INNTERESTING

INNOVATIVE FUTURE-PROOF TESTING METHODS FOR RELIABLE CRITICAL COMPONENTS IN WIND TURBINES

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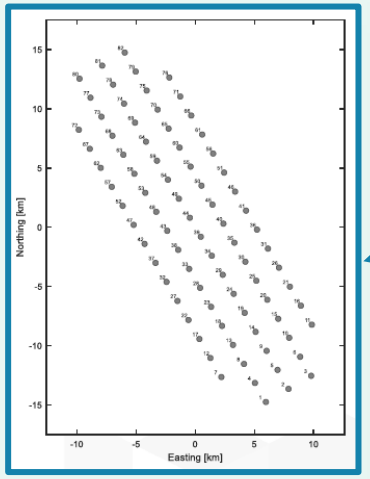
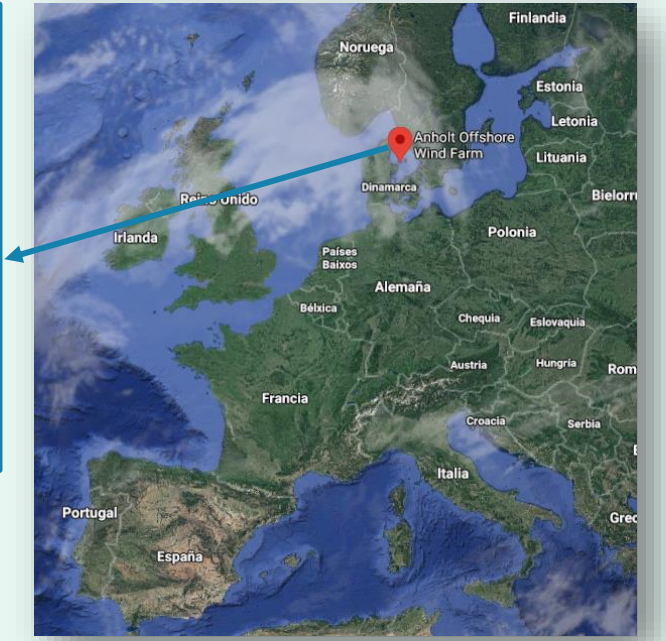
Review of the case studies

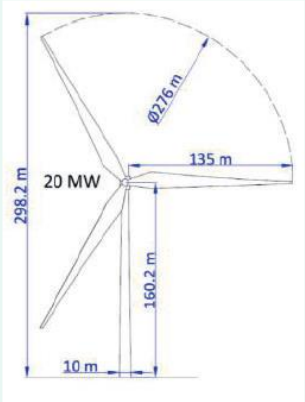
CS1Novel pitch bearing design concept for a 20 MW offshore wind turbine

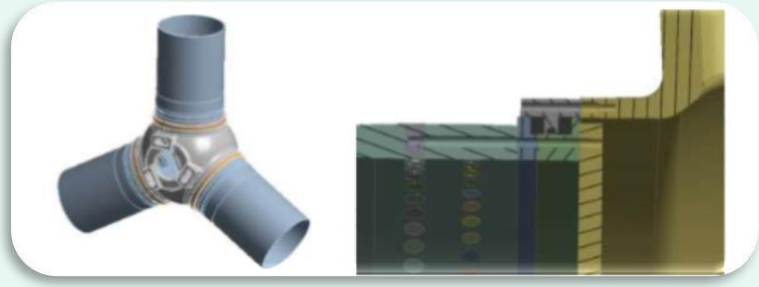
CASE STUDY 1: PITCH BEARING FOR A 20 MW OFFSHORE (2030-2050)

- CS1 is based on a pitch bearing that will be installed in a **20 MW wind turbine** from the year 2030 onwards.
- Reference wind farm with a size of **2.04 GW** and **102 turbines:** Wind farm location **Anholt Offshore Wind Farm**
- The wind turbine will be based on the 20 MW RWT (from upscaling the DTU 10MW reference wind turbine), with a hub height of 160, rotor diameter of 276 m
- Pitch bearing diameter of 7 m. and required lifetime **40 years**.
- Loads: DLCs from IEC 61400









