MARINE CONTRACTORS

Floating installation of WTGs

February 2022

RNA METHOD TEST CAMPAIGN (2021)

Heerema and offshore wind

The world needs offshore wind, and Heerema Marine Contractors is ready to deliver safe and sustainable installation methods for our clients.

Flexible and versatile solutions

Heerema vessels have unique capabilities and unmatched redundancy to ensure a predictable project execution.
We operate globally in water depths from shallow to deep and can lift light or ultra-heavy offshore structures. Our clients are encouraged to get in touch and involve Heerema early to make the best use of our sixty years of offshore experience.

Floating installation of wind turbine generators

Heerema Marine Contractors has developed installation methods for next generation wind turbines using floating crane vessels. These methods tackle key issues for the industry, such as: water depth, remote locations, wind turbine size, reducing the need for marshalling yards and ports, amongst others. This document provides an overview, and for more information do not hesitate to get in touch with our team.

Why Choose a Floating installation?

No connection to the seabed

There is no negative impact of soft soils, boulders, UXOs, earthquakes, or other seabed-related risks at any water depth.

Offshore feeding

Offshore feeding keeps the crane vessel working in the field with WTG components transported on separate transportation vessels. This reduces marshaling port requirements and enables a direct-to-side model straight from the fabricator to the vessel.

Large and stable work platform

A semi-submersible crane vessel provides a large and stable deck, allowing the WTG to be pre-assembled on deck in a controlled and accessible environment. Also, dual cranes allow for simultaneous WTG component load-in and assembly activities.

Installation speed

High installation speeds can be achieved by remaining in the field, pre-assembling the WTG on deck, and the superior workability of a semi-submersible crane vessel.

Synergies with substation and foundation installation

By using a semi-submersible crane vessel, one vessel can install the WTGs, foundations, and substations.

BENEFITS	TARGET PROJECTS
• No connection to the seabed	• Challenging soil and/or earth quake areas
• Offshore feeding (incl. direct to site)	• Deep water
• Large and stable work platform	• Harsh environment
• Installation speed	• Large distance to shore
• Synergies with OSS and FOU installation	• Poor port conditions
	• Jones Act regulated
	• Floating foundations

Installation methods

Heerema has developed two WTG installation methods that are showcased below. Both have been designed to reduce cost, maximise efficiencies, and deliver reliable solutions offshore.

Rotor Nacelle Assembly (RNA) Method

The approved in principle RNA method (London Offshore Consultants, 2019) minimizes the number of critical, dynamic lifts by installing the Rotor-Nacelle Assembly (RNA) in a single lift. The RNA is assembled on the vessel's deck using a dummy tower before connecting the blades to the nacelle in a controlled environment. The RNA is assembled on the vessel's deck using a dummy tower, which allows connecting the blades to the nacelle in a controlled environment.

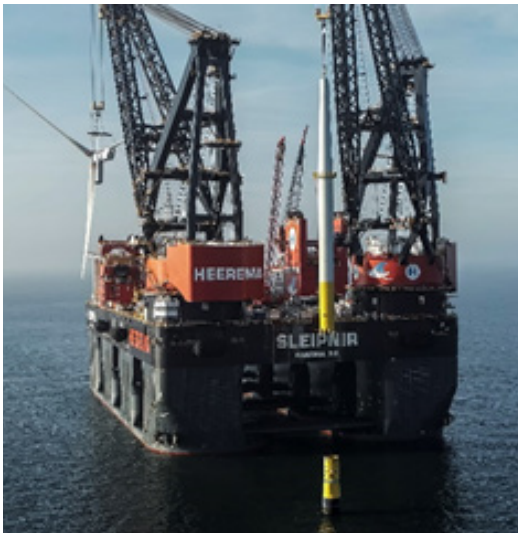
RNA ASSEMBLY ON DUMMY TOWER

One specific point of attention within the RNA method is the blade installation, which has been identified as the most critical part of the turbine installation offshore for any vessel. To combat these challenges, Heerema has developed the Guided Root End Positioning Tool, known as the GREPT. This in-house developed blade assembly tool enables offshore handling and installation of blades safely and efficiently.

GREPT TESTING AT PRINSES AMALIA WIND PARK

The RNA Method has been tested extensively within Heerema's Leiden Office based Simulation Center and was put into practice in Eneco's Prinses Amalia wind park, the Netherlands, in 2021. A video of the test campaign can be found here.

With the test results implemented the RNA method is ready to be used for installing 27 Vestas V174-9.5MW wind turbines for Parkwind's Arcadis Ost 1 project in 2022.



