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Vensys 62 — The next Generation of Gearless Wind Turbines goes into Production

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Overview Vensys 62

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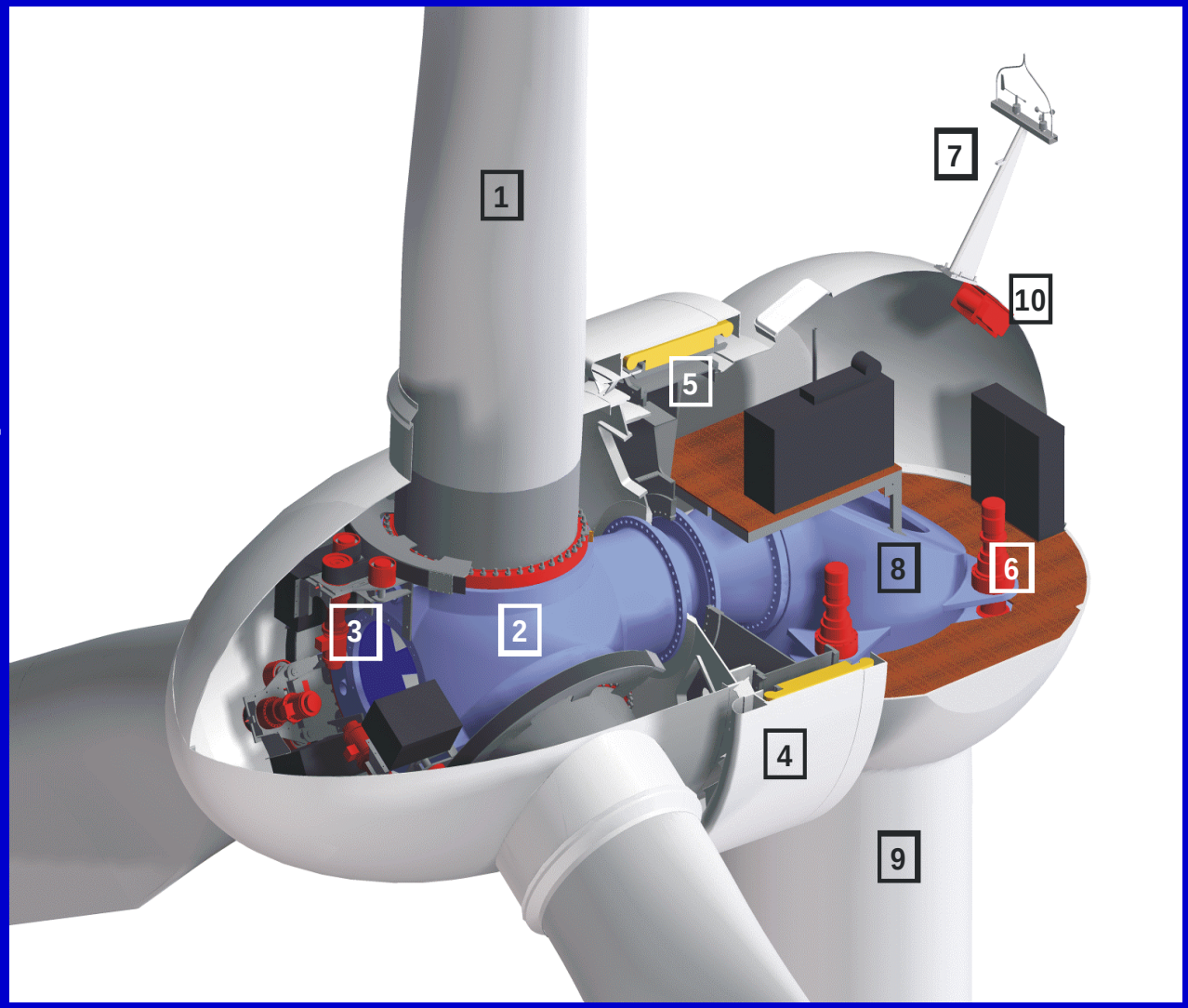
1. Rotor blade
2. Cast hub
3. Pitch drive
4. Generator rotor
5. Generator stator
6. Azimuth drive
7. Anemometer
8. Main frame
9. Tower
10. Auxiliary crane



