Task Descriptions and Specifications

1. Introduction

This document presents the detailed task descriptions and specifications for the 2018 Maritime RobotX Challenge, which will be conducted 08 – 15 December 2018 at Sand Island on Oahu, Hawaii. The primary landmark is the Honolulu Community College's Marine Education Training Center (METC).

RobotX Challenge Rules and Requirements are available on the official competition website. The official competition website is www.RobotX.org. The 2018 documents posted on www.RobotX.org are the official documents for the 2018 competition. All documents referenced here and in other RobotX documents are also available at the official competition website. These documents are updated regularly. Teams are responsible for checking the website for the most recent revisions.

The term **AMS** will be used through this document to mean the Autonomous Maritime System (AMS) and any ancillary (offboard) subsystems used to accomplish the tasks. It will be necessary for teams to develop a System of Systems (SoS) consisting of systems and subsystems operating in multiple domains. All teams must use the Wave Adaptive Modular Vessel (WAM-V) surface craft, but will also need the ability to sense and act underwater. This may be accomplished by incorporating an underwater vehicle into the system to act as an off-board sensor.

2. Goals

The purpose of the RobotX Challenge is to enhance the community of innovators capable of substantive contributions to the domain of autonomous, unmanned, multi-domain vehicles. This enhancement is achieved by providing a venue and mechanism whereby the practitioners of the autonomous vehicle community may form new connections and collaborations, increase their proficiency and inventiveness, and foster their passion for robotics and the maritime domain.

This competition is designed to promote student interest in autonomous robotic systems operating in the maritime domain, with an emphasis on the science and engineering of cooperative autonomy. In addition, the competition should facilitate the building of international relationships among students, academic institutions, and industry partners to advance research in maritime autonomy.

The Maritime RobotX Challenge is a capstone robotics competition which builds upon the successful implementation of other student robotics competitions such as RoboBoat and RoboSub. We encourage student teams to participate and learn from other competitions, and then apply those skills to the advanced challenges presented in the RobotX Challenge. RoboBoat and RoboSub are annual events that can serve as test beds for future RobotX Challenges.

3. Competition Structure

3.1. Overall Approach

The competition is structured to include several autonomous performance challenges and technical documentation and communications requirements. The latter requirements provide an opportunity for teams to present their work to the judges and explain their design philosophy. Details of these requirements are given in the RobotX Project Deliverables and Presentations section.

Teams must remain on site at the competition venue at all times during the Maritime RobotX Challenge to be eligible for prizes.

The venue is large enough to support installation of multiple instances of each task in which teams may practice and qualify for spaces in the Semi-finals round. An example of the overall competition area is shown in Figure 1. Note that the following caveats apply:

- Sizes and bearings shown are preliminary.
- Final size and layouts are subject to change.
- Dotted lines shown are for the purpose of identifying tasks and courses on the drawing. They do not represent anything physical that will be present on or under the water.

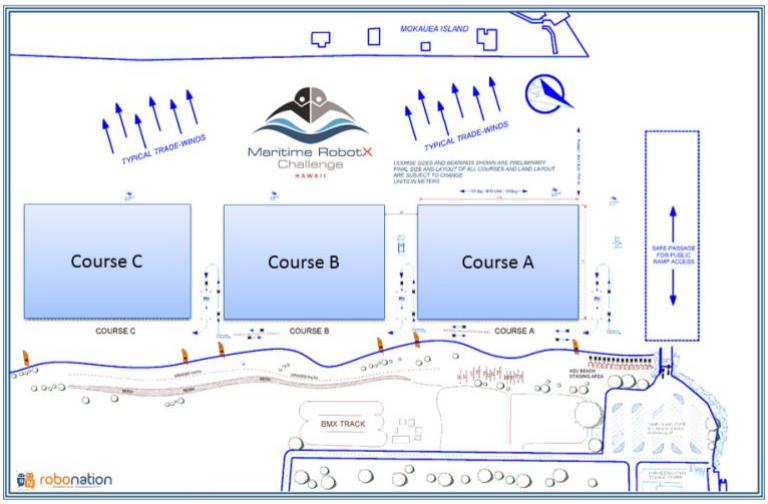


Figure 1. Planned RobotX Challenge Layout

The tasks provide opportunities to showcase the performance of the AMS by autonomously completing a range of challenges designed to represent real-world research and applications.

3.1.1. Challenge Courses (Practice / Qualifying Areas)

There are multiple instances of each task element organized as sets of tasks, referred to as **Challenge Courses**. Teams will have time slots during which they may earn points towards qualifying for the Semi-finals Round. Teams will rotate through the tasks on the Challenge Courses in a scheduled order.

The practice / qualifying area will be set up along the shore and in the water. Challenge Courses will be arranged such that multiple teams may practice or qualify at the same time.

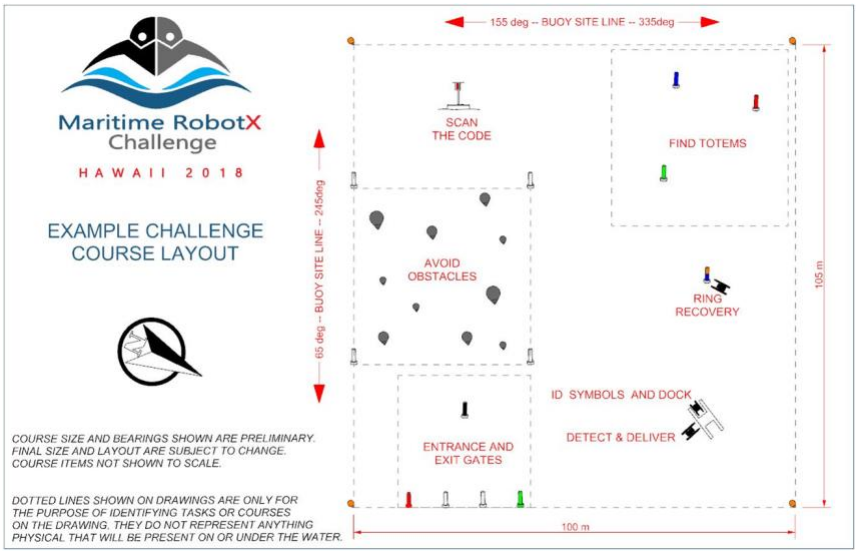


Figure 2. Example Challenge Course Layout

Once a team has successfully demonstrated proficiency on individual tasks of the Challenge Course, they will be qualified for the Semi-finals round and become eligible to sign up for time slots on a **Competition Course**.

