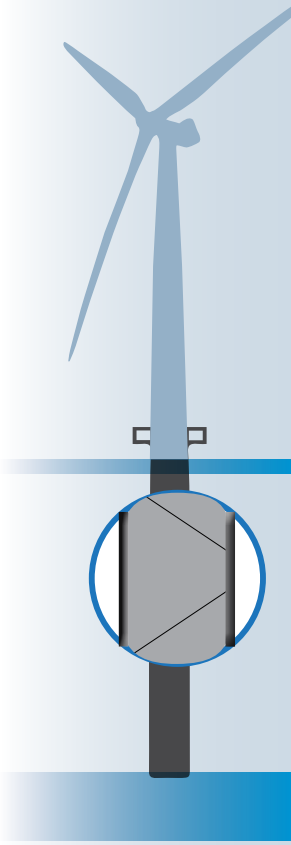
Expert Interview

RWE Innogy GmbH on Reasons for Corrosion Protection Failures



Artur Czarnecki is Civil Engineer - NSO Project at RWE Innogy GmbH and one of the expert speakers on-site this year's international conference Corrosion Protection for Offshore Wind, 28 - 30 April 2015 in Bremen.

Before Artur Czarnecki will be speaking on "Corrosion protection offshore FMEA (failure mode and effect analysis)" at the event, our very own Sara Scheuer had the chance to discuss reasons for corrosion protection failures with him in detail, to find out why corrosion protection often does not function as expected. Read the full interview here!

Sara Scheuer: You work for the "Nordsee Ost" project. Can you give us a little information on your background and explain how far you are involved with the project?

Artur Czarnecki: The function I carry out, as opposed to the title I have, is Foundation Fabrication Manager. I was the one who looked after the foundation production preparation, production planning and manufacture for RWE Innogy.

Up to this day I support the foundation structures until they are fully handed over to our operation team. During the start-up, some small modifications were required, as is to be expected, due to some mechanical damages, especially in terms of corrosion protection, which I am also in charge of.

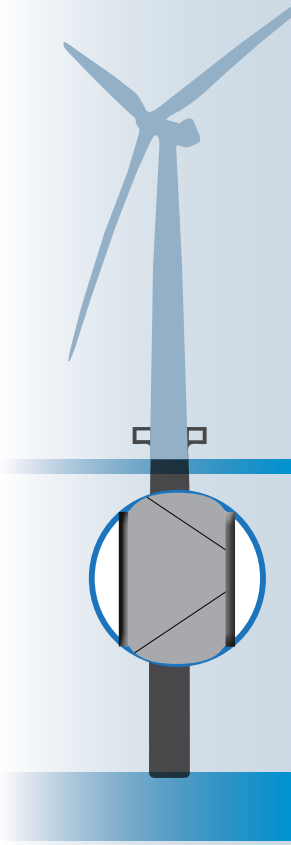
Sara Scheuer: In your opinion, what is the greatest challenge the wind industry has to face when it comes to corrosion protection?

Artur Czarnecki: There are many challenges when it comes to corrosion protection of structures exposed to the harsh offshore environment. Luckily the wind industry is not the first to enter this area and we can adopt solutions applied within the oil- and gas sector. Neverthelss, in the wind industry we are talking about serial produced components and a massive cost pressure to lower down the levelised cost of energy as a whole.

The challenging part is that the permitting body in Germany for offshore installations, Bundesamt für Schiffahrt und Hydrografie (BSH) requires an environmental impact assessment (UVS for short in German) from the project owner. Clear threshold values for pollutants or other inputs into the marine environment are not clearly defined.

The challenging part of this is that the requirements, whether this assessment is able to be approved, are not clearly defined by the appropriate authorities. Ultimately, we are asked to create an environmental impact assessment before we are able to assess whether it is at all likely that it will be approved.

Via associations we are in exchange with other companies on this issue, in order to have a common frame for the studies, so we can ascertain whether we are all working on



the same professional basis.

Sara Scheuer: What's the reason for not receiving any exact guidelines from BSH up until now?

