Offshore – Learning by doing

Offshore terminals are the most important interfaces during the construction of wind farms off the coasts of the North and Baltic Seas. Many wind farms have been created in recent years and more are already in the planning stages. The Hamburg-based company Buss Port Logistics (Buss) recognised the opportunities early on, and with their own Orange Blue Terminal (OBT) in the Dutch port of Eemshaven, they developed the "Offshore" sector. Martin Schulz, Head of Offshore Logistics at Buss, offers PES a glimpse behind the scenes: from the initial planning of a terminal to the completed offshore project.

Martin Schulz

From sandy desert to a heavy cargo terminal

The Eemshaven offshore terminal was already an important hub for many projects in the North Sea. However, in order to bring ashore the massive components, to put them in intermediate storage, to perform the pre-installation and to ship them back out, extensive construction measures were required at the terminal, situated on the southwestern bank of the Ems estuary.

"When Buss came to visit the future terminal in Eemshaven for the first time, it looked more like a sandy desert, without even a quay wall in place," explains Schulz, adding: "The management team was quite optimistic however. This way, Buss was able to develop the area from scratch, entirely in line with its own ideas and in a manner suitable for offshore activities."

When construction commenced in 2011, it literally got off to a 'rocky' start. A substrate with a thickness of some 80 centimetres was created, consisting of various layers of rock, slag and concrete. Another substance was used, namely a recycled material from the incineration industry, which was also mixed with a foam.

"Only this combination was able to compact the soil to such a degree that it could withstand the immense pressures produced," says Schulz.

Another very important topic for any terminal is drainage. For the paved terminal area in Eemshaven, Buss opted for drainage gullies. Four concrete gullies, capable of handling heavy loads and traffic, run through the area lengthways, and convey any rainwater directly into the harbour basin. Next to each gully and using the "century rainfall" formula, Buss has also

installed interconnected pipes with a diameter of 50 centimetres. In the event of excess water, they serve as an intermediate buffer tank.

The usual downward slope for drainage of 1.5 percent is a little reduced at OBT. This is due to the fact that during the planning phase and the subsequent construction phase, the deployment of mobile port cranes and crawler cranes had to be taken into consideration. From a certain angle of pitch, this kind of equipment requires shimming underneath to guarantee its safe operation.

A huge terminal with a lot underneath

Aside from the drainage pipes, a glance beneath the surface of the 250,000 m^2 terminal reveals further infrastructure. There are water pipes for the fire extinguishing system and also the lightning protection system. The latter is particularly important for terminal areas featuring large towers.

Another special feature is the six shafts containing electricity connections. These were inspired by the concept used at Copenhagen Airport. Through these shafts and additional electrical power connections, offshore equipment in intermediate storage at OBT, such as nacelles and hubs, can be powered. “We are able to deliver 1.3 Megawatts power to a total of 64 wind power units,” Schulz explains. Before the components can generate power at sea, they have to be supplied with energy ashore.

Following completion of the one-year construction project in 2012, the terminal boasts a number of impressive key performance indicators. Thanks to extreme load-bearing capacities, there are almost no limits to its ability to meet the exceptional demands of the offshore industry.

The core area, created by Buss, features a load capacity of 55 metric tonnes per m^2 for static loads and 35 metric tonnes per m^2 for dynamic loads. The front-facing quay area, which was built by Groningen Seaports, can bear loads of 15 metric tonnes on its first 33-metre-wide stretch, or 6 metric tonnes per m^2 immediately at the quay edge.

Schulz is quick to point out yet another special feature: “Buss has also built a 30x70-metre-heavy cargo platform with a load-bearing capacity of 20 metric tonnes per m^2 along the quay wall.”

And these dimensions were chosen with good reason. “We had to bear in mind that, if monopiles of up to 100 metres in length are manufactured in the future – and

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"Our latest order requires the storage of monopiles with a weight of up to 1,300 metric tonnes apiece"

currently we are already at 84 metres – then the platform has to be long enough to accommodate two cranes to lift the monopiles in tandem at a distance of 70 metres parallel to the quay. The 30-metre measurement was chosen so that a crawler crane with a lifting capacity of 1,300 metric tonnes will still have some leeway. These types of large cranes feature counter-balancing weights of up to 650 metric tonnes and a length of 25 metres. This leaves 5 metres of extra room."

