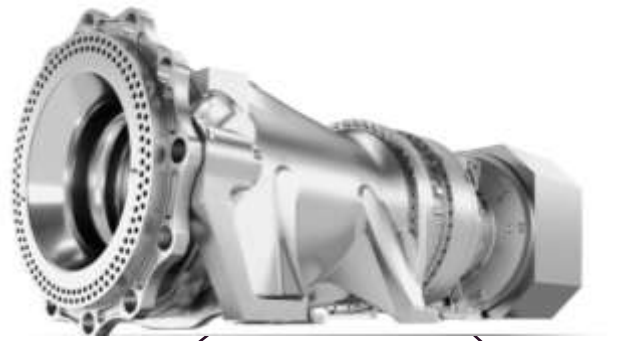


# Gearing up for cold climate validation testing of 15MW+ wind turbine drivetrains

PIETER JAN JORDAENS – PROGRAM MANAGER ON & OFFSHORE WIND

WINTERWIND 2023





©Sirris

# Joint industry innovation center

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**1,300**  
INNOVATION  
PROJECTS A YEAR

  
**>75%**  
SMES



← **sirris**



**VUB** VRIJE  
UNIVERSITEIT  
BRUSSEL

  
UNIVERSITEIT  
GENT

Wind energy knowledge & expertise network set-up in 2010

Mission: industry driven R&D and Innovation projects and initiatives

[www.owi-lab.be](http://www.owi-lab.be)

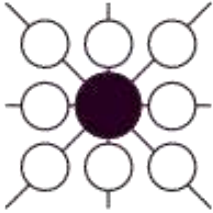
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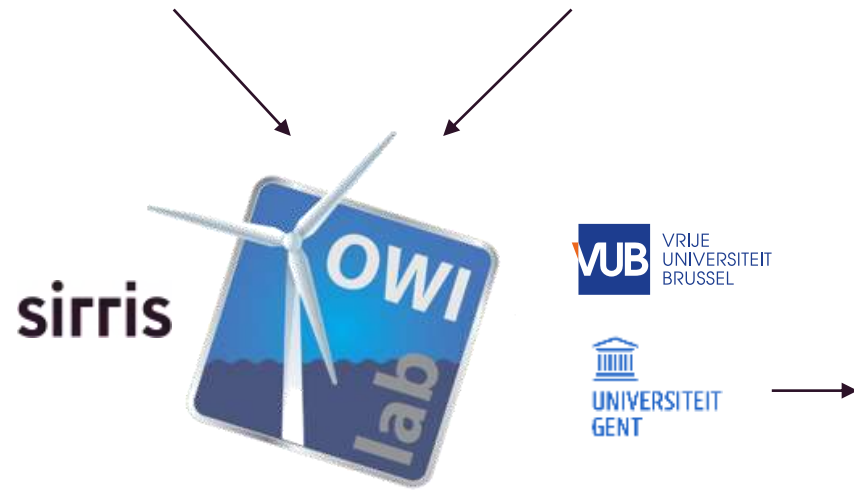
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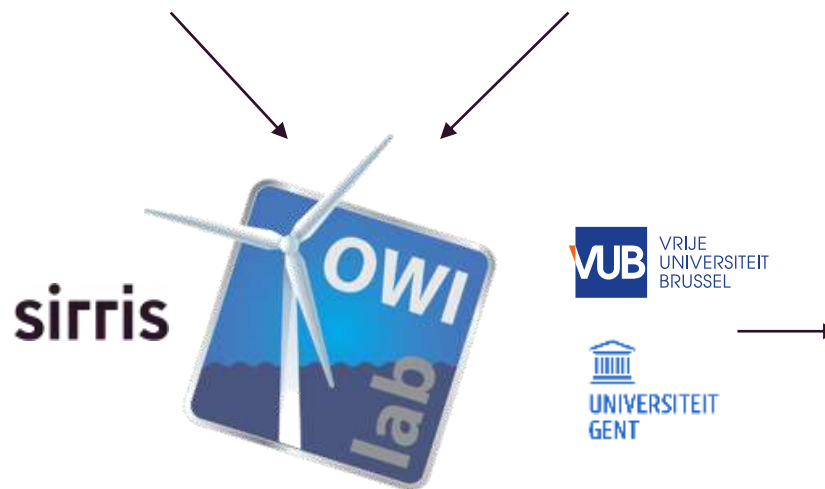
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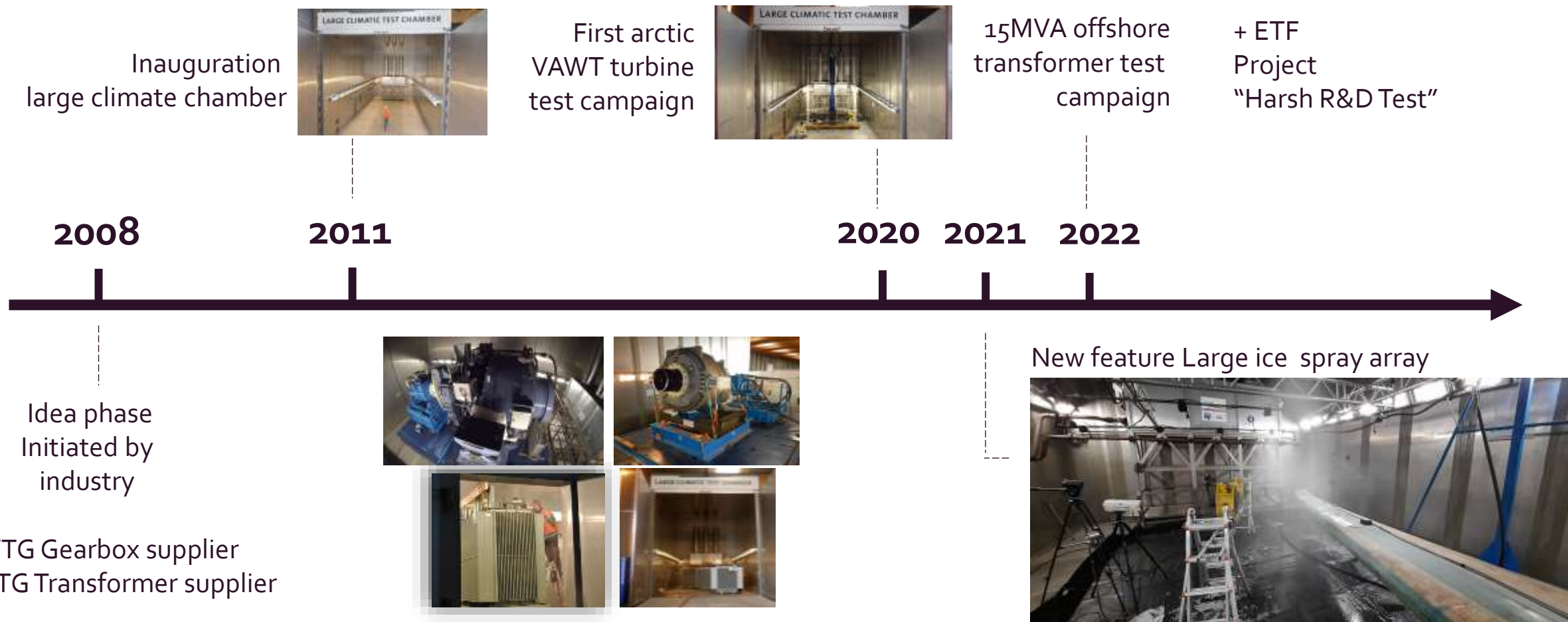