The practice/qualifying areas will be available throughout the competition on an assignment basis. The schedule will be presented to teams during the on-site orientation.

3.1.2. Competition Courses (Semi-finals and Finals)

Individual tasks, when clustered together, shall be referred to as **Competition Courses**. For the Semi-finals, at least one of the Challenge Courses will be converted to a Competition Course. On a Competition Course the AMS must demonstrate the ability to collect and use information from individual tasks to complete other tasks. During the Semi-finals and Finals rounds successful completion of the full course will require the AMS to use information from multiple task elements.

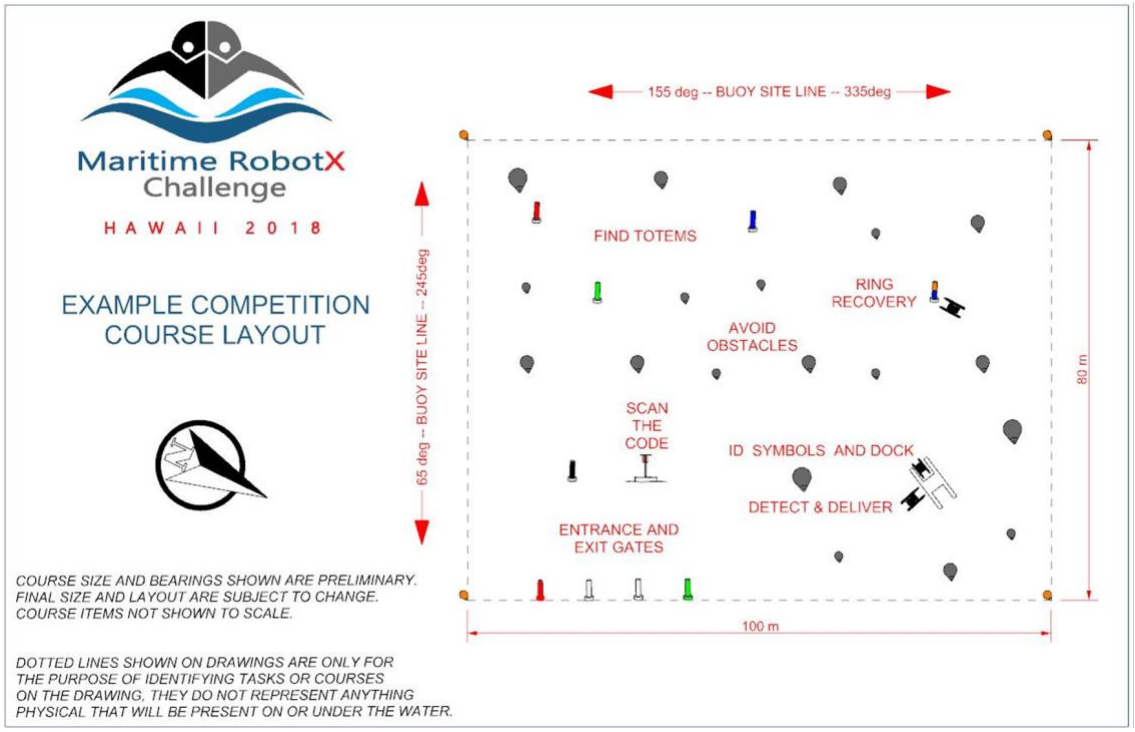


Figure 3. Example Semi-finals or Finals Course Layout

3.1.3. 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.

3.2. Planned Sequence of Events

This section summarizes the main events of each day of the 2018 Maritime RobotX Challenge.

3.2.1. Competition Phases

There are three (3) phases to the 2018 Maritime RobotX Challenge:

- During Practice and Qualifying, teams will be given time to assemble and test their unmanned systems, participate in initial safety inspections, practice, and qualify for Semi-finals in the water on the Challenge Courses.
- During the Semi-finals Round, teams will have the opportunity to advance to the Finals Round by completing runs on the Competition Courses. Only teams that have qualified for the Semi-finals will have access to the Competition Courses. Teams that have qualified for the Semi-finals may also continue to use the Challenge Course for practice on individual tasks.
- The Finals Round will be held on **Saturday, 15 December 2018**.

Figure 4. Example Semi-finals or Finals Course Layout

3.2.2. Daily Events

Each day will start and end with a MANDATORY TEAM MEETING conducted by the Technical Directors. At a minimum, TEAM CAPTAINS are required to attend. All participants are strongly encouraged to attend.

During the morning meetings, the TD will present the plan of the day; Teams will have an opportunity to provide feedback and ask questions.

During the evening meetings, the TD will summarize the day's events and teams will be encouraged to provide feedback. It is likely that at the evening meetings, teams will have an opportunity to sign up for or trade time slots for the next day's competition events. Course changes for the following day will be described at the evening meeting.

3.3. Judging and Scoring Guidance

Detailed task scoring breakdowns are in development. They will be provided in a separate document, *2018 Maritime RobotX Preliminary Scoring Guidance*. Scores will be calculated by the Judges, and all decisions of the Judges are final.

3.4. Team Operations

The 2018 Maritime RobotX Challenge will be set up along the shore and in the water near the primary public boat ramp near the METC on Sand Island in Hawaii, as represented in Figure 4.

Figure 5. Overall 2016 Maritime RobotX Challenge Venue

3.4.1. Competitor's Village

Each team will be provided with a covered working area near the Marine Education Training Center (METC). This work area will have 120VAC, 60Hz power and an internet connection. The Competitor's Village resides on a flat, paved surface. This is where teams should conduct development, maintenance, and repair of their systems. Batteries may be charged during the day at Competitor's Village, but may not be left overnight.

3.4.2. Team Operating Areas (shoreline)

Teams will be provided with an area along the shoreline near the course areas in which they will be able to set up their shore equipment. This space will consist of a tent-covered area (10 ft x 10 ft tent) with a table (6 ft long table), 120VAC, 10A, 60Hz power, and a hard-wired Ethernet connection to the TD network. The power provided is for Operator Control Station (OCS) use only, and shall not be extended to any platforms on the beach.

3.4.3. Transporting the AMSs at the Competition Venue

The RobotX organizers will provide trailers for the AMSs at the competition venue. These trailers shall be used to move the AMSs between locations on site using vehicles provided and operated by the organizers. These trailers will be used to launch and recover the AMS using the public boat ramp. Additional information regarding the trailers is available on the RobotX Forum.

