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Step change in cost and size for powerful HVDC offshore wind connections

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Abstract

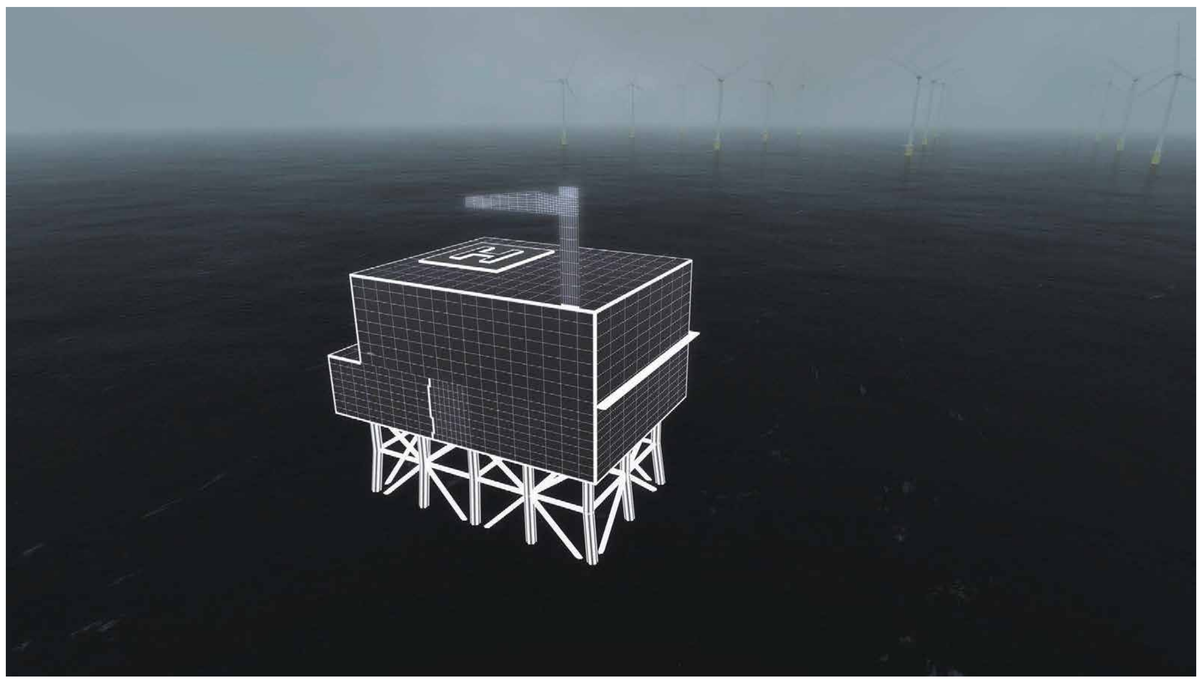
Presently, nine HVDC offshore stations have been installed in North Sea conditions, all facing various challenges and a high level of uncertainty during their execution in relation to cost, schedule and quality. This situation is not acceptable or sustainable for any of the stakeholders in the system.

ABB has developed a modular topside structure, including well defined interfaces and a high level of flexibility in relation to installation vessels and yards. Additionally, the weight and volume have been decreased by 50 %, the number of systems offshore minimized and the offshore hook-up scope is limited. Testing will as far as possible be completed onshore.

The required functionality in the AC stations has been integrated into the new HVDC station, by using 66 kV, and thereby no AC stations are required in this system.

Health and safety is a primary factor and the concept has received approval in-principle from Lloyds.

This offshore station represents a great step change and a new paradigm for offshore HVDC platforms whilst also reducing risk, enabling execution and retaining full HVDC functionality.



Objectives

The compact platform concept balances many practical requirements through extensive discussions, development of alternative concepts, collaborative decision meetings to deliver a concept that reaches the overall targets of:

- Predictable execution and significantly reduced risk profile.
- Contribute to a 30 % lower LCOE.
- Installation independent of weather conditions making installation possible during the entire year.
- Limited seabed preparations.
- Flexibility.
- Low dependency on specific lifting and installation vessels.
- Overall lead time reduction.
- Established technology and pre-approved offshore systems.
- Minimized hook-up scope and offshore commissioning.
- Ensure authority and third party approval in a timely manner.
- Elimination of AC substation platforms.

Methods

A conventional jacket and topside structure is preferable. This is a well known method of building up an offshore structure, including a great number of references and available manufacturing yards.

Increased manufacturing flexibility is another key factor, enabled by a modular topside structure. The HVDC equipment will be located in different modules, with this modular approach, allowing for parallel manufacturing and installation of equipment on ground-level.

This allows the concept to be constructed, mechanically completed, and commissioned in a conventional manner, in a single manufacturing yard, and assembled into a single lift. However, this flexibility allows the modules to be completed at different locations, then transported to a key site for final integration and transportation.

Alternatively, the modules could be transported and integrated offshore. There are advantages, in logistics and installation, by dividing the platform into low-weight modules.

Weight reduction has been achieved by removal of equipment, such as shunt reactors, high voltage filters, no permanent living quarters, reduced redundancy (but maintaining availability), minimized number of active platform systems, etc.

In addition, compacting has been the other method for weight and volume reduction, including re-arrangement of converter valves, transformer configuration, layout optimization and elimination of unproductive area.

Results

The base case for the offshore HVDC platform concept is a remotely controlled, normally un-manned installation with an emergency shelter, according to DNVGL-ST-0145 [5].

The assembled topside concept is 50 meters length, 37 meters width and 25 meters height with a volume of 45,000 m^3 and a weight of <7,000 metric tons. These figures indicate a volume and weight reduction of 40-60 % with comparable projects.

The modular topside consists of the following modules:

- 2 valve modules, similar configuration
- 1 HVDC module, including transformers, GIS, etc.
- 1 yard module for platform support systems
- The HVDC and yard module can be integrated into one module
- Plus optional modules, such as living quarter, helideck, etc.

Conclusions

A completely new concept for offshore HVDC stations has been proposed. This concept takes lessons learned from previous projects into account and many of the past challenges have been addressed and mitigated [1, 2, 3, 4]. This concept should not be mistaken with what has been installed so far, as this is a new paradigm for HVDC offshore stations.

The key improvements and advantages are:

- **Weight and cost reduction** – The new platform structure results in volume and weight reduction in the range of 50 % and the cost will also be significantly lower.
- **Lead time reduction** – The lead time reduction is achieved with a pre-approved concept, limited scope for the HVDC offshore platform and parallel modular fabrication.
- **Flexibility** – The modular approach allows for a more flexible set-up, in which the number of available yards and vessels for installation has increased dramatically.
- **Risk profile** – The overall risk profile has been reduced, due to the reduction of offshore scope, only known technology offshore and the pre-approved conceptual design.

References

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