System of Systems (SoS) Requirements:** Teams must build an SoS to compete that meets all safety and system requirements. (Section 5.2: Safety Requirements, Section 5.3: System Requirements).
3. **General System Requirements:** Teams that arrive at the competition failing to meet the system requirements will not be permitted on the course until the system is modified to meet all requirements. (Section 5.3: System Requirements)
4. **Uncrewed System Safety:** Prior to entering the Autonomy Challenge courses, teams must demonstrate the ability to operate their uncrewed systems safely. (Section 5.2: Safety Requirements)
5. **Team Composition:** Teams must be comprised of 75% or more full-time students. (Section 1.3: Eligibility)
    a. Team Lead: One student member of the team must be designated as the "team lead".
    b. The team lead, and only the team lead, will speak for the team during competition runs.
    c. The team must have at least one member on site who is conversationally fluent in English.
6. **Attendance:** Teams must have at least one representative present onsite at the competition venue during the competition hours (8:00 am – 6:00 pm) to be eligible for prizes. If teams cannot be onsite, they must notify RoboNation staff in a timely manner.
    a. **Orientation Attendance:** Teams must have at least one representative present for the team orientation. Teams who miss orientation will not be permitted to deploy their uncrewed systems.
    b. **Daily Team Meetings:** Team leads are required to attend daily team meetings. (Section 1.5.1: Daily Team Meeting)

7. **Competition Suspension:** The officials may suspend the competition at any time they deem that it is required (i.e. for safety or security reasons).
8. **Course Entry:** Unless otherwise specified, no team member is allowed to enter the course at any time (this includes wading, swimming and diving as well as floats, boats, etc.).
9. **System Recovery:**
    a. Competition officials are responsible for recovering disabled or out of control systems.
    b. Officials make all reasonable efforts to recover a lost system but cannot guarantee that they will be able to do so.
10. **Risk of Damage:** RoboNation is not responsible for any damage to a team's uncrewed systems as a consequence of participating in the competition. The judges, officials, hosts, and sponsors can take no responsibility for such damage or loss.
11. **Course Boundaries:** An Autonomy Challenge run will be terminated if an uncrewed system interferes with course elements or crosses outside of a course boundary. This includes entangling, dragging, pushing, or damaging course elements or landscape.
12. **Award Money:** Only the student component of each team is eligible for award money.
13. **Judge Decisions:** All decisions of the judges are final. (Section 4: Scoring & Awards)

5.2 Safety Requirements

Safe operations are a priority for RoboNation. All considerations to maintain safety for team members, volunteers, spectators, staff, and the surrounding environment must be made. These guidelines are the minimum requirements for all teams and their vehicles during the competition.

1. All Radio Frequency (RF) equipment must be operated within the rules and regulations of the host country. This includes, but is not limited to, frequency, transmitting power, antenna height, etc.
2. Uncrewed vehicle power systems must follow the safety rules and regulations of the host country as well as the team's home country.
3. RoboNation staff may suspend operations at any time for safety or security considerations. The staff is not required to advise the team prior to the decision to terminate the run attempt. In all matters of safety, the decisions of the RoboNation staff are final.

The sponsors and the host organization, their employees and agents, as well as the organizing committee, are in no way liable for any injury or damage caused to or by any vehicle.

5.2.1 Safety Inspections

Before operating in the water, each system **must pass a safety inspection**. This includes, but is not limited to:

1. A Safety Inspector completes a safety checklist, verifying successful operation of all safety features prior to deployment of each system.
2. Teams demonstrate compliance with all the requirements, to include identifying all actuators, and moving parts and their associated protection mechanisms (shrouds, etc.).
3. Verification of operation of system kill switch systems (remote and physical). This may be repeated each time a team enters the water.

Safety Checklist

- Vehicle Kill systems
  - Are they correctly placed for ease of access?
  - Do on-board Kill Switches function as required?
  - Does the Remote Kill Switch function as required?
  - Does the system revert to a killed condition when the remote transmitter loses link?
- Verify tele-operation link (remote control)
- Does the vehicle (USV and UUV only) have a clearly marked forward and/or aft tow line?
- Does the vehicle (USV and UUV only) have a clearly identified lift point?
- Do the USV and UUV have appropriate lifting harnesses?
- Is there a clearly marked area for safety illumination systems?
- Are there any safety issues related to the propellers?
- Any potentially dangerous protrusions?
- Is everything properly secured to the system?
- Is system properly protected from rain? (recommended)

5.2.2 Battery Safety Requirements

Teams are required to understand and follow battery safety best practices on the battery chemistry selected by the team. Lithium-ion chemistry batteries may become damaged and create a hazard if misused/abused, representing the greatest risk to people, facilities, and the environment. The following safety rules and requirements must be followed:

1. Teams will be required to attend a mandatory battery safety briefing prior to the start of the competition.
2. Teams must submit battery specifications, Material Safety Data Sheets (MSDS), and proper disposal procedures, sourced from the battery manufacturer for all batteries.

3. Teams must keep a hard copy of the battery safety documentation for all batteries in Team Village (onsite) at all times, for reference.
4. Teams using LiPo batteries must bring their own LiPo safe bag(s) adequate for the lithium batteries used. Team LiPo bag(s) must be available at both the competition site and at the hotel.
5. Li-Po (Lithium Polymer) battery packs must use cell level safety and balancing circuits.
6. Batteries must be shipped according to required shipping regulations based on battery weight/type. Note that most batteries are considered HAZMAT and must be shipped using HAZMAT regulations.
7. Each team must understand and follow their own country's regulations as well as those of the host nation.
8. All batteries must be stored, used, and maintained in accordance with manufacturer guidelines.
9. Teams are required to inspect their batteries daily for signs of swelling, heat, leaking, venting, burning or any other irregularities.
    a. Lithium batteries that become too warm during use or have become swollen or malformed must be removed from use and reported to RoboNation.
    b. Lithium batteries that do not hold a charge must be removed from use and reported to RoboNation.
10. A team member must be present at all times to monitor charging batteries.
11. At the competition site, if any of the above battery conditions are observed, students must immediately notify RoboNation and provide the battery specifications and safety information.
12. At the hotel, if a battery irregularity occurs at any time, students must notify RoboNation's Senior Events Manager, Cheri Koch immediately by phone at 850.642.0536 and provide the battery specifications and safety information.
13. Failed or failing Lithium-ion batteries must be handled in accordance with manufacturer's safety and disposal guidelines. In the absence of specific guidelines, batteries must be placed in a LiPo safe bag, which must then be placed in a bucket, covered with sand, and placed in a designated safety zone.
14. Teams are not permitted to change or replace batteries while the system is in the water.
15. All pressure vessels containing batteries must have pressure relief valves.

