Powering the Blue Economy™

OCEAN OBSERVING PRIZE

AMERICAN MADE WATER PRIZE

U.S. DEPARTMENT OF ENERGY

NOAA

BUILD CONTEST

Official Rules Document

January 2022

Preface

The U.S. Department of Energy's Ocean Observing Prize will be governed by this Official Rules document, which establishes the prize rules and requirements for the BUILD Contest.

The Prize Administrator reserves the right to modify this Official Rules document if necessary and will publicly post any such notification as well as notify registered competitors.

The Pacific Northwest National Laboratory and the National Renewable Energy Laboratory are supporting the U.S. Department of Energy and the National Oceanic and Atmospheric Administration on the development and administration of this prize.

Date	Modification
May 21, 2021	• Revisions in Appendix E on dimensions and mounting points of DPPM. The CAD drawings have not changed.
June 10, 2021	• Revisions in Appendix E to remove the downward-facing constraint of the DPPM and provide clarity. • The CAD drawings have been slightly modified.
July 15, 2021	• Revisions to Appendix E to remove the requirement that the DPPM face must have no obstructions to its field of view and addition of improved DPPM images for clarity. • Deadline for requesting a second DPPM was extended. • In Section 3.5.2, Wave Profiles, Table 1. An omitted "a" superscript was added to TB2, meaning that only regular wavefields will be created for both TB2 and TB3.
October 7, 2021	• Revisions to Appendix L to specify that kill switches should be mechanical and should not rely on software.
January 6, 2022	• Revisions to the timeline to incorporate a delayed testing schedule, outlined in Section 3.6.1. • Added the safety plan requirement in Section 3.6.8 and Appendix J. • Added a description of the preliminary design review process in Section 3.6.4. • Added a distribution of competitor support, described in Section 3.6.5 and Appendix O.

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Acronym List

ADCP	acoustic Doppler current profiler
AUV	autonomous underwater vehicle
CAD	computer-aided design
CRADA	Cooperative Research and Development Agreement
CTD	conductivity, temperature, and depth
DOE	U.S. Department of Energy
DPPM	dummy payload and power monitor
GPS	Global Positioning System
IOOS	Integrated Ocean Observing System
MASK	maneuvering and seakeeping
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NSWCCD	Naval Surface Warfare Center, Carderock Division
TDR	Technical Design Review
WPTO	Water Power Technologies Office

1. Introduction

This prize program challenges innovators to integrate marine renewable energy with ocean observation platforms, revolutionizing our ability to collect the data needed to understand, map, and monitor the ocean.

This joint prize between the Water Power Technologies Office (WPTO) at the U.S. Department of Energy (DOE) and the U.S. Integrated Ocean Observing System (IOOS®) program at the National Oceanic and Atmospheric Administration (NOAA) seeks to develop new technologies that can help fill the data gaps that are currently making it difficult to realize the full potential of the blue economy.

The Ocean Observing Prize: DEVELOP Competition invites teams to compete for up to $2.4 million in cash awards through three contests by designing, building, and testing innovative, functionally viable prototype systems suitable for hurricane monitoring that incorporate wave energy harvesting for self-charging of autonomous underwater vehicles (AUVs). Prototypes emerging from this competition are not meant to be mature systems but should demonstrate basic functionality and potential for refinement into a commercially viable product.

As described in this document, the BUILD Contest invites DESIGN Contest prizewinners to build and test those designs in realistic ocean conditions within a world-class test facility.

1.1. BUILD Contest Summary – Up to Five Winners, $500,000 in Cash Prizes Split Evenly Between Winners

The BUILD Contest tasks the seven winners of the DESIGN Contest to build and test a functioning prototype of their design. Only these seven winning teams are eligible to participate in the BUILD Contest.

This document outlines the official rules for the BUILD Contest. Up to five awards totaling up to $500,000 will be awarded to winning teams at the end of the BUILD Contest. These winning teams will be eligible to participate in the subsequent SPLASH Contest.

BUILD Contest Key Dates

All dates are subject to change, and the most updated timeline is available on the HeroX website. Additional key dates to remain eligible to compete are noted within Section 3.6.1.

Accepting Submissions: April 19 through December 7, 2021

Tank Testing: Anticipated June 2022

Awards: Anticipated July 2022

1.2. Additional Terms and Conditions

Please see Appendix A for additional requirements. COMPETITORS THAT DO NOT COMPLY WITH THE ADDITIONAL TERMS AND CONDITIONS IN APPENDIX A MAY BE DISQUALIFIED.

2. Ocean Observing Prize Overview

The goals of the Ocean Observing Prize are to:

- **Enable collection of valuable new data.** Proposed innovations should increase the spatial coverage, temporal resolution, and/or types of ocean and atmospheric variables that can be observed, collected, processed, and transmitted, leading to improved understanding, monitoring, and management of the ocean.
- **Generate sufficient power from co-located marine resources.** Solutions must be able to generate sufficient power to meet the energy needs of end users from the ocean observing community and prove the viability of marine energy to power ocean observing.
- **Accelerate commercialization of marine energy systems.** Traditional development timelines of marine energy devices for the electrical grid can take many years to design, build, and test. By working at smaller scales and addressing ocean observing system energy needs, marine energy may find a faster path to commercialization.
- **Grow a diverse community of innovators.** This Prize will help bring new innovators into the marine energy and ocean observing space. It will also help form new partnerships and collaborations between industry, academia, and government in order to create innovative ocean observing technologies powered by marine energy.

The Competition is made up of three separate contests: DESIGN, BUILD, and SPLASH.

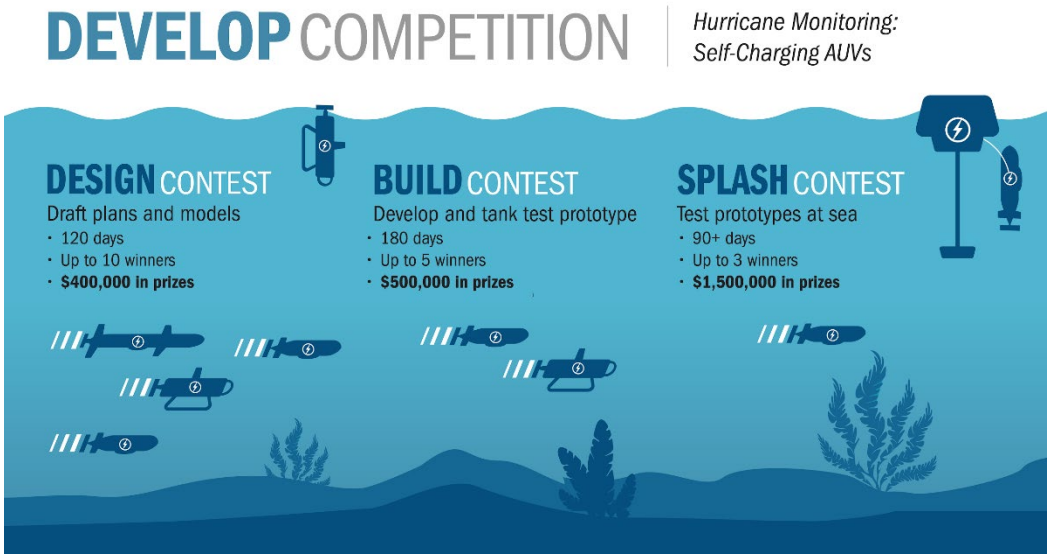

Figure 1: Ocean Observing Prize timeline

2.1. Mission Space

The technologies used for ocean observing are numerous and vary significantly in terms of function, size, cost, and power consumption. Examples include autonomous underwater vehicles, buoyancy gliders, profiling floats, weather and drifter buoys, and electronic tags on marine animals. Nearly all of these systems rely on batteries, but batteries are by definition temporary energy sources and must be recharged or replaced periodically. For systems that are operating far offshore or deep underwater for sustained periods, recharging a battery becomes a challenging and costly endeavor.

These energy limitations force ocean scientists to make tough choices between what sensors they can host on a platform, how much data they can collect, how often they can communicate with the system or relay the data back to shore, and how often they must visit it once deployed.

Ultimately, the Ocean Observing Prize will incentivize new solutions that integrate marine energy with ocean observing instruments, platforms, and systems that reduce or eliminate the energy constraints hindering our ability to effectively monitor and manage the ocean. Improved ocean observations fueled by marine energy sources can promote growth in the blue economy and help us better understand the ocean and its value to humankind.

> *"While modern AUVs are able to operate autonomously when on-mission and underwater, they still rely on manual intervention by a support vessel between individual missions…in situ recharging represents the next major evolution in subsea robotic capabilities. With these capabilities, future AUV systems will be able to reside at sites of interest for durations greater than a single mission, becoming Resident AUV (RAUV) systems."* [1]

Within the theme of buoys and autonomous systems there are many different ocean observing platforms serving a wide variety of missions. Through interviews of ocean scientists there emerged a clearly evident need to address the energy limitation of AUVs.

AUVs come in many different shapes and sizes and are used for numerous purposes, including subsea pipeline inspections, seafloor mapping, and fish tracking. Like electric cars, these systems are limited in their range and duration before their energy storage systems must be replenished. Unfortunately, replenishing energy storage systems on AUVs at sea is far more difficult and costly than it is for electric cars. This energy limitation constrains AUV missions. If an AUV had access to a reliable source of energy for self-charging without the need for human intervention, it would change this paradigm and help enable resident AUVs.

While a self-charging AUV would be a game-changer for a number of applications and missions, interviews with ocean scientists suggest that such a system could help close an important data gap in hurricane monitoring. The Competition is structured around this real-world need.

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[1] D. Manalang, J. Delaney, A. Marburg and A. Nawaz. 2018. "Resident AUV Workshop 2018: Applications and a Path Forward." Presented at the 2018 IEEE/OES Autonomous Underwater Vehicle Workshop (AUV), Porto, Portugal, 6–9 November 2018, doi: 10.1109/AUV.2018.8729720.

2.2. Competition Objectives

The primary objective of the Competition is to spur innovative designs that integrate wave energy harvesting with autonomous underwater vehicles. These designs could help ocean observing systems become more self-sufficient and create a missing but necessary capability in resident autonomous vehicles. A secondary objective of this competition is community building. Through cash awards and other incentives, the prize aims to bring together a diverse community of ocean scientists, roboticists, marine energy technologists, and others that creates an environment ripe for creative solutions.

In alignment with these objectives, the Competition attempts to bring together diverse, multidisciplinary teams to design, build, and test innovative, functionally viable systems that incorporate wave energy harvesting for self-charging of autonomous underwater vehicles. Prototypes emerging from this competition are not meant to be fully mature systems but should demonstrate basic functionality and potential for refinement into a commercially viable product that addresses a real-world challenge such as hurricane monitoring, as outlined in detail in Appendix K. Each of the three contests in the Competition is structured to help competing teams rapidly design and prototype their ideas while competing for cash prizes and other awards.

2.2.1. DESIGN Contest (CLOSED) – Seven Winners, $400,000 in Prizes

The DESIGN Contest, now concluded, tasked competitors to design systems that use ocean surface waves as an energy source for recharging autonomous underwater vehicles at sea for the purpose of monitoring hurricanes in the Atlantic. From the opening date, competitors had approximately 3 months to design systems that met the requirements as laid out in the Rules Document.

Submissions to the DESIGN Contest were reviewed by a panel of experts in wave energy, marine robotics, and ocean science to assess the design's potential. Seven awards totaling $400,000 have been made to high-scoring submissions as prizes for the DESIGN Contest. **Only these selected seven competing teams are eligible and encouraged to participate in the BUILD Contest,** where they will build and test their prototype designs in the controlled environment of a test facility.

If you're among those winners, congratulations! We look forward to seeing your submission to the BUILD Contest.

2.2.2. BUILD Contest – Up to Five Winners, $500,000 in Cash Prizes

The BUILD Contest tasks the seven winners of the DESIGN Contest to build and test a functioning prototype of their design. Only these seven winning teams are eligible to participate in the BUILD Contest.

Build Contest Key Dates

All dates are subject to change, and the most updated timeline is available on the HeroX website. Additional key dates and submission deadlines should be noted within Section 3.6.1.

2.2.3. SPLASH Contest – Up to Three Winners, $1.5 Million in Cash Prizes

The Competition will conclude with the SPLASH Contest, which will test prototypes in an at-sea environment. Winning teams from the BUILD Contest will have up to 6 months to refine their prototypes after the BUILD Contest concludes and will then have the opportunity to deploy and test their refined systems for approximately 1 week at sea to verify their performance in real-world conditions. Up to 3 awards totaling up to $1.5 million will be awarded to competitors at the end of the SPLASH Contest.

SPLASH Contest Anticipated Key Dates

All dates are subject to change.

Registration: Anticipated July 2022 through January 2023

Testing at Sea: Anticipated April 2023

Awards: Anticipated April 2023

3. BUILD Contest

3.1. Background

3.1.1. Overview of the BUILD Contest

The BUILD Contest invites DESIGN Contest prizewinners to build and test those designs in realistic ocean conditions at the maneuvering and seakeeping (MASK) basin at the Naval Surface Warfare Center, Carderock Division (NSWCCD), a world-class test facility in Bethesda, Maryland.

The goal of the BUILD Contest is to test promising technologies (see description in Appendix K) that can be tested in an open water environment in the subsequent SPLASH Contest. To meet contest requirements, competitors must:

- Submit the intent to compete disclosure
- Submit responses to the National Environmental Policy Act (NEPA) questionnaire
- Execute a Cooperative Research and Development Agreement (CRADA) with NSWCCD
- Complete a Technical Design Review (TDR)
- Submit a lift plan
- Submit a safety plan
- Submit a statement of work outlining the intended use of additional support funds
- Integrate the dummy payload and power monitor (DPPM) into the prototype
- Submit the necessary base access request forms
- Submit a prequalifying video
- Ship prototype equipment to test site with prearranged return shipping.

It is DOE's intent to prevent the release of any of these materials to the public. DOE will make a reasonable effort to protect these materials from public disclosure. Please see the section on the Freedom of Information Act under Appendix A for more info.

More details on specific deadlines, templates, and scoring for each element are included in Section 3.6.1.

3.2. Awards

During the BUILD Contest, the Prize Administration team will distribute an additional round of support funding to supplement competitor resources. This additional support will equate to $20,000 per team, and teams will be responsible for developing and submitting a scope of work for approval outlining how these funds will be spent. The evaluation criteria by which the scope of work will be reviewed is included in the following Section 3.3.1, and a description of the distribution process can be found in Section 3.6.5. A template for the scope of work can be found in Appendix O.

Following the competition, the Prize Administrators, judges, and facility staff will confer to evaluate the team and prototype performance and identify up to five prizewinners to split up to $500,000 total in prize awards. The Prize Administrators will notify prizewinners via email and request the necessary information to distribute cash prizes. The Prize Administrators and DOE will publicly announce winners.

3.3. Judging Process

3.3.1. Scoring

All submissions in the Ocean Observing Prize: BUILD Contest will be scored using the following 1-6 scale for both the supplementary funding and the final in-water test:

1	2	3	4	5	6
Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree

Submissions for the competitor Statement of Work will be evaluated against the following criteria. More specific information on the distribution process can be found in Section 3.6.5 and a submission template is available in Appendix O and on HeroX.

BUILD Contest Scope of Work Evaluation Criteria	
Suggested Content You Provide • Specific tasks, supplies, and or equipment the competing team plans to purchase or pursue.	**Each Statement Scored on 1–6 Scale** • The submitted Statement of Work provides adequate evidence that the additional support will be used in

• Detailed budget describing how the funds will be used to in alignment with the outlined tasks, supplies, and/or equipment • Proposed start and completion date for the proposed work.	furtherance of BUILD Contest preparedness • The proposed funding amounts are commensurate with the proposed outlined tasks, supplies, and/or equipment • The proposed work will be started within the BUILD Contest timeline

Performance during the final test will be scored both quantitatively and qualitatively. The quantitative scores from the on-site scoring sheet (Appendix N) will inform the reviewers' qualitative analysis of the performance of each competitor's prototype. The reviewers will score the following four statements according to the 1–6 scale:

1. Data – 15%

- The prototype, if deployed broadly, would increase the collection of oceanic and atmospheric data to inform improved understanding, monitoring, and management of the ocean. (Scored 1–6)

2. Maneuverability – 30%

- The prototype's demonstrated maneuverability shows capability to increase the spatial and temporal resolution of data to significantly improve NOAA modeling of hurricanes. (Scored 1–6)

3. Power – 40%

- The prototype generates sufficient power to meet the energy requirements of this contest as described in Appendix L and demonstrates the viability of marine energy to power the prototype. (Scored 1–6)

4. General Requirements – 15%

- The prototype and competitors' performance complies with the following sections of Appendix L (Scored 1–6)
    - Operations and Safety
    - Physical Characteristics and Principal Dimensions
    - Required Components

Each 1–6 score will be multiplied by the criterion weight to achieve a final score for each reviewer. During the on-site testing, four reviewers will score and provide comments for each prototype. The reviewers' scores and comments will then be provided to the judge. The reviewers will include experts in marine energy, naval architecture, undersea robotics, field operations, and hurricane science.

