

HYÖTY
TUULI®



Offshore wind farm at icy conditions - Tahkoluoto

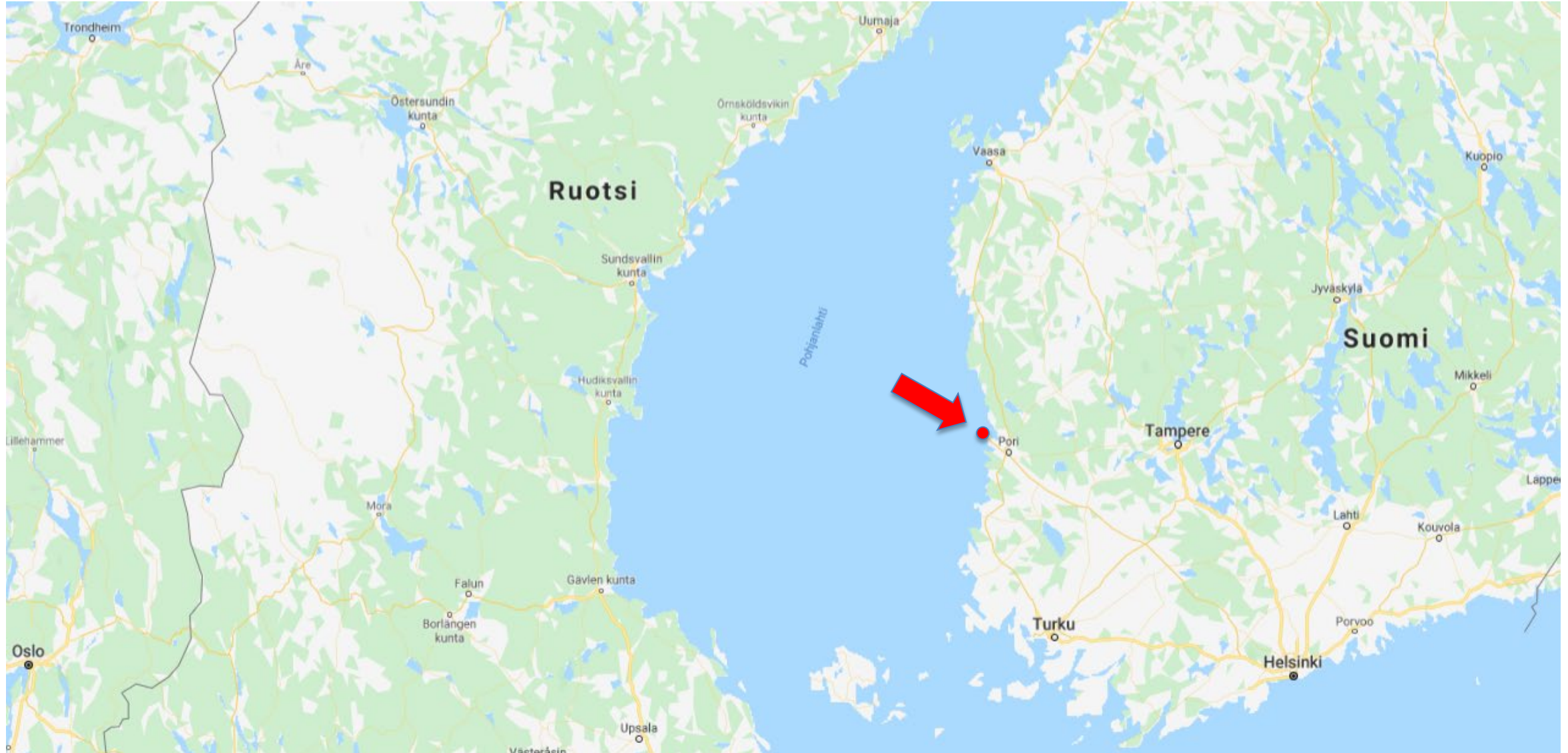
Winter Wind 2020

Outline

- Location and site conditions
- Advantages and disadvantages
- Turbine
- Gravity based steel foundation
- Ice load calculations
- Project management and schedule
- Construction phase
- Production and service
- Acces to turbines
- Questions