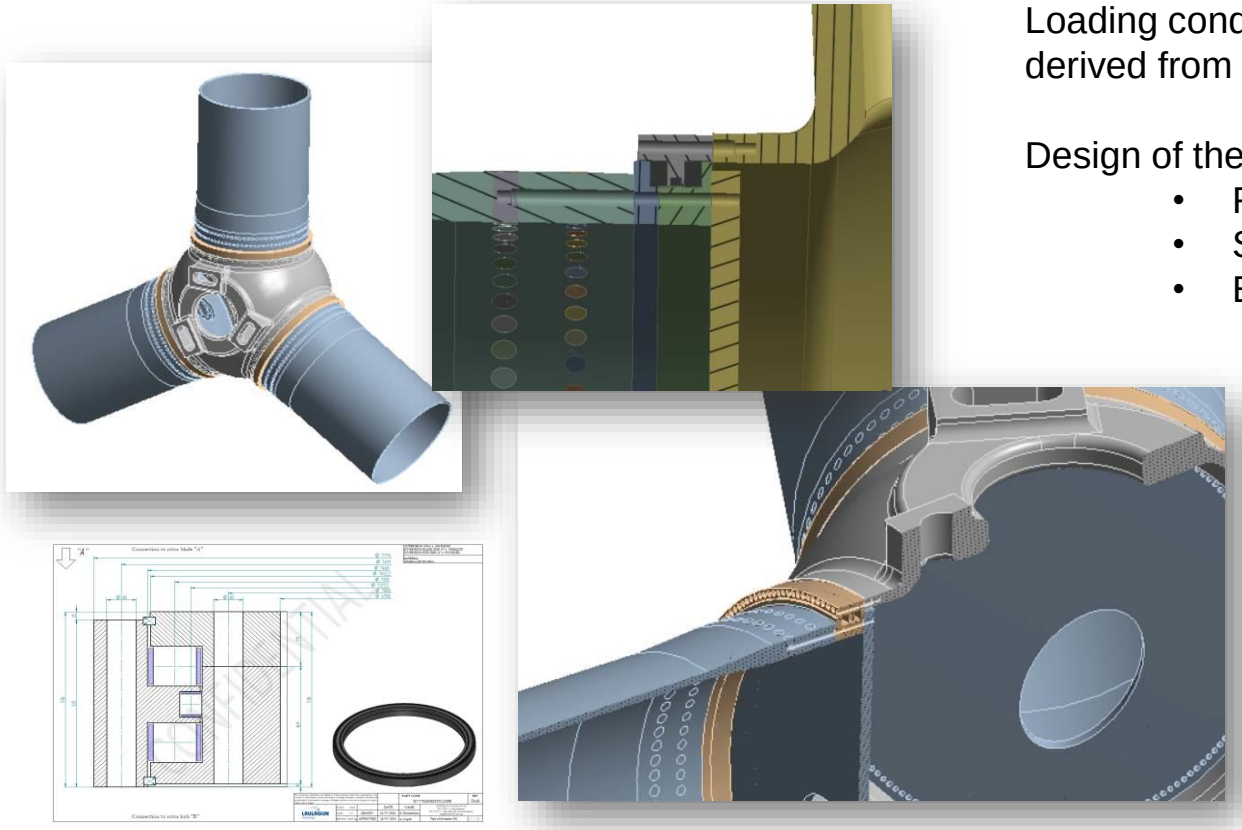
Some other environmental condition requirements are included in the next list:

- o Surrounding temperatures in the range of -30°C (243K) to +50°C (323K) and humidity up to 100% for operational conditions.
- o Surrounding temperatures in a range of -45°C (228K) to +55°C (328K) and humidity up to 100% for survival conditions.
- o Ozone and ultraviolet radiation protection.
- o Salinity: 35 mug/m3
- o Solar radiation: 1000W/m2
- o Salt, sand, and general dirt particles in the air.
- o Lightning strike possibility

The component must fulfil the regulations in force

CASE STUDY 1: PITCH BEARING DESIGN

- The **innovative rolling element concept** will try to improve and reduce the loading pressure profile on the raceway surface**.**
  - A **patent was expected before December 2020,** but finally, this idea **<u>was rejected after receiving the review from patent agents (risk foreseen in the proposal):</u>** Roller to test: optimized logarithmic profile roller.

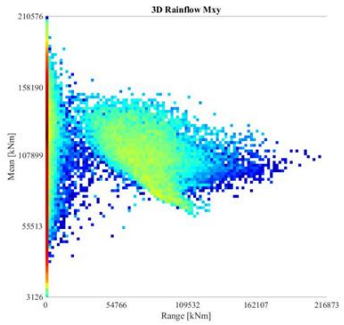


Loading conditions: using an OpenFAST model (20MW wind turbine model has been derived from upscaling the DTU 10MW reference wind turbine in the Innwind project).

