DEHN protects Wind Turbines

www.dehn.de

Ensure safe operation, protect investments: With lightning and surge protection

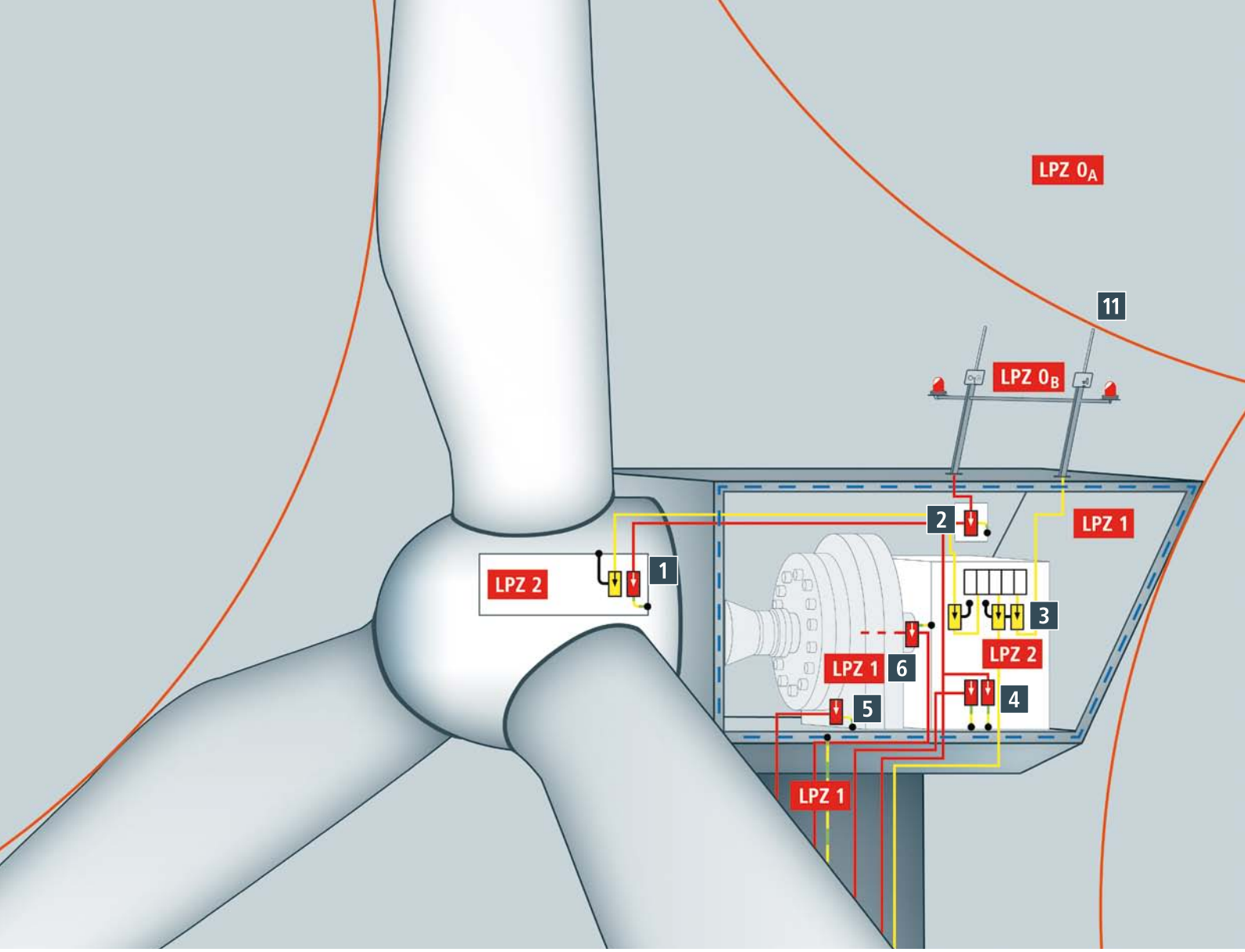
Make your investment a long-term win

The global wind power market recovered somewhat in 2011, thanks to a strong year in a number of national markets. The market grew by about 6 % compared to 2010, and the 40,5 GW of new wind power brought on line in 2011 represents investments of more than € 50 billion (about US$ 68 billion). The new global total at the end of 2011 is just shy of 238 GW, representing cumulative market growth of more than 20 %, which is certainly a respectable figure for any industry in this economic climate, even though it is lower than the average over the last 10 years, which is about 28 %.*

