BUILD CONTEST

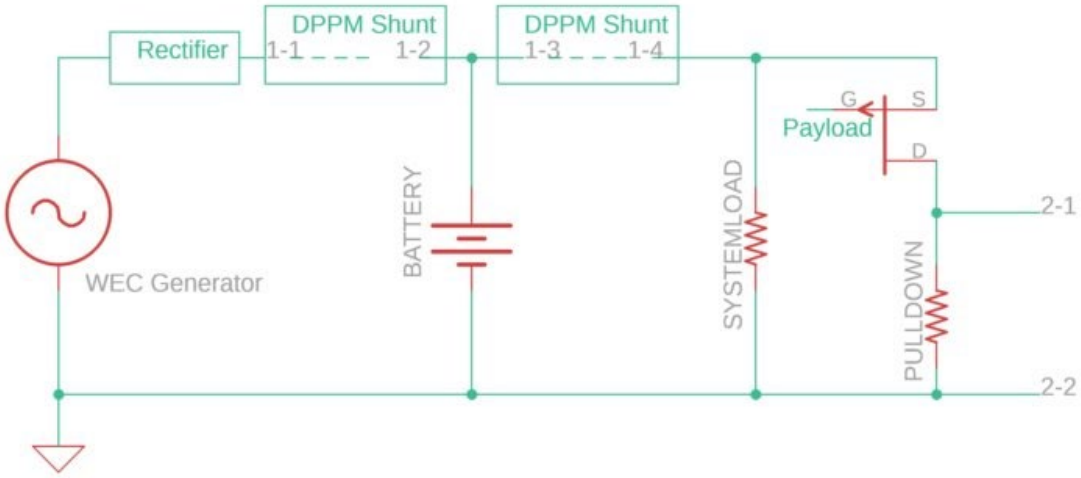
Webinar Q&A Responses

Ocean Observing Prize Administration Team

Dummy Payload

- Please advise on how the dummy payload described on pages 36 and 37 will be employed. The wording appears to indicate it will measure power quality coming from the WEC. Will we be graded on that? Our concern is that WECs generate wild AC, which is rectified into DC. Therefore, the power flow and voltage will be inconsistent and without energy storage at the generator side of the DPPM they will naturally fall to zero at twice the wave frequency. An energy storage device between the WEC and the DPPM is key to a clean power quality for propulsion and payload. Is this allowable? In order to make it easier to comply with these rules, we recommend 1) power generated be measured over an average of several wave periods (per page 13 wave period is 3-5 sec), 2) an energy storage device be allowed between the rectifier and primary battery, or 3) that the dummy load just consider power output after the primary battery.

    - The DPPM is designed to monitor power generated by the WEC and flow to the battery and other system loads. Its two measurement positions, between the generator and battery positive terminal and balance of system loads, is intended to enable measurement of net power generation or consumption during the recharge phase of the competition. Total system energy storage limits and minimum requirements are found in the rules document as Requirement 10. WEC power should flow in DPPM pin 1-1, out from pin 1-2 to system battery, in pin 1-3 from the system battery, out pin 1-4 to power loads (e.g., the AUV system). Please see Appendix M test IDs 75-78 for power metrics that will be assessed, as well as the associated illustration of a sample implementation of the DPPM.



Example implementation of the DPPM.

- Will any changes in form factor [of the DPPM] be considered for the BUILD competition? This is relevant in terms of our AUV design complexity and cost as well as how realistic our design is.
    - No changes in form factor at this time. Any changes will be immediately updated on the website, but the team does not anticipate any changes.

- Is the DPPM/ADCP you provide watertight?
    - Yes, to a 50 meter depth.

- There is a mention of data collection during testing. What are we collecting? Are we provided a CTD?
    - Data will be collected as described in the Rules Document on Page 19, Section 3.6.11. Participants must procure their own commercially-available CTD.

Tank Test

- Will waves be directed dominantly from N actuator or W actuator or both?
    - This will be determined by the test coordinator. Best effort will be made to accommodate specific needs of a device provided the test still conforms with the description in the rules document.

- Will the wave states in section 3.5.2 be randomly combined, changed, or executed sequentially?
    - Wave states will be executed sequentially but potentially in random order from competitor to competitor at the discretion of the competition coordinator.