RNA METHOD AND GREPT TESTING AT PRINSES AMALIA FIELD

Heerema has developed two WTG installation methods that both have been designed to reduce cost, maximise efficiencies, and deliver reliable solutions offshore.


SLEIPNIR

Full WTG Method

The Full WTG method reduces the number of critical, dynamic lifts further by installing the full WTG in one single lift, either using a single or dual crane lifting arrangement.

COMPONENTS TRANSFERRED TO DECK | 1

WTG PRE-ASSEMBLY | 2

FULL WTG LIFT FROM DECK TO FOUNDATION | 5

DUAL CRANE FULL WTG LIFT TO FOUNDATION

FULL WTG TEST CAMPAIGN (2018)

1. WTG components are transferred to the HLV deck offshore.

2. The full WTG is assembled on the vessel's deck, eliminating relative motions between the crane and the WTG and easing the installation of components.

3. After assembly the WTG is lifted from the tower bottom using a collar type connection integrated in the tower bottom flange. Additionally, a stabilizing frame below the nacelle is used to keep the WTG upright.

4. The WTG is then moved to the foundation location and set-down. In-house designed equipment is used to ensure accurate positioning of the WTG and to keep the WTG stable and latched during the set-down phase and the bolting phases.

5. After the WTG is latched the crane vessel moves away and the final connection of the WTG to its foundation is made. When the connection is completed, the crane vessel removes all installation tooling and moves to the next installation site.

An alternative to the above shown single crane installation is the dual crane installation method. This method largely follows the same principles as described above, but with the final installation lift performed using both cranes as shown below.

Heerema successfully demonstrated the full WTG installation method during the DOT SJOR project in 2018. You can find more information below in the Track Record section and view the installation video here. The major wind turbine suppliers have accepted the installation concept.

The Full WTG method is suitable for the following turbine sizes:

	Jib extension	Dual crane
Thialf	17MW	15MW
Sleipnir	20MW+	20MW+

Floating to Floating

Heerema has introduced a novel floating wind installation method to upscale the commercialization of offshore floating wind.

Heerema's Floating to Floating installation method was developed to deliver solutions to industry challenges, such as efficient use of resources like steel and port infrastructure, offshore logistics and maintenance, and reaching the required scale and rate of installation.

Currently, there are various proposed methods that involve assembling floating foundations (floaters) in port before wet-towing to the field. This presents logistical challenges, as well as there being pressure on the number of suitable harbors.

Therefore, Heerema has developed an alternative method that does not require a wet-tow and removes the need for marshalling yards. Using the floating to floating installation method floaters can be constructed on land before being dry-towed on a transport vessel to location. After arrival, they will be installed using Heerema's floating installation frame to lift the floaters from the barge using either a single or dual crane lift. After that, they will be installed on location. Heerema's floating installation frame will submerge the floaters down by weight, removing the need for high-tech ballasting or tensioning systems and reducing installation duration. The bottom foundation work can be executed in parallel by optimizing the capabilities of Heerema's semi-submersible crane vessels.

A deeper dive into benefits

Delivering a lower EPC cost

The floaters' volume and weight is reduced by removing the need for wet-towing. Also, as the floater is lifted directly from the transportation asset in the field, which means both the floater and wind turbine generator can be optimized for in-place conditions only. A low-tech floater design is possible by integrating installation requirements such as ballasting provisions into reusable installation tooling, removing the requirement to build these functionalities into the floater.

Reducing transport and marshalling costs and infrastructure requirements

By efficiently using space onboard transport vessels to deliver multiple floaters directly from the fabrication yard to the offshore wind site transport and marshalling costs are significantly reduced.

By removing the need for in-port assembly of the floater and WTG there is less space and draught required in port and a reduced quayside capacity, which helps avoid one-off mega-investments in port areas.

Ensuring higher, more efficient, and predictable field delivery

By removing time-consuming and highly weather-sensitive wet tows and mooring connections, higher throughput can be achieved on floating wind projects. The floating to floating installation method means floater and WTG campaigns can be decoupled, reducing supply-chain pressure, and resulting in a more efficient process.

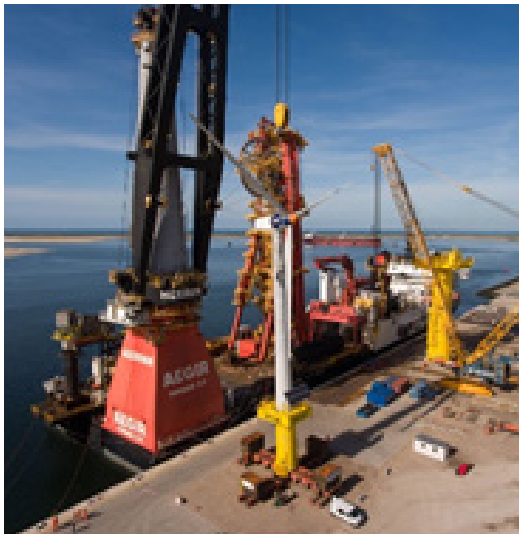
The crane-supported floating to floating installation method is built on proven technologies from the oil and gas floating platform industry. It allows the saving of tons of steel per floater, and will reduce overall project CAPEX.

