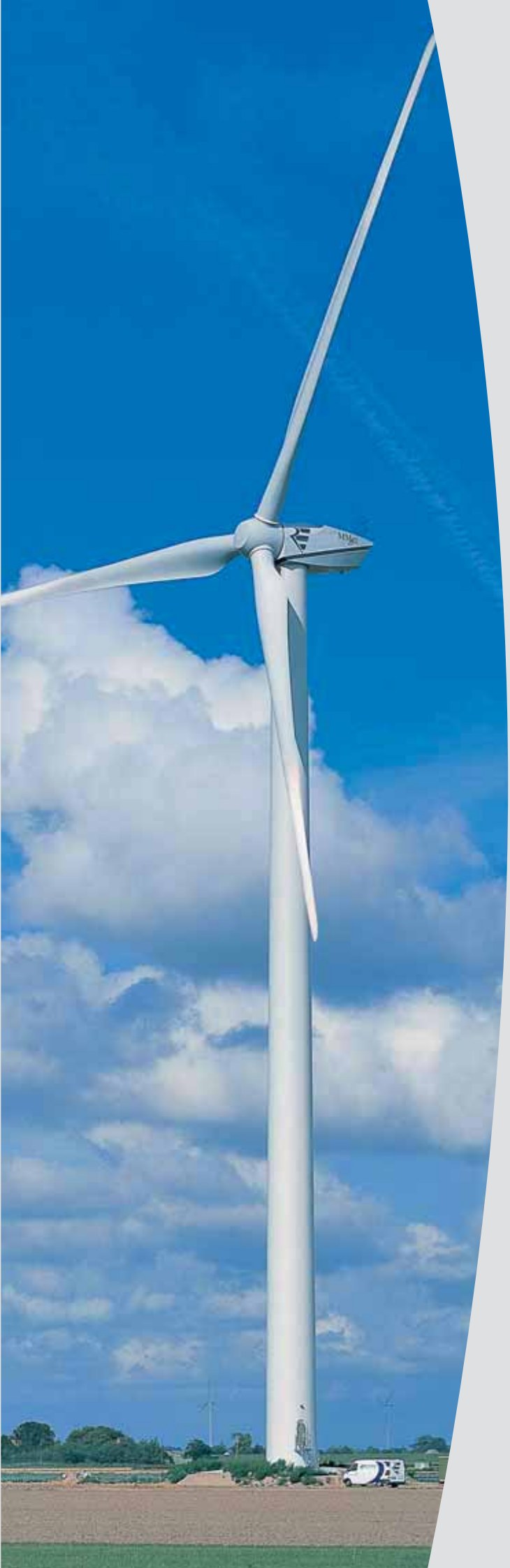
Annexe D1

Caractéristiques techniques des éoliennes REpower MM82 et MM92

REpower Systems

MM82

The 2-megawatt power plant
with 82 metre rotor diameter



MM82

Technical data

Design data	
Rated power	2,000 kW
Cut-in speed	3.5 m/s
Rated wind speed	13.0 m/s
Cut-out speed	25.0 m/s
Wind zone	up to DIBt 3
Type class	up to IEC Ia
Rotor	
Diameter	82.0 m
Rotor area	5,281 m^2
Rotor speed	8.5 – 17.1 rpm (+16.0 %)
Rotor blade	
Length	40.0 m
Type	GFC shell construction
or	GFC/CFC shell construction
Yaw system	
Type	Externally geared four-point bearing
Drive system	Gear motors
Stabilisation	Disc brake
Gear system	
Type	Helical planetary stage with two spur gear stages
or (optional)	helical planetary step-up gear with one spur gear step
Transmission ratio	i = approx. 105.4
Electrical system	
Generator type	Double-fed asynchronous generator, 4-pole
Rated power	2,000 kW
Rated voltage	690 V (50 Hz) 575 V (60 Hz)
Rated speed	900 – 1,800 rpm (50 Hz) 720 – 1,440 rpm (60 Hz)
Generator protection class	IP 54
Converter type	Pulse width-modulated IGBTs
Power control	
Principle	Electrical blade angle adjustment - pitch and speed control
Tower	
Type	Steel tube
Hub height	59 / 69 / 80 / 100 m

Foundation

Reinforced concrete foundation with foundation insert, adjusted on site conditions