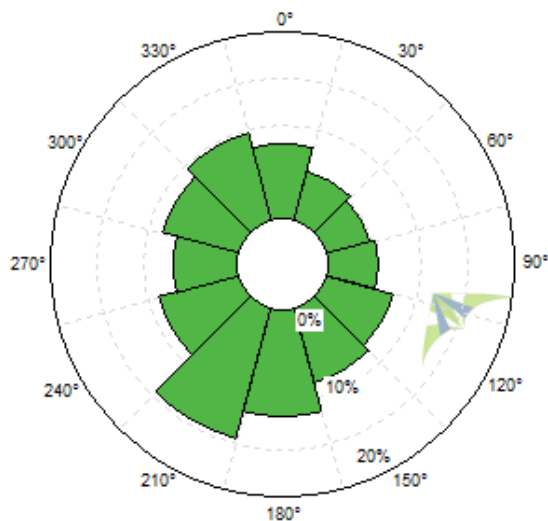


Location, Tahkoluoto, Pori, Finland



Location and site conditions

- Mean wind 8.0 m/s (HH 90m)
- Wind shear exponent 0.09
- Turbulence intensity 5.8%
- Average air density 1.243 kg/m³
- Water level max from +132 cm to min -80 cm (no significant tide)
- Temperature from +30 to -30 °C



Advantages and disadvantages

Advantage

- Kokemäki river, keep the port open from ice most of the winter
- Port of Pori, infra structure is close to site
- Grid connection, close to site
- Positive local attitude
- Sea bottom properties, bed rock close to surface (typical around 15 meter)
- Wind conditions, one of the best in Finland

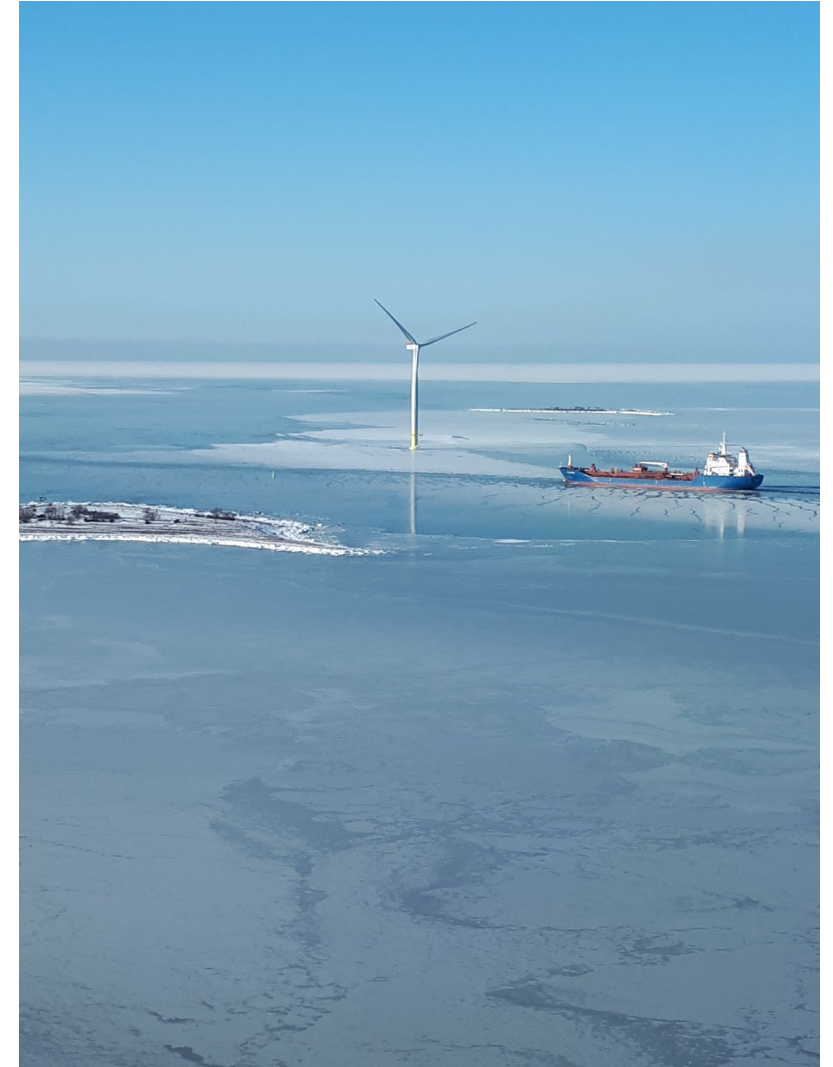
Disadvantage

- Cold climate general
- Ice loads
- Frozen sea limit the access to site
- “Classic” monopile not possible to use