Generator Design

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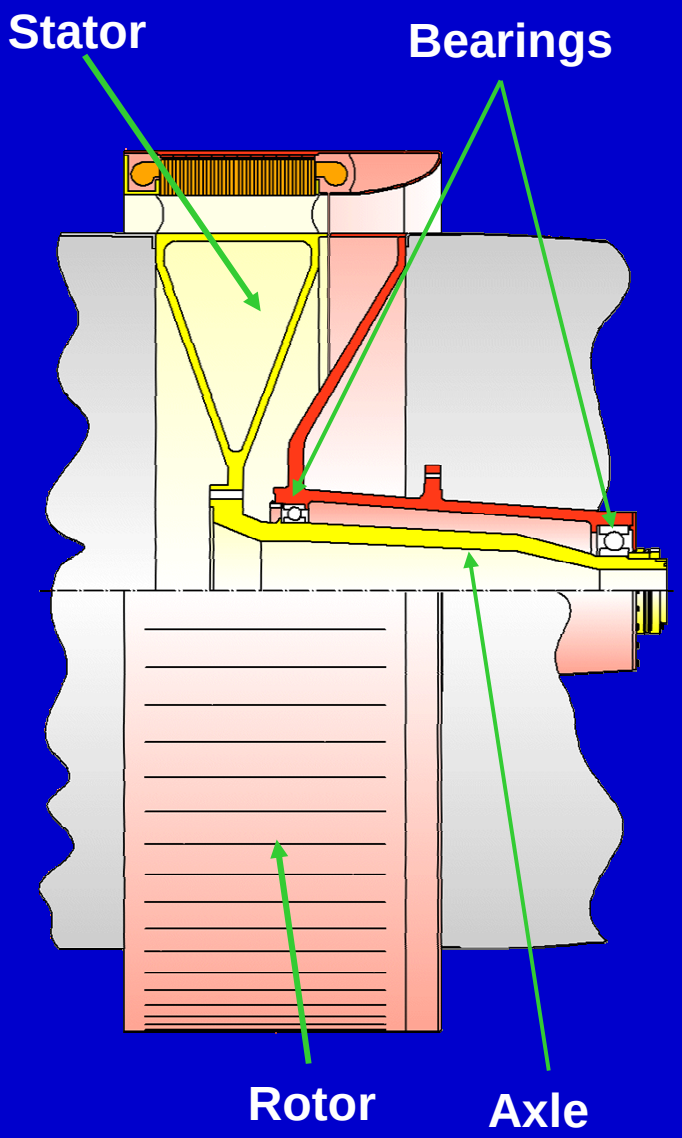

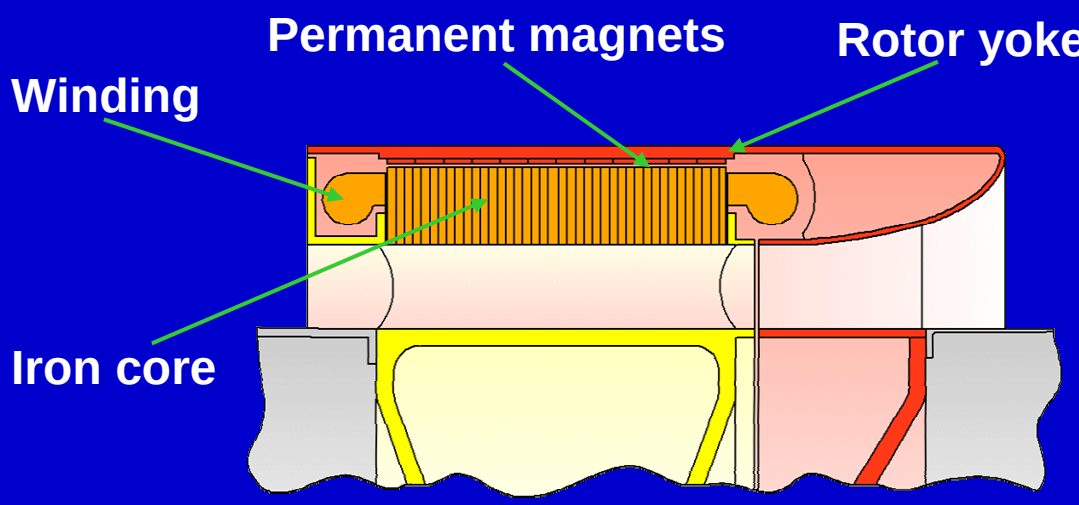

- **Permanent magnet excitation**
  - → High partial load efficiency
  - → Compact and low-weight design
- **External rotor, internal stator**
  - → Largest airgap diameter for given dimensions
  - → Cool magnets, high flux, no demagnetisation
- **Passive cooling system**
  - → Robust, no additional energy needed
  - → High cooling performance
- **Integrated bearing concept**
  - → No extra generator bearings needed

