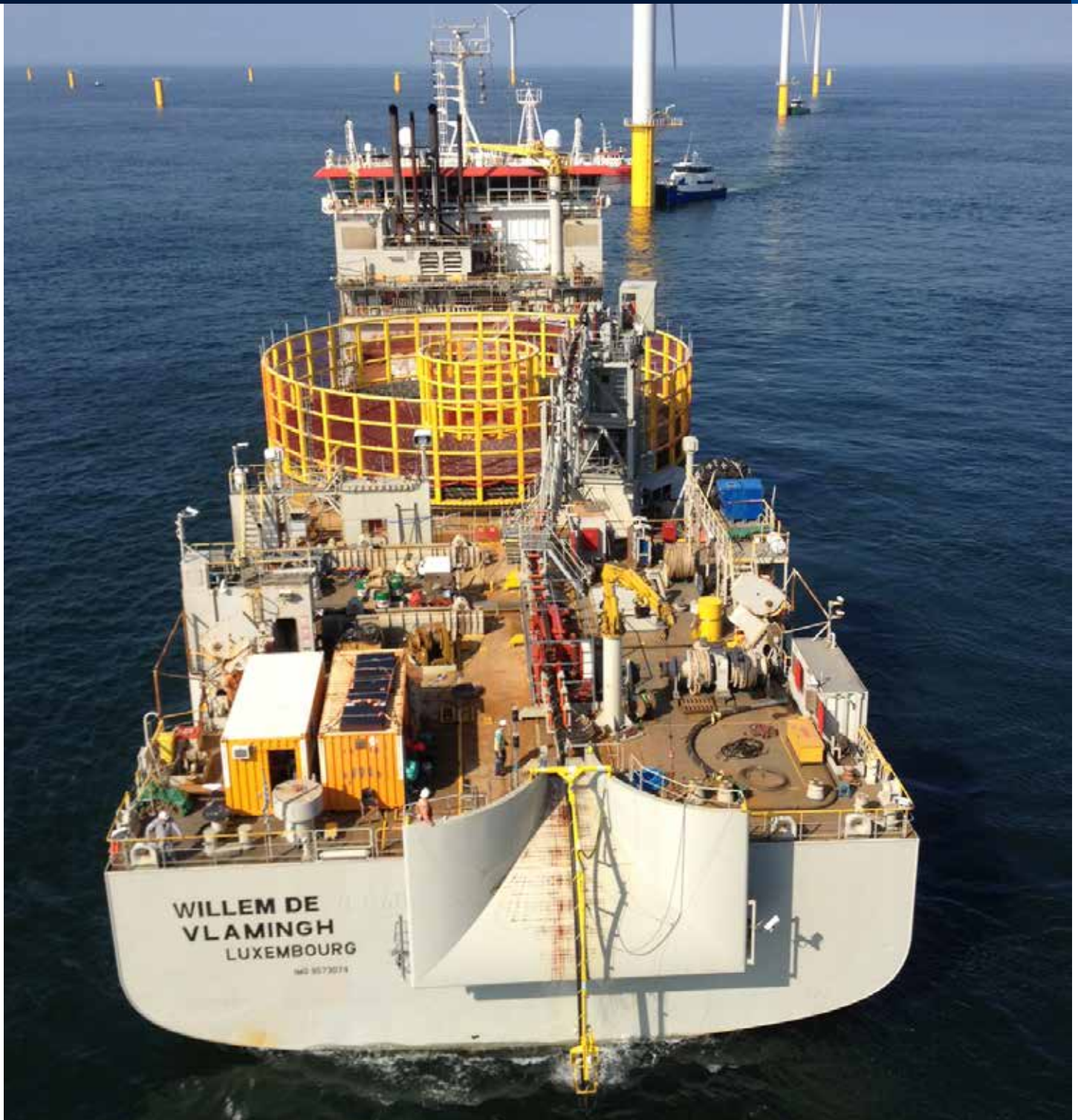




Jan De Nul
GROUP



INSTALLATION OF 245KV **NORTHWIND** EXPORT CABLE



PROJECT DESCRIPTION

Northwind NV has been established by shareholders Parkwind NV and Aspiravi Offshore to build the Northwind wind farm at the 'Lodewijk Bank', 40 km offshore the Belgian coast at the eastern border of the territorial waters. The wind farm has a total production capacity of 216 MW with 72 turbines and 1 OHVS installed.