3.4.4. Safety Considerations

Course boundaries will be clearly identified. The AMS must stay within the course or task boundaries at all times while attempting any tasks.

If a RobotX staff member determines that there is an unsafe condition present or imminent, that person may activate the kill switch. The RobotX staff member is not required, nor will they have time to advise the team prior to the decision to terminate the run attempt. In this and all other matters of safety, the decisions of the RobotX staff are final.

4. Qualifying for Course Entry

Prior to being launched into the water all unmanned systems must pass the prescribed safety inspection.

4.1. Demonstrate Navigation and Control

Teams must demonstrate the AMS can maintain positive control and effectively detect and navigate the channel markers. This **MANDATORY TASK** is a minimum requirement for course entry during practice and Semi-finals days.

4.1.1. Detailed Task Description

The AMS must successfully navigate through two pairs of red and green buoys in a fully autonomous manner, demonstrating effective control of the system. After demonstrating this capability, the AMS will be allowed to proceed to the team's assigned area.

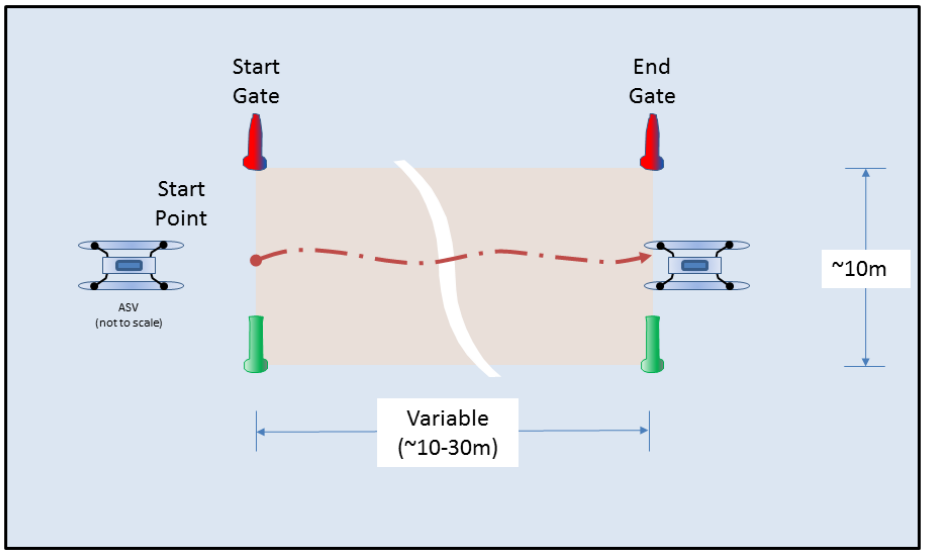


Figure 6. Demonstrate Navigation and Control

4.1.2. Task Elements

Table 1. Navigation and Control Task Elements

Task Element	Description	Model No.	Ht. Above Waterline	Tower Diam.	Base Diam.
Start Gate Port Marker	Taylor Made Products Sur-Mark Can Buoy (Red)	950410	39in.	10in.	18in.
Start Gate Starboard Marker	Taylor Made Products Sur-Mark Can Buoy (Green)	950400	39in.	10in.	18in.
End Gate Port Marker	Taylor Made Products Sur-Mark Can Buoy (Red)	950410	39in.	10in.	18in.
End Gate Starboard Marker	Taylor Made Products Sur-Mark Can Buoy (Green)	950400	39in.	10in.	18in.

4.2. Demonstrate AUV Launch and Recovery

Teams must demonstrate safe deployment and recovery of any offboard system or Autonomous Underwater Vehicle (AUV). Any off-board system must comply with all requirements detailed in the *RobotX Rules and Requirements* document. Prior to being allowed to operate their AUV in the course areas, teams will be required to demonstrate safe launch and recovery of their AUV from the surface platform.

The AUV shall be tethered to the surface platform at all times.

4.2.1. Detailed Task Description

The AMS must be able to transit from its start point on shore to the course areas with the AUV onboard the surface platform. The AMS must start and end each run with the AUV in a captured state aboard the base surface platform. While performing competition challenges the AUV must be autonomously launched and recovered by the WAM-V.

Teams must verify that the AMS is capable of safely launching and recovering the AUV. This verification will consist of a visual inspection and demonstration. This safety demonstration will be conducted at a designated area. RobotX Safety Inspectors will have teams verify the function of the launch and recovery system prior to deployment of the AMS into the water. Once the AMS has been put into the water, the system will need to demonstrate the capability to successfully launch and recover the AUV in water.

The AUV will be considered successfully launched when it is free to perform its assigned mission separated from the surface platform.

The AUV will be considered successfully recovered when it is brought under positive control within the boundaries of the surface platform.

5. RobotX Challenge Tasks

This section provides details of the individual RobotX 2018 Challenge tasks. For practice and qualifying days teams will attempt the tasks individually. For the Semi-finals and Finals, the tasks may be combined into new, multi-tier tasks. Potential combinations of the tasks for the Semi-finals and Finals will be released at a later date.

Autonomous station keeping and controlled maneuvering are capabilities that enable successful completion of several tasks in the 2018 Maritime RobotX Challenge.

5.1. Entrance and Exit Gates

A set of three gates will be located in the course area with a beacon placed underwater within each gate. The AMS must detect the active underwater beacon and transit through the gate in which the active beacon is located. Beacon specifications are available in the *RobotX 2018 Beacon Specifications* document.

5.1.1. Detailed Task Description

There will be four marker buoys designating the three gates: Gate 1 will be bounded by a red buoy and a white buoy, Gate 2 will be bounded by two white buoys, Gate 3 will be bounded by a white buoy and a green buoy. The AMS must detect and pass through the gate with the active beacon.

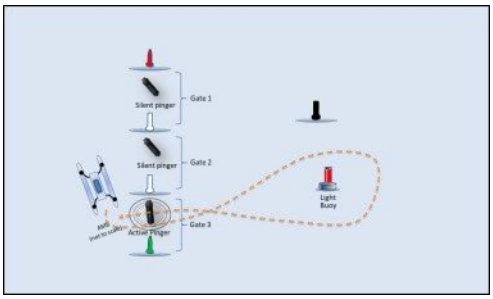


Figure 7. Entrance and Exit Gates (showing possible Competition Course configuration)

After transiting through the active gate, the AMS must detect and circle one of two buoys in the field beyond the gates. The beacon frequencies for each course will be separated by at least 2kHz and staggered in time as well as frequency. Beacon frequencies for each instance of this task will be posted daily during the competition.

