Instalación de 89 Monopiles y sus completas aerogeneradores para el parque eólico de Frysland en el lago Ijssel - Holanda.

Installation of 89 Monopiles and their complete wind turbines for the Frysland Wind Farm. Ijssel Lake - Holland

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RESUMEN

Sarens realizó toda la ingeniería, suministró una barcaza combinación de varias (CAB) y una grúa sobre ella para la instalación de 89 aerogeneradores en el lago más grande de los Países Bajos. Este es el parque eólico más grande del mundo en aguas continentales. La poca profundidad de las aguas limitó los métodos de instalación convencionales, y el acceso restringido por las estrechas esclusas limitó el uso de cualquier barco de carga pesada. La CAB constaba de 88 barcazas modulares (SMB) acopladas a dos barcazas gemelas ubicadas entre ellas, con una grúa de 1250T en cubierta (PC6800). La CAB se diseñó para mantener un calado al mínimo de 2,5 metros y estaba equipada con cuatro patas de estabilidad de 400T.

ABSTRACT

Sarens provided engineering, supplied a Combined Assembled Barge (CAB) and crane on top for the installation of 89 wind towers on the biggest lake of the Netherlands. This is the largest windfarm inland water in the world. The shallow waters limited conventional installation methods and the restricted access by narrow locks limited the length and breadth of any heavy lifting vessel that could be used. CAB was made of 88 Sarens Modular Barges (SMBs) coupled to two twin barges positioned in between and with a 1.250T crane on the deck (PC6800). CAB was designed to keep the draft at a minimum of 2,5 meters and it was equipped with 4x400 tonnes legs for stability.

KEYWORDS: Construcción estructuras, barcaza, barcazas modulares, grúa PC6800, aguas superficiales.
KEYWORDS: Construction of structures, barges, modular barges, PC6800 crane, shallow waters.

1. Introduction

This Frysland Wind Farm at Ijssel lake, the biggest lake of the Netherlands, with 89 wind towers of 4.3 MW each and 130 meters rotor diameter is the largest windfarm built within inland waters in the world. It is placed at south of the Afsluitdijk, six kilometres off the Frisian coast. With a total capacity of 382.7 MW, it will produce enough energy to supply 500.000 households.

Sarens was contracted by Van Oord Offshore Wind to lift and install these monopiles and all their complete wind towers components. The requirement for a big lattice boom crane went without saying but just getting into the

right installation locations and lifting these heavy loads in a lake with a maximum allowable draft of 2,66 meters, was another huge challenge all together.

The CAB was composed of 88 SMB (Sarens Modular barges) coupled to two Sarens twin barges positioned in between (Josef & Rosa with dimensions 51,86 x 19 x 3,5 meters, see figures 1 and 3) with a 1.250T pedestal crane on its deck (a PC 6800-1, see figure 6).

CAB created a total area of 62x53 meters and was designed to keep the draft at a minimum of less than 2,5 meters.

The 42 meters long modular beams (with 2,5 meters height, see figures 1, 2 and 3) were installed crossing on all the barges decks in order to support the crane. Crane outriggers were placed on these modular beams that distributed the loads along all twin barges and SMBs.

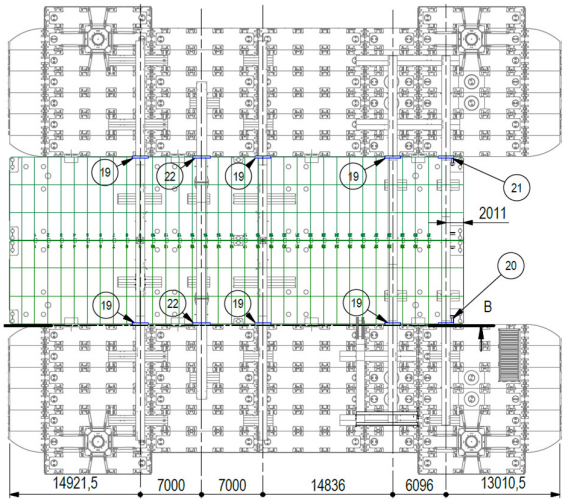

Figure 1: Top view dwg of the CAB before the installation of the PC 6800-1 crane.

