



Renewable Energy



Made in Germany

High Efficient Factory of Wind-turbines
with the help of SETEC-Dresden

Improved Direct-Drive technology
for the optimized return of investment.

Presented by
Fritz Fahrner , CEO and Owner of the Company.

The topics of the presentation

1. The first chapter of this presentation will answer to:
“how can innovative technology for wind-turbines
be the key for optimized return of investment”

We will show the key features of innovation to achieve

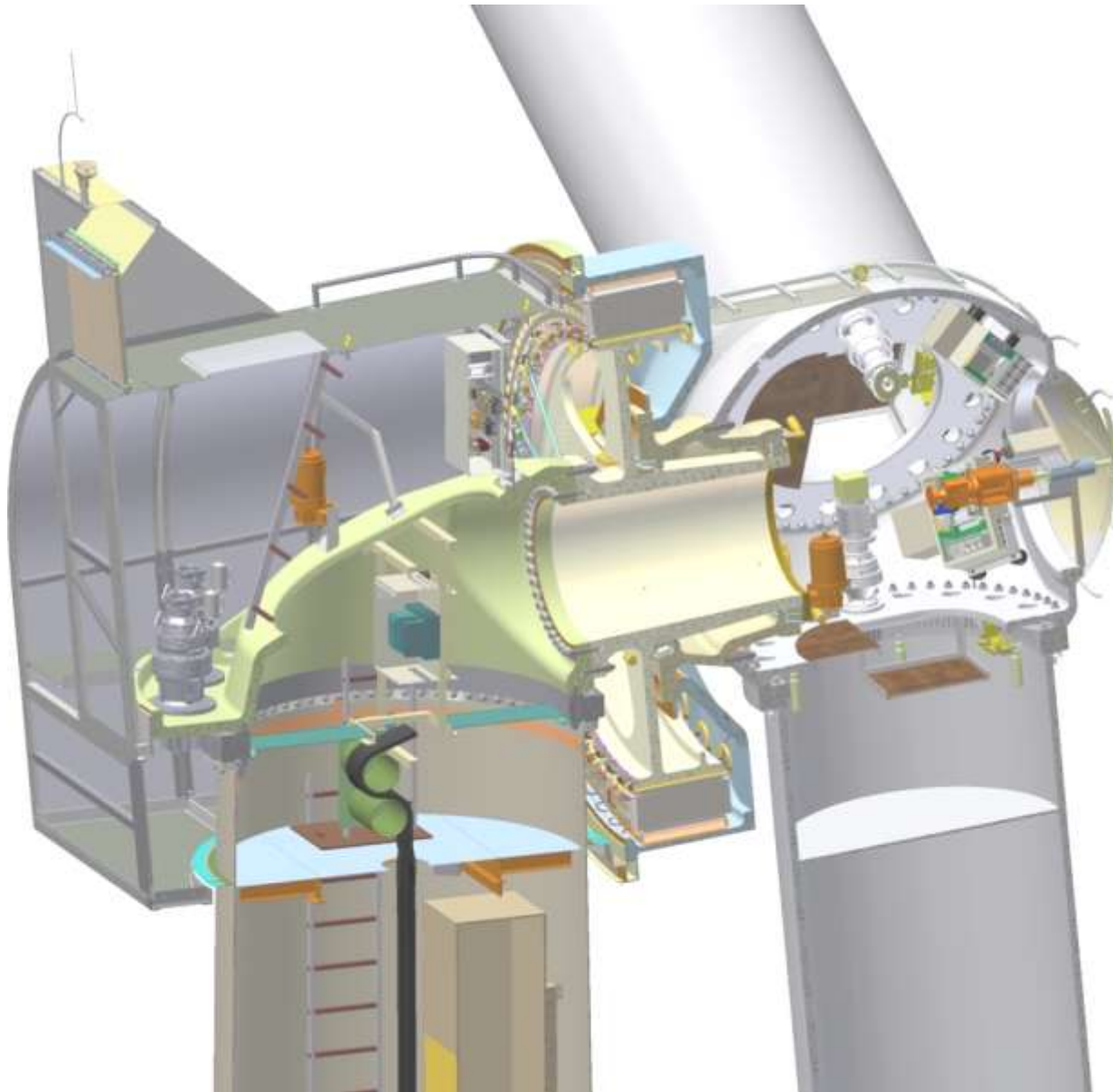
- a high range of local manufacturing at lowest costs.
- energy generation of high safety at operation
- at a minimum effort for maintenance and repair.

**Such a project shall also effect
the creation of local high-tech jobs and provit.**

2. Secondly I will inform you about the basic requirements and the needs of investment for a local factory for wind-turbines.

3. My last point will deal with cooperation of technology transfer, and resulting conclusions.

SETEC's Wind-turbine Engineering to keep complicated Technology simple

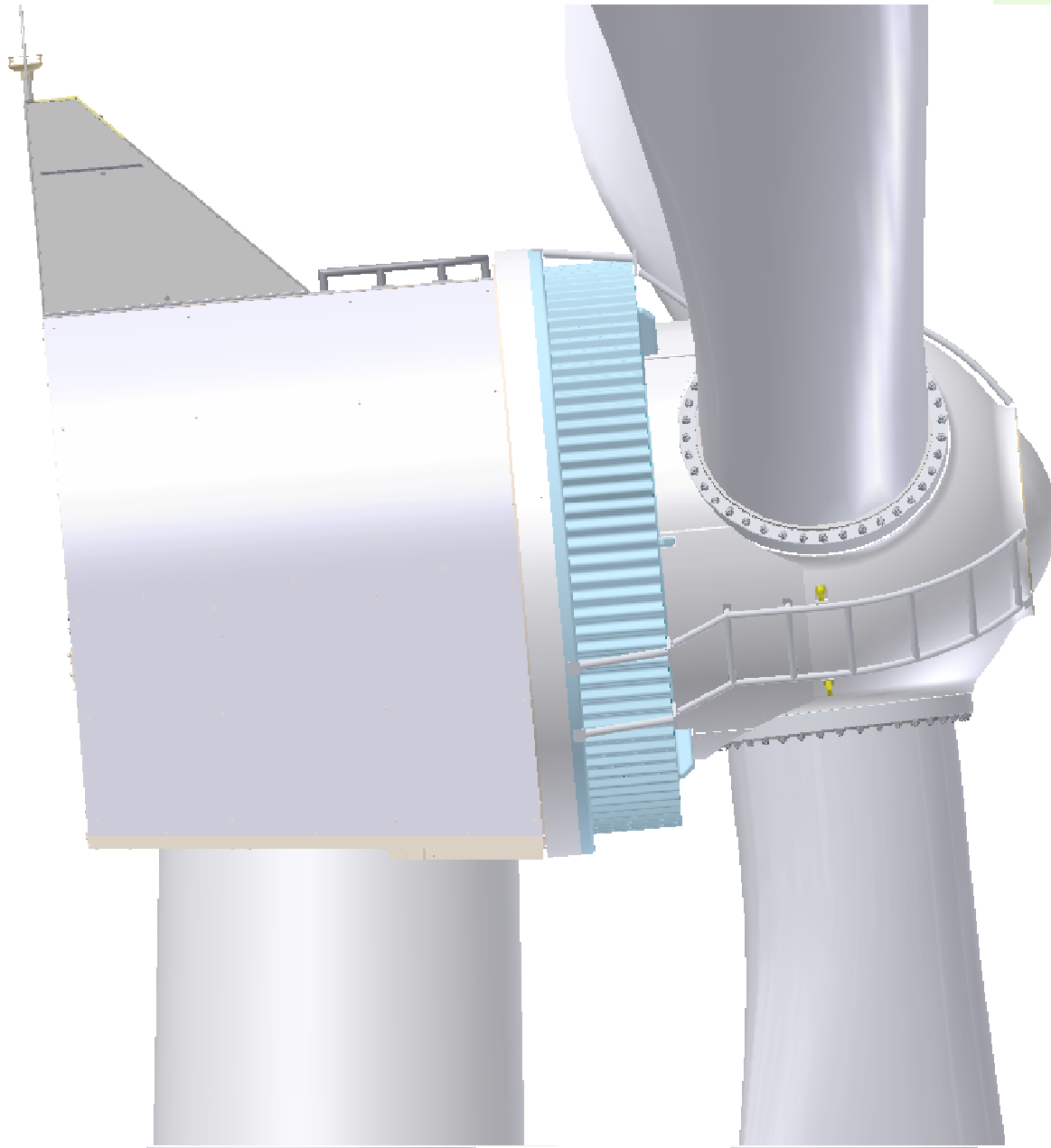


The level of SETEC's technology includes simplifications of structure for mechanics, PM-generator and electronics software and hardware and it achieves:

- Short time for setup of a new wind-turbine factory
- Reduced costs and risk of technical malfunction.