Patented Cooling Concept

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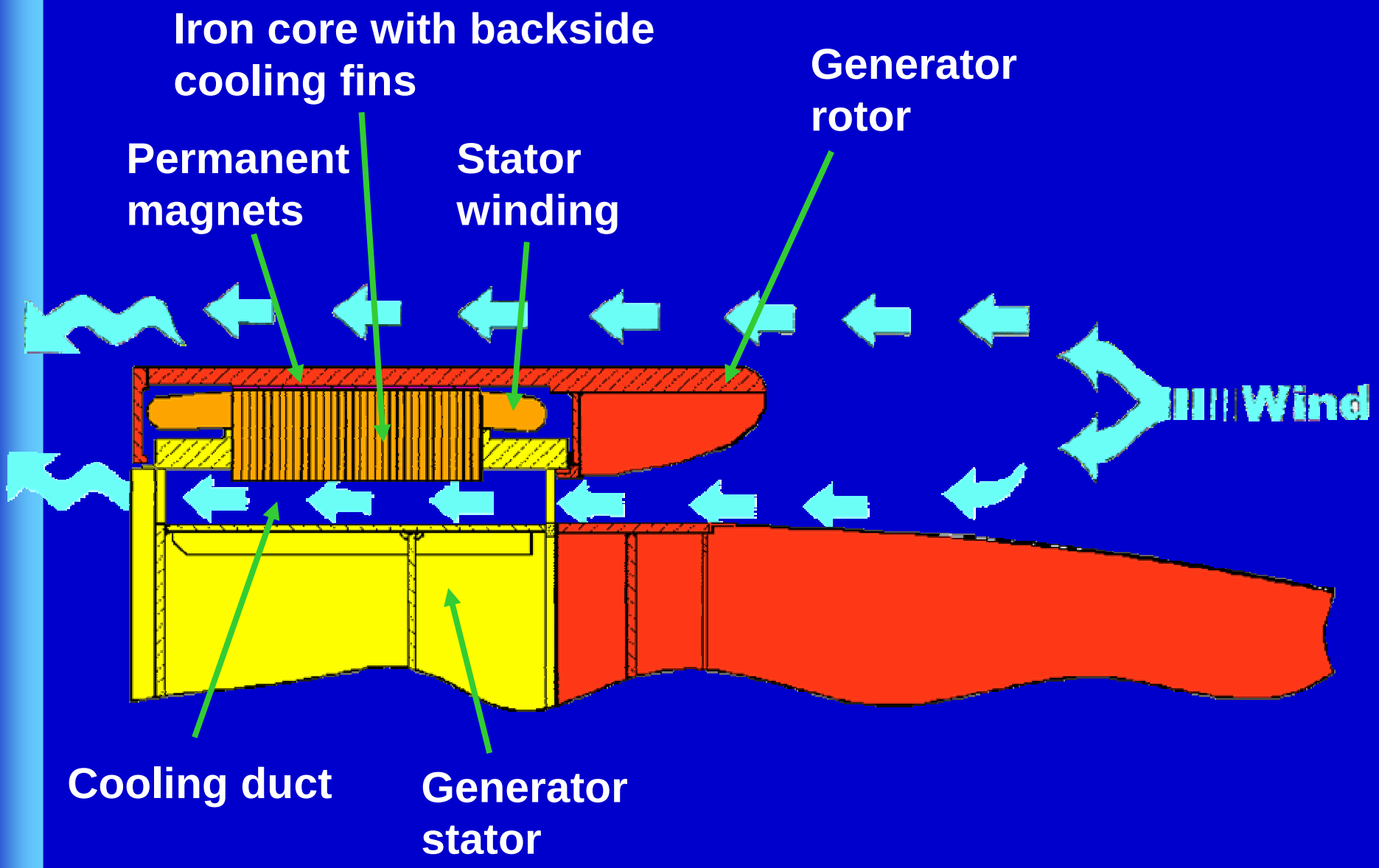

Frequency Converter

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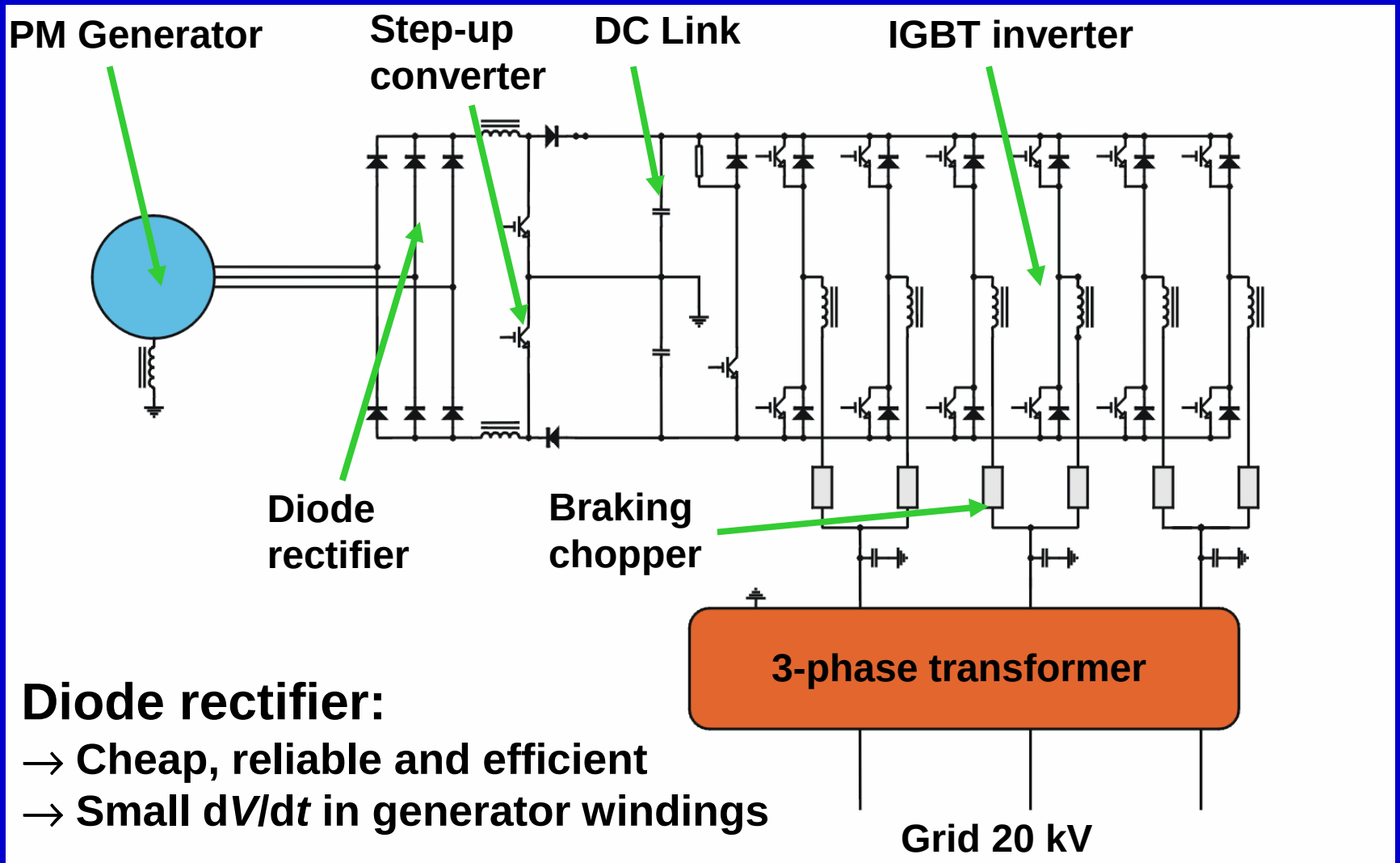

