



PLACE AND PLUG Method

High capacity offshore installation
BY LOGIMA



Experience gathered from installation of the first Full Scale offshore wind parks have revealed a number of limitations and drawbacks in the current approach. These weak points have made the process of installing wind turbines offshore more time consuming and costly than what was absolutely necessary. With the promise of even bigger project that have already been put forward e.g. Round 2 projects in England. There is a real need for addressing the approach of erecting windmills at sea.

The complex way in which projects have previously been done is probably one of the biggest obstacles for reaching a capacity that will enable companies to handle the large future offshore wind parks. The risk of getting bottlenecks in several steps of the construction process is inherent in the methods used so far. This has led to the development of a new method that seeks to eliminate or dramatically reduce the work processes that are required at sea to a very minimum. Furthermore it has been possible through the new process to reduce product cycle time and the need for binding capital during the construction process. Finally it has been possible to reach a higher quality standard on the finished wind park as quality assurance is prioritised earlier in the process.

The PLACE AND PLUG method made by Danish company LOGIMA includes the use of concrete foundations. This enables the contractors or manufacturers to fully assemble the wind turbine before it is transported to its unique location in the future wind park. The possibility of working under harsh weather conditions is thus extended. The new method is furthermore bringing a considerable cost saving to the process.

The method is not just covering the technical aspects of constructing offshore wind parks but also provides a new frame work for project management in order to secure the results that the method is able to bring. The LOGIMA Project Management System is an integrated part of achieving strong results before, during and after the construction of the wind farm.

The PLACE AND PLUG Method

The new method will be presented in a short version, to enable an overview of the significant differences between this and the traditional method. Then we will present the different parts of the process in more detail to highlight where and why the new method is able to gain different advantages. Finally we will present a project management system that has been specially designed for Offshore Wind Park construction.

The turbine is erected and installed on land at a facility that can be used in many locations.

- 1) Foundation in concrete with a shaft that is adapted to the water depth is produced.
- 2) Steel tower is produced and installed on the foundation.
- 3) Nacelle with spinner is mounted.
- 4) All three wings are mounted.
- 5) The turbine is mounted completely with internal cable work. Start-up control is performed and finally the wind turbine is fully tested.
- 6) Turbine is placed ready for loading onto the designated transport vessel.

Foundation in concrete is designed to have the same abilities as a floating barge with enough stability to carry one fully assembled turbine. The foundation needs to be divided into a number of chambers so that it can be filled and emptied for seawater or another floating substance without having the free surface making the foundation unstable when afloat.

When the launch is made, the foundation should contain only enough water to allow a free floating barge condition.

The choice of crane is depending on the facilities in the production port. Cranes are used to erect the turbines. It is preferred to have a stationary crane carrying out the lifts throughout the project period.

The Offshore installation process consists of the following steps:

- 1) The seabed is examined, to secure that the bottom will be able to carry the weight of the foundation and turbine including the ballast water/fluid. It also needs to be established whether a layer for support is needed.
- 2) The seabed at each individual location is planned out.
- 3) 3 to 5 fully assembled and tested turbines are loaded onto the designated carrier being e.g. a Dock type vessel with semi submersible capabilities. The turbines are floated onto the vessel. The ship is then lifted to its sailing condition.
- 4) The vessel arrives at the first turbine location and manoeuvres into position using a Dynamic Positioning system or Anchor system. The ship is then lowered to allow the first turbine to be afloat.
- 5) The turbine is dragged aft freely floating out of the cargo hold and is guided by the 4-winch system on the outriggers to its final position.
- 6) The turbine is lowered to the seabed using the 4 winches as the foundation is being filled with water/fluid. The turbine is then released by remote onto the seabed.
- 7) The vessel is lifted and sails off to the next turbine location. The points from 3-6 are repeated until all 3 to 5 turbines are placed.
- 8) The vessel returns to the shipping port.
- 9) Connecting the turbine to the shore cable is done and operation of the turbine is ready to start.

