Rules and Regulations
Round 1 Technology Readiness Test
Mapping and Imaging

These Rules and Regulations for the Round 1 Technology Readiness Test are an updated attachment to the Competition Guidelines for the Shell Ocean Discovery XPRIZE. This revision results from the devastation visited upon the original Round 1 test site in Puerto Rico by Hurricanes Irma and Maria in September 2017, and the subsequent inability of the location to support the Mapping and Imaging component of the competition at the present time. The contents of this document supersede all previous documents including Rules and Regulations, Guidelines, and FAQs concerning the Round 1 Mapping and Imaging component only. Information on the NOAA Bonus Prize Innovation Test that was to have been conducted during the Round 1 Field Test will be released in a subsequent document.

All Teams that participate must adhere to the Round 1 Technology Readiness Test Rules and Regulations to qualify for Round 2. Failure to adhere to these Rules and Regulations may result in the suspension or disqualification of the Team by the Judging Panel. Based on the results of this Test, Judges will determine if a Team passes and moves on to Round 2. More than 10 Teams will be permitted to move forward to Round 2, however there are no further changes to Round 2 Rules and Regulations beyond that change. Winners of the Shell Ocean Discovery XPRIZE Grand Prize and the NOAA Bonus Prize will be determined during Round 2.

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Round 1 Technology Readiness Test

Introduction
Due to the inability of the original site location in Puerto Rico to support competition operations at the present time, the format of Round 1 has been revised to be a Technology Readiness Test in which Teams must demonstrate that their Entry would have been capable of meeting the operational requirements necessary to successfully compete in the original Round 1 Mapping and Imaging Field Test. The Round 1 Technology Readiness Test is designed to be a relatively straightforward test of each Entry, that otherwise at this point in time would already have been competing in the original Round 1 Field Test. This Test will take the form of a four day Site Visit by XPRIZE to a location selected by each Team.

Milestone Prize
A Milestone Prize in the amount of $1,000,000 will be shared equally between all Teams whose Entries pass the Round 1 Technology Readiness Test according to the Round 1 Technology Readiness Test Criteria (Table 1).

Judging
The performance of the Entry in meeting each of the 11 Round 1 Technology Readiness Test Criteria (Table 1) will be documented by XPRIZE. After all Teams have completed their Technology Readiness Test, the Judging Panel will meet and determine the Entries that proceed to the Final Round based on their performance. There is no limit on how many semi-finalist Teams can move on to the Final Round.

Entries will be evaluated based on eleven (11) criteria. The criteria are designed to provide sufficient information on each Entry for the Judges to assess whether the Entry would have successfully completed the original Round 1 Field Test Judging Criteria. Each criterion is a pass/fail test. The Judges decisions are final. Whereas the expectation is that a successful Team will pass all 11 criteria, the Judges have leeway to include Teams who do not pass up to two (2) criteria. In such cases, for those two criteria, Teams will need to submit documentation to explain why their Entry failed and how their Entry will achieve success in the Round 2 Field Test.

Table 1. Round 1 Technology Readiness Test Criteria

	Criteria	Score
A.	Autonomy	Pass/Fail
B.	Collision Avoidance	Pass/Fail
C.	Data Retrieval	Pass/Fail
D.	Depth Capability	Pass/Fail
E.	Endurance	Pass/Fail
F.	Imagery	Pass/Fail
G.	Mapping Resolution	Pass/Fail
H.	Navigation	Pass/Fail
I.	Seaworthiness	Pass/Fail
J.	Size and Weight	Pass/Fail
K.	Speed	Pass/Fail

Test Criteria Description and Verification

A. **AUTONOMY:** Team needs to demonstrate that their Entry can conduct autonomous and untethered operations. While the Entries must function without a physical link to operators, untethered "connectivity" between the shore and the systems are welcome.

Verification: Demonstration of autonomous and untethered operation of the Entry can be achieved by completing both of the following:

I.   Launch and recovery: Providing documentation (plan for Launch and Recovery, schematics, mission plan, etc.) of autonomous and untethered operation.
II.   Demonstration of submergence capability and untethered operation for at least six hours. Providing documentation of subsurface autonomous and untethered operations (dive logs, navigation data, etc.).

B. **COLLISION AVOIDANCE:** Team needs to demonstrate that their Entry shall operate safely in water and avoid contact with other obstacles using passive or active avoidance measures.