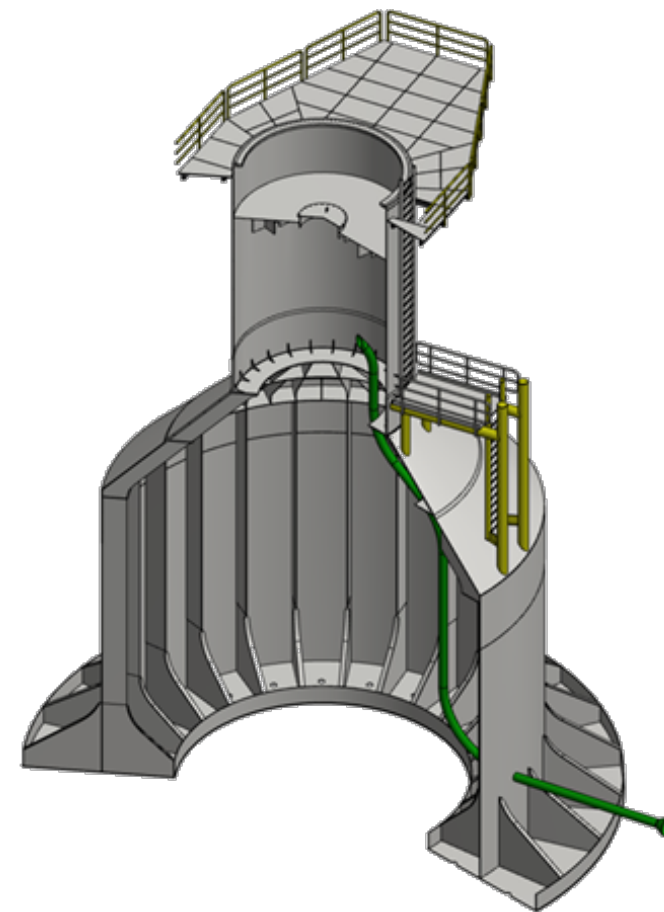
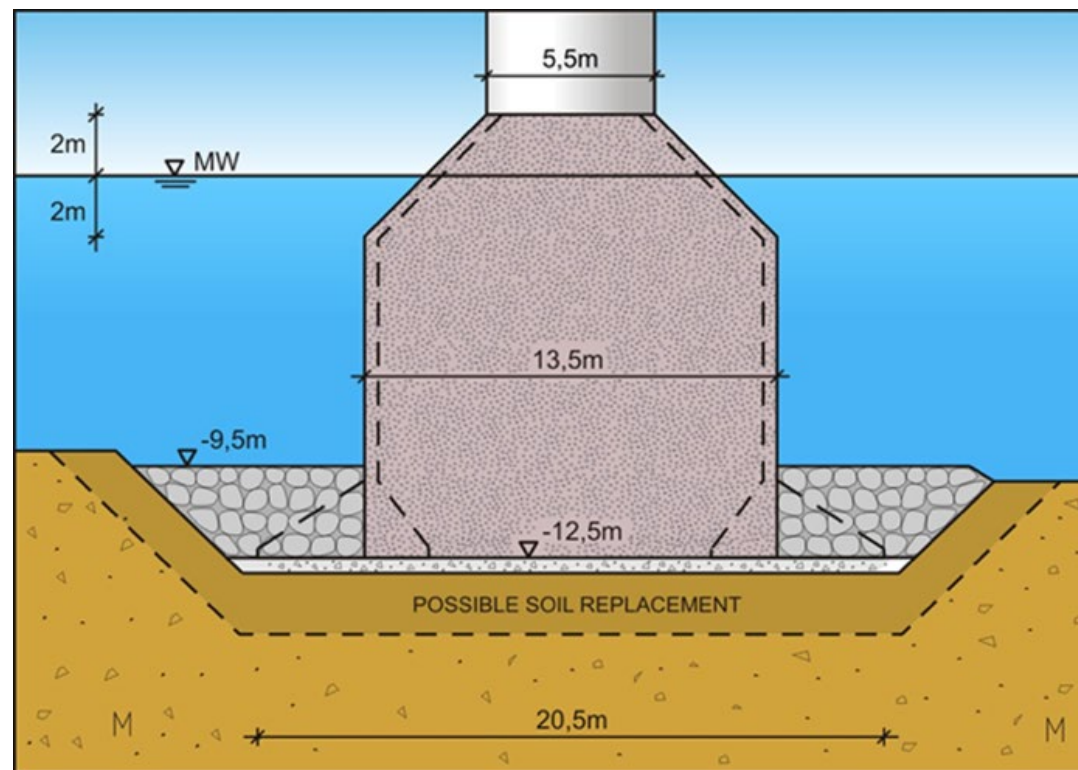