Diode rectifier:

→ **Cheap, reliable and efficient**

→ **Small d*V*/d*t* in generator windings**

Vensys 62 - Exterior View

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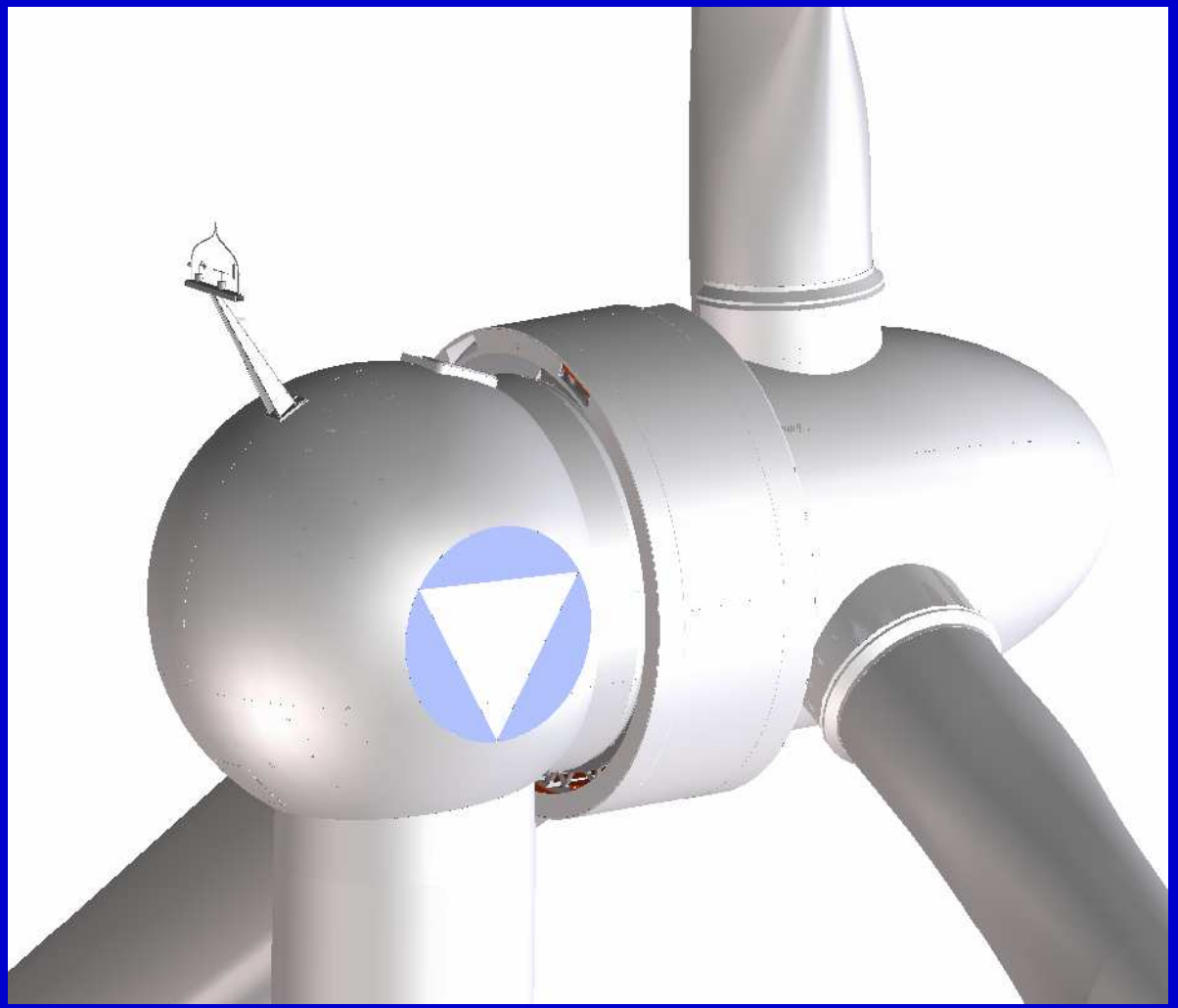
Ball-shaped nacelle casing:

