Streamlining floating offshore wind port installations

This article explores the global challenges impeding large-scale deployments of Floating Offshore Wind (FOW) farms, specifically focusing on the logistical difficulties met during the installation of massive Wind Turbine Generators (WTGs) at ports. It examines CLS Wind's pioneering approach to tackling the issue of port installation, which is one of the two main bottlenecks. The other being the repair or replacement of major wind turbine components at sea, without needing to disconnect the floater and tow it back to port. Through an analysis of the company's innovative strategies, we shed light on potential solutions to enhance the efficiency of FOW deployments worldwide.

Founded in 2021, CLS Wind is dedicated to enhancing the economics of wind energy by optimizing the installation and maintenance of wind turbine towers and generators. The company's products minimize dependence on scarce, high-capacity cranes and offshore heavy lift vessels, which are major cost factors in the industry. By facilitating the use of smaller, more readily available cranes, the CLS Wind technology boosts efficiency, reduces expenses, and improves both the speed and safety of installations.

Its patented system builds on field proven jack-up leg technology, used in offshore rigs since 1956. These units have demonstrated reliability in extreme conditions, lifting over 10,000 tons per leg. Its advanced design incorporates an elevating platform, automated controls, and a counterweight system that ensures balanced loads, eliminating stress on the wind tower structure itself.

The adaptable system works with any wind turbine brand without requiring OEM tower modifications, offering a universal solution for the industry, that is likely to become a game-changing proposition for the economics of WTG installation and servicing.

How it works

The WT component is first placed onto the elevating platform, which securely holds and prepares it for lifting. The platform then raises the component vertically to the required height. Once it reaches the designated position, the component is moved horizontally to its final location, where it is securely bolted in place from within, per normal procedure. After completing the process, the elevating platform returns to its starting position, ready for the next lift (Figure 1). Finally, the blades are lifted using a patented adapter, ensuring a seamless assembly.

This fully automated, remote controlled system, equipped with sensors and cameras, ensures precise and safe operations.

Floating offshore wind applications

A recent third party study by a leading UK engineering firm specializing in floating offshore wind validated the system's effectiveness. The study, using real offshore project data, analyzed a 15 MW WTG on a three-column semi-submersible structure, similar to the units used in recent commercial projects such as Kincardine.

The results confirmed the feasibility of using CLS Wind's self-erecting system for floating wind installations. The company is now in discussions with FOW developers and operators to implement this solution.

FOW power serves two key purposes. It supplies electricity to the grid, and decarbonizes offshore oil and gas operations. With over 100 floating wind substructure designs in development, only a handful have been tested at full scale. Regardless of floater

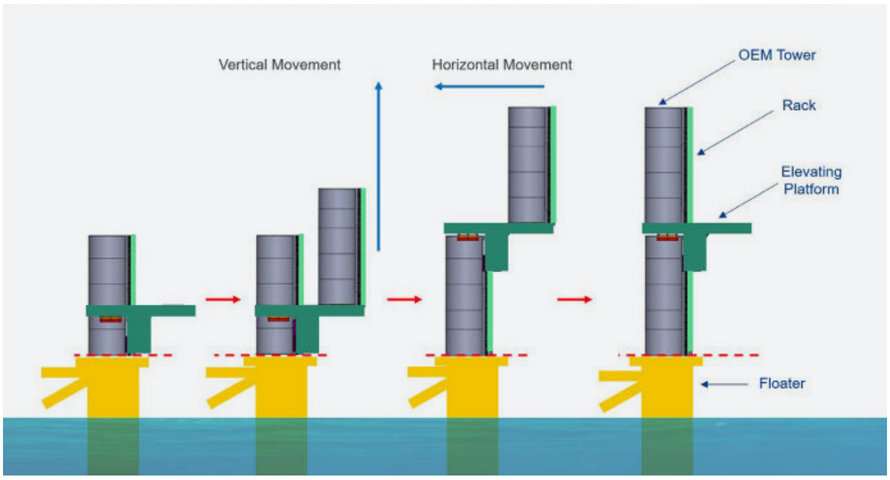

Figure 1: CLS Wind system, lifting sequence

type, whether semi-submersible, tension leg platform, spar, or barge, CLS Wind's system is compatible if a conventional wind tower is used. This flexibility makes it revolutionary for the industry.

Even the few deployed FOW units have already faced challenges, including slow portside integration and premature wind turbine component failures, requiring costly disconnections and repairs. The system expedites integration and reduces maintenance risks, with promising early results for Major Component Replacements (MCR), to be detailed in a future article.

Challenges and opportunities in port installations

Ports are critical to offshore wind development, handling logistics, supply chains, and infrastructure. However, existing port cranes are often insufficient for installing next generation 15 MW to 25 MW WTGs, which require 600+ ton lifts at heights of 120 m or more.

A study commissioned by Crown Estate Scotland and conducted by Arup, assessed Scottish port capabilities for offshore wind. The findings provided essential insights for the project and highlighted the urgent need for cost-effective, scalable lifting solutions, which are precisely what the company offers.

The system is designed to scale easily, enabling it to accommodate increasing turbine sizes as needed. It allows the utilization of widely available cranes, eliminating the need for costly and specialized lifting equipment. Additionally, the system is modular and removable, allowing it to be reused for O&M operations and in future projects for greater efficiency and cost-effectiveness.

Speed and cost advantage

A key industry goal is completing a wind farm of 50+ units within one season, lasting typically 20 to 24 weeks in the North Sea. Traditional ring cranes are expected to complete one floater per week, requiring two or more seasons to finish a wind farm, raising costs, increasing project risks, and delaying revenue generation.