- May the vehicle use any portion of tank for wave generation (e.g. the deep south section or closer to actuators?
    - The tank test coordinator will work with the teams to place the vehicle in a suitable location. The ultimate decision of placement always lies with the tank test coordinator.

- It seems that during the wave tank testing at MASK, we are overlapping schedules with other device developers (i.e. while we are in the tank there will be 2-3 other teams present going through their testing.) Shape/size/design and other IP-related information would be difficult to protect from our competitors if we can visually see the other devices in the water. Can you elaborate how this will be managed?
    - Each team will have one 4-walled, outdoor tent or container to stage their crates and equipment in for all 4 days. On Day 1 and Day 4, teams will not enter the MASK building, they will remain outside and will have the option of utilizing one of two CONEX boxes to aid in mobilization and demobilization. Only two teams will be inside the MASK facility simultaneously for Day 2 and Day 3. The static test tank being used for Day 2 wet checks is physically distanced from the MASK wave tank used for testing on Day 3; there is also a barrier wall between the two tanks. There may be times when stationary visual shielding is impractical (e.g. transporting the system from outdoor staging location to inside the MASK building, satellite communication demonstration when a clear view of the sky is required). Teams may choose bring their own visual barrier to shield their equipment during cart transport

- There is 120 minutes of tank time with 60 minutes of wave action. What is the other 60 minutes for? Is it just to hold a position?
    - The additional 60 minutes is for device preparation and set up/take down of the test section.

- Rules say to be submerged for 10 minutes, how far down do we go, up to 35 meters max depth?
    - Devices are required to be rated for a minimum of 35 meters depth in preparation for the SPLASH Contest. The maximum depth expected for the BUILD Contest tank tests is less than 7m.

- How do we establish the initial waypoint? Are we set at a particular position to begin with? Are the waypoints underwater?
    - Devices will be placed at a starting point in the tank provided to the contestants by the tank test coordinator, along with headings and distances to subsequent waypoints. During the maneuvering mission defined in Appendix M, waypoint 1 and waypoint 2 are underwater.

- Please confirm if telemetry is NOT allowed during underwater maneuvering. If so, how are waypoints programmed when at the surface? This is applied to a fully submerged vehicle.

    - Because of the overhead structure of the wave basin, satellite telemetry is difficult if not impossible. For the maneuvering mission detailed in Appendix M, all waypoints and vehicle behaviors are expected to be executed without GPS support and without operator intervention.

- Is good wifi available to be used at the test tank facility? Or, do we have to use a different wireless technology?
    - Neither internet access nor any other wireless network access will be provided by Carderock. Teams must supply their own equipment to establish and demonstrate wireless communication with their system. All portable electronic devices (e.g. computers, tablets, hotspots) that will enter the test site must be approved ahead of time (see Appendix F: Carderock Access Forms, Electronic Devices Permissions)

- It seems there is actually very little scoring from the amount of energy recovered; is that correct? Even if our system is unable to capture energy due to the artificial size constraint, is this ok?
    - The weightings of the different categories are explicitly defined in Section 3.3.1 in the rules document, and detailed scoring can be found in Appendix M. Please also see Appendix M test IDs 75-78 for metrics used to assess power generation and consumption during the tank test.

- Tell us more about the weight of the tank tests on energy production relative to all the other scoring criteria?
    - The weightings of the different categories are explicitly defined in Section 3.3.1 in the rules document, and detailed scoring can be found in Appendix M. Please also see Appendix M test IDs 75-78 for metrics used to assess power generation and consumption during the tank test.

- We would probably require quite a bit of play-time in this wave tank to ensure that all our systems operate as anticipated in the wave tank - and fix the issues.
    - The time allotted for tank testing is fixed and is detailed in the rules document. Please review section 4 for specific information on tank testing times and preparation requirements, and Appendix M, Day 3 for detailed tank test plans.

Communications and System Design

- According to p. 19 of Build contest rules, "… 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." According to p. 66, "At the conclusion of Day 3, teams are required to provide the judges with a preliminary visualization of downloaded data…" - does this mean we will have time to format the data? Or does "immediate" mean the representations must be done automatically/at the click of a button?
    - At the conclusion of Day 3, teams must show judges their downloaded data. There will not be very much time for teams to format data on Day 3, so teams are expected to develop a method to generate quick-turn visualizations, whether formatting is done manually or automatically.