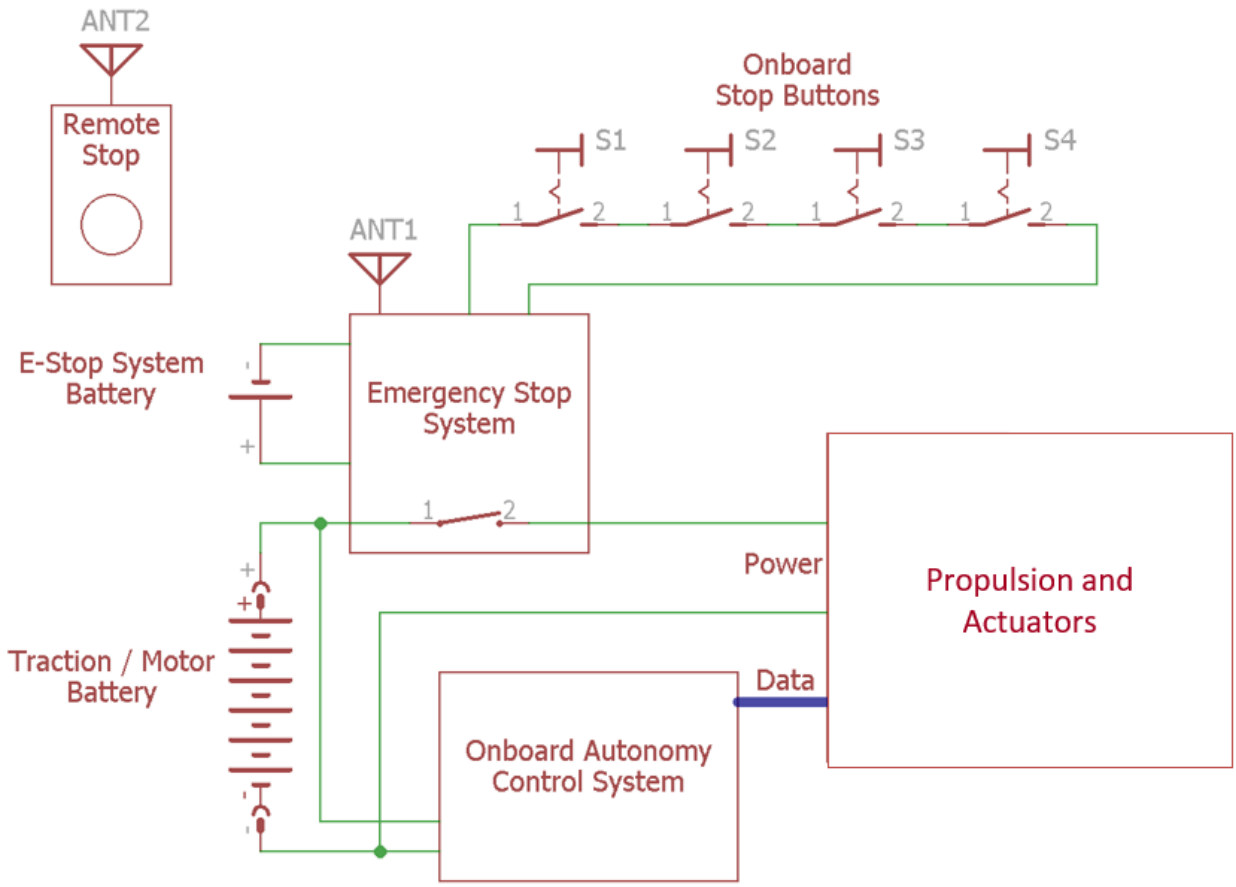
5.2.3 Kill Switch (Emergency Stop) Requirements

The USV and UUV must comply with the kill switch requirements detailed below. The systems must have two emergency stop systems, also known as ‘kill switches’ or ‘E-Stops’.

- On-Board: A hard-wired, on-board, emergency stop system.
- Off-Board: A wireless remote emergency stop, located off-board and on its own frequency and link.

Both systems must operate in a failsafe fashion (if any part of the system fails, the battery dies or is removed, the system must enter emergency stop) and upon activation of either system (on-board or off-board), the switch must instantaneously disconnect power from the vehicle’s propulsion systems and actuator units. An example of how to implement this is shown in the figure below. The system should be designed such that power to the propulsion systems and actuators cannot be restored until the emergency switch is reset.

The Technical team will conduct a detailed engineering and safety inspection of all safety systems, including tests to verify the proper operation of kill switches. This includes the removal of the remote kill switch battery to prove it fails safe. Teams must be prepared to discuss the design and implementation of their fail-safe systems in detail.



Sample Emergency Stop System

Onboard Emergency Stop System

All uncrewed surface and underwater systems must have an onboard emergency stop capable of being actuated by personnel from a support craft. For personnel safety, the switch may be triggered from a distance by a wooden or plastic pole/paddle. Keeping this in mind, teams should select rugged and reliable components for their safety system.

Onboard Emergency Stop Button

A kill switch should be installed in such a way that safety personnel, either from the support craft or in dive gear, can easily actuate the kill function. The engage/disengage switch should be red in color and function in such a way that it can be quickly actuated, but requires intentional effort to disengage. Examples of this are switches that have a ‘press to activate and twist/pull to reset’ feature or magnetic switches that engage (kill) when a device is removed and re-energize the system only when the device is placed back on the system.

This button, momentary contact switch or not, should cut power to the propulsion systems and actuators immediately on actuation. The propulsion systems and actuators must remain in a powered-down state until the course manager gives permission for the team to reinitialize the system.

Wireless Emergency Stop

All uncrewed systems must be equipped with a portable, handheld, Wireless Emergency Stop controller that operates while the system is not underwater.

- This controller must immediately (less than 2 seconds) disconnect power to the system's propulsion systems and actuators when activated or when power/battery is removed from the transmitter.
- This system must also meet the host country RF guidelines for frequency and transmit power.
- This system may NOT be a laptop, tablet, or phone.

