When were you last inside the wind turbine?

– There is a risk of corrosion inside the foundation

The present design on offshore wind turbines requires that the foundations are completely tight and leakproof and thus corrosion will stagnate in time. However, this is not entirely the case.

Important to check design condition

The typical design basis for offshore wind turbines is a service life of 20-25 years and in some of the Northern European wind farms half of this time period has already been spent.

Presumably most wind turbines will have even longer service lives. Nevertheless it is important to examine the condition of the present structures/designs and if needed perform repairs in order to better estimate the future service life and gain more from large investments.

FORCE Technology has examined a number of offshore turbines with monopile steel foundations, in which corrosion, quite unexpectedly, has been found on the inside. This has been found on the actual monopile, which is the turbine's foundation in the sea bed and in the transition pieces that connect the foundation with the actual wind turbine tower.

Unexpected corrosion

Some of the offshore wind foundations that FORCE Technology has examined turn out to have fluctuating/varying water levels, i.e large surfaces that will often be flushed with fresh sea water and corrode more than expected.

Reasons for corrosion

The following leaks may be the cause for corrosion::

- The sealing between the foundation and the inside pipe that holds the conductive cable (the J-tube)
- The so-called air-tight deck between tower and foundation
- The joint between the monopile and transition piece, the socalled grout connection.

In all of the above cases, the situation is that instead of an airtight compartment you have periodic injections of oxygen and seawater. In seawater environments and e.g. in harbours with tidal water activities it is also known that microbial activity may increase the corrosion rate significantly and the organisms' activity and effect on the corrosion depend on the access to oxygen and nutrition in the seawater. Thus the risk of microbial corrosion should also be considered.

Time consuming examination

Since the turbines are offshore they are not easily accessible. It may be very time consuming to conduct condition assessments on offshore wind turbines since access to them is only possible under tranquil wind and weather conditions.

Furthermore the job requires:

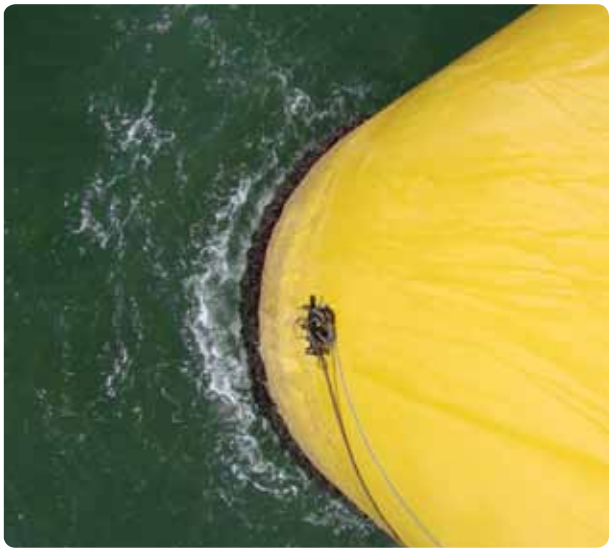
- Specially trained staff to work at heights and in closed compartments
- Back-up personnel due to safety measures
- Difficult transportation of equipment up and down staircases
- Possible pumping out of water in the foundation prior to inspection.

Ultrasonic examination

It is seldom enough to conduct a visual inspection of the walls as the corrosion attack may seem more severe than it actually is. Therefore the wall often needs to be cleansed of rust and biofilm, so that the depth of pits and cavities from corrosion attacks may be measured.

Another way to examine such corrosion attacks is to scan cleansed areas by ultrasonic probes, by which you may determine the remaining wall thickness very accurately. Alternatively, it is possible to scan from the outer side of the transition piece with automated ultrasonic scanning equipment and thus measure the wall thickness and visualise the distribution of the corrosion attacks.

After removal of corrosion, shape and depth of the attack is assessed



Ultrasonic inspection of transition piece from the outside

Coupons monitor the corrosion rate

Another way of measuring the corrosion rate is to apply sensors or corrosion coupons. Coupons are metal plates that are placed inside the foundation and thus are exposed to the same environment. After e.g. a year's exposure they will be retrieved, cleansed and weighed in order to determine how much of the material has corroded away. The above is used to predict the service life of the foundation wall.

Future design

The results that FORCE Technology achieves by examining offshore wind turbines may be used for service life assessments, repairs and to change/alter the design on future structures.

To avoid similar corrosion problems it is important to identify the reasons for the increased corrosion in a specific design and if necessary implement the appropriate remedial actions, e.g. the inside surfaces may be protected by organic coating, so that the steel surfaces will be protected from the rough environment at sea if the completely airtight structures are unattainable in practice.

Furthermore it may be possible to mount anodes inside the structures to provide cathodic protection, or corrosion monitoring may be thought into the design. Furthermore, other possibilities may be tested to ensure the structures long and predictable service lives.

Further information
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