Many North Sea projects handled via Eemshaven

Since the inauguration of OBT, a good number of wind farms has been built via Eemshaven. There were two projects in 2015 alone. Almost simultaneously, a large number of components for "Gemini" and for "Gode Wind I & II" were shipped via the quayside. Up to three jack-up installation vessels, were able to jack-up in front of OBT, at the same time and take on monopiles and transition pieces as cargo. But the jack-up manoeuvre cannot be performed unless the port basin has been prepared and equipped accordingly. When these specialist vessels lift themselves out of the water with the help of their 'legs', a pressure of up to 8,000 metric tonnes per m^2 is exerted onto the sea floor. The ideal location for jacking-up within the harbour basin therefore had to be determined in advance. In Eemshaven, the minimum distance from the quay wall is 15 metres. Up to four wind turbine installation vessels can berth simultaneously along the 694-metre-long quay wall of OBT.

Figures from recent projects show that the proper fortification of the terminal surface area is absolutely essential. The shipped monopiles, which were stored on the terminal lying down on gravel dunes, weighed up to 1,000 metric tonnes apiece. The measurements of the highly compacted dunes were meticulously calculated so that the load could be distributed over a sufficient amount of load-bearing surface, ensuring the necessary stability. This is because monopiles cannot be allowed to deform during flat storage.

"Our latest order requires the storage of monopiles with a weight of up to 1,300 metric tonnes apiece, which means we need to build dunes that are eleven metres wide at their base and two metres high," Schulz explains.

The right solution for every project

"This year, the offshore project Veja Mate posed some new challenges for us," says Schulz. Buss was responsible for handling

67 monopiles from the factory in Rostock, their shipping and subsequent storage, all the way through to staging the components for the wind turbine installation vessel in Eemshaven.

The Veja Mate offshore wind farm is being built some 130 kilometres north of Eemshaven, in the German part of the North Sea.

From early March until the end of July, Buss shipped the world's largest and heaviest monopiles ever. The foundation elements, with a length of around 84.5 metres and a diameter of around 7.8 metres, weighed around 1,300 metric tonnes apiece. These steel pipes cannot be moved by a crawler crane with a lifting capacity of 1,350 metric tonnes alone.

"Due to the high costs involved, deploying two cranes would not have been economically feasible, which is why we decided on a RoRo procedure with SPMT (self-propelled modular transporter) axles," Schulz explains. "For the first time we were able to offer the all-round package of shipping plus all related transportation and terminal services."

The shipment from Rostock via the Kiel Canal to Eemshaven was carried out as near-shore transport.

In order to accomplish this, four storage trestles, or cradles, as they are known, were installed under each monopile on the factory grounds of the manufacturer EEW Special Pipe Constructions. These were placed in carefully calculated positions. One important factor at this stage was the conical shape of the monopiles, which is why the cradles were also constructed with varying measurements.

"The first design of the cradles exhibited a number of flaws in the real world, so we had to tweak it a little. But that's offshore for you – learning by doing, because there are precious few empirical values available. This way, we learn something new with every new project," says Schulz. For transport by sea, the cradles were mounted on the deck of a barge with stopper plates. Once in Eemshaven, these plates were loosened and the monopiles were moved to the constructed gravel dunes for storage.

Moving the monopiles is actually one of the smaller challenges in all of this. The real question is: how do you load and unload three steel pipes weighing 1,300 metric tonnes each onto a barge without unbalancing the barge? The tidal difference in Eemshaven also has to be compensated for while unloading. But even for these problems, Martin Schulz has a solution: "To ensure an even weight distribution and the full carrying capacity of the barge, we use a pumping system with an output of 1,800 m3an hour. Water is pumped to the appropriate locations in the barge and pumped out again. In technical terms, this weight compensation is the most challenging aspect, which allows the heavy components to be loaded and unloaded in a safe manner. With this method, we were able to load three monopiles within 24 hours."

All told, 126 SPMT centre line axles were used during the shipment process in Rostock and Eemshaven. During the installation of the cradles in Rostock, Buss was also able to use its own SPMT axles for the first time. "This investment was not just essential for the implementation of the project. Rather, it represents a long-term boost for the further expansion of our Offshore segment," Schulz emphasises.

"For each offshore project, method statements are generated which summarise all of the project processes and any certificates and studies. For the project Veja Mate, various sizeable folders were therefore created to hold the necessary documentation." The company also reports that it is currently involved in a number of new projects, each requiring the development of customised concepts. ■

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