American-Made Water Prize

WAVES TO WATER

U.S. DEPARTMENT OF ENERGY

DRINK STAGE TEST SITE

Jennette's Pier

JUNE 2020

Jennette's Pier Test Site and DRINK Stage Details

This resource covers more technical details for the DRINK Stage of this contest. Final evaluation criteria, including metrics, will be detailed at the beginning of the DRINK Stage.

Set Shipping Container Size

In the DRINK Stage, competitors will be required to have their entire system fit within a standardized container. The container that has been selected is a standard, commercial, off-the-shelf container that is approximately 45 x 48 x 42 inches (e.g., DuraGreen DGR454842). The internal dimensions that all system components must fit inside are approximately 41 x 44 x 35 inches. The contest is seeking technologies that can fit into a predefined container to standardize the shipping constraints that face many disaster response and recovery scenarios. Specifically, the prize is targeting locations that may have damaged infrastructure and therefore may have limited access to on-road transportation. For this reason, the container that has been selected is sized so that any light-duty pickup truck will be able to transport a single unit to its final location. The U.S. Department of Energy Water Power Technologies Office (WPTO) may supply the final contestants with one container to ensure that every competitor at the final DRINK Stage has the same shipping constraints.

Site Testing Conditions and Set Up

All solutions competing in the DRINK Stage will be evaluated at an open-water test site with the following site characteristics at Jennette's Pier:

- Significant wave height range between 0.5 meters (m) and 2.0 m
- Average wave period range between 5 and 15 seconds
- Water depth between 2 and 5 m
- Deployed less than 1 kilometer from shore.

It is anticipated that the test site configuration will look like the following schematic. The deployment area adjacent to the Pier extends East and West from the sub tidal zone, seaward of the typical surf zone, and from approximately 50 m (164 ft) to 100 m (328 ft) of the Pier to the North and South.

An electric pallet jack, a Bobcat with forks (T550), and a manual pallet jack will be provided to move devices between the staging area in the Pier parking lot and onto and along the Pier. There will also be a lift truck (4000 lb. capacity) for use in the staging area (Jennette's Pier parking lot).

The Pier deck is 96" wide, at the narrowest point, with benches removed, and 60" when benches are left in place.

Water will need to be either desalinated directly on the pier—in the case that competitors are using wave energy to provide electricity to run a reverse osmosis system—or pumped to the pier in the form of desalinated water. The pier deck is approximately 26 ft (~7.9 m) from the water surface. The water depth in the testing area ranges from approximately 3.6 – 6 meters (12 to 20 ft) Competitors will work for a set period of hours during the DRINK Stage with the team at the Coastal Studies Institute (CSI) in advance of the DRINK Stage to finalize—at a minimum—their mooring configuration, NEPA compliance, and deployment strategy.

Standard Moorings

At the test site, competitors will be provided with a standard mooring connection. It is anticipated that the standard mooring will be a 3" shackle that is approximately 24" from the seafloor. The anchor will be approximately 1,000 lbs. The weakest weight load limit of any component of mooring would be at least 10,000 lbs. Design failure load links are not designed in the mooring systems. Competitors are responsible for designing failure loads into their connection. Additionally, and tension line from the

shackle to the device is the responsibility of the competitor. Should a competitor seek an alternative mooring, this will have to be approved by CSI and the National Renewable Energy Laboratory (NREL).

Deployment

In the DRINK Stage, solutions will need to address the ability to deploy quickly and easily in a disaster response scenario where there is large uncertainty around site conditions. Competitors will have to deploy their systems in under 48 hours. Devices will be assembled onsite and deployed by a qualified team of divers and staff from CSI with a spydercrane. Should a competitor seek to use an alternative deployment method, this will need to be approved by CSI, WPTO, and NREL.

As part of the DRINK Stage, competitors will work with CSI, WPTO, and NREL to finalize the assembly plan, including how the device will be assembled onsite. As devices will be deployed on a schedule, each device should have an inactive mode of operation. Once the devices have all been installed, there will be at least 1 hour of inactive time for the devices to ensure fairness. This 1 hour of inactive time will not count against the 48-hour deployment window.

Water Delivery and Collection

Water will need to be collected at Jennette's Pier on the pier. Should competitors not pump fresh water to the pier, they will be responsible for pumping sea water to the pier to feed into their reverse osmosis system. This can include delivery methods like a pump for fresh water, or bucket pulley systems.

Water will be collected in 55-gallon drums and will be continuously monitored for total dissolved solids (TDS), pH, and turbidity. The drums will be emptied every 12 hours, or as needed. At the beginning of the contest, competitors can choose when to begin collecting water, should they choose to flush their system.