Lightning and surge protection of wind turbines is of particular importance since these facilities are especially vulnerable to lightning strikes due to their design, height and exposed location. The risk of lightning striking a wind turbine increases quadratically with its height. Cloud-to-earth flashes and earth-to-cloud flashes, which are also referred to as upward flashes, present a risk to wind turbines of more than 60 m in height. Long strokes with a high charge potential importance as due to their complexity, height and exposed location they are especially vulnerable to lightning strikes. Long-duration currents with high charging values, which must be especially taken into account for protecting the rotor blades and the dimensioning of lightning current arresters, are characteristic of upward flashes. Therefore, comprehensive lightning and surge protection is required for wind turbines.

You can rely on our experience in lightning and surge protection: We are a worldwide recognised expert – also in the field of wind energy. We develop customised protection concepts for wind turbines and test sub-components pursuant to IEC 61400-24 in our impulse current laboratory. Our customers include renowned manufacturers of wind turbines worldwide.

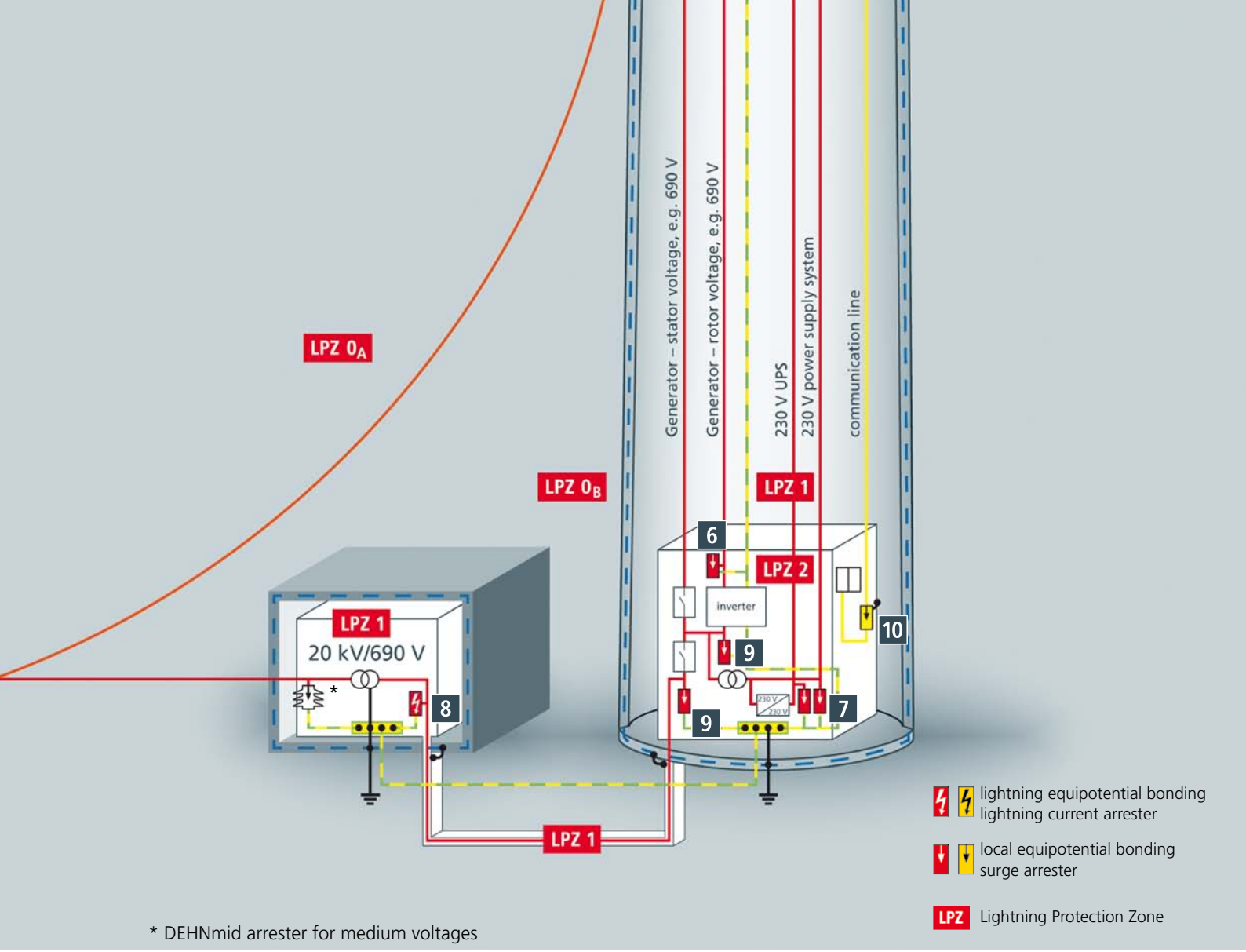
* Source: GWEC (Global Wind Energy Council), Global Wind Report, annual market update 2011.