Safety system

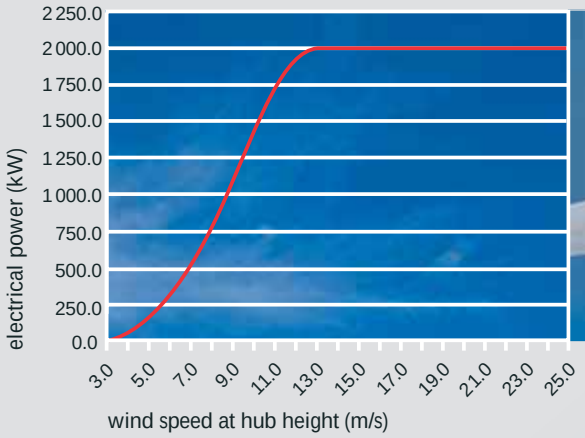
- Individually adjustable blades (electrically controlled) - fail-safe system
- Extensive redundant temperature and speed sensing system
- Fully integrated lightning protection
- Shielded cables and power rails protecting people and machinery
- Rotor holding brake with soft-brake function

The 2-megawatt power plant with 82 metre rotor diameter

The wind power plants of the MM series are based on the well-established technology driven concept of the 1.5 megawatt MD series with variable speed generator and converter system and electrical single-blade adjustment. The second generation of these high-performance power plants offer the same high reliability and maximum power output as previous models. Due to the leading technology and innovative solutions developed by REpower, the company's wind turbines can be fully integrated into the existing power grid.

Due to the excellent design in every detail, the MM series offers you excellent returns over its entire service life of the equipment.

The MM82 has a swept rotor area of 5,281 square metres and is available with hub heights between 59 and 100 metres. It has been specifically optimised for use in regions of high wind speeds.



Powerful, economical and long term reliability

By choosing REpower turbines, you are opting for power plant technology of the highest quality. To ensure that your investment retains its value, we offer you a comprehensive after-sales service.

Our permanent monitoring system monitors your power plants 365 days a year, 24 hours a day, ensuring the shortest possible response times of our locally based service team. We also offer you integrated service packs (ISPs) that allow you to set your long-term operating costs.

We are constantly upgrading our services to meet the increasingly stringent requirements of monitoring, documenting and optimising the operational behaviour of windfarms. With our "REguard" package, we offer you a comprehensive modular windfarm management system that can be flexibly configured to suit local factors, ensuring that your plant is operated in an efficient manner at all times.

