A Floating LiDAR Roadmap

Implications for offshore wind

By Graham Howe

METEOROLOGICAL MASTS ARE OFTEN an integral part of wind energy project development, as they provide the instrumentation that properly measures wind speed and direction, among other weather variables. Designing and installing a met mast demands a fairly integral approach, however—particularly for offshore wind turbines—and many of the challenges involved are often overlooked or unaccounted for.

For instance, offshore met masts in 30 meters of water currently cost up to $15 million, while only measuring winds at up to 100 meters—a concern when compared to the 150-meter blade tip of modern wind turbines. Alternative technologies that are cheaper and more accurate are needed as a long-term solution for many wind energy project. Floating LiDAR Devices (FLDs) provide one such technology, and offer substantial advantages in terms of cost and the capacity to deliver data at heights up to 200 meters.

In November 2013, the UK-based Carbon Trust launched their Roadmap for the commercial acceptance of FLDs. The roadmap was a major step in the ongoing development of this valuable technology as, for the first time, a major organization has set out a clear set of performance expectations from these systems. Although the United States is still in the pre-development stage of its very first offshore wind farm, Cape Wind, it is a roadmap worth considering.

A look at technology

A remote sensing technology, LiDAR's designed to measure wind speed and wind direction. An alternative to met masts, there are still two main challenges facing the use of LiDARs in offshore wind: motion and power.

• Motion

LiDARs typically take between 4.5 and 10 seconds to gather wind speed and direction data across all of their range gate heights (typically numbering between 6 and 10). The motion of a floating platform can induce error into this data.

Systems providers have two main routes to follow to address motion. The first is to create a platform that dampens the motion of the LiDAR by absorbing the sea's energy. These platforms are typically either a spar buoy or a tension leg buoy (such as the platform deployed by Deepwater Wind off the coast of Block Island*). Although these platforms do offer the necessary stability, they can be expensive and are difficult to re-deploy.

The second option is a smaller buoy, typically between three to six meters, which includes either mechanical motion damping or algorithmic motion compensation—or a combination of both. It is this style of system that's becoming increasingly common, with three six-meter systems currently deployed in the US, two in Europe, and one in Taiwan. Although these systems are increasingly able to address the motion issue, they also face long-term deployment issues as a result of the second main challenge, which is power.

• Power

LiDARs require a consistent power draw of between 45 watts and 100 watts, which can be difficult to achieve on a floating platform. All system providers seek to address this with renewable power, such as from solar panels or wind turbines. To date, however, the most successful system has been deployed with an integrated diesel generator, which has led to a successful cumulative deployment time of over two years.

Nonetheless, as a result, it's fair to say that FLDs have successfully demonstrated that they're capable of long-term deployments, which provide accurate data. The final challenge now facing these systems is market acceptance.

Bankability

As mentioned, the Carbon Trust issued their roadmap for commercial acceptance of FLDs. This section seeks to address the issue of "bankability" of FLDs. Bankability is a misleading term as it implies that banks are assessing the data provided by these systems, and basing their financial decisions on that data. In fact, the assessment of data is undertaken by wind resource assessment consultancies, which then make their recommendations to the financial institutions.

Onshore, the acceptance of LiDAR for bankability purposes was effectively completed in late 2012, when the leading sensors on the market completed GL Garrad Hassan's (GL GH) previous technology roadmap. Although LiDARs had previously been used for financing purposes, the GL GH roadmap provided clear guidelines for the use of these systems going forward, which offered a consistent and widely accepted standard.

The Carbon Trust roadmap seeks to achieve the same result for FLDs. Its key features include:

- Clear key performance indicators for FLDs, outlining acceptable standards of accuracy and data availability, which enables all such systems to be assessed on a level playing field;
- Recommendations with regard to the number of trials required before these systems can be accepted as having completed the full roadmap; and
- Recommendations with regard to deployment practices to ensure successful deployments.

As a result of this work, prospective purchasers now have clear standards against which they can evaluate FLDs, prior to making a commitment to deploy such a system on their wind farm lease.

The future

As of January 2014, there have been eight commercial sales of FLDs, along with four known research projects in various stages of testing. As a result of the publication of the Carbon Trust roadmap, it's expected that the number will increase in 2014.

Clients and research institutions have now begun to assess the data provided by these initial deployments, discovering some interesting details about the performance of the wind offshore. Ranging from slower wind speeds (above 150 meters in the Great Lakes, for example), to the activities of low-level jets in certain areas (such as off the coast of Maryland), this information could lead to increased power generation at times of peak demands.

The publication of the roadmap was a pivotal moment in the adoption of FLDs, which will hopefully simplify project planning and help generate wind power at a lower cost than ever before.

** The Block Island Wind Farm is a 30-megawatt offshore wind farm to be located approximately three miles southeast of Block Island. With five turbines, the wind farm will be located entirely in Rhode Island state waters, and will generate over 125,000 megawatt-hours annually (enough to power over 17,000 homes). Construction is planned for this year. Read more at: http://dwwind.com*

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