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# Time-line climatic test lab for wind turbine components



# Storyline for this presentation

## 1. AS-IS situation

## 2. TO-BE scenario's

(Developed as part of the "Harsh R&D Test project")

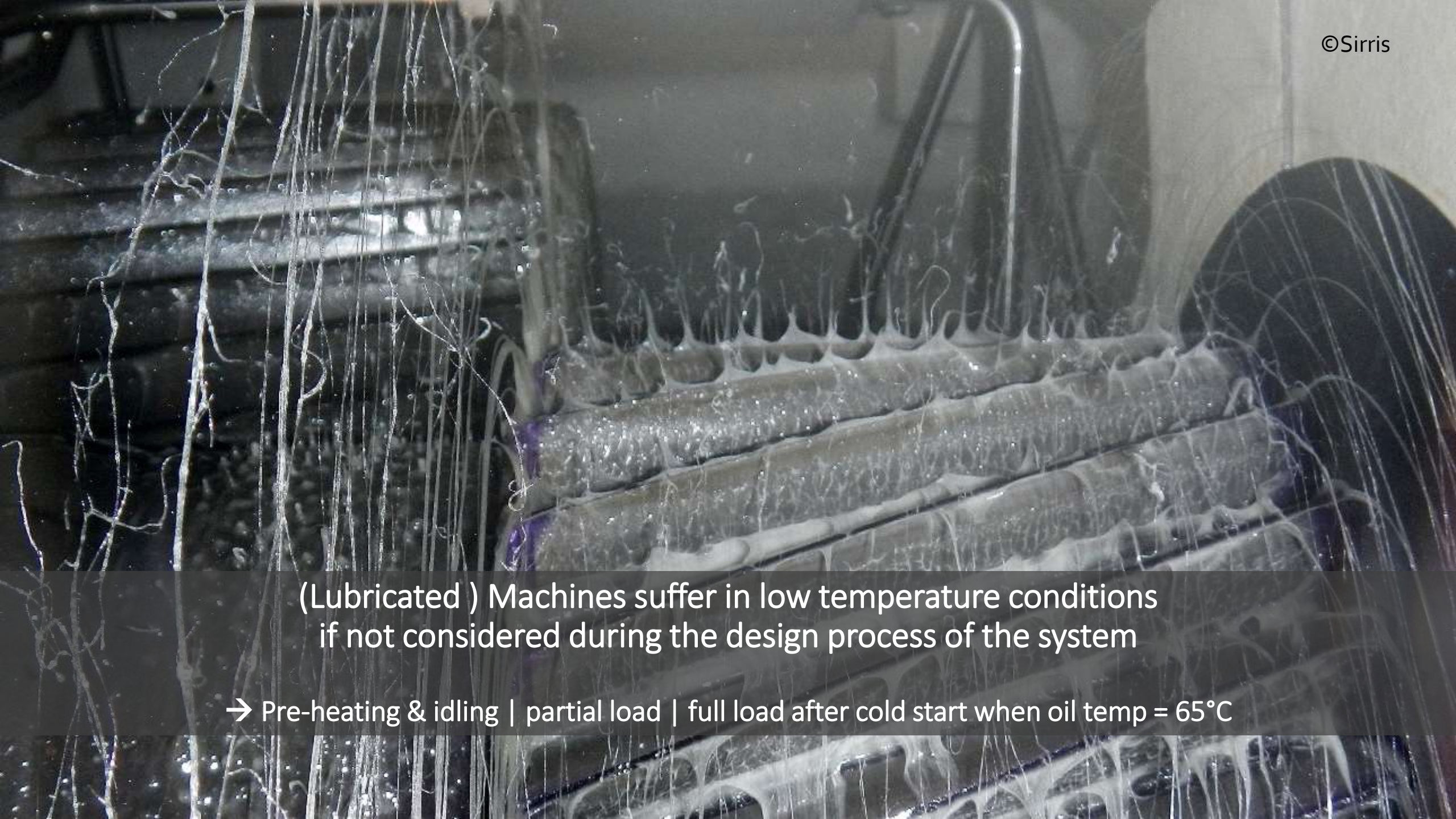
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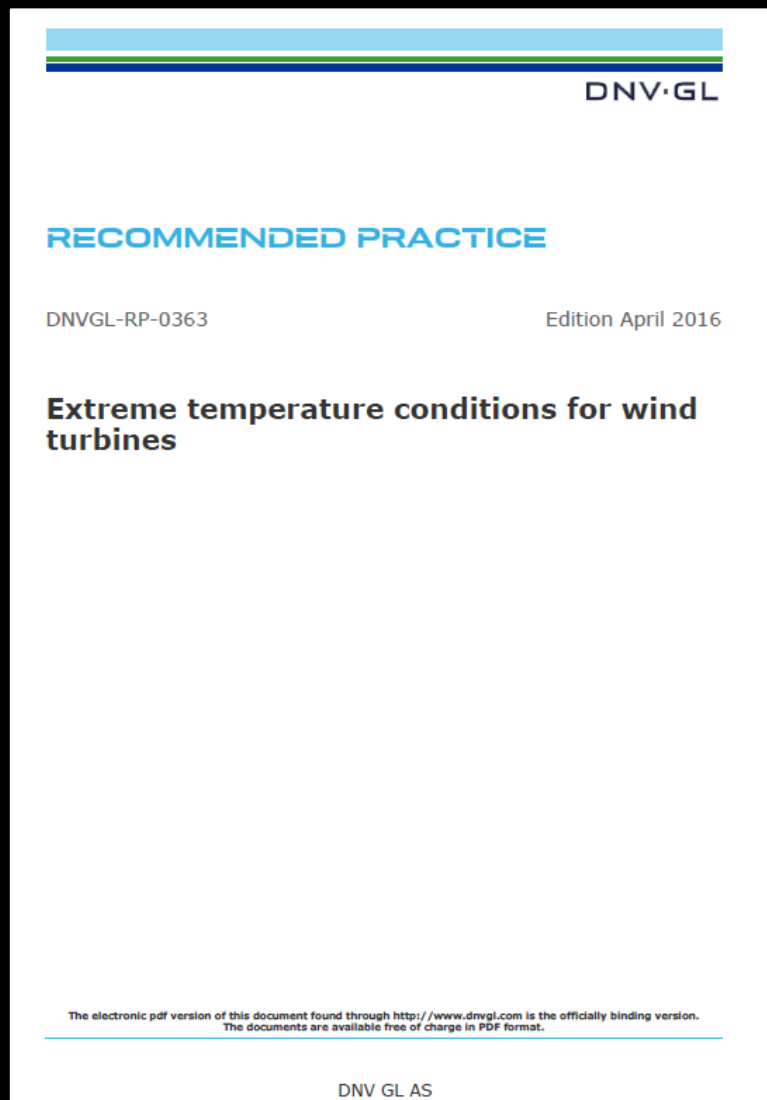




(Lubricated ) Machines suffer in low temperature conditions  
if not considered during the design process of the system

→ Pre-heating & idling | partial load | full load after cold start when oil temp = 65°C