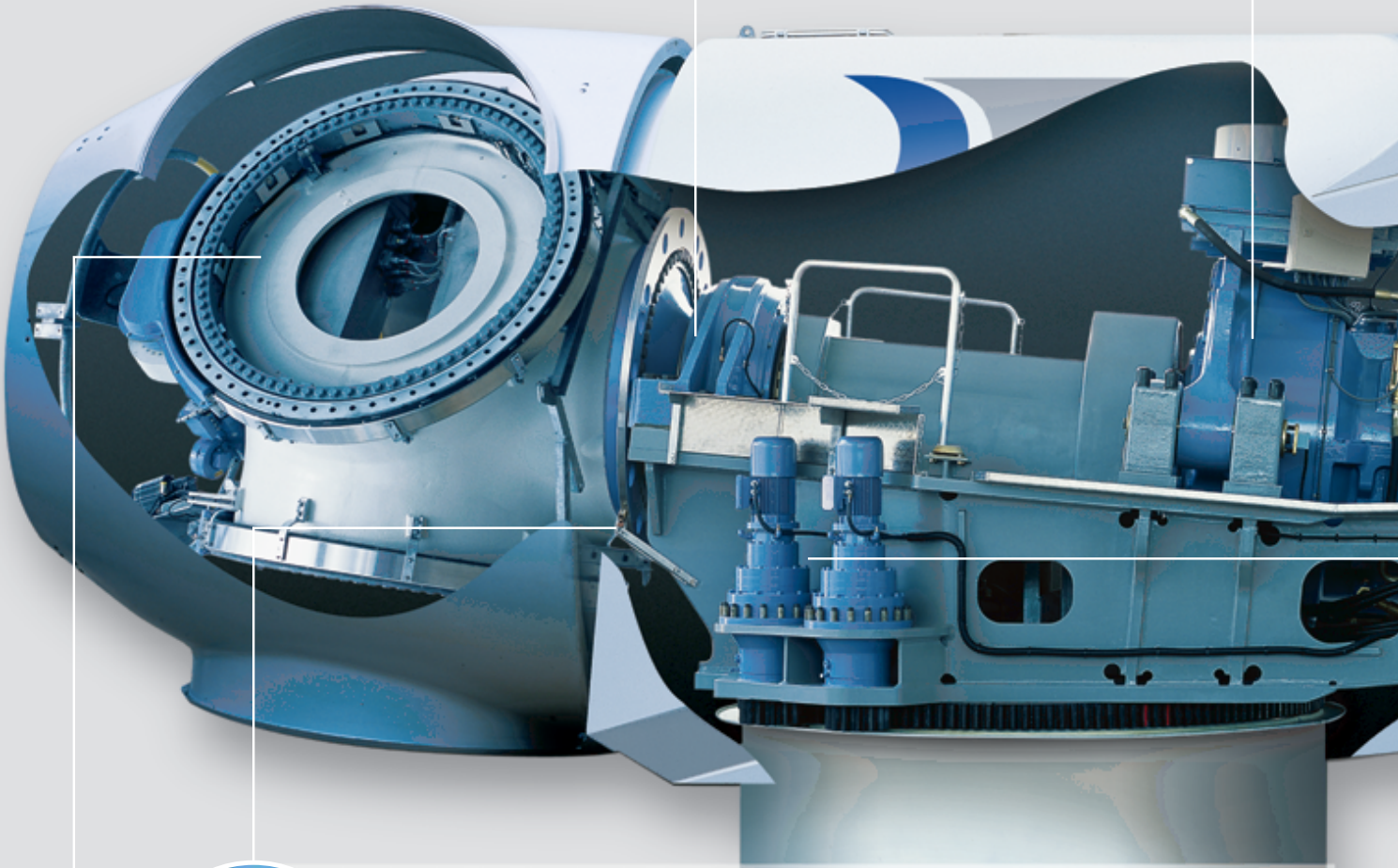
For more information, please refer to our brochures or contact our sales team for a personal consultation.

Rotor bearing and shaft

- High-performance spherical roller bearing with adjusted bearing housing and permanent lubrication for prolonged service life
- Rotor shaft forged from heat-treated steel and optimised for power flow

Gear system

- One helical planetary stage and two s
- Dimensioned according to REpower g life and smooth running ■ Optimised sound insulation ■ Low temperature three-stage oil filter system



Lightning protection

- Lightning protection concept conforming to IEC regulations with internal and external lightning protection
- External lightning protection system with blade receptors and lightning rod at the weather mast
- Reliable protection of bearings due to defined lightning conduits
- GFC coupling for the galvanic insulation of the generator system from the gear system
- Over-voltage arrester protecting the electric system
- Reliable protection of the generator by means of insulated bearing bushings

Pitch system

- Virtually maintenance-free electronic system ■ High-quality, generously dimensioned blade bearing with permanent track lubrication ■ Protected against the elements by means of integrated deflector in the spinner ■ Maximum reliability via redundant blade angle detection by means of two separate measuring systems ■ Fail-safe design with separate control and regulation systems for each rotor blade

Rotor hub

- Low deformation due to compact design adjusted to power flow ■ Optimised integration into pitch drive
- Generously dimensioned spinner allowing access to the hub in all weather

Environment

- No leakage of lubricants at hub or nacelle, due to
  - labyrinth packing in spinner
  - coaming edges in nacelle panelling and
  - grease pan below azimuth gearing
- Closed central lubrication system of blade bearings
- Shielding of all relevant cables and use of power rails to protect workers and machine

ry stage and two spur gear stages, or helical step-up gear with one spur gear stage
ding to REpower gear regulations, meeting the most stringent requirements regarding service
ning ■ Optimised efficiency ■ Elastomer bearing of torque multiplier for structure-borne
Low temperature level due to effective oil cooling system ■ Excellent oil quality due to
system

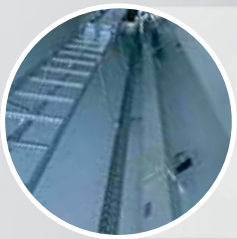
Holding brake
- Secure holding of rotor due to generously dimensioned disc brake
- Soft-brake function reducing stress to the gearbox