5.3 System Requirements

5.3.1 USV Requirements

5.3.2 UUV Requirements

5.3.3 UAV Requirements

The following is a list of minimal requirements and design constraints for an uncrewed system to be permitted access to a course or practice area. **Teams that arrive at the competition failing to meet the vehicle requirements will not be permitted on any course or practice area until the vehicle is modified to meet all requirements.**

General System Requirements

1. RoboNation may disqualify any vehicle that they deem to pose an unreasonable safety hazard to teams, volunteers, staff, competition venue, or surrounding environment.
2. Any uncrewed system that does not meet the required specifications may be disqualified from use until the requirements are met.
3. If uncrewed systems become entangled with course elements, RoboNation will pause operations until the systems can be disentangled and the course restored to normal operations. RoboNation will take this time out of the team's remaining allotment of the impacted timeslot.
4. All deployed systems must be capable of operating as fully autonomous systems.
    a. Each vehicle must operate solely on its ability to sense and maneuver in the operating area using on-board resources or in collaboration with other systems **operating autonomously** in the competition area.
    b. While in autonomous mode, vehicles, may ONLY share sensor or control information with other systems operating in autonomous mode.
    c. The remote controllers and Operator Control Stations (OCS) may NOT be used when in autonomous mode.

5. All systems must be positively buoyant.
6. No materials may be released by any vehicle into the waters of the operating area.
7. All systems must meet the domain-specific requirements as described in the following sections.
8. All systems must be capable of interacting successfully with the RoboCommand system as defined in Section 3.4 Communications Protocol.
    a. All systems must **transmit heartbeat messages** as defined for each domain **at all times** when they are in the course areas.
    b. The System of Systems will only be given the Run Start permission when all declared systems for a run have transitioned to Autonomous Mode.
    c. Course elements will be activated only when a system is attempting the challenge. This is determined by the heartbeat message coming from the systems attempting a task, and when the SoS has been sent the *RunStart* message.

- Teams are permitted to use Real-Time Kinematic positioning systems during the RobotX 2026 as long as they operate within the following constraints:
    - Teams may not exceed the footprint of the waterside course operations tents at any time.
    - RTK transmitters may only be active (turned on) while a team is operating within their scheduled timeslot on a course.
    - All RF transmitters must be approved to be in compliance with Singapore IMDA rules and regulations as part of the RobotX Proof of Readiness process.

General Safety Requirements

1. All vehicles must have the ability to be killed such that they are safe to approach and handle without danger of thrusters or propellers being activated.
    a. Systems must have both a clearly marked on-board kill button as specified in the domain-specific sections, as well as the ability to be killed remotely by team operators.
    b. Specific requirements for USV, UUV, and UAV systems are described in the sections below.

2. All systems must have their propellers protected as described in the specific system sections. Commercial thrusters with integrated shrouds may be used as is.
3. All sharp, pointy, moving, or sensitive parts must be covered and clearly marked.

Overall Power Requirements

1. All vehicles may only use **battery-powered** electrical systems.
   a. All batteries must be sealed to reduce the hazard from acid or caustic electrolytes
   b. The open circuit voltage of any battery (or battery system) may not exceed 60Vdc.
2. No combustion engines of any type may be used on the uncrewed systems.

Manual Control Requirements

1. Each vehicle must have the ability to be remotely piloted (tele-operated) by a human operator; this may be required to bring the system back to the dock or other launch area.
2. If the uncrewed system loses connection to the remote controller (such as remote being turned off, losing power, or out of range), the vehicle must default to a safe state as described in the domain-specific sections below. ***The exception is for UUVs operating properly underwater.***
3. The manual remote controller must be a dedicated unit, not used for any other purpose; use of a laptop as the manual control station is not permitted.
4. If the remote controller is turned off (or power is interrupted), vehicle must default to a state in which all propulsion systems and actuators are automatically commanded to 0% thrust or an off state.

Multi-Vehicle Operations

1. Each team may operate one (1) system within a single domain at a given time during the competition.

   a. If a UUV is tethered to a USV, this is counted as one vehicle in each domain towards the team operating limits.
2. Each system to be used must meet the requirements for its operating domain. Each system is subject to inspection and safety checks by RoboNation.
3. Each system will be measured and weighed independently.
4. Each uncrewed system will have designated launch and recovery locations marked on site during the competition.
5. Systems are not required to start joined together, nor are they required to rejoin at the end of an autonomous run.
6. Teams may elect to kill one or more systems during a run, but once a system leaves autonomous mode, it may not return or continue earning points during that attempt.
7. If one (or more) systems are still operating autonomously on the course, the run may continue until the last system is no longer operating autonomously.
8. Teams wishing to have communication between each vehicle must post their method and frequencies on the RobotX Technical Forum ↗ channel.
   a. Acoustic transmitters that operate in the frequency range used by the RoboNation pingers are always off limits for acoustic communication.
   b. Inter-vehicle communication and cueing of one system by another is an advanced behavior that merits special points. If such behavior is executed, teams are required to notify judges **in advance** and present post-run supporting documentation (e.g., vehicle logs) to the judges.

Vehicle Transport Requirements

Teams must be prepared to move their systems around the competition site. To transport from Team Village to the launch areas require transport across multiple surfaces.

Event organizers will provide a pool of carts that may be shared amongst teams for transportation of their systems during the competition. These carts will be commercial off-the-shelf carts to which students may attach cradles suited to the specific considerations of their systems while in use. Since these will be shared resources, any attachments must be easy to attach and remove.

Teams may provide their own carts as long as they meet the following requirements.

- Carts must be manually propelled on site, no motorized carts.
- Cart handles must be solid, no rope or chain.
- Cart must not exceed 1.1 meter in width.
- Carts must have rubberized wheels that are at least 7cm in diameter.
- Carts must be able to get wet with minimal impact to function.
- Carts must be **negatively** buoyant in the water.

5.3.1 USV Requirements

The following is a list of minimal requirements for a USV to be permitted access to a course.