# EXTREME CLIMATIC CONDITIONS – DESIGN & TEST GUIDELINES



DNV·GL

**RECOMMENDED PRACTICE**

DNVGL-RP-0363 Edition April 2016

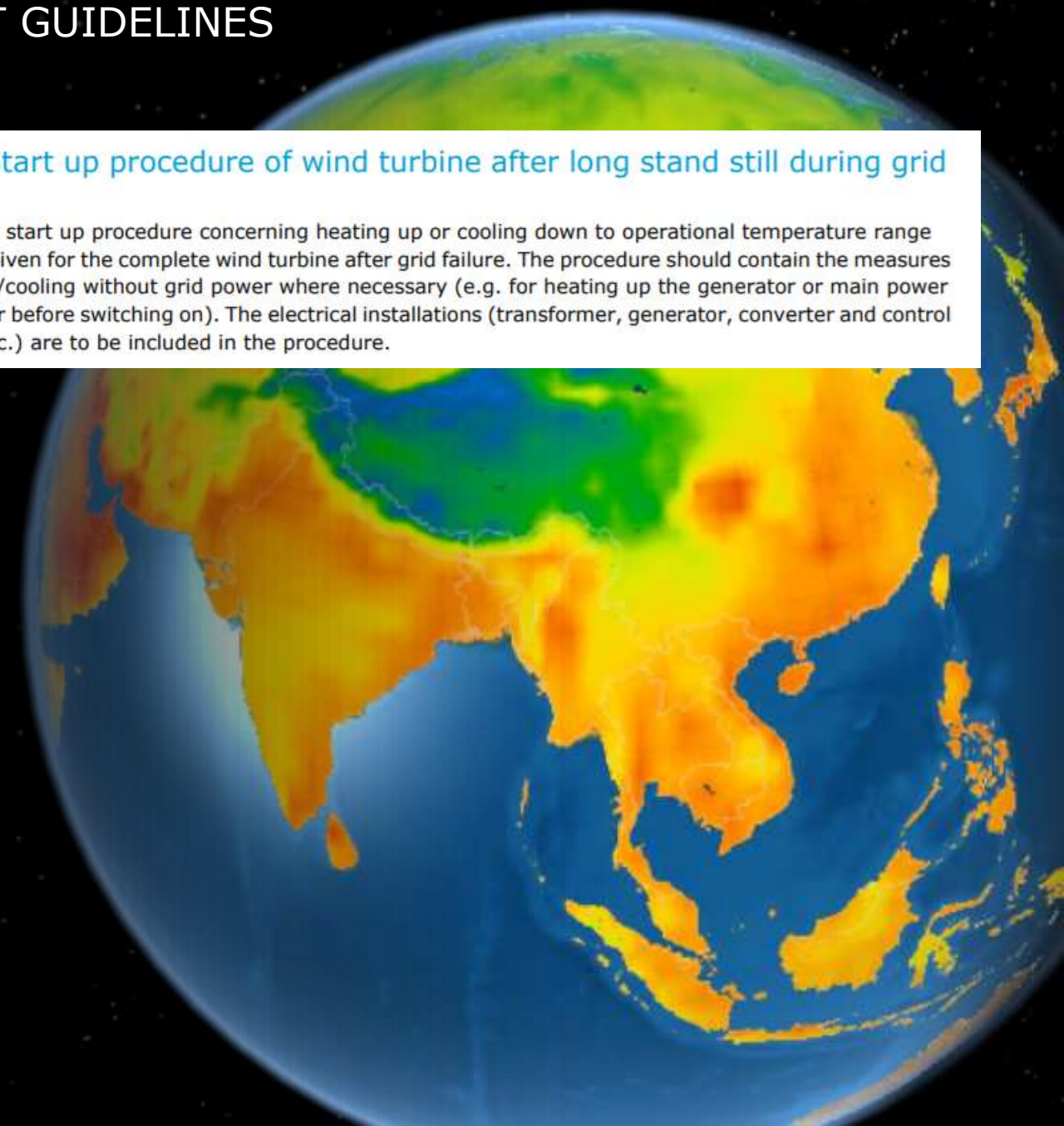
**Extreme temperature conditions for wind turbines**

The electronic pdf version of this document found through <http://www.dnvgl.com> is the officially binding version. The documents are available free of charge in PDF format.

DNV GL AS

## 8.2.2 Start up procedure of wind turbine after long stand still during grid failure

A complete start up procedure concerning heating up or cooling down to operational temperature range should be given for the complete wind turbine after grid failure. The procedure should contain the measures for heating/cooling without grid power where necessary (e.g. for heating up the generator or main power transformer before switching on). The electrical installations (transformer, generator, converter and control cabinets etc.) are to be included in the procedure.



## 4.4 Type testing

### 4.4.1 General

- 1. The purpose of type testing is to provide data needed to verify power performance, aspects that are vital to safety and need additional experimental verification, and any other aspects that cannot be reliably evaluated by analysis. Type testing comprises the elements shown in Figure 5.