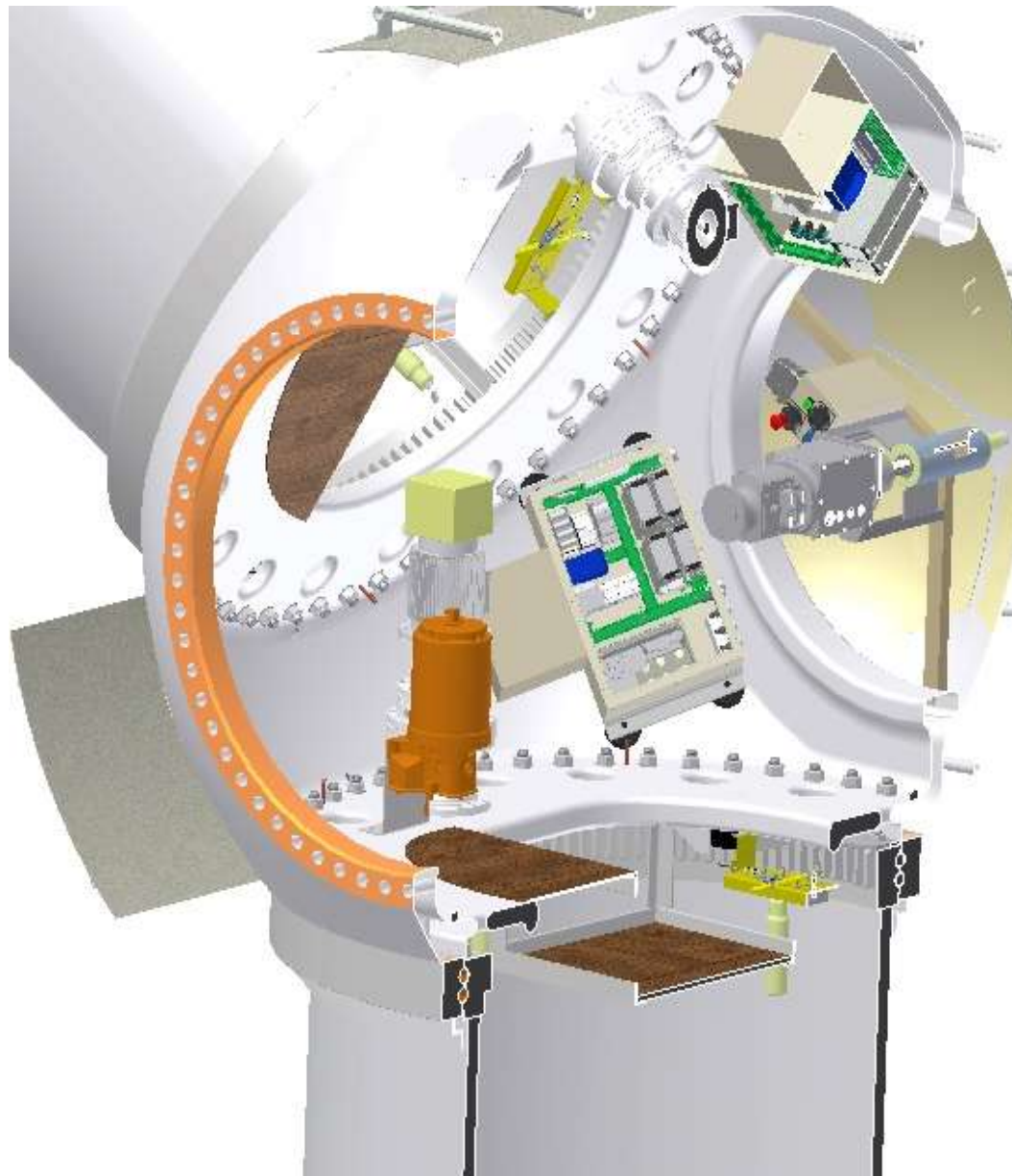
The improved technology also applies to parts that in the past could be made in special factories only, and have required costly import.

SETEC's Design of Tower-Head Assembly



The modular structure of mechanics and the direct drive PM-generator offer advantages, as for example simple transport and installation in modules, because of smaller size and lower weight for lifting

The Rotor-Hub including NEW Front Wind-Sensing



This results a reduction of loads at the rotor-blades and at the complete mechanical structure. Because of improved adjustment to wind-direction, a 5 % increase of energy can be expected.

The inside of rotor-hub is showing:

- Pitch-drives and control boxes
- Rotor-blade connections to bearings and the greasing.
 - The installation of front wind-sensor

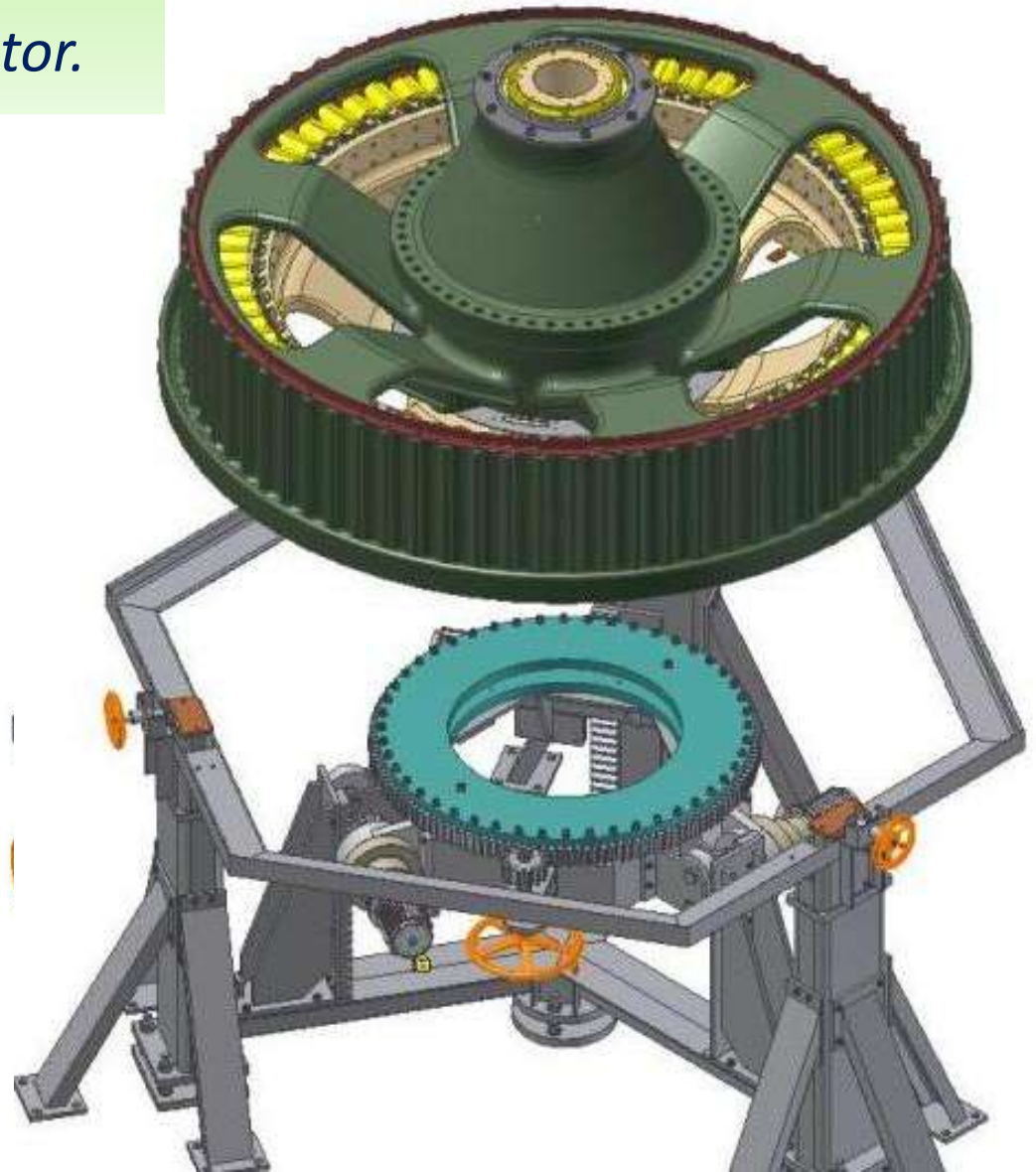
An Example of the Assembly of a Water-Cooled Permanent-Magnet Generator.

Here we show the process
of assembling the stator,
rotor and the main bearing.

Because of a new design with
modular structure of the stator,
the costs are very competitive.

If compared with a field excited
generator, or when used a
gearbox in the drive train,
the complete advantages of
PM- generator are visible.

However, these are not the
only improvements.

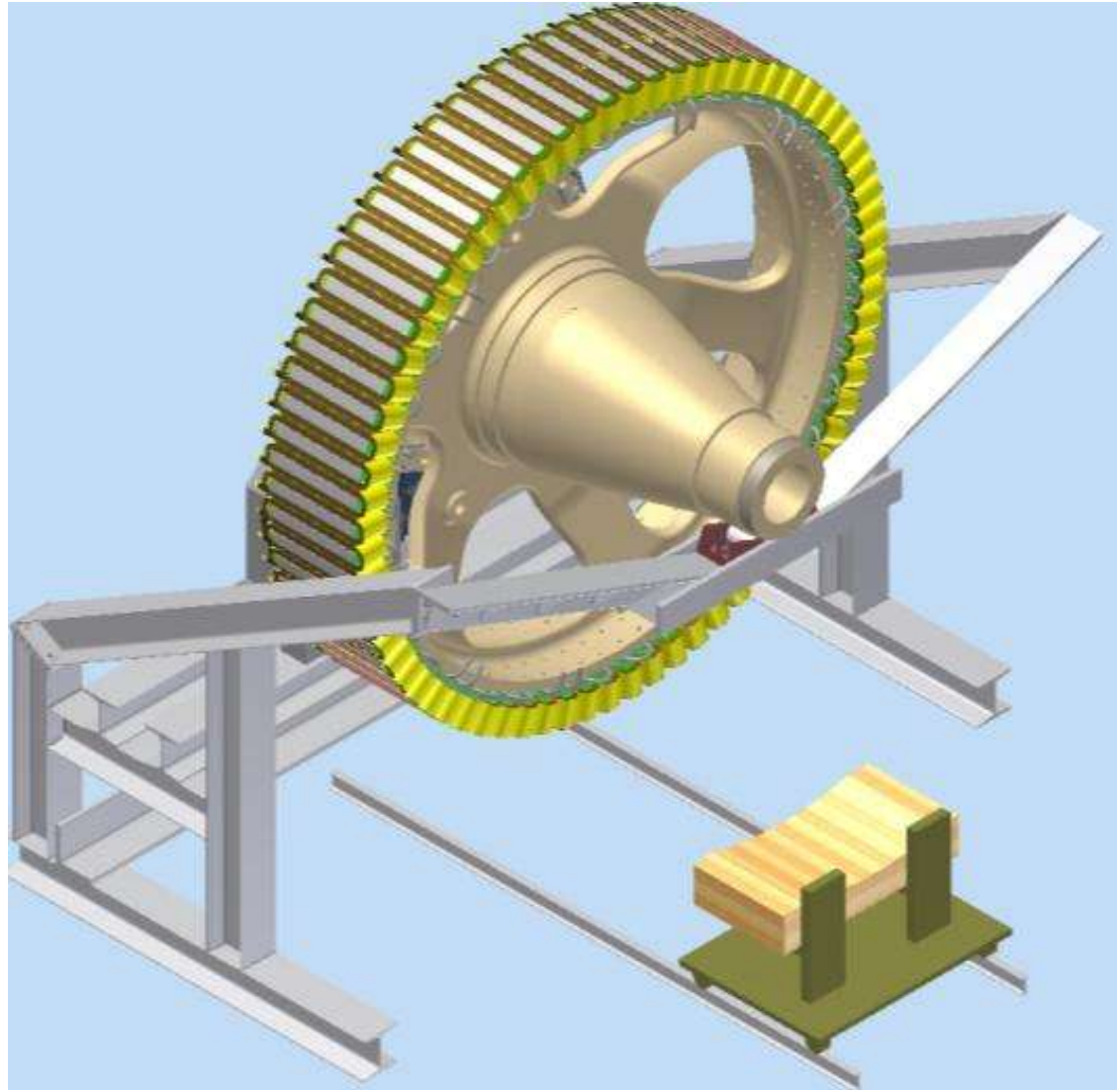


Example of Assembly Process of the Stator of Generator

Because of simplicity of the structure, the generator can be assembled and tested in the wind-turbine factory.