To make progress toward demonstrating wave powered desalination systems, in the DRINK Stage there will be both minimum threshold requirements for water quality as the output of the system and a target goal:

- **Maximum Level TDS**: 1,000 mg/L (World Health Organization advises water with TDS concentration less than 1,000 mg/L as being 'usually acceptable' for palatability)
- **Target Level TDS**: Range of 300 to 600 mg/L TDS to achieve generally good acceptability in terms of taste.

Ultimately the prize seeks to produce drinking water at the final DRINK Stage of the competition that meets both EPA's Secondary Standards and mandatory limits of the National Primary Drinking Water Regulations. It is anticipated that as part of the prize, WPTO and NREL will send samples from competitors' water produced in the prize to an EPA certified laboratory for certification of results.

Local water quality will vary considerably across different regions, and it is necessary to design systems so that fit-for-purpose pretreatment and post treatment can be adopted with minimum efforts. Disinfection technology that functions without chemical consumption is also important to establish for remote communities with limited operational capacity. Examples include UV, laser (local temperature increase for short time), or ultrasonication can prevent biofouling and reduce operating cost, including chemical cost.

Maintenance During Test

At the DRINK stage, there will be no set time for maintenance. No data cabling will be provided to competitors. Any data collection needed for operations of the devices will be the responsibility of the competitor.

National Environmental Policy Act Compliance

- Overview of Scientific Data Gathering Devices
- Passive Acoustic Monitoring
- Passive EMF Monitoring
- Active Devices – Marine Wildlife Monitoring and ADCP Devices
- Entanglement
- Collision with Vessels
- Acoustic Disturbance
- Exposure to Light Sources
- Direct Physical Impact or Scour
- Elevated Turbidity or Sedimentation

Brine discharge, or other salt concentration issues from the process of desalinating water, will need to be managed effectively depending on existing environmental regulations. The development of zero or near-zero liquid discharge technologies can be tactically important toward achieving highly efficient desalination systems. In addition, it is important that desalination systems do not introduce biological or chemical contaminants, such as unregulated or nontraditional constituents (e.g., Boron). Brine management strategies that effectively address both the economic and environmental cost of brine diffusion, disposal, or other applications will be encouraged. Specific strategies that are robust across a variety of feedwater types could also be critical for some applications and should be considered. Another critical factor might be the tradeoff between concentrating brine recovery versus brine volume and determining an optimal level of water production to resource recovery.

Additionally, consideration will be given to system recovery, cleanup, and possible re-deployment. At a minimum, technology that is deployed at the test site will have to be completely removed from the test site at the end of the testing period.

Relevant Regional Observations

Waves

Jennette's Pier Historical Wave heights from a moored Acoustic Wave and Current Meter at the 11m test berth: https://chlthredds.erdc.dren.mil/thredds/catalog/frf/oceanography/waves/awac-jpier-11m/catalog.html

USACE Army Corps Field Research Facility Regional Waves Information: https://chlthredds.erdc.dren.mil/thredds/catalog/frf/oceanography/waves/catalog.html

Waverider 243 at the 26m isobath ~10 miles offshore of Jennette's Pier: https://cdip.ucsd.edu/themes/?d2=p70:s:243&zoom=auto&pub_set=public&regions=all&tz=UTC&units=standard

Waverider 192 at the 26m isobath south of Jennette's Pier ~10 miles offshore of Pea Island: https://cdip.ucsd.edu/themes/?d2=p70:s:192&zoom=auto&pub_set=public&regions=all&tz=UTC&units=standard

Spotter Buoy: https://spotters.sofarocean.com/?spotter-filter=SPOT-0560&fbclid=IwAR1VRVR6Oo4avL4xTQUaN6HwyKX_f33my63vpM8T6VGN50ZcIFSlotJFaHo

Currents

The most relevant available currents may be from this AWAC deployed at the Field Research Facility at the same depth as the test site: https://chlthredds.erdc.dren.mil/thredds/catalog/frf/oceanography/currents/awac-5m/2009/catalog.html

Surface currents offshore of the test site from the North Carolina HF Radar network can be found here: https://dods.ndbc.noaa.gov/thredds/hfradar.html

Viewed here in near-real time: https://cordc.ucsd.edu/projects/mapping/maps/

Tides

Most accurate tidal information from Field Research Facility tide gauge in Duck: https://tidesandcurrents.noaa.gov/noaatidepredictions.html?id=8652226&units=metric&bdate=20220401&edate=20220430&timezone=LST/LDT&clock=12hour&datum=MLLW&interval=hilo&action=monthlychart

Wind

Three years of historical met data, including winds, are located here*: https://americanmadechallenges.org/wavestowater/docs/JennettesMetData.xlsx
**Any party using these wind data must acknowledge WeatherFlow Inc. as the provider*