Profit from our expertise in developing lightning protection zones concepts

Our experience in lightning protection over decades and our intensive research and development activities in the field of wind turbines are key factors for the design and development of lightning protection systems (LPS). Our aim is to prevent lightning damage to rotor blades, bearings and gearboxes as well as downtime as a result of lightning strikes and surges.

The lightning protection zones (LPZ) concept for wind turbines as per IEC 61400-24 is based on IEC 62305, which defines the selection and arrangement of lightning and surge protection measures.



* DEHNmid arrester for medium voltages

The IEC 61400-24 standard recommends to dimension the lightning protection system of a wind turbine according to class LPS I unless a risk assessment demonstrates that a lower LPS class is sufficient for the individual components.

The complete LPS of a wind turbine consists of

- an external lightning protection system
- surge protective devices (SPDs)

to protect electrical and electronic equipment. In order to plan protection measures, it is advisable to subdivide the wind turbine into lightning protection zones (LPZ). The rolling sphere method can be used to determine LPZ 0_A and LPZ 0_B.

LPZ 0 is the outer zone where the threat is due to the undamped lightning electromagnetic field and where the internal systems may be subjected to the full or partial lightning current.

LPZ 0 is subdivided into:

- LPZ 0_A: Parts of the wind turbine which may be subjected to direct lightning strikes and the full lightning electromagnetic field.
- LPZ 0_B: Parts of the wind turbine which are protected against direct lightning strikes, but where the full lightning electromagnetic field is active.

LPZ 1 and **LPZ 2** are inner zones that are protected against direct lightning strikes. However, impulse currents must be limited by current distribution, isolating interfaces and SPDs on the zone boundaries.

1 Signal lines nacelle – hub
Voltage supply of the hub

Type	Part No.
DG M TN CI 275 FM	952 178
BXT ML4 BE 24	920 300 / 920 324
DPA M CLE RJ45B 48	929 121

2 Protection of the aircraft warning light
LPZ 0_B – LPZ 1

Type	Part No.
DG M TN CI 275 FM	952 178

3 Signal line of the weather station
LPZ 0_B – LPZ 2

Type	Part No.
BXT ML4 BE 24	920 300 / 920 324
BXT ML2 BE S24	920 224

4 Control cabinet in the nacelle
230/400 V voltage supply

Type	Part No.
DG M TNC 275 FM	952 305

5 Protection of the stator side

Type	Part No.
DG M WE 600 FM	952 307

6 Protection of the rotor side
"NEPTUNE" arrester combination:
3 x DEHNguard® 1000 FM
1 x TFS SN1638

Type	Part No.
Mains connection box with "NEPTUNE" arrester combination	989 405/S NAK SN4563

