Corrosion Damage Effects on the Structural Integrity Assessment of Offshore Structures

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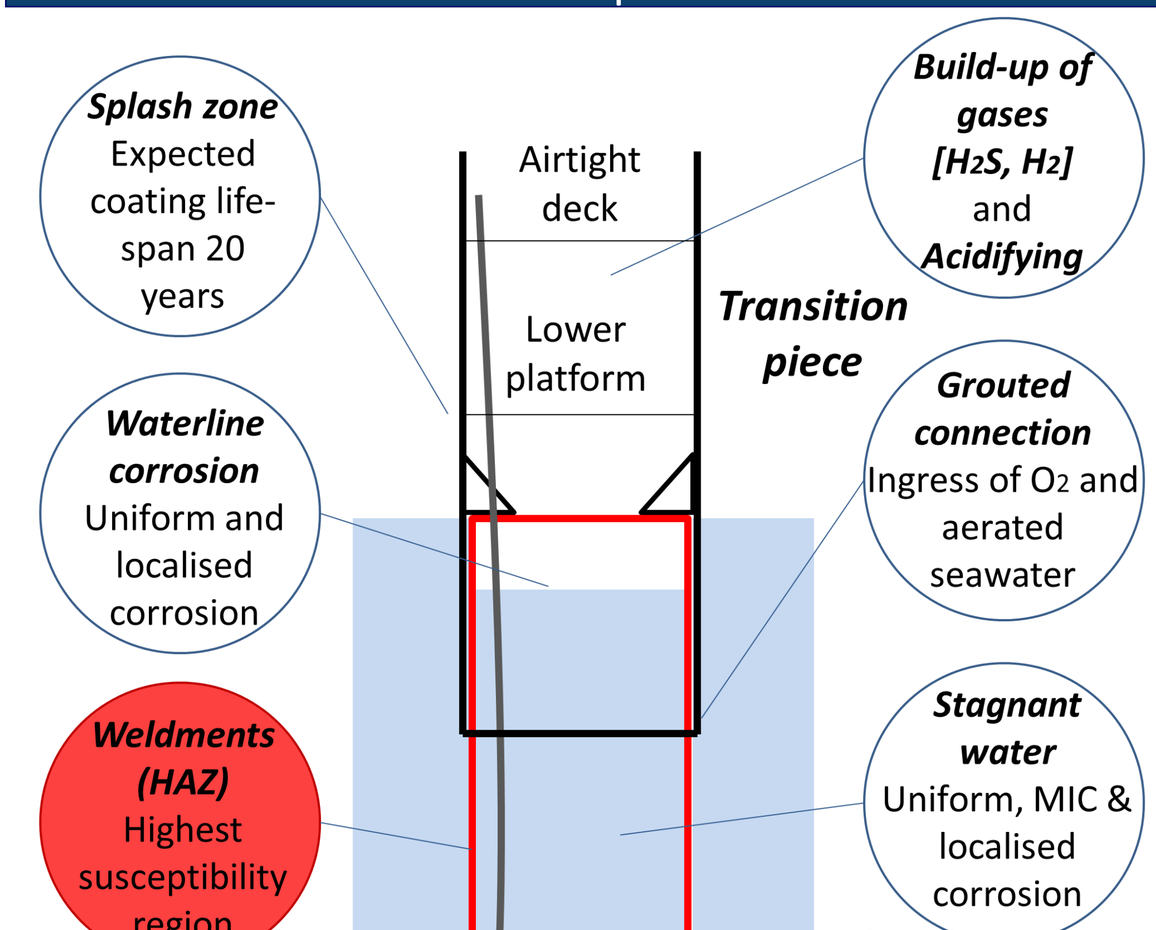
Background

One of the biggest and most expensive challenges for the offshore wind power sector is corrosion degradation of offshore structures. Many offshore wind foundations were installed with inadequate corrosion protection and remedial management plans rely heavily on practices from the oil and gas sector. These are not always appropriate given the differences in cost, damage tolerance and structural reliability between the two sectors. Consequently, suboptimal corrosion protection and management can result in unexpected failures that lower the design life, increase interventions and result in significant adverse financial consequences.

Potential Corrosion Locations in Offshore Wind Monopiles



Adapted from: Mathiesen T., Black A., Grønvold F. Presented at NACE Corrosion 2016, Paper C2016-7702 Vancouver, BC, March 2016. Monitoring and Inspection Options for Evaluating Corrosion in Offshore Wind Foundations.

Research Aim and Objectives

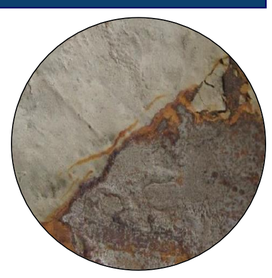
This research ***aims*** to provide a vital in-depth experimental investigation into corrosion of welded offshore structural steel S355 with further development of mathematical model to predict various corrosion processes, e.g. pitting, MIC and uniform corrosion, and remaining life of the structure.

The following ***objectives*** are identified:

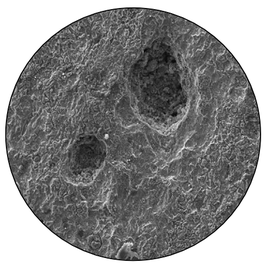
- Carry out a long-term (1 year) corrosion immersion test in natural seawater and sea-mud.
- Conduct a post-mortem examination to collect the data on corrosion behaviour.
- Perform an experimental study to compare corrosion progression in two solutions: artificial seawater (ASTM 1141) and stored natural seawater.
- Use the obtained data to predict metal deterioration and preferred location at any given time.

Area of Investigation

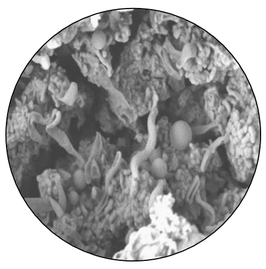
Uniform corrosion
Uniform dissolution of the metal in the environment. [1]



Pitting
Type of a localised attack when local metal dissolution leads to formation of small cavities on the surface of the metal. [2]



Microbially induced corrosion (MIC)
Type of corrosion influenced by the products of bacterial metabolism, e.g. hydrogen sulphide production by sulfate-reducing bacteria (SRB). Form of attack is often pitting. [3]



Potential corrosion locations [red on image]

- Weld, HAZ, base material
- Submerged unprotected surface of carbon steel
- Mudline corrosion

Examination of the accuracy of corrosion results obtained in simulated seawater

- Artificial seawater (ASTM 1141)
- Stored natural seawater

References

[1] Jensen, B. B. (2015). Corrosion Protection of Offshore Wind Farms, protecting internal sides of foundations. *NACE Corrosion 2015*, (Paper No. 5762), 1–12.

[2] Wang, X., & Melchers, R. E. (2017). Long-term under-deposit pitting corrosion of carbon steel pipes. *Ocean Engineering*, *133*(August 2016), 231–243.

[3] Stipaničev, M., Turcu, F., Esnault, L., Schweitzer, E. W., Kilian, R., & Basseguy, R. (2013). Corrosion behavior of carbon steel in presence of sulfate-reducing bacteria in seawater environment. *Electrochimica Acta*, *113*, 390–406.

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