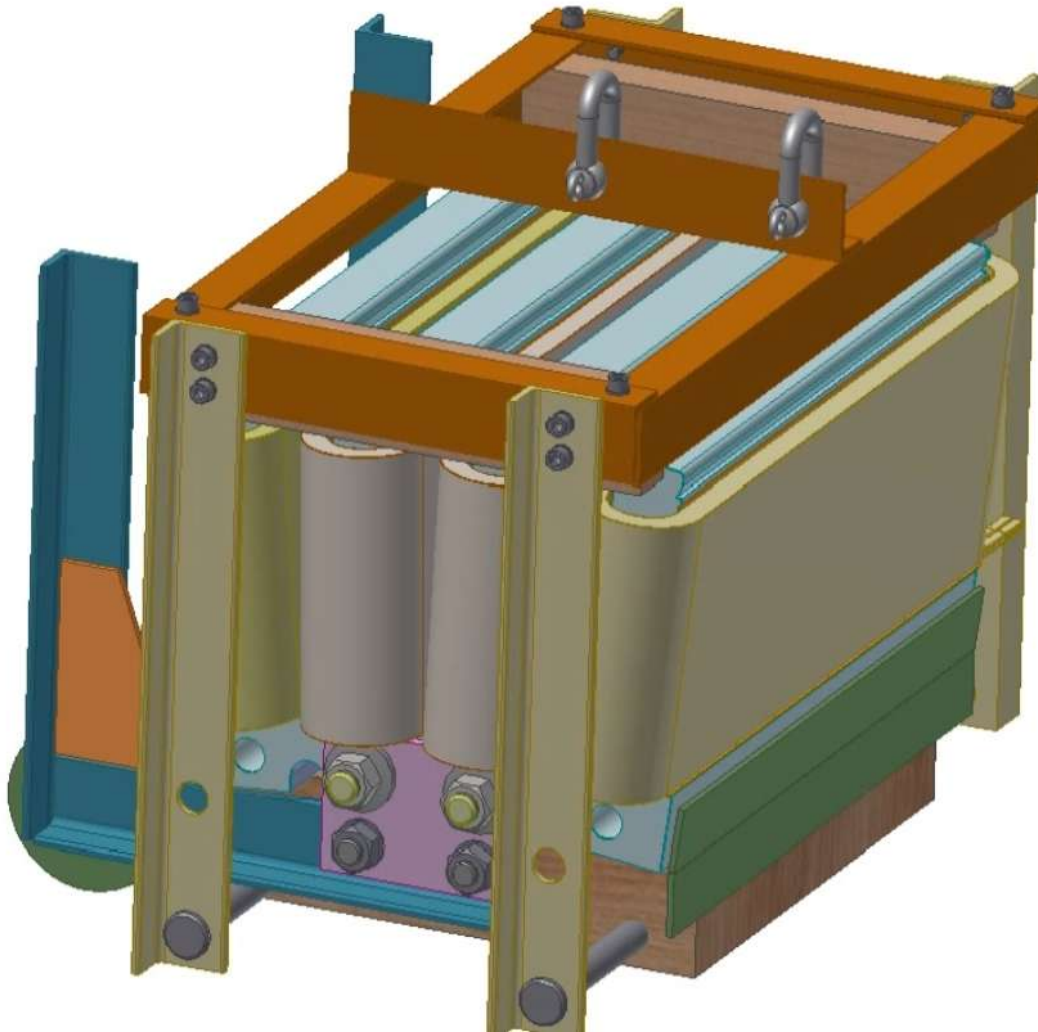
The key features are:

- the modular design of the stator-winding reduces manufacturing costs and eliminates the risks of short circuit.
- Power losses are derived by water cooling with high advantage in harsh ambient conditions of the wind-turbine installation.



Generator Stator

The Fabrication of a Phase-module



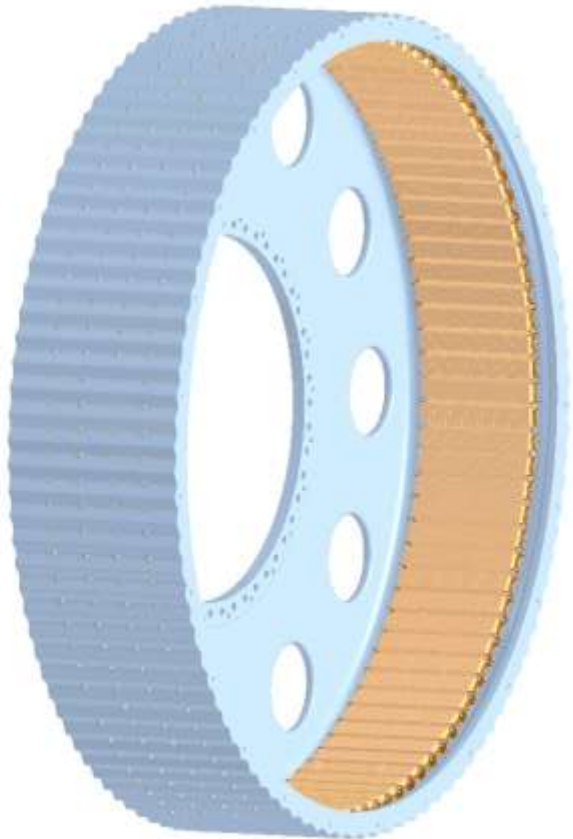
The main steps of the process of steel stack handling and assembling:

- Packing the laminated steel.
- Attachment of electrical insulation at slots for the coils.
- Installation of the coils and assembly of the handling equipment for the transport to tank of the vacuum-pressure impregnation (VPI).

The design of equipment for manufacturing generators, is also included at a contract of technology transfer.

PM- GENERATOR

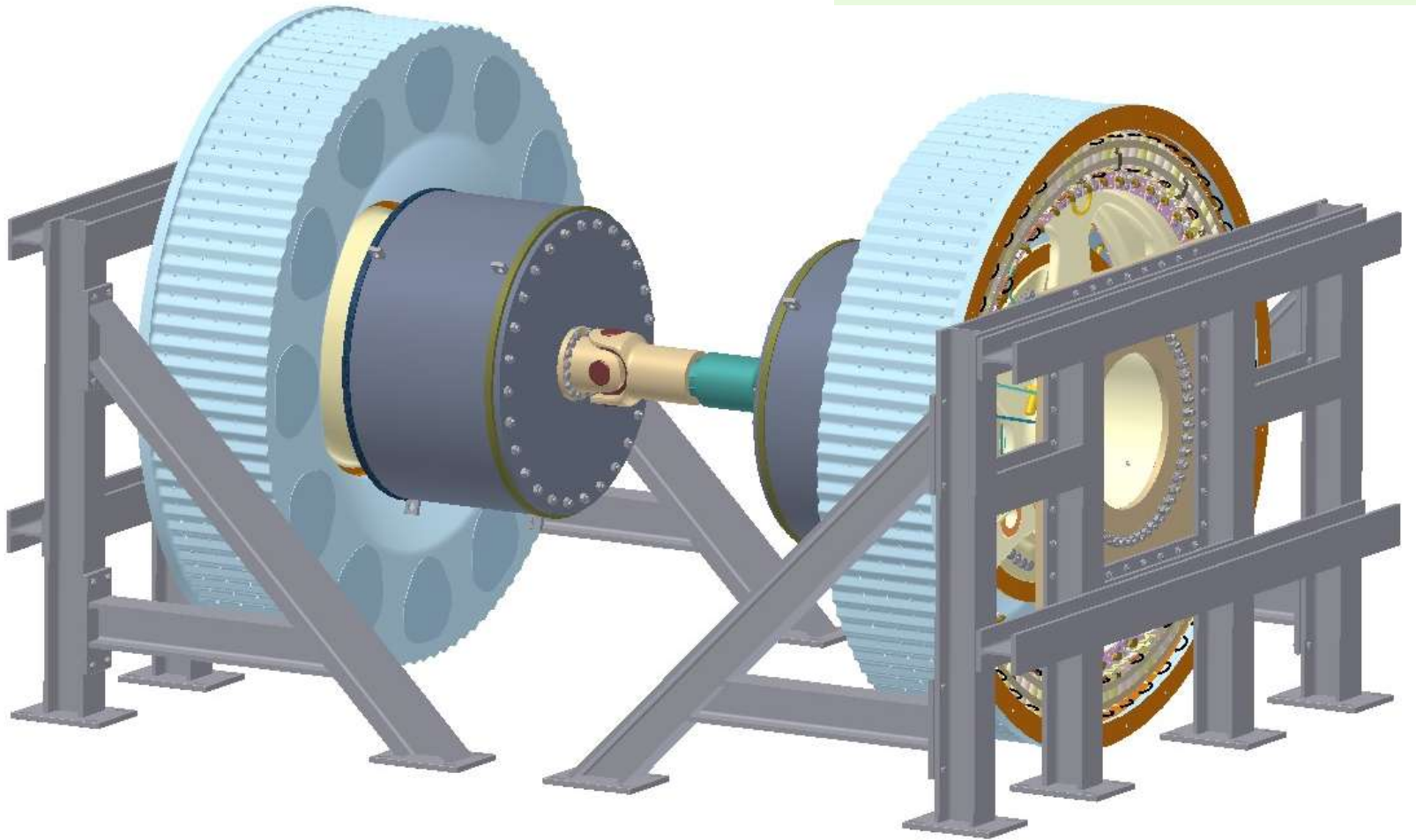
Assembling the Permanent Magnets



The frame of magnet-rotor which has an inner surface prepared for the installation of the permanent-magnets.

