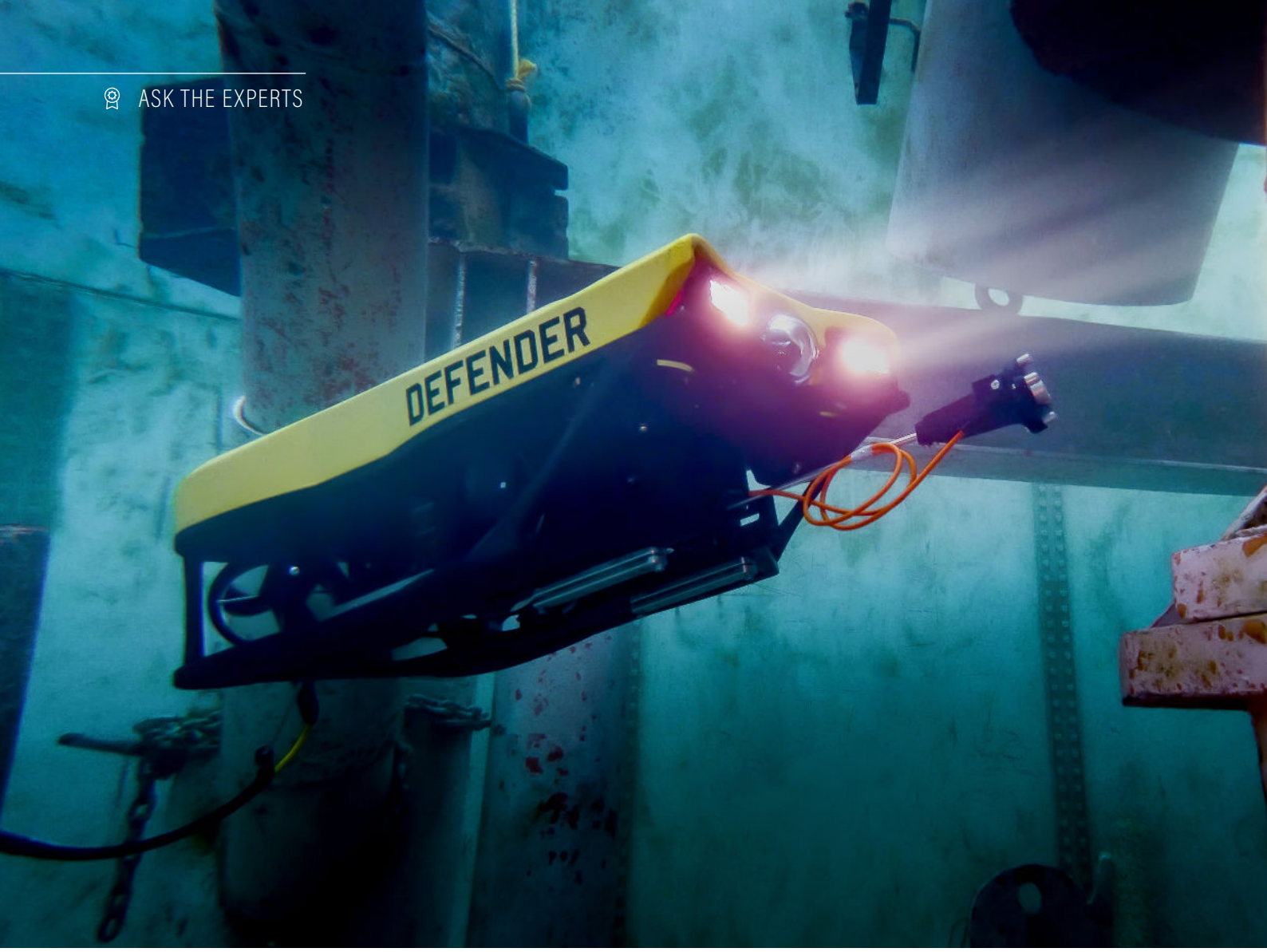

Rugged, nimble, underwater robots help to maintain offshore wind farms

PES spoke with Brad Clause, an account executive specializing in offshore energy applications at VideoRay, the world's leading manufacturer of underwater robotic systems. We wanted to learn how VideoRay systems can improve the efficiency of maintaining offshore wind monopiles and turbine jackets and foundations.

PES: It's lovely to welcome a new name to PES, and I look forward to getting to know more about VideoRay. Briefly talk us through the kind of solutions you provide to wind farm managers.