For practice and qualifying, the target buoys will include one black and one yellow buoy which the AMS must circle after passing through the ENTRY Gate. The AMS must then return through the EXIT Gate with the active beacon. The TD will assign a color of the day for the AMS to circle when attempting this task. The gate with the active beacon may change between ENTRY and EXIT.

For the Semi-finals and Finals rounds, the gates will serve as entry and exit points for the Competition Courses. One or both of the marker buoys may be replaced with another task. A single beacon will be activated at the start of each run to indicate the correct ENTRY GATE. The beacon may change during the run to indicate a different EXIT GATE. The AMS should **record the correct ENTRY gate number** for use in combination with other tasks. For example, if the ENTRY GATE is Gate 1, then the first color of the Scan the Code sequence may indicate the color of totem to be circled.

For the Semi-finals and Finals rounds, one of the buoys to be circled will be an instance of the light buoy, used in the Scan the Code task. The Scan the Code buoy must be circled if it actively displays a light pattern. If the light buoy is off, then the AMS must circle the marker buoy.

5.1.2. Task Elements

Planned task elements for this task are detailed in Table 2.

Table 2. Entrance and Exit Gate Task Elements

Task Element	Description	Model No.	Ht. Above Waterline	Tower Diam.	Base Diam.
Entry Gate Port Marker	Taylor Made Products Sur-Mark Can Buoy (Red)	950410	39in.	10in.	18in.
Entry Gate Middle Marker	Taylor Made Products Sur-Mark Can Buoy (White)	46104	39in.	10in.	18in.
Entry Gate Starboard Marker	Taylor Made Products Sur-Mark Can Buoy (Green)	950400	39in.	10in.	18in.
Exit Gate Port Marker	Taylor Made Products Sur-Mark Can Buoy (Green)	950410	39in.	10in.	18in.
Exit Gate Middle Marker	Taylor Made Products Sur-Mark Can Buoy (White)	46104	39in.	10in.	18in.
Exit Gate Starboard Marker	Taylor Made Products Sur-Mark Can Buoy (Red)	950400	39in.	10in.	18in.
Buoy to Circle Around	Taylor Made Products Sur-Mark Can Buoy (White) with black/yellow cover	46104	39in.	10in.	18in.

5.2. Avoid Obstacles

5.2.1. Detailed Task Description

For the 2018 Maritime RobotX Challenge, this task has been modified to provide a real-world challenge. Rather than being grouped as a separate task, as has been done in previous years, obstacle buoys will be placed throughout the operating areas.

During the practice and qualifying days, the obstacle area may be marked by four white buoys (listed in Table 3) around an area approximately 40m x 40m. The obstacles will be placed inside the area. The AMS must transit across the field without striking an obstacle. The transit must start near one of the boundary markers and transit to the marker buoy diagonally across from the starting buoy. Entering the obstacle avoidance field and avoiding at least one obstacle will be considered as an attempt at completing this task.

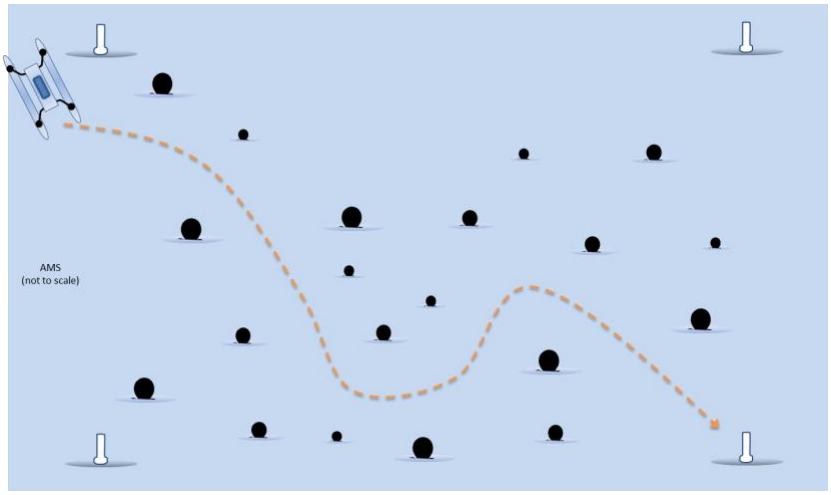


Figure 8. Obstacle Avoidance Challenge

5.2.2. Task Elements

The task elements used for this task are listed below.

Table 3. Find Totems and Avoid Obstacles Task Elements

Task Element	Description	Model No.	Ht. Above Waterline	Tower Diam.	Base Diam.
Obstacle Field Boundary Marker	Taylor Made Products Sur-Mark Can Buoy (White)	46104	39in.	10in.	18in.
Obstacle – Small	PolyForm A-3 Black Buoy (17")	A-3 Black			
Obstacle – Medium	PolyForm A-5 Black Buoy (27")	A-5 Black			
Obstacle – Large	PolyForm A-7 Black Buoy (39")	A-7 Black			

5.3. Find Totems

5.3.1. Detailed Task Description

The Find Totems task requires the AMS to locate and completely circle two distinct objects, representing traditional Hawaiian Tiki totems.

For practice and qualifying days, the totems may be placed within a field of obstacles; the totem area may be marked by four white buoys (listed in Table 3) around an area approximately 40m x 40m.

On these days, the TD will announce the assigned totem sequence and direction. The AMS will demonstrate it has identified the object of interest by circumnavigating the correct totems in the correct direction. On practice and qualifying days the Technical Director (TD) will post the order and color totems for that day.

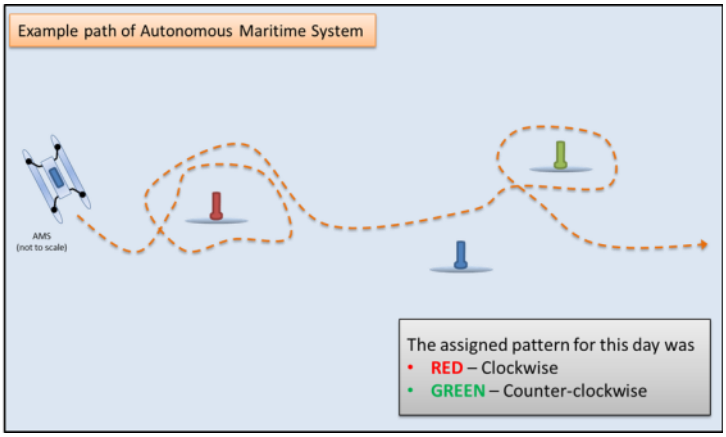


Figure 9. Find Totems

For the Semi-finals and Finals courses the totems will be placed at random locations around the competition course. The AMS will be required to find and circle totems based on information gathered from other tasks.