- Fixing the assembly equipment and the magnet-pole carrier.
- Insert each piece of magnet by the use of magnet-assembling tools, including the feature of a precise positioning of each magnet.
- Fixing the protection cover of magnets.
- Magnet-rotor ready for assembly with the stator.

Generator at the Power Test at Factory

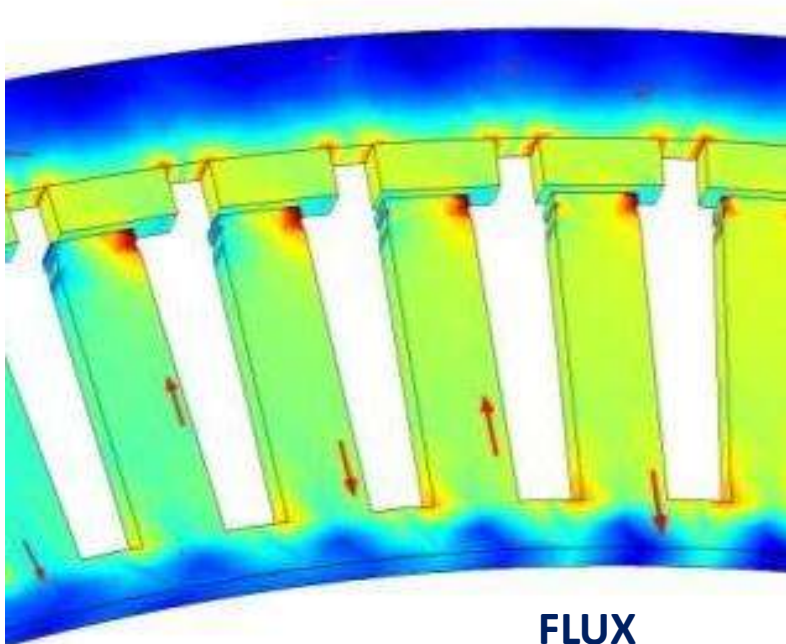


Two generators are controlled by two pieces of inverter
One in motor-mode and one as the generator.

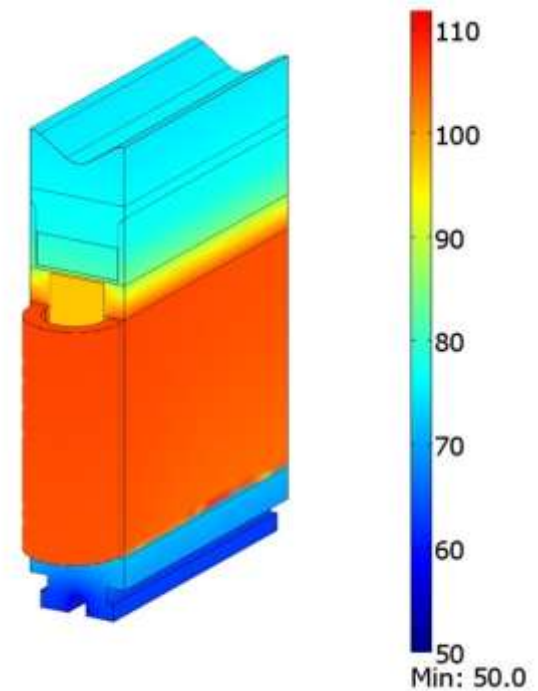
PM-Generator Design and Calculation of Electro-magnetic and Electrical Properties

Latest theory and computer simulation is used for optimization of efficiency, and achieves also low ripple of the torque.

Further result is a simplification of the manufacturing process because of the modular stator and the single tooth winding.



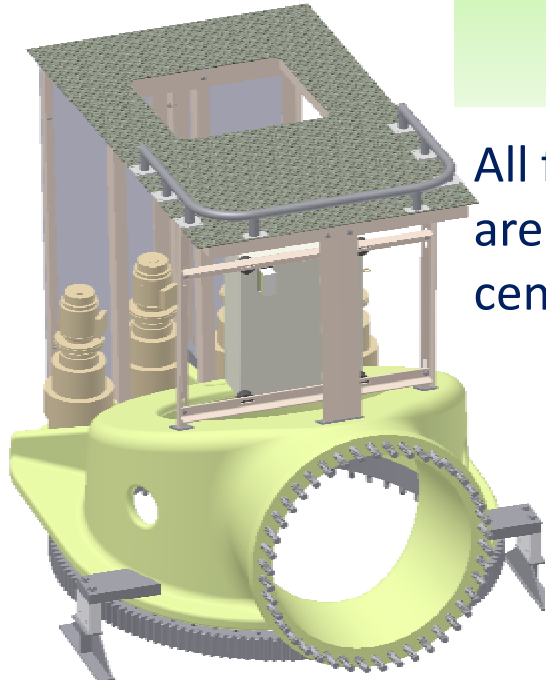
**FLUX
Simulation**



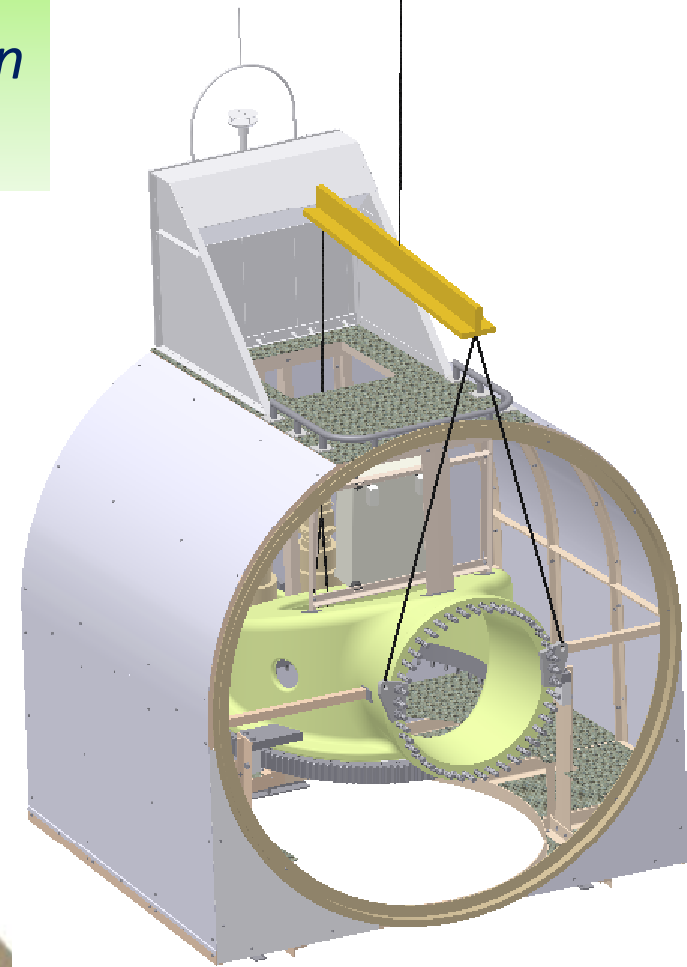
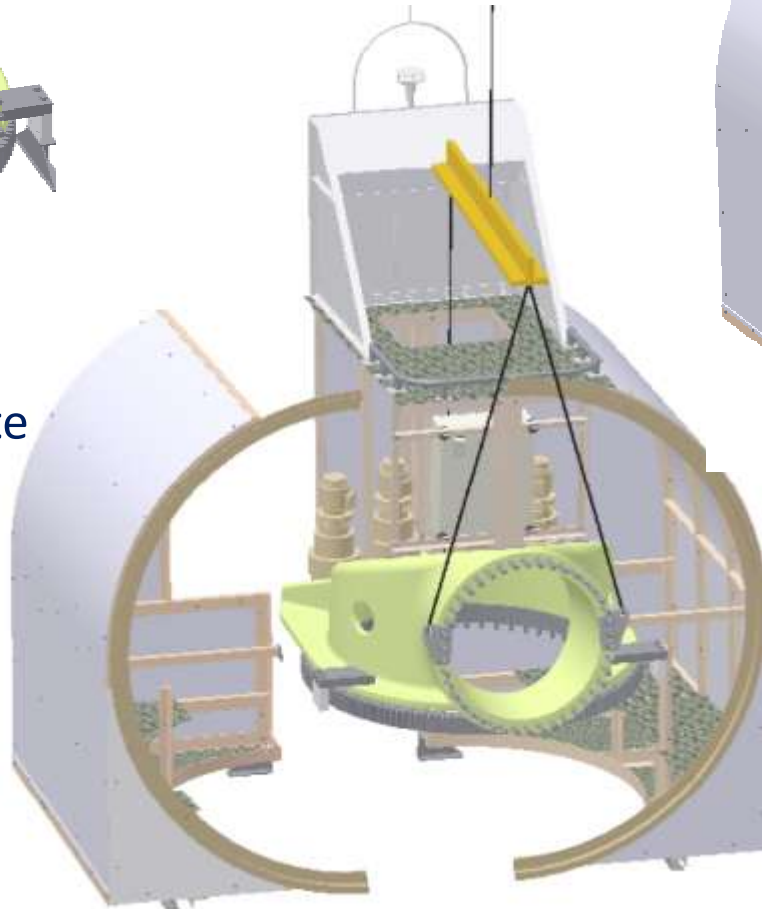
**Temperature
Simulation**

The Modular Nacelle Design for easy Transport

All functional components
are installed in the
centre part of the nacelle



After transport to site
of wind-farm:
The assembly of the
right and left side
of the nacelle-cover
is executed.