The judge will be the director of DOE's Water Power Technologies Office. The judge will consider the reviewers' scores and any relevant program policy factors and make the ultimate determination for awards. The cash prize purse will be split evenly among winning competitors.

The on-site scoring sheet for the BUILD contest is broken out into 80 technical criteria, which are categorized according to the four review criteria: Data, Maneuver, Power, and General. The on-site scoring sheet is included in Appendix N.

Awards will be reported to the participants in the weeks following the contest, per Section 3.6.1.

REVIEWER SCORES AND JUDGING DECISIONS ARE FINAL AND THERE IS NO PROCESS FOR APPEAL.

3.4. Expectations of Conduct

3.4.1. General Conduct

The Ocean Observing Prize is a forum for advancing ocean energy technologies for use in ocean observing systems and for fostering a community at the intersection of those two sectors. The prize is structured to protect intellectual property and competitive advantage for participants while creating a safe and equitable format for competition.

The BUILD Contest is the first opportunity for competitors to have their designs' performance judged in simulated conditions. Although competitors' schedules at the test facility will overlap, precautions will be in place to keep the competitors and their designs isolated from one another. The test facility itself will also require strict adherence to established procedures and access.

Competitors are ultimately responsible for the safety of their operations in accordance with their contract agreements with the test facility and will be held strictly accountable for adhering to the competition and facility safety guidelines. Safety violations are grounds for disqualification.

Teams must follow Occupational Safety and Health Administration rules for safety equipment based on expected activities. Any person on site may issue a stop-work order at any time during the project if a hazardous condition is identified.

Steel shipping containers outfitted as workspaces are available to competitors for staging their devices. These spaces, and all other test and work spaces at the test facility, shall be respected and returned to the organizers' possession in a clean, tidy, and timely fashion.

Competitors are expected to respect the space and privacy of other teams and of the test facility.

Finally, renewable energy and sustainability are a part of DOE culture. We encourage competitors to embrace and showcase sustainability where possible during all aspects of the event (e.g., reducing waste in packaging for shipping, reusing packaging materials used in transporting items to the competition, and eliminating the use of nonrecyclable materials such as foam packing peanuts). In addition, we encourage team members to engage in common sustainable activities such as recycling paper and utilizing reusable beverage containers. Team creativity to support this mission is encouraged, but not scored.

Teams are responsible for the transport of their marine energy device and all necessary tools and equipment, as well as any damage to or loss of such items. Shipping information to the test facility is available in Section 3.6.12 and Appendix G and return shipping will be coordinated with the Prize Administrators and the test facility at the time of shipment.

3.5. Test Facility

3.5.1. General Overview

Located in Maryland, the NSWCCD has been at the forefront of technologies vital to the success of the U.S. Navy and maritime industry. Since component organizations were founded at the turn of the 20th century, the Division has earned a distinguished reputation as the birthplace of superior naval technology.

NSWCCD provides cradle-to-grave support for technical products over an enormous range of scientific areas related to surface and undersea platforms. The division addresses the full spectrum of applied maritime science and technology, including theoretical and conceptual beginnings, design and acquisition, and implementation and follow-on engineering. This includes all technical aspects of improving the performance of ships, submarines, military watercraft, and unmanned vehicles, as well as research for military logistics systems. In addition, the Division is uniquely chartered by Congress to support America's maritime industry.

The MASK basin at Carderock is among the largest wave basins in the world. The freshwater basin is 110 m (360 ft) long, 73 m (240 ft) wide, and 6.1 m (20 ft) deep, and has a 10.7-m-deep (35-ft) by 15.2-m-wide (50-ft) trench parallel to the long side of the basin on the south side. The basin is spanned lengthwise by a 114.6-m (376-ft) bridge supported on a rail system that permits the bridge to traverse one-half the width of the basin and to rotate through angles up to 45 degrees from the longitudinal centerline of the basin.

The MASK basin is equipped with a wavemaker with 216 "finger"-type paddles along the west and north banks of the basin. The paddles operate as both wave generators and active wave absorbers. The wavemaker has a frequency range of 0.20 to 2.0 Hz and can generate regular waves from 0.4 to 32.0 m (1.6 to 105 ft) in length and up to 0.9 m (35 in) in height. The wavemaker can produce model sea spectra of any distribution up to 0.5 m (19 in), modal period-dependent, with the ability to create multidirectional and/or short-crested seas (spread). There are three entry points to the MASK basin: (1) via the MASK slip, 1.5-m (5-ft) wide by 0.7-m (2.5-ft) deep that leads directly into the MASK for float-in capability and is isolated by a moveable beach section; (2) crane access by the 5-ton overhead crane, with approved lift plan; or (3) hand launch via a limited-access pier with a two-step ladder to a 0.6-m-long (2-ft) by 1.8-m-wide (6-ft) platform near the water surface. With all entry points, a small boat will be used to assist in transiting and deploying each device.

Outside the MASK basin but within the building are two freshwater tanks to support the wet checks. The first tank is the aforementioned MASK slip for MASK entry. The second is the drop tank, which can allow designs up to 4.5-m (15-ft) wide, 7.3-m (24-ft) long, and 4.5-m (15-ft) deep. Overhead cranes can access both tanks to aid in operations, with an approved lift plan. Shore power of 110-V AC and 15 A is readily available; if more than that is required, it can be accommodated with prior approval from the Prize Administrators and NSWCCD Test Director. The indoor staging area will have adequate space to store each team's cart and allow for dry and wet checks to be performed with supervision from the Prize Administrators. More specific details on basin dimensions are available as a resource and in Appendix B.

3.5.2. Wave Profiles

Within the capabilities of the wave basin, the devices will be tested in a created Bretschneider spectrum:

$$S(\omega) = \frac{5}{16}\frac{\omega_m^4}{\omega^5}H_s^2 e^{-5\omega_m^4/4\omega^4}$$

where ω is the wave frequency in radians per second, ω_m is the most likely frequency of any given wave, and H_s is the significant wave height in meters. Here, a significant wave height means the average height of the highest one-third of all waves created.

The spectra created may have the following significant wave height (H_s) and energy period (T_e):

Table 1: Wave Spectra for the Wave Basin

Test Basin State	Significant Wave Height (m)	Energy Period (s)	Approximate Time for Each Wave Condition (%)
TB1	0.5	3	40%
TB2 [a]	0.5	5	10%
TB3[a]	1.0	3	50%

[a] Only regular wavefields will be created for this specific combination of H_s and T_e.

The Prize Administrators may choose spectral or monochromatic test basin states at various stages of the Day 3 tank tests and may change the order of the basin states relative to Table 1. Each competitor will be presented with the same test basin states in total.

3.5.3. Staging Area

The MASK basin parking lot will be used by the four teams concurrently on base at any one time. Facilities available will be a mix of Conex containers with heating and electrical power, tents, and an area open to the elements. Over 4 days, teams will rotate between the various facilities, and their staging equipment should be sufficiently mobile to be moved to a new staging area at the end of each day.

Given typical Maryland weather in January, teams are encouraged to prepare for cold inclement weather.

3.5.4. Test Facility Requirements

The objective of the safety program is to mitigate hazards that can cause injury to personnel, damage or loss of test equipment, and damage to test facilities. Primary emphasis is placed on personnel safety.

3.5.4.1. COVID-19 Precautions

Due to the current COVID-19 pandemic, teams must follow the guidelines set forth by the Commanding Officer and Technical Director. Guidelines will be provided shortly before on-site testing starts.

3.5.4.2. Security Procedures

There will be no photography or video recording of any nature by any competitors or visitors. Videography may be provided by the Prize Administrator. Only approved personal electronics are allowed on site at any time. All competitors and personnel are only allowed to access approved work areas and common areas as will be explained upon arrival by the NSWCCD Test Director or designee.

3.6. Competition Logistics

3.6.1. Timeline of Competition

Important dates including deliverables, deadlines, and events detailed in the following sections are summarized in Table 2. All dates are subject to change, in which case the Prize Administration team will modify the rules document and publish an updated timeline on HeroX; please follow the HeroX prize website for updates.

Table 2: BUILD Contest Deliverable Requirements and Deadlines

Date	Deadline/Deliverable/Event	Reference Section
04/19/2021	BUILD Contest launch	2.2.2, 3.1.1
05/31/2021	Deadline to submit disclosure of intent to compete	3.6.2, Appendix C
05/31/2021	Deadline to submit NEPA questionnaire	Appendices A, M and HeroX
07/31/2021	Deadline to have NSWCCD CRADA executed	3.6.3
11/19/2021	Deadline to complete preliminary design review and submit presentation to competition Box folder	3.6.4, Appendix D, HeroX
1/31/2022	Deadline for statement of work describing the use of additional support funding. Distribution of funds will follow.	3.3.1, 3.6.5, Appendix O, HeroX
2/2022	DPPM delivered to teams for integration into system	3.6.9, Appendix E, HeroX

3/4/2022	Deadline to submit safety plan	3.6.8, Appendix J
3/11/2022	Deadline to complete formal TDR and submit presentation to competition Box folder	3.6.6, Appendix D, HeroX
4/15/2022	Deadline to submit lift plan	3.6.7, Appendix I
4/15/2022	Deadline to submit response to safety and noncompliance issues (if applicable)	3.6.6
5/6/2022	Base access request form submission deadline	3.6.10, Appendix F, HeroX
5/6/2022	Deadline to upload prequalifying video submission	3.6.11
5/31/2022	Deadline for equipment delivery to the test site	3.6.12, Appendix G
5/31/2022	Prearranged return shipping finalized	3.4.1, 3.6.12
6/6/2022	On-site testing at NSWCCD begins (total duration 10 days)	4, Appendices B, N
7/2022	Awards notifications (anticipated)	3.2

3.6.2. Disclosure of Intent to Compete

To facilitate the planning and execution of the BUILD Contest, competitors must formally disclose their intent to compete (example in Appendix C) and submit an initial NEPA questionnaire (available in Appendix M) via email to the Prize Administrators at OceanObserving@nrel.gov no later than May 31, 2021. The email should clearly state:

- The team's name
- The technology's name
- The intent to compete at the test facility in June 2022
- Dates and times within the month of October or early November when representatives of the team will be available for a Technical Design Review (see Section 3.6.6).
- Completed NEPA questionnaire.

Although this disclosure is nonbinding, we ask entrants to respect the time and effort that go into supporting their entries, and only submit if they are confident that they will compete. Failure to notify Prize

Administrators of the intent to compete by email with the requisite content will constitute disqualification from the prize and ineligibility to receive a prize award. Entrants are encouraged to submit early.

Prize Administrators will confirm receipt of the letter and provide the teams with their anticipated test dates at the BUILD Contest.

An example letter is included in Appendix C, and the NEPA questionnaire is available in Appendix M.

3.6.3. NSWCCD Cooperative Research and Development Agreement

To explicitly establish the relationship between the parties involved in testing, including the handling of intellectual property, competitors will be asked to execute a CRADA with the test facility, NSWCCD. Once competitors have indicated their intent to participate in the BUILD Contest, they will be connected with the team at NSWCCD and provided a draft CRADA for review and approval. Teams unable to execute a CRADA with NSWCCD by July 31, 2021, may be deemed ineligible to compete in the BUILD Contest.

3.6.4. Preliminary Design Review

A preliminary design review will be conducted by the Prize Administration team early in the development process to ensure system compliance with the requirements outlined in Appendix L. This review will include technical subject matter experts and representatives from the testing facility, and responses to questions relevant to all teams will be published following the conclusion of all reviews.

This review will not be scored but will provide teams an opportunity to understand any safety or noncompliance issues with their system and prepare for the formal TDR in March.

3.6.5. Competitor Support Scope of Work

To ensure teams have the resources to build and test their devices at the conclusion of the BUILD Contest, the Prize Administration team will provide a one-time supplementary award of $20,000 to competing teams. This additional award can be used for activities that will support the development of BUILD Contest systems and could include, but is not limited to:

- Access to hardware and development tools
- Access to national laboratories, universities, and private laboratories
- Specialized facilities with additive, reductive, and digital manufacturing support
- Testing and validation capabilities
- Other expert services that may be negotiated between the winners and the lab, organization, or facility.

This list is not comprehensive but is intended to instead guide competitors on acceptable uses for these additional funds.

To receive this one-time supplementary payment, competitors are required to develop a statement of work on their intended use for these funds to be approved by the Prize Administration team. A template for the Competitor Support Scope of Work can be found in Appendix O and on HeroX. This scope of work

must be submitted to oceanobserving@nrel.gov by January 31, 2022, for the Prize Administration team to review and approve the uses for these funds and distribute payments to competitors.

3.6.6. Technical Design Review

A TDR conducted by the Prize Administration team, technical subject matter experts at the discretion of the Prize Administrators, and representatives of the testing facility will evaluate critical design components and system functionality. Please submit your design table and specifications sheet highlighting any changes your team has made since the DESIGN Contest submission and/or the preliminary design review. Your design must still meet all requirements from the DESIGN Contest (Appendix L). The purpose of the review is to ensure adherence to competition rules and facility regulations, and those designs that are deemed in violation of the facility rules and not in compliance with the specifications in Appendix L may constitute disqualification from the BUILD Contest.

The Prize Administrator reserves the right to ask competitors to resubmit any or all portions of the DESIGN Contest submission components.

Any safety or noncompliance issues with the DESIGN Contest System Requirements (Appendix L) identified by any of the reviewers must be addressed through a design change and the competitor must resubmit the relevant documentation to show that the team has addressed the deficiencies identified by the reviewers by April 15, 2022.

A slide deck containing the review agenda and template is available as a resource on HeroX. Competitors should use this template to structure their presentation, and a synopsis of the content required is included in Appendix D. Competitors should upload their presentations to the private competition Box folder in advance of their scheduled TDR. The review will be held through teleconferencing software and will be limited to 2 hours in duration. In the week immediately following the review, entrants will have an opportunity to respond to feedback provided by the review team during and immediately following the teleconference. A final determination on qualification resulting from the TDR will be made 1 week following its occurrence. For the safety of the competitors, facility staff, and prize staff, this decision is final and cannot be appealed.

3.6.7. Lift Plan

Teams shall provide a system lift plan that clearly documents lift points, load ratings, the weight of loads to be lifted, and any specific lifting hardware required, including but not limited to straps, slings, shackles, and taglines. NSWCCD may provide standard lifting hardware, but teams should be prepared to provide their own if any specific sling lengths or shackle sizes are required. The lift plan should be included in the TDR, and the lift plan documentation should be submitted by April 15, 2022. Appendix I contains an example of an appropriately documented lift plan. The NSWCCD facility will not lift anything without a lift plan.

3.6.8. Safety Plan

Each team is responsible for discussing the potential risks and hazards with regards to handling and testing their devices. A full safety plan must be completed by March 4, 2022, in advance of the TDR. The full safety plan template and additional critical information can be found in Appendix J.

Each potential risk will be clearly explained below (bulletized or table format) with the controls/mitigating safety features. For example:

Hazard	Type	Risk	Control / Mitigation
Lubrication Fluid	Hazmat	Risk to Eye	Don't put in eye
Mechanical Pinch Point	Mechanical	Pinch point	Clearly Label
Propeller	Mechanical	Cutting or abrasion	Kill Switch / Lock Out

All relevant hazards should follow OSHA guidelines, to include labelling and MSDS sheets. Please include an MSDS sheet for all fluids, not just those perceived as hazardous.

3.6.9. Dummy Payload and Power Monitor

The DPPM will be delivered to each team for integration into their system no later than February 2022. Teams shall show the DPPM successfully integrated and operational in their system in their video submission (see Section 3.6.11). Teams shall be prepared to remove the DPPM that was sent to them and install a separate competition unit on the morning of the tank test. For more information about the DPPM requirements, please refer to Appendix E and the DPPM specifications on HeroX. The expectation is that the DPPM will be compatible with the prototype system; however, if compatibility is overly burdensome, DOE will make a reasonable effort to work with competitors to find a solution to collect the necessary data. Teams will not be allowed to conduct any tank tests without a functional DPPM.

3.6.10. Base Access Requests

The test facility is on property owned and operated by the U.S. Navy. Getting onto the premises will require each competing team member that will be attending the tank test to be added to an approved visitors list approximately 1 month in advance of the contest date. Teams may change on-site members throughout the 4 days of testing, but due to facility occupancy restrictions, only three team members will be allowed on site at the same time.

Each team member wishing to come on base at any time must complete either Form 5512-1: U.S. Citizen Visit Request Form or Form 5512-6: Foreign National Visit Request Form (Appendix F), as appropriate.

