



**RAMBOLL**

## OFFSHORE SUBSTATION DESIGN

**A substation enables energy to be transformed and sent over long distances, thereby minimising power loss and distribution costs.**

Ramboll is world leading in offshore foundation design for wind turbines. Our specialised engineers have vast expertise with development and design of offshore facilities.

This includes smaller, unmanned facilities, as well as larger platforms with emergency accommodation and access by sea or air.

### **Offshore substations**

More and larger wind farms are being located offshore. The capacity of these wind farms range from several hundred MW up to 4-5 GW. To minimise the electrical transmission losses and cable costs, the turbines in such wind farms are electrically connected to an offshore substation provided with a step-up transformer.

Transmission into shore is then achieved by an HVAC connection or a HVDC link.

With Ramboll as your partner, our extensive offshore experience will be implemented in your substation with a strong focus on

safety, operations and maintenance (O&M), and a cost-effective design. The development and design of the substation strongly depends on the location and the operation and maintenance philosophy of the wind farm.

### **Multi-discipline services**

Ramboll provides multi-disciplinary engineering consultancy for all areas of the offshore substation:

- Definition of design standards, codes and safety philosophy
- General layout development with consideration of safety, mechanical handling and O&M
- Implementation of electrical equipment such as step-up transformers, reactors, Gas-Insulated high-voltage Switchgear (GIS), Low Voltage (LV)-switchgear, Uninterruptible Power Supply (UPS) system and control systems
- Substructure design including j-tubes for cables, boat landings and foundation
- Specification of all auxiliary

equipment such as cranes, emergency diesel systems and workshop requirements

- Emergency facilities and helideck if required
- Installation engineering for topside and substructure as well as cable pull-in planning
- Establish O&M programmes

For further information, please visit [www.ramboll.com](http://www.ramboll.com) or contact us directly:

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### Substructure design

The substructure of an offshore substation can be a simple steel monopile, a larger jacket for deeper waters, and higher topside loads, or it can be a concrete gravity-base structure.

The structural design is carried out using Ramboll's own state-of-the-art software program, ROSAP or the SACS Offshore Structural Analysis package. All topside and substructure designs are performed within a fully integrated 3D system (e.g. PDMS, Tekla, Solidworks or SmartPlant 3D).

### Design codes

The designs can be made according to all acknowledged standards e.g. DNV GL (e.g. DNVGL-ST-0145), IEC, NFPA, ISO, API or other international codes as required, to have the project approved by a certifying authority.

### Operation and maintenance

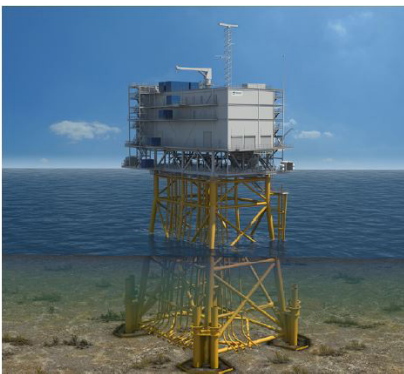
We endorse operations and maintenance (O&M) strategies that are deeply rooted in the individual corporate culture and we strive to deliver solutions that suit our client's overall operating economy. Our O&M programme is carried out in close cooperation with our clients and focuses on ensuring the structural integrity of the systems while minimising costs on service contracts. Our programme also includes lean scheduling of offshore trips to reduce costs on travel, maximising efficiency when offshore, and comply with applicable legislation and standards.

The efficiency of the maintenance programme is subsequently evaluated by a thorough follow-up on reliability to indicate whether there are necessary changes to be made.

### Optimum solutions

With more than 30 years of experience within offshore substructure design, Ramboll is the ideal partner to determine which kind of facility is the most advantageous at a given location. Our track record of offshore substations goes back to the first offshore wind farms in 2005 and since then we have delivered optimum solutions through feasibility studies, basic designs, front-end engineering designs, and detailed designs.

We have provided assistance in developing one of the world's largest wind farms, Hornsea One (UK), which is estimated to significantly support household energy consumption. Additionally, Ramboll has delivered smart and cost-effective designs to projects in the Netherlands, Belgium, Germany, Taiwan and has also entered the market for offshore wind in China as the first non-Chinese company to design a complete wind farm.



#### BASIC AND CONCEPTUAL DESIGN OF 700 MW AC OFFSHORE SUBSTATION

##### CLIENT

TenneT

##### LOCATION

The Netherlands

##### PERIOD

2015

##### SERVICE PROVIDED

Basic and conceptual design of topside and substructure.

#### WORLD'S LARGEST OFFSHORE WIND FARM DEVELOPMENT - HORNSEA ONE

##### CLIENT

Ørsted

##### LOCATION

United Kingdom

##### PERIOD

2015 - 2017

##### SERVICE PROVIDED

Detailed design and follow-on engineering for topside and substructure.

#### SPIC BINHAI NORTH H2 400 MW SUBSTATION

##### CLIENT

Powerchina Huadong Engineering Corporation Limited

##### LOCATION

China

##### PERIOD

2016

##### SERVICE PROVIDED

Detailed design of topside and substructure.