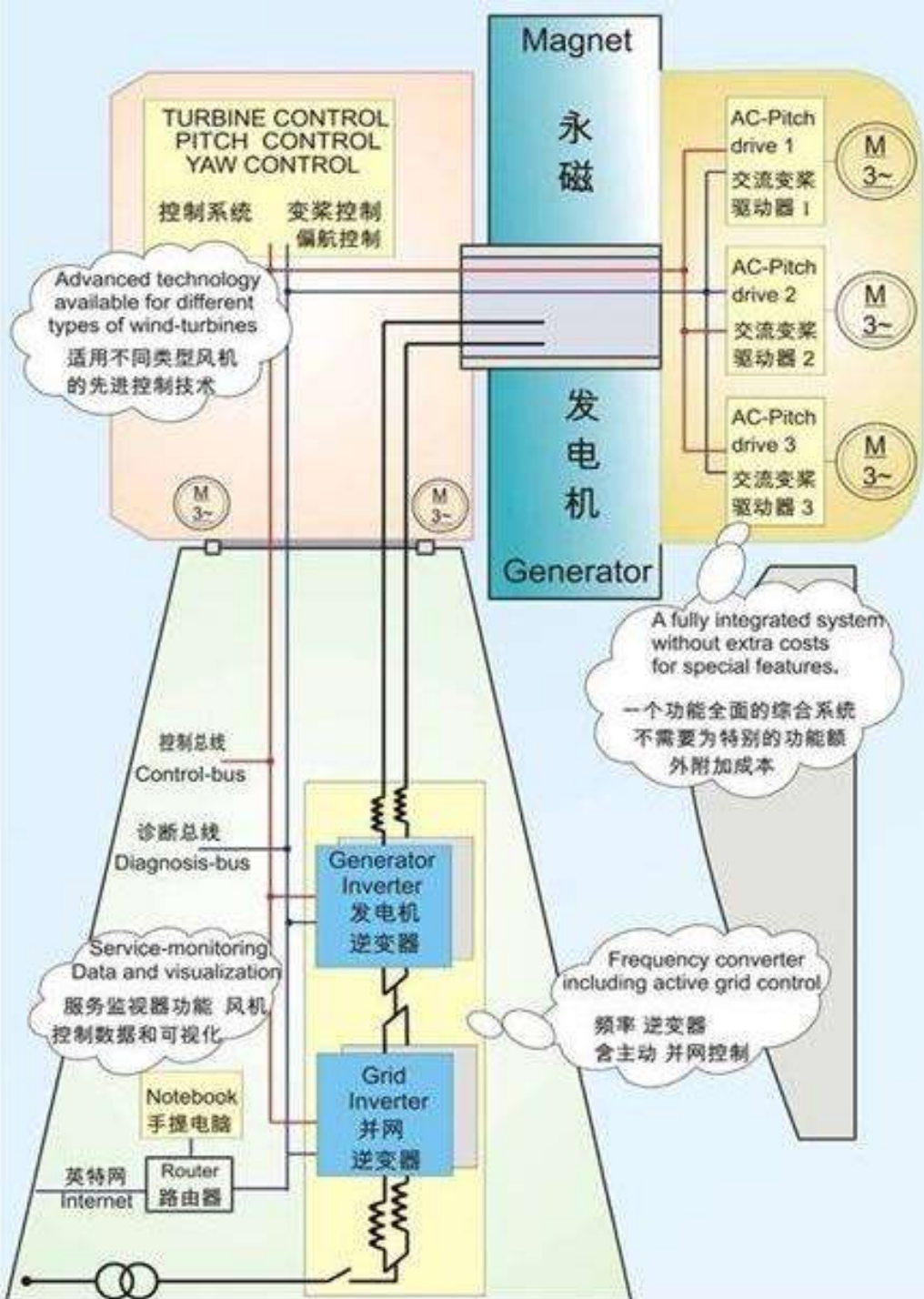


Now the nacelle is
ready for lifting up
to head of tower.

The Wind-turbine Control

The outstanding features:

- Remote control and monitoring by direct bus inside each wind-turbine.
- Diagnosis without barriers because of direct-bus between pitch-drives, turbine-control and IGBT converter.
- No PLC or PC-control required, because of decentralized computing



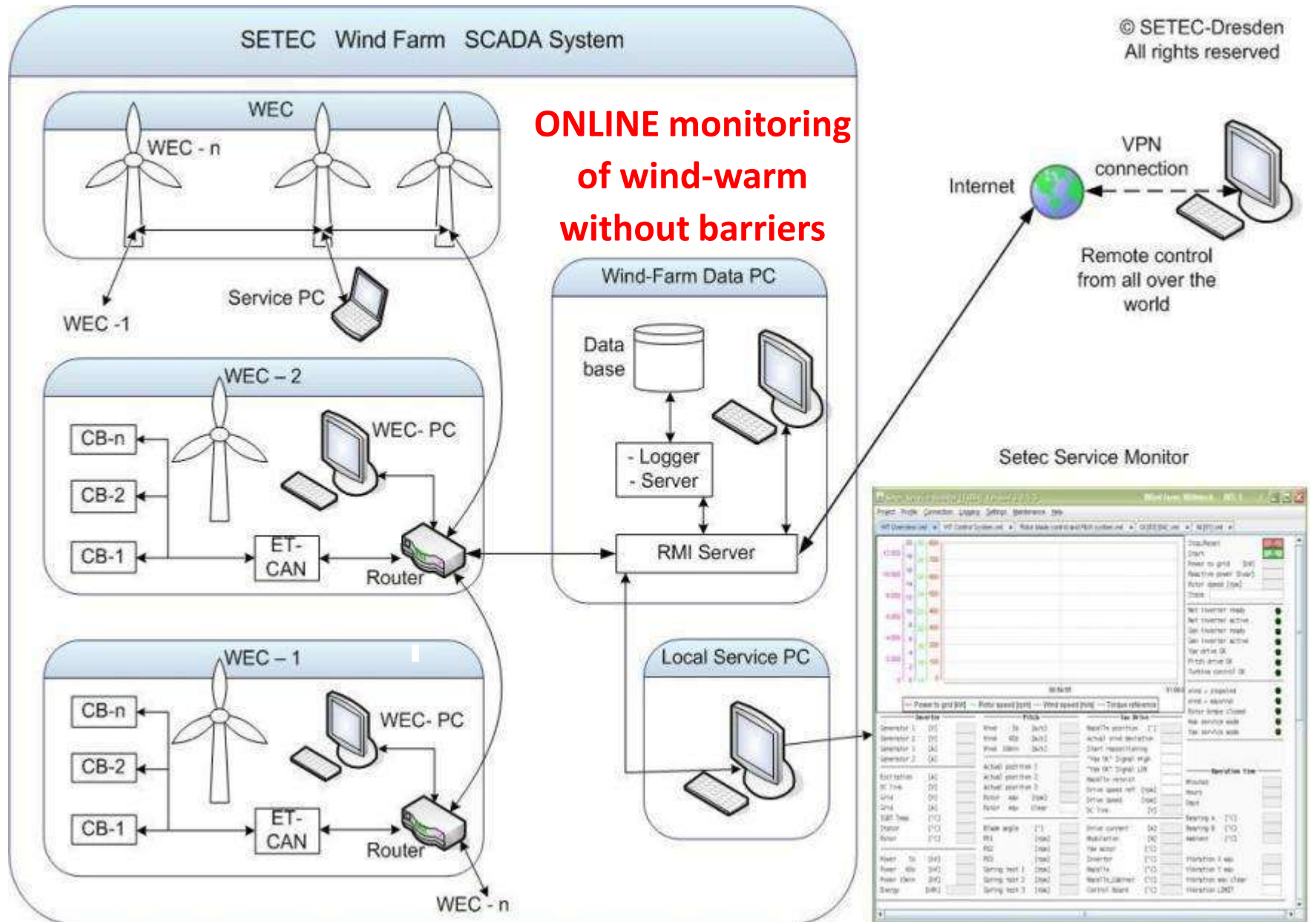
SETEC's wind-turbine control cabinet



SETEC's Remote Control for Detailed Monitoring and Service

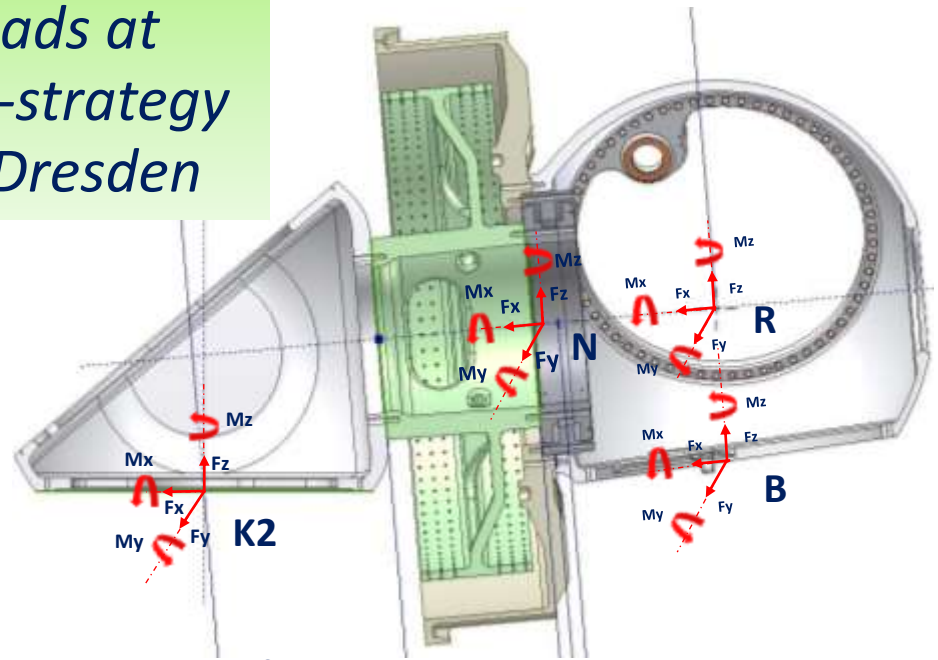
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**ONLINE monitoring
of wind-warm
without barriers**



Example: Reduction of the Loads at Rotor-blade, using a New Control-strategy Designed by Engineers of SETEC-Dresden

FX	thrust
FY	sideways
FZ	along z-axis
FS	radial, resulting (z-y-plane)
MX	torque
MY	on y-axis
MZ	yaw
MS/MBB	tilt, resulting (z-y-plane)



Values of DLC-1.1 at 12 m/s

Result of the improved control strategy:

Despite of setting the nominal power from 2MW up to 2.5MW, the peak loads stay on similar levels as with a conventional pitch-master-control at 2MW power.

