



Revolutionising offshore wind farm inspections: the power of underwater robots

Underwater inspections are critical to offshore wind farm operations. They help determine whether an area is suitable for development, gathering geophysical and geotechnical information. They also keep offshore wind monopiles, turbine jackets, and foundations safe and functional. Offshore wind farms are home to harsh aquatic conditions, including strong currents, tidal erosion, and marine growth. These elements cause offshore structures to corrode over time. By performing regular inspections, operators can identify damage and minimise its impact on operations. To this end, subsea robots have an important role to play.

Inspection-class underwater remotely operated vehicles (ROVs) are increasingly used for offshore wind applications, from preinstallation site surveys, foundation installations, and cable connections to field inspections and decommissioning. These underwater robots can perform visual inspections, cathodic protection readings for corrosion management, marine growth cleaning and removal, photogrammetry, 3D point cloud modeling, material thickness gauging, and laser imaging.

These systems are unmanned and remotely controlled with supervised autonomy, which

simplifies inspections and maintenance tasks. Robots use sensors, cameras, sonar, and artificial intelligence to navigate, inspect, and report on the condition of subsea infrastructure. These tools reduce the costs and risks of manual inspections, which often require costly vessels and skilled crews.

Mission Specialist underwater robots

VideoRay is the world's leading manufacturer of inspection-class underwater robots and has delivered more than 4,000 vehicles worldwide. These vehicles reduce the time, cost,



and environmental impact of renewable installations, maintenance, and repair while improving the safety of missions. VideoRay's Mission Specialist systems are designed to carry heavy payloads and tools while navigating tight spaces that larger work-class vehicles cannot access.

Both the Mission Specialist Pro 5 and the Defender are ideal for performing inspections and maintenance tasks throughout the life cycle of the wind array. Weighing just 10 kg, or 22 lb, the Mission Specialist Pro 5 is easy to transport and suits missions with space, weight, and deployment limitations. The high-performance Pro 5 has a forward speed of over 4.4 knots and a 305-metre depth rating and is especially useful when size, speed, and reliability are essential.

Designed for precise control and heavier payloads, the Mission Specialist Defender is VideoRay's largest and most powerful system weighing 17.2 kg, or 38 lb. It is a modular system ideal for lifting or conducting

specialised operations because it easily accommodates a wide variety of payloads. This flexibility greatly increases the robot's capabilities while maintaining a compact size. The Defender's seven powerful thrusters can handle currents up to four knots at depths of up to 1,000 metres.

Many wind farm operators opt to purchase both the Defender and Pro 5 systems, which operate using the same topside controller. This dual-purpose solution offers operators the best of both worlds, delivering the versatility and power of the Defender, as well as the size and speed of the Pro 5.

Inspection-class versus work-class underwater robots

Inspection-class vehicles are more affordable and can be operated from a much smaller vessel, saving operators time and money while reducing risk and emissions. Not all inspection-class vehicles can handle harsh subsea conditions. VideoRay's underwater systems are field-proven to perform critical jobs in

tough environments. They have the power and functionality to carry heavy-duty payloads, tooling, and sensors, but are much smaller and more agile than work-class ROVs. With VideoRay you get most of the functionality of a work-class ROV in a portable package: the best of both worlds.

The company's compact Mission Specialist systems are lightweight and come in durable, waterproof cases that one person can roll. It is easy to transport the equipment needed for an inspection in a car trunk, a helicopter, or as checked airline baggage on a commercial flight.

On the job site, only one person is needed to drop the submersible into the water with minimal effort, even in rough seas. Operators do not need to pay for expensive trucks, cranes, welding, or nondestructive testing inspections to start the work, significantly reducing deployment costs and lowering carbon emissions.

Modular design and open architecture for easy expansion

The combination of a modular design and open architecture allows for the integration of a wide range of advanced accessories to expand the vehicle's capacity far beyond its size.

Mission Specialist robots use customisable, flexible platforms incorporating a system of interchangeable modular components that communicate through a digital network. Operators can custom equip the system with the right sensors, tools, depth rating, and thrust for each mission, all of which can be upgraded without needing to purchase a new system.

The vehicle's open architecture design also allows for the integration of a broad range of highly advanced third-party sensors and tooling. VideoRay's close collaboration with these manufacturers enables customers to customise their vehicle accessories to increase the capabilities of their underwater robotic systems and improve accuracy and efficiency across a diverse range of operational scenarios.

Reduced downtime

The robust and durable Mission Specialist robots are built to maximise uptime and vehicle availability. Their unique design also allows operators to perform vehicle maintenance and sensor swaps in the field without the need to return the vehicle to the factory, saving both transit and factory repair time.

Customers can also start their missions quickly and easily. Thanks to the simple system interface and on-site training, customers can independently complete successful missions within days of buying their ROV.

The user-friendly interface lets users quickly learn how to execute missions even

in unpredictable conditions. The advanced software makes it possible to conduct advanced tasks, like orbiting a point of interest in a 360° circle, operating with stability at a high degree of pitch, or lifting heavy objects while maintaining precise trim.

Precision and accuracy in data collection

The systems can easily navigate and capture high-quality images in low-visibility conditions. Supervised autonomous control uses the system's sensor data to increase project efficiency in critical path operations. Autonomous functionality also enables the ROVs to perform complex tasks, including cleaning and manipulation.

Mission Specialist ROVs integrated with advanced third-party technology provide user-friendly navigation. These innovations enable the system to operate with different levels of autonomy so the pilot can focus on the mission objectives. Advanced features like auto heading, auto depth, auto pitch, and station keeping can help the novice operator appear to be a seasoned pilot. At the same time, acoustic positioning can pinpoint the exact underwater location of the robot in real time.