FLOATING TO FLOATING WTG INSTALLATION

Track Record

DOT SJOR 2018 – Full WTG Method

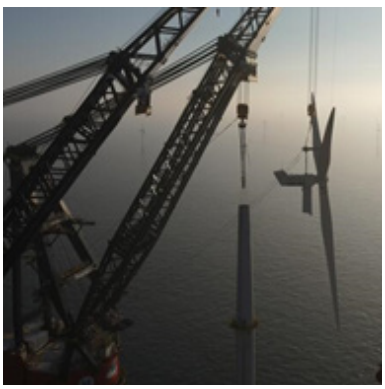
In 2018, Heerema lifted a WTG from an inshore location before sailing to the Prinses Amalia wind farm and installing the turbine onto a monopile foundation. One of the key innovations tested was a slip joint connection between the foundation and the WTG. This resulted in the WTG being installed in minutes rather than days. After installation, the turbine was removed using a reversed installation process. A video of the project can be found here.



WTG INSTALLATION DURING SJOR DEMONSTRATION PROJECT

DOT FOX (2021) – RNA Method

In 2021, Heerema performed a demonstration project to test the RNA Method and collect valuable operational data. A modified NEG Micon NM92 turbine was installed using the RNA Method and the GREPT. The project was executed in collaboration with Delft Offshore Turbine and the Delft University of Technology. A video and more information can be found here.




WTG INSTALLATION DURING FOX DEMONSTRATION PROJECT

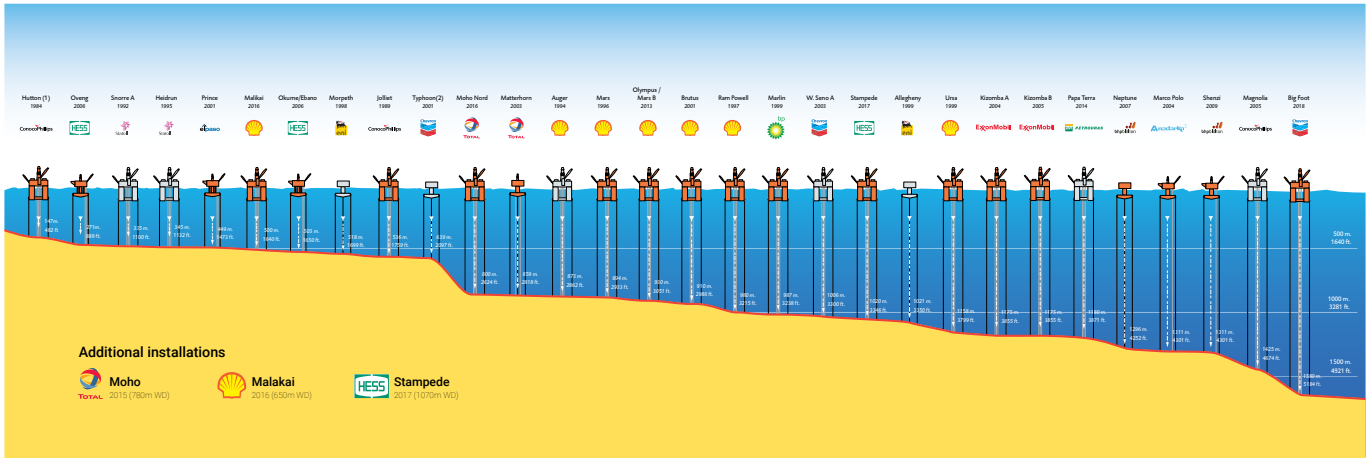
Arcadis Ost 1 (2022) – RNA Method

In 2019, Heerema was awarded Parkwind's Arcadis Ost 1 WTG installation project. This campaign will be the first offshore wind farm that will use a floating vessel for the installation of Wind Turbine Generators. Approval in Principle for the selected method was received from London Offshore Consultants. An announced video of the project can be found here.

RNA METHOD FOR ARCADIS OST 1

TLP installation

Heerema is world leader in the installation of TLPs for the oil and gas industry, with a track record including TLPs installed up to a water depth of 1,500m.



HEEREMA TLP EXPERIENCE

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