USV General Requirements

- **Size:** The USV must fit within a 2m x 1m x 1m (L x W x H) "box".
- **Weight:** The entire maritime system must weigh less than or equal to 60kg.
- **Buoyant:** The USV must be positively buoyant and hydrodynamically stable enough to operate safely in autonomous and manual modes, as well as when being towed during competition.
- **Visual Feedback System:** The USV must have an onboard visual feedback system to clearly indicate the operational status of the system to improve the safety of competition operations.
  - This visual feedback system will serve as a visual status indicator to anyone in the vicinity of each team's USV.
  - The visual feedback system must be able to display a minimum of three (3) states: RED, YELLOW, and GREEN, and provide a 360-degree daylight visibility when viewed from shore or nearby vessel (approximately 100 meters).
  - Lighting system colors shall correspond with the applicable mode of the team's autonomous system as indicated in the table below. The lights may be flashing or steady on/off according to the state of the system.

Color	Mode
RED	Killed (Actuators disabled)
YELLOW	Teleoperation or Manual
GREEN	Autonomous Mode

USV Safety Requirements

- **USV Launch, Recovery, and Towing:**
  - The USV must have a clearly marked multi-point tow harness installed at all times to allow competition staff to attach a rope and tow the system through the water. The harness must be accessible by competition staff who will be in kayaks or on small support boats.
    - Underslung harnesses will NOT be permitted.
  - The USV must have clearly marked lift point attachments and the team must provide a lifting harness. These will be used to launch and recover the systems for in-water operations.
- **USV Emergency Stop (Kill Switch) Systems:**
  - The USV must have at least ONE (1) on-board physical kill switch that, when actuated, must instantaneously disconnect power from all propulsion systems and actuators. Note: this does not have to kill the onboard computer.
    - Kill switches must be red in color and at least 3cm or greater in diameter.
      - The kill switches must be easily accessible by competition staff in kayaks or on small support boats, either by hand or by using marine implements such as a boat hook or paddle.
      - When activated, the kill switch must change the on-board state indicator to solid RED.
      - Upon reactivation, the system must return to a safe state (props do not start spinning).
    - Systems will not be allowed in the water without a properly working kill switch.
  - In addition to the physical kill-switch, the USV must have at least one remote kill switch that, when actuated, must instantaneously disconnect power from all motors and actuators.
    - If the USV loses connection to the remote kill switch (such as loss of power or out of range), the USV must default to a state in which power is disconnected from all motors and actuators. (Section 5.2.3: Kill Switch Requirements)

- An example of a suitable button for USVs can be found at www.mcmaster.com ↗ and is shown in the figure below.

Example USV Kill Switch

- **USV Physical Safety Systems:**
  - Any propulsion system may be used (thruster, paddle, etc.).
  - All propellers must be shrouded.
    - The shrouds must surround the prop and have at least a 5cm distance between the spinning disk of the prop and the edges of the shroud (front and back).
      - Commercial thrusters with integrated shrouds may be used as is.
      - If you have a guard across the opening to prevent the insertion of a finger, this distance can be reduced.
      - Systems will not be allowed in the water without prop shrouds.
  - All moving parts must have protection.

USV Manual Control Systems

Each USV must be remote-controllable (tele-operated) with its own dedicated remote control.

- If the USV loses connection to its remote controller, the system must default to a state in which all motors and actuators are automatically commanded to 0% thrust or to an OFF state.

- Driving the system using a laptop is NOT allowed.

5.3.2 UUV Requirements

The following is a list of minimal requirements for a UUV to be permitted access to a course.

UUV General Requirements

- **Size:** The UUV must fit within a 2m x 1m x 1m (L x W x H) "box".
- **Weight:** The entire maritime system must weigh less than or equal to 60kg.
- **Buoyant:** The UUV must be positively buoyant such that they float at the water surface when they have been shut off via the kill switch.
- **Fully Submerged:** When performing a scoring run, everything attached to the vehicle must be submerged with the vehicle. Any part that breaks the surface is considered a breach.
  - NOTE: If the UUV is tethered to an autonomously operating USV, this is not considered a breach.
- **Tether Allowances:** The UUV is permitted to have a tether connected to the USV.
  - Tether must be positively buoyant.
  - Tether may not be longer than 6m in total length..
  - Tether must include a structural component that is strong enough to allow for recovery of the UUV by pulling it up from a surface support boat.
- **Visual Feedback System:** The UUV must have an onboard visual feedback system to clearly indicate the operational status of the system to improve the safety of competition operations.
  - This visual feedback system will serve as a visual status indicator to anyone in the vicinity of each team's UUV while it is on the surface.
  - The visual feedback system must be able to display a minimum of three (3) states: RED, YELLOW, and GREEN, and be visible when viewed from shore or nearby vessel (approximately 80 meters).
  - Lighting system colors shall correspond with the applicable mode of the team's autonomous system as indicated in the table below. The lights may be flashing or steady on/off according to the state of the system.

Color	Mode
RED	Killed (Actuators disabled)
YELLOW	Teleoperation or Manual
GREEN	Autonomous Mode