Generator and converter
- Yield-optimised variable speed range
- Low conversion loss and high total efficiency as converter output is limited to maximum 20 % of the overall output
- Fully enclosed generator with air/air heat exchanger
- Optimised temperature level in generator, even at high outside temperatures

ction

Azimuth
- Externally geared four-point bearing, driven by generously dimensioned high-quality gear motors
- Holding brakes with fail-safe function implemented with hydraulic pressure accumulator release the drives in idle mode and stabilise the nacelle
- Minimum load on drives due to low friction at four-point bearing and release of brakes during tracking

bility
ntrol



Power rail
- Prevention of electrical interference in the plant
- Compliance with VDE regulations
- Best possible protection in the event of a short circuit or fire

Tube tower
- Characteristic frequency of the tower is above rotating frequency of the rotor (rigid design) and ensures minimum stress in tower and machine
- No restrictions regarding speed range of unit, as there is no risk of frequency interference
- Excellent component safety due to elbow flanges and load-optimised door opening

Serviceability
- Ample space in nacelle for ergonomically optimised and reliable service
- Hub easily accessible in all weathers without having to leave the nacelle
- Excellent accessibility of all components
- Guards mounted over all rotating components ensure safe servicing
- If necessary, virtually all components of the plant can be easily and safety dismantled

The REpower sales teams are always there for you.

Germany
REpower Systems AG · Headquarters · Alsterkrugchaussee 378 · 22335 Hamburg · Germany
Phone: +49-40-53 93 07-0 · Fax: +49-40-53 93 07-37
E-mail: info@repower.de · www.repower.de

REpower Systems AG · Rödemis Hallig · 25813 Husum · Germany
Phone: +49-48 41-6 62-80 00 · Fax: +49-48 41-6 62-82 00
E-mail: info-husum@repower.de · www.repower.de

France
REpower S.A.S. · 13 rue Salomon de Rothschild · 92150 Suresnes · France
Phone: +33-1-41 38 93-93 · Fax: +33-1-41 38 93-94
E-mail: info@repower.fr · www.repower.fr

United Kingdom
REpower UK Ltd. · 5 Coates Crescent · Edinburgh · EH3 7AL · United Kingdom
Phone: +44-131-6 23 92-86 · Fax: +44-131-6 23 92-84
E-mail: info@repower-uk.co.uk · www.repower.de

Italy
REpower Italia S.r.l. · Via Ruggero di Lauria 12/b · 20149 Milan · Italy
Phone: +39-02-3 45 94 71 · Fax: +39-02-34 59 47 37
E-mail: italia@repower.de · www.repower.de

Portugal
REpower Portugal - Sistemas Eólicos S.A. · Zona Industrial · Apartado 17 · 3684-001 Oliveira de Frades · Portugal
Phone: +351-232-76 77 00 · Fax: +351-232-76 77 50
E-mail: portugal@repower.pt · www.repower.de

Spain
E-mail: iberica@repower.de · www.repower.de

Australia
REpower Australia Pty Ltd · Suite 610 · 370 St. Kilda Rd · Melbourne Victoria 3004 · Australia
Phone: +61-3-96 26 48 01 · Fax: +61-3-96 90 44 71
E-mail: info@repower.com.au · www.repower.com.au

Japan
Meidensha Corporation · Riverside Building, 36-2, Nihonbashi Hakozakicho, Chuo-ku · Tokyo 103-8515 · Japan
Phone: +81-3-56 41-72 08 · Fax: +81-3-56 41-93 10
E-mail: pubre@honsha.meidensha.co.jp · www.meidensha.co.jp

China
REpower Systems AG · Beijing Office · c/o AREVA China Headquarters-Suite 306
Beijing International Club Office Tower · 21, Jianguomenwai Avenue, Chaoyang District · Beijing 100020 China
Phone: +86-10-85 32-27 84 · Fax: +86-10-85 32-40 14
E-mail: delin.song@repower.de · www.repower.de

REpower North (China) Co., Ltd · Changqian Road, Qingshan District · Baotou, Inner Mongolia, P.R. China
Mail Add: No.3-4 mailbox, Baotou, 014033 · Inner Mongolia, P.R. China
Phone: +86-4 72-3 38 45 26 · Fax: +86-4 72-3 38 45 27
E-mail: northchina@repower.de · www.repower.de

