FIGURE 1: ISV Siem Moxie operating in Offshore Wind Farm - The calm before the storm

Subsea cable installation in bad weather – making it work

Constructing offshore wind farms is a tricky business. In particular, the current generation of offshore wind projects are moving further from shore into deeper, less sheltered water.

FIGURE 2: ROV as deployed on the CLV Siem Aimery

This makes absolute sense when you consider it from the perspective of the soon-to-be proud owners, after all, you want your wind farm where the wind blows strongest on the most continuous basis to generate the electricity and in turn the revenue.

However, from the perspective of the construction side, putting the turbines in the water and connecting them is getting trickier and demands a new kind of approach.

Siem Offshore Contractors has revolutionized the installation of inter array cables on offshore wind farms in bad weather and harsh conditions with their innovative, next generation, Siem Duo, consisting of the cable lay vessel Siem Aimery and the installation support vessel Siem Moxie. To understand just how revolutionary this solution is, you need to understand a few things….

First, a crash course in cable installation limitations

Weather windows are the periods of weather in which one can undertake an operation. For example, if it takes twelve hours to lay a subsea cable between two offshore wind turbine foundations, which includes pulling the cables into these using traditional cable installation ships and equipment, plus two hours to get to the first turbine from a sheltered port and a further two hours to return back, then your weather window for laying the cable should be 16 hours.

Now, let's say that the ship, its crew and its equipment can lay a cable in 1.5m significant wave heights – this means that it will require a continuous 16 hours in which the statistical significant wave height will not exceed 1.5m to be able to leave port, get to the first turbine, lay the cable and then head back to port from the second turbine.

To make things even more complex, the cable laying and pull-in activity can be split into a number of tasks, each of which has its own weather limits. For example, the weather limits for deploying a remotely operated vehicle (ROV) are different from the limits for actually deploying the cable from the ship.

Similarly, getting people onto the wind turbines to perform the pull-in has different limits to the pull-in itself. In the past this lead to an oversimplification of working weather windows, whereby the entire operation was classified as limited to the conditions of its most weather sensitive operation.

Below is an excerpt from an existing wind farm's significant wave height data for a single month by hour. You can see clearly

that the maximum duration where the significant height of waves does not exceed 1.5m is quite small when contrasted against 2.5m. Furthermore, in this example if you could work in 3m significant wave heights there would be no restriction on operations.

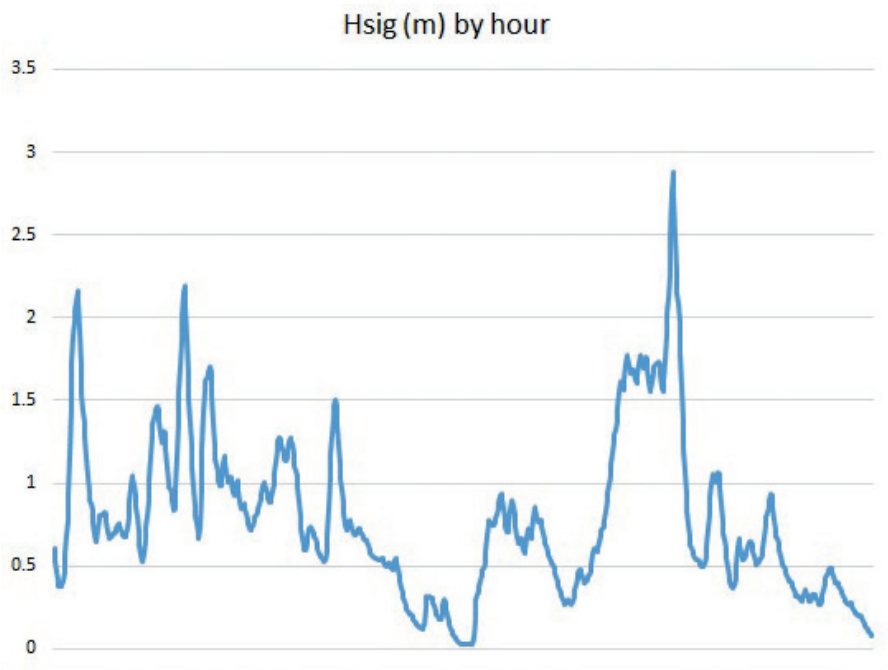

FIGURE 3: Example weather window graph

It gets trickier: there are also limits on the wave period (a frequency measurement of the waves), working wind speeds, surface and subsea currents, visibility and temperature, and depending on the exact activity being undertaken offshore, any one of these can halt work so when you start building wind farms in ever more challenging environments, planning for bad weather becomes of utmost importance.