UUV Safety Requirements

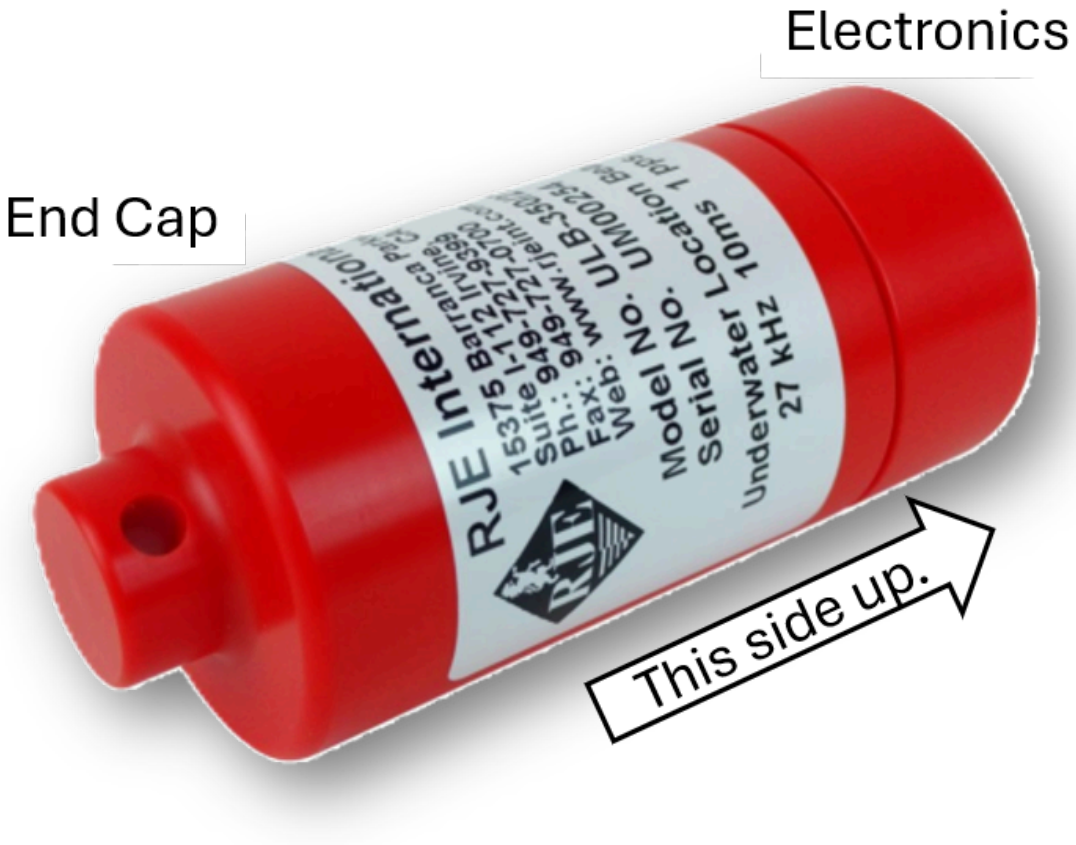
- **UUV Launch, Recovery, and Towing:**
  - The UUV must have a clearly marked multi-point tow points to allow competition staff to attach a rope and safely tow the system through the water.
  - The UUV must have clearly marked lift point attachments and the team must provide a lifting harness. These will be used to launch and recover the systems for in-water operations.
- **UUV Emergency Stop (Kill Switch) Systems:**
  - The UUV must have at least one (1) on-board kill switch that, when actuated, must instantaneously disconnect power from all propulsion systems and actuators. Note: this does not have to kill the computer.
    - The kill switch must be red in color and at least 3cm in diameter or greater.
      - The kill switch must be easily accessible by personnel in a small support craft by hand or by divers wearing protective equipment such as gloves.
      - When activated to kill the vehicle, the kill switch must change the on-board state indicator to RED.
      - Upon reactivation, the vehicle must return to a safe state (props do not start spinning).
      - Vehicles will not be allowed in the water without a properly working kill switch.
  - In addition to the physical kill-switch, the UUV must have at least one remote kill switch for use when the system is surfaced that, when actuated, must instantaneously disconnect power from all motors and actuators.

- **UUV Physical Safety Systems:**
  - Any propulsion system may be used (thruster, paddle, etc.). However, all moving parts must have protection. For instance, propellers must be shrouded.
    - The shrouds must surround the prop and have at least a 5cm distance between the spinning disk of the prop and the edges of the shroud (front and back).
      - Commercial thrusters with integrated shrouds may be used as is.
      - If there is a guard across the opening to prevent the insertion of a finger, this distance can be minimal.
      - Systems will not be allowed in the water without prop shrouds.

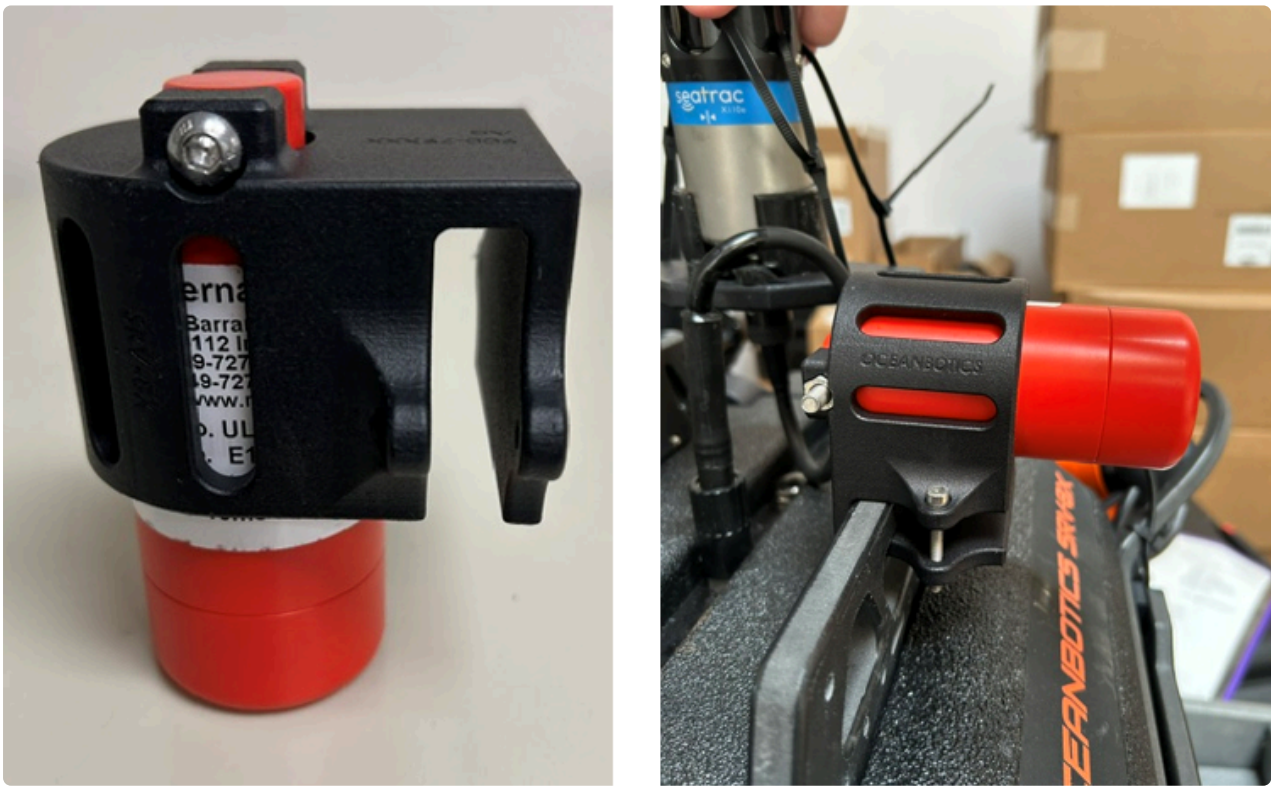
- **UUV Operational Safety**
  - In addition to other safety requirements, the UUV must have a dedicated mounting location for a safety localization beacon to be attached to the UUV.
    - Beacon must be attached prior to a UUV being allowed into the water on a course.
    - This beacon will allow for real-time tracking of each team's UUV for improved situational awareness, as well as an independent method for locating the UUV in the event the system can not be easily located or recovered from the surface.
  - The ULB-350 Low Cost Location Beacon from RJE International has been selected to provide the required functions.
    - Beacons will operate at 37kHz and 45kHz (+/- 1Hz) frequencies with pre-programmed pulse length and repetition rates.
    - The ULB-350 with a battery weighs 283g in the air and 78g in the water.
    - Additional specifications for the beacon may be found at the RJE International ↗ website.
  - Mounting Considerations:
    - The preferred orientation for the ULB-350 is **vertically in the water column**, with
      the end cap (the end with the mounting hole) pointed down and the electronics module facing up.