USA
REpower USA Corp. · USA
E-mail: info@repower-usa.com · www.repower.de

	MM82	MM92	5M
Rated power	2,000 kW	2,000 kW	5,000 kW
Rotor diameter	82.0 m	92.5 m	126.0 m

03/2007

REpower Systems

MM92

The 2-megawatt power plant
with 92 metre rotor diameter

MM92

Technical data

Design data

Rated power	2,000 kW
Cut-in speed	3.0 m/s
Rated wind speed	11.2 m/s
Cut-out speed	24.0 m/s
Wind zone	up to DIBt 3
Type class	up to IEC IIa

Rotor

Diameter	92.5 m
Rotor area	6,720 m^2
Rotor speed	7.8 – 15.0 rpm (+12.5 %)

Rotor blade

Length	45.2 m
Type	GFC shell construction

Yaw system

Type	Double-row externally geared four-point bearing
Drive system	Gear motors
Stabilisation	Disc brake

Gear system

Type	combined planetary/spur wheel gearbox
Transmission ratio	i = approx. 120.0

Electrical system

Generator type	Double-fed asynchronous generator, 4-pole
Rated power	2,000 kW
Rated voltage	690 V (50 Hz) 575 V (60 Hz)
Rated speed	900 – 1,800 rpm (50 Hz) 720 – 1,440 rpm (60 Hz)
Generator protection class	IP 54
Converter type	Pulse width-modulated IGBTs

Power control

Principle	Electrical blade angle adjustment – pitch and speed control

Tower

Type	Steel tube
Hub height	68.5 / 78.5 / 80 / 100 m

Foundation

Reinforced concrete foundation with foundation insert, adjusted on site conditions

Safety system

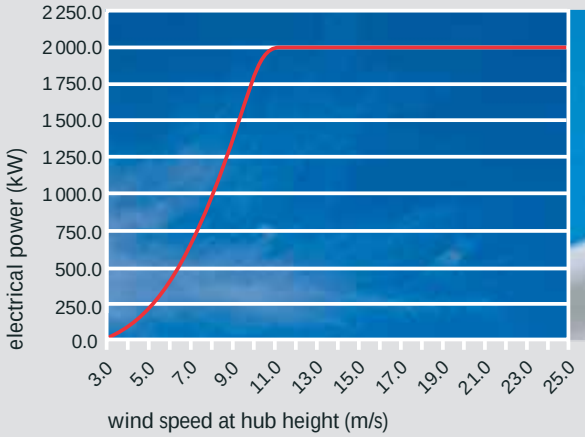
- Individually adjustable blades (electrically controlled) – fail-safe system
- Extensive redundant temperature and speed sensing system
- Fully integrated lightning protection
- Shielded cables and power rails protecting people and machinery
- Rotor holding brake with soft-brake function

The 2-megawatt power plant with 92 metre rotor diameter

The wind power plants of the MM series are based on the well-established technology driven concept of the 1.5 megawatt MD series with variable speed generator and converter system and electrical single-blade adjustment. The second generation of these high-performance power plants offer the same high reliability and maximum power output as previous models. Due to the leading technology and innovative solutions developed by REpower, the company's wind turbines can be fully integrated into the existing power grid.

Due to the excellent design in every detail, the MM series offers you excellent returns over the entire service life of the equipment.

The MM92 has a swept rotor area of 6,720 square metres and is available with hub heights between 68.5 and 100 metres. It has been specifically optimised for use in regions of low to medium wind speeds.