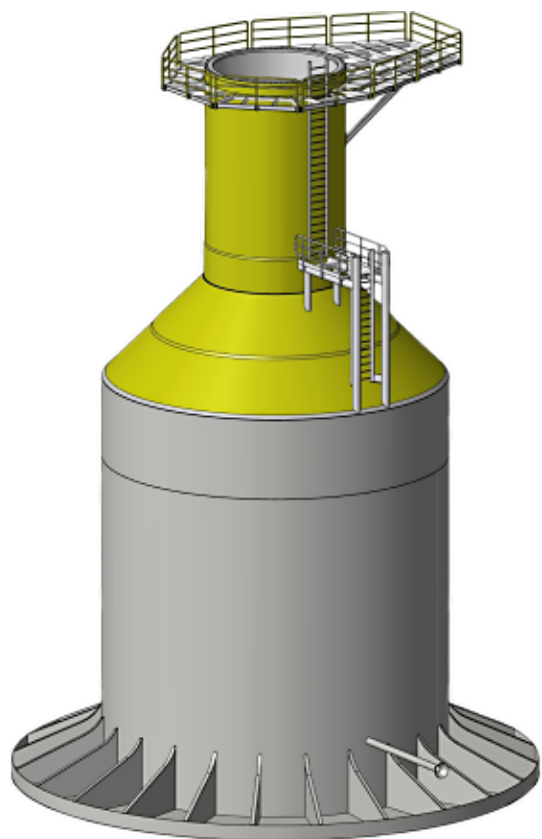
Turbine