- The electronics module must be free of obstruction so that it has a clear path to send the acoustic signal through the water.

> The beacon will be provided by event technical team prior to any UUV being allowed to operate in water during the event.



ULB-350 Beacon



Example Mounting Bracket

UUV Manual Control Systems

Each UUV must be remote-controllable (tele-operated) with its own dedicated remote control while on the surface.

- Driving the system using a laptop is NOT allowed.

5.3.3 UAV Requirements

The following is a list of minimal requirements for a UAV to be permitted flight during competition and access to a course or practice area.

UAV General Requirements

- The Civil Aviation Authority of Singapore ↗ (CAAS) serves as Singapore's national aviation authority, responsible for safety and air traffic management.
  - Teams must meet all requirements mandated by the CAAS for their UAV. Compliance with CAAS regulations will be collected in the UAV Proof of Readiness and UAV Safety Check.
  - Only licensed pilots will be allowed to operate UAVs during the competition. (UAV Pilot Requirements)
  - Only UAVs that have successfully passed airworthiness testing may be operated during the competition. See sections below for additional information.
- **Weight:** The UAV must have a maximum all up flying weight of 7kg or lower.
  - The maximum all up flying weight will be verified during safety inspections.
  - The UAV must be capable of carrying a water-activated emergency safety light, to be provided on site by competition organizers.
- **Altitude:** The maximum allowable flight altitude is 60m above mean sea level. This allowance is subject to change, as defined by CAAS.
- **Heavier-than-Air Flight:** The UAV must be capable of heavier-than-air flight and be free flying without any ground encumbrances such as tethers.
- **Battery-Powered:** The UAV must be battery electrical powered (non-fuel based). Exotic batteries will not be allowed. Any option deemed by RoboNation as high risk will be denied.
  - All batteries must be brightly colored for easy identification in a crash, and it is preferred if they are wrapped in bright colored tape.
  - Batteries must be located on the UAV so that they can be easily removed/added without any vehicle deconstructions (e.g. batteries cannot be embedded into the UAV airframe); this is to allow for rapid removal in the event of battery failures.

- **Communications:** The UAV must be able to transmit the required telemetry messages as specified in Section 3.4 Communications Protocol. If this requirement is not met, the UAV will not be allowed to operate during the competition.
- **Airworthiness Test:** The UAV will be subject to airworthiness tests before being granted permission to fly by licensed pilots. The airworthiness tests will include submissions in the UAV Proof of Readiness submissions and the on-site UAV Safety Check and testing of the system.

> Airworthiness certification is anticipated to be a cooperative process between competition organizers, CAAS, and teams. This means that teams are strongly encouraged to begin submission of their technical data packages **as early as possible** to allow for feedback and modifications to meet Singaporean requirements.

UAV Safety Systems

- Each UAV must be able to float in fresh water. This will enable recovery in the case of an emergency and will minimize damage to onboard systems.
- Each UAV must have **clearly marked** safe handling areas so that recovery personnel may safely retrieve the system, if necessary.
- Each UAV must be capable of operating safely in sunny, rain, and varying wind conditions.
- Each UAV must carry an **emergency recovery light** that operates independently from all other platform power systems and is capable of functioning underwater for at least 12 hours. Activation of this light must be demonstrated prior to each launch of the system.
  - At the start of the competition each team with a UAV will be provided with a water-activated flashing light to attach to their UAV.
  - The selected water activated light is available at Amazon: https://a.co/d/0g1AjKYO ↗

UAV Manual Control Systems

- The UAV must have a dedicated remote controller.
  - If the remote controller is turned off (or power is interrupted), the system must default to a safe state in which one of the following occurs:
    - All motors and actuators are automatically commanded to 0% thrust or an off state.
    - The UAV autonomously returns to its original launch location and lands safely.
  - A dedicated, licensed safety pilot must be assigned and available to takeover any UAV operating in the air via its dedicated remote controller.
  - Piloting the UAV using a laptop is NOT allowed.
- The UAV must be capable of autonomous and manual takeoff and landing.

UAV Pilot Requirements

All teams will be required to have **at least one (1) licensed pilot** for the UAV that will be used during the competition. Teams are recommended to have at least one additional licensed pilot available.

- **Pilot Tests (in country):** At a minimum, pilots will be required to pass a **theory test** and a **practical piloting test**, both of which will be be administered by event organizers in country prior to the competition.

  - Note: The pilot tests are not easy. If students are not able to pass the pilot licensing requirements on the first attempt, they will not be able to fly any UAVs during the competition.
- Competition organizers will cover the licensing costs for up to two (2) licensed UAV pilots per team. Teams are responsible for the additional costs for any additional pilot licensing.

> The details surrounding the pilot tests and additional requirements are being finalized and will be provided in a future revision of the Handbook. This update will include a practice theory test for students to better prepare.

Section 6: How to Compete

This section includes detailed instructions and requirements that are required to register and participate in the competition.

6.1 Registration

6.2 Event Submissions

6.3 Design Documentation Submissions

6.4 Event Expectations

6.5 Team Communications

6.6 Data Sharing

6.1 Registration

All teams are required to register to compete using the Registration form found on the RobotX website, RobotX.org/2026↗. This registration collects each team's point of contact information, demographics, and the Pre-Competition Requirements outlined in Section 6.2: Event Submissions and Section 6.3: Design Documentation Submissions.