The evolution of a solution to working in bad weather

In the early days of offshore wind farms in sheltered, shallow water, subsea cable installation tended to be done using a bare-decked unpowered, or 'dumb', barge which was fitted with anchors and a temporary cable lay spread.

This barge and its spread would then be towed out to each turbine by so-called anchor handling ships which would manoeuvre the barge between the turbine structures and deploy and retrieve the anchors all while the cable was slowly laid from the equipment on board the barge.

The whole barge would then be brought back into port to reload cables, and escape bad weather. Meanwhile, a converted fisherman's ship was used to get personnel to the turbines. They would generally sail from port each day, right up to the turbine and push up against an external ladder where the engineers would step across and climb up into the turbine foundation.

Generally, the personnel climbing, up into the foundation to assist with the pull-ins, relied very heavily on having the support of the cable lay barge – in particular if it included a crane of some description. The cable lay barge was therefore limited in its work not just by its own various discrete operations, but also in the personnel getting onto the foundations.

Even in later evolutions of cable lay spreads, where a construction ship capable of manoeuvring without the anchor handlers was specifically configured for cable laying operations - there was still the bottle neck surrounding movement of personnel onto the foundations and supporting them during the pull-in.

In the history of subsea cable installation in offshore wind farms, there have been many instances where the cable lay vessel was unable to begin operations even though weather conditions were sufficiently mild, simply because the personnel transfer solution to get the engineers onto the foundations was unable to perform in the same conditions.

Part of the problem was that the personnel transfer ship (often referred to as crew transfer vessel or CTV) had limited personnel transport capacity and transited directly from the port each time. For nearshore wind farms this was less of an issue. However when offshore wind farms began to be situated sometimes two or three hours sail at high speeds from port this added significant delays to operations and requisite weather windows.

The cable lay vessel also posed a problem, as the inter array cable installation solutions which were swift enough to undertake the cable lay work efficiently tended not to have the tonnage capacity to take sufficient cables offshore requiring the need for repeated trips to and from port. Alternatively, those ships which could take sufficient cables and cable protection systems tended to be slow and expensive.

A particular set of requirements took shape, for subsea cable installation on offshore wind farms, in far from shore, harsh environments. It required a task specific cable lay vessel which could work unaided in conditions up to 3m significant wave height, while staying offshore for long periods without the need to return to port to collect cables and/or personnel.

In addition, the personnel transfer solution to get the pull-in teams and equipment onto the foundations needed to be able to match

FIGURE 4: The Siem Installation DUO – foreground CLV Siem Aimery, background: ISV Siem Moxie

the cable lay vessel's weather resistance step for step while also being able to stay offshore for long periods without needing to return to port.

This brings us to the Siem Duo, the most advanced offshore wind inter array cable installation solution available. The Siem Duo has been designed to separate the bottle neck of the cable pull-ins in the wind turbine towers from all subsea activities.

The installation support vessel, Siem Moxie, transfers personnel to the wind turbine foundations using its active heave compensated 'Walk-to-Work' gangway, supporting cable pull-in, termination and testing while deploying the 'Offshore Support Units' equipped with generators, pull-in winches, tools and equipment for personnel life support using the on-board 3D motion compensated crane. The Siem Moxie is able to prep up to nine different foundations, ready for pulling-in or later terminating and testing the power cables.

This frees up the cable lay vessel, Siem Aimery, to concentrate on laying and then trenching its maximum payload of 4,250 tonnes of subsea cables as safely and efficiently as possible. As both vessels have been specifically designed to work in harsh weather, with accommodation for sixty on each, reducing the need for frequent crew changes in port, they are currently setting new standards for efficiency and working weather windows.

On a recent project in the North Sea working between October and February, the Siem Duo completed the cable lay activities over a month ahead of schedule. Both vessels have received certificates of approval from marine warranty surveyors for specific operations in 2.5m and 3m significant wave heights, while in fair weather beating off the competition with a rate of laying four cables a day.

The Siem Duo is unique in the market place and has begun to attract international attention from emerging offshore wind markets. The Siem Duo are wholly owned and operated within the Siem companies.

www.siemoffshorecontractors.com

Siem Offshore Contractors is headquartered in Leer, Germany with offices in the Netherlands and Scotland and has completed cable installation jobs on five offshore wind farms in the UK & Germany since 2011 and has most recently commenced work on the Beatrice, Hornsea One and Trianel Borkum II offshore wind farm array cable packages.