Table 4. Totem Colors and Directions

Color	Direction
Red	Clockwise
Green	Counter-clockwise
Blue	Clockwise
Yellow	Counter-clockwise

The AMS must circumnavigate the totems in the correct order and in the correct direction, as listed in Table 4. During the practice and qualifying days, the required order will be posted. Entering the totem field and circling any totem will be considered as an attempt at completing this task.

Figure 10. Totem Concept Image

5.3.2. Task Elements

The "Tiki totems" will rise 1-2 meters high above the water's surface. The Taylor Made White Sur-Mark Buoys will be covered by red, green, yellow, or blue sleeve.

Table 5. Find Totems and Avoid Obstacles Task Elements

Task Element	Description	Model No.	Ht. Above Waterline	Tower Diam.	Base Diam.
Totem Marker	Taylor Made Products Sur-Mark Can Buoy (White)	46104	39in.	10in.	18in.
Totem Field Boundary Marker	Taylor Made Products Sur-Mark Can Buoy (White)	46104	39in.	10in.	18in.

5.4. Scan the Code

The AMS is required to observe a light sequence displayed by an RGB buoy and report the color pattern. This is similar to the 2014 and 2016 RobotX light buoy task.

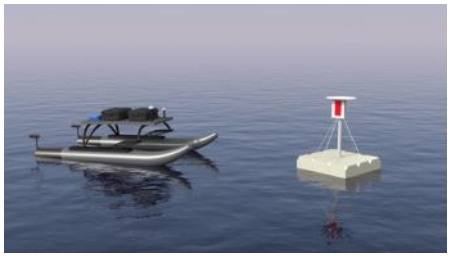


Figure 11. Scan the Code

5.4.1. Detailed Task Description

A floating platform with a vertical pole (similar to Figure 10) will be located within the search area, of approximately 40 X 40 meters. The light bar atop the buoy will be no more than 3 meters above the water's surface and will display any three of the three colors: red, green, or blue. The light bar will appear black when it is off. The light assembly on the buoy will successively display colors one at a time to generate a sequential pattern of three colors (e.g., red-green-red). Each individual color will appear for 1 second, after which the lights will remain off (black) for 2 seconds before repeating the same pattern. A color may be repeated in the pattern, but the same color will not appear twice in a row.

During Practice, Qualifying, Semi-finals, and Finals, teams will report the detected light sequence using a Scan the Code graphical display as detailed in Figure 11. The example Scan the Code report in Figure 12 shows the report of Red, Green Blue for the light buoy.

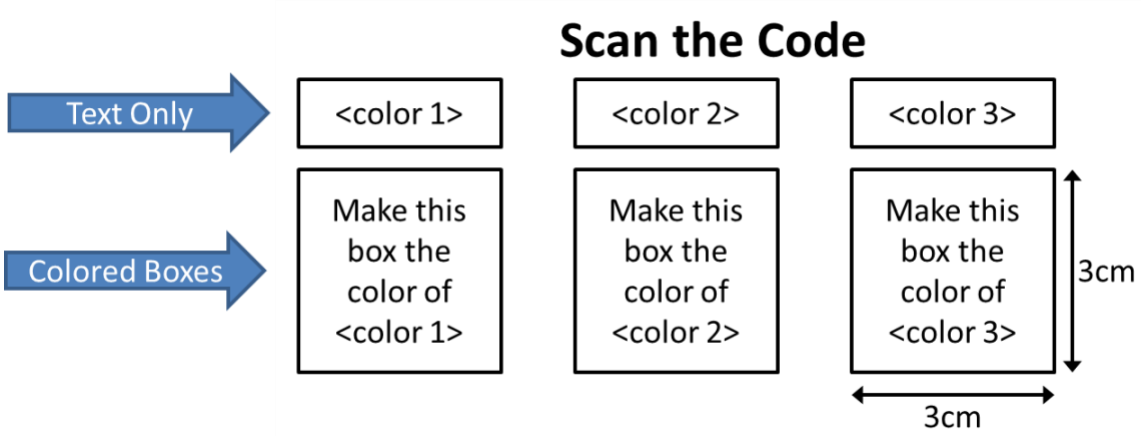


Figure 12. Scan the Code Judge's Display Specifications.
(Teams must provide this.)

In addition to providing the Judge's graphical display shown above, during Semi-finals and Finals, the AMS will also demonstrate that it has successfully observed the light buoy by using the sequence to inform completion of other tasks.

No contact with the light buoy is permitted. Striking the buoy will result in termination of the run.

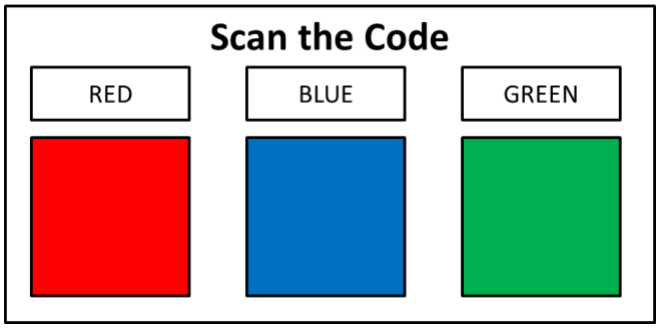


Figure 13. Example Scan the Code Report

5.4.2. Task Elements

Further details of the light buoy are available in the *2018 RobotX Light Buoy Specifications* document.

5.5. Identify Symbols and Dock

The docking task will be configured as shown in Figure 13 with symbols similar to those used in the 2016 RobotX Challenge. Dock materials will be the same as those used in 2016.

5.5.1. Detailed Task Description

The AMS must demonstrate the ability to successfully dock in bays identified by a symbol. The symbols may be red, green, or blue in color and may be in the shape of a circle, triangle, or cruciform on a white background.

The task will consist of two identical docking bays arranged as depicted in Figure 13. The dock will be anchored in a fixed location, with the symbols affixed at the closed end. Each bay consists of floats positioned to form a cul-de-sac with sufficient clearance on both port and starboard sides.