→ Least material
for given volume

→ Completely
enclosed
azimuth system

→ **Simply beautiful !!**



Generator Test Rig

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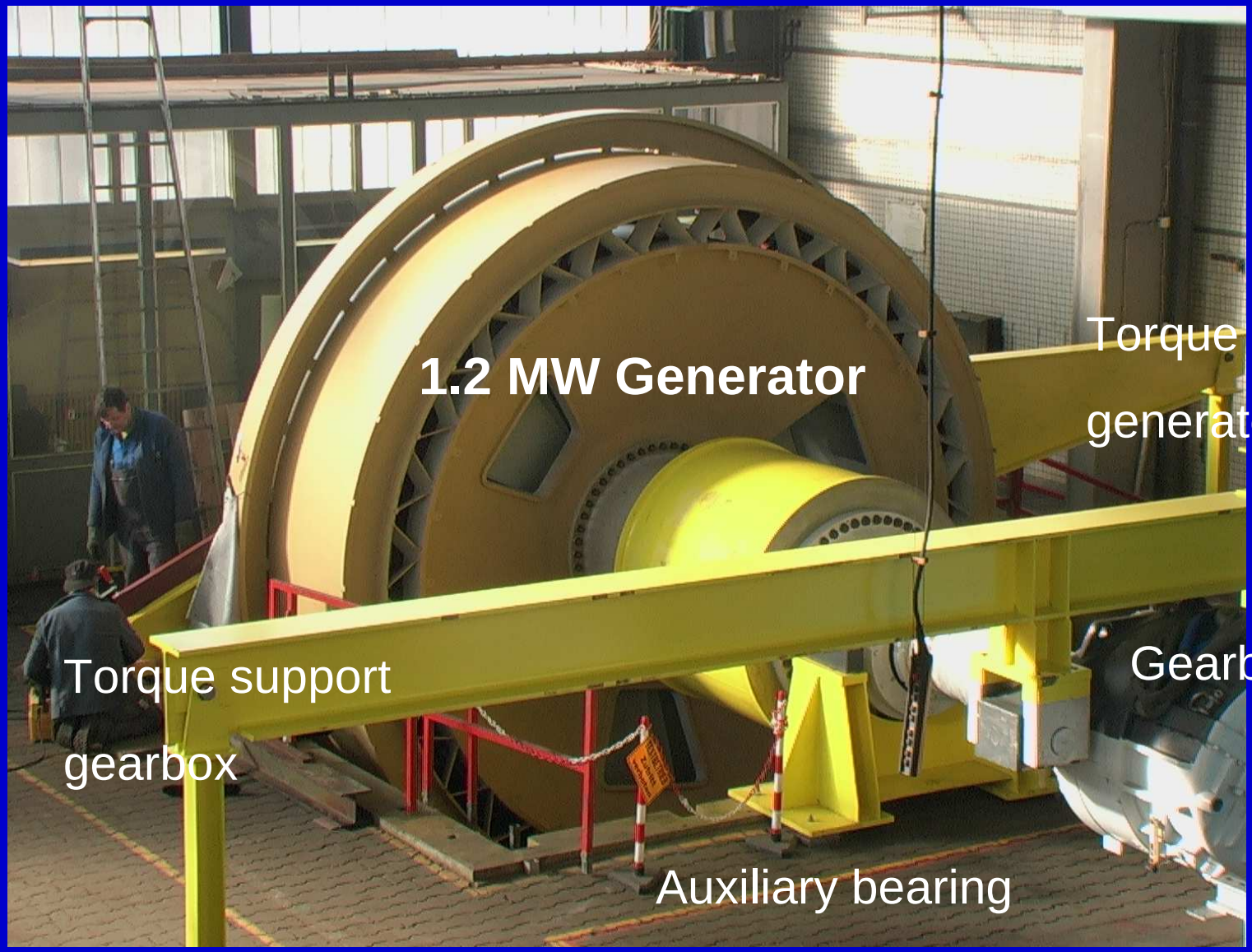

High-power Generator Test

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5 Main Objectives of generator lab test:

1. Pre-commissioning of generator system (PM generator + frequency converter)
2. Test of interaction between PM generator and frequency converter and fine-tuning of torque control
3. Validation of calculated flux, voltage, current and efficiency characteristics
4. Preliminary measurements of generator noise emission
5. Proof of compliance with E.On requirements for grid compatibility

Test Results (1)