Artur Czarnecki: Unfortunately I can only speculate. BSH has little experience of environmental impact studies and are therefore very careful and cautious when it comes to concrete specifications. This is fully understandable since we are still a young industry, and are still all collecting experience, and this applies to the authorities as much as it does to the manufacturers and investors.

Sara Scheuer: When has corrosion protection not functioned as expected? What were the reasons? And how can making the same mistakes be avoided?

Artur Czarnecki: The most important reason for serious damage to corrosion protection is in the majority of the cases errors during manufacturing. It begins with the surface finish of the steel not being correct before the paint is applied. This can be due to the manufacturing instructions at the paint fabricators being ignored at the processing plant.

A further reason is choosing the wrong corrosion protection system. This means that special ancillary components, which are large in themselves, are sometimes insufficiently coated using an incorrect system. Repairing offshore installations is a very cost intensive issue. So the manufacturer had not dealt with it or the specification was incorrect.

Another point which concerns laminate coatings is mechanical damage which is not repaired in a timely manner. If small spots are not swiftly mended, then it quickly escalates from small, local damage into large-scale damage which can cost ten times or even hundreds of times more to fix. So it is all about sensibly and quickly repairing coating damages.

Then, there's the issue of corrosion damage to supposed corrosion-resistant parts (stainless steel or other metals). In such cases, an incorrect material and/or problematic combination of materials has sometimes been chosen. Corrosion-resistant or rust-free steels of too low resistant grade are used which simply cannot hold up as they are required to do under the saline conditions.

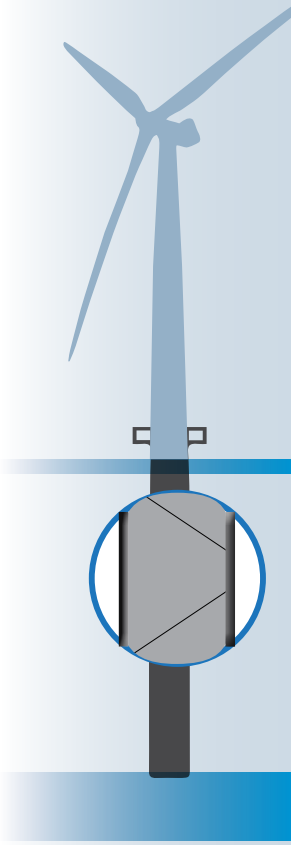
In this scenario it is often the case that grinding dust from normal steel finds its way onto the surface of the stainless steel which is then not im-mediately cleaned away. These metallic particles then cause rust build-up in situ and seed further rust throughout the stainless steel, thus it is losing its resistance to corrosion.

Another problem that causes costs is simply unawarness, e.g. by electri-cians. This is because all ancilliary components in particular installed on the transition piece must be earthed and steel structures lend themselves to having holes drilled into them and a screw or thread being inserted, so as to act as a grounding point. This is a widely occurring phenomenon.

Sara Scheuer: How can you avoid this?

Artur Czarnecki: This can be avoided by making all involved parties aware to the high corrosion potential by acts of their work.

Also small damages need to be repaired swiftly as already mentioned. Continuous monitoring of all activities and immediately intervene before something goes wrong is the key.



Sara Scheuer: And that's not really common practice already?

Artur Czarnecki: No, unfortunately not. Short cuts are made in quality assurance to save money. High costs in quality management are often seen as an indication that something isn't right. From my viewpoint, and in particular for the offshore wind industry that is a wrong conclusion. One must attain a relatively high level of quality with a relatively large amount of time and effort because we work with individual components made by craftsmen.

Sara Scheuer: When we now think in terms of basic groundwork and assume that corrosion protection begins at the design level, are there specific structures that are less badly affected by corrosion than others? For example when you think of monopile or jacket foundations?

Artur Czarnecki: There is a standard specification already present EN ISO 12944-3. This explains exactly how you should carry out a construction so that it costs as little as possible in terms of corrosion protection. This standard is not always known by the designers, regularly ignored by the workmen or even not part of the specification. That is the first big mistake.