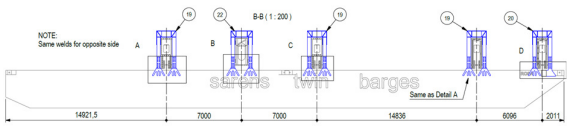

Figure 2: Side view dwg of the CAB before the installation of the PC 6800-1 crane.

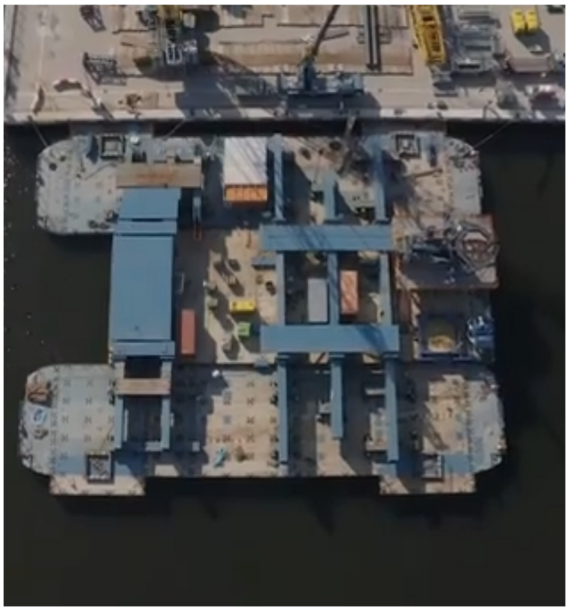

Figure 3: Top view of the CAB during its rigging, right before the installation of the PC 6800-1 crane.

For the rear Superlift ballast a steel platform was created for slewing of the carrier (see figures 3, 4, 6 and 9).

The CAB was equipped with 4 spud legs of 400t single capacity that were pushed into the lakebed to ensure the stability (see figures 5, 6 and 8 to 11).

But due to the limited space on the CAB, the rigging and set up of the crane had to be planned meticulously. The PC 6800-1 was rigged in SSL/LSL S1 configuration, with a 72 meters main boom, and a 40,5 metre Superlift/derrick mast (see figures 5 to 9).

The crane superstructure counterweight was 250 tonnes, while the Superlift ballast on a wheeled carrier was 360 tonnes (see figures 6, 8, 9 and 11).

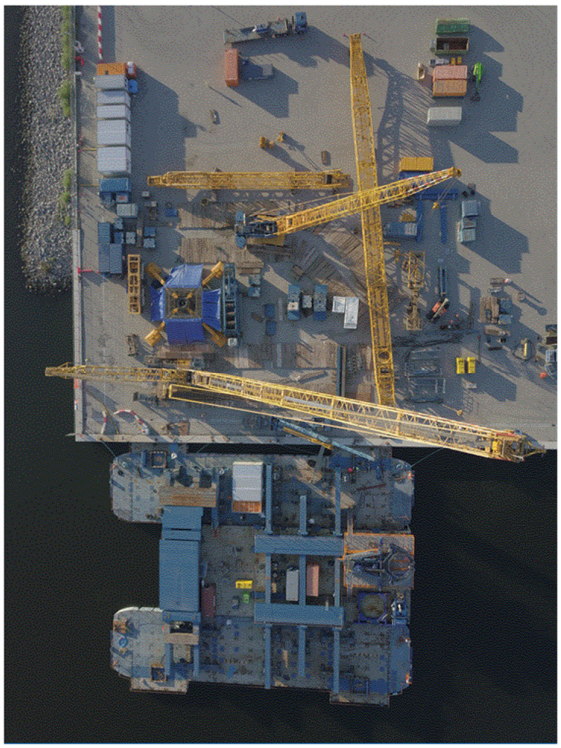

Figure 4: Side view dwg of the CAB before the installation of the PC 6800-1 crane.