Teams wishing to use computers on base must submit Form D5239-9: Personal Electronics Device (PED) Form (also in Appendix F). Cell phones do not require completion of Form D5239-9. No cameras or video recording devices are allowed on site and USB stick-type storage devices are strictly prohibited. All personal electronics must be disclosed to the organizers upon arrival for approval and to be briefed on where electronics are allowed to be operated.

All forms should be submitted to organizers at OceanObserving@nrel.gov no later than May 6, 2022. Please limit the number of personal and electronic devices to what is needed to complete the testing.

Additional detail on visitor information can be found on the test facility website.

3.6.11. Prequalifying Video Submission

Entrants shall submit a prequalification video via the private competition Box folder demonstrating reasonable progress toward readiness to complete their prototype development no later than May 6, 2022. Videos shall include all content included in Table 3 and be no less than 4 minutes and no longer than 10 minutes in duration.

Videos will be reviewed by the Prize Administration team and representatives of the testing facility and will be used as a final stage-gate for clearance prior to shipping. Video content will not be used in the judging of BUILD Contest scores; however, failure to submit a video containing the requisite information by May 6, 2022, may constitute disqualification from the prize and ineligibility to receive a prize award. Entrants are encouraged to submit early.

Table 3: Prequalifying Video Submission Requirements

Video Content	Suggested Duration
Overview of the dry, assembled, integrated prototype from multiple angles	1–3 minutes
Benchtop testing of any articulation or actuation of interest	1–3 minutes
Prototype(s) actuating and/or articulating in a water tank (no waves required)	1–3 minutes
Demonstrate that the DPPM fits within the hull and is integrated into the power/data system	1–3 minutes
Total video duration	**4–10 minutes**

3.6.12. Shipping

Competitors must make their own arrangements for the transport and/or shipment of their system to the test facility. The Prize Administration team is standing by to assist, but it is the sole responsibility of the team to ensure the prototype arrives on time.

Shipped dimensions and weight of the prototype container must be no larger than 1,165 mm × 2,400 mm × 1,220 mm and 500 kg. Items must be labeled indicating relevant contents (e.g., for lithium batteries) and handling instructions. Additional shipments to the facility for supplies, tools, and test article handling equipment are permissible and must be approved by the testing facility prior to shipping. These shipments must not exceed two double-pallet crates of 1,000 kg *total* combined weight.

Included in the packed materials, competitors must provide their own wheeled carts that securely and safely stow their system for transport to and from the tank. No carts will be provided by the test facility staff or prize staff, and competitors will be forbidden to carry loads larger than 15 kg to and from the tank unassisted by a cart, dolly, or similar. The cart will also be used when presenting the system to judges during the dry checks. Competitors must ensure that the cart/cradle allows relevant parts of the system to be accessible for judges to properly assess with reasonable effort.

Tracking numbers shall be provided to the Prize Administration team (OceanObserving@nrel.gov) and the testing facility coordinator (miguel.quintero1@navy.mil) at the time of shipment. **DO NOT SEND SITE ACCESS PERSONNEL FORMS (Appendix F) TO THESE EMAIL ADDRESSES.**

Shipments must be received no earlier than May 6, 2022, and no later than May 31, 2022. Neither DOE nor the national laboratories will be held responsible for shipping delays, and teams are encouraged to send their shipments with adequate time to reach the facility. Shipments must be addressed to:

Attn: Miguel Quintero
9500 MacArthur Blvd
Building 18 Room 170
West Bethesda, MD 20817

Prearranged return shipment from the facility is required. Please contact the Prize Administration team (OceanObserving@nrel.gov) and the test facility coordinator (miguel.quintero1@navy.mil) to arrange return shipping at time of shipment to the facility.

Please affix the provided Ocean Observing Prize shipping label to the outside of EVERY container being shipped to the facility (see Appendix G).

3.6.13. Test Event Presentations

Design Overview

Each team will be required to give a 30-minute presentation to a panel of reviewers in an inside office near the MASK basin at the outset of their individual Day 2 checks at NSWCCD. The presentation should cover:

- The team

- The design methodology and approach
- The system
- The build process, including challenges and how they were overcome
- Significant changes from design covered in the TDR
- Any noted deviations from the rules and requirements as described in this document and the DESIGN Contest rules document
- Commercialization plan.

3.6.14. Quick-Turn Data Visualizations

Throughout the test event, teams must be prepared to download vehicle and payload data and provide immediate visual representations and informative interpretations (quick-turn visualizations) of the newly collected data for the reviewers. Data download may be completed via wired or wireless connection (wireless will be scored higher). Preparation of the following data visualizations is required (data presentation format is at the discretion of the teams):

- Conductivity, temperature, and depth (CTD) data per position with timestamp
- Power to the dummy payload as a function of time
- Battery status (voltage, state of charge, and, if available, recharge rate)
- Comms log through all channels
- Vehicle data (position, speed, depth, etc.).

Teams are encouraged to provide a method for executing a quick check over wireless to confirm mission data were recorded without downloading the file.

4. On-Site Testing Event

Each team will be allotted 4 days at the facility. Teams will have access to the facility 8 a.m.–6 p.m. local time. Competitors must be **off campus** by the 6 p.m. deadline with no exceptions. The outline of the test schedule for each team is shown in Tables 4 and 5, and brief descriptions of each activity is described in Appendix N. The schedule is subject to change at any time by the test facility or Prize Administrators. Teams will be staggered such that only one team's system will be tested in the tank at one time.

Table 4: Tentative Schedule for On-Site Testing

Day	Activities
1	**Check-In and Staging** 0800 – Teams check in at facility 0900 – Mobilization/uncrating and staging for testing
2	**Dockside**

	0800 – Mobilization 0900 – Presentation 0930 – Dockside demonstrations: Dry Check, Pre-Dive check, Wet Check
3	**Tank Test** 0800 – Pre-Dive Check 0900 – Tank demonstrations: Maneuvering, Recharge, optional Integrated Test 1700 – Post-dive checks, Post-Mission Analysis
4	**Demobilization** 0800 – Post-Mission Analysis 0900 – Demobilization – crating and staging for shipping

Table 5: Potential Competitor Schedule

June 2022														
6	7	8	9	10	13	14	15	16	17	20	21	22	23	24
M	T	W	R	F	M	T	W	R	F	M	T	W	R	F
Team 1														
		Team 2												
				Team 3										
						Team 4								
									Team 5					
										Team 6				

4.1. Day 1: Check-In and Staging

Day 1 is scheduled for check-in, unpacking, and mobilization of the prototypes.

Upon arrival at the facility, teams will check in with facility security and proceed to their designated staging area. Teams will confirm all their shipped containers are present and begin mobilizing their system, staging their equipment on the required cart for transport into the test facility on Day 2. If a team requires more than 10 hours to complete mobilization of their system, arrangements must be made with the Prize Administrators at least 3 weeks ahead of time. Teams may request up to 24 hours to assemble

and prepare the system for testing, split over multiple days and during hours where access on base is allowed. The clock for mobilization time begins with the opening of base (8 a.m.) on Day 1 (or per previous arrangement with staff). Forklifts and other facility heavy lift equipment can be made available upon request (and require preapproved lift plans; see sample in Appendix I), though teams are encouraged to develop mobilization protocols that can be deployed without such equipment.

It is up to the teams to ensure that they can be mobilized and ready for checks and trials in time, per the schedule in Table 4. Any delays are the responsibility of the team, and will cut into time that they can spend in checks or trials; lost time may mean the inability of a delayed team to participate in later checks or trials of the contest. With checks and trials staggered across the various teams, there likely are no extensions possible. Given DOE's interest in furthering the technology, the Prize Administrators will make reasonable efforts to allow teams to maximize their time in the testing facility. The Prize Administrator understands that unforeseen events may occur and may ask teams to be flexible to maximize the utility of this opportunity for all competitors.

4.2. Day 2: Dockside

Day 2 is scheduled for final mobilization efforts, dry check, pre-dive check, and wet check.

Teams will complete any final mobilization tasks and transport their system on their supplied cart into the test facility. The Ocean Observing Prize reviewers will assess the team's system on three "dockside" test checks. Dry check assesses compliance with physical requirements and basic system specifications. During dry check, teams will present their design presentation detailed in Section 3.6.13. Pre-dive check assesses basic functionality of all subsystems (e.g., communications, command execution, propulsion, payload, and other peripheral functionality). Wet check assesses buoyancy and system functionality in a static water tank.

4.3. Day 3: Tank Test

Day 3 is scheduled for tank trials, specifically maneuvering and recharge tests.

Teams will be given time to complete pre-dive system checks prior to launch. Reviewers will assess system performance in the areas of maneuvering, recharge, and post-tank-test system functionality. Scoring will encourage efficiency and expediency in executing the expected tasks. Throughout the day, judges will request mission data download and data visualizations to exercise the expected communications capabilities. Teams are required to demonstrate quick-turn mission data display to facilitate efficient assessments of post-mission data analysis (see Section 3.6.14). Such data demonstrations will have a time limit for all teams.

4.4. Day 4: Demobilization

Day 4 is scheduled for demobilization, packing, and coordinating to have all materials shipped back off base.

Any post-mission data analysis that was not completed on Day 3 may be completed and presented on Day 4. During demobilization, teams are expected to transport their equipment back to their designated

staging area and pack equipment back into shipping crates in the most efficient manner possible. Day 5 site access may be requested to prepare return shipments appropriately; however, teams requiring longer than 24 hours total elapsed time to demobilize may be penalized in scoring. Prearranged return shipment from the facility is required. Please contact miguel.quintero1@navy.mil to arrange return shipping.

Materials left on base after the close of the competition may be destroyed at the team's expense.

4.5. Travel and Accommodations

The Washington, D.C., area is a popular tourist destination with many lodging options. However, there are no hotels within walking distance of the test site. Though there is a public transit route from the Bethesda Metro station to the test facility, given the strict hours of the test facility and the likelihood for a need to transport bulky items, competitors are encouraged to rent a vehicle for convenient transit between hotels and the test facility.

Three areas near the test site to consider for lodging are Tyson's Corner, Chevy Chase, and Georgetown. Please note that traffic in the Washington, D.C., area can significantly increase transit times during peak rush hour (7:30–9 a.m. and 3–5 p.m. local time).

There are three airports that serve the Washington, D.C., area: Reagan Washington National Airport (DCA), Dulles International Airport (IAD), and Baltimore/Washington International Thurgood Marshall Airport (BWI).

Competitors will receive reimbursement for some travel expenses incurred for the BUILD Contest. More specific details will be provided closer to the contest date.

4.6. COVID-19 Contingencies

Particularly in light of the ongoing global pandemic, the Prize Administrators reserve the right to alter test plans and dates as needed to comply with facility health and safety requirements and travel restrictions.

4.7. BUILD Contest Eligibility Requirements

The competition is open only to winning teams of the Ocean Observing Prize DESIGN Contest as named by DOE.

DOE employees, employees of sponsoring organizations, members of their immediate families (i.e., spouses, children, siblings, or parents), and persons living in the same household as such persons, whether or not related, are not eligible to participate in the prize. Federal entities and federal employees, acting within the scope of their employment, are also not eligible to participate in any portion of the prize. DOE national laboratory employees cannot compete in any stage of the prize. Individuals working under a competing entity may participate if they are legally allowed to work in the United States.

BEST OF LUCK TO ALL COMPETITORS!

Appendix A: Additional Terms and Conditions

Universal Contest Requirements

Your submissions are subject to following terms and conditions:

- You must upload the final content of your submission by the dates noted in Section 3.6.1 to the private competition Box folder. Any other form of submission will not be accepted. Late submissions will not be accepted.
- By clicking "Submit" in HeroX, the competitor is agreeing to make their video and cover page public.
- The narrative, modeling documentation, letters of commitment/support, and résumés are not intended to be made public, however, see Additional Terms & Conditions regarding the Records Retention and Freedom of Information Act.
- You must include all the required submission's elements. The Prize Administrator may disqualify your submission after an initial screening if you fail to provide all required submission elements. Competitors may be given an opportunity to rectify submission errors due to technical challenges or to fix non-substantive mistakes or errors in their submission packages.
- Your submission must be in English and in a format readable by Microsoft Word or a PDF viewer. Handwritten submissions will be disqualified.
- Submissions and competitors will be disqualified if any engagement with the Ocean Observing Prize—included but not limited to the submission, the HeroX forum, or emails to the Prize Administrator—contains any matter that, in the sole discretion of DOE or NREL, is indecent, obscene, defamatory, libelous, lacking in professionalism, or demonstrates a lack of respect for people or life on this planet.
- If you click "Accept" on the HeroX platform and register for any of the contests described in this document, you are agreeing to be bound by these rules in addition to the existing HeroX Terms of Use for all purposes relating to these contests. You should print and keep a copy of these rules. These provisions apply only to the contests described here and no other contests on the HeroX platform or anywhere else.
- As part of your submission to this prize program, you will be required to sign the following statement:

  I am providing this submission package as part of my participation in this prize. I understand that I am providing this submission to the Federal Government. I certify under penalty of perjury that the named competitor meets the eligibility requirements for this prize competition and complies with all other rules contained in the Official Rules document. I further represent that the information contained in the submission is true and contains no misrepresentations. I understand false statements or misrepresentations to the Federal Government may result in civil and/or criminal penalties under 18 U.S.C. § 1001 and § 287

Verification for Payments

The Prize Administrator will verify the identity and role of all competitors before distributing any prizes. Receiving a prize payment is contingent upon fulfilling all requirements contained herein. The Prize Administrator will notify winning competitors using provided email contact information for the individual or

entity that was responsible for the submission. Each competitor will be required to sign and return to the Prize Administrator, within 30 days of the date on the notice, a completed NREL Request for ACH Banking Information form and a completed W-9 form (https://www.irs.gov/pub/irs-pdf/fw9.pdf). In the sole discretion of the Prize Administrator, a winning competitor will be disqualified from the competition and receive no prize funds if: (i) the person/entity does not respond to notifications; (ii) the person/entity fails to sign and return the required documentation within the required time period; (iii) the notification is returned as undeliverable; (iv) the submission or person/entity is disqualified for any other reason as specified in Section 4.7.

In the event of a dispute as to any registration, the authorized account holder of the email address used to register will be deemed to be the competitor. The "authorized account holder" is the natural person or legal entity assigned an email address by an internet access provider, online service provider, or other organization responsible for assigning email addresses for the domain associated with the submitted address. All competitors may be required to show proof of being the authorized account holder.

Teams and Single-Entity Awards

The Prize Administrator will award a single dollar amount to the designated primary submitter, whether consisting of a single or multiple entities. The primary submitter is solely responsible for allocating any prize funds among its member competitors or teammates as they deem appropriate. The Prize Administrator will not arbitrate, intervene, advise on, or resolve any matters or disputes between team members or competitors.

Submission Rights

By making a submission and consenting to the rules of the contest, a competitor is granting to DOE, the Prize Administrator, and any other third parties supporting DOE in the contest, a license to display publicly and use the parts of the submission that are designated as "public" for government purposes. This license includes posting or linking to the public portions of the submission on the Prize Administrator or HeroX applications, including the contest website, DOE websites, and partner websites, and the inclusion of the submission in any other media worldwide. The submission may be viewed by the DOE, Prize Administrator, and judges and reviewers for purposes of the contests, including but not limited to screening and evaluation purposes. The Prize Administrator and any third parties acting on their behalf will also have the right to publicize competitors' names and, as applicable, the names of competitors' team members and organization, which participated in the submission on the contest website indefinitely.

By entering, the competitor represents and warrants that:

1. Competitor's entire submission is an original work by competitor and competitor has not included third-party content (such as writing, text, graphics, artwork, logos, photographs, likeness of any third party, musical recordings, clips of videos, television programs or motion pictures) in or in connection with the submission, unless (i) otherwise requested by the Prize Administrator and/or disclosed by competitor in the submission, and (ii) competitor has either obtained the rights to use such third-party content or the content of the submission is considered in the public domain without any limitations on use.
2. Unless otherwise disclosed in the submission, the use thereof by Prize Administrator, or the exercise by Prize Administrator of any of the rights granted by competitor under these rules, does not and will not infringe or violate any rights of any third party or entity, including, without

limitation, patent, copyright, trademark, trade secret, defamation, privacy, publicity, false light, misappropriation, intentional or negligent infliction of emotional distress, confidentiality, or any contractual or other rights;

3. All persons who were engaged by the competitor to work on the submission or who appear in the submission in any manner have:
    a. Given the competitor their express written consent to submit the submission for exhibition and other exploitation in any manner and in any and all media, whether now existing or hereafter discovered, throughout the world;
    b. Provided written permission to include their name, image, or pictures in or with the submission (or, if a minor who is not competitor's child, competitor must have the permission of the minor's parent or legal guardian) and the competitor may be asked by the Prize Administrator to provide permission in writing;
    c. Not been and are not currently under any union or guild agreement that results in any ongoing obligations resulting from the use, exhibition, or other exploitation of the submission.