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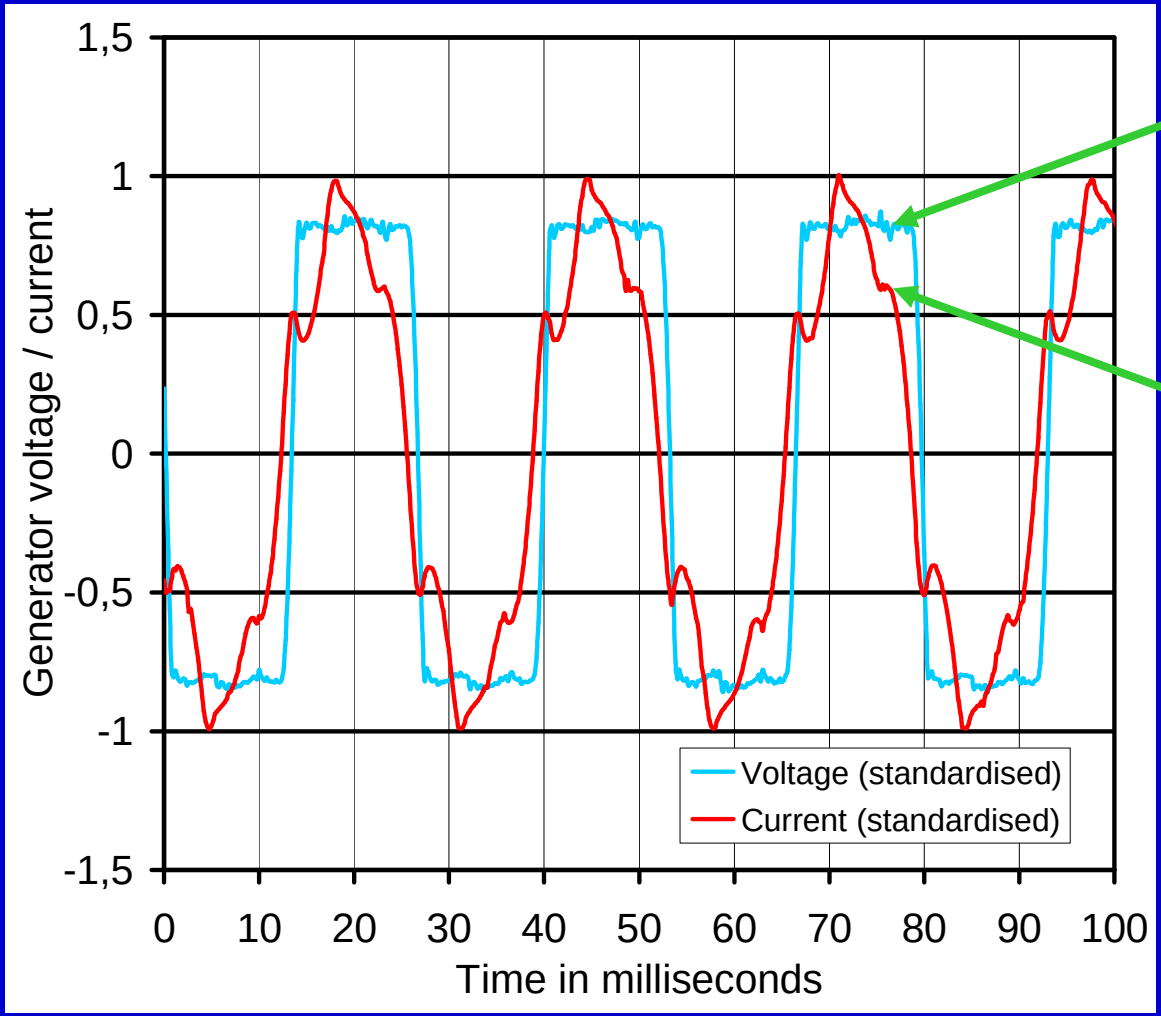
Stator voltage and current at full load



Typical block-shaped stator voltage

Current well smoothed by large inductances

⇨ Both voltage and current characteristics like simulated before!!

Test Results (2)

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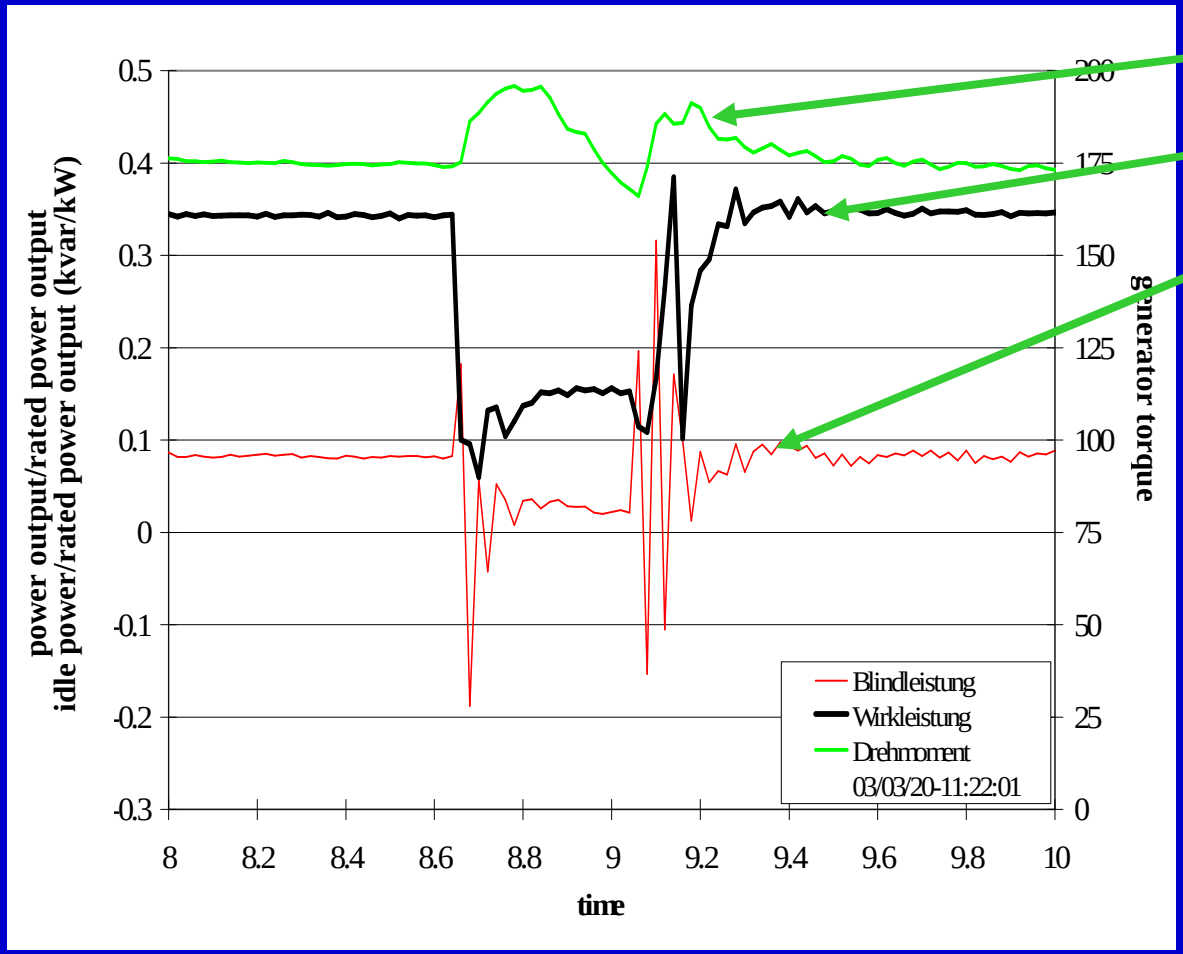
E.On requirements for grid compatibility (measured by *DEWI*)