Brad Clause: VideoRay is a manufacturer of advanced inspection-class underwater robotic systems, often referred to as remotely operated vehicles or ROVs. These systems substantially reduce the cost, time and environmental footprint of wind monopile maintenance, in addition to improving the safety of these offshore missions.

PES: For offshore wind farms to continue to be a cost-effective solution, maintenance costs must be minimized. How does your technology help with this?

BC: Underwater robots can be used throughout the lifecycle of the wind farm project, from geophysical and geotechnical assessments to installation and inspections of the assets. Often, these functions are performed using work-class ROVs. This comes at a higher cost to the operators because it involves deploying an offshore support vessel (OSV). Inspection-class vehicles can be operated from much smaller craft, thereby reducing cost, risk and emissions while providing operators with thorough, efficient results.

Inspection-class systems are smaller and less expensive, but most vehicles in this category are not designed to withstand harsh subsea environments. However, VideoRay underwater robotic systems are engineered and built to perform critical jobs in harsh conditions. They pack the power and functionality necessary to perform important missions and eliminate the need to purchase and upkeep larger, more expensive systems. Our Mission Specialist systems can carry heavy payloads and a wide variety of tools and sensors, but they are much smaller and more maneuverable than work-class ROVs, which enables them to navigate tight spaces.

Our Mission Specialist family features two vehicle configurations, The Defender and Pro 5. The Defender is the larger and more powerful vehicle, optimized for precise control, heavier payloads, lifting and specialized operations and is still highly portable. The Pro 5 system is designed for speed, efficiency and portability.

Key cost-saving considerations with these systems are the portability and ease of deployment. The Defender system weighs only 17.2 kilograms, or 38 pounds, and the Pro 5 system weighs 10 kilograms, or 22 pounds, with standard payload. One person can easily launch the robot into the water, even in marginal ocean conditions. Therefore, the need for large-scale trucks, crane, welding, and non-destructive testing (NDT) inspections to initiate the work is eliminated, thus substantially reducing costs.

Operators can simply drop a Mission Specialist submersible into the water from the monopile. Since no OSV is deployed, the overall carbon footprint of the mission is reduced significantly. In addition, wind farm operators can be trained to run the system so they may perform inspections themselves, eliminating the need to hire an ROV team, again another significant cost reduction to the wind farm operator.

Mission Specialist systems are fitted in impact-resistant, waterproof, rolling cases and can be handled by one person. Usually, only a few cases are needed to transport all the equipment you need for a subsea full inspection. So, the systems are easy to transport and don't take up a lot of storage room. In fact, the entire system can be easily transported by helicopter, in the trunk of a car or as checked baggage on a commercial airline.

PES: Can you explain more about the technology and how the Mission Specialist submersibles actually work?

BC: Our technology is based on customizable and flexible platforms that use a system of interchangeable, modular components communicating through a digital network. As a result, the platform can be easily adapted to target specific missions. The philosophy behind this technology is to fit each robotic

Brad Clause

system to the sensors, tools, depth rating and thrust needed for the job at hand.

VideoRay's design methodology allows us to very rapidly create optimized vehicles that meet customers' needs. Each Mission Specialist system starts with a purpose-built frame customized around the payload requirements of the operator's chosen sensor and tooling package.

For example, the Defender modules include cameras with a wide range of performance levels and resolutions. They also feature LED lighting, powerful thrusters and power systems ranging from 75 volts to 400 volts DC, as well as an on-board battery option with fiber optic tether.

You can also select various manipulators, positioning capabilities and sensors for measuring metal thickness, cathodic protection, marine growth cleaning, flooded member detection, along with imaging and multibeam sonars.

The modularity of the Mission Specialist systems stands out in a variety of ways. Each modular device tied to the system operates independently from the others, providing more flexibility. The communications module provides power via the Ethernet, allowing for a more open platform to add accessories. There is no need to reconfigure the system to accommodate new modules. It's essentially a plug-and-play setup, so operators don't experience any significant down time.

In addition, VideoRay Mission Specialist systems can be equipped with navigation, control and user interface technologies from Greensea Systems, Inc. These vehicle control systems are advanced yet user-friendly and provide exceptional stability and maneuverability. This technology provides multimode control, which means the system can operate at a high level of autonomy, enabling the pilot to focus on the complexity of the mission.

PES: What kind of applications can Mission Specialist systems help with?

BC: Common offshore wind energy production applications include pre-installation site surveys, foundation installations, cable installation and life-of-field inspections. VideoRay's Mission Specialist technology can assist in every phase of the project from the initial planning to the decommissioning.

