

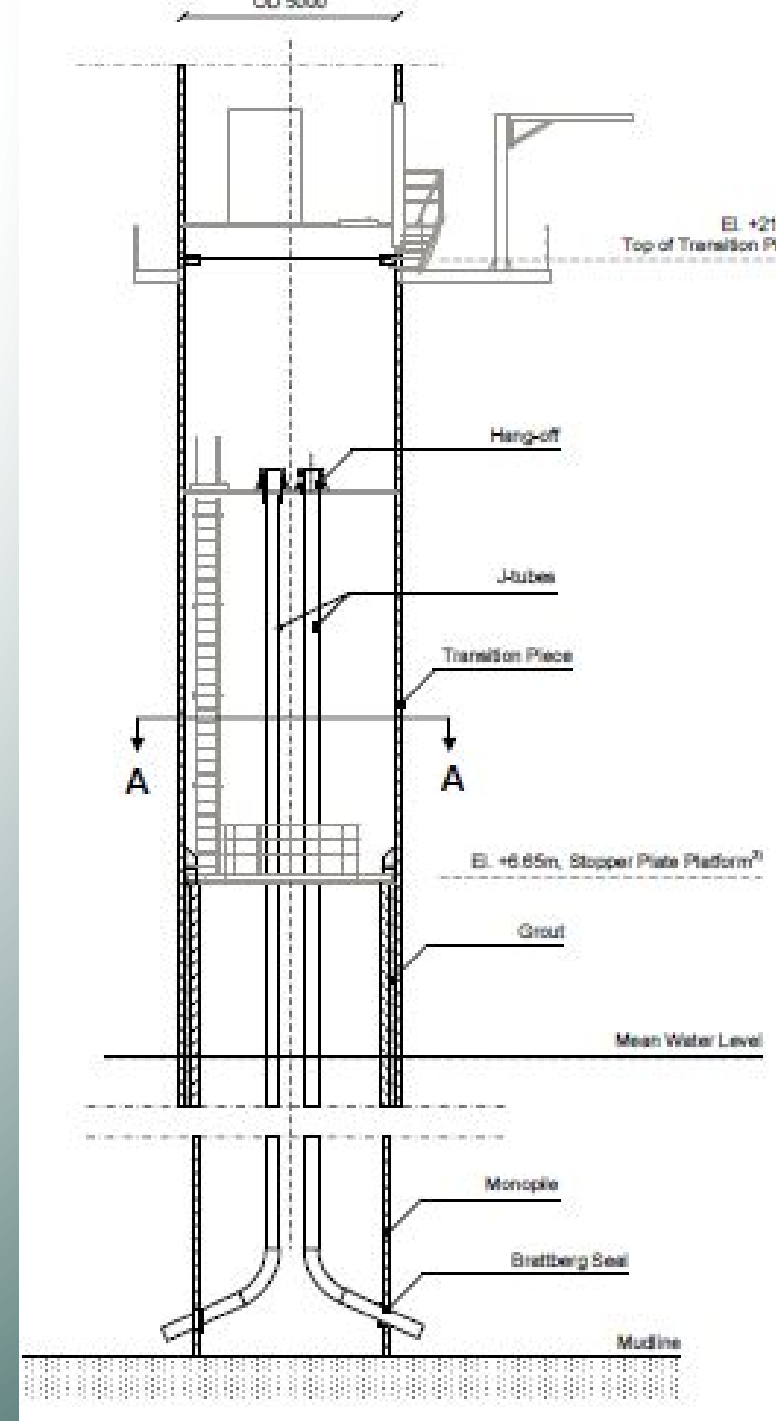
Offshore Wind Turbine Foundation

Monopile CP Retrofit Options

Deepwater Norway AS

Environmental Variables Internal

- Conditions
 - Partially filled with Static Seawater
 - Mixture of atmospheric and submerged
 - Sealed conditions or are they??