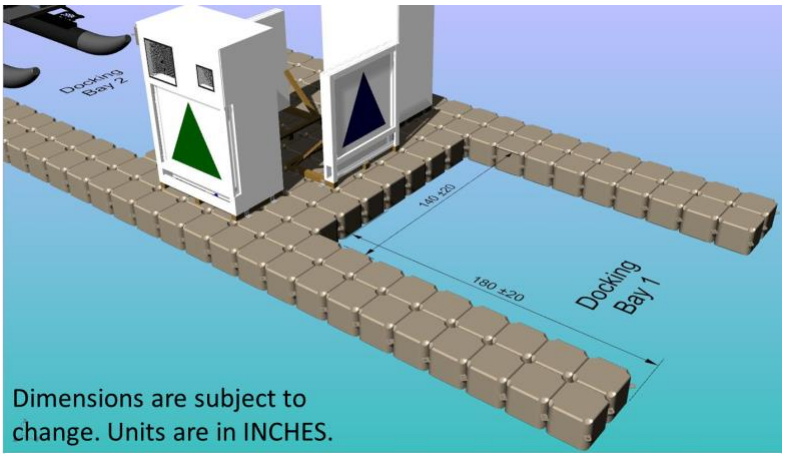


Figure 14. Docking Bay Details

A large white placard with the symbol will be affixed to each docking bay as shown in Figure 14. The symbols will be at least 1m across on the white background, and may not be precisely centered in the docking bay. During the Practice and Qualifying days the Technical Director will designate a symbol of the day for the docking task.

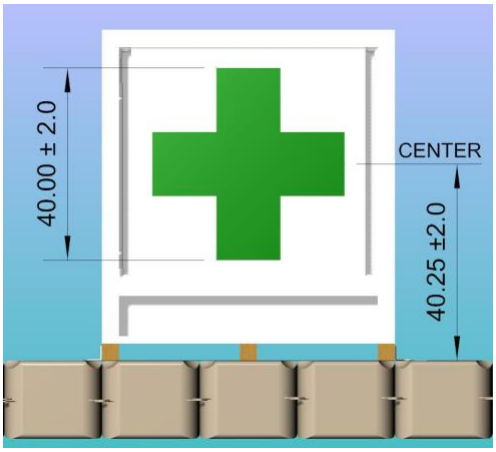


Figure 15. Front View of Docking Symbol
(Units are INCHES. Dimensions are subject to change.)

When the AMS approaches this task, it must identify the symbol for that day, and enter the docking bay that displays that symbol. The symbol placards may be randomly moved from one docking bay to another at any time during each day of the competition. There may be multiple placards with the same color but a different shape. There may be multiple placards with the same shape but a different color. Once a team begins their time slot, the position of the symbols will remain fixed throughout that time slot.

Identify Symbols & Dock and Detect & Deliver are physically located on the same floating platform. For the Practice and Qualifying days teams will be required to attempt points on each task independently, and only one team will be assigned to the floating platform during a timeslot.

5.5.2. Task Elements

The docks for this task will be constructed from Jet Dock assembly cubes (size large). The Jet Dock System is made from Ultra High Molecular Weight High Density Polyethylene Plastic. Jet Dock Large Cubes are 20" X 20" square by 16" tall. Jet Dock Large Cubes weigh 14 pounds each, and have 3.7 cubic feet of volume.

Table 6. Task Elements for Identify Symbols & Dock and Detect & Deliver

Task Element	Description	Manufacturer	Example Image
Dock Material	CUBE - LARGE (BEIGE) Item code: C000000008	Jet Dock www.jetdock.com	

5.6. Detect and Deliver

The Detect and Deliver task will be configured as shown in Figure 15 with symbols similar to those used in the 2016 RobotX Challenge. Dock materials will be the same as those used in 2016. The dock material to be used will be the same as what is used for the Identify Symbols and Dock task, listed in Table 6.

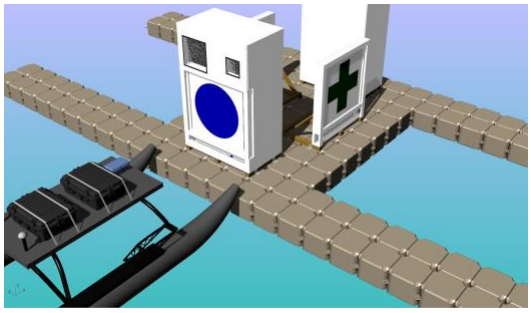


Figure 16. Detect and Deliver Structure

A floating platform will be tethered in an open area. A symbol and a pair of square target holes, one small and one large, will be visible on two opposite faces of the platform. The symbols may be red, green, or blue in color and may be in the shape of a circle, triangle, or cruciform on a white background. The AMS must propel or insert objects through the target holes on the correct platform face. During practice and qualifying days the TD will designate the symbol of the day.

5.6.1. Detailed Task Description

For each run, teams will be provided with four (4) balls described in Table 7. The AMS must detect the correct symbol on the target face. The target symbol will be at least 1m across. Once detected, the system must place or launch the balls into one of the two target holes on the upper part of the floating platform. There will be two holes, one larger than the other, each outlined in black on a white background. The larger hole will be a square 0.5m on a side, and the smaller hole will be a square 0.25m on a side. Figure 16 depicts a concept drawing of the DETECT AND DELIVER task. For the Semi-finals and Finals, this task will be paired with the Identify Symbols and Dock task as depicted in Figure 15, and the correct symbol may be determined by the AMS successfully completing other tasks.

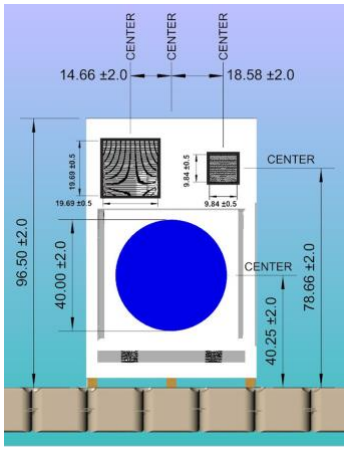


Figure 17. Detect and Deliver
(Units are INCHES. Dimensions are subject to change)

Detect & Deliver and Identify Symbols & Dock are physically located on the same floating platform. For the Practice and Qualifying days, teams will be required to attempt points on each task independently, and only one team will be assigned to the floating platform during a timeslot.