- SWT4.2-130
- Rotor diameter 130 m
- Hub height 90,75 m
- Worldwide approx. 2000 units
- Reliability offshore
- Critical components availability
- Environmental conditions do not require heating system for blades



Gravity-based steel foundations

- The monopile was not possible to use at Tahkoluoto, because of the hard sea bottom.
- Design is owned by Suomen Hyötytuuli (Patented)

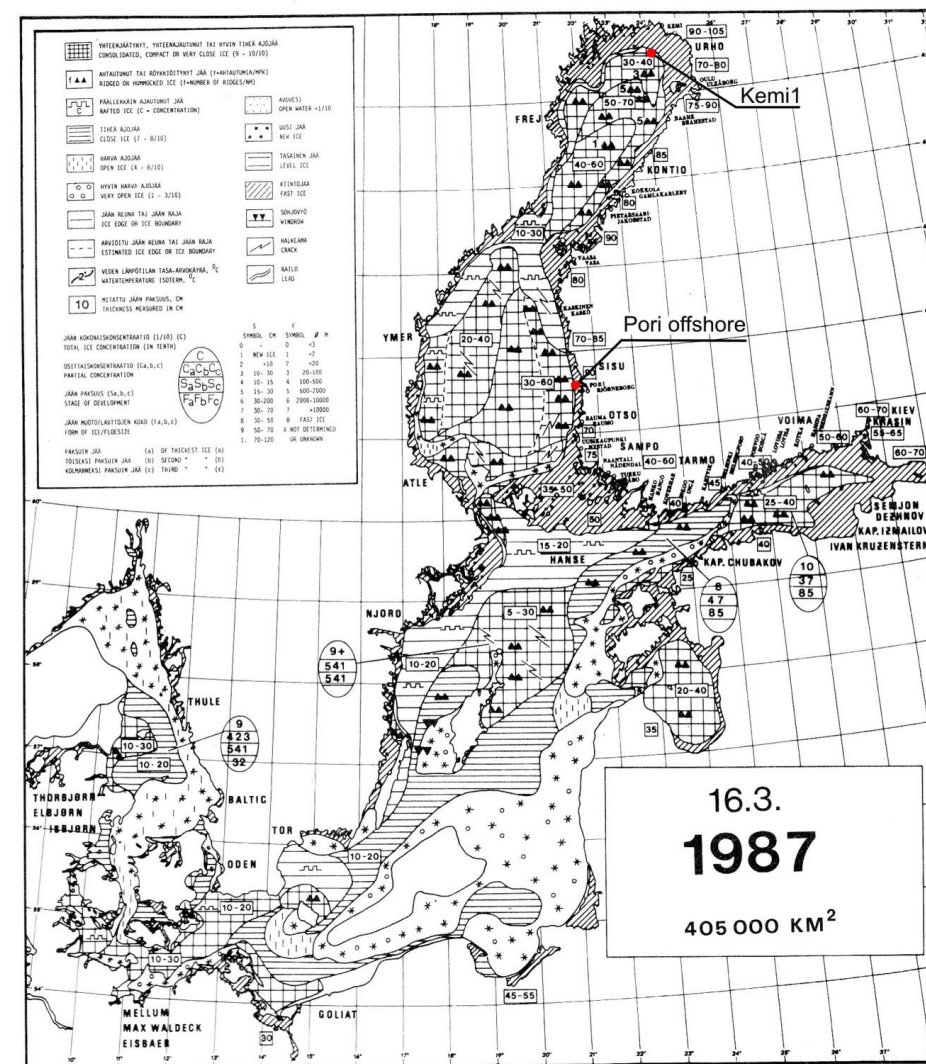


Ice load calculations

- The icing loads are necessary to take account in load calculations
- No protection of archipelago
- Open sea until the Sweden coastline
- Calculations used three different ice class

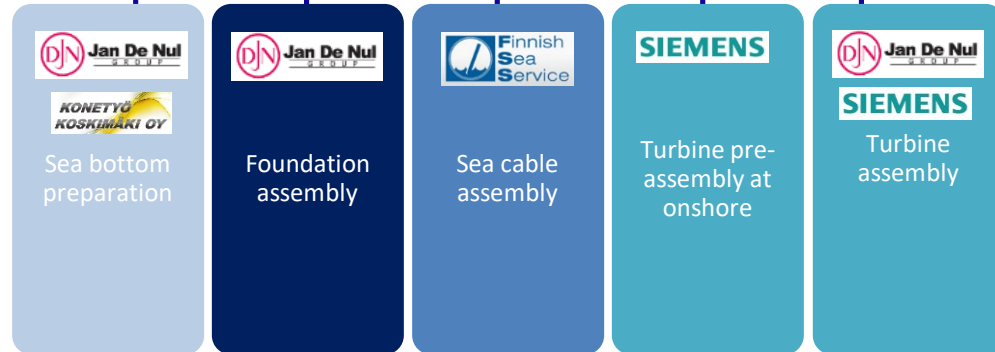
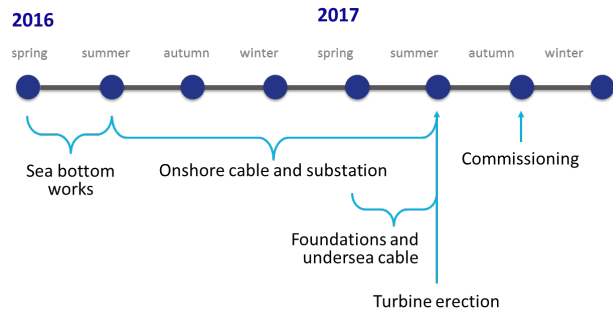


The Pori offshore pilot turbine in heavy ice in winter 2011.