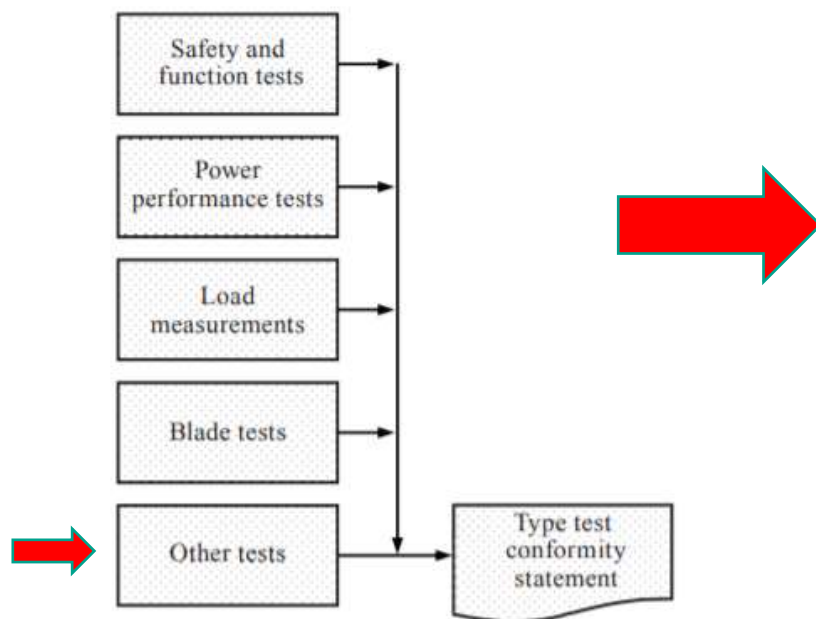
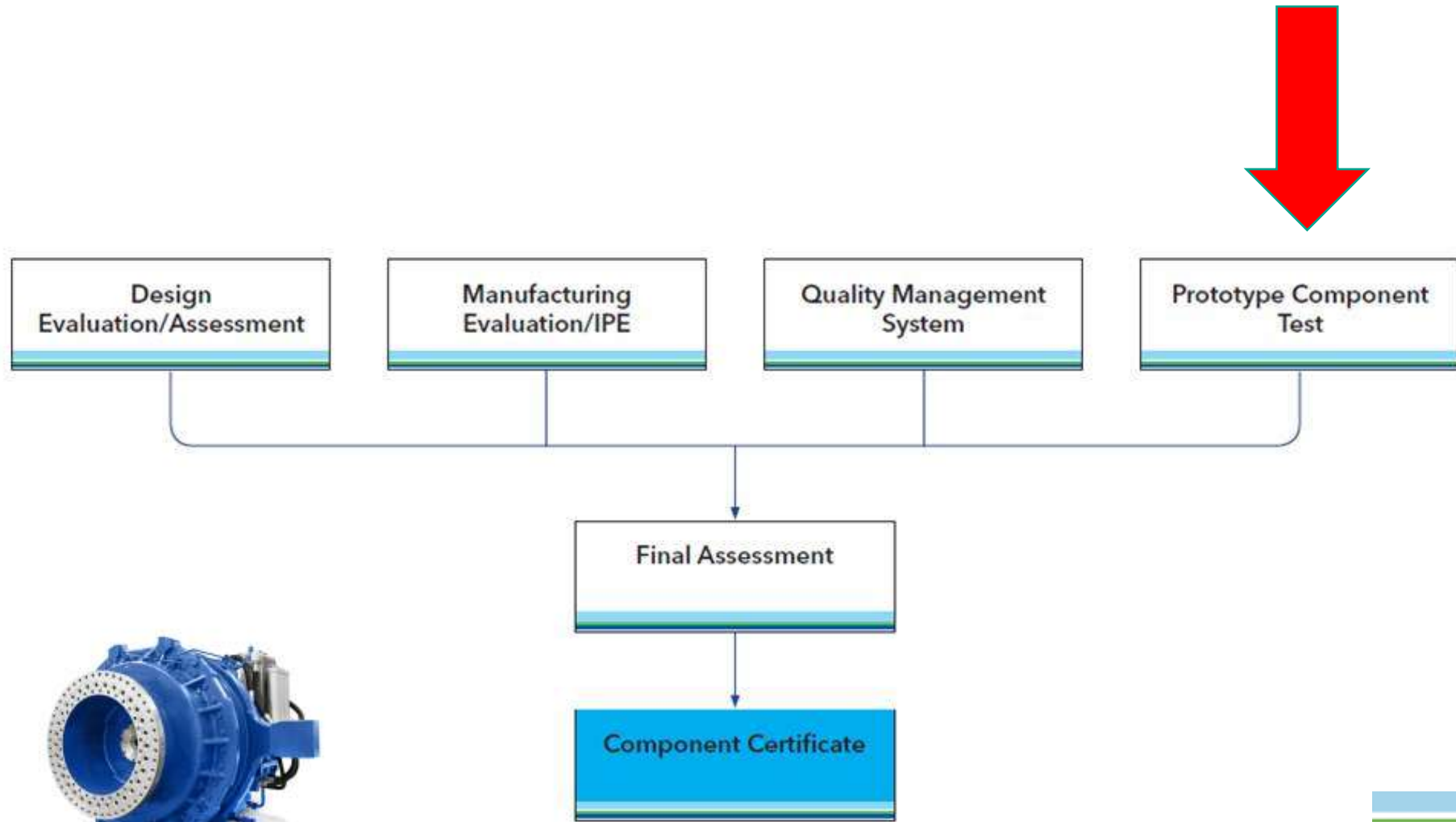