To connect the wind farm with the onshore grid, Jan De Nul Group was awarded with the installation contract for a 245 kV submarine export cable of 42 km length. Additionally, a second export cable of 14 km was installed by Jan De Nul Group between the Northwind OHVS and wet stored at the future location of the affiliated Belwind 2 expansion.

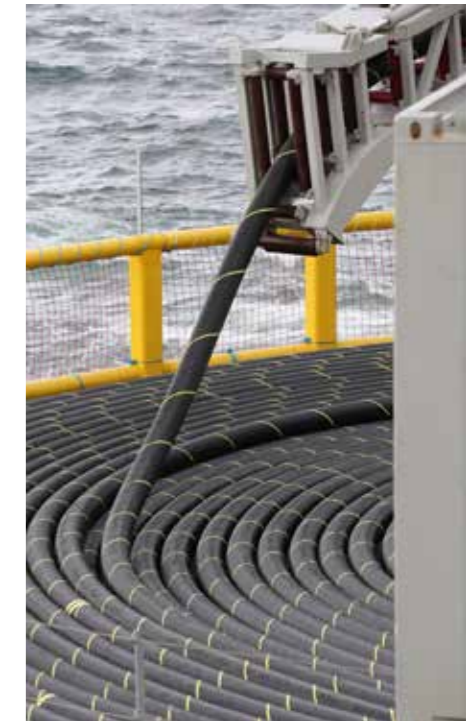
The scope further involved the installation of the onshore connection cable (3.1 km) from the joint pit at the beach in Zeebrugge to the high voltage onshore grid connection in the port of Zeebrugge.

The project was awarded in March 2012. Engineering continued until April 2013 when construction started as scheduled, resulting in a successful completion of the works in October 2013.



SUMMARY PROJECT PARTICULARS

	Northwind Export Cable	Belwind Export Cable
Cable type	245kV	220kV
Cable length	42 km	14 km
Cable diameter	256 mm / 265 mm	220 mm
Cable weight per meter	120 kg / 130 kg	80 kg
Total Cable weight	5,110 ton	1,120 ton
Minimum bending radius	4 m	3.4 m
Maximum pulling tension	310 kN	150 kN
First end pull in	OHVS	OHVS
Second end pull in	beach - 2.3 km	wet storage
Trenching	pre-trenching with TSHD	pre-trenching with TSHD
Burial	post-burial with TSHD	post-burial with TSHD
Burial depth	6 m / 3 m / 2 m / 1.5 m	1.5 m
Joints	only at beach	none