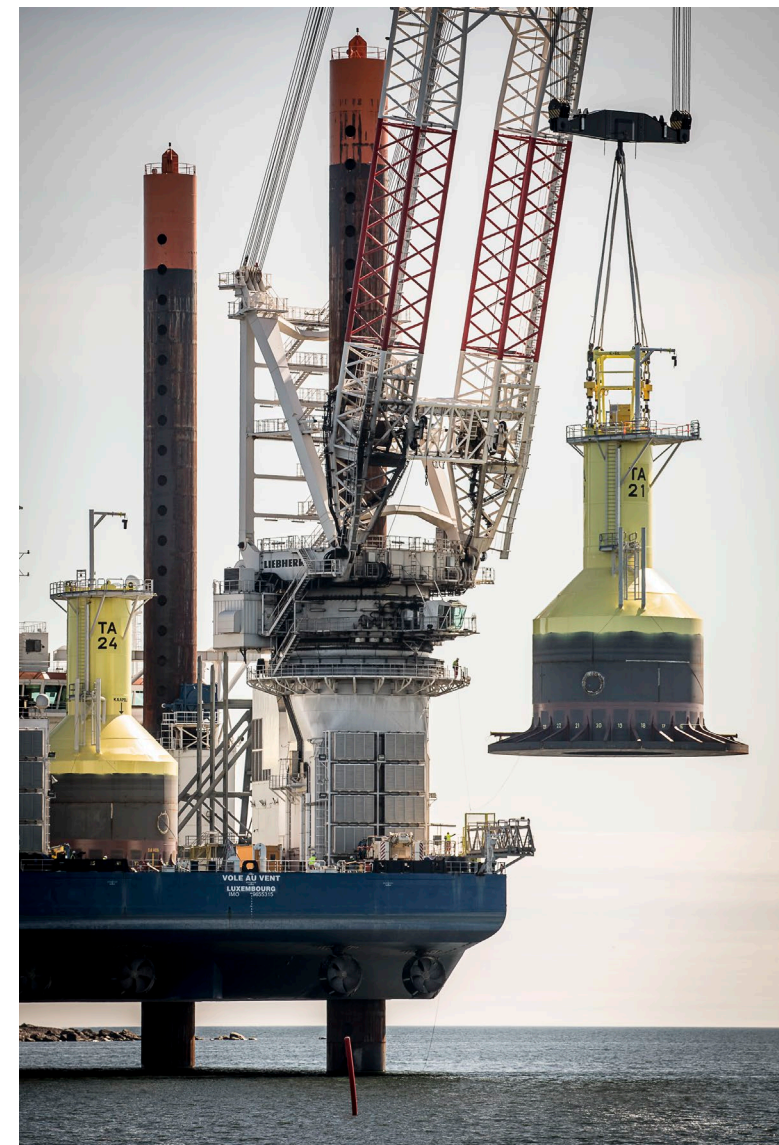
Ice conditions in the Northern Baltic Sea during in a very severe winter.

Project management and schedule



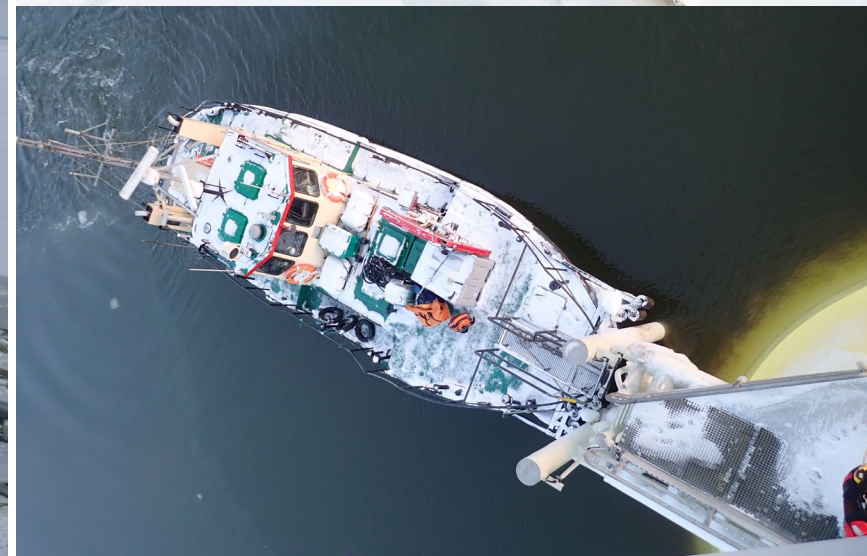
Construction phase

- Winter-time limits the available time to make sea operation
- All sea operations where done between April to October at years 2016 and 2017