Verification: Demonstration of Entry collision avoidance capabilities can be achieved by completing both of the following:

I.   Providing documentation of collision avoidance features and capabilities for safe aerial and sea-surface (as applicable), and sub sea-surface operations.
II.   Demonstration of surface collision avoidance features in a field trial.

C. **DATA RETRIEVAL:** Team needs to demonstrate that data collected by the Entry can be retrieved completely and accurately and delivered to XPRIZE.

<u>Verification:</u> Demonstration of Entry data retrieval can be accomplished by completing all of the following:

    I.   Providing documentation on how data is retrieved from Entry. Include your estimated data capacity.

   II.   Providing data collected by Entry within 24 hours of Entry recovery during the XPRIZE Site Visit, including imagery (Criterion F) and raw and processed bathymetry data (Criterion G).

D.   **<u>DEPTH CAPABILITY:</u>** Teams need to demonstrate that their Entry is capable of achieving the original Round 1 depth rating (2000 m).

<u>Verification:</u> Demonstration of the required depth rating can be achieved by completing one of the following:

    I.   Providing documentation of verified pressure tests of critical components. If Entry has commercial off-the-shelf components, manufacturer specifications of component depth ratings are acceptable. Teams have until 31 January, 2018 to submit this to XPRIZE.

   II.   Providing documentation (to include mission logs, depth sensor data, etc.) from a field trial to demonstrate 2000 m maximum depth achieved.

E.   **<u>ENDURANCE:</u>** Team needs to demonstrate that their Entry can meet the original Round 1 operational endurance.

<u>Verification</u>: Demonstration of endurance can be achieved by providing both:

    I.   Detailed power engineering plan with Energy Budget. This should include any manufacturer specifications of energy storage components.

   II.   Six hour operational submergence demonstration.

F.   **<u>IMAGERY:</u>** Team needs to demonstrate that their Entry can collect underwater images. There are no specific restrictions on the format of eligible image types.

<u>Verification:</u> Demonstration of Entry imaging capability can be accomplished by providing all of the following:

    I.   Documentation of the imaging systems used.

   II.   Photographs of the systems installed on the Entry.

  III.   Between 5 - 50 identifiable underwater images from the Entry imaging system collected during the XPRIZE Site Visit (include timestamp, location metadata).

G.   **MAPPING RESOLUTION:** Team needs to demonstrate that their Entry can meet the original Round 1 horizontal mapping resolution (5 m horizontal).

<u>Verification:</u> Demonstration of mapping resolution will be achieved by completing both of the following:

I.   Documentation of mapping sensor capabilities including error budgets (e.g. manufacturer specifications, peer reviewed literature, field trial results, etc.)
II. Production of a 3-D map during a field trial using the ESRI software platform. The 3-D map must consist of an area of at least 10 km^2. A minimum of 5% of the mapped area must be sampled at least twice.

H.   **NAVIGATION:** Team needs to demonstrate that their Entry can meet the original Round 1 navigational requirements (i.e. navigate from shore to specified location and return to shore).

<u>Verification:</u> Demonstration of the navigation capability can be achieved by providing:

I.   A mission planning demonstration and documentation of the navigation plan.

And completing one of the following:

II. Documentation from a mapping mission field trial with data and map showing navigation to specified waypoints.
III. Demonstration of surface navigation during XPRIZE site visit.

I.   **SEAWORTHINESS:** Team needs to demonstrate that their Entry is capable of operating and surviving at sea.

<u>Verification:</u> Demonstration of Entry seaworthiness can be achieved by completing the following:

I.   Demonstration of operations in the water for six hours, including launch and recovery.

J.   **SIZE AND WEIGHT**: Team needs to demonstrate that their Entry meets the size and weight specified in the Physical Requirements of Entry in the original Rules and Regulations.

<u>Verification</u>: Demonstration that an Entry will fit into a single International Standards Organization (ISO) Intermodal shipping container of 2.44 m (8 feet) wide by 2.59 m (8 feet 6 inches) high, and 12.19 m (40 feet) long and the maximum weight for any Entry Unit will be 27,000 kg can be accomplished by completing both of the following:

I.   Graphical documentation (e.g. engineering drawing) with Entry sizes or photographs to show all components required for original Round 1 field test can fit into a 40' container.

II.   Packing list of weight and sizes of all components required for original Round 1 field test.

K.   **SPEED:** Team needs to demonstrate that their Entry can meet the original Round 1 requirements to map at least 100 km^2 in 16 hours.