Measured torque

Active power

Reactive power

⇨ Torque well controlled, converter delivers active and reactive power

⇨ E.On requirements are met!!

Test Results (3)

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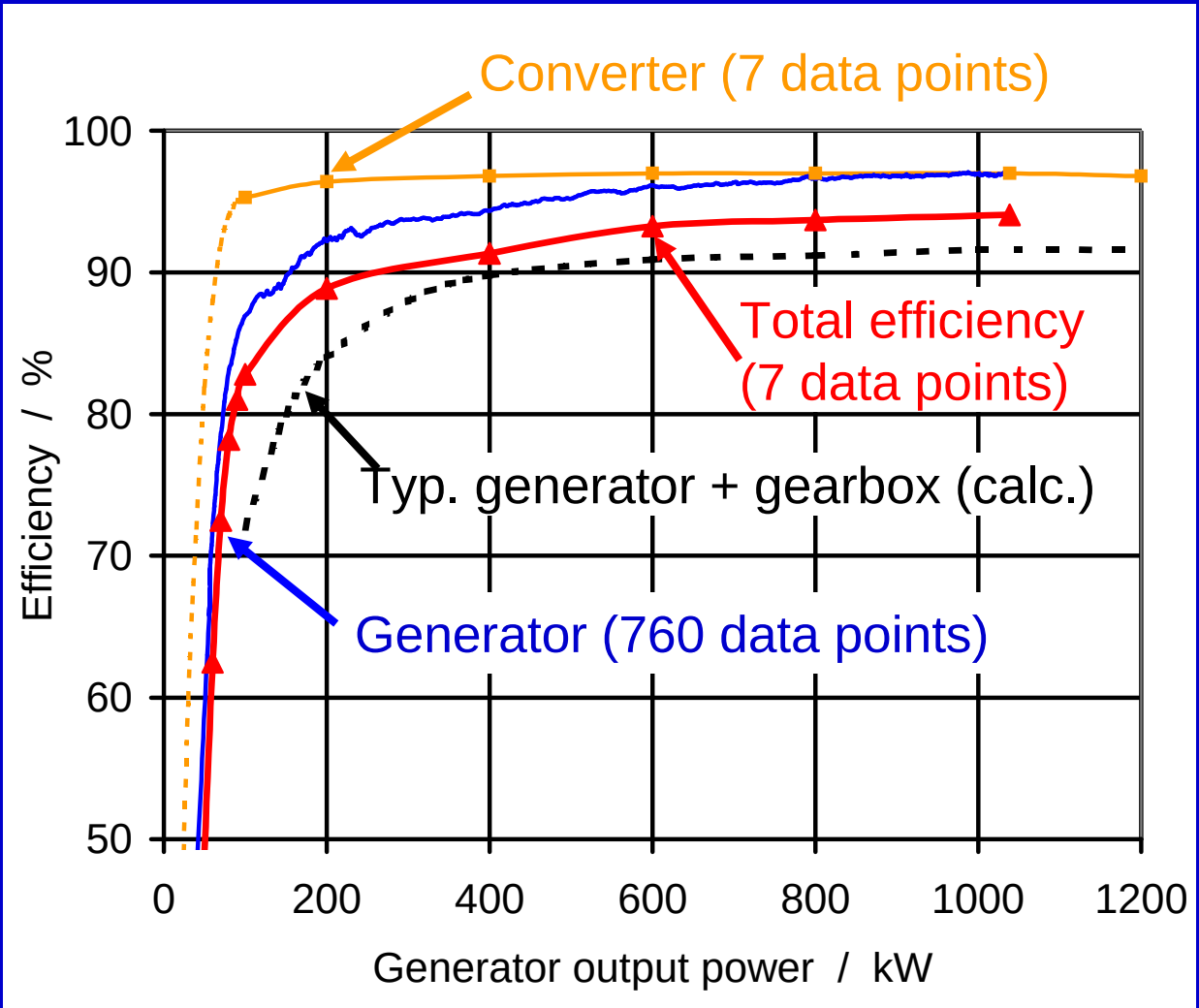
Efficiency (directly measured 1 - P_{out} / P_{in})



Freq. converter and generator separately measured (accuracy!)