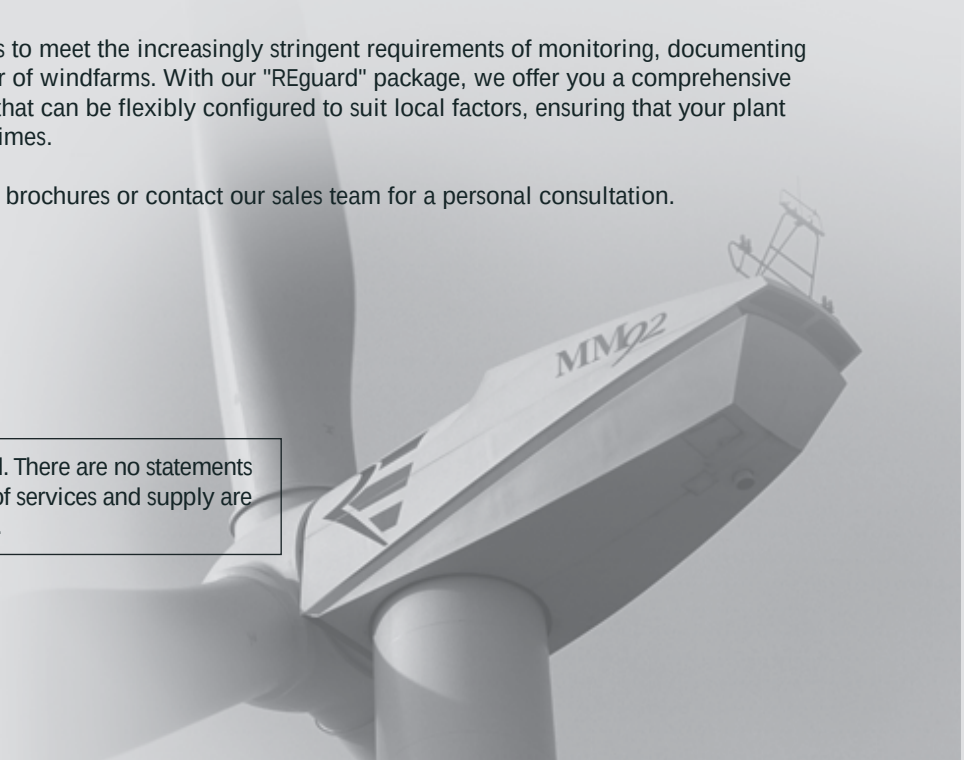
Powerful, economical and long term reliability

By choosing REpower turbines, you are opting for power plant technology of the highest quality. To ensure that your investment retains its value, we offer you a comprehensive after-sales service.

Our permanent monitoring system monitors your power plants 365 days a year, 24 hours a day, ensuring the shortest possible response times of our locally based service team. We also offer you integrated service packs (ISPs) that allow you to set your long-term operating costs.

We are constantly upgrading our services to meet the increasingly stringent requirements of monitoring, documenting and optimising the operational behaviour of windfarms. With our "REguard" package, we offer you a comprehensive modular windfarm management system that can be flexibly configured to suit local factors, ensuring that your plant is operated in an efficient manner at all times.

For more information, please refer to our brochures or contact our sales team for a personal consultation.