Figure 5- Type testing elements

### 4.4.6 Other tests

- 1. The Society may request the applicant to carry out additional tests or measurements if deemed necessary. The following tests may be included in additional tests or measurements:
  - (1) thermal conditions of main mechanical and electrical components;
  - (2) mechanical conditions (vibrations, clearances, response) of main mechanical and electrical components;
  - (3) environmental testing of electronic assemblies; and
  - (4) electromagnetic compatibility testing.
- 2. The type test for a wind turbine equipped with main gearbox(es) shall additionally include a field test for main gearboxes as required in ISO 81400-4 (this standard will be substituted with IEC 61400-4, when it becomes available).



<https://www.dnvgl.com/services/wind-turbine-component-certification-70120>

# LARGE CLIMATIC TEST CHAMBER



**Climatic torture chamber in Antwerp: Functional testing in extreme climatic conditions**

Cold (-60°C) | Hot (+60°C) | Thermal cycling | Humid conditions (95%RH) | IR-heat | Icing

6.15MW  
(2014)



# Cold start test offshore 6.15MW gearbox: -20°C



Known knowns: check viscosity

Known unknowns: break away torque

UnKnown unknowns:...



**SENVION**  
wind energy solutions

<https://www.owi-lab.be/ZF-wind-power>

6.XMW  
(2020)



<https://www.sirris.be/en/inspiration/zf-wind-power-subjects-6-mw-wind-turbine-components-cold-start-testing>





