JACKET SUB-STRUCTURES FOR OFFSHORE WIND FARMS

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DESIGNED FOR YOUR SITE AND YOUR TURBINE

As offshore wind projects move into deeper waters and the turbines increase in size and weight, the jacket structure will be increasingly competitive as compared to today’s favoured monopile and gravity base foundations.

Jacket design experience

Our expertise in jacket design is based on 30 years of Oil & Gas experience from the hostile North Sea.

During the past 15 years we have also been involved in more than 35 detailed design projects of substructures for offshore wind farms, which have already been built or will be built over the next few years. The total number of substructures is more than 2,500 - mostly monopile foundations. Within this design portfolio we have experience in offshore wind jacket designs from three completed detailed designs, one currently ongoing detailed design and two ongoing FEED designs and different concept and FEED studies for most of the 5-8 MW turbines available on the market. By combining our jacket design experience from Oil & Gas with our market leading experience in design of substructures for the offshore wind market, we are able to support the offshore wind business to successfully develop in the future.

Load exchange with wind turbine manufacturers

In Ramboll we are experienced in working together with all the key wind turbine manufacturers. In a detailed design we perform load exchange with the wind turbine manufacturer in order to optimise the structural design of both the substructure and the wind turbine tower.

Design expertise

Our offshore design experience enables us to offer all services necessary to capture all relevant design effects, including installation/handling analyses and sea transportation analyses. Our in-house expertise in jacket design comprises primary and secondary structures as well as geotechnical and electrical engineering. This means that we apply all design works in-house with our own staff, which eliminates time, cost and interfaces between the individual disciplines. Within Ramboll the offshore wind business employs close to 100 people in our four offices in Copenhagen, Esbjerg, London and Hambur.

Project-specific design

Ramboll is an independent consultant and we are therefore not connected with any design solution. This means that we have full flexibility to design the best suited substructure for the client and the project.

Transition piece design

The transition piece is a highly complex and important part of the substructure design connecting the wind turbine tower to the jacket and is therefore designed using advanced FE software. The layout of the transition piece is designed to best fit the given project. Possible project specific specifications may include a door in the transition piece wall or the addition of hatches to give access to otherwise inaccessible locations in order to ease inspection of the transition piece.

Several optimisation rounds are performed to ensure that the best compromise between weight and manufacturing cost for the transition piece is reached.

Pile-jacket connection design

For piled jacket designs, the setup consists either of pre-plied or post-plied solutions based on the best suited concept for the given project. In both cases the pile-jacket connection will include a grouted connection with shear keys. The design of the grouted connection may utilize detailed FE analyses.

Pile swaging, which is a concept without grouting for the pile-jacket connection, may alternatively be adopted for a post-plied jacket. An alternative to foundation piles is the suction bucket foundations, which can be welded to the bottom of the jacket avoiding a grouted or swaged connection.

Suction buckets

We are experienced in designing jackets supported by suction buckets and have designed the first structure of this type installed in the world.

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DESIGN

Primary structures

Some of the design options that can be investigated are:
• 3-legged vs. 4-legged jackets
• Pre-plied vs. post-plied vs. suction bucket foundations
• Welded joints vs. cast joints
• Transition Piece layout

Secondary structures

Detailed design of secondary structures on a jacket substructure comprises the following items:
• J-tubes and J-tube supports
• External and internal platforms
• Boat landing
• Ladders and resting platforms
• Cathodic protection system

HSEQ - Health & Safety, Environment and Quality

The primary and secondary structures are modelled using 3D software providing the required overview of the entire substructure layout thus minimising the risk of clashes in the manufacturing phase. Furthermore, the 3D model is the basis for design risk assessment workshops, including all parties in the project.

Design software

When designing offshore substructures we apply a combination of our own developed ROSAP program package and commercial design tools, such as FE and CAD tools. In ROSAP we have the option of designing the substructure according to selected design standards, such as DNV, Eurocodes and DIN.