5.6.2. Task Elements

Table 7. Detect and Deliver Task Elements

Task Element	Description
Blue Projectile	Penn Ultra-Blue Racquetball

5.7. Underwater Ring Recovery

The AMS must recover rings suspended underwater in the competition field.

5.7.1. Detailed Task Description

For this task rings will be attached at varying depths to a PVC structure suspended underneath a marker buoy on the water's surface. The rings will be secured at three levels, with the top tier starting 30-42" below the water surface. The middle tier will be placed 24 inches below the top tier, and the bottom tier will be placed 24 inches below the middle tier similar to the image in Figure 17. Each tier will be offset by 45 degrees from the tier above as shown in Figure 18. The tiers will be colored red, green, and blue from top to bottom.

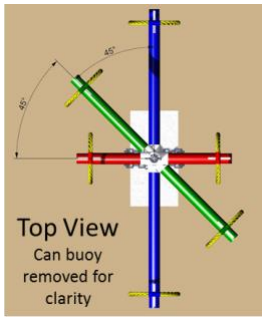


Figure 19. Ring Recovery Top View

The rings will be similar in size to each other, made from yellow polypropylene rope, and marked with colors to indicate the tier from which they were recovered. Rings will be positively buoyant.

The AMS will demonstrate completion of this task by recovering a ring to the surface platform. The ring must be secured by the AMS to be considered successfully recovered.

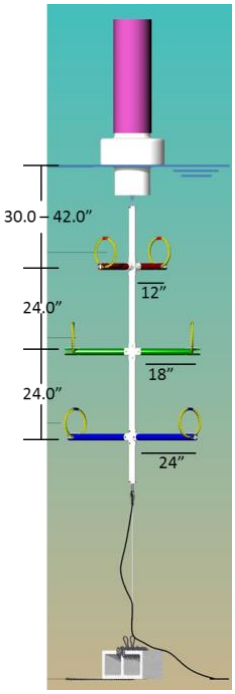


Figure 18. Ring Recovery Side View

5.7.2. Task Elements

A reference buoy will be visible above the water's surface. It will have a distinctive pattern on it to distinguish it from other buoys in the Challenge Course fields.

Table 8. Underwater Ring Recovery Task Elements

Task Element	Description	Model No.	Ht. Above Waterline	Tower Diam.	Base Diam.
Reference Buoy	Taylor Made Products Sur-Mark Can Buoy (White) with pattern	46104	39in.	10in.	18in.
Ring Fastener	Utilitech Nylon Cable Tie, 175lb rated	https://www.lowes.com/pd/Utilitech-15-Pack-36-in-Nylon-Cable-Ties/50005760			
Ring Structure	1.5" Schedule 80 PVC Pipe				
Ring Color Marker	Scotch #35 Electrical Tape				

The rings are made from ¾" yellow, 3-strand polypropylene rope and color coded using Scotch #35 electrical tape. The rings are 8.25" – 8.75" in diameter, and are positively buoyant. The color of the ring recovered may be used as input to guide completion of other tasks during the Semi-finals and Finals rounds.

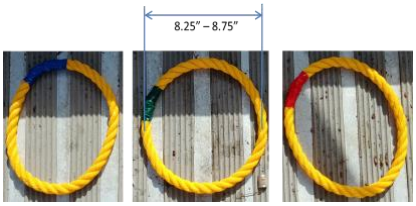
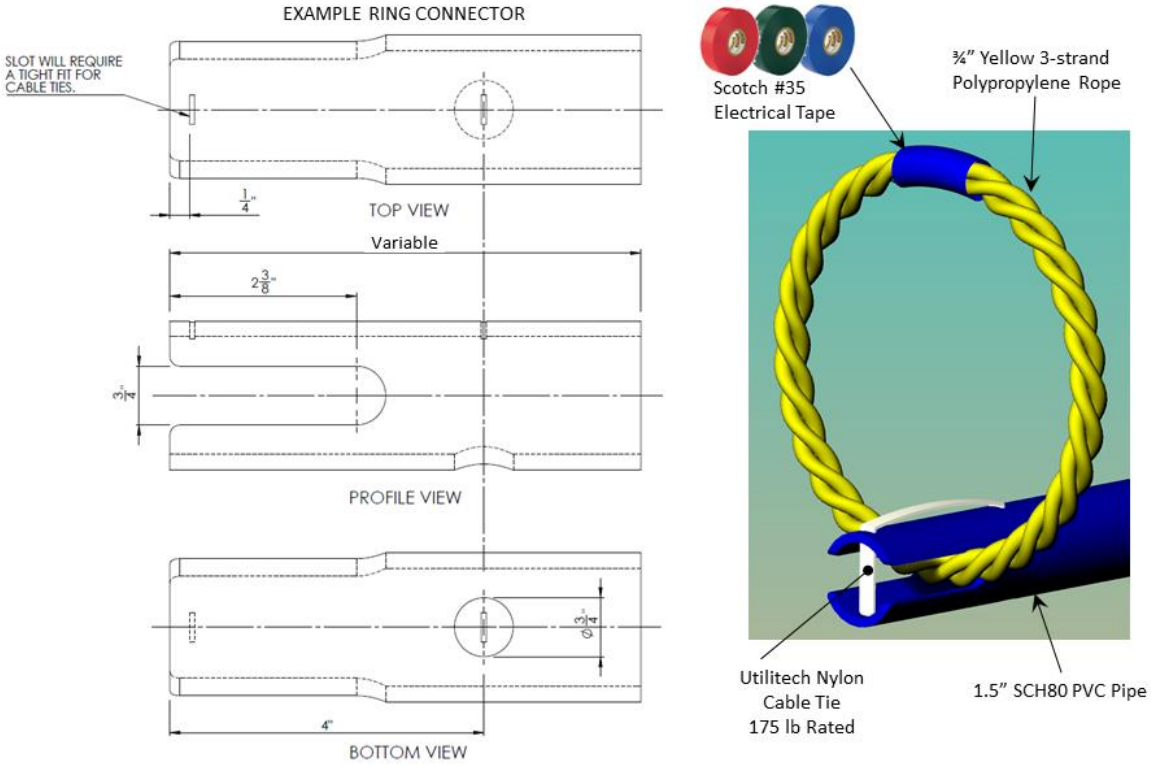


Figure 20. Polypropylene Rings

The method of attachment for the rings to the bars on each tier is shown in Figure 20.



Dimensions are approximate and may differ at the time of the event.

