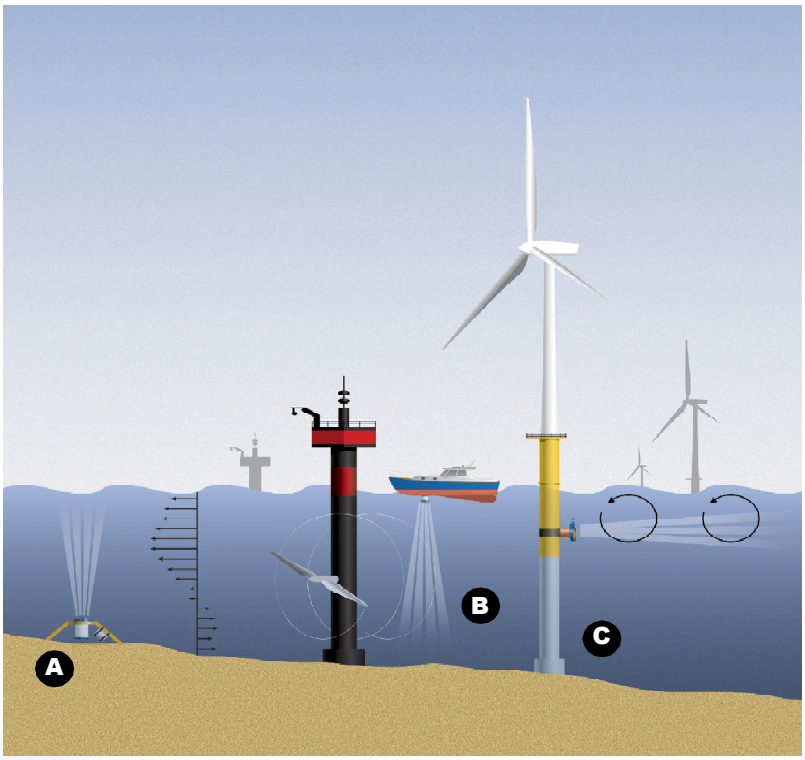
Application Note: Renewable Energy

Access to accurate, real-time current and wave information is a critical component of offshore and inland renewable energy site assessment and monitoring activities. Teledyne RD Instruments Acoustic Doppler Current Profilers (ADCPs) and multi-directional Waves Array products are ideal tools for this environment, offering highly reliable environmental data when and where you need it most.



Why do you need current and wave data in the offshore and inland renewable environment?

To support harvesting the marine environment for its renewable energy, instrumentation for measuring currents, waves, and tides must operate and survive in very dynamic environmental conditions for extended periods. For such conditions, the proven operational and performance advantages of the Acoustic Doppler Current Profilers (ADCP) become more valuable. This versatile tool provides a single device that can deliver a wide scope of water measurements (currents, waves, water level) required for the various stages of designing, installing, and operating a marine energy farm.

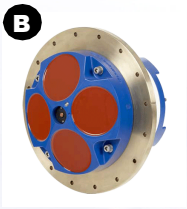
Teledyne RDI's Products:

A

Teledyne RDI's highly versatile **Workhorse Sentinel** can be deployed on the seafloor or within a surface buoy to collect high resolution profiles of the current speed and direction throughout the water column, providing you with a clear illustration of the currents at play. This instrument can be configured to collect and store data until the unit is retrieved, or can transmit data in real time to an offshore platform or shore station using a cable or underwater acoustic modem.

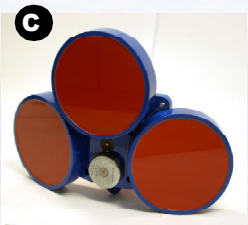
Teledyne RDI's Workhorse Sentinel can also be upgraded to include a **Waves Array**. This economical upgrade allows you to collect both high resolution current information and multi-directional wave data.

B



Teledyne RDI's **Workhorse Mariner** has been designed specifically for moving boat survey operations. The Mariner offers all of the benefits of Teledyne RDI's traditional ADCP products in a compact package designed specifically for coastal hull-mount applications.

C



Teledyne RDI's 300 kHz long-range **Horizontal Acoustic Doppler Current Profiler (H-ADCP)** is a narrow beam acoustic monitoring system that "looks" out horizontally to measure near-surface water currents and multi-directional waves. This unit can be conveniently installed and powered from an existing offshore renewable structure.

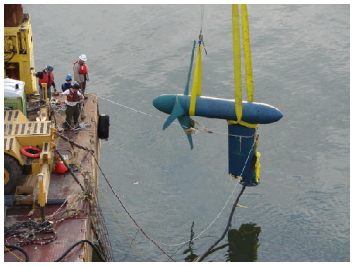
MEASURING WATER IN MOTION AND MOTION IN WATER

TELEDYNE RD INSTRUMENTS
A Teledyne Technologies Company

Operational Solutions

Design And Layout Of An Energy Farm

In the East River in New York City, Verdant Power is installing a field of turbines to capture the energy of tidal currents reaching 4 knots off Roosevelt Island. As well as revealing the impressive speeds of these currents, the ADCP boat sections showed an asymmetric distribution of the currents across the river section, which will be key information for deploying the field of turbines.



A little farther to the north, the Cape Wind project is exploring a site for an offshore wind farm. Here ADCPs are being used for a year-long study of the surface wave field. More than just wave energy, the ADCP provides a directional array capability. These data permit detailed analysis of how the wave energy and direction vary with wave period as well as over time. Further the ADCP can resolve waves of the same period arriving from different directions—a unique advantage compared with traditional wave sensors.

Once a field has been surveyed and generator sites selected, the same ADCP can be moored to collect time series of current velocity at many levels through the water column. This information can aid design plans about the depth levels for locating the turbines and how this might change with the direction or phase of the tidal cycle.

Tuning Performance of the Turbines

After an energy farm is installed, the same ADCP used for initial survey work can be employed for real-time monitoring of currents through the water column.

For devices like the offshore tidal turbine “Seaflow” designed by Marine Current Turbines, which can reposition the rotor turbines through depth, this type of information can be valuable for tuning the performance of the system or avoiding depth layers where vertical shears might cause problems. In other cases, these real-time ADCP data might be used for tuning the pitch of the rotor blades as water speeds vary.

Operational Advantages

What are operational advantages of this method compared with mechanical instrumentation?

The ADCP uses acoustic signals that are scattered off suspended materials moving with the water. As a result, the ADCP can remotely sample many levels at once throughout a range of the water column while deployed in relative safety on the seabed. In addition, the ADCP has no moving parts. This makes it well matched to a highly dynamic environment, avoids the need for recurring calibration, and permits reduced maintenance compared with mechanical meters.

The hardware is a compact, low profile, and robust package. It houses low-power electronics that permit long-term unattended deployments.

For systems that capture energy from both ebb and flood tides, like Engineering Business’s Stingray, which uses the flow of the tidal stream over a hydroplane, or Verdant Power’s, which uses a yaw system to rotate the turbines, real time current data from the ADCP can help choosing the best time to reconfigure the system.

Real-time ADCP data can also aid in interpreting variability in the output of turbines or for knowing when to shut down if environmental conditions approach design thresholds. In a similar way, the suspended load observed with an ADCP might provide the basis for an alarm at sites where currents can stir up sediments storms that might degrade the operation of the turbines. Another type of ADCP that provides interesting possibilities for operational energy farms is the Horizontal ADCP. This device can be deployed to look upstream to see the incident currents in front of the turbines without concern about hardware being sucked into the turbines.

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