With the CLS Wind system, multiple turbines can be erected simultaneously, enabling an efficiency boost by 2 to 10 times. This reduces direct cranage costs by 50% to 75%, minimizes quayside reinforcement expenses, improves port flow, and shortens project timelines, providing major financial and operational benefits.

Assembly at port

Reviewing recent projects like Windfloat Atlantic, which includes three semi-submersible units of 8.4 MW each, Kincardine with five units of 9.5 MW each, and HyWind Tampen in Norway, featuring 11 spar units of 8 MW each, it was clear that all of them encountered significant installation challenges. These included considerable delays often caused by high wind days and weather related waiting periods. Massive cranes had to be used, including a 3,200 ton ring crane, to place the large, heavy nacelle generators to heights usually exceeding 90 m above the water line.

CLS Wind will look at options for the port assembly of a 15 MW WTG based on existing approaches against a new methodology and identify operational improvements. It will then review how the improvements lower the overall cost and time expenditures, accelerating FOW development.

As previously described, this new system simplifies the assembly by allowing the use of a much smaller crane. It works alongside the company's elevating platform, which typically operates at under 15 m above the quayside. Together, they lift the tower sections and other WT components into their final positions.

Once on the platform, the wind turbine components are securely fastened, eliminating the 'pendulum effect' and the

Figure 2: Base case – ring crane installation

Figure 3: Option 1 – gantry crane installation

need for stabilization or guy wires. This setup permits lifting operations in stronger winds. The platform then elevates each component to its designated height.

A summary table, including cost comparison, is shown further below.

General specifications

The 15 MW generic wind turbine generator with:

- Nacelle weight, including drive train and hub: 600 ton (1,322,800 lbs)
- Tower height: 12 m (412 ft), three tower sections of 45 m, 40 m, and 40 m

The three pontoon semi-submersible floater with:

- Max width: 136 m (450 ft)
- Max draft: 15 m (50 ft)

Base case: ring crane

The assembly process requires a special-purpose 6,000 ton ring crane or a similar alternative. The land requirements are significant, with approximately 10,000 square meters, or 2.4 acres, of quayside space needed.

For port loading, the infrastructure must support a load capacity of approximately 30 tons per square meter. Additionally, port flow will be constrained during operations, as no through traffic will be possible in the quayside area (Figure 2).

Regarding the installation schedule for wind turbines on new floaters, the most realistic completion rate is approximately one unit per week.

Option 1: gantry crane

The assembly process will use a traveling cargo or gantry crane, a commercially available system with a capacity of approximately 1,000 tons at a 50 meter radius. The exact capacity may vary depending on the rail distance from the quayside border (Figure 3).

Land constraints are minimal, as the gantry crane is mobile and operates on rails. This mobility allows it to be used for other port functions when not in use for wind turbine assembly.

Port loading requirements are minimal, depending on the selected crane. Additionally, port flow will not be restricted, as the traveling gantry allows through traffic underneath and works seamlessly with a feeder line for WT components.

Regarding the installation schedule, the flexibility of this system, combined with multiple CLS Wind systems, can increase throughput by 2 to 10 times, depending on the number of units moored at the quayside.

Most importantly, this system ensures that the port maintains flexibility for seasonal quayside use while also adapting to future increases in equipment sizes. This prevents the risk of port infrastructure and equipment becoming obsolete over time.

Option 2: crawler crane

The assembly process will use a rental or owned heavy lift crawler crane with a capacity of 1,000 tons or similar (Figure 4).

Land constraints are negligible, as the crawler crane will be used temporarily. Port loading requirements are minimal, with only minor quayside modifications needed to accommodate the crawler or its pad.

Port flow will not be significantly impacted, as the crane can also be used for other port operations when not in use for wind turbine assembly.

Regarding the installation schedule, the flexibility of this solution, along with multiple CLS Wind systems, can increase throughput by 2 to 5 times, depending on the number of units moored at the quayside.

Figure 4: Option 2 – crawler crane installation

Summary table

Case / Requirements	Base case	Option 1	Option 2
	Conventional method (ring-crane)	CLS Wind System solution	CLS Wind System solution
Suggested Lifting Equipment	~6000 ton ring crane	~1000+ ton Gantry Crane	~1000 ton Crawler Crane
Port Reinforcement	Substantial	Minimal	Minimal
Quayside (land) constraints	~ 2.5+ Acres locked at quayside	Completely flexible	Completely flexible
Port Flow	Highly disrupted	Seamless – gantry crane can be used for multiple operations	Minimal disruption
Lifting Equipment CAPEX, approximate (crane + quayside reinforcement)	Extremely high (100%) USD $80 - $100 m	> 50% reduction in cost from Base Case	>75% reduction in cost from Base Case
Ability to install	Single units only	Able to perform multiple unit installations (if more than one CLS Wind system is used)	Able to perform multiple unit installations (if more than one CLS Wind system is used)
Schedule for WTG integration	1 per week	2 to 10 per week	1 to 5 per week
Additional Savings from: - schedule compression - minimizing port disruption	NA	Substantial	Substantial

Conclusion: transforming offshore wind ports

FOW developers have identified the reliance on massive ring cranes as a major risk and bottleneck. If innovative solutions are not implemented, FOW projects will face delays, excessive costs, and financial risks.

CLS Wind's system provides a breakthrough alternative by significantly increasing installation speeds, making the process up to ten times faster than traditional methods. It also reduces cranage costs by as much as 75% or more, while minimizing or even eliminating the need for expensive quayside reinforcements.

The system also enhances port flexibility by allowing multiple installations to take place in parallel, improving overall workflow. Most importantly, it enables broader port use, making floating offshore wind projects feasible in more locations worldwide.

By bringing this technology to market, CLS Wind is redefining offshore wind economics, accelerating deployment, and making wind farms operational in a single season.

www.clswind.com

References

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