The time span between planning out and preparing the seabed and installing the turbine should be of a short interval. This is to prevent sandbanks or other sediment to erupt and make the surface unstable. The time for allowing such sand movement will vary from one project to the next. The conditions at each location must therefore be determined to allow for this to be a part of the planning process prior to carrying out the project.

Foundations are equipped with an liftingeye in each corner to allow for wires to be connected. These eyes will have a dimension that allows for both vertical and horizontal impact. The turbine is floated onto the carrier using wires that are connected to the above-mentioned eyes. When the fully assembled turbine is loaded onto the carrier enough water is filled into the chambers to secure that it remains stable during transport. During transport airbags will be

used for fixing the turbines against the side of the vessel or dedicated strong points in the cargo hold. This will ensure that the cargo is not able to move during transport.

At this point the foundation is emptied for water/fluid so that it can float of the carrier leaving the remaining turbines in the cargo hold standing at the bottom.

Before lowering the unit into position, enough water is filled into the chambers to allow the turbine to hang in the 4 winches with a stability that balance out the lack of natural stability when lowering the turbine into the water. The release of the 4 lifting wires is done using hydraulic cylinders that pull the pin out of the lifting shackle.

When evaluating the effect of the new PLACE AND PLUG method and the economical gain all of the above-mentioned topics need to be taken into account.

When comparing the traditional and the PLACE AND PLUG method it is our belief that a price reduction for setting up a full-scale offshore wind farm will be up to 15 % of the total cost involved. The improvement of the total cost is secured together with a major increase in the capacity for setting up a wind farm offshore. The higher level of quality on the finished turbine will furthermore mean less down time when it has begun operating resulting in considerably less costs for service and maintenance.

Project Management

LOGIMA Project Management System goes hand in hand with the PLACE AND PLUG method as part of the savings will come from working with tight schedules and high quality throughout the project.

The experience gathered from the traditional method of building offshore wind farms are clearly showing that to keep budgets it is imperative to have the projects being managed very tightly by individuals with authority to act and access to the resources needed. The Management process starts well ahead of the building of the wind park as time pressed planning will lead to short sighted decision making.

The LOGIMA Project Management System includes the following elements:

- Pre planning and method selection based on knowledge of the wind farm site.
- Detailed planning of design period, contract making with subcontractors, purchase of materials, build up of work sites, execution of building of foundations, execution of on shore assembly, execution of offshore activities, tight system to have just in time delivery of all parts, execution of cable laying, execution of start up phase.
- Quality system that gives clear flow of documents and that secures that all faults are dealt with when discovered.
- Reasonable level of method statements and risk assessments for all phases of the project.
- Plans for bringing the project back on track if delays occur.
- Plan for handling authorities.
- Project evaluation.

Using above elements for execution of a bigger offshore project is deemed necessary by LOGIMA to secure that time plans and delivery dates are reached.

Ideal sites for using the PLACE AND PLUG method

As most people involved in this business already know there hardly ever is an offshore site with ideal conditions. Experience shows that it is essential to have substantial data from the specific site for each individual turbine location. If resources in this phase of the project is not spend there is almost always going to be additional challenges in the construction phase. Whether the method is monopile or gravity foundation it is vital to have accurate data concerning the seabed, tidal conditions, surge and local weather conditions.

The seabed needs to have sufficient load capacity. A condition with very soft bottom is unfit for the special concrete gravity foundations. In such conditions it will only be possible to use mono pile foundations. The method is aimed at projects with water depths from app. 7-8 meters up to app. 25-30 meters.

To reap the full advantage of the method projects are likely to consist of 70-80 turbines or more, this is where the advantages of the high capacity level kicks in with full effect, making it possible to have very short project life cycles and economies of scale in all chains of the process.

The PLACE AND PLUG method by LOGIMA offers effective offshore installation with high capacity. Together with the Project Management system that enables a tight project management process where contractors are able to deliver on time with no unforeseen costs.