PROJECT EXECUTION

USED INSTALLATION EQUIPMENT

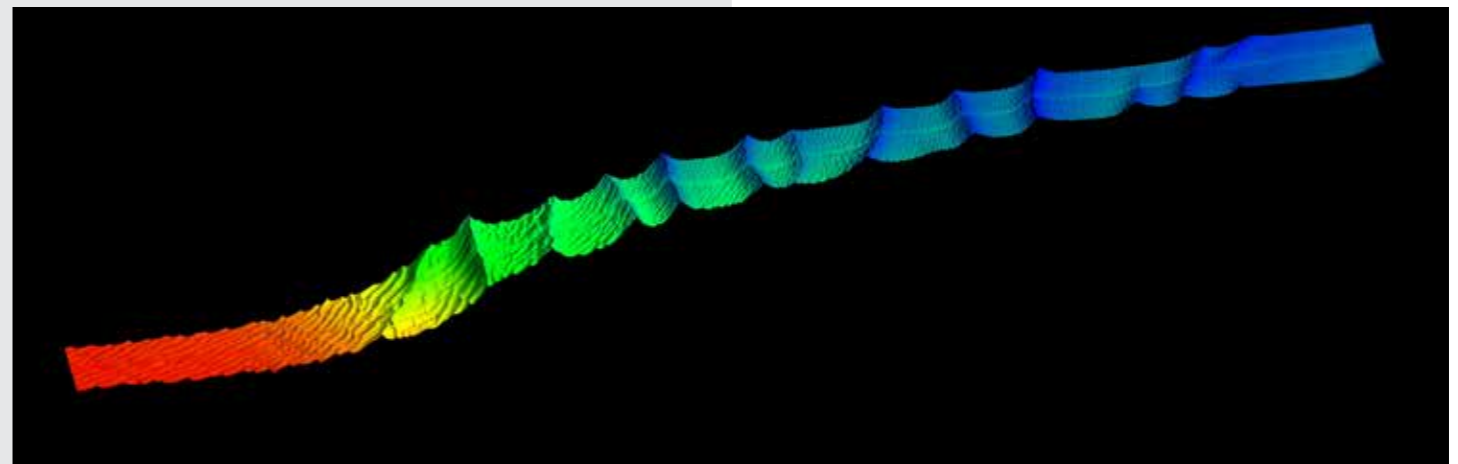
Jan De Nul Group has purchased a carousel with a capacity of 5,400 ton and a cable loading system and converted its DP2 vessel *Willem de Vlamingh* from Rock Installation Vessel to Cable Installation Vessel. The existing rock installation equipment was removed and the turntable with cable system was installed in Poland where after testing and commissioning was conducted offshore Poland in the Gulf of Gdansk and in Norway in the Tønsbergfjorden. The final vessel layout has been a secure process involving the cable supplier Nexans, the Marine Warranty Surveyor and the Client, eventually resulting in a layout whereby the cable specifications are respected and all parties were satisfied.

Trailing Suction Hopper Dredgers *Alexander von Humboldt* and *Bartolomeu Dias* were mobilized and fitted with a 3 m wide (reduced) drag head to pre-trench and afterwards backfill the whole cable route from -4m LAT onwards.

The Fall Pipe Vessel *Simon Stevin* was mobilized twice to install pre-lay rock and post-lay rock mattresses at the SEA-ME-WE3 and FRANPIPE crossings.

For the shallow part near and onshore, chain trencher *Nessie II* from the German company *Christoffers* was hired.

The onshore cable works included 5 HDD's plus open trench installation with one joint (3 cores and 2 FO) in the middle. These works were sub-contracted to Company *Van den Berg*.



PRE-TRENCHING

Whilst the Cable Laying Vessel (CLV) *Willem de Vlamingh* was mobilized from Australia to Poland for conversion, Trailing Suction Hopper Dredgers (TSHD) *Alexander von Humboldt* and *Bartolomeu Dias* commenced with pre-trenching of the cable trajectories. To do so, they had to cross two heavily used shipping channels, a shallow sandbank and work nearby the existing C-Power (Thornton Bank) wind farm.