	FX	FY	FZ	FS	MX	MY	MZ	MB
FXMax	160.1							
FXMin	80.4							
FYMax		89.8						
FYMin		-128.0						
FZMax			555.0					
FZMin			242.5					
FSmax				197.9				
FS min				92.2				
MXMax					1805.0			
MXMin					-772.9			
MYMax						4263.0		
MYMin						2319.0		
MZMax							27.4	
MZMin							10.1	
MB max								4588.1
MB min								2533.2

2,5 MW with advanced pitch-master

reduction of cycling-load

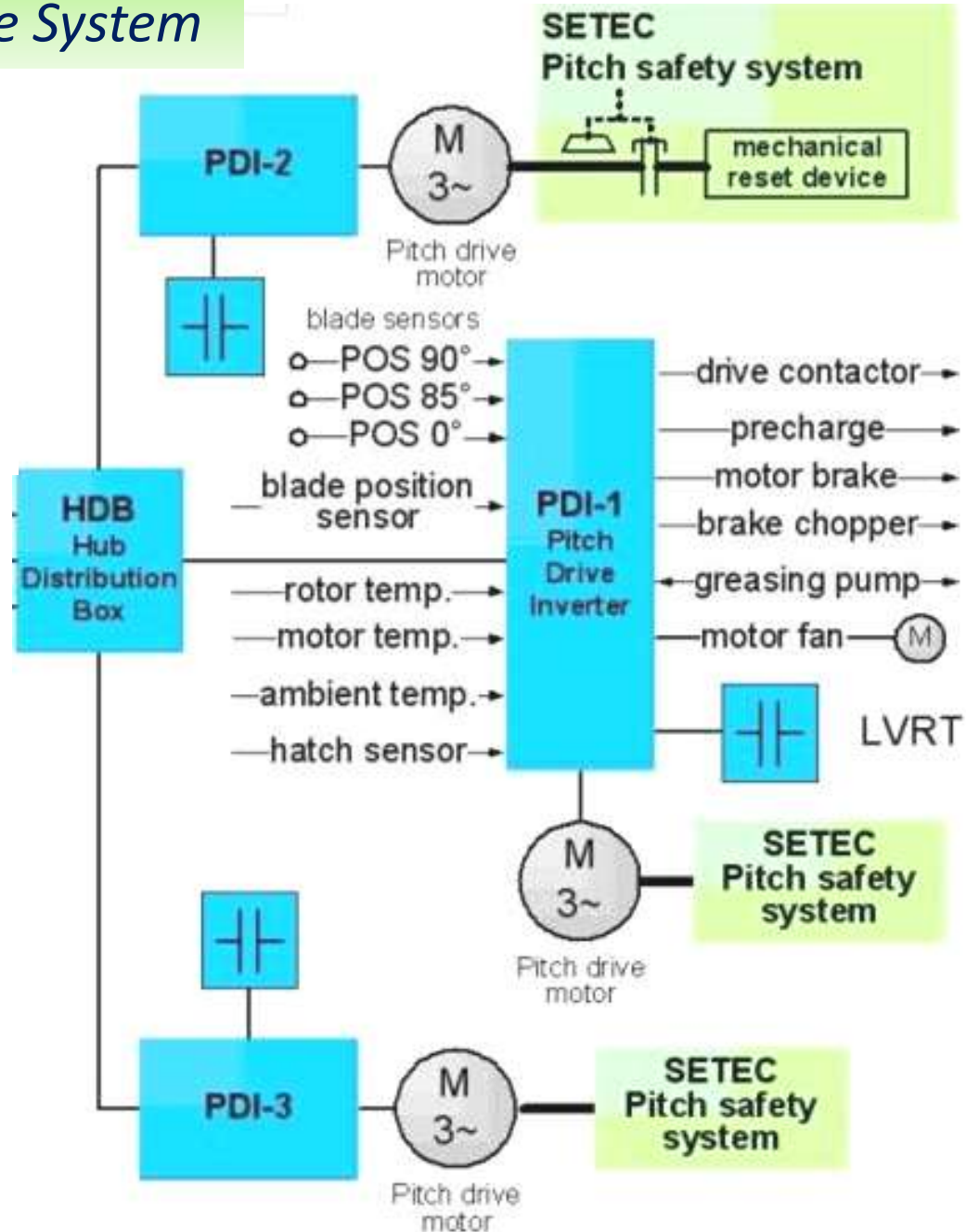
	FX	FY	FZ	FS	MX	MY	MZ	MB
FXMax	163.4							
FXMin	23.8							
FYMax		91.4						
FYMin		-129.2						
FZMax			583.0					
FZMin			243.1					
FS max				198.5				
FS min				45.1				
MXMax					1708.0			
MXMin					-819.7			
MYMax						4340.0		
MYMin						536.8		
MZMax							25.6	
MZMin							-1.0	
MB max								4636.2
MB min								1108.9

2 MW with conventional pitch-master

The Structure of the Pitch-Drive System

Main feature:

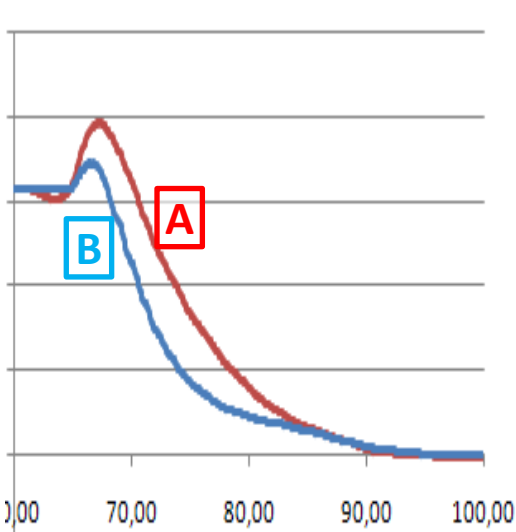
Double safety at each rotor-blade, to increase protection of the wind-turbine from damage, when either one or more rotor-blades are blocked, or drives are out of work.



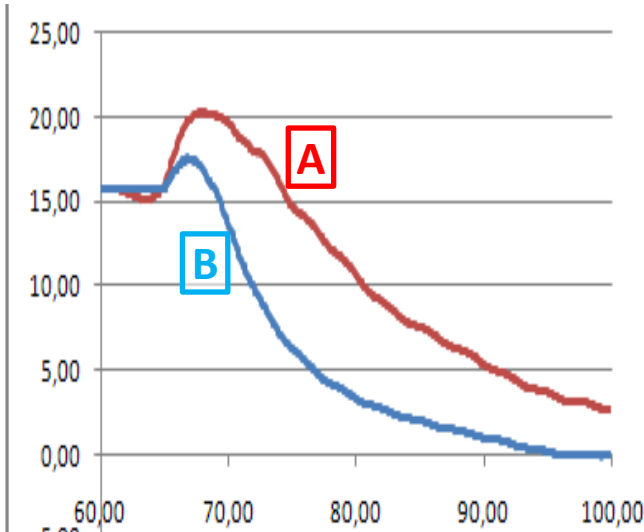
Simulation of behavior after *lack of pitch-drive adjustment*

Rotor-Speed **graph A**: Behaviour with standard pitch-drives safety.

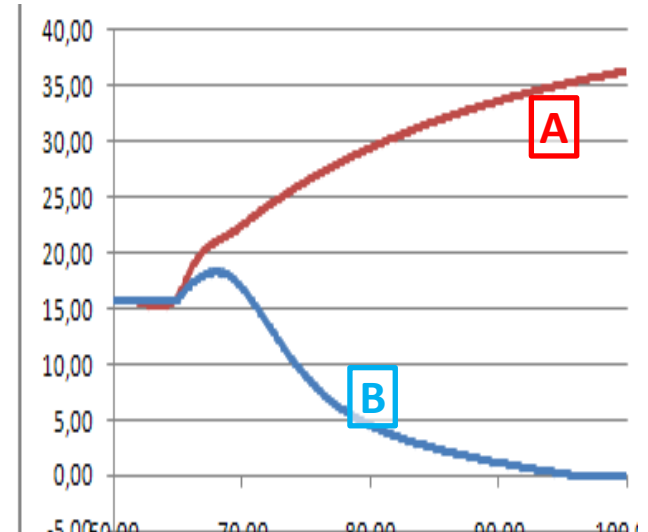
Rotor-Speed **graph B**: Double safety for rotor-stop with the NEW pitch-drives by SETEC.