Design Codes

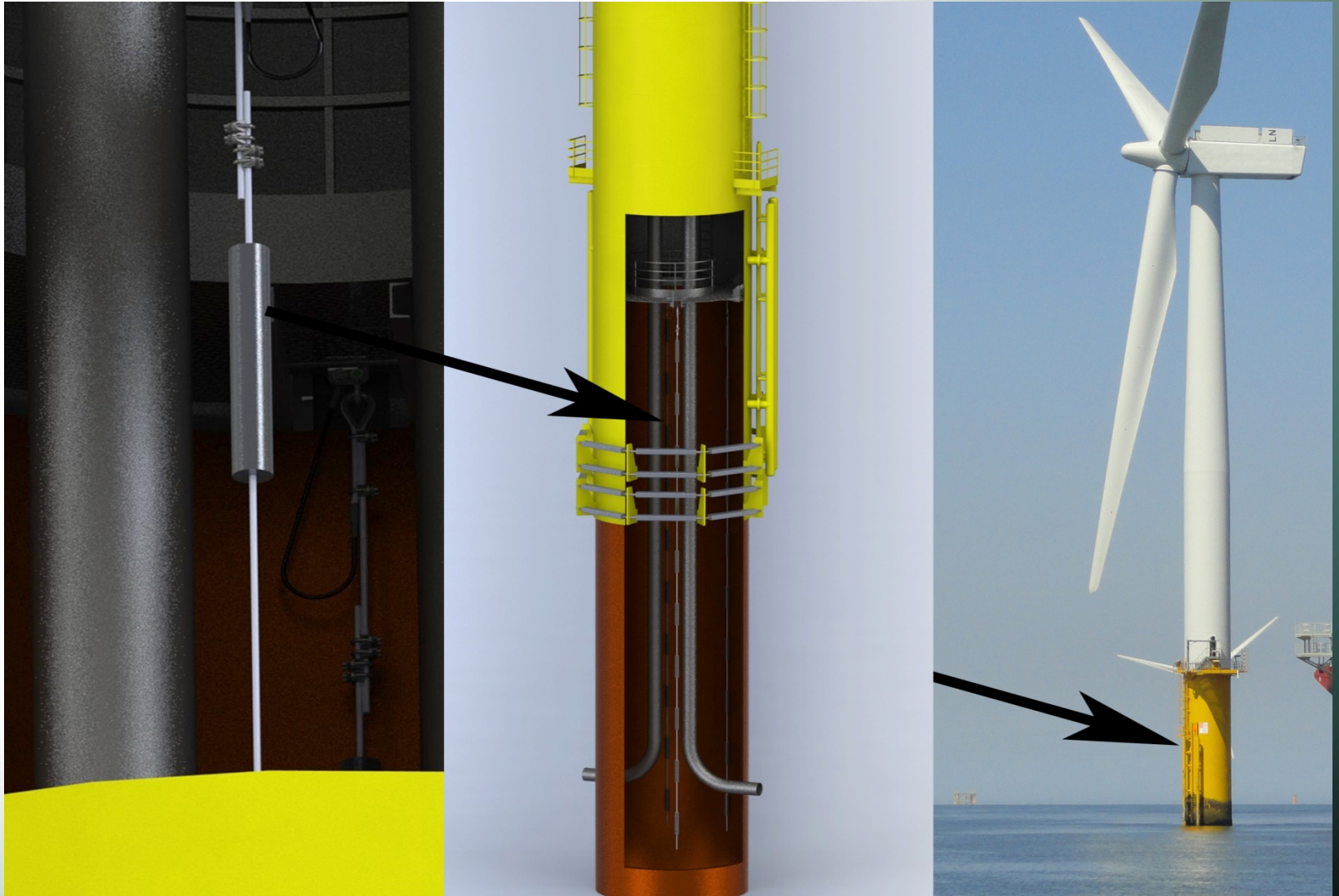
- DNV (Det Norske Veritas) Certification
- DNV OS-J101 Design of Offshore Wind Turbine Structures
- Early versions a bit vague on corrosion protection
- Later revisions of OS-J101 included improved corrosion protection/ monitoring
- Cathodic Protection refers to DNV-RP-B401
 - is this applicable??