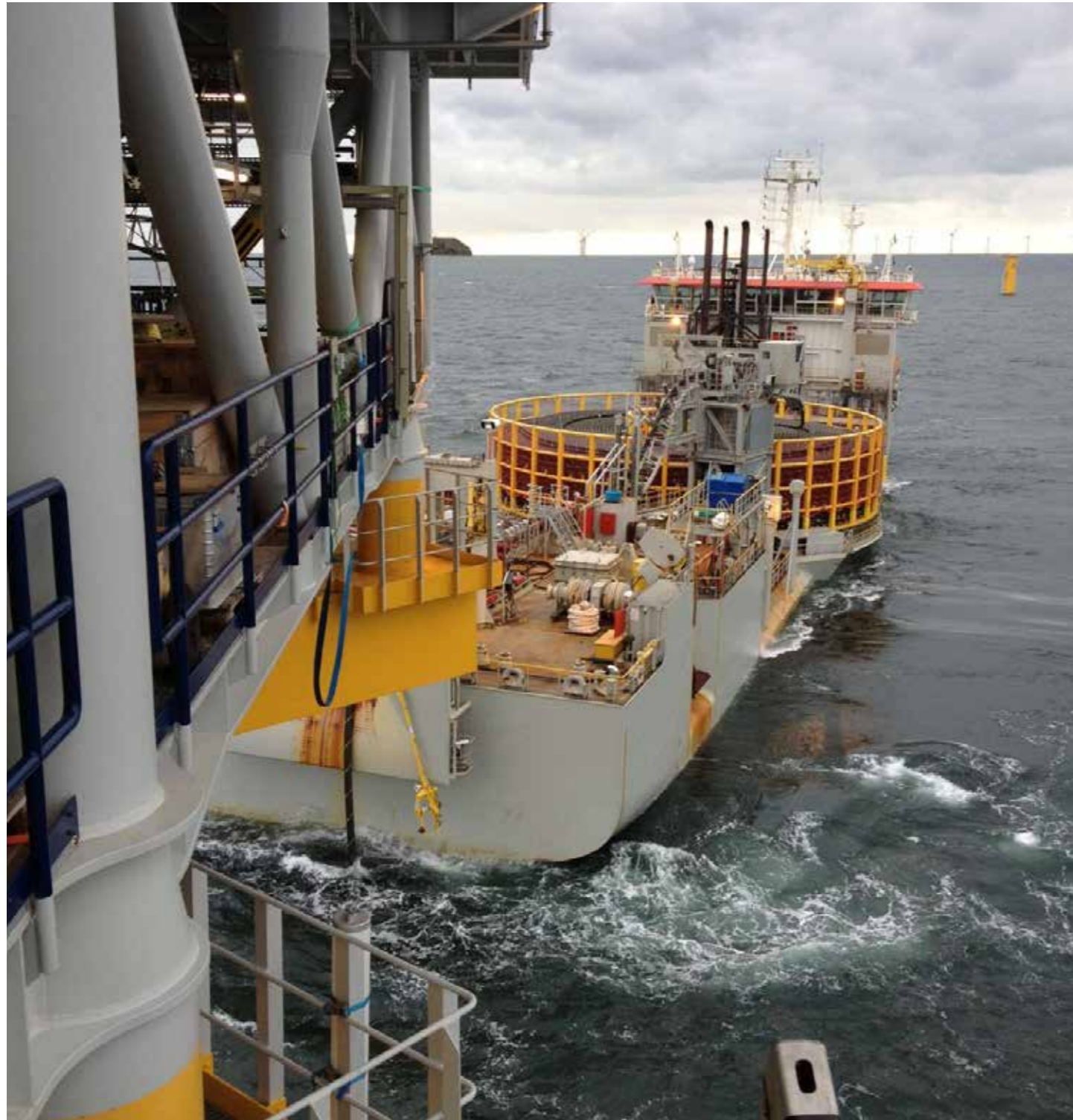
Prior to commencing trenching works, separate PLGR's were done on alleged disused cable positions. In the same period, the SEA-ME-WE3 and FRANPIPE crossings were covered with pre-lay filter layer mattresses by FPV *Simon Stevin*. Pre-trenching by Trailing Suction Hopper Dredgers offer a guaranteed trench depth before start of cable installation with no risk for damaging the cable during post lay burial.



CABLE INSTALLATION WORKS

ENGINEERING

During the engineering phase, the Project was studied in-depth with several analysis and documents being conducted including but not limited to a detailed micro-routing of the cables, static and dynamic cable installation analyses including the use of Orcaflex software, analysis of weather capabilities using the vessel's RAO files, sea fastening calculations and detailed method statements for each phase of the works.



CABLE INSTALLATION

The cables were both loaded from Nexans' factory in Halden, Norway and transported by *Willem de Vlamingh* to the project site.

The first cable being installed was the shorter Belwind 2 export cable from the OHVS to the future Belwind 2 OHVS location. The pull in operation commenced on 20 August 2013 and was completed the same day where after the cable was successfully laid in the 3 m wide trench with several bends over 14 km.

The main cable was then loaded in Halden and transported to Zeebrugge. The cable installation commenced on 19 September 2013 after a short weather standby period and ended with the beach pull-in being completed one week later, on 27 September.