Design of the bearing/hub/connections (20 MW- 7 m ∅)

- Rolling elements/ raceways
- Static/dynamic criteria
- Bolt connections (M80)

Challenge: Test Roller diameter: ∅ 125mm



Analysed failure mode is denominated as roller break

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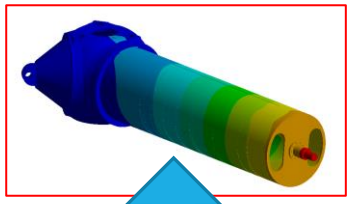
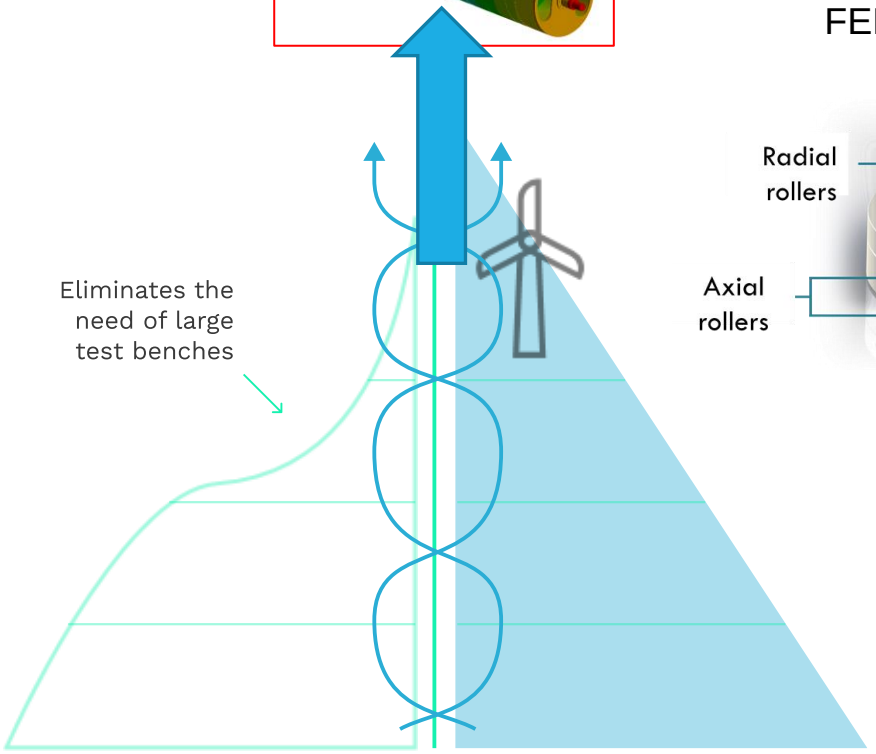
Downscaling tests:
The roller concept is validated in a 400 Tn. test bench using a simplified test. Roller ∅ 64 mm

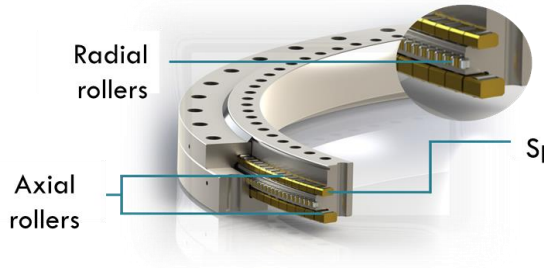
Roller to test: optimized logarithmic profile roller.

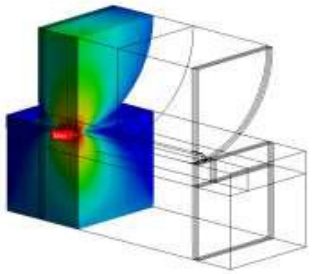
Pressure distribution
∅ 125
Upscaled models

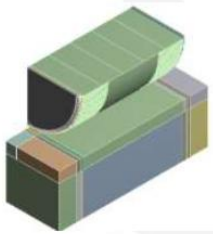




Virtual methodologies:
FEM methodology to obtain the **optimize profile**







Mono-contact model of the logarithmic roller.

CS1: INNTERESTING APPROACH

Validation INNTERESTING APPROACH Test bench (downscale) in a realistic scale: