AREVA Multibrid Experience and Outlook

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Agenda

- **Introduction**
  - **AREVA Multibrid**
  - **Technical Data M5000**
- **Project Alpha Ventus - experience**
  - **Pre transportations and mobilization**
  - **Installation Tripods**
  - **Erection tower segments S3 & S2**
  - **Erection S1, nacelle and rotor**
  - **Commissioning**
- **Outlook**
  - **Markets and new challenges**

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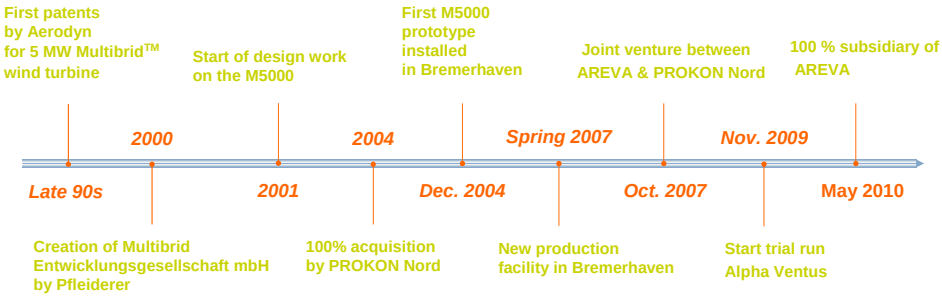
Multibrid subsidiary: a pioneer company…



… becoming a global player

Objective

- **Industrialize the M5000 turbine technology with focus on reliability and standardization**
- **Become an important market player in the offshore wind market**
- **Extend presence into markets like UK, Scandinavia, US and China**
- **Increase of wind turbine production capacity**
  - **80 to 100 wind turbines in Bremerhaven workshop**
  - **Production capacity extension under planning in Germany**
  - **Additional facility in US or China**
- **Strategic investments in supply chain (blades,…)**
- **Recruitment plan for high-skilled personnel**

Turbine Concept

- **Lightweigt**
  - **Nacelle and Rotor together weight only 349 tons**
  - **It can be lifted offshore onto the tower as a complete unit**
  - **Cost-effective tower and foundation structures**
- **Compact**
  - **Intelligent integration of the rotor bearing, gearbox and generator**
  - **The small plant dimensions lead to short paths for load transmission to the tower head**
- **Reliable**
  - **The low rotational speed and the low number of rotating parts and roller bearings reduce the risk of damage to the central drive train of the M5000**
  - **All key auxiliary aggregates and sensors are installed in duplicate**
  - **A special system permanently monitors the status of key components and reliably reports any irregularity.**
- **Protected**
  - **M5000 is equipped with a patented air treatment system to protect the plant technology. It sucks in the surrounding air and filters out the corrosive particles.**

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Main technical data

General	
Rated power	5,000 kW
Cut-in wind speed	4 m/s
Rated wind speed	12,5 m/s
Cut-out wind speed	25 m/s
Design life time	20 years
Type class	GL 2005 -TC 1

Rotor	
Rotor diameter	116 m
Number of blades	3
Rotor area	10,568 m^2
Speed range	4.5 -1 4.8 rpm ± 10%
Rated speed	14.8 rpm
Tilt angle	5°
Cone angle	-2°

Pitch system	
Principle	electrical single pitch
Power control	blade speed control

Tower	
Type	tubular steel

Gearbox	
Type	1 step-planetary gear, helical
Rated power	5,540 kW
Rated torque	3,575 kNm
Ratio	1: 10

Generator and Converter	
Generator type	synchronous, permanentmagnet
Rated voltage	3,000 V
Rated power generator	5,315 kW
Speed range	45.1 – 148.5 rpm
Protection class	IP 54
Converter type	4-quadrant-converter
Power factor (grid)	0.9 ind.- 0.9 cap.

Masses	
Blade	16,500 kg
Hub	62,000 kg
Nacelle	233,000 kg

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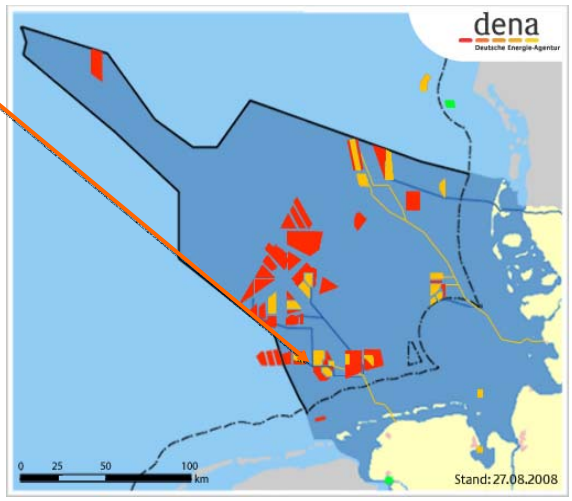
Alpha Ventus: Germany`s pilot project