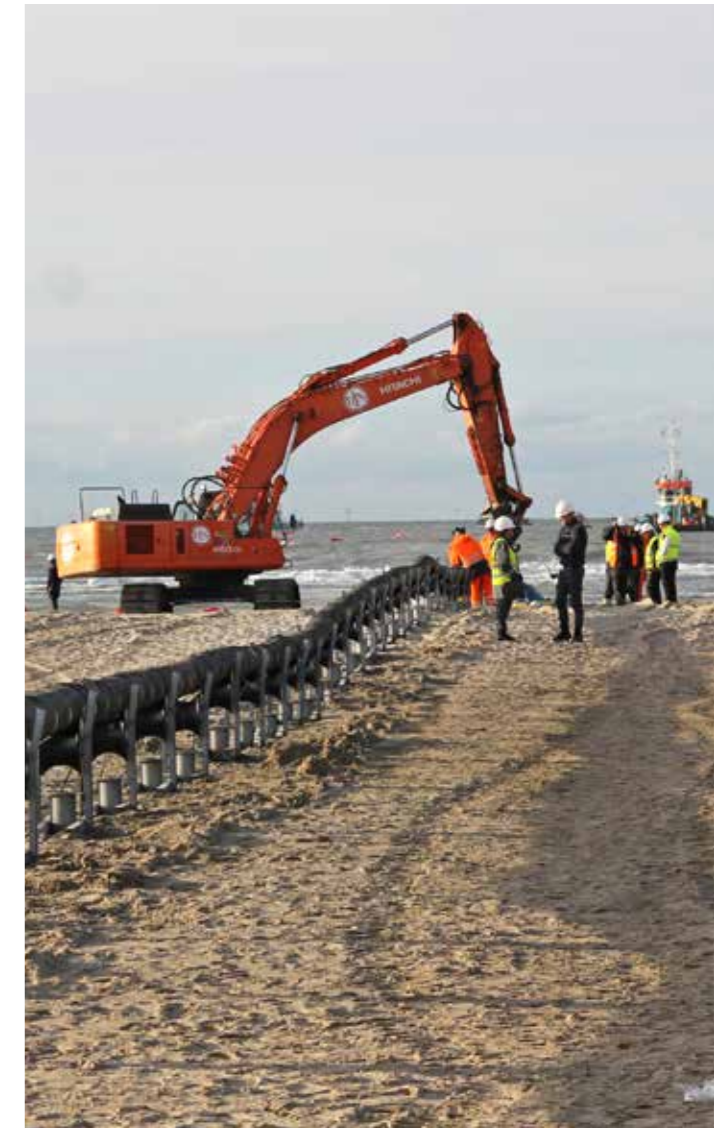
Both first end pull-ins and the second end beach pull-in were engineered by Jan De Nul Group and all necessary customized auxiliary equipment was fabricated for the job at Jan De Nul Group's workshop in Aalst. The cable systems for onboard the OHVS were mobilized to Denmark and pre-installed on the OHVS cable deck prior to shipping of the OHVS topside from its fabrication yard in Denmark to the Project site offshore the Belgian Coast.



During the cable lay, the cable touchdown point was monitored by a separate vessel, fitted with a blue view and multibeam sonar and connected with a direct Wifi link to *Willem de Vlamingh*. As such the difficulties with TDM by ROV in shallow water were overcome and the responsible installation superintendent could review the real-time touchdown information online

The beach pull-in itself was a challenging operation with 2.3 km of cable floating in relatively high currents in front of Zeebrugge at the Belgian coast, but Jan De Nul Group mobilized 7 powerful working vessels to maintain control over the cable, yet ensuring the cable's integrity by monitoring the cable loads by the vessels and the use of special rigging on the cable. The whole operation was monitored and managed from *Willem de Vlamingh* with the aid of a specially fitted remote Vessel Monitoring System.

Cable burial on the beach was conducted consequently with Christoffers' *Nessie II*. Ultimately the cable was then connected with the pre-installed land cable and successfully energized.



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JAN DE NUL GROUP (SOFIDRA SA)

Luxembourg

info@jandenul.com | www.jandenul.com

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