Total efficiency

$\eta_{tot} = \eta_{Con} * \eta_{Gen}$

⇨ Rated total efficiency over 94 % !!!

⇨ Between 2.5 and 5 % higher efficiency than conventional drive train !!!

Main Technical Data

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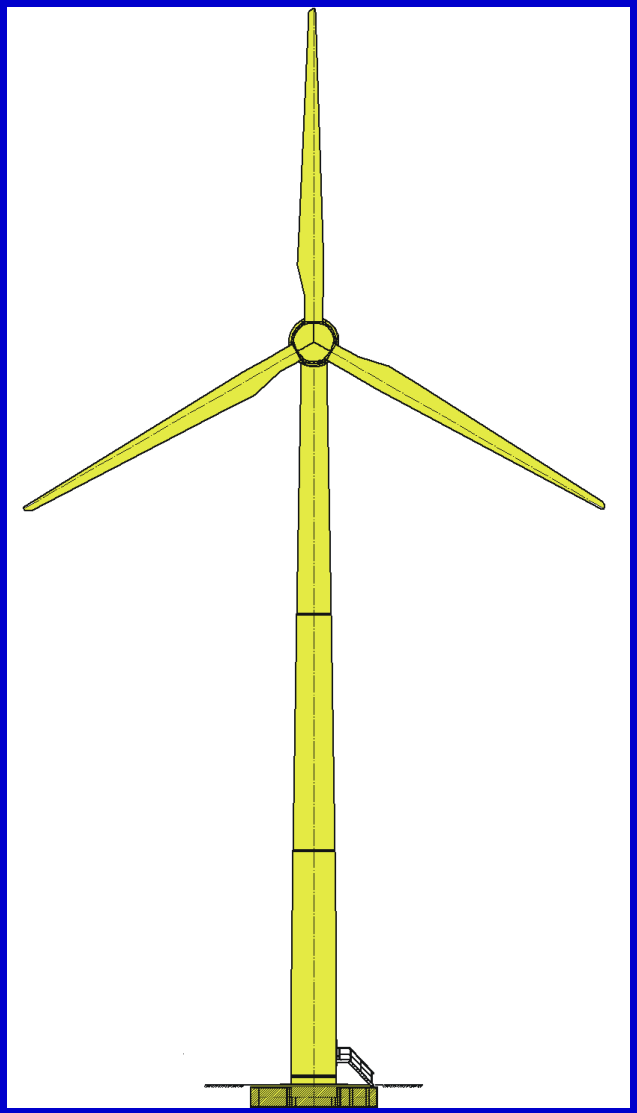


1. Rotor

Rotor blades:	3 x LM 29.1 P
Diameter:	62 m
Control:	pitch
Speed range:	11 - 20 rpm

2. Direct Drive Generator

Type:	multipole synchronous
Excitation:	permanent magnets
Rated power:	1200 kW

3. Safety system

Full-span blade pitch, 3-times redundant

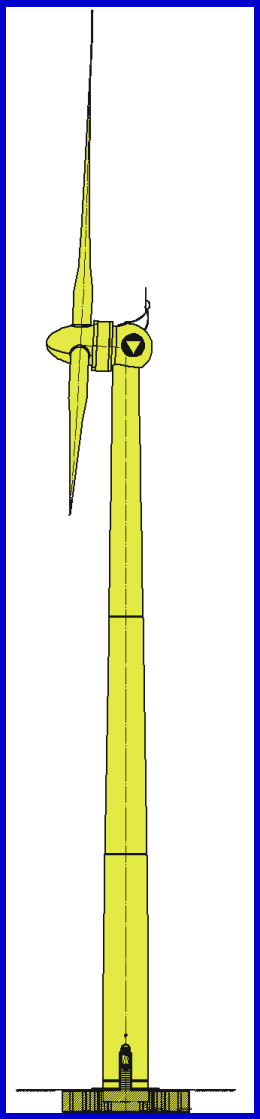
4. Tower head

Mass less rotor:	ca. 56 t
Rotor mass:	ca. 23 t

5. Tower

Type:	conical steel tube
Hub height:	69 m
Mass:	98 t

6. Wind Class: GL III, 8.5 m/s, 20 % TI



Prototype Erection

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Wind Turbine Site

Sitzerath (Northern Saarland)

Wind Conditions

AWS: ca. 6.2 m/s (hub height)

Turbulence: ca. 15 % (at 6.2 m/s)

Measurements (ongoing)

1. **Loads and safety system**
2. **Power curve**
3. **Noise emission**
4. **Grid compatibility**

Goal: Type Certificate in 2003

Summary & Outlook

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- **Design, construction, erection, test of gearless Vensys 62, 1200 kW**
  - → Direct drive, PM generator
  - → Reliable frequency converter
  - → Passive cooling
- **High-power generator lab test**
  - → High efficiency validated
  - → E.On compliance proven
  - → Low noise emission shown
- **Prototype testing (ongoing)**
  - → Loads and safety system
  - → Power curve, noise and grid
- **Outlook**
  - → Production of pilot series of 5 additional machines started
  - → Development of follow-up turbine in the 2 - 2.5 MW class started