DHI CASE STORY

A SAFE & EFFICIENT PATH TO RENEWABLE ENERGY

Metocean forecasting – supporting the construction of the world's largest wind farm

To complete the world's largest offshore wind farm – London Array – knowledge of the physical environment was essential to ensure safe and efficient operations. Before and during the construction phase, daily as well as more extreme conditions had to be taken into account. As such, London Array Ltd. asked us to develop a robust and reliable Metocean forecasting system. Our real-time system provided accurate forecasts of Metocean conditions on a detailed spatial and temporal scale. This enabled London Array Ltd. to optimise the construction of the offshore wind farm, minimising delays and ensuring the safety of those working on the project.

METOCEAN FORECASTING EXPERTISE

From building an oil rig or a wind farm to dealing with undersea cables and pipes, offshore construction is risky and expensive. Several factors must be considered to lower expenses and ensure the safety of those working on the project. As such, some important questions need to be asked, such as:

- How high will the waves be at the construction site?
- Will the wind allow for safe construction works?
- Is there any danger of heavy fog or thunderstorms?

Companies undertaking offshore construction need to know exactly what conditions they will encounter at sea.

Situated in the outer Thames Estuary about 20 km off the coasts of Kent and Essex in England is the world's largest offshore wind farm: the 1 GW London Array. Weather conditions in this area are often challenging, which made construction and installation of the wind farm difficult. As such, high-quality and reliable Metocean data was vital for the successful planning and installation of London Array's foundations and turbines.

London Array Ltd. – the consortium behind the wind farm – needed to be able to predict available weather windows. After an open tender, they chose us to develop a Metocean forecasting system.

For this project, we used our 30 years of experience in Metocean forecasting, gained from major offshore construction works such as the on-going Fehmarnbelt project. In addition, we utilised our Metocean forecasting experience from other offshore wind farms in the United Kingdom, including Robin Rigg, Walney, Gunfleet

SUMMARY

CLIENT

London Array Ltd. (a consortium comprising E.ON, DONG Energy and Masdar)

CHALLENGE

- Rapidly varying spatial and temporal conditions in the construction area
- Lack of detailed knowledge about the physical environmental conditions
- Potential impact on construction works including delays, leading to increased costs
- Ensuring safe working conditions for workers

SOLUTION

Robust, accurate and timely Metocean forecasting

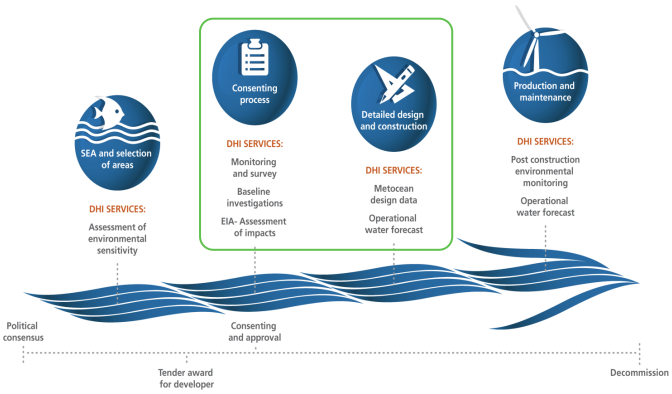
VALUE

- Minimisation of delays during the construction phase
- Ensured safe conditions during operations
- Reduction in bad weather stand-by charges
- Efficient planning of maintenance works during operations phase

LOCATION

United Kingdom, Europe

Sands and Thanet. This ensured that the London Array project benefitted from the most up-to-date and advanced technologies, combined with local experience of forecasting techniques and equipment.



Our services to support the offshore industry. For the London Array, we provide services within the green line.

COMPLEX MODELS FOR A COMPLEX SITE

The Outer Thames Estuary at the London Array site has a complex underwater shape, large tidal variations, strong currents and large spatial variations in the wave conditions. Consequently, the working environment varies across the site. To tackle this challenge, we set up a high-resolution local model of the Thames Estuary and part of the English Channel. This local model included a three-dimensional (3D) hydrodynamic model as well as a wave model. We embedded the local model in a coarser regional 3D hydrodynamic model covering the waters around the British Isles and the North Sea. This regional model incorporated real-time data of water levels from more than 20 stations, contributing to the high accuracy of the water level and currents forecast by the local model.

One of the wave buoys which provides on-line data and supports the hydro-dynamic model.

We gathered the data that fed the models from three wave and current buoys plus a tide gauge deployed by EMU (a local contractor). In addition, a meteorological mast continuously supplied various types of meteorological data. All the instruments were equipped with iridium satellite communication, which allowed for easy online data transfer. We then used the online measurements to feed the hydrodynamic models. Combined with meteorological models, this provided a complete five-day forecast system for:

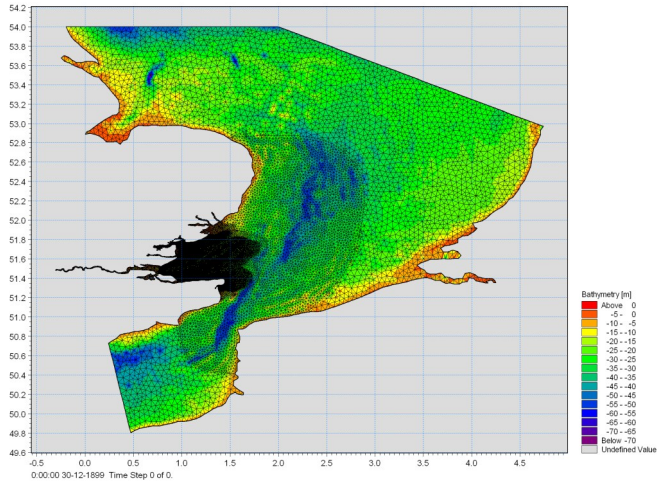
- wind
- air temperature
- sea temperature
- visibility
- lightning risk
- cloud height
- water levels
- wave heights
- Currents

The forecasts were disseminated via the Internet and e-mail. From engineers to ship captains, everybody involved in the project could receive direct and instantaneous access to the latest Metocean data and forecasts.

ENSURING COST-EFFECTIVE OPERATIONS AND SAFETY

To further support the day-to-day operations of the London Array project, we set up a 24/7 hotline service staffed with experienced meteorologists provided by our partner StormGeo. This hotline included urgent alerts on storms and lightning risks to ensure the safety of those working offshore. This was supported by a reliable back-up system for the gathered data, along with regular data reports and performance reviews.

By assisting London Array Ltd. with forecasting Metocean conditions, our system helped keep delays to a minimum during the construction phase. This in turn helped reduce the amount of non-working time and bad weather stand-by charges. In addition, our system also enabled London Array Ltd. to efficiently plan maintenance work during the operations phase. This enabled London Array Ltd. to control costs effectively and keep their workers safe.



The complex bathymetry of the outer Thames estuary (increasing depth from red to blue) required the set-up of a number of embedded models of varying mesh sizes, ranging from 200 m to 2000 m.

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