6.1.1 No Registration Fee

Due to the support from the RobotX sponsor, the registration fee is waived for all participating teams.

6.1.2 Cancellation Policy

To cancel a registration, teams must complete the Cancellation Form↗. Cancellation requests submitted via email will not be accepted. Click here to review the cancellation policy: robotx.org/cancellation-policy↗.

6.2 Event Submissions

This information is collected prior to participation on-site at the competition, during the registration process.

6.2.1 Team Member Registration

This form is required for all team members, advisors, and chaperones planning to attend the competition on-site. Each individual will be able to enter and submit their own information using this process. This information includes name, contact information, dietary restrictions, academic information, optional resume, emergency contact information, signed forms, and a request for an invitation letter.

- Download the waiver ↗ (required of all minor and adult participants)
- Download the youth protection policy form ↗ (required of all adult participants, over the age of 18 years)

> The registration owner will need to collect an email address for each team member to send the team member registration form. For team members that are minors, please enter the email of a parent or guardian to complete the form.
>
> The registration owner is responsible for following up with each team member to complete this task before the deadline.

6.2.2 Team Demographics

Team demographics are collected to determine program impact on students and in educational settings. This information may also be shared with any eligible sponsors.

6.2.3 Merchandise Order

Using the RobotX Competition Shop, teams place an order for their team's shirts. A discount code is provided in the registration portal to receive the first five (5) t-shirts for free. Additional shirts cost $15 each.

6.2.4 Vehicle Information

This submission documents a list of all components utilized in the system design. In cases where components were developed by the team versus purchased off the shelf, this information should be included. Additionally, if commercial off the shelf equipment were significantly modified this should be noted. Under the column marked “Specs” a web link to the manufacturer’s specifications may be provided. This standardized table will help document and track trends in component (hardware and software) usage and team metrics.

	Vendor	Model/Type	Specs	Custom/Purchased	Cost	Yea Pur
UxV Hull Form/Platform						
Waterproof Connectors						
Propulsion						
Power System						
Motor Controls						
CPU						
Teleoperation						
Compass						
Inertial Measurement Unit (IMU)						
Doppler Velocity Logger (DVL)						
Camera(s)						
Hydrophones						
Algorithms						
Vision						

Localization and Mapping						
Autonomy						
Open-Source Software						

6.2.5 On-Site Requirements

Battery Safety Requirements

Teams are required to submit battery specifications, Material Safety Data Sheets (MSDS), and proper disposal procedures, sourced from the battery manufacturer for all batteries. More information can be found in Section 5.2: Safety Requirements.

Shipping Plan

Teams are required to submit a shipping plan to facilitate shipment receipt/handling at the competition hotel. Shipping guidelines can be found in Section 6.4.2: Shipping. This shipping plan must include:

1. Organization name
2. Team name
3. Shipping POC
4. Shipping POC mobile number
5. Shipping POC email address
6. Number of crates
7. Dimensions for each crate
8. Estimated shipping date
9. Shipping Company
10. Type of shipment – Air, ground, ocean

11. Has initial pick-up or drop off been scheduled – include date of pick-up or drop off
12. Is this a dangerous good shipment? If so, has a dangerous goods shipment been arranged?
13. Have you scheduled your outbound shipment pick-up or drop off? Provide pick-up details (date/time) for any pick-up from the hotel.
14. Additional information for shipment, if needed.

6.3 Design Documentation Submissions

This information is collected prior to participation on-site at the competition, during the registration process. Submission requirements, guidelines, and scoring rubrics can be found in Section 2: Design Documentation.

Design Documentation submissions collected before the competition include:

- Technical Design Report
- Team Website
- Team Introduction Video

6.3.1 Optional Community & Outreach

Teams are invited to outline their educational outreach efforts. This activity is not scored; however, it will be shared online for the community and can be eligible for special awards and recognition. Teams may submit one page description of their activities, that may include supporting photos.

6.4 Event Expectations

Teams are responsible for coordinating their own lodging and travel plans.

6.4.1 Travel + Lodging

Teams are responsible for coordinating their own lodging and travel plans.

Lodging—Event Hotel

RoboNation has contracted with a local hotel to provide a special rate for Robotx teams. Teams are responsible for booking their own lodging for the event. Once available, the booking information can be found on the RobotX website↗.

> Overnight pool access is not permitted at the 2026 RobotX Challenge event hotel. Teams wishing to test outside competition hours must secure their own overnight testing facility.

Travel Considerations

VISA Process – It is recommended for students to acquire a appropriate visas (if required) to attend the competition. Explore visit requirements: www.visitsingapore.com↗.

Invitation Letter – Once a team is officially registered and the registration fee is paid, they are eligible to request invitation letters. During the Team Member Registration, each team member are given the opportunity to request an invitation letter issued by RoboNation. Contact support@robonation.org with any questions.

> **Need to bring medication to Singapore?** Regulations for bringing medications into Singapore are very specific. All medications should be checked and cleared for entry **at least two (2) weeks prior** to arriving in Singapore. More information is available here: www.hsa.gov.sg↗.

6.4.2 Shipping

Teams are responsible for coordinating the necessary shipping to ensure arrival of vehicle and equipment. Any shipping questions can be directed to Cheri Koch at ckoch@robonation.org / +1.850.642.0536. More shipping instructions to be released at a later date.

6.4.3 Event Logistics

Team Village

Each team is provided with a covered working area in a tent that includes three tables / ten chairs, one electrical outlet (230VAC 50 Hz 13A), and a wireless internet connection. The Team Village is a tent with sidewalls that resides on a flat grassy field surface. Although the covered workspace is weather resistant, teams are discouraged from leaving sensitive electronics/equipment exposed in the tent.