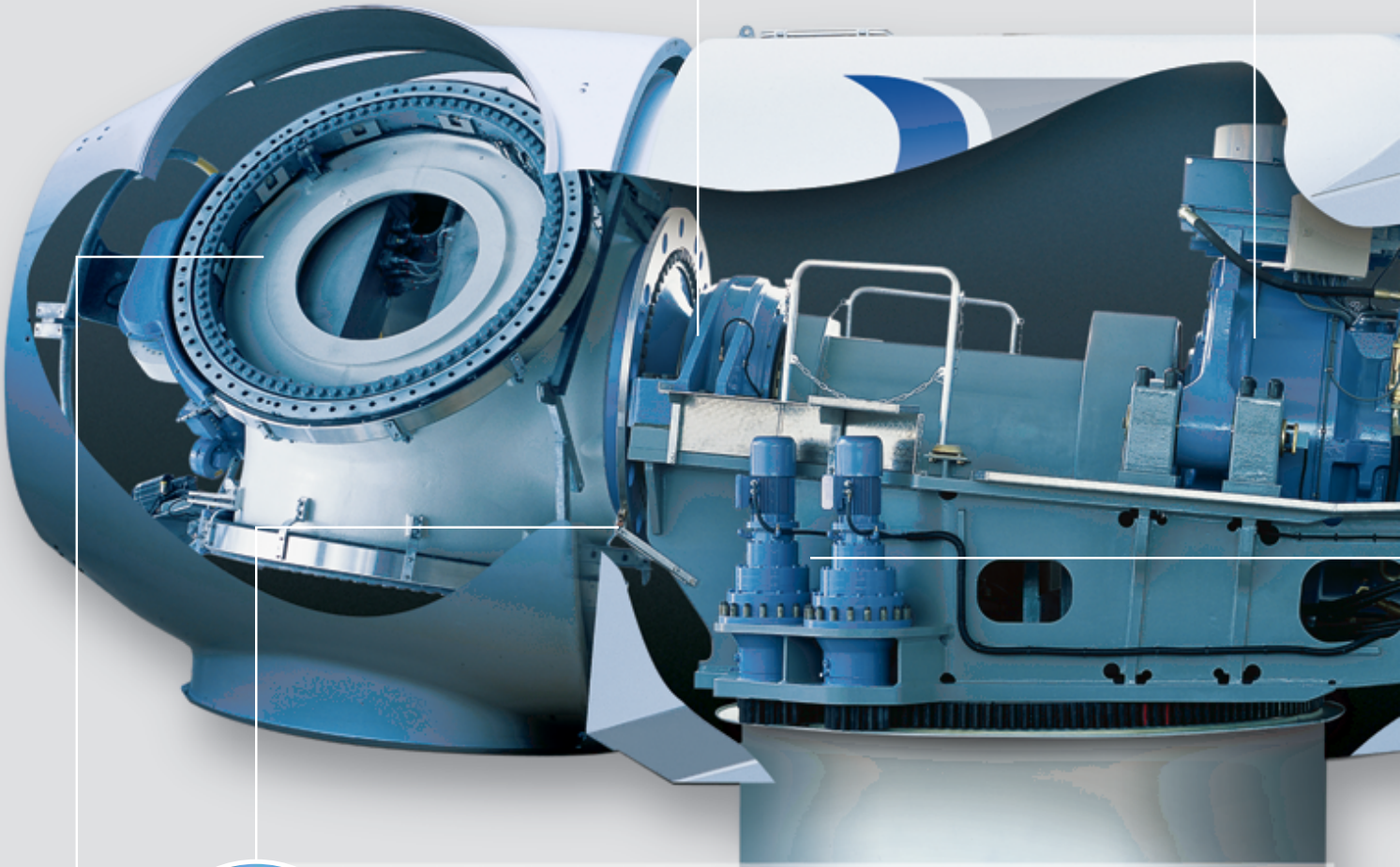


Rotor bearing and shaft

- High-performance spherical roller bearing with adjusted bearing housing and permanent lubrication for prolonged service life
- Rotor shaft forged from heat-treated steel and optimised for power flow

Gear system

- Combined planetary/spur wheel gear
- most stringent requirements regarding
- bearing of torque multiplier for structu
- cooling system
- Excellent oil quality



Lightning protection

- Lightning protection concept conforming to IEC regulations with internal and external lightning protection
- External lightning protection system with blade receptors and lightning rod at the weather mast
- Reliable protection of bearings due to defined lightning conduits
- GFC coupling for the galvanic insulation of the generator system from the gear system
- Over-voltage arrester protecting the electric system
- Reliable protection of the generator by means of insulated bearing bushings

Pitch system

- Virtually maintenance-free electronic system
- High-quality, generously dimensioned blade bearing with permanent track lubrication
- Protected against the elements by means of integrated deflector in the spinner
- Maximum reliability via redundant blade angle detection by means of two separate measuring systems
- Fail-safe design with separate control and regulation systems for each rotor blade

Rotor hub

- Low deformation due to compact design adjusted to power flow
- Optimised integration into pitch drive
- Generously dimensioned spinner allowing access to the hub in all weather

Environment

- No leakage of lubricants at hub or nacelle, due to
  - labyrinth packing in spinner
  - coaming edges in nacelle panelling and
  - grease pan below azimuth gearing
- Closed central lubrication system of blade bearings
- Shielding of all relevant cables and use of power rails to protect workers and machine

y/spur wheel gearbox ■ Dimensioned according to REpower gear regulations, meeting the rements regarding service life and smooth running ■ Optimised efficiency ■ Elastomer ultiplier for structure-borne sound insulation ■ Low temperature level due to effective oil xcellent oil quality due to three-stage oil filter system

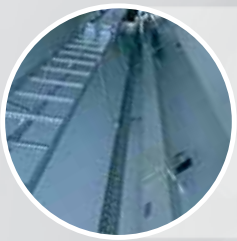
Holding brake
- Secure holding of rotor due to generously dimensioned disc brake
- Soft-brake function reducing stress to the gearbox