Also due to the limited space on the CAB and for minimising the risks of assembly on water and at height, the crane was preassembled on the shore (see figure 4). And then tested the larger components once it was complete assembled on the CAB.

It took a six person assembly crew for week and a half to set up the crane, including the required application of a protective coating against saltwater corrosion.

The wind conditions on the lake posed another additional big challenge. Sarens Research and Development department and crane manufacture (Demag) engineers had to study the feasibility of the specific conditions of this job and adjust the permissible wind conditions for the crane configurations.

It was also required to develop new charts for the maximum lifting capacities at with the ability to work with the crane in a situation of up to two degrees of inclination.

And last, but not least, also a new crane software had to be loaded into the crane's control system.

After the installation of the monopiles in 2020, by spring' 21 started the installation of the complete wind towers (including the tower sections, the nacelle and the blades) with the same CAB and crane but equipped with a longer boom of 126m (see figures 10 and 11).

2. Summary of works performed by Sarens

The following items were installed by the CAB and PC 6800-1 crane:

- The 89 monopiles weighing up to 250 tonnes and with a total length of 39 meters (see figures 6 to 8). The monopiles were delivered from the manufacturing yard in Rostock (Germany). With the monopiles stowed horizontally on the delivery ship, a floating sheerleg crane 'tailed in' the monopiles for their verticalization before their installation (see figures 6 and 7).
- The hydraulic hammers (which drive the monopiles into the lake bed) weighing up to 300 tonnes (see figure 9). The PC 6800-1 crane installed the hammers on top and the monopile is piled until designed depth on the lakebed. And finally
- The complete wind turbine including three tower sections, nacelle and blades (see figures 10 and 11). Five liftings were required to complete the installation of a complete tower, being the heaviest one the 147 tonnes of the bottom tower part. For these installations it was required to enhance the length of the main boom of the

crane from 72 up to 126 meters in order to install turbines with a hub height of 115 meters. This long main boom required a unique system for fastening it during the transits among the different tower positions (see figure 5).

Figure 5: Specific fastening system of the 115 meters boom during the transits among different towers.

3. Schedule

CAB was fully operational within six weeks. Then it was towed to the lake location.

The installation of the monopiles started in September 2020. Installation of the monopiles was a 24/7 operation, always weather permitting, and required a total crew of 18 experienced Sarens' employees are on board of the CAB for each lift.

The fact that all these activities have to be carried out in a sort of floating arrangement between other vessels made all these manoeuvres particularly challenging.

After a learning curve, the lifting and positioning of a monopile took only between 30 and 90 minutes. The fastest the crew has managed to install two monopiles is during one 12-hour shift which was a big achievement.

Just before Christmas 2020 all of the monopiles were already installed, exactly in line with the planning.

From March since end July 2021 Sarens performed the installation of the complete wind towers with the same barges and same crane equipped with a longer boom.

Also after a learning curve, at the final stages and with good weather, the team of the CAB was able to perform the 5 liftings of a complete tower in a single day including CAB relocation to the next location.

4. Conclusions

A main achievement of all these operations was that there were no Sarens' incidents and/or accidents recorded. With more than 25.000 hours worked, not a single person went home with an injury.

Both Sarens' client and the end client have expressed their satisfaction starting from the way Sarens engineered the project, following with innovative solutions to overcome the site-specific challenges and finally ending with the professional manner during the execution of all our activities.