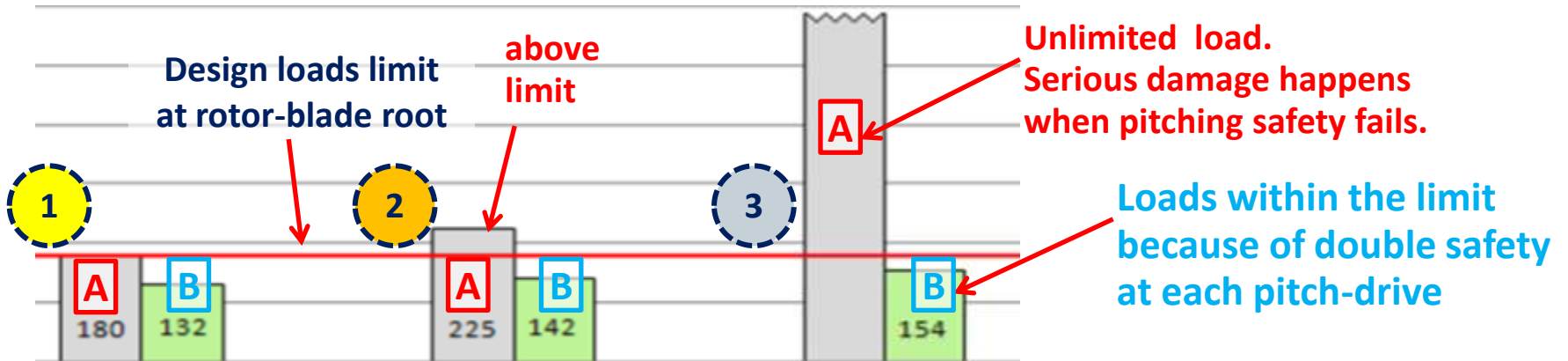
1 one R-blade not adjusting



2 two RB not adjusting



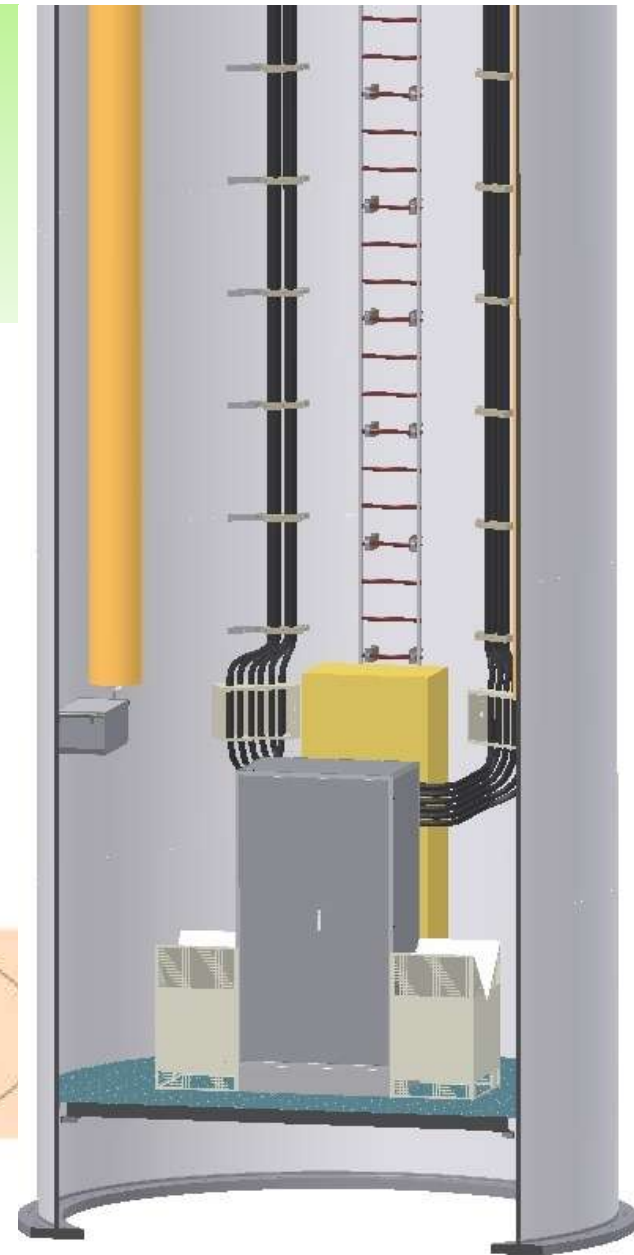
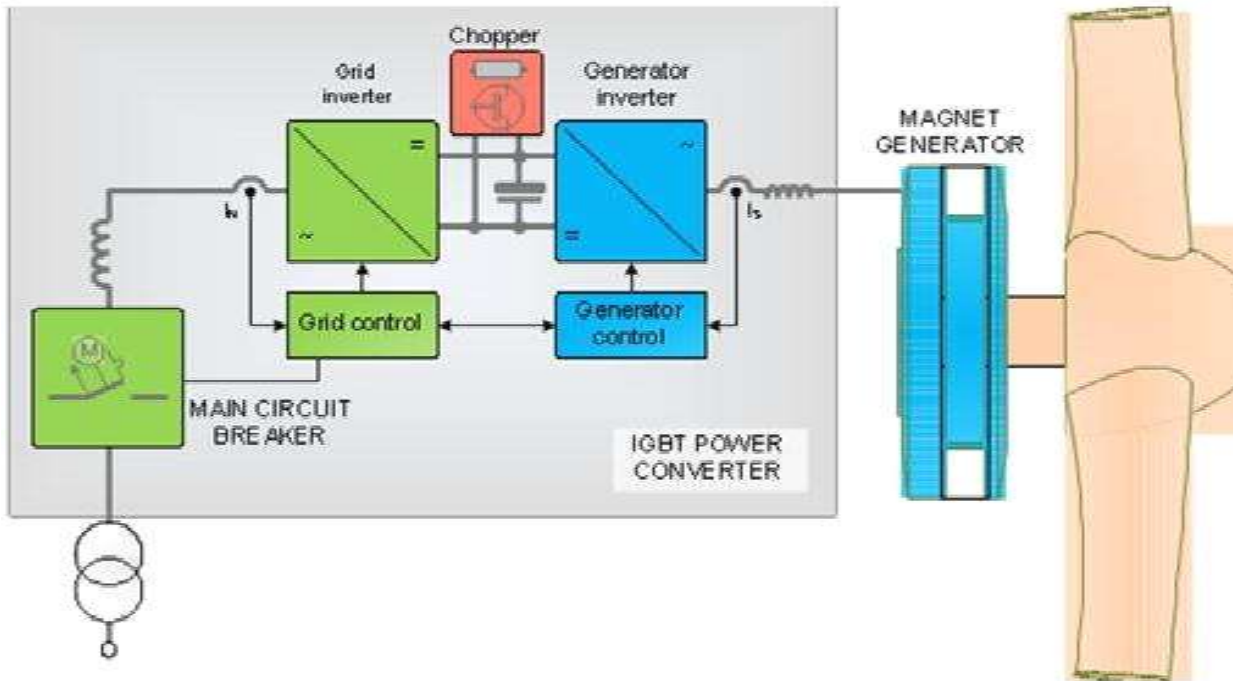
3 all RB remain in work





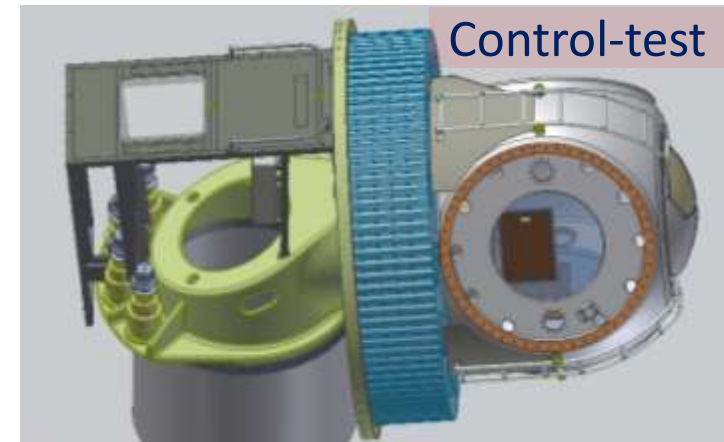
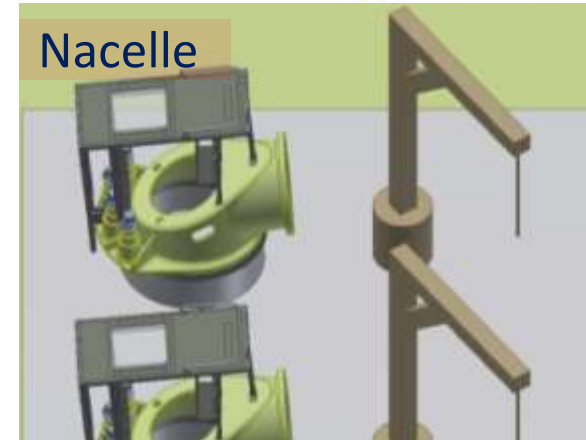
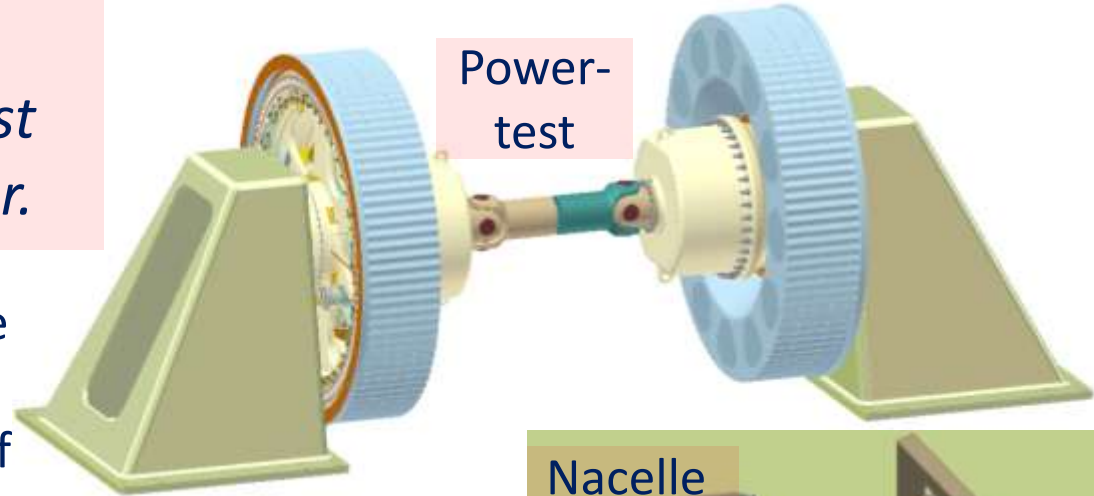
Direct-drive wind-turbine with the frequency converter, installed at basement of the tower

- Including the automatic control of active and reactive power, depending on the requirements of grid.
- Compact size and experience with more than 500 pieces in use.



The Wind-turbine Factory Stations of Assembly and Test of 80 sets of 1.5MW per year.

1. The space requirement for the PM-generator assembly:
 - one line for the assembly of the magnet-rotor;
 - one for the stator and main-bearing unit.
2. The rotor-hub and nacelle assembly lines:
 - one HUB-line for installation of pitch-drives, blade bearing
 - one nacelle line for installation of yaw-bearing and drives, control-system, generator-cooling.
3. At the end of the assembly lines:
 - function and power test,
 - storage and preparation for transport to site of installation.



EXAMPLE: Layout of an workshop of DIRECT-DRIVE-wind-turbines

Planning the process of manufacturing and the design of equipment is part of the proposal of cooperation.