- In the quick data visualization it asks for a " Comms log through all channels". Could you please elaborate on this? Do we need to just show initial connection Or every packet of information transmitted?
    - The comms log through all channels should show at a minimum a record of connection for each comms channel.

- What is the beam length?
    - The beam length is the measurement of the widest part of the system, orthogonal to the axis aligned by the direction of travel.

- Our WEC is intended for deep sea wave motion - the shallow test tank will prevent us demonstrating its full potential. Are there means to provide this data from ocean tests?
    - No, all data will be collected during the tank test. External data cannot be considered as there would be no way to standardize across teams. Teams that are successful during the tank test will move on to the SPLASH Contest, the open water test, during which ocean test data will be collected.

- The waves generated in the wave tank are much shorter period than what we would encounter at sea. WEC device performance is very sensitive to wave period (and related length scale) and a device that may perform well in short period waves in a wave tank may do very poorly in longer period waves in the open ocean. How do you intend to translate the performance in the wave tank to the performance in the ocean to make the wave tank testing a meaningful exercise?
    - Information on the basin waves can be found in Table 1 (Page 13) of the BUILD Rules Document. These wave conditions supersede the conditions included in the DESIGN Rules Document to align with the conditions that the facility allows. The BUILD Contest will evaluate the performance of these devices at the wave conditions specified. The reviewers and judges may extend wave basin performance results to estimate performance in openwater conditions at their discretion, and if so, will apply the same analysis to all teams equally. For those teams who advance, the SPLASH Contest will evaluate performance of those devices in openwater conditions.

- The rules require two forms of wireless communication, one of which must be satellite communications. Can you say if GSM/3G communications are allowable as the second form of wireless comms? If yes, is there GSM/3G reception in the Carderock MASK building? If there is reception in the Carderock MASK building are there any reports (formal or informal) available on the signal strengths of the various carriers/channels/frequencies?
    - GSM/3G is allowable as a form of satellite communication, but 3G reception inside the MASK building is very unreliable. Teams are required to demonstrate wireless communication inside the MASK building during tank testing. The satellite communication requirement may be briefly demonstrated outside the MASK building with a clear view of the sky.

- The rules state GPS cannot be relied upon for navigation in the test tank as the sole means of navigation. What other means would be suggested that have worked in the past.
    - This is correct - the GPS constraint is that the test facility is covered so GPS may not be available. A single point, stationary GPS repeater is available in the MASK building, but it will only provide time synchronization and cannot be used to determine location within the basin. We cannot provide technical guidance but there are other methods of communication that participants can leverage.

- Is there an issue with utilizing a compass to determine direction in the Carderock facilities? Given the presence of large electrical machines (wave makers), I am not clear how well a compass would work.
    - The large bridge and carriage structures over the tank and the metal roof have caused some issues with compass headings, but it is still implemented for general understanding of heading in the facility since GPS is not available.

- Will we be allowed to communicate over an RF link (remote control) with our machine while testing? Since our device is always surface piercing, this could be a suitable option and provide a

positioning solution. At the very least, we would want to monitor the machine on a ground-control station to understand if the system is on track.
    - The maneuvering mission, recharge mission, and optional integrated tests executed on Day 3 of the tank test are meant to be autonomous. Teams may passively monitor their systems throughout the tests, but shall not interfere with the autonomous mission (i.e. remote commands may not be executed).

- For commercial purposes, we would simply rely on GPS and because we do always have a surface-piercing vessel, we would never really encounter a GPS-denied environment. So the operation in a GPS-denied environment seems to be an additional burden that we would have to meet just for the competition. We can get direction from compass and depth from pressure, but position in X and Y are difficult to determine and will likely require an expensive IMU because of the slow drift response over longer time-periods. We have thought about relying on heading and speed to determine position in X and Y (given that we are not exposed to currents), but we are concerned that our position accuracy is going to be poor. Can you provide access to resources on how to solve this positioning problem in a cost-effective manner?
    - A single point, stationary GPS repeater is available in the MASK building, but it will only provide time synchronization and cannot be used to determine location within the basin. Devices will be placed at a starting point in the tank, and teams will be provided with headings and distances to subsequent waypoints. While position accuracy is desirable, there are no specific requirements related to position accuracy for the BUILD Contest.