443.2M



EMPIRE STATE BUILDING

324M



EIFFEL TOWER

182M



STATUE OF UNITY

15MW



OFFSHORE TURBINE

260M



BIG BEN

96M



**Vestas**

VSTU 221002 B  
4506

VSTU 221001 Z  
4506

DANMARK

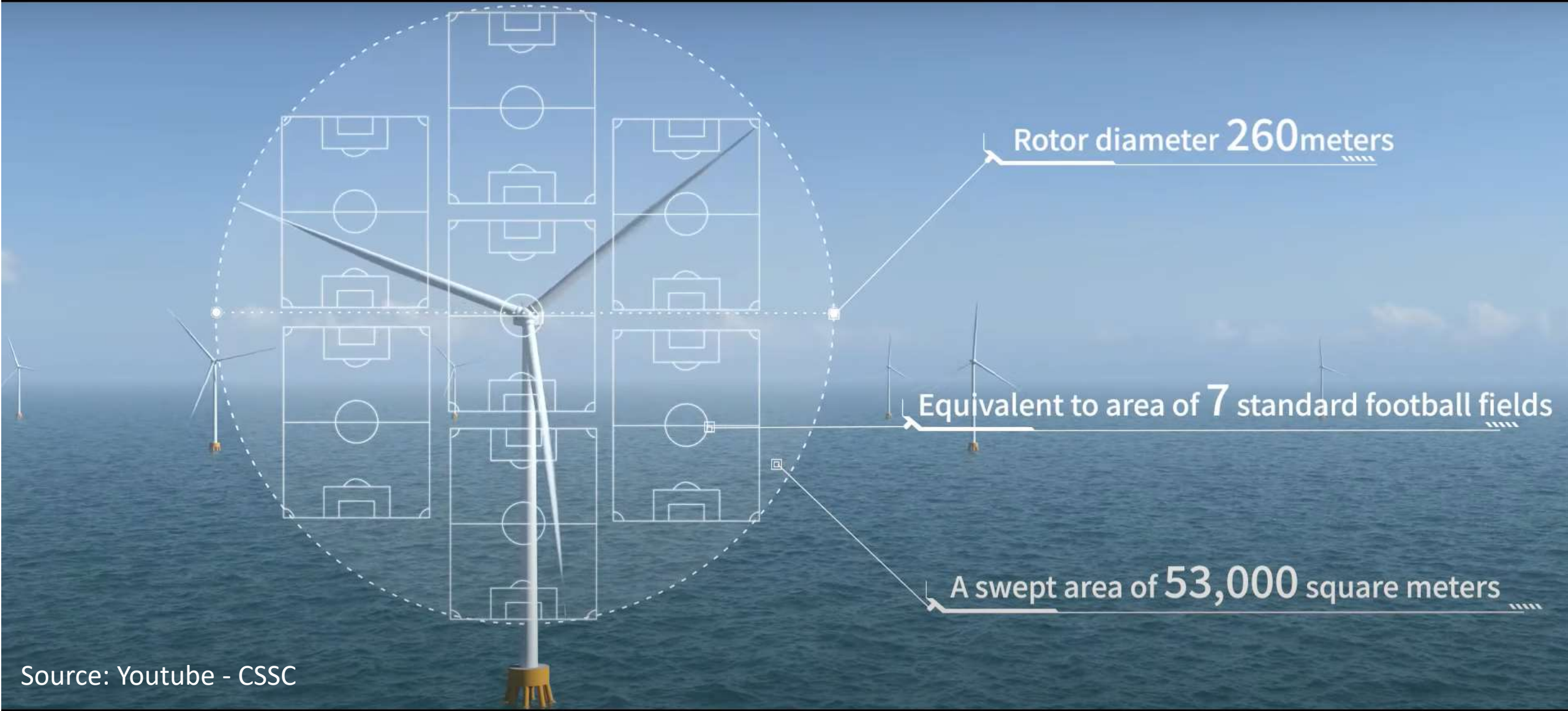
MAN

SERTRANSPORT

Source: Vestas

**15MW**

# CSSC Haizhuang H260 18MW offshore wind turbine giant emerges



Source: Youtube - CSSC

# Evolution towards 15MW+ drivetrain designs



# TO-BE Scenario's



2023: 15MW

# 27MW

Towers: 385 metres above sea level  
Rotor diameter: 320 metres



## Orsted scopes gargantuan 27MW wind turbines into Swedish offshore project

Danish utility submits environmental report for 1.5GW Skåne Havsvindpark built with turbines almost double the nameplate of the largest heading into serial production today