Copyright

Each competitor represents and warrants that the competitor is the sole author and copyright owner of the submission; that the submission is an original work of the competitor or that the competitor has acquired sufficient rights to use and to authorize others, including DOE, to use the submission, as specified throughout the rules; that the submission does not infringe upon any copyright or any other third-party rights of which the competitor is aware; and that the submission is free of malware.

Contest Subject to Applicable Law

All contests are subject to all applicable federal laws and regulations. Participation constitutes each participant's full and unconditional agreement to these Official Contest Rules and administrative decisions, which are final and binding in all matters related to the contest. This notice is not an obligation of funds; the final award is contingent upon the availability of appropriations.

Resolution of Disputes

The U.S. Department of Energy is solely responsible for administrative decisions, which are final and binding in all matters related to the contest.

Neither the U.S. Department of Energy nor the Prize Administrator will arbitrate, intervene, advise on, or resolve any matters between team members or among competitors.

Publicity

The winners of these prizes (collectively, "winners") will be featured on the DOE and NREL websites.

Except where prohibited, participation in the contest constitutes each winner's consent to DOE's and its agents' use of each winner's name, likeness, photograph, voice, opinions, and/or hometown and state information for promotional purposes through any form of media worldwide, without further permission, payment, or consideration.

Liability

Upon registration, all participants agree to assume any and all risks of injury or loss in connection with or in any way arising from participation in this contest. Upon registration, except in the case of willful misconduct, all participants agree to and, thereby, do waive and release any and all claims or causes of action against the federal government and its officers, employees, and agents for any and all injury and damage of any nature whatsoever (whether existing or thereafter arising, whether direct, indirect, or consequential, and whether foreseeable or not), arising from their participation in the contest, whether the claim or cause of action arises under contract or tort.

In accordance with the delegation of authority to run this contest delegated to the director of the Water Power Technologies Office, the director has determined that no liability insurance naming DOE as an insured will be required of competitors to compete in this competition per 15 USC 3719(i)(2). Competitors should assess the risks associated with their proposed activities and adequately insure themselves against possible losses.

Records Retention and Freedom of Information Act

All materials submitted to DOE as part of a submission become DOE records and are subject to the Freedom of Information Act. The following applies only to portions of the submission not designated as public information in the instructions for submission. If a submission includes trade secrets or information that is commercial or financial, or information that is confidential or privileged, it is furnished to the Government in confidence with the understanding that the information shall be used or disclosed only for evaluation of the application. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act. Without assuming any liability for inadvertent disclosure, DOE will seek to limit disclosure of such information to its employees and to outside reviewers when necessary for review of the application or as otherwise authorized by law. This restriction does not limit the Government's right to use the information if it is obtained from another source.

Submissions containing confidential, proprietary, or privileged information must be marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose.

The submission must be marked as follows and identify the specific pages containing trade secrets, confidential, proprietary, or privileged information:

> <u>Notice of Restriction on Disclosure and Use of Data:</u>
>
> Pages [list applicable pages] of this document may contain trade secrets, confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes. [End of Notice]

The header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: "Contains Trade Secrets, Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure." In addition, each line or paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets.

Competitors will be notified of any Freedom of Information Act requests for their submissions in accordance with 29 C.F.R. § 70.26. Competitors may then have the opportunity to review materials and work with a FOIA representative prior to the release of materials.

Privacy

If you choose to provide HeroX with personal information by registering or completing the submission package through the contest website, you understand that such information will be transmitted to DOE and may be kept in a system of records. Such information will be used only to respond to you in matters regarding your submission and/or the contest unless you choose to receive updates or notifications about other contests or programs from DOE on an opt-in basis. DOE and NREL are not collecting any information for commercial marketing.

General Conditions

DOE reserves the right to cancel, suspend, and/or modify the contest, or any part of it, at any time. If any fraud, technical failures, or any other factor beyond DOE's reasonable control impairs the integrity or proper functioning of the contests, as determined by DOE in its sole discretion, DOE may cancel the contest.

Although DOE may indicate that it will select up to several winners for each contest, DOE reserves the right to only select competitors that are likely to achieve the goals of the program. If, in DOE's determination, no competitors are likely to achieve the goals of the program, DOE will select no competitors to be winners and will award no prize money.

Program Policy Factors

While the scores of the expert reviewers will be carefully considered, it is the role of the prize judge to maximize the impact of contest funds. Some factors outside the control of competitors and beyond the independent expert reviewer scope of review may need to be considered to accomplish this goal. The following is a list of such factors. In addition to the reviewers' scores, the below program policy factors may be considered in determining winners:

- The degree to which the proposed project incorporates diversity, equity, and inclusion elements, including but not limited to team members from Minority Serving Institutions (e.g. Historically Black Colleges and Universities (HBCUs)/Other Minority Institutions), Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, or members within underserved communities.
- Geographic diversity and potential economic impact of projects.
- Whether the use of additional DOE funds and provided resources are non-duplicative and compatible with the stated goals of this program and the DOE mission generally.
- The degree to which the submission exhibits technological or programmatic diversity when compared to the existing DOE project portfolio and other competitors.
- The level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers.
- The degree to which the submission is likely to lead to increased employment and manufacturing in the United States or provide other economic benefit to U.S. taxpayers.

- The degree to which the submission will accelerate transformational technological, financial, or workforce advances in areas that industry by itself is not likely to undertake because of technical or financial uncertainty.
- The degree to which the submission supports complementary DOE funded efforts or projects, which, when taken together, will best achieve the goals and objectives of DOE.
- The degree to which the submission expands DOE's funding to new competitors and recipients who have not been supported by DOE in the past.
- The degree to which the submission enables new and expanding market segments.
- Whether the project promotes increased coordination with nongovernmental entities for the demonstration of technologies and research applications to facilitate technology transfer.

National Environmental Policy Act (NEPA) Compliance

DOE's administration of the American Made Challenges: Ocean Observing Prize is subject to NEPA (42 USC 4321, et seq.). NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at http://nepa.energy.gov/.

While NEPA compliance is a federal agency responsibility and the ultimate decisions remain with the federal agency, all participants in the BUILD Contest will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their participation in the prize competition. Participants may be asked to provide DOE with information on fabrication and testing of their device such that DOE can conduct a meaningful evaluation of the potential environmental impacts.

Return of Funds

As a condition of receiving a prize, competitors agree that if the prize was made based on fraudulent or inaccurate information provided by the competitor to DOE, DOE has the right to demand that any prize funds or the value of other non-cash prizes be returned to the government.

Definitions

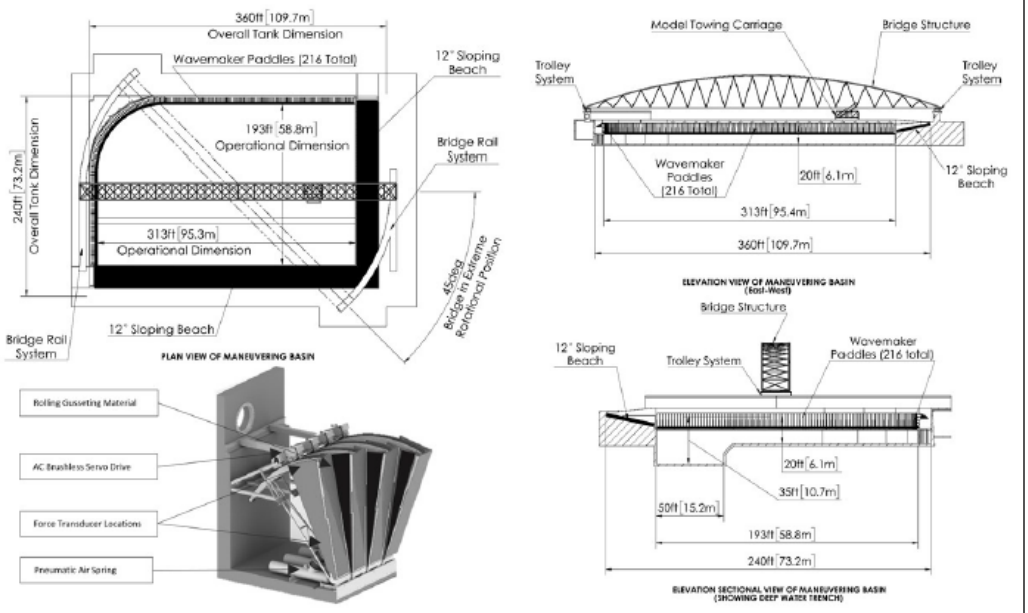
Prize Administrator means both the Alliance for Sustainable Energy LLC operating in its capacity under the Management and Operating Contract for the National Renewable Energy Laboratory (NREL), and the U.S. Department of Energy. When the Prize Administrator is referenced in this document, it refers to staff from both the Alliance for Sustainable Energy, staff working at the Pacific Northwest National Laboratory and U.S. Department of Energy. Ultimate decision-making authority regarding contest matters rests with the Director of the Water Power Technologies Office.

ALL DECISIONS BY DOE ARE FINAL AND BINDING IN ALL MATTERS RELATED TO THE CONTEST.

Appendix B: MASK Basin Dimensions and Safety Procedures

A PDF of this file is also available as a resource on HeroX.

MANEUVERING AND SEAKEEPING BASIN (1961/2013)



DESCRIPTION OF WAVE BASIN: Indoor basin, overall length 110 m (360 ft), overall width 73 m (240 ft), depth 6.1 m (20 ft) with a 10.7 m (35 ft) deep by 15.2 m (50 ft) wide trench parallel to the long side of the basin on the south side. Large underwater viewing windows are located in the basin wall. Water kept photographically clear by recirculating filters. Overhead catwalks and camera platforms are available for observation, photography and video. Overhead cranes located in fitting areas and over basin centerline.

BEACH TYPE & LENGTH: Wave absorbers are a discontinuous 12 deg slope style type made up of seven permeable layers of rectangular precast concrete bar panels resting on an impermeable beach. They are located along the full length of the two sides of the basin opposite the wavemaker units. Beach absorption is on average 97% effective, worse case being 92% at 0.28 Hz. Results based on studies by Herbich and Bowers (1957).

DESCRIPTION OF BRIDGE: Basin is spanned lengthwise by a 114.6 m (376 ft) bridge supported on a rail system that permits the bridge to traverse one-half the width of the basin and to rotate through angles up to 45 degrees from the longitudinal centerline of the basin. Tracks attached to the bottom of the bridge support the towing carriage, bridge width is constant 6.1 m (20 ft).

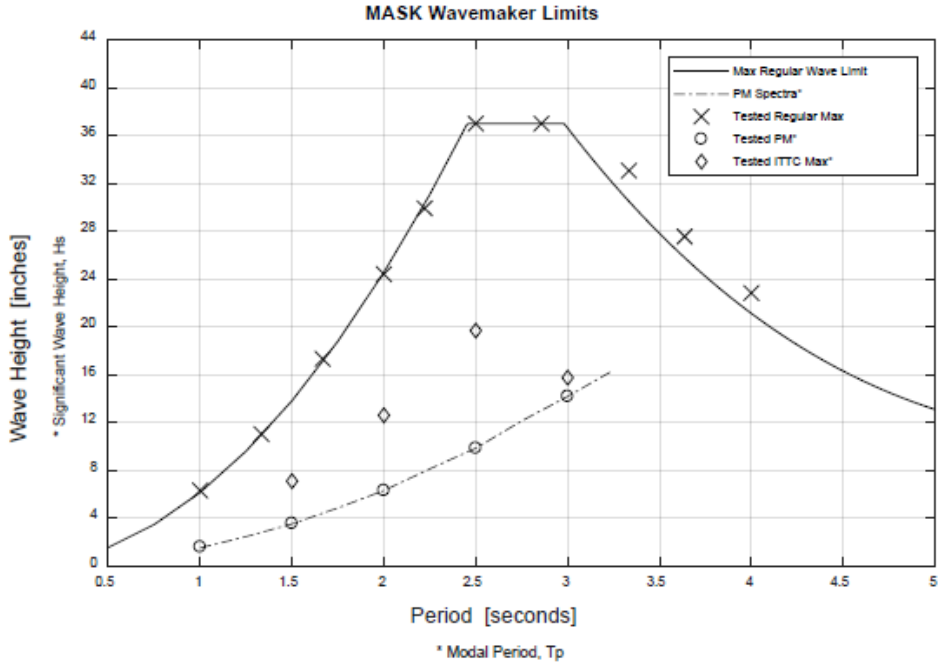
DESCRIPTION OF CARRIAGE: A 6.1 m (20 ft) wide by 6.6 m (21.8 ft) long by 2 m (6.76 ft) high towing carriage is hung from the bridge. This 147 kN (16.5 ton) carriage has a maximum speed of 7.7 mps (15 knots) and is driven by a pair of opposing traction wheels powered by 93 kW (125 Hp) electric motors thru a worm gear drive.

DESCRIPTION OF WAVEMAKER: 216 "Finger" type paddles, 2.5 m (8.2 ft) hinge depth, with a width of 0.658 m (26 in) along the west and north banks of the basin. Each wavemaker paddle has a 3.46 kW (4.64 Hp) electric motor, producing motions thru a toothed-belt on a circular-sector. To minimize generation of singularities, the wavemaker has a curved corner with 60 paddles, with 106 on the long side and 50 on the short side. The paddles operate both as a wave generator and active wave absorber.

WAVEMAKER CAPABILITY: The wavemaker has a frequency range of 0.20 to 2.0 Hz and can generate regular waves from 0.4 to 32.0 m (1.6 to 105 ft) in length and up to 0.97 m (38 in) in height. The wavemaker can produce model sea spectra of any distribution up to 0.5 m (19 in), modal period dependent. The attached wavemaker limit plot shows the maximum regular waves, maximum Pierson–Moskowitz spectra, and maximum ITTC spectra tested by the MASK wavemaker. Spatial variability across majority of the usable testing area and repeatability at a single point is within 5% accuracy (Quintero and Lee 2019). Consultation with a MASK testing engineer can provide further details on limits for specific wave testing requirements.

DIRECTIONAL AND UNIQUE CAPABILITIES: The wavemaker can produce multi-directional and short-crested seas. This includes multiple sea systems coming at ±45 deg headings from the short or long banks, as well as short-crested seas at a prescribed spreading. Deterministic time histories can be produced in the operational area of the basin along with wave grouping and episodic events. All wave programs can be pre-viewed prior to generation on the computer monitor using the Virtual Wavemaker, which is the hub of the wave synthesis software.

MANEUVERING AND SEAKEEPING BASIN (1961/2013)



WAVE MEASUREMENT: There are six single point ultrasonic transducers and one directional array consisting of twelve ultrasonic transducers permanently installed along the MASK bridge. Supplemental ultrasonic transducers and capacitance rods are available for use as needed.

MODEL SIZE RANGE: 3 - 9 m (10 - 30 ft)

INSTRUMENTATION: Heave measuring apparatus, pitch-yaw-roll measuring gyros, inertial measurement units, force balance dynamometers, model propeller torque and thrust transmission dynamometers, accelerometer sensors, rate sensors, carriage mounted tug sensors to support tethered models, ultrasonic transducers for distance/elevation measurement, capacitive water elevation rods, acoustic velocity measurements, wireless communications to support free running maneuvering and seakeeping models.

POWER AVAILABILITY: Carriage Power: 7.5 – 200 volts AC, 14 amps max; 0-400 volts DC, 75 amps max.; 5 kVA 3-phase solid state variable frequency, 15-400 Hz

MODEL TRACKING TECHNIQUES: Carriage mounted encoders track the carriage position along the MASK bridge, Ultra Wide Band system to track x- and y- position in the MASK basin, carriage mounted 6 DOF motion tracking

TESTS PERFORMED:

- Maneuvering Experiments
- Seakeeping And Propulsion Experiments At Various Headings And Loading Conditions In Waves
- Motions And Loads On Ships, Floating Structures And Buoys
- Dynamic Stability And Capsizing Studies
- Free Running Surface Ship And Submarine Experiments
- Slamming Studies
- Autonomous Surface and Submarine Experiments
- Wave Energy Conversion (WEC) Experiments

Published Documents:

- Brownell, W. F., "Two New Hydromechanics Research Facilities at the David Taylor Model Basin", DTMB Report 1690, Dec 1962 (presented to SNAME Chesapeake Section Meeting).
- Hackenberg, D. and Harper, R., "NSWCCD Maneuvering and Seakeeping Basin (MASK) Wavemaker Fabrication and Installation", The 29th American Towing Tank Conference, Annapolis, MD, Aug 2010.
- Hayden, D. D. and Hoyt, J. G. III., "Naval Surface Warfare Center's Wavemaker Modernization Program", The 29th American Towing Tank Conference, Annapolis, MD, Aug 2010.
- Quintero, M. R. and Lee, S. A., "Maneuvering and Seakeeping Basin Wave Characterization Study", Naval Surface Warfare Center - Carderock Division, Technical Report NSWCCD-80-TR-2019/017, July 2019.
- Herbich, J. B. and Bowers, C. E., "An Experimental Study of Wave Absorbers." St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Project Report 54. Jan 1957.

Facility Safety Procedures

All test personnel must promptly report injuries, near misses, hazards, and potential hazards to the NSWCCD Test Director and Prize Administrators during a shift. At any time, any test team participant is empowered to stop testing if safety is believed to be in jeopardy. If a point of disagreement occurs on a safety issue, the immediate supervisor or proper safety personnel will be notified. No reprisals will be allowed for safety concerns raised by any personnel.

All personnel and visitors are expected to comply with these general workplace safety rules. Visitor safety briefs will be conducted as necessary to convey these rules.

Personal protective equipment such as safety shoes, safety glasses, hearing protection, and personal protective floatation devices are to be used in accordance with posted instructions. Personal flotation devices must be worn at all times when operating outside of safety rails in the test basins as well as when in support craft used for model rigging, servicing, and towing. United States Coast Guard-approved personal flotation devices are supplied by NSWCCD facilities personnel. Clothing and personal protective equipment appropriate to the operation or task shall be worn. Loose clothing such as neckties, rings, wristwatches, etc., will not be worn in the vicinity of machinery with moving or rotating parts or exposed to electric current-carrying components.

Red mushroom emergency stops are located on each of the 27 electronic cabinets along the wavemaker's upper catwalk along with one downstairs and one upstairs in the wavemaker/model control room. These are intended for test team and facility operator usage to stop operations due to imminent danger to the wavemaker or model. Access to the wavemaker's upper catwalk while the wavemaker is operational is permissible provided all flooring panels are in place. Access to the shelf level of the wavemaker, the area behind the paddles, is strictly forbidden except for authorized personnel, and then only while the wavemaker is not operational. Operational lockouts are provided at each access door to the shelf level to keep the wavemaker from starting when they are opened. Safe operating procedures require these doors to remain open while personnel are on the shelf level and are to be closed only by those exiting the shelf.

Appendix C: Sample Letter of Intent

[Name]
[Team Role]
[Team Name]
[Organization Name]
[Organization Address Line 1]
[Organization Address Line 2]
[Organization Phone Number]
[Organization Web Address]

[Month Day, Year]

Ocean Observing Prize
U.S. Department of Energy
OceanObserving@nrel.gov
https://www.herox.com/oceanobserving

RE: [Team Name]'s Intent to Compete in the Ocean Observing Prize BUILD Contest

Dear Ocean Observing Prize Team,

This letter is to disclose [Team Name]'s intent to participate in the Ocean Observing Prize BUILD Contest at NSWCCD in Carderock, Maryland, in January 2022. While we recognize that this is a nonbinding disclosure, we are excited to participate in the wave basin trials and are confident in our ability to meet the key deadlines outlined in the BUILD Contest Rules Document.

We would also like to take this opportunity to schedule our Technical Design Review (TDR). Our team has 2-hour availability from noon until 5 p.m. ET on the following dates in November:

- [date 1]
- [date 2]
- [date 3]
- [date 4]
- etc.

We look forward to confirming TDR dates with the Ocean Observing Prize staff and working with them toward a fair and competitive BUILD Contest.

Kind Regards,
[Signature]
[Name]
[Title]
[Team Name]

Appendix D: TDR Content Overview

Competitors should use this template on HeroX to structure their presentation. The following is a synopsis of the content required:

- Title Slide
- DESIGN Team Summary Slide
- Technical Design Review Agenda
- Project Goals & Objectives
- High-Level System Overview
- System Assembly
- Power System
- Locomotion System
- Communication Systems
- Operations Overview
- Schedule
- Current Status & Challenges

Appendix E: Dummy Payload and Power Monitor

Overview

Competing teams wishing to compete in the Ocean Observing Prize must incorporate the dummy payload and power monitor (DPPM) into their designs as outlined in this document. The DPPM serves two purposes: (1) to emulate a 100W load and (2) measure the power produced and consumed by the system. If competitors successfully design their systems to accommodate this DPPM, later modifications to the system to accommodate a real ADCP will ideally be less onerous. During the DESIGN Contest, only the designs of the DPPM will be provided. During the BUILD and SPLASH Contests, the physical unit will be provided to competing teams to integrate into their prototype. Teams with a multibody system will have the option of using two DPPMs. Teams interested in using a second DPPM must submit a request to OceanObserving@nrel.gov by August 6, 2021.

Detailed computer-aided design (CAD) models of the DPPM are available on the HeroX resources page.

Physical Dimensions

Physical dimensions will be based on a commercially available ADCP; please see the CAD drawings on the HeroX resources page for dimensions. The DPPM will be neutrally buoyant at the time of testing. The DPPM will be a 5.5-inch (139.2 mm) diameter cylinder that is 9.25 inches (235.0 mm) long (excluding length of connectors), with a 7.2 inch (182.9 mm) diameter head.

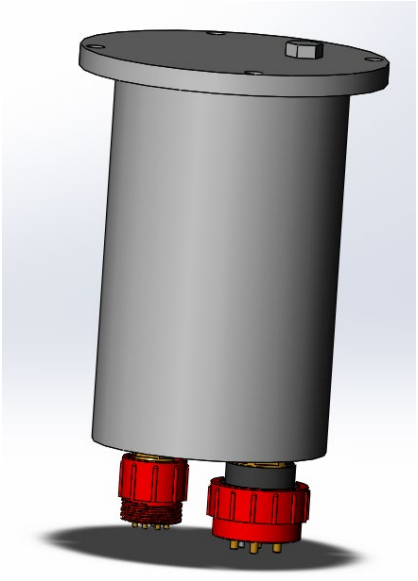


Figure E-1. DPPM reference model

Mounting

The DPPM must be mounted in the profiling body, and the face must be in contact with water. The DPPM will have four mounting points as located in the CAD drawings.

Connectors and Interfacing

The competing team's power system will be integrated into the DPPM for power monitoring and scoring purposes. All power from the wave energy converter and battery will be actively monitored through two connectors: a four-pin power connector to measure current and voltage from the wave energy converter (WEC) and battery system, and an eight-pin connector to provide system ground and payload interfaces.

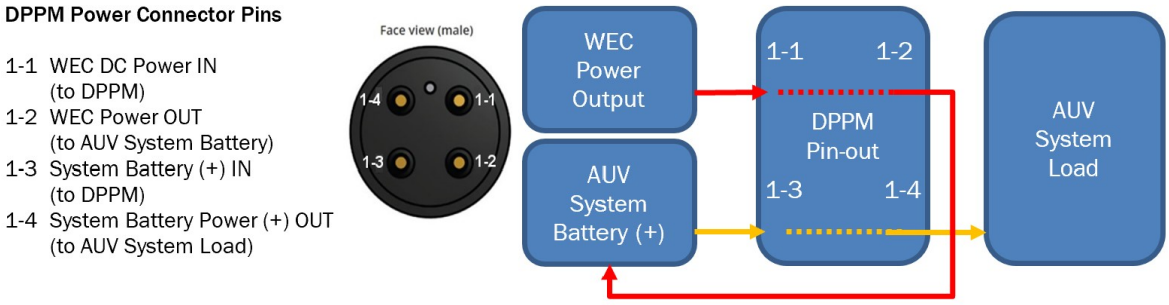


Figure E-2. DPPM power connector pins

The DPPM will have a male Subconn 4-pin wet-mateable connector as specified here (HPBH4M). To interface with the DPPM, competitors will use the power connector pin labels indicated in Figure E-2 and the payload connector pin labels in Figure E-3 to integrate their system to the DPPM.

Dummy Payload Connections and Power

The DPPM will be connected to the competitor's profiling body with an eight-pin connector, as specified here (BH8M).

The DPPM will have an eight-pin male connector with the following pinout. The competing team's female connector should have the following pinout.

Payload Connector Pin Labels

2-1 Payload Power (+)
2-2 System Ground (−)
2-3 Reserved for judge's use
2-4 Reserved for judge's use
2-5 Reserved for judge's use
2-6 Reserved for judge's use
2-7 Reserved for judge's use
2-8 Reserved for judge's use

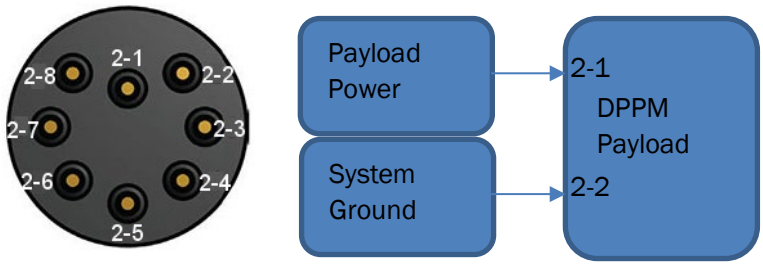


Figure E-3. Payload connector pin labels

For all dimensions and connector locations, consult the CAD drawing.

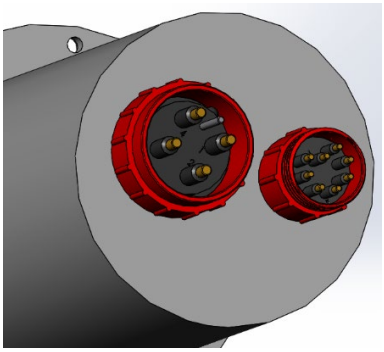


Figure E-4. Connector placement

For scoring purposes, the dummy payload may be powered by applying 12–48 DC volts to the input of the DPPM (Pin 2-1). The DPPM will begin to draw 100W when the input voltage is between 12-48V for >5 seconds. If the voltage drops below 12 V, the DPPM will stop drawing power. The load will only be considered powered for scoring purposes when actively drawing 100 W.

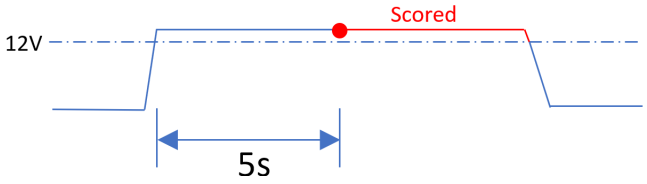


Figure E-5. Powering the payload

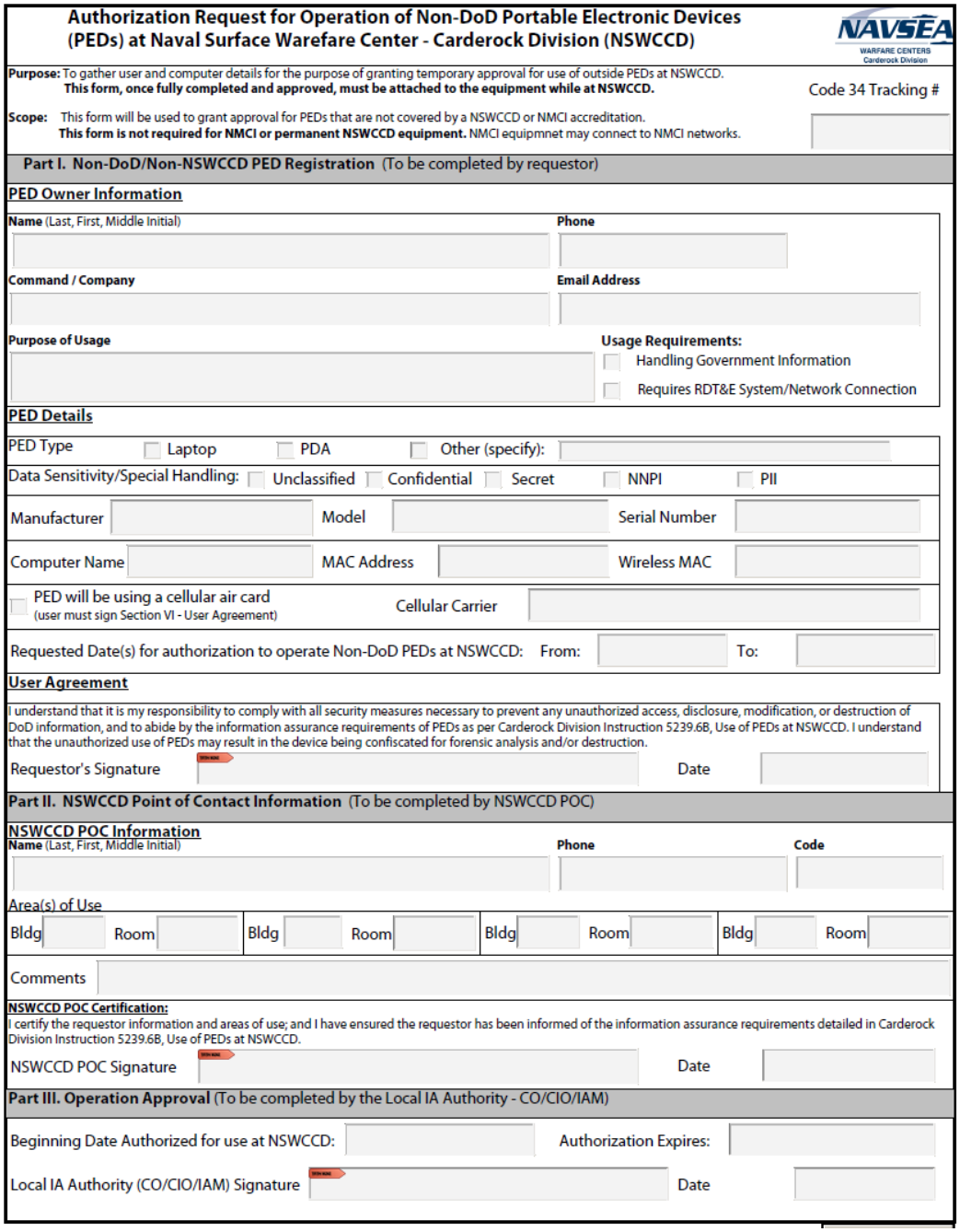
Internal Batteries

There shall be no batteries or other energy storage devices except those specified in the competition rules apart from small primary batteries integrated into clocks/Global Positioning System (GPS)/memory assemblies. If there are any questions on whether a given battery is allowable, email the prize administration team at OceanObserving@nrel.gov.

Appendix F: Carderock Access Forms

The first page of each access form needed for every team to enter Carderock and test their devices are included in this appendix for reference. The full fillable PDF forms, available as individual resources on HeroX, are linked above each of the appropriate form previews and are required.

Electronic Devices Permissions



Authorization Request for Operation of Non-DoD Portable Electronic Devices (PEDs) at Naval Surface Warefare Center - Carderock Division (NSWCCD)

NAVSEA WARFARE CENTERS Carderock Division

Purpose: To gather user and computer details for the purpose of granting temporary approval for use of outside PEDs at NSWCCD.
This form, once fully completed and approved, must be attached to the equipment while at NSWCCD.

Code 34 Tracking #

Scope: This form will be used to grant approval for PEDs that are not covered by a NSWCCD or NMCI accreditation.
This form is not required for NMCI or permanent NSWCCD equipment. NMCI equipmnet may connect to NMCI networks.

Part I. Non-DoD/Non-NSWCCD PED Registration (To be completed by requestor)

PED Owner Information

Name (Last, First, Middle Initial) | **Phone**

Command / Company | **Email Address**

Purpose of Usage | **Usage Requirements:**
Handling Government Information
Requires RDT&E System/Network Connection

PED Details

PED Type: Laptop PDA Other (specify):

Data Sensitivity/Special Handling: Unclassified Confidential Secret NNPI PII

Manufacturer | Model | Serial Number

Computer Name | MAC Address | Wireless MAC

PED will be using a cellular air card (user must sign Section VI - User Agreement) | Cellular Carrier

Requested Date(s) for authorization to operate Non-DoD PEDs at NSWCCD: From: To:

User Agreement

I understand that it is my responsibility to comply with all security measures necessary to prevent any unauthorized access, disclosure, modification, or destruction of DoD information, and to abide by the information assurance requirements of PEDs as per Carderock Division Instruction 5239.6B, Use of PEDs at NSWCCD. I understand that the unauthorized use of PEDs may result in the device being confiscated for forensic analysis and/or destruction.

Requestor's Signature | Date

Part II. NSWCCD Point of Contact Information (To be completed by NSWCCD POC)

NSWCCD POC Information

Name (Last, First, Middle Initial) | **Phone** | **Code**

Area(s) of Use

Bldg Room | Bldg Room | Bldg Room | Bldg Room

Comments

NSWCCD POC Certification:
I certify the requestor information and areas of use; and I have ensured the requestor has been informed of the information assurance requirements detailed in Carderock Division Instruction 5239.6B, Use of PEDs at NSWCCD.

NSWCCD POC Signature | Date

Part III. Operation Approval (To be completed by the Local IA Authority - CO/CIO/IAM)

Beginning Date Authorized for use at NSWCCD: | Authorization Expires:

Local IA Authority (CO/CIO/IAM) Signature | Date

Personnel Access

DEPARTMENT OF THE NAVY LOCAL POPULATION ID CARD/BASE ACCESS PASS REGISTRATION

PRIVACY ACT STATEMENT:

AUTHORITY: 10 U.S.C. 113, Secretary of Defense; DoD Directive 1000.25, DoD Personnel Identity Protection (PIP) Program; DoD Instruction 5200.08, Security of DoD Installations and Resources and the DoD Physical Security Review Board (PSRB); DoD 5200.08-R, Physical Security Program; DoD Directive 5200.27, Acquisition of Information Concerning Persons and Organizations not Affiliated with the Department of Defense (Exception to policy memos); Directive-Type Memorandum (DTM) 09-012, Interim Policy Guidance for DoD Physical Access Control; DTM 14-005, DoD Identity Management Capability Enterprise Services Application (IMESA) Access to FBI National Crime Information Center (NCIC) Files; and E.O. 9397 (SSN), as amended; OPNAVINST 5530.14E, Navy Physical Security and Law Enforcement Program; Marine Corps Order P5530.14, Marine Corps Physical Security Program Manual; SORN NM05512-2 Badge and Access Control System Records and DMDC 16, Identity Management Engine for Security and Analysis (IMESA): http://dpcld.defense.gov/Privacy/SORNsIndex

PURPOSE(S): To control physical access to Department of Defense (DoD), Department of the Navy (DON) or U.S. Marine Corps Installations/Units controlled information, installations, facilities, or areas over which DoD, DON, or U.S. Marine Corps has security responsibilities by identifying or verifying an individual through the use of biometric databases and associated data processing/information services for designated populations for purposes of protecting U.S./Coalition/allied government/national security areas of responsibility and information; to issue badges, replace lost badges, and retrieve passes upon separation; to maintain visitor statistics; collect information to adjudicate access to facility; and track the entry/exit times of personnel.

ROUTINE USE(S): To designated contractors, Federal agencies, and foreign governments for the purpose of granting Navy officials access to their facility.

DISCLOSURE: Providing registration information is voluntary. Failure to provide requested information may result in denial of access to benefits, privileges, and DoD installations, facilities and buildings.

IDENTITY PROOFING AND APPLICANT INFORMATION

1. LAST NAME:	2. FIRST NAME:	3. MIDDLE NAME:	4. NAME SUFFIX: ☐ Jr. ☐ Sr. ☐ I ☐ II ☐ III ☐ IV

5. HISPANIC OR LATINO *(Check one)*: ☐ YES ☐ NO	6. RACE *(Check one or more)*: ☐ WHITE ☐ AFRICAN AMERICAN OR BLACK ☐ ASIAN ☐ AMERICAN INDIAN OR ALASKIN NATIVE ☐ NATIVE HAWAIIAN OR OTHER PACIFIC ISLANDER

7. GENDER *(Check one)*: ☐ MALE ☐ FEMALE	8. DATE OF BIRTH:	9. CITY OF BIRTH:	10. STATE OF BIRTH:	11. BIRTH COUNTRY:

12. US CITIZEN *(Check)*: ☐ YES ☐ NO	13. DUAL CITIZENSHIP: ☐ YES ☐ NO CITIZENSHIP IF OTHER THAN US *(Country)* :

U.S. Citizen Minimum Documentation Required:
By Birth - Social Security No and/or State ID/Drivers License.
Naturalized - Certification Number, Petition Number, Date, Place and Court, United States passport number, Social Security No and/or State ID/Drivers License.
Derived - Parent's certification number, Social Security No and/or State ID/Drivers License.
Alien Minimum Documentation Required:
Registration Number, Expiration date, Date of entry, Port of entry.

14. IDENTITY SOURCE DOCUMENTS PRESENTED:	15. DOCUMENT NUMBER:	16. ISSUED BY STATE/COURT:	17. ISSUED BY COUNTRY:	18. ISSUED:	19. EXPIRES:
☐ Social Security No.			United States		
☐ State ID/Drivers License			United States		
☐ Passport No.					
☐ Certification Number and Petition Number					
☐ Derived - Parent's Certification Number:			United States		
☐ Alien Registration No.			United States		
		Date of Entry:	Port of Entry:		
OTHER APPROVED IDENTITY SOURCE DOCUMENTS:					
☐					
☐					

20. WEIGHT *(Pounds)*:	21. HEIGHT *(Inches)*:	22. HAIR COLOR *(Check one)*: ☐ Blond ☐ Brown ☐ Black ☐ Gray ☐ Red ☐ White ☐ Silver ☐ Auburn ☐ Bald	23. EYE COLOR *(Check one)*: ☐ Brown ☐ Green ☐ Blue ☐ Hazel ☐ Black ☐ Gray ☐ Violet ☐ Unknown

24. HOME ADDRESS *(Include city, state, zip code)*:	HOME PHONE *(Include Area Code)*:
25. BASE SPONSOR'S NAME:	SPONSOR PHONE *(Include Area Code)*:

Foreign National Access

FOREIGN VISIT APPROVAL REQUEST

Part I - Classification of Information for Disclosure During Visit

☐ Classified (TS/S/C) ☐ Unclassified Sensitive ☐ Public Domain

Part II - Visitor Information

Visitor Name:

Citizenship:

Place of Birth:

Date of Birth:

Agency/Company:

Rank/Title:

Part III - Visit Specifics

Visit Type: ☐ Official ☐ Unofficial ☐ Business ☐ Courtesy Call

Visit Duration: ☐ One Time ☐ Recurring ☐ Extended

Visit Dates:

Location:

Type of Information: ☐ Navy ☐ Proprietary ☐ Academic ☐ Other

Direction of Information Exchange: ☐ Mutual ☐ NSWCCD to Visitor ☐ Visitor to NSWCCD

Specific Topics to Discussed:

Visit Requested by: ☐ Visitor ☐ NSWCCD ☐ Other

Request Submitted via NAVY IPO: ☐ No ☐ Yes Date:

Case No.:

Part IV - Disclosure Authority

*REQUIRED FOR ALL DISCLOSURES OF CLASSIFIED AND UNCLASSIFIED SENSITIVE INFORMATION

Agreement: ☐ DEA ☐ IEP ☐ MOU ☐ Contract ☐ Other ☐ N/A

Agreement Number:

Project Officer Name: Phone:

Part V - Visit Purpose

Visitor Purpose: (BE SPECIFIC)

Appendix G: Carderock Shipping Label

When shipping materials to the test facility, use the following shipping label, also available as a resource on HeroX.

PROPERTY OF OCEAN OBSERVING PRIZE PROJECT.

DO NOT OPEN

before contacting Miguel Quintero (miguel.quintero1@navy.mil)

Attn: Miguel Quintero

9500 MacArthur Blvd

Building 18 Room 170

West Bethesda, MD 20817

PROPERTY OF OCEAN OBSERVING PRIZE PROJECT.

DO NOT OPEN

before contacting Miguel Quintero (miguel.quintero1@navy.mil)

Appendix H: Example Letter of Affirmation

[Name]
[Team Role]
[Team Name]
[Organization Name]
[Organization Address Line 1]
[Organization Address Line 2]
[Organization Phone Number]
[Organization Web Address]

[Month Day, Year]

Ocean Observing Prize
U.S. Department of Energy
OceanObserving@nrel.gov
https://www.herox.com/oceanobserving

RE: [Team Name]'s Affirmation of Compliance with the Ocean Observing Prize BUILD Contest

Dear Ocean Observing Prize Team,

This letter is to disclose [Team Name]'s compliance with the rules and regulations of the Ocean Observing Prize BUILD Contest, per the BUILD Contest Official Rules Document. Our intent is to conduct our team in a fair and equitable manner over the course of the Ocean Observing Prize BUILD Contest at NSWCCD in Carderock, Maryland, in January 2022.

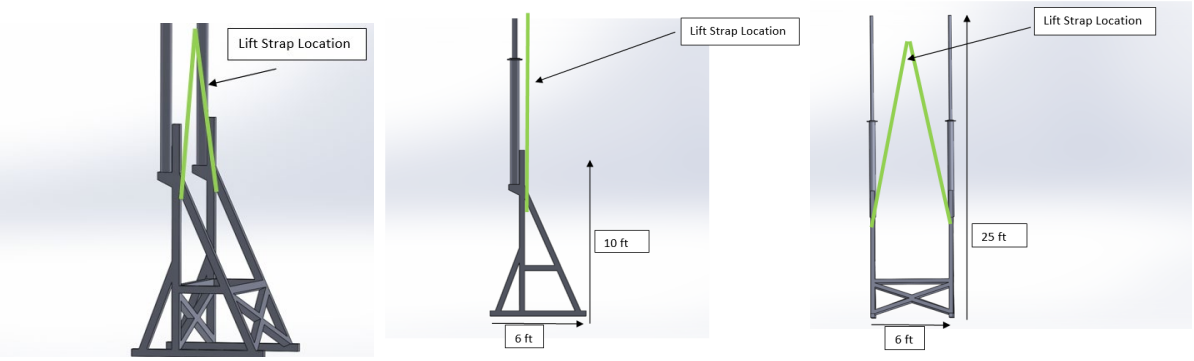
Kind Regards,

[Signature]
[Name]
[Title]
On behalf of
[Team Name]

Appendix I: Sample Lift Plan

Complex Lift Plan for Installation of RNLC Vibration Mitigation Structure
Scheduled Lift: January 27, 2022
By: Jane Doe, Acme Corp

Background: The Resilient Nonlinear Control (RNLC) Wave Energy Device Test consists of a buoy mounted on to a large superstructure that is cantilevered off the north side of the MASK Bridge. This structure has been reviewed by the Acme Corp personnel and is structurally sound. The issue is there is an unacceptable amount of vibration that needs to be corrected. This brought a need for a structure that would interface between the MASK floor and the bottom of the superstructure. The structure weighs ~4,500 lb and does not have a large surface area to limit the change in center of buoyancy or center of mass. The lateral center of mass is shown by the lift strap locations in the figures below and the vertical center of mass is below the lift strap location. The structure was lifted to just above the ground to verify this location. At no point will the crane hook be near the waterline.



Description

The structure will be lifted as follows:

- Step 1: Choke straps on the designated lift points and add buoys to the straps
- Step 2: Lift to just above the ground to confirm center of gravity
- Step 3: Lift above obstacles and traverse west to landing location
- Step 4: Begin lowering to just above the waterline
- Step 5: Lower slowly in the water to allow the buoyancy effects to stabilize
- Step 6: Once the structure is on the basin floor and straps are loose, the straps can be released.

Hazards and Mitigation

Water Hazard: The basin will be full, so all personnel will use personal protective equipment as required.

Mitigation: Selected rigging will ensure that crane hook blocks will not come in contact with the water.

Any personnel on site can stop the operation should they see a hazard.

Personnel

Engineers: 2
Mechanical Technicians: 2
Electrical Technicians: 1
Supervisor: 1

Supervising Engineer: Jane Doe

Appendix J: Safety Plan Template

Safety Precautions and Security Procedures

The overall objective of the safety program is to mitigate hazards that can cause injury to personnel, damage or loss of test equipment, and damage to test facilities. Primary emphasis is placed on personnel safety.

COVID-19 Precautions

Due to the current COVID-19 pandemic, the test team must follow the following guidelines set forth by the Commanding Officer and Technical Director.

1. Everyone must take responsibility of themselves and answer the following four questions from the COVID-10 Screening Questionnaire before coming on site:
    a. Are you currently sick, or feeling ill, short of breath, or generally not well?
    b. Have you had close contact with anyone diagnosed with COVID-19 in the past 14 days?
    c. Have you been in public situations of close contact without face covering?
    d. Have you been on travel (personal or official) in the past 14 days?
2. Everyone must wear face coverings in facilities and buildings.
3. If you are to eat or drink, which requires removing the face covering, you must maintain 6 feet separation for all other individuals.
4. All shared workstations, tabletops, and tooling shall be wiped down daily with disinfectant.

Facility Safety Procedures

All test personnel must adhere to the safety procedures outlined in this document. Test personnel must promptly report injuries, near misses, hazards, and potential hazards to the Test Director (or appropriate authority) during a shift. At any time, any test team participant is empowered to stop testing if safety is believed to be in jeopardy. If a point of disagreement occurs on a safety issue, then the immediate supervisor or proper safety personnel will be notified. No reprisals will be allowed for safety concerns raised by test personnel.

All personnel and visitors are expected to comply with general workplace safety rules, that include:

- Housekeeping
- Fire Prevention
- Hand and Foot Protection
- Electrical and Hand Tools
- Lead Handling
- Noise Abatement & Hearing Protection

- Fall Protection

The rules and practices applicable to these areas are described in the NSWCCD Department 80 Facility Safety Policy. Visitor safety briefs will be conducted as necessary by the Test Director to convey these rules. The following OSHA Standards are to be used as refence, which the Policy was derived from:

- For PPE: OSHA Safety and Health Standard (29 CFR 1910)
    - Basic PPE will be provided by NSWCCD
        - PFDs, Hardhats, Hearing Protection, and Eye Protection
- For HazMat: 29 CFR 1910.1200, OSHA Hazard Communication Standard
    - Needs to be disclosed below in Team's Safety
- For Electrical Safety: OSHA 3073 Guide to Electrical Safety
    - Needs to be disclosed below in Team's Safety
- For Respiratory Safety: OSHA Standard 29 CFR 1910.134
    - Needs to be disclosed below in Team's Safety
- For Energy Control Program: 29 CFR 1910.147
    - This is covered with the kill switch

Personal protective equipment (PPE) such as safety shoes, safety glasses, hearing protection, and personal protective floatation devices (PFDs) are to be used in accordance with posted instructions. PFDs must be worn at all times when operating outside of safety rails in the test basins as well as when in support craft used for model rigging, servicing, and towing. United States Coast Guard-approved PFDs are supplied by Building 18 facilities personnel (Code 896 of the MASK, Water & Wind Tunnels Operations (Mechanical) Branch, 301-227-2885). Clothing and PPE appropriate to the operation or task shall be worn. Loose clothing such as neckties, rings, wristwatches, etc. will not be worn in the vicinity of machinery with moving or rotating parts or exposed to electric current-carrying components.

The TD or designee shall be the only personnel to provide instructions to the wavemaker operator during the test and will discuss the emergency stop procedures with the operators prior to commencing testing. The wavemaker will transition its light stakes from green to red to flashing yellow depending on the machine's operational state. Green indicates the machine is safe to access, red indicates the paddles are armed and ready, and flashing yellow occurs when the machine is operating.

Red mushroom emergency-stops are located on each of the 27 electronic cabinets along the wavemaker's upper catwalk along with one downstairs and one upstairs in the wavemaker/model control room. These are intended for test team and facility operator usage to stop operations due to imminent danger to the wavemaker or model. Access to the wavemaker's upper catwalk while the wavemaker is operational is permissible provided all flooring panels are in place. Access to the shelf level of the wavemaker, the area behind the paddles, is strictly forbidden by all other than authorized personnel and then only while the wavemaker is not operational. Operational lockouts are provided at each access door to the shelf level to keep the wavemaker from starting when they are opened. Safe operating procedures require these doors to remain open while personnel are on the shelf level and are to be closed only by those exiting the shelf.

Test Team Safety Procedures

Each team is responsible for discussing the potential risks and hazards with regards to handling and testing their devices. Each potential risk will be clearly explained below (bulletized or table format) with the controls/mitigating safety features. For example

Hazard	Type	Risk	Control / Mitigation
Lubrication Fluid	Hazmat	Risk to Eye	Don't put in eye
Mechanical Pinch Point	Mechanical	Pinch point	Clearly Label
Propeller	Mechanical	Cutting or abrasion	Kill Switch / Lock Out

All relevant hazards should follow OSHA guidelines, to include labelling and MSDS sheets. Please include an MSDS sheet for all fluids, not just those perceived as hazardous.

Personnel Mitigation

Please indicate any personal issues / allergies for personnel on base (no need to indicate the individual's name as this is HIPAA). Anything the facility should be aware of and ready to accommodate.

Important Points-of-Contact and Phone Numbers

In case of an emergency, including injury, illness, fire or fire alarm, oil or HAZMAT spill, the following on-station numbers should be contacted:

24-hour Emergency Response Line:

From Desk: 433-3333

From Cell: 202-433-3333

The associated non-emergency numbers are:

Security Office (Bldg. 42): 301-227-1408

Command Duty Office: 301-821-2779

Non-Emergency Fire: 301-227-1550

Non-Emergency Police: 301-227-1502

Team Member Emergency Contact Info:

[Please enter an emergency POC for each team member on site!]

Appendix K: Relevant Mission Space

The Ocean Observing Prize invites competing teams to compete for up to $2.4 million in cash awards by designing, building, and testing novel, wave-powered self-charging autonomous underwater vehicle systems that, with refinement, would be suitable for a 6-month deployment in the Atlantic Ocean to monitor hurricane formation. Prototypes built during this competition are not meant to be mature systems but should demonstrate basic functionality and potential for refinement into a commercially viable product. When designing systems, competing teams must adhere to the contest rules and requirements specified in this document. Designs and prototypes will be assessed through the three contests: DESIGN, BUILD, and SPLASH.

This section presents information regarding how ocean scientists use existing ocean observing platforms such as gliders and drifting floats to study and forecast hurricane formation, path, and intensity at sea. This information is provided to competing teams for real-world context and was used to inform the rules, requirements, and scoring.

In the description of hurricane monitoring that follows, relevant system requirements (Appendix L) are cross-referenced with the notation "*[Req. X],*" where *X* is the requirement number. This cross-referencing of requirements provides additional context for competing teams to better understand the motivation for the requirement. Not all requirements are referenced. See the System Requirements and Required Components (Appendix L) for official rules.

Hurricane Monitoring Mission Description

Tropical storms, cyclones, and hurricanes are extremely energetic storms that originate far out at sea. As these storms strengthen over warmer waters, they create high winds and large waves. When these storms reach the coast, they can devastate coastal communities through wind damage and flooding.

Society's ability to forecast the trajectories of these storms has improved significantly over the past two decades, yet our ability to forecast the *intensity* of the storms is still limited. Without the ability to provide communities with good intensity forecasting, evacuation plans and coastal protection efforts are adversely affected. For example, the difference between a Category 3 and 4 hurricane could be the difference between a storm surge of 9 feet and 18 feet, respectively, above normal levels.

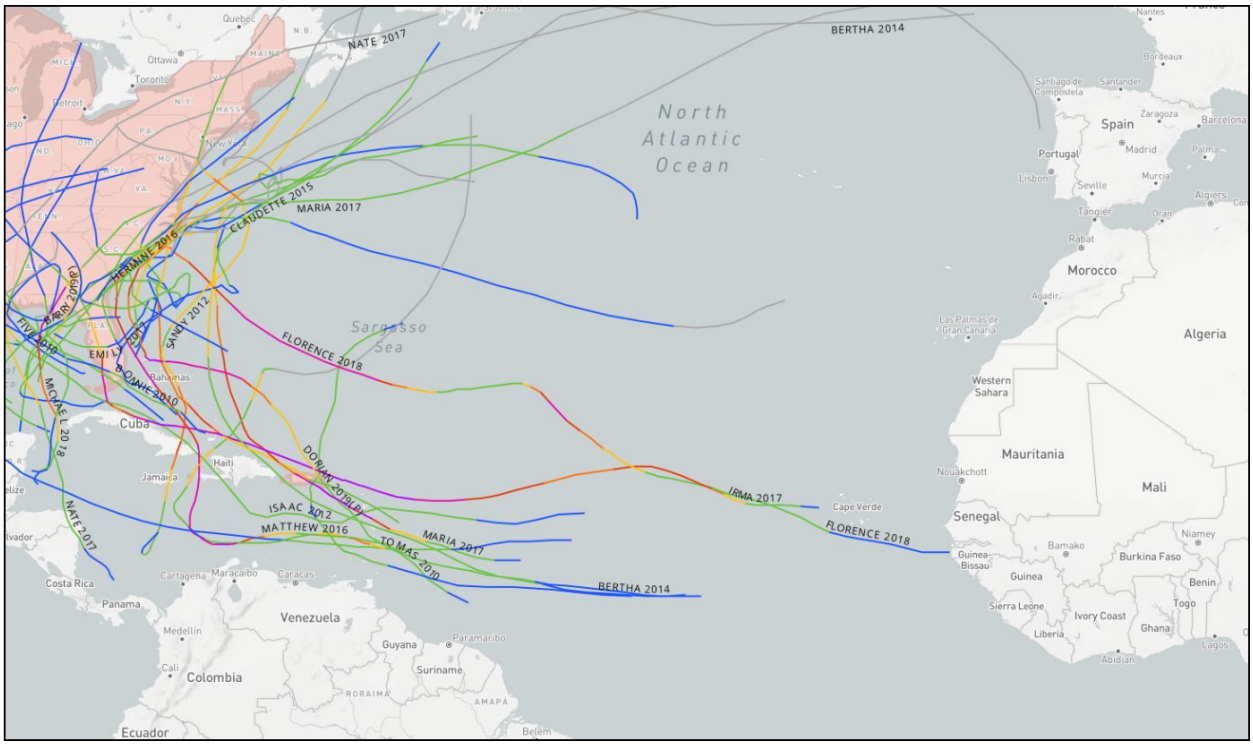


Figure J-1: Major Atlantic hurricane tracks for the past decade. Source: NOAA National Ocean Service

Models can be useful for predicting the effects of storms, but they rely on accurate data collected from within the storms. Unfortunately, collecting in situ data on tropical cyclones and hurricanes is difficult for three reasons: (1) their stochastic nature makes it difficult to anticipate when and where they will occur; (2) storm environments are extremely energetic and create difficult operating conditions for people and robots; and (3) even with austere power management measures, existing systems struggle to operate in one location for the full length of a hurricane season. If these data could be collected, scientists might better understand storms and improve intensity forecasting accuracy, ultimately saving lives and reducing financial impact to coastal communities.

The data desired to inform these models would be basic ocean and atmospheric properties measured before, during, and after a hurricane. Those who model hurricane intensity desire ocean data on temperature, conductivity, wave motion, and current velocity. Desired atmospheric measurements are, air temperature, air humidity, and wind velocities. Such properties are commonly collected using commercially available conductivity, temperature, and depth (CTD) and acoustic Doppler current profiler instruments *[Req. 13, 14].*[2] Collecting these types of data requires a platform that can be quickly and safely deployed in advance of the storm and then loiter in a designated area until it approaches. Loitering could be as short as a couple days or as long as 6 months from June through November (the typical hurricane season in the Atlantic). Ideally these ocean and atmospheric properties that characterize the

[2] Where applicable, relevant requirements and rules from this document are cross-referenced to the mission need. See the System Requirements and Required Components (Appendix L) for the official rules.

air-sea interaction would be sampled at regular intervals by performing a controlled descent from the surface to approximately 200-meter depths and then returning to the surface *[Req. 3]*.

Some scientists have noted that during ascents, sometimes buoyancy gliders are unable to reach the surface when there is a plume of freshwater near the surface *[Req. 5]*. Data collected by systems out at sea need to be precisely located temporally and spatially *[Req. 15]*, and then delivered to scientists on shore; ideally this is done via satellite communication, at least once per day *[Req. 16]*.

Particular areas of interest to scientists and researchers that study hurricane formation include the Gulf of Mexico, east of the Caribbean Sea, the Gulf Stream offshore of the Southeast coast of the United States, and the mid-Atlantic near New Jersey and Delaware. These locations are known to have essential ocean features and processes important to hurricane formation, such as mixing of deep cold water and warm surface waters. Some of these locations are in very deep waters, rendering systems that require moorings impractical and cost-prohibitive *[Req. 6]*. These likely deployment locations often have strong surface currents that could vary from 0.2 m/s to more than 1.5 m/s, often pushing platforms off their intended course *[Req. 4]*. Existing gliders are unable to respond quickly to changes in course or explore areas of interest and lack the ability to overcome even a marginal surface current due to energy limitations. Responsive navigation is needed to respond to changes in mission needs and dynamic environmental conditions *[Req. 15, 17, 23]*.

Current ocean observing platforms used for at-sea hurricane monitoring, such as buoyancy gliders and drifter floats, are typically shipped to deployment locations using commercial carriers like UPS and FedEx *[Req. 2, 7]*. On shore, the platforms are often moved from the assembly location to the deployment vessel in the bed of a pickup truck to avoid the need for specialized trucks. It is common practice to use any vessel of opportunity that could be chartered in the area to deploy the ocean observing platform. Such vessels used for deploying the platform vary in size, but are typically less than 10 meters long and will have between two and five crewmembers aboard *[Req. 2, 8, 9]*. Existing platforms are often deployed and recovered with only two trained crewmembers *[Req. 12, 19, 20, 21, 22]*.

Once the system is deployed, it is unlikely to be visited again by a ship unless it is to be recovered, so systems must account for storm survivability, biofouling, and other issues that may affect the performance over the deployment duration. If platforms can't perform as needed, this limits the amount of useful data that they can collect and jeopardizes the mission.

The current paradigm that ocean scientists struggle with is a balancing system power consumption and deployment duration. More frequent sampling, propulsion, or communications increases power consumption, which rapidly drains batteries and reduces the length of time the system can be deployed and increases the frequency at which it needs to be recovered *[Req. 10]*. Power management is crucial to the system design to maximize data collection and deployment time. A system that possesses the ability to self-charge would change this paradigm and allow scientists to focus on maximizing data collection instead of minimizing power consumption *[Req. 11]*.

> *"Everything about autonomous platforms at sea comes down to power budget. This is our limiting factor." – Ocean scientist studying hurricanes at sea using buoyancy gliders*

There are a variety of in situ energy harvesting options available to systems performing hurricane monitoring at sea: solar, wind, waves, currents, and even thermal gradients in the ocean. Regardless of the energy harvesting method used, the system should have a battery that is sufficiently sized to ensure that it maximizes uninterrupted data collection without jeopardizing loss of the system over the entire 6-month deployment *[Req. 10]*.

Finally, the safety of humans and the environment is paramount when using ocean observing platforms. Technologies used are safe to handle by trained crew and cause no adverse environmental impact *[Req. 12, 18, 19, 20, 21, 22]*.

Appendix L: System Requirements and Required Components

The system requirements and required components detailed in this section are mandatory when designing prototype systems for the Competition. These requirements were informed by interviews with scientists and researchers that use autonomous platforms to monitor hurricanes in the ocean as well as the likely safety restrictions of possible test environments. These requirements will apply to all three contests. Submissions that do not meet these requirements will be disqualified and rendered ineligible for any awards.

The following tables include System Requirements in the following categories:

- Physical Characteristics and Principal Dimensions
- Self-Charging and Power Management
- Data Collection and Communications Requirements
- Operations and Safety.

System Requirements: Physical Characteristics and Principal Dimensions

Number	Requirement
1	Up to two separate bodies (a multibody design) may be used for the proposed system. The profiling body is defined as a standalone system element that houses the dummy payload package and CTD. Only the profiling body may move vertically within the water column while profiling. If a standalone system element exists that does not house the dummy payload and CTD, then it will be referred to as the nonprofiling body. See Req. 14.
2	The assembled system dry weight, measured in air, at the point of deployment must be less than or equal to 250 kilograms (kg). At the point of recovery, the system must be less than or equal to 250 kg within 5 minutes (to allow for water drainage) once recovery is initiated. If the design uses two separate bodies, both count toward the maximum weight limit.
3	The profiling body of the system must be able to withstand depths of at least 30 meters[a] for at least 30 minutes. See Appendix E for specifications on the dummy payload.
4	The system must have a minimum sustained speed of 0.5 knots for 30 minutes, and a top speed less than or equal to 6 knots. If the design uses multiple bodies, both must demonstrate this speed requirement.

5	All bodies of the assembled system must be positively buoyant in freshwater during deployment/recovery.
6	The system must not touch the bottom (e.g., no moorings or anchors).
7	The volume of the packaged system must fit within the dimensions of a double pallet-sized crate, with external dimensions of 117 centimeters (cm) by 240 cm by 122 cm (w x l x h). If the design uses two separate bodies, both count toward the maximum packaged volume limit.
8	The assembled system must be safe and stable while lifted during deployment and recovery and have at least one hard lift point that is easily accessible, or as many as needed to ensure stable orientation while lifted. If the design uses two separate bodies, each body may be lifted separately or together.
9	All bodies of the assembled system must have a maximum beam less than or equal to 150 cm.

[a] This is under NOAA's mission requirement of a 200-m depth. As pressure vessel engineering is a mature field, 30 m was chosen for safety in contest operations and reduced costs to competitors.

System Requirements: Self-Charging and Power Management

Number	Requirement
10	The system must use batteries. The total energy storage capacity of the system, including all system bodies, must have a minimum capacity to continuously power the dummy payload and all thrusters while operating at maximum power consumption for 30 minutes, or 250 Watt-hours, whichever is greater. The maximum energy storage capacity of the complete system must be less than or equal to 1,000 Watt-hours.
11	System must use only wave energy for self-charging while in the water. Other methods of charging, such as plugging into a wall outlet or USB, are allowed while the system is onshore or in a boat.
12	The battery charging subsystem must have ground fault circuit interruption protection.

System Requirements: Data Collection and Communications Requirements

Number	Requirement
13	System must accommodate the provided dummy payload package into the profiling body and provide it with energy harvested from waves. If wave energy harvesting is performed in a body separate to the profiling body, then there must be a method of power transfer between the two bodies (see Req. 1). See the provided specification sheet in Appendix E for details on the payload interfaces. The dummy payload package will be provided to competing teams during the BUILD Contest.
14	System must incorporate a commercially available CTD instrument that is able to sample at the rated depth of the system. The CTD does not need to be a single instrument, but the conductivity, temperature, and depth must all be captured using commercially available sensors, powered by wave energy.
15	The system must incorporate a global positioning system (GPS) module with sub-5-m precision and be able to relay its geospatial position over wireless communication. A clear view of GPS satellites may not be available during the BUILD Contest and should not be relied upon as the sole means of system navigation.
16	System must be able to transmit and receive data and commands wirelessly. At least two wireless communication subsystems must be used, one of which must be satellite communication. The other communication subsystem is up to competing teams and must have an indoor range of at least 100 m when at the water's surface.
17	The proposed design includes navigation systems that can be utilized in a tank or at-sea environment. If multiple bodies are used, the bodies must be able to navigate independently and in a coordinated fashion.

System Requirements: Operations and Safety

Number	Requirements
18	The system may not emit any materials or fluids other than air and water.
19	All propellers must have shrouds. The shrouds must surround the propellers and have at least a 5.1- cm distance between the spinning disk of the propeller and the edges of the shroud (front and back). Commercial thrusters qualify as is, as long as they are shrouded.
20	All conductive chassis surfaces on the assembled system must be electrically grounded.

21	System surface temperatures must not exceed an external temperature of 60°C for more than 5 seconds or be otherwise considered unsafe to handle because of high temperatures. High temperature surfaces must be clearly labeled.
22	All systems must have a clearly marked mechanical kill switch that a support diver can easily find and activate while in the water. The switch must de-energize all propulsion components and devices on the system. The kill switch does not have to kill the onboard computer or control unit. The kill switch should not rely on software to de-power the propulsion system[3]. Upon reactivation, the vehicle must return to a safe state (propellers do not start spinning).
23	The profiling body must be able to turn through 360 degrees of compass heading, in both directions, with a turn radius less than or equal to 7.5 m.

Required Components

The following table summarizes components that are required for prototype systems as specified in the Rules. Competing teams should note the make and model for each required component in the Narrative of their submission package.

Required Component	Quantity Required	Note	Provisioning
Wireless communication subsystem	2	Competitor may choose. One subsystem must be satellite communication. For the other communication subsystem, its indoor range must be at least 100 m. BUILD Contest testing may be performed indoors without a clear view of the sky.	Competitor will acquire for BUILD Contest
GPS module	1	Competitor may choose. Sub 5-m precision. BUILD Contest testing may be performed indoors without a clear view of the sky.	Competitor will acquire for BUILD Contest
CTD instrument	1	Must be a commercially available CTD but does not need to be scientific-grade.	Competitor will acquire for BUILD
Power monitoring system and dummy payload package	1	Specifications provided in Appendix E and on HeroX resources page. Representative in dimensions and power consumption of an ADCP	Will be provided to competitor during the BUILD Contest

[3] This requirement is to provide a fail-safe way to de-energize all propulsion devices to protect divers and support staff handling the vehicle. Kill switch designs should utilize a direct feed hardware switch (e.g. mechanical relay or reed switch) and should not rely on software to de-power the propulsion system. While kill switch design will be approved or rejected during the team's TDR, teams are encouraged to submit their proposed kill switch design for approval prior to their TDR.

Appendix M: NEPA Questionnaire

To comply with the National Environmental Protection Act (NEPA), the Prize Administration team needs to collect the following information describing competitors' devices and ancillary equipment. This is a separate process from the review and scoring process, and this information will not be used by the reviewers or judges. More information on this process can be found Appendix A. Please use the template available as a resource on HeroX to provide this information.

Some of this information may not be in your submission package, but where there are overlaps, the information must be consistent. Please provide clear and comprehensive information for each of the questions below. Even if you have provided this information elsewhere in your submission package you must provide it again here.