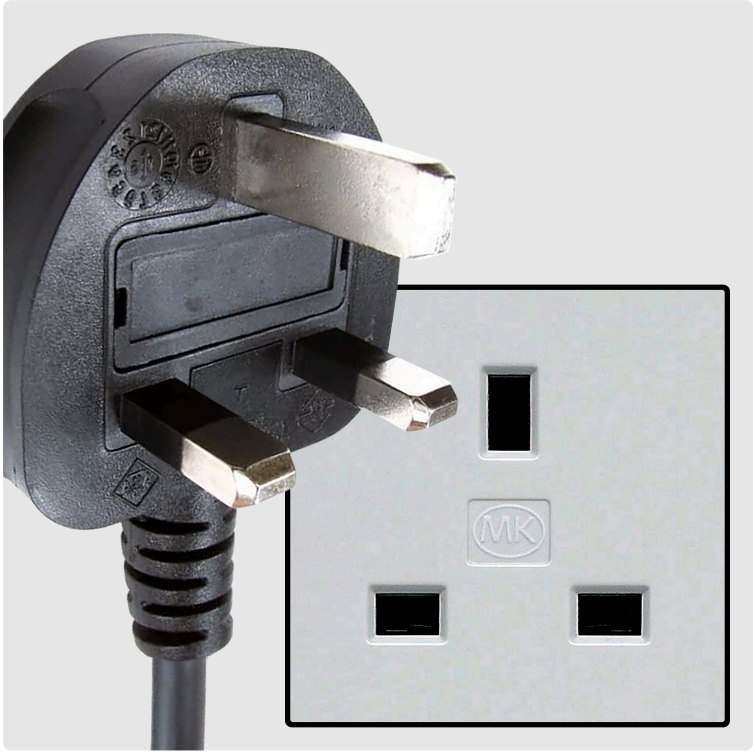
Teams should conduct development, maintenance, and repair of their systems in their designated area in Team Village. Batteries may be charged during the day at the Team Village but may not be left charging overnight.

Team Course Operating Areas (Shoreline)

Teams are provided with an area along the shoreline near the course areas where they are able to set up their equipment. This space consists of a tent-covered area with tables, power, a hard-wired Ethernet connection, and a hard-wired Ethernet connection to the RoboCommand network. The power provided is for Operator Control Station (OCS) use only and shall not be extended to any platforms on the beach. This space is shared between all teams utilizing the course.

Power

Singapore uses a standard 230VAC, 50Hz electrical system with Type G (3-pin) sockets, which are rated for a maximum of 13 amps (13A). Teams will only get one 13A service and should not connect more load than that.



Singapore Electrical Outlets

Vehicle Deployment and Recovery

Vehicles will be transported by teams to the launch and recovery areas near each course. This includes transit over sidewalks, ramps, and docking pontoons. Teams will need at least two (2) people to launch a USV or UUV. The USV and UUV systems will be deployed recovered by manually lifting and lowering them using the team-provided lifting harnesses.

UAVs may be hand-carried to or from the course launch and recovery areas as long as they are in a safe to handle state.

RobotX staff are responsible for retrieving any lost vehicles. All reasonable efforts to recover a lost vehicle will be made, but the recovery of a lost vehicle cannot be guaranteed. All teams recognize by entering the competition, they risk damage to, or the loss of, their vehicle.

Open to the Public

This event is open to the public in a very public area. Consider the possible attendance from future employers or sponsors.

6.5 Team Communications

6.5.1 Pre-Competition Communications

RobotX teams have a variety of opportunities to interact with each other and the RobotX staff leading up to the event.

TeamTime Meetings

Leading up to the on-site competition, teams are asked to send a representative to regularly scheduled virtual meetings. These TeamTime meetings are hosted by the RobotX organizers and technical team to provide teams with competition updates and the opportunity to ask questions. Teams can find the meeting dates and details on the website ↗, Discord ↗, and email.

RobotX Discord

All questions, comments, and suggestions should be posted on the RobotX Discord ↗. Teams are encouraged to actively participate in the online community and monitor it for the latest news and updates regarding all things RobotX.

6.5.2 Event Communications

Team Lead

Each team must designate a student team member as their team lead. The team lead is the only person allowed to speak for the team. The team lead is the only person permitted to request vehicle deployment, run start, run end, or vehicle retrieval. The team lead must be conversationally fluent in English to communicate with RobotX staff. Teams who do not have members fluent in English should contact RobotX staff as soon as possible.

Technical Director Team

The RobotX Technical Director Team consists of a Technical Director, Safety Inspectors and Course Managers.

Other RobotX Staff

The RobotX Staff are identified with “Staff” shirts.

6.5.3 RobotX Website

The official competition website is www.RobotX.org/2026↗. This website includes all official documents and a detailed list of the registered RobotX teams. Helpful resources, past competition results, and other engagement opportunities can be found on this website. Information and documents are updated regularly, and it is the team’s responsibility to check the website for updates.

6.6 Data Sharing

A Data Sharing project has been established for registered teams competing in RoboNation's autonomous competitions: RoboBoat ↗, SUAS ↗, RoboSub ↗, and RobotX ↗. This project aims to increase collaboration between teams and to provide access to shared resources and test data to validate and debug the reliability and robustness of teams' machine vision algorithms.

For the data sharing guide and more information on Data Sharing, visit RoboNation.org/data-sharing. ↗

6.6.1 Data Sharing Access Requirements

During the registration process, teams must provide a generic email account and a team acronym that is used in the Data Sharing project. The generic email can be associated with any email provider. An example of the Generic Email is: robotx-team@outlook.com. The team acronym must be within 2-6 characters, abbreviating the team's school or organization. Examples of the team acronym are: RNX or RNTEAM.

Only official registered teams maintain access to the Data Sharing project for the competition season. Access is provided to teams at the close of registration, using the generic team email address entered during registration. Contact competitions@robonation.org for any access questions.

Section 7: Glossary & Acronyms

7.1 Glossary

Phrase	Definition
Judge	Subject Matter Experts that observe and score the Autonomy Challenge and Design Documentation.
Mission Start	The starting condition for all uncrewed systems. In this state, they are docked (USV/UUV) or grounded (UAV) and must safely leave the starting area in autonomous mode to begin the mission.
Practice Courses	These courses are designed to provide opportunities to demonstrate proficiency in one task at a time. They contain an instance of each task.
Return to Base	This is the end state (last mission element) for each subsystem.
Team Lead	Designated spokesperson for each team.
Technical Director Team	Technical team that runs the courses, safety inspections, set-up, and tear-down.
RobotX Event Staff	RobotX support personnel.
Sponsor	Organizations that provide support to RobotX.

7.2 Acronyms

Acronym	Definition
N/A	Not available
OCS	Operator Control Station
RGB	Red, Green, Blue
RF	Radio Frequency
TD	Technical Director
TDR	Technical Design Report
SoS	System of Systems
UAV	Uncrewed Aerial Vehicle
USV	Uncrewed Surface Vehicle
UUV	Uncrewed Underwater Vehicle