Figure 21. Close-up of Ring attachment method.

5.8. Situational Awareness Reporting Task

Situational awareness is an integral component of unmanned systems. Understanding an unmanned system's intent is critical in building operator trust. The *2018 RobotX Communications Protocol* document provides a standardized protocol through which heartbeat and task information may be communicated to judges and TD staff.

Any task described in the *2018 RobotX Communications Protocol* may be reported using the guidance provided in the document.

6. RobotX Project Deliverables and Presentations

Each team shall design a Website, write a Technical Design Paper, create a Team Introduction Video, conduct an oral presentation, and present their System for inspection. Each team is responsible for ensuring all deadlines are met by the specified date. A Dropbox folder has been set up for each team participating in the Challenge. An invitation will be sent to

6.1. Technical Submission Package *(Due 12 November 2018)*

The Technical Submission Package and Design Presentation Tasks comprise a critical element of the competition. Scores from this element will be used as a tie-breaker, if needed. Special prizes may be awarded in several categories.

6.1.1. Website

Teams must maintain a website documenting their efforts and progress leading up to the competition. The website should include at a minimum the following information:

- Team information (name and team contact information)
- Team member information (name, picture, contact information)
- System design approach
- Media (pictures, video, etc.) taken during development and testing
- List of sponsors (with logos)
- Teams are encouraged to build an archive of previous vehicles and design reports

The exact layout and contents of the website are left for the teams to develop. The technical team and the judges may visit this site prior to the competition to follow the teams' progress. The website development must be complete and ready for judging by **12 November 2018**. However, teams are expected to continually update their website up to the start of the competition. Team Website URL's will be posted on the RobotX website.

6.1.2. Technical Design Paper

Each team is required to submit a technical design paper in English that describes the design of their USV autonomy system, propulsion system, and control systems, as well as strategies for their approach to the tasks. They should include the rationale for their design choices. Specific requirements for the technical design paper are provided in the documents available in the Team Dropbox folders. All teams' papers will be published on the RobotX website after the competition.

6.1.3. Team Introduction Video

Each team is required to submit a 2-3 minute video introducing their team. This video will be scored, and will be used online and onsite during the webcast. The video is not intended to present teams' vehicle design and it may not be used as part of the design presentation.

6.1.4. Design Documentation Presentation and Questions

Each team is required to present their sensing, integration, power, propulsion, and autonomy scheme to the Judges in the form of an oral presentation (conducted in English) with visual aids.

This component of the Challenge will include a presentation to the Judges, as well as an opportunity for the Judges to interact with the team members using a specific set of standard questions. During the presentation each team should introduce its members, discuss their AMS, any specific challenges they overcame, and their strategies for the competition.

All team members present in Hawaii must be in attendance for the design presentation.

Planned Presentation Breakdown:

- Team Video will be played first (2-3 minutes)
- Teams will conduct a 20-minute oral presentation with visual aids
- Ten (10) minutes will be allotted for questions
- Ten (10) minutes will be allotted for the Judges to interact with the team

Teams should not bring their AMS to the presentation; Judges will inspect each team's AMS at a later time during the competition days. Teams are permitted to bring their AUV or other visual aids to the Design Documentation Presentation.

6.1.5. System Inspection

Judges will inspect the team's unmanned system, assessing technical design, craftsmanship, technical innovation, and visual impact of the design. Team members should be present to answer technical questions posed by the judges during this inspection. The System Inspection schedule will be provided at the competition site.

At least one team representative must be present for the System Inspection.

6.2. Information Package *(Due 05 November 2018)*

Teams are required to submit the following items to the RoboNation organizers through their Team Dropbox.

6.2.1. Team Roster

Confirm all registration information, including Official Team Name and School or Organization Name. List each individual that worked on your vehicle, along with their corresponding information. International teams, complete the additional passport and birth information to provide RoboNation with the necessary information to issue your team an official Invitation Letter. Additionally, confirm your Team Website, Social Media information and t-shirt sizes. confirm all registration information, including Official Team Name and School or Organization Name.

6.2.2. Waiver and Release of Liability Forms

In order to participate in the 2018 Maritime RobotX Challenge, each on-site team member and faculty advisor must submit a signed Photographic Release and Liability Waiver. Failure to submit these forms will result in non-participation. Forms must be collected electronically prior to the competition. Each team is required to submit all completed forms to their Team Dropbox.

6.2.3. LinkedIn Profiles

Each team member is encouraged to submit a LinkedIn profile. LinkedIn profiles will be distributed to official RoboNation sponsors, offering students the opportunity to connect with industry professionals. Each team is encouraged to submit links to Linkedin profiles in their Team Roster.

6.3. Shipping Plan

As stated in the *RobotX Rules and Requirements* document, teams will be required to submit a shipping plan to RobotX organizers no later than **08 October 2018**. This is to allow time for organizers to work with teams to ensure that their systems and support equipment can be received, worked through U.S. Customs, and staged for use during the competition. A shipping plan form, shipping address, and point of contact for the RobotX freight forwarder will be provided directly to teams.

Table 9. Summary of Deliverables

Deliverable	Due Date
Registration Deadline	01 September 2018
Shipping Plan	08 October 2016
Information Package	05 November 2018
Technical Submission Package: Website, Video and Journal Paper	12 November 2018

7. Important Terms

Term	Definition
AMS	Autonomous Maritime System
AUV	Autonomous Underwater Vehicle
Challenge Course	Group of RobotX task elements organized as a set of seven tasks which teams can attempt individually to earn points towards qualifying for the Semi-finals Round of the competition.
Competition Course	A set of RobotX tasks organized as an integrated course which teams may attempt for points towards qualifying for the Finals Round. When using the Competition Course, teams must attempt multiple tasks in which the information required to complete some tasks are dependent on information gathered attempting another task.
USV	Unmanned Surface Vehicle
WAM-V	Wave Adaptive Modular Vessel

8. Change Log

This change log lists many of the most significant changes made in this revision of the Rules. It may not be all-inclusive, as minor corrections and changes may not be listed. Teams should review and understand the entire document.

Version	Changes	Date
v1.0	First release of Preliminary Task Descriptions, based on "Task Summary" document from 25 December 2017.	31 January 2018
v1.1	Updated all tasks • Entrance and Exit Gates • Scan the Code • Identify Symbols and Dock • Detect and Deliver • Underwater Ring Recovery Updated Technical Submission Requirements section	12 March 2018
v2.0	Major document revision	17 September 2018