CP Retrofit

- Need to minimise any retrospective activities
- Working inside is very difficult
- Need to Consider overall Solution including the installation
- Not just about the material costs

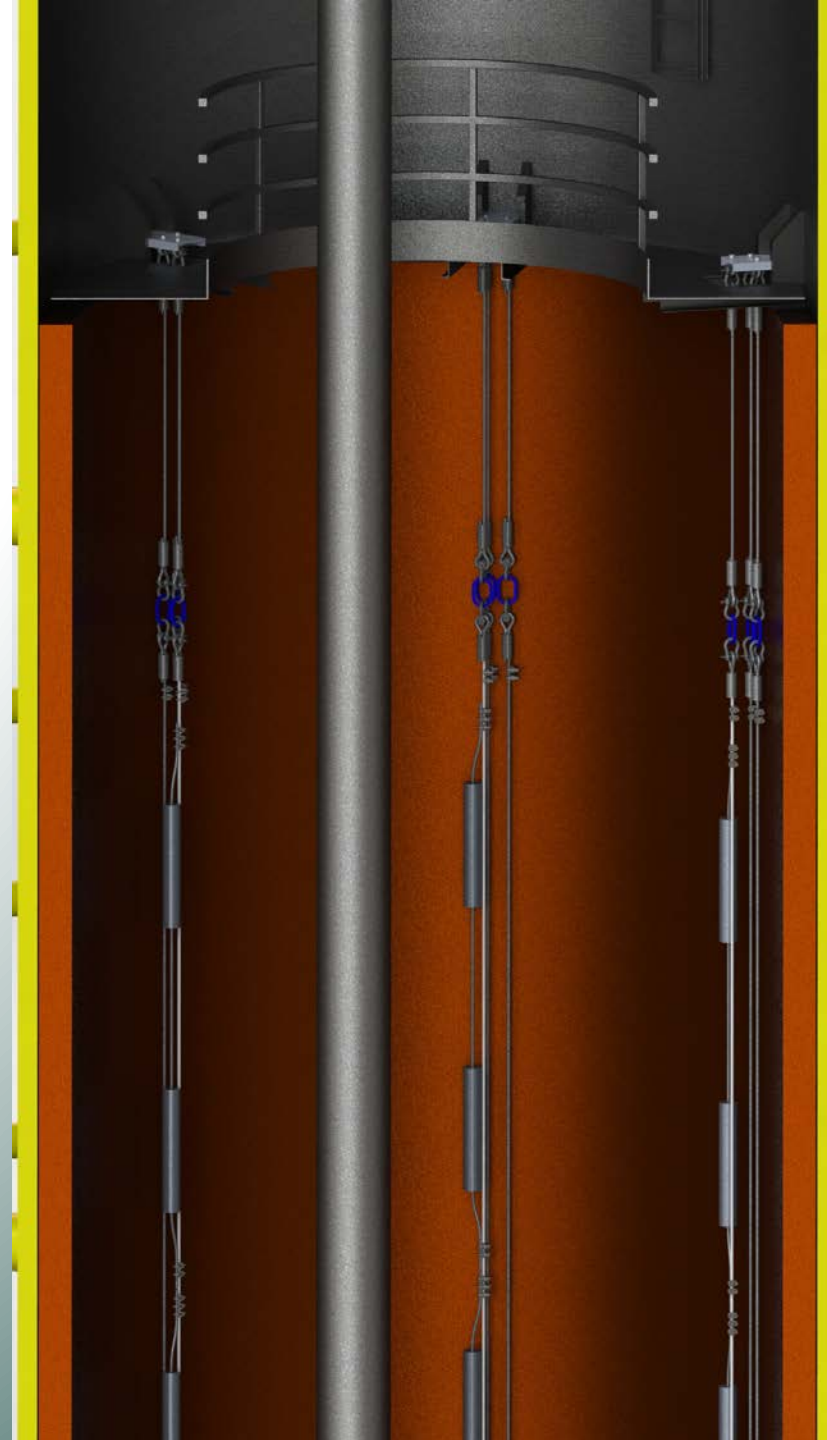


Internal CP Systems - Monopiles



Sacrificial Anode Retrofit

- RetroLink
- Simple suspended anode solution,
- Designed and engineered for durable service
- Can be customised