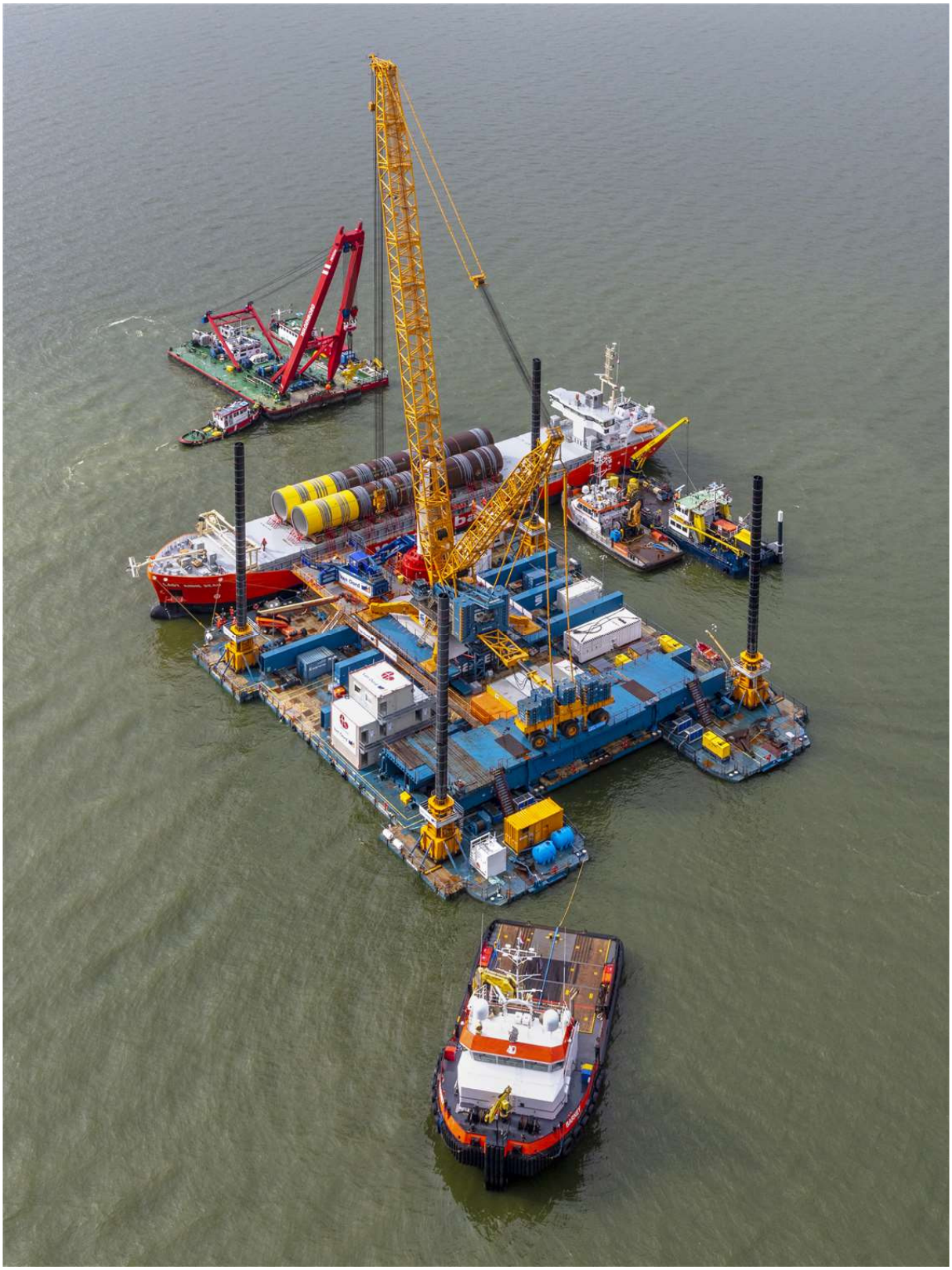

Figure 6: Top view of the CAB on a final tower lake place right before the installation of a monopile.