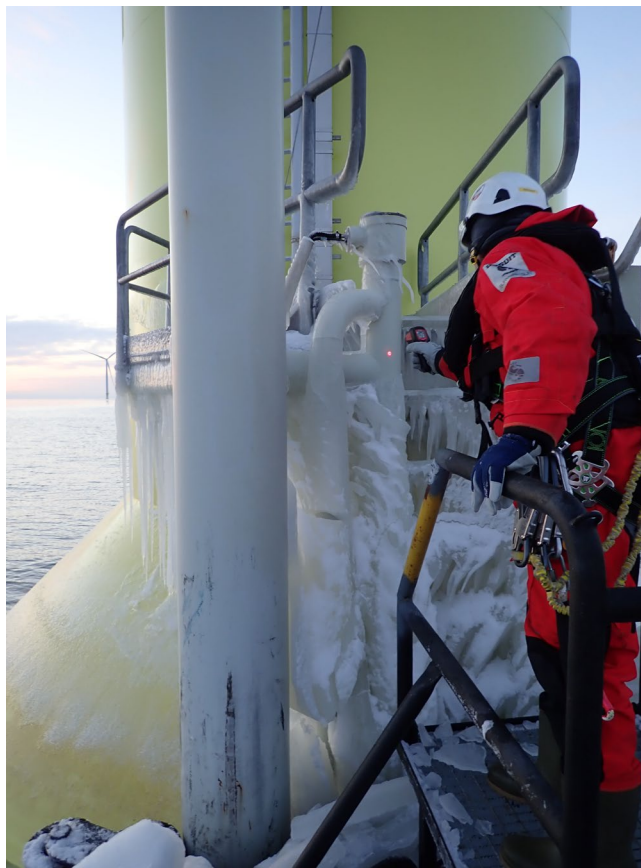
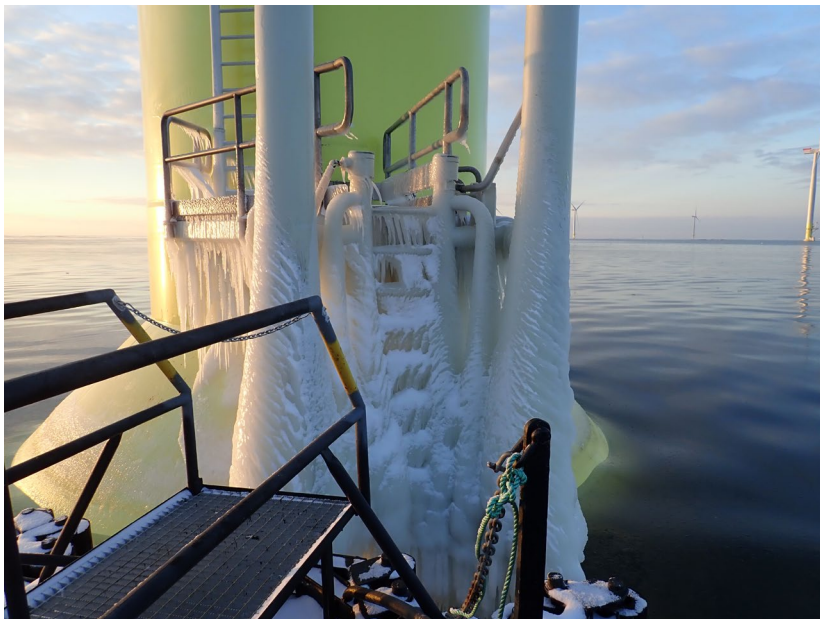
Production and service

- Operation at 2,5 year
- Serviced currently by SHT together with Pori Energia.
- Crew transfer vessel and other vessels needed at site are coming from Finnish Sea Service (FSS)
 - Vessels needs to be suitable for operating frozen sea
- No Jack-up available close by because only offshore site at Gulf of Bothnia
 - One of the main risk for production
- Port of Pori has ice breaker to support port operations



Access to turbines

- Waves and winds limits mainly the access
- Ice on port might cause problems but further at the sea the ice is not problem so often
- Boatlanding heating – system
 - ice melting from vertical tubes
 - remotely operated
 - easier ice removal
 - not to melt entire ice



Any questions?

Thank you!

Suomen Hyötytuuli Oy

jaakko.kleemola@hyotytuuli.fi

www.hyotytuuli.fi