- Location:
  - 40 km from Borkum
- No. Of turbines:
  - 6
- Hub heigh max.
  - 90 m
- Total heigh max.
  - 148 m
- Customer:
  - DOTI
- Water depth:
  - 28 m
- Foundation Type:
  - Tripod
- Scope of delivery:
  - Foundation
  - Turbine
  - Installation



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1st Step
Transport and Mobilization

1st Step Mrz - Jul | 2nd Step Apr - Mai | 3rd Step Jun -Jul | 4th Step Jul - Aug | 5th Step August

- **Tripods**
  - Vedal – Eemshaven
  - Wilhelmshaven – Eemshaven
- **Tower sections S1 and S2**
  - Bremen – Eemshaven
- **Blades**
  - Stade – Eemshaven
- **Tower sections S3, Nacelle and Hubs**
  - Bremerhaven – Eemshaven
- **Assembling Rotors**

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Tower sections in Eemshaven

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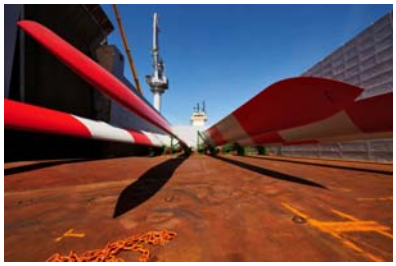
Loading of Blades in Stade



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Loading of Nacelle in Bremerhaven

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2nd Step Installation Tripods

1st Step Mrz - Jul | 2nd Step Apr - Mai | 3rd Step Jun -Jul | 4th Step Jul - Aug | 5th Step August

- **Mobilization of the jack-up barge ODIN for the tripod installation**
- **On 23rd April after four days the first tripod was installed**
- **On 30th May the last Tripod is installed.**

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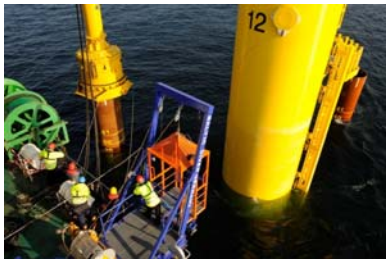
Installation of the 1st Tripod



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3rd Step
Erection of the Tower Segments S3 & S2

1st Step Mrz - Jul | 2nd Step Apr - Mai | 3rd Step Jun -Jul | 4th Step Jul - Aug | 5th Step August

- **Remobilization ODIN for tower installation**
- **On 15th June are the first tower segments S3 & S2 installed**
- **On 3rd July the last tower segments are installed**
- **Demobilization ODIN**

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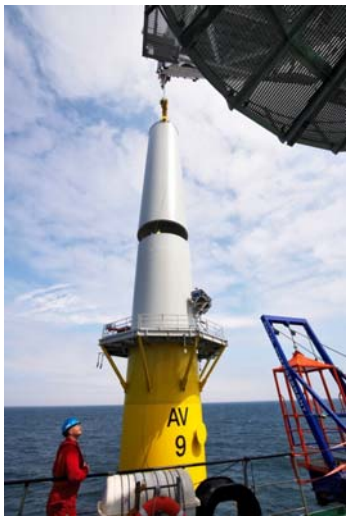
Erection Tower Segments S2 & S3



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4th Step
Nacelle and Rotor Installation

1st Step Mrz - Jul | 2nd Step Apr - Mai | 3rd Step Jun -Jul | 4th Step Jul - Aug | 5th Step August

- **Mobilization Jack-Up Barge JB-114**
- **The first WEC was installed on 15th July**
- **The last WEC was erected on 15th August**
- **Demobilization JB-114**

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Nacelle and Rotor Installation

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15th July 2009

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5th Step Commissioning of the first German offshore WEC

1st Step Mrz - Jul | 2nd Step Apr - Mai | 3rd Step Jun -Jul | 4th Step Jul - Aug | 5th Step August

- **Commissioning in 3 phases**
  - **Pre Commissioning**
  - **Cold Commissioning**
  - **Hot Commissioning**
- **On 4th August the AV9 producing first German offshore KWh**
- **On 27th August all WEC are commissioned**

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Markets and new challenges

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Markets and new challenges

- In order to harness the offshore wind potential of deeper waters such as those off the Norwegian coast, the Atlantic Ocean or the Mediterranean Sea, floating designs are required.
  - Three demonstrators are available in Europe today: the Hywind concept from Statoil Hydro (consists of a steel jacket filled with ballast); the Blue H concept, an integrated solution for a 5 MW floating turbine
  - The Sway concept, which is developed in partnership with Statkraft and Shell in particular. It is based on a floating elongated pole far below the water surface with ballast at the bottom part.
- Optimisation and adaptation of M5000 for new markets like Scandinavia, Baltic Sea and Mediterranean region and US

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Thank you for your attention

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