Generator and converter
- Yield-optimised variable speed range
- Low conversion loss and high total efficiency as converter output is limited to maximum 20 % of the overall output
- Fully enclosed generator with air/air heat exchanger
- Optimised temperature level in generator, even at high outside temperatures

ction

Azimuth
- Externally geared four-point bearing, driven by generously dimensioned high-quality gear motors
- Holding brakes with fail-safe function implemented with hydraulic pressure accumulator release the drives in idle mode and stabilise the nacelle
- Minimum load on drives due to low friction at four-point bearing and release of brakes during tracking

bility
ntrol



Power rail
- Prevention of electrical interference in the plant
- Compliance with VDE regulations
- Best possible protection in the event of a short circuit or fire

Tube tower
- Characteristic frequency of the tower is above rotating frequency of the rotor (rigid design) and ensures minimum stress in tower and machine
- No restrictions regarding speed range of unit, as there is no risk of frequency interference
- Excellent component safety due to elbow flanges and load-optimised door opening

Serviceability
- Ample space in nacelle for ergonomically optimised and reliable service
- Hub easily accessible in all weathers without having to leave the nacelle
- Excellent accessibility of all components
- Guards mounted over all rotating components ensure safe servicing
- If necessary, virtually all components of the plant can be easily and safety dismantled

The REpower sales teams are always there for you.

Germany
REpower Systems AG · Headquarters · Alsterkrugchaussee 378 · 22335 Hamburg · Germany
Phone: +49-40-53 93 07-0 · Fax: +49-40-53 93 07-37
E-mail: info@repower.de · www.repower.de

REpower Systems AG · Rödemis Hallig · 25813 Husum · Germany
Phone: +49-48 41-6 62-80 00 · Fax: +49-48 41-6 62-82 00
E-mail: info-husum@repower.de · www.repower.de

France
REpower S.A.S. · 13 rue Salomon de Rothschild · 92150 Suresnes · France
Phone: +33-1-41 38 93-93 · Fax: +33-1-41 38 93-94
E-mail: info@repower.fr · www.repower.fr

United Kingdom
REpower UK Ltd. · 5 Coates Crescent · Edinburgh · EH3 7AL · United Kingdom
Phone: +44-131-6 23 92-86 · Fax: +44-131-6 23 92-84
E-mail: info@repower-uk.co.uk · www.repower.de

Italy
REpower Italia S.r.l. · Via Ruggero di Lauria 12/b · 20149 Milan · Italy
Phone: +39-02-3 45 94 71 · Fax: +39-02-34 59 47 37
E-mail: italia@repower.de · www.repower.de

Portugal
REpower Portugal - Sistemas Eólicos S.A. · Zona Industrial · Apartado 17 · 3684-001 Oliveira de Frades · Portugal
Phone: +351-232-76 77 00 · Fax: +351-232-76 77 50
E-mail: portugal@repower.pt · www.repower.de

Spain
E-mail: iberica@repower.de · www.repower.de

Australia
REpower Australia Pty Ltd · Suite 610 · 370 St. Kilda Rd · Melbourne Victoria 3004 · Australia
Phone: +61-3-96 26 48 01 · Fax: +61-3-96 90 44 71
E-mail: info@repower.com.au · www.repower.com.au

Japan
Meidensha Corporation · Riverside Building, 36-2, Nihonbashi Hakozakicho, Chuo-ku · Tokyo 103-8515 · Japan
Phone: +81-3-56 41-72 08 · Fax: +81-3-56 41-93 10
E-mail: pubre@honsha.meidensha.co.jp · www.meidensha.co.jp

China
REpower Systems AG · Beijing Office · c/o AREVA China Headquarters-Suite 306
Beijing International Club Office Tower · 21, Jianguomenwai Avenue, Chaoyang District · Beijing 100020 China
Phone: +86-10-85 32-27 84 · Fax: +86-10-85 32-40 14
E-mail: delin.song@repower.de · www.repower.de

REpower North (China) Co., Ltd · Changqian Road, Qingshan District · Baotou, Inner Mongolia, P.R. China
Mail Add: No.3-4 mailbox, Baotou, 014033 · Inner Mongolia, P.R. China
Phone: +86-4 72-3 38 45 26 · Fax: +86-4 72-3 38 45 27
E-mail: northchina@repower.de · www.repower.de

USA
REpower USA Corp. · USA
E-mail: info@repower-usa.com · www.repower.de

	MM82	MM92	5M
Rated power	2,000 kW	2,000 kW	5,000 kW
Rotor diameter	82.0 m	92.5 m	126.0 m

03/2007
www.bartsch-design.de