

Building the Foundation for One of the World's Largest Offshore Wind Farms

Installing foundations for one of the world's largest offshore wind farms - The Gwynt y Môr Offshore Wind Farm - is no easy task. The sheer scale of the project as a whole, and the colossal size of each individual turbine create design and logistical challenges unique to an initiative on this scale.

Located 13 km off the North Wales coast near to the shore, this project will involve the installation of 160 Siemens 3.6 MW turbines for a total installed capacity of 576 MW. That's enough energy to supply 400,000 homes with electricity, which could potentially offset the electricity needs of one-third of all homes in Wales.ⁱ Creating a solid foundation for this immense undertaking requires some specialized designs, equipment, and techniques, as you'll soon discover.

Foundation Design for the World's Second Largest Offshore Wind Farm

The rough waters and harsh weather conditions, as well as typical water depths of 12 to 28 meters combine to create some not so welcoming conditions for these turbine foundations. The huge size of each turbine - each with a tip height of up to 150 meters above mean sea levelⁱⁱ - also requires an equally large foundation.

To support them, the wind farm will use steel monopile foundations, each between 60 and 70 metres long and 6 to 7 metres wide. The size of these foundations are astounding; they are the largest monopiles ever used for a wind farm anywhere in the world. So huge, they are about the same size as an Airbus A380 passenger jet.ⁱⁱⁱ



Detailed foundation design by [Ramboll Group - Transition Piece](#)

Each foundation will be fitted with a yellow transition piece and access platform. This will be the means by which the wind turbines will be fitted out and maintained. The two steel sections are each designed uniquely for the project. The first 92 foundations are designed with grouted connections, scour protection, and corrosion protection. The second steel design will include external access, internal access, platforms, and details.^{iv}

The first foundation was completed in the fall of 2012. According to the project director, Toby Edmonds, "The first foundation was installed using the heavy lift vessel Stanislav Yudin, in the early hours of Wednesday morning (08 August) and to the specified depth of 23.3 metres. We are delighted with this very successful first installation which marks a next crucial stage of the two year construction period for this flagship wind farm, which began with the installation of scour protection in January."^v The first of two offshore substations and export cables were being installed around the same time.^{vi}

Creating Custom Equipment to Complete the Mammoth Offshore Wind Farm Foundation Project

Ensuring the monopiles are solidly installed is equally important as the success of



The LDD [LD5000 hydraulic monopile drill](#)

these foundations. For this, the project commissioned the design of the world's largest and most powerful pile-top reverse circulation drill known as the LD5000 by LDD. Requiring a 12 month investment of intensive design, building, and testing, the drill was designed specifically for this

astoundingly large project in order to accommodate the special monopiles being use for each turbine.

Since each monopile is designed with an open steel tube weighing in at 750 tonnes and a transition piece that weighs another 350 tons, the drilling rig needed to be able to lift and manouver these components easily. It also needed to be configured

to allow the bottomhole assembly to pass through the narrower 4.3 metre diameter neck of the pile to drill rock sockets. The diameter is designed to then increase to 6 metres once the drill is inside the pile. If necessary, this rig can even drill to 8 metre diameters.^{vii}

LDD is a somewhat new player in the field of large offshore wind projects. In fact, this is their first contract in the renewables market. The design and construction of the LD5000 has gone relatively well, though there have been some challenges. Conducting the drilling from a purpose-built jack-up rig with less than ideal deck space, for instance, created some hurdles for the effective use of the drill.

In order to overcome this challenge, the deck layout was redesigned to optimise it for maximum production value. In particular, certain elements of the drill design needed to be re-engineered. Additionally deck storage was rearranged to accommodate the equipment.^{viii}

Drilling for these foundation installations also posed some challenges, including the variable nature of the North Wales seabed rock and soil profiles. The potential to run into large boulders is high, but the LDD team is confident their design will not have a problem with this potential challenge.

Drilling services will be provided by LDD on a continuous relief basis for two years as the construction of the project continues. This will require the work of four specialist engineers to operate the drill. They will do so using the computerised system that gives the engineers precise control over the hydraulically powered machine. This modern approach to controlling the drill (rather than manual controls) should make the process more efficient and cost-effective.

Transportation Requirements for the Offshore Wind Farm Foundation Project

To support the work of the project, £100 million was invested to commission Seabreeze construction vessels for the installation of the foundations. To transport the sets of foundations to the construction site, a barge from the Gwynt y Môr base harbor port facility will be employed. Once complete, the foundations will be fitted with three-bladed wind turbines that will be installed using a jack-up barge.

Gwynt y Môr Offshore Wind Farm will be connected to the local grid via two offshore substations and one new 132/400 kV substation at St. Asaph Business Park. The substations are installed on jacket foundation structures. This new St. Asaph substation, which is already live, will transport electricity from the offshore substations to the national grid.

The project, which has generated £80 million in economic benefits for Welsh businesses, will provide hundreds of local jobs, with at least 100 long term jobs for skilled engineers for the operation of the farm over its lifetime.^{ix}

Completion of the foundation installation phase of the project is anticipated for Q4 of 2013.^x The first energy generation is scheduled to commence May of 2013, with a complete project commissioning for 2014.^{xi}

Who's Behind the Completion of Gwynt y Môr Foundation Installation?

Gwynt y Môr is a joint investment project between RWE Innogy, Stadtwerke Munchen and Siemens. They awarded the contract for building the foundations to a specialist consortium of Bladt Industries A/S and EEW Special Pipe Construction GmbH, with a total value of € 240 million.

This consortium, which has extensive offshore wind energy experience, as extolled by Mr. Edmonds, "Gwynt y Môr will deliver significant benefits in terms of clean, low carbon energy to the UK. By selecting Bladt and EEW, we are able to work with some of the most experienced foundations engineers, and one of the very few currently with the capability and experience to produce monopiles of the size, quantity and quality required for the Gwynt y Môr project."^{xii}

The construction and development for the foundations of this project is being handled by Cammell Laird, Birkenhead out of their facility on River Mersey. Operating under a £5 million contract, this is the company's first major deal and so posed significant ramp-up for the growing firm.^{xiii}

As one of the most exciting offshore wind projects in the world, the construction of the Gwynt y Môr offshore farm will definitely be one to watch. No doubt, many lessons will be learned along the way which will prove valuable to the industry as a whole as it adds more and more offshore installations of this size.

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