**Scoping Consultation Report**  
prior application for permits for installation  
and operation of the offshore wind farm  
Skåne Havsvindpark

[https://mst.dk/media/221680/report\\_scoping-consultation-report-eia-skaane-havsvindpark-07005729\\_a.pdf](https://mst.dk/media/221680/report_scoping-consultation-report-eia-skaane-havsvindpark-07005729_a.pdf)



# ETF Harsh R&D Test project: offshore temp conditions

EVALUATION OF REAL LIFE SCENARIO'S AND TRANSLATION INTO RELEVANT TEST PROCEDURES

## Cooling power need?

2m/s & 30m/s



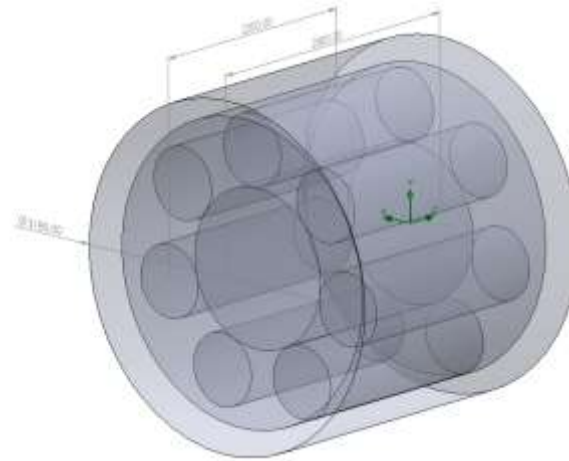
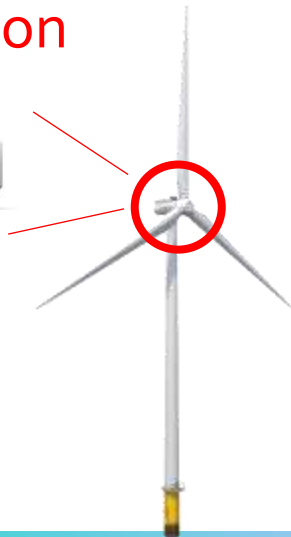
-20°C



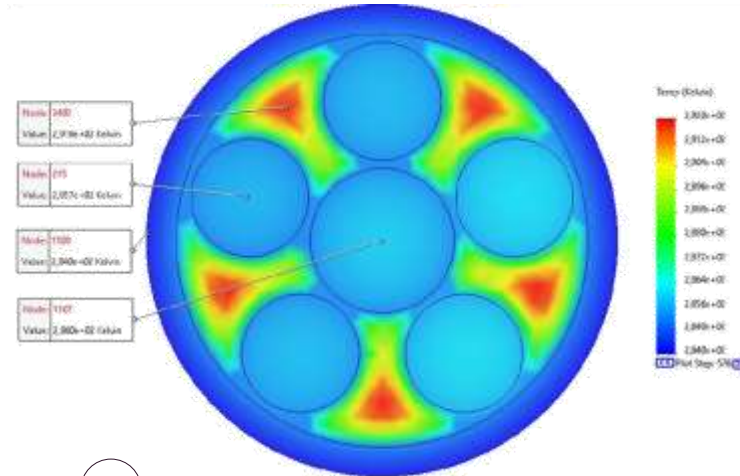
15MW  
200 ton



X days ?