Up the Ladder



Vessel to Turbine Lift



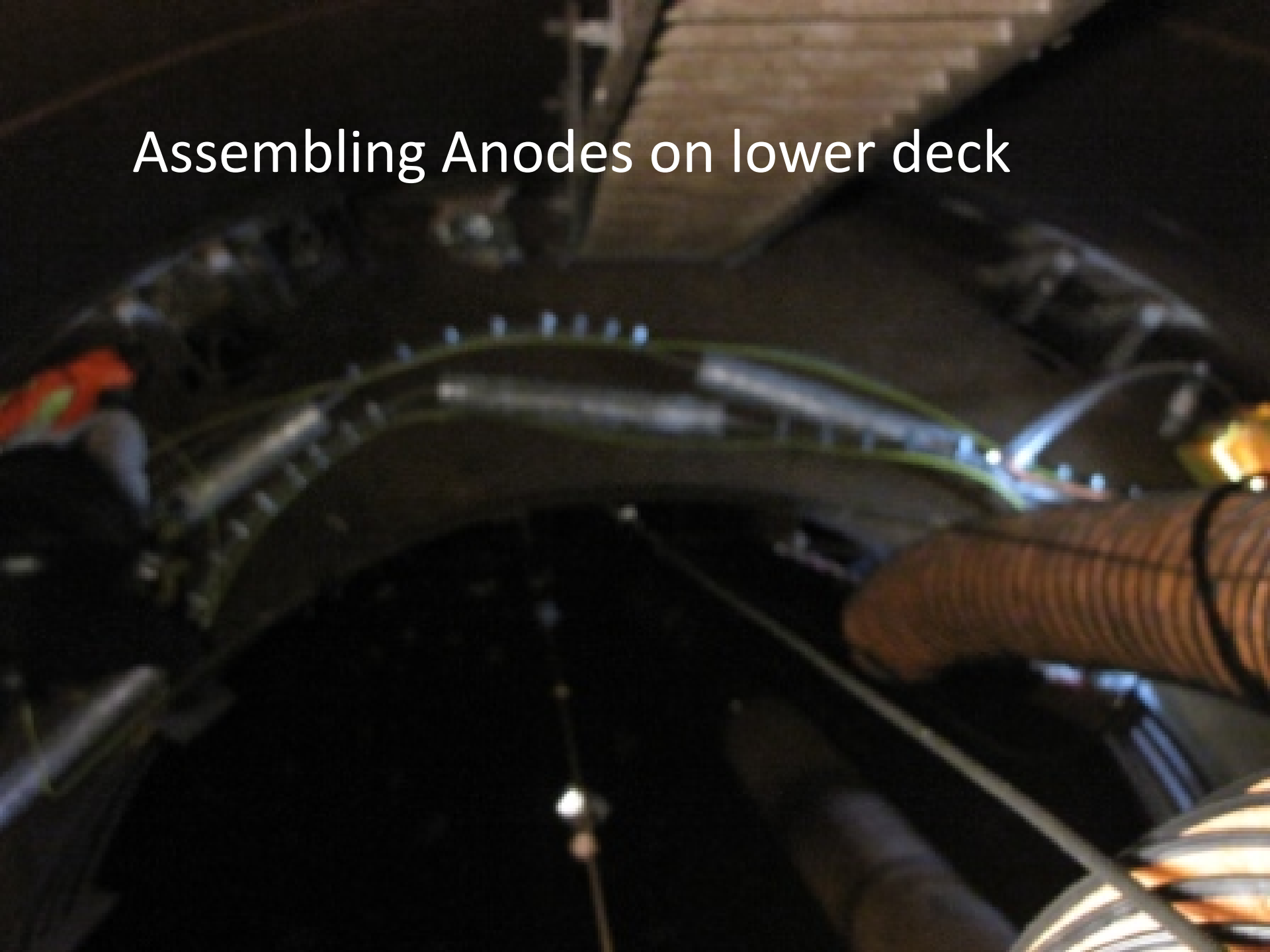
Through the Door



And Down Again



Assembling Anodes on lower deck



Ready to Lift Anodes



**Total
Anode Lift**



**Lowering
of String**



Insert Rope

- Very Expensive
- Stainless rope difficult to cast
- Over-potential issues
- Does not solve corrosion issue necessarily

Monitoring

Remote Monitoring



Current

Current Density

Hydrogen

Oxygen

Temp./RH