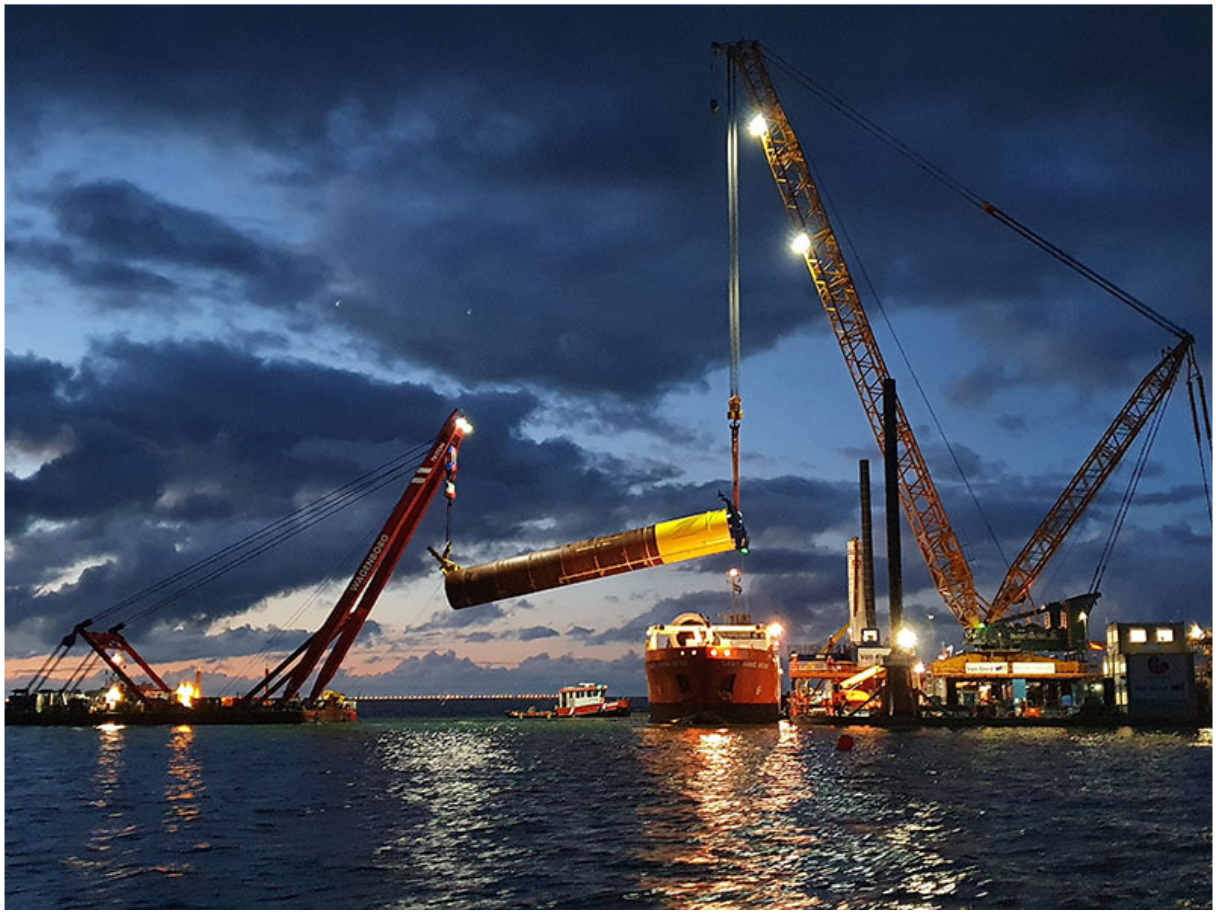

Figure 7: Side view of the CAB plus a floating sheerleg crane during the tilting up of a the monopile.

Figure 8: Side view of the CAB during the installation of a monopile on its final lake place.

Figure 9: Side view of the CAB during the installation of the hydraulic hammers on top of a monopile.

Figure 10: Side view of the CAB with the long boom of 126m during the installation of the tower sections.

Figure 11: Top view of the CAB with the long boom of 126m during the installation of the blades.