Batteries

- Can we expect to begin our testing with charged batteries? Will we be able to swap batteries mid day since the charge rate may not facilitate recharging a battery during a short test window?
    - Yes, the batteries can be charged and swapped. The charging portion will test for power generated, not a full recharging of a battery.

- How is the capacity of the battery determined? Lipos can't be discharged completely, so would this just be until our battery management system cuts off?
    - Total battery capacity will be determined as the sum of the nameplate capacities of all batteries contained in the system and must conform to the limitations found in the rules document as Requirement 10. Per the requirement, your system must be able to run for 30 minutes at maximum power consumption or have a usable minimum capacity of 250 Wh.

Scoring and Submission Requirements

- Some scores are pass/fail - are these "one strike you're out" or are they 1 point for passing?
    - Teams will receive one point for passing the pass/fail questions. Failure of a criteria does not mean disqualification or dismissal from the contest unless otherwise stated in the rules as grounds for dismissal.

- Is the submission of all documents for the BUILD Contest managed in the private Box folder that was sent to us aside from those specified to send to OceanObserving@nrel.gov?
    - Yes, all submissions should be shared via email to OceanObserving@nrel.gov or to the private Box folder designated for your team following the submission guidelines in the rules document. No submissions will be accepted for the BUILD Contest on the HeroX platform.

- In the NEPA Questionnaire question one, it asks for the dimension of each component. Does this mean the dimensions of each body or each component?
    - This refers to the dimension of each body of your device once assembled and sea-ready. Some devices may have one body, while others may have two. If your device has two bodies once assembled, please provide the dimensions of each.

- Are we able to submit the financial forms after May 31st if we submit the NEPA and intent to compete by the deadline?
    - Yes, but please know that processing the financial forms takes time and your disbursement may be delayed.

- Can I get clarification for official rule 3.6.7: no cameras or video recording devices are allowed. My cell phone and laptop has a camera and video recorder, and our WEC is expected to have an onboard camera potentially for autonomous navigation, will this be an issue.
    - Please refer to Appendix F of the rules document, where the facility-specific restrictions are provided in detail.
    - Teams wishing to use personal electronic devices (computers, tablets, hotspots, etc.) on base must submit Form D5239-9: Personal Electronics Device (PED) Form (see Appendix F: Carderock Access Forms, Electronic Devices Permissions). 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.

- Is it required to use a commercial shipping company, or are we able to deliver the system ourselves if we bring components with us as we arrive to the test facility?
    - Teams are not required to use a commercial shipping company and may carry their own equipment with them to the test facility.
    - As a reminder applicable to both shipped items and items carried on base: Teams wishing to use personal electronic devices (computers, tablets, hotspots, etc.) on base must submit Form D5239-9: Personal Electronics Device (PED) Form (see 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.

- Have you established any competition metrics for the final stage of this competition (i.e. how the final stage will be scored and what the relevant metrics are that we are competing on)? We are redesigning our device and optimizing it for the final stage. We would like to do this redesign before building the device during this next phase.
    - During the SPLASH Contest, teams will have the opportunity to deploy and test their refined systems for approximately one week at sea to verify their performance in real-world conditions. Additional information on specific metrics will be available with the release of the SPLASH Contest rules document.

Prize Partner Information

- How do I contact the prize sponsors?
    - The Ocean Observing Prize has three sponsors and a group of power connectors to support competitor advancement in the BUILD and SPLASH Contests. The Prize Administration team has shared the contact information for each of the sponsors and connectors via email, but if you need this information, please reach out to OceanObserving@nrel.gov.

- Does NOAA have a plan or guarantee to purchase any technologies that are a result of the prize?
    - No. Though the prize was structured to meet real-world needs at NOAA, NOAA never has guaranteed nor plans to guarantee a purchase of any of the technologies. Competitors may be interested in opportunities from the IOOS Ocean Technology Transition program.

- Could you comment on the partnership opportunity on the NSF Convergence Accelerator?
    - While there is no current partnership with NSF, competitors may be interested in opportunities from the NSF Convergence Accelerator.