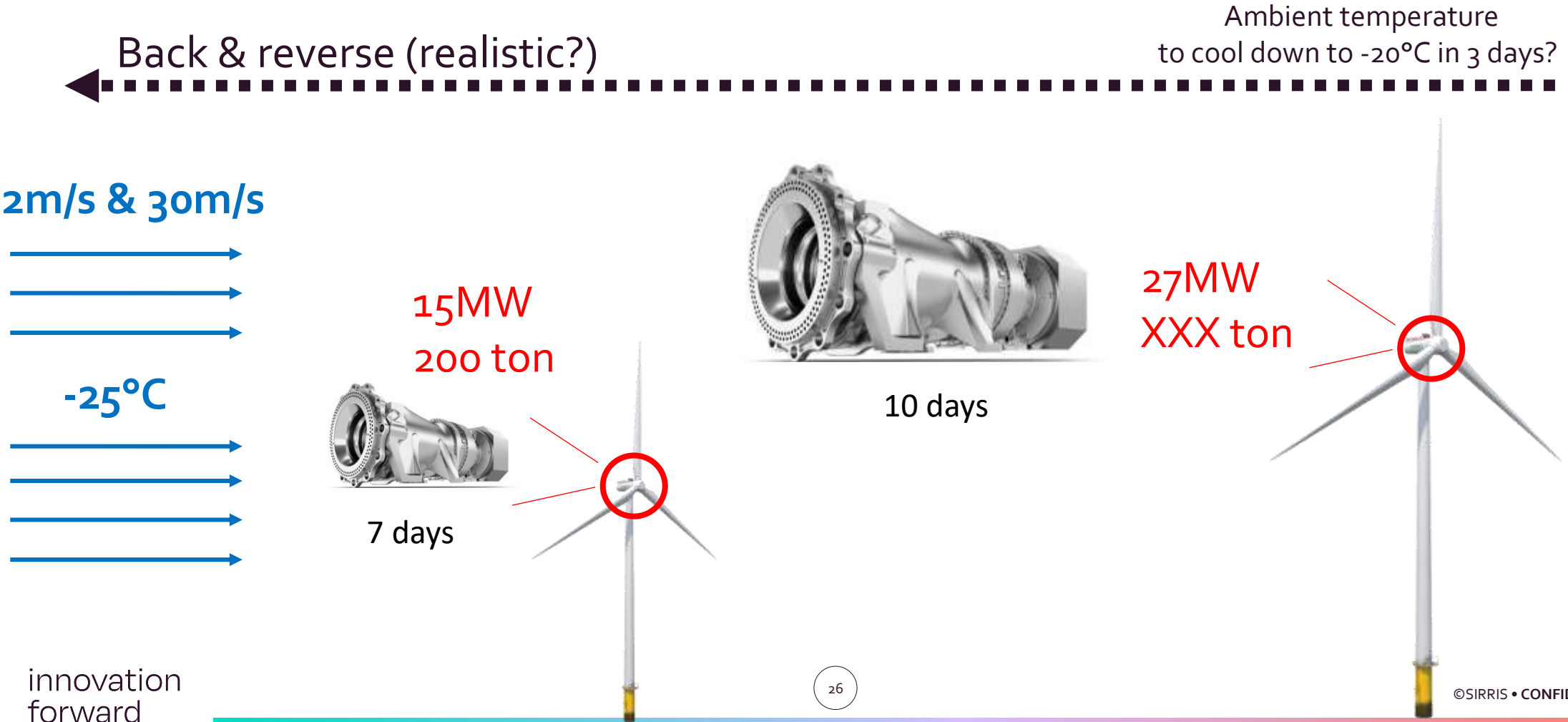


- 2D - transient
- No heat transfer axially
- Initial temperature  $T = 20\text{ }^{\circ}\text{C}$



# ETF Harsh R&D Test project: offshore temp conditions

EVALUATION OF REAL LIFE SCENARIO'S AND TRANSLATION INTO RELEVANT TEST PROCEDURES



# Industry leading Test & Prototype Center



**7500** Axial  
kN

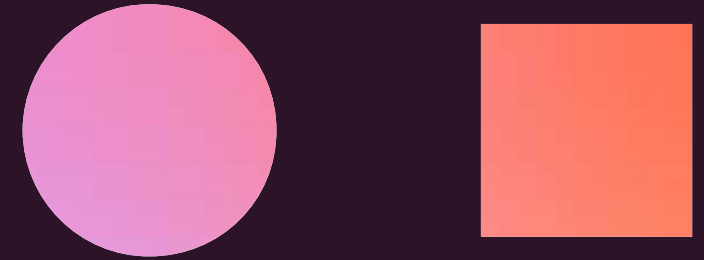
Maximum specifications

**64** Bending  
MNm

**45** Torque  
MNm

**30** Motor  
MW

# Thank you for your attention !



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<https://www.linkedin.com/in/pieterjanjordaens>