The Mission Specialist Defender system has seven degrees of freedom: forward, aft, up, down, yaw, roll, and pitch. It 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 performing manipulation tasks on the seafloor.

Specialised accessories to meet mission needs

Mission Specialist submersibles can be equipped with advanced third-party accessories that users can select based on their specific jobs and underwater environments. For example, VideoRay's vehicles can be equipped with innovative ROV camera systems designed for both low-latency vehicle piloting and 3D inspections that deliver sharp still images and 4K video from a single robust platform. The system's real-time enhancement algorithm provides images for immediate use in photogrammetry. In addition, these camera systems can be used as an alternate means of metrology.

The company also offers specialised manipulators designed for operation in harsh environments, such as multifunctional rotating electronic underwater arms that are rugged enough to withstand deep-water pressure and deliver high-performance lift capacity. It also offers ROVs equipped with dexterous arms developed by Sarcos that can be teleoperated or operated via supervised autonomy. The submersible can be equipped with one or two arms, each with six degrees of freedom, that perform at depths of up to one kilometre, or 1000 metres.

Anticipated advancements in ROV technology

Our engineers and partners are continuously developing technological advances and leveraging AI to enable our underwater robotic systems to perform increasingly complex and hazardous jobs in the most challenging conditions under supervised and unsupervised autonomy. While much of this technology is available for Mission Specialist ROVs today, additional innovations are always in the works for future commercialisation.

Anticipated advancements include fully autonomous or untethered vehicles with subsea transmission capabilities to communicate telemetric data and video, as well as the integration of artificial intelligence and virtual reality (AI and VR) that will significantly enhance human/machine interaction to deliver total situational awareness underwater.

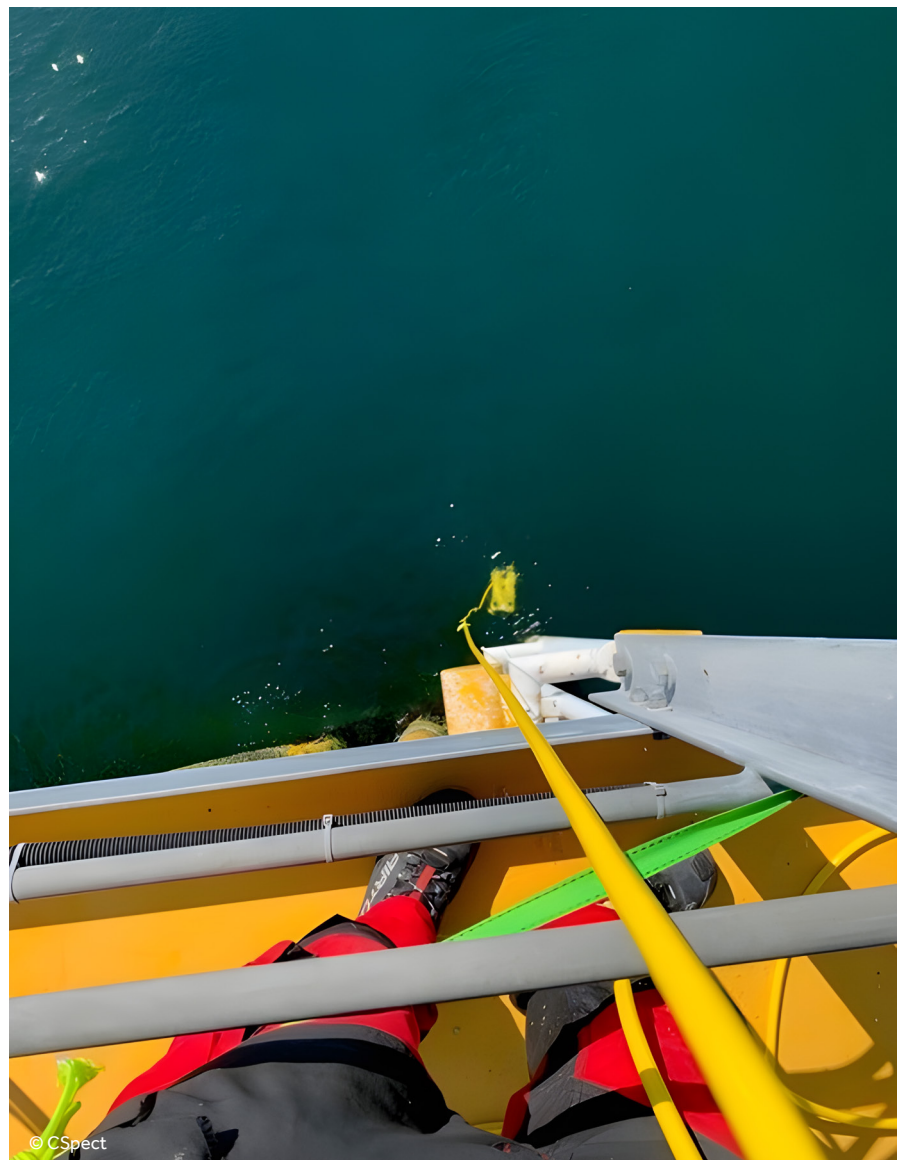
Especially useful for wind farm inspection and maintenance is the developing technology

to support subsea resident systems that will eliminate the need for ROV operators to be present on-site. Ideal for recurring jobs, these underwater garage systems will house and charge a parked fleet of ROVs.

Resident systems technology will enable a network of ROVs to monitor and maintain subsea assets by flying scheduled automated patterns and sending the data to operators wherever they are located.

VideoRay is proud to continuously lead the charge in developing robotic technology to simplify complex jobs, improve mission efficiency, and increase employee safety. With the recent acquisition of Blue Ring Imaging, it is poised to transform the way operators interact with and control their unmanned vehicles, in many cases eliminating the need for experienced operators while saving organisations time and money.

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