The second large mistake which is made is that the designers weld many breakpoints, lots of fittings to the surface of a hitherto smooth plate (e.g. signage, navigation lights) and in doing so create many corners and edges on which corrosion can take hold and spread. This means that the design office needs to take more time when designing secondary and tertiary steel in order to adequately address the demands of corrosion protection.

Sara Scheuer: You mentioned that the standard specifications are often or almost always ignored?

Artur Czarnecki: I prefer to put it like this, gladly and frequently ignored.

Sara Scheuer: Gladly and frequently. What's the reason?

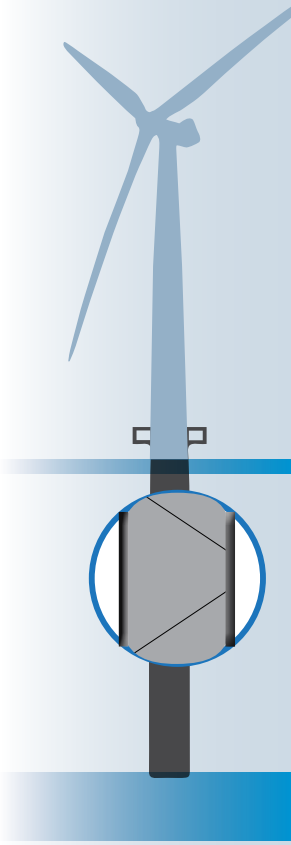
Artur Czarnecki: On one hand, it's a question of time pressure, and on the other hand, lack of knowledge on behalf of the responsible persons.

There's certainly no malign intent behind it. It is rather abstruse seeing as corrosion protection in an investment such as a wind farm is a very small expense but is not prioritised during the project implementation phase.

Sara Scheuer: Is there a specific system that you prefer for monopiles or jacket foundations for example?

Artur Czarnecki: There is no simple or general answer. In general, it could be said that from the technical point of view cathodic corrosion protection is the best choice in the submerged zone. Also, the general consensus in the industry is that underwater cathodic protection systems are the method of choice for those installations.

In oil and gas installations it's a little different, but this is due to the fact their planned period of use is considerably higher than in wind energy installations. Current designs assume that none of the offshore wind energy installations will ever physically stand on the seabed for longer than thirty years. It all comes down to the structures. In the case of more complicated structures such as jackets, with a relatively high number of tight curves, tight radii and lots of edges, one should choose products



which can be applied well and safely.

For simpler structures such as transition piece monopiles, which only have round, smooth surfaces, you can make use of products which may pose more difficulties in application but which boast better properties as part of a final product. In such cases it comes down to how strong the mechanical strain is. There are differences between the North Sea and the Baltic Sea where we must reckon with ice drift, and this demands especially hard-wearing systems.

Across-the-board you can say that duplex systems (hot sprayed or dip galvanized zinc over coated with an organic paint system) provide the best corrosion protection above the waterline according to our best current knowledge. But duplex systems are the most expensive solution.

Sara Scheuer: Can you briefly explain how the corrosion protection is looking for jacket foundations in the "Nordsee Ost" project?

Artur Czarnecki: In the underwater zone we have sacrificial anodes as passive corrosion protection which are made of an alloy of zinc and aluminium. In the splash zone (zone of fluctuating high and low water) of the main structure we have a polyester resin based thick layer system. This is applied in two layers, wet on wet, and at the end a continuous plastic coating arises even though you had used two layers. The boat landing parts are all hot dip zinc galvanised.

These parts for landing boats – the fenders below and the ladder - are additionally coated with a two-layer system and results in a duplex system. In the atmospheric zone we use a traditional three-layer epoxide based system where the top layer (the part you see) is polyurethane based because this material is simply more resistant to UV than epoxide. All secondary steel parts up top on the platform are all hot dip galvanised or made from a corresponding stainless steel. Normally they are made out of the material 1.4462 (duplex steel).