Verification: Demonstration of Entry speed can be accomplished by completing both of the following:

I.   Documentation of how Entry would achieve Round 1 minimum mapped area requirement.

II.   Demonstration of speed of Entry in water to accomplish Round 1 minimum mapped area.

Test Procedure

This test will take the form of a four day Site Visit visit by XPRIZE to a site selected by each Team. The Site Visit will comprise of a demonstration of the Team Entry that allows for the testing of the Round 1 Technology Readiness Criteria. Unless otherwise stated, data for all Criteria must be submitted to XPRIZE by the conclusion of the Site Visit. The format for the Site Visit is:

Day 1: Preparation Day

Day 2: Testing of Criteria

Day 3: Data Retrieval

Day 4: Weather Day

PREPARATION DAY: Teams will have one day to prepare their Entry to address the Round 1 Technology Readiness Test Criteria. This may include wet tests, lab tests, and any adjustments, repairs, and preparations necessary to ensure Entry is ready for testing. Teams may begin Testing of Criteria early if they are ready to proceed with their Team Test Plan during Preparation Day.

TESTING OF CRITERIA: Prior to arrival, XPRIZE will work with each Team to set up and schedule a Team Test Plan. The Team Test Plan will incorporate the verification options that Teams choose to demonstrate that their Entry meets the criteria. The Teams are advised to choose verification options that best collectively demonstrate that their Entry would have been operationally successful in Round 1. XPRIZE encourages Teams to test their Entry prior to the Site Visit.

This test does not require a comprehensive field trial meeting the original Round 1 operations criteria, i.e. XPRIZE does not require a full 2000 m depth field trial to pass these criteria. If you are conducting a field trial or wet test to any depth as part of your Entry development prior to 31 January, 2018, the XPRIZE Site Visit schedule may be coordinated to utilize that to verify the criteria.

Wet tests do not need to be conducted in deep-ocean environments. They may be conducted in near-shore, shallow-water environments (e.g. off a pier or beach), or in a lake. A written request to Test in any other type of water body may be permitted pending judges approval.

<u>DATA RETRIEVAL AND PROCESSING</u>: Teams will have up to 24 hours from recovery of Entry to retrieve, process and submit any data from their Entry to meet Criterion C: Data Retrieval.

<u>WEATHER DAY</u>: Supplemental day to allow for any wet test weather delays.

Environmental and Safety Regulations

Health safety and environment (HSE) are fundamental concerns in marine operations. Teams will:

- Comply with all existing environmental, health and safety regulations in the Team test site.
- Design their systems to avoid impact on marine life.
- NOT use nuclear reactor power sources or allow any emissions of chemical or biological pollutants.
- NOT influence or harm marine life in any way.
- Recover all equipment deployed within the Team test site.
- Research and obtain any necessary permits for operation in the Team test site.
- Document their approach to health safety and environmental compliance.

XPRIZE will have the final decision on all HSE factors and reserve the right to disqualify any Entry, or deny any action, that is determined to be an undue risk.

XPRIZE will make all determinations on safe and acceptable weather conditions for competition operations.

XPRIZE encourages and will seek to recognize innovations in technology that reduce HSE risk in marine operations.

Intellectual Property (IP) and Public Data Availability During Competition

The IP and Entries remain the property of the Teams. Details about IP rights are in the Competitor Agreement.

The only information that will be disclosed publicly (on the Team Portal, on the XPRIZE website, or otherwise) in connection with the Shell Ocean Discovery XPRIZE will be:

1. Bathymetric Maps submitted by Teams for Judging.
2. Images submitted by Teams for Judging.
3. Summary results and related point scores.

It is the intent of XPRIZE that none of the disclosed information will amount to a public disclosure of patentable technology under applicable law, as detailed in the Competitor Agreement. With regard to detailed information that Teams will provide to XPRIZE as part of judging the competition, that information will only be shared with XPRIZE employees and contractors and with technicians and judges involved in administering and/or judging the competition on a need-to-know basis. All such persons will be under nondisclosure agreements with XPRIZE, similar to the nondisclosure terms and conditions between XPRIZE and the Team. In addition to being used for judging, data from each Entry will be provided only to the Team who owns the Entry. This will occur at the conclusion of the competition, unless otherwise noted. Therefore, these disclosures should not amount to a public disclosure under applicable patent law. Teams will not have any other access to non-public information about other Teams or their technology or performance during the competition.