Mission Specialist systems are used for asset maintenance tasks such as high-resolution visual inspections, marine growth cleaning and removal, cathodic protection readings for corrosion mitigation, 3D point cloud modeling, photogrammetry, laser imagery and material thickness gauging, just to name a few.

PES: With no need for human divers and work-class ROVs, how are accuracy and reliability determined?

BC: Divers and work-class ROV systems will never be obsolete from offshore inspection of projects. In fact, underwater robots are often used as a tool to aid in human diving operations and work alongside work-class systems. When comparing robot technology to divers, it is important to consider that using a cost-effective underwater robotic system reduces expenses, risk and exposure, while increasing efficiency.

The system's level of autonomous capability helps to determine where and how the robot can be used in place of divers. The higher a system's ability to pilot and perform complex navigation, intervention, cleaning and manipulation tasks, the less need there is to risk the safety of divers.

Technology is constantly improving the performance of underwater robots including innovations like increasingly complete autonomous operation, artificial intelligence (AI) and object perception and recognition systems. These expanded capabilities will enable the systems to replace divers in many missions and ensure safer diver operation because they provide a better picture of the underwater environment.

PES: Offshore conditions are often quite rough and unpredictable. How do you counteract these harsh environments and strong currents?

BC: First, you need to consider if your underwater robotic system is built to withstand these harsh conditions. Mission Specialist technology was developed and engineered with an impressive thrust-to-weight-to-drag ratio, consequently resulting in a technology that can work in inclement ocean conditions.

Other features such as auto heading can assist with keeping the operator on the proper bearing to the subsea work site, while subsea acoustic positioning can pinpoint exactly where the robot is in real time in the ocean environment, similar to your GPS unit in your car or phone.

VideoRay's Mission Specialist Defender system has seven reliable and powerful DC brushless thrusters that can handle currents and has a 1,000-meter depth rating. It has seven degrees of freedom, comprising forward, aft, up, down, yaw, roll and pitch, and can maintain active pitch control to face the vehicle in an upward or downward orientation when needed. This feature is particularly beneficial when inspecting objects directly overhead or when performing manipulation tasks on the seafloor.

The Mission Specialist Pro 5 has a three-thruster system, a forward speed of over 4.4 knots and a 305-meter depth limit. It is configured to handle missions with size, space, weight and deployment speed constraints, such as inspections beyond the reach of divers.

PES: These inspection-class systems have a compact framework which is great for working in compact spaces, but what about handling heavy loads?

BC: The weight-to-horsepower ratio of the Defender is best-in-class compared to other inspection vehicles. In fact, the Defender can lift to 11.33 kilograms, or 25 pounds and remain level.

PES: Do you have any examples of VideoRay systems being utilized in real world scenarios?

BC: Energy production operations worldwide use VideoRay underwater robotic systems for offshore missions. For example, CSpect, a company specializing in offshore wind monopile and wind turbine foundation inspections in the North Sea, uses a combination of the VideoRay Defender and Pro 5 systems, coupled with its own engineered tooling, to conduct comprehensive inspections of wind turbine jackets. This eliminates the need for larger work-class ROV systems and teams onboard an OSV, and CSpect has reduced costs by more than 50%, decreased inspection time by more than 50% and improved safety by eliminating the need for a shipboard team.

Another example is the Proceanic Group of Companies, a full-service engineering, project management and underwater robotic inspection company that works extensively in the West Africa, the Gulf of Mexico, Brazil and Southeast Asia regions. For more than a decade, Proceanic has been relying on VideoRay's Mission Specialist Defender and Pro 5 systems to provide the toughness needed in a marine environment.

And there's Oceaneering International, a global subsea engineering company that uses the Mission Specialist Defender to inspect and clean ships because these systems can handle difficult underwater environments, transport easily to locations around the world, require only one operator and maneuver in confined spaces.

In addition, VideoRay underwater robotic systems are used every day around the world for missions in defense, civil inspection, search and recovery, nuclear energy, hydroelectric, salvage, science, aquaculture and shipping.

PES: What's the future for this technology?

BC: Engineers at VideoRay are rapidly developing technological advances and leveraging AI that enable our underwater robotic systems to autonomously perform increasingly complex and hazardous jobs in the most challenging conditions. The future of underwater robotics technology is fully autonomous, or untethered, vehicles that have the ability to transmit telemetric data and video subsea. Fully autonomous modes will be available to commercial markets in approximately one year.

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