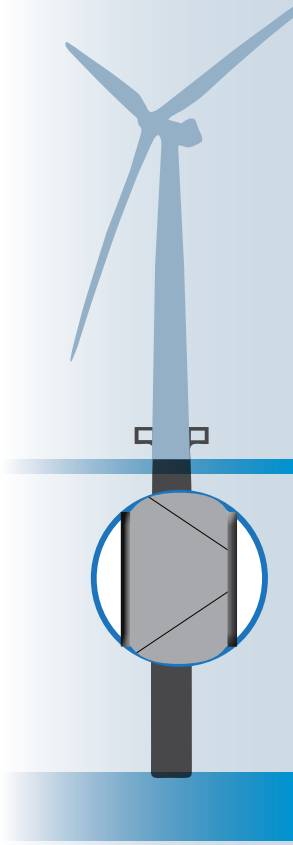
Sara Scheuer: Those are now industry standards, why are there still big surprises that arise? Such as monopiles suddenly strongly corroding from the inside?

Artur Czarnecki: Those are occurrences which are hard to get a handle on from an engineering/technical point of view, such as microbially-influenced corrosion. This is a topic which will come up in the conference.

In normal chemical corrosion you can calculate the amount of rust very accurately. In the case of microbial- or bacterial-influenced corrosion the problem arises that there are local corrosion effects which are so strong that you could easily label them as acid attacks. This is hard to predict. There are current studies on this issue and I hope that my colleagues will provide some new information in their presentations. All you can hope for is simply achieving a better planning groundwork.

Another reason, as previously mentioned, is the lack of duty of care and duty of supervision during the manufacture of the components which you don't readily see in corrosion protection. Shiny surfaces tell you nothing about the effectiveness of the corrosion protection of the system. This is why unsuitable components are installed with the result that the low quality first shows itself after a few years.

In order to prevent this happening in practice, you need to relied on supervising the corrosion protection work 100%. Supervision on the side of the manufacturer



is simply insufficient. Every component in ”Nordsee Ost” –is released to us before the coating, and if it wasn’t made available to us, then it wasn’t coated. Many companies on the market shy away from this time and effort.

Sara Scheuer: That’s quite significant.

Artur Czarnecki: Yes. For concrete results we have had two permanent staff members on location. They must of course be paid and they are highly qualified people. In busy phases, such as when working through the night is necessary, we even had four people on site so that they can work using a shift system. These sorts of quality-related costs are often avoided by some.

Sara Scheuer: Back to the conference. You have already mentioned micro-biological corrosion. What other topics do you find particularly interesting? What are you looking forward to?

Artur Czarnecki: What I’m especially looking forward to aside from microbially-influenced corrosion is the discussion involving the exchange of ideas between representatives from BSH and BAW concerning the new trend of switching to solvent-free or water-based coating systems.

Personally, and based on my experience from ship building, I am rather sceptical because these systems are very difficult and demanding to use. So I’m rather interested in what the experts from BSH and BAW will say. Hopefully there will be new insights.

And a third topic is the corrosion phenomena within monopiles we already spoke about.

Sara Scheuer: Would you please summarise once more what you will be reporting on?

Artur Czarnecki: At the conference I will present a failure mode and effect analysis (FMEA) in terms of corrosion protection with the respective people from commercial management and possible ways of introducing them into future projects.

It’s basically about making a comparison between CAPEX costs and OPEX costs and using the two intersections that arise as criteria for deciding on the correct, or appropriate, corrosion protection which can be chosen. This means that I’d like to present how the mechanisms are running, have run in the past, and whether they have run incorrectly, much like the background decision scenarios here at RWE.

To do this I will name a few examples, not just in relation to the ”Nordsee Ost” wind farm, but also to other wind installations especially in the UK. I will do this in order to raise awareness of the issue and also to give them tools to enable them to work concretely and to support their decisions and reasoning using analysis.

Sara Scheuer: Wonderful, that certainly sounds very interesting and promising. Many thanks for taking the time to speak to me.