1. Please provide a general description of your proposed device including approximate physical dimensions. Please note the units used in each description (e.g., mm, cm, kg, mm^3)
   a. Maximum height of each component/subcomponent (if applicable)
   b. Maximum length of each component/subcomponent (if applicable)
   c. Weight in air (by component/subcomponent, if applicable, and total)
   d. Total approximate dimensions of device.

2. Please attach a list of materials and estimated quantities (all materials including metals, foams, resins, fluids, electronics, etc.), from which your device would be fabricated and assembled.

Material	Quantity

3. Please provide locations (name of facility and address) where any work on the designing, fabricating, assembling or testing of your device will occur, and describe the work that would occur at each location (you do not need to include the NSWCCD testing facility).

Facility Name	Address	Work Type	Description of Work

4. Please identify health and safety risks associated with work at each of the above locations, and the health and safety procedures that would be implemented to address those risks.

Work Type	Health and Safety Risk	Safety Procedures

5. Please identify all waste product (hazardous and non-hazardous) that you will produce (including excess materials from the fabrication and assembly process) and how that waste will be disposed of.

Type of Waste Material	Hazardous? (Yes/No)	Waste Disposal Method

6. If you have any figures or diagrams of your proposed device, please attach or paste those here.

Appendix N: Detailed On-Site Test Plan and Scoring

The evaluation of each team's system will take place at NSWCCD over 4 days. The majority of testing will occur on the second and third day, while the first and last days are reserved for mobilization and demobilization. The following sections describe the events planned for each stage of testing. Prize Administrators reserve the right to alter these events as needed to keep the test event running smoothly.

Day 1: Mobilization

Check-In and Staging

Upon arrival at the facility, teams will check-in with facility security and proceed to their designated staging area. Teams will confirm all their shipped containers are present and begin mobilizing their system, staging their equipment on the required cart for transport into the test facility on Day 2.

ID	Description	Score	Weight	Notes
1	Note time of initial check-in with administration staff upon arrival on base			
2	Note start time and end time of mobilization duration The proposed design demonstrates a feasible deployment and installation approach, and can be practically unpacked, assembled, and deployed in less than 24 hours (measured continuously) from its packaged state. Faster times will receive a higher score.	1 / 2 / 3	General	
3	Confirm packed dimensions and volumes are compliant The volume of the packaged system must fit within the dimensions of a double pallet-sized crate, with external dimensions of 117 centimeters (cm) by 240 cm by 122 cm (w x l x h). If the design uses two separate bodies, both	1 / 3	General	

	count toward the maximum packaged volume limit.			
4	Confirm all required materials were submitted prior to arrival on base			

Day 2: Dockside

Dry Check

The Dry Check will be used to verify the design matches the system specifications the team submitted during TDR (section 3.6.6) and verify that the prototype or prototypes meet **all** safety requirements. Prototypes that fail to meet safety requirements will not be permitted to enter the tank until they meet said requirement. If Prize Administrators determine a team is violating the rules, the team will be disqualified and become ineligible for prize awards.

Unless required for proof of system requirement and safety compliance, systems may be powered off for this stage. Only after a competitor has passed the Dry Check may they proceed to the Pre-Dive Check.

ID	Description	Score	Weight	Notes
5	Confirm assembled dimensions and volumes are compliant. All bodies of the assembled system must have a maximum beam less than or equal to 150 cm.	Pass / Fail	General	
6	Team presents design overview			
7	Confirm lift points are safe to use The assembled system must be safe and stable while lifted during deployment and recovery and have at least one hard lift point that is easily accessible, or as many as needed to ensure stable orientation while lifted. If the design uses two separate bodies, each body may be lifted separately or together.	Pass / Fail	General	
8	Load vehicle onto team cart or chassis	Pass / Fail	General	

9	Confirm all chassis sections are grounded	Pass / Fail	General	
10	Review of system survivability of submergence and wave action Criteria will be scored in other categories.			
11	Confirm battery capacity is sufficient to power system for 30 minutes or 250 Watt-hours The total energy storage capacity of the system, including all system bodies, must have a minimum capacity to continuously power the dummy payload and all thrusters while operating at maximum power consumption for 30 minutes, or 250 Watt-hours, whichever is greater.	1 / 2 / 3	Power	
12	Confirm battery capacity is less than 1000 Watt-hours The maximum energy storage capacity of the complete system must be less than or equal to 1,000 Watt-hours.	Pass / Fail	Power	
13	Review wave power recharge system Verify that recharge system is the same as what was presented in TDR or submitted in final technical design.	Pass / Fail	Power	
14	Review ground fault circuit system The battery charging subsystem must have ground fault circuit interruption protection.	Pass / Fail	Power	
15	Confirm CTD integration System must incorporate a commercially available CTD instrument	Pass / Fail	Data	

	that is able to sample at the rated depth of the system.			
16	Confirm dummy payload integration System must accommodate the provided dummy payload package into the profiling body and provide it with energy harvested from waves. If wave energy harvesting is performed in a body separate to the profiling body, then there must be a method of power transfer between the two bodies (see Req. 1, Appendix L).	Pass / Fail	General	

Pre-Dive Check

The Pre-Dive Check of the test will be used to verify communications and all other systems are operating as expected. This stage is expected to immediately follow Dry Check and be conducted in the team's staging area. Only after a competitor has passed the Pre-Dive Check may they proceed to the Wet Check.

ID	Description	Score	Weight	Notes
17	Validate performance of wireless communications System must be able to transmit and receive data and commands wirelessly. At least two wireless communication subsystems must be used, one of which must be satellite communication. The other communication subsystem is up to competing teams and must have an indoor range of at least 100 m when at the water's surface.	1 / 2 / 3	Data	
18	Validate performance of satellite communications System must be able to transmit and receive data and commands wirelessly. At least two wireless communication subsystems must be used, one of which	1 / 2 / 3	Data	

	must be satellite communication. The other communication subsystem is up to competing teams and must have an indoor range of at least 100 m when at the water's surface.			
19	Validate performance of receipt of GPS signal The system must incorporate a global positioning system (GPS) module with sub-5-m precision and be able to relay its geospatial position over wireless communication	1 / 2 / 3	Data	
20	Confirm all propellers are shrouded All propellers must have shrouds. The shrouds must surround the propellers and have at least a 5.1-cm distance between the spinning disk of the propeller and the edges of the shroud (front and back). Commercial thrusters qualify as is, as long as they are shrouded.	Pass / Fail	General	
21	Confirm propulsion system accepts and executes commands.	Pass / Fail	Data	
22	Confirm CTD operational	Pass / Fail	Data	
23	Confirm DPPM operational	Pass / Fail	General	
24	Complete any other required system functionality checks. These could include, but are not limited to, payload cycling, ground fault circuit, charging system			
25	Emergency system check. Kill switch operational. Demonstrate any other safety systems.	Pass / Fail	General	

Wet Check

The Wet Check will be conducted in a small, shallow tank or section of the basin, and will be used to ensure the vehicle meets system requirements.

ID	Description	Score	Weight	Notes
26	Hoist system with overhead crane using scale The assembled system must be safe and stable while lifted during deployment and recovery and have at least one hard lift point that is easily accessible, or as many as needed to ensure stable orientation while lifted. If the design uses two separate bodies, each body may be lifted separately or together.	Pass / Fail	General	
27	Measure weight The assembled system dry weight, measured in air, at the point of deployment must be less than or equal to 250 kilograms (kg). If the design uses two separate bodies, both count toward the maximum weight limit.	Pass / Fail	General	
28	Place system in the water and check buoyancy. Teams may use some time to adjust trim and ballast during this step. All bodies of the assembled system must be positively buoyant in freshwater during deployment/recovery.	1 / 2 / 3	General	

29	Check wireless communications System must be able to transmit and receive data and commands wirelessly. At least two wireless communication subsystems must be used. The other communication subsystem is up to competing teams and must have an indoor range of at least 100 m when at the water's surface. Satellite communications will be tested if possible based on testing facility capability.	1 / 2 / 3	Data	
30	Check/explain ground fault circuit throughout in-water checks	1 / 2 / 3	General	
31	Confirm all electrical systems and required sensors are operating as expected	Pass / Fail	Data	
32	With vehicle tethered, check thruster controls are operational	Pass / Fail	Maneuver	
33	Begin recording mission data. Submerge vehicle using either internal ballast controls or weights, leave submerged for 10 minutes, and bring back to the surface.	1 / 2 / 3	Data	
34	Stop recording mission data. Prove that data was recorded successfully, and values make sense	1 / 2 / 3	Data	
35	Complete any other in-water checks unique to the system			
36	Confirm ground fault circuit has not been tripped	Pass / Fail	General	
37	Hoist system out of the water with overhead crane and check weight after 5 minutes At the point of recovery, the system must be less than or equal to 250 kg	1 / 2 / 3	General	

	within 5 minutes (to allow for water drainage) once recovery is initiated. If the design uses two separate bodies, both count toward the maximum weight limit.			
38	Confirm no littering	Pass / Fail	General	
39	Confirm no surface temperatures are > 60°C with infrared temperature gun	Pass / Fail	General	

Day 3: Tank Testing

Maneuvering/Mission(s)

The Maneuvering stage of the test will be used to ensure the system can demonstrate that the device can dive, maintain submerged depth, propel itself forward, turn, and resurface. The Prize Administration team acknowledges that operating in the MASK basin introduces additional navigation challenges that do not exist in the open ocean. Teams will be judged on basic maneuverability, not on navigational accuracy. The Prize Administration team encourages teams to keep the navigation element in mind for the open water test, where the artificial constraints presented by the tank test will no longer be an issue and a design for the real world is encouraged. Two waypoint locations will be given as distance coordinates based on a zero origin in one corner of the tank to define (1) where profiling data collection should begin and (2) where the vehicle should turn. Teams will be required to execute the maneuvering mission a minimum of two times to demonstrate the vehicle is capable of turning both right and left.

ID	Description	Score	Weight	Notes
40	System preparation & abbreviated pre-dive (maximum 60 minutes) Teams will be given the following details to pre-program the mission: • Start point • Waypoint 1 and 2 • Vertical profiling depth • Horizontal profiling transit distance • Direction of turn • Horizontal transit distance			
41	Hoist system into tank	Pass / Fail	General	

	The assembled system must be safe and stable while lifted during deployment and recovery and have at least one hard lift point that is easily accessible, or as many as needed to ensure stable orientation while lifted. If the design uses two separate bodies, each body may be lifted separately or together.			
42	Position system in tank at team's desired location and power on DPPM and CTD, and any other desired sensors.			
43	Start: Position the profiling body in the tank at the start point. The start point may be located anywhere in the tank, though the recommended start point is at one end of the deep trench. The system operator onshore must demonstrate two-way communications with the vehicle.	Pass / Fail	Maneuver	
44	Maneuver 1 - Dive: Submerge the profiling body to profiling depth Operator executes the dive via wireless communication with the system. The profiling body must submerge and reach profiling depth. The distance between the start point and the end of maneuver 1 is at the discretion of the team.	1 / 2 / 3	Maneuver	
45	Waypoint 1: the location where the vehicle begins profiling The profiling body must pass by waypoint 1 and continue on its transit towards waypoint 2			
46	Maneuver 2 - Transit: Collect data while transiting at profiling depth (scored in Post-Mission Analysis)	1 / 2 / 3	Maneuver	

	The profiling body must transit on a straight horizontal path along the deep trench for a distance > 20m in length (actual distance will be defined by the test director). Data must be collected during the entirety of the transit and should show consistent data collection at a specified depth.			
47	Waypoint 2: the location where the vehicle executes turn The profiling body must pass by waypoint 2			
48	Maneuver 3 -Turn: Profiling body demonstrates a turn ≥ 90° The profiling body must execute a turn of at least 90° to demonstrate the 7.5m turning radius system requirement. This maneuver must be executed at profiling depth.	1 / 2 / 3	Maneuver	
49	Maneuver 4 - Finish: Option 1: Profiling body surfaces Option 2: Profiling body returns home After turning, the profiling body must maneuver to a location such that wireless communications may be established between the system and the operator.	1 / 2 / 3	Maneuver	
50	System successfully re-establishes wireless communications	1 / 2 / 3	Data	
51	Power off DPPM, CTD, and any other devices team desires			
52	Data download Teams will demonstrate the retrieval of data collected during the mission and	1 / 2 / 3	Data	

	prove that data collection was successful. Data download may be accomplished via wired connection if wireless connection fails.			

Recharge

The Recharge stage of the test will consist of ~120 minutes of tank time with ~60 minutes of wave action to facilitate system charging. Teams have the option to tether systems during recharge; time spent tethering systems will not count toward the 60-minute active recharge period.

ID	Description	Score	Weight	Notes
53	Navigate to recharge area and transition system to recharge mode Note: maximum of 20 minutes. If transition to recharge mode fails, teams may request manual transition with a point penalty	1 / 2 / 3	Maneuver	
54	Confirm both bodies transit to recharge area at > 0.5 knot	Pass / Fail	Maneuver	
55	Optional: Move to desired tank position and attach tether(s) to system Facility staff will execute			
56	Maintain recharge mode system state for 10 minutes to establish baseline power draw Scored in Post-Mission Analysis			
57	Harvest wave energy for recharge Scored in Post-Mission Analysis			
58	Transition system to survey standby mode Teams will have 20 minutes to complete this task	1 / 2 / 3	Maneuver	

59	Data download Teams will demonstrate the retrieval of data collected during the mission and prove that data collection was successful. Data download may be accomplished via wired connection if wireless connection fails.	1 / 2 / 3	Data	

Integrated Test

If a team is satisfied with their performance in the maneuvering and recharge trials and time permits on Day 3, teams may choose to demonstrate a full mission cycle that includes mission execution (maneuvering and communications) and recharge with no operator interventions, and/or choose to showcase other capabilities to showcase system technology maturity to the judging panel as time allows.

ID	Description	Score	Weight	Notes
60	Position system in tank at team's desired location			
61	Repeat steps 42-49 from Day 3: Maneuvering	1 / 2 / 3	Maneuver	
62	Repeat steps 53, 56-59 from Day 3: Recharge	1 / 2 / 3	Power	
63	System successfully re-establishes wireless communications	1 / 2 / 3	Data	
64	Data download Teams will demonstrate the retrieval of data collected during the mission and prove that data collection was successful. Data download may be accomplished via wired connection if wireless connection fails.	1 / 2 / 3	Data	

Post-Dive Check

Once the trials in the wave basin have concluded for a given team, they will be asked to execute their Post-Drive Check.

ID	Description	Score	Weight	Notes
65	Check vehicle is still positively buoyant	Pass / Fail	General	
66	Check system is safe and stable when hoisted with entrained water (if any)	Pass / Fail	General	
67	Check system is <= 250kg by inline scale after 5 minutes hoisted out of water	Pass / Fail	General	
68	Check for evidence of water intrusion or other system failure due to submergence	1 / 2 / 3	General	
69	Check no littering	Pass / Fail	General	
70	Check no system surface temps are >60C	Pass / Fail	General	
71	Check for physical system damage			

Tank Test Post-Mission Analysis

At the conclusion of Day 3, teams are required to provide the judges with a preliminary visualization of downloaded data, particularly for the following key metrics (data presentation format is at the discretion of the teams):

ID	Description	Score	Weight	Notes
72	CTD data per position with timestamp	1 / 2 / 3	Data	
73	Vehicle data (position, speed, depth) with timestamp at a sampling interval of 5 s	1 / 2 / 3	Data	
74	Evidence of communications log through all channels	1 / 2 / 3	Data	

75	Average power to the dummy payload as a function of time during operation in survey mode	1 / 2 / 3	Power	
76	Average power consumed during recharge phase without wave actuation	1 / 2 / 3	Power	
77	Average power generated during recharge phase under wave actuation	1 / 2 / 3	Power	
78	Net power generation calculated from 76 and 77	1 / 2 / 3	Power	

Day 4: Demobilization

Staging and Checkout

On day 4, teams will demobilize and pack their vehicle and equipment into the crates, and coordinate with the facility representative for pickup and removal from the staging area for shipping. Once completed, the teams will check-out with Prize Administrators and depart through facility security.

ID	Description	Score	Weight	Notes
79	Deliver packed crates to test facility or Prize Administrator	Pass / Fail	General	
80	Note time and end time of demobilization duration Teams requiring longer than 24 hours total elapsed time to demobilize will be penalized in scoring	Pass / Fail	General	

Appendix O: Competitor Support Statement of Work Template

The following is a screenshot of the template provided on HeroX for competitors to support their statement of work outlining the intended use for additional BUILD Contest support. Completed forms must be submitted to the Prize Administration team at oceanobserving@nrel.gov by January 31, 2022, for approval of the scope before funds will be distributed.

BUILD Contest SOW Request

Objective:

Anticipated Scope of Work:

Tasks:

Deliverables:

AMERICAN-MADE WATER PRIZE | POWERING THE BLUE ECONOMY: OCEAN OBSERVING PRIZE | U.S. DEPARTMENT OF ENERGY