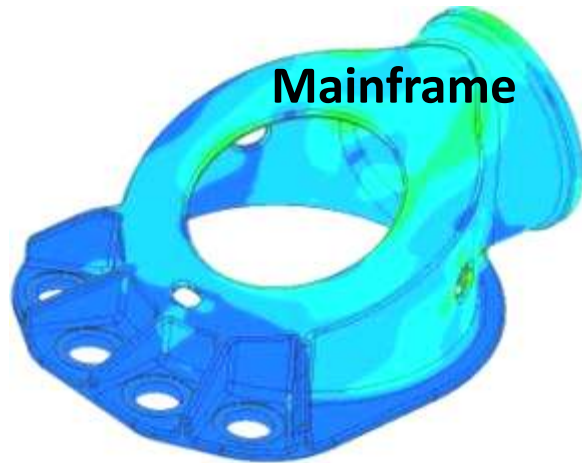
Floor dimensions:
Length: 130m; Width: 4x15m
Height: 15m
with 4 cranes between 20-40 t



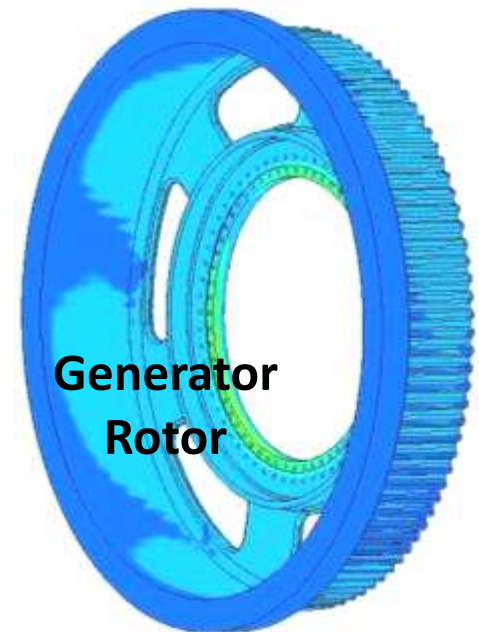
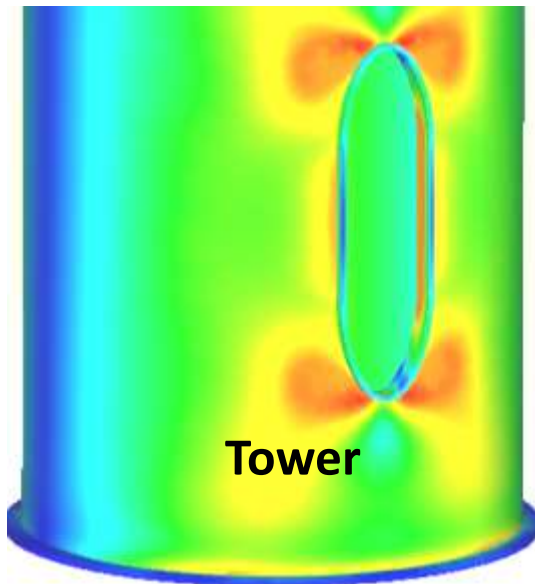
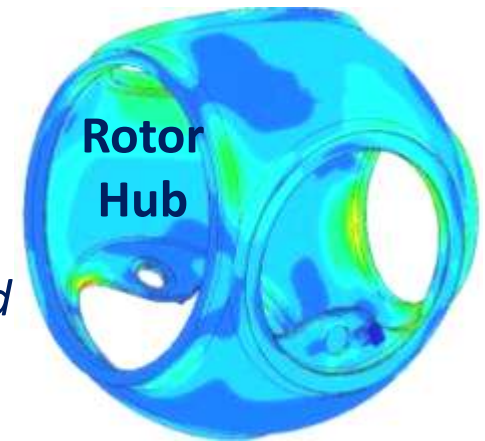
What are the options for cooperation and technology transfer for the set-up of a local manufacturing plant for wind-turbines ?

- The drawings and documents of whole mechanical structure and permanent-magnet generator, and even the possibility for the electronic hardware and software.
- The selection of wind-turbine characteristics, the range of power, and the locally available material and technology of the new factory will be respected.
- The detailed instruction and training on the technology, which has completely been designed by SETEC engineers.

Example: Structural design of the main components and the calculation of loads, stress, lifetime and deformation.

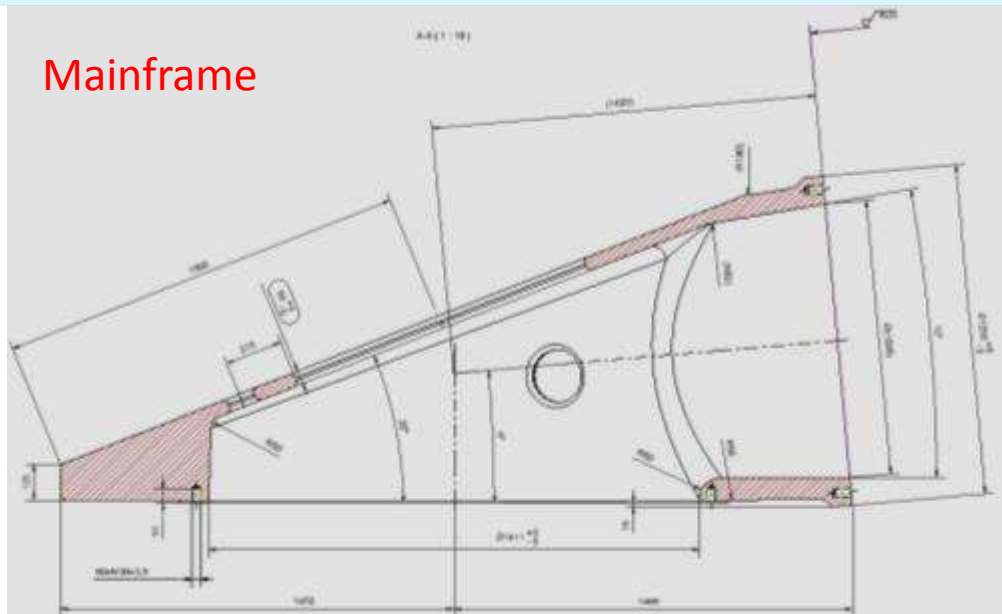


The FEM calculations are executed by the software "NX-Nastran" and the fatigue-life is proved by software "winlife"

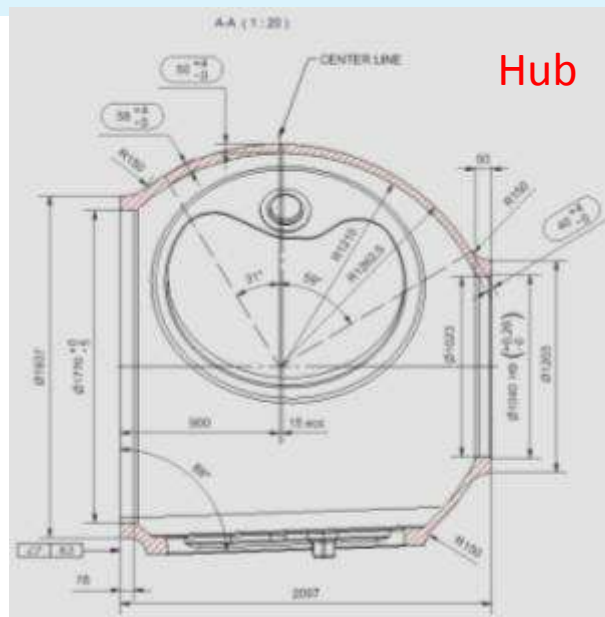


Example: Drawings of components of drive-train

Mainframe

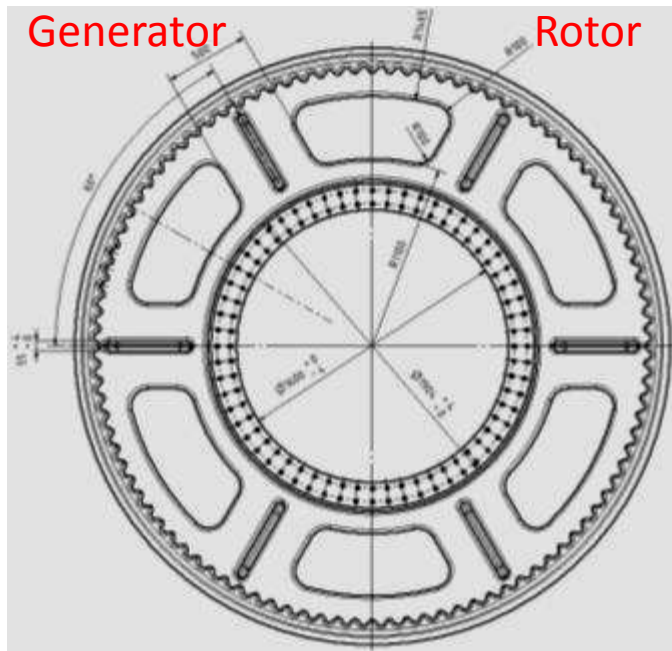


Hub



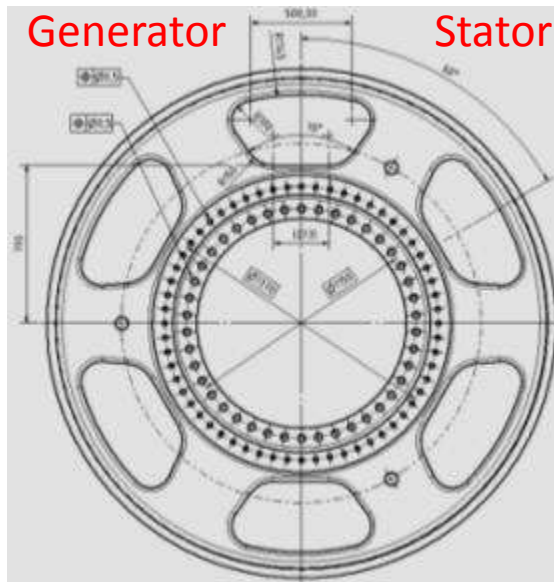
Generator

Rotor



Generator

Stator



All the drive-train parts are made of castings.



We are interested in cooperation with companies, that want to produce **wind-turbines in their own factories with high efficiency for the investment.**

The complete technology is available for technology transfer. This gives the opportunity for local manufacturing of the mechanical components, the PM-generator, and offers the option of technology transfer of the electronic systems hard- and software.

Experience of direct drive wind-power since 1997.

SETEC GmbH

Dresden / Germany

HP: www.setec-windpower.com

Email: info@setec-dresden.de

CEO: Mr. Fahrner ; Engineer and owner of the company which he founded in 1989