7 Voltage supply of the control cabinet in the tower base
230/400V TN-C system

Type	Part No.
DG M TNC 275 FM	952 305

8 Low-voltage side of the transformer
400/690 V TN system

Type	Part No.
DBM 1 440 FM	961 145

9 Protection of the inverter and the main incoming supply

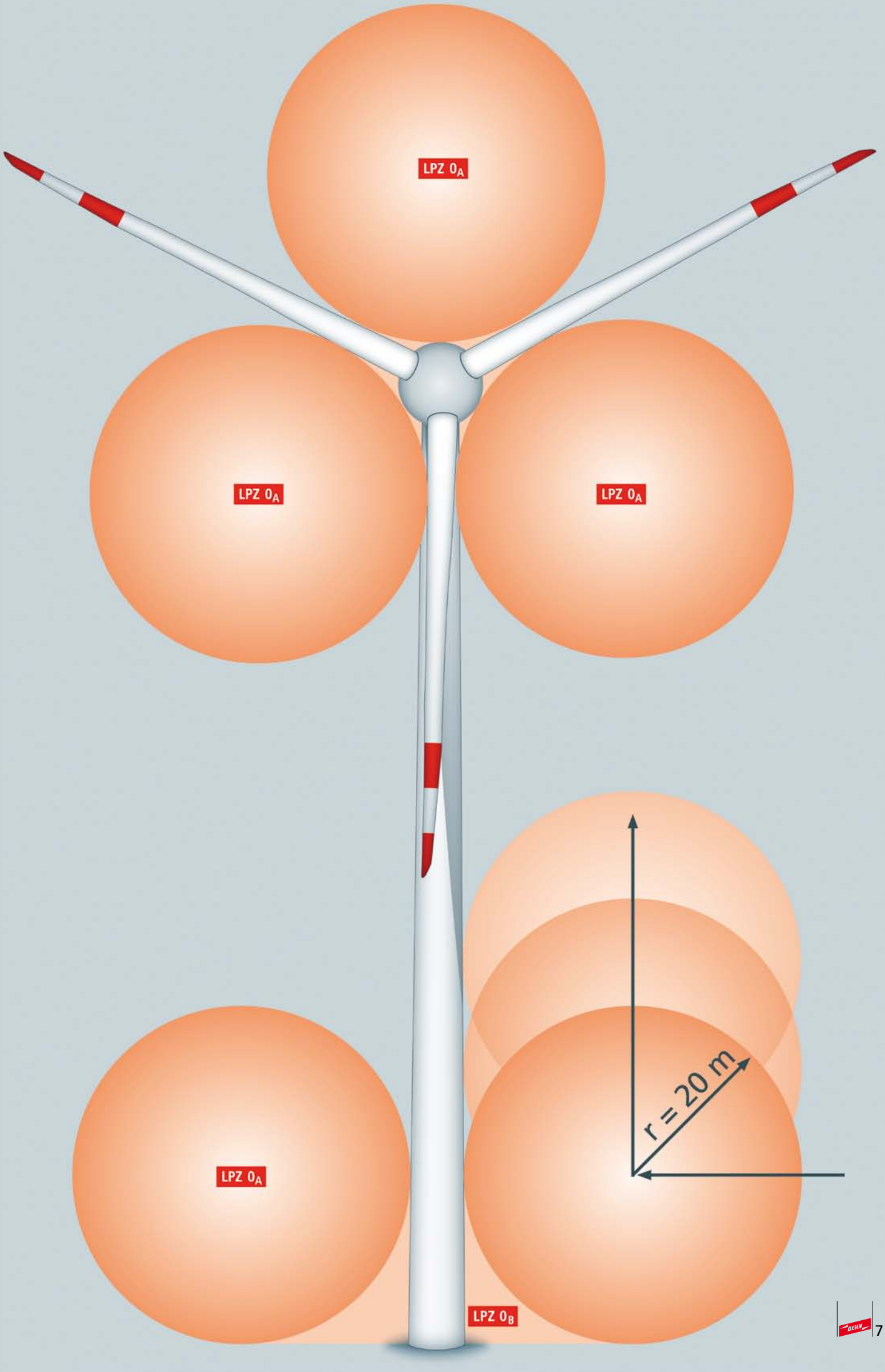
Type	Part No.
DG M WE 600 FM	952 307

10 Protection of the signal lines in the control cabinets of the nacelle and the tower base

Type	Part No.
BXT ML4 BE 24	920 300 / 920 324
BXT ML2 BE S 24	920 224

11 Protection of wind sensors

Type	Part No.
air-termination rods	103 449
pipe clamp	540 105


LPZ 0A
LPZ 0A
LPZ 0A
LPZ 0A
r = 20 m
LPZ 0B

Lightning / surge protection for power supply systems

Hazards can be avoided by implementing coordinated surge protection measures for power supply systems. This increases the availability of wind turbines in the long term.

DEHNbloc® Maxi

Coordinated single-pole type 1 lightning current arrester*

Type	Part No.
DBM 1 760 FM**	961 175
DBM 1 440 FM**	961 145

DEHNguard®

Type 2 surge arrester*

Type	Part No.
DG M WE 600 FM**	952 307
DG M TNS 275 FM**	952 405
DG M TN 275 FM**	952 205
DG 1000 FM**	950 112

Arrester combination "NEPTUNE" circuit

NEPTUNE arrester combination:
3 x DEHNguard® 1000 FM
1 x TFS SN1638

Type	Part No.
Mains connection box with "NEPTUNE" arrester combination	989 405/S NAK SN4563

P2 impulse counter

Registration of discharge processes and indication via floating contact

Type	Part No.
Serial No. 1632	910 502/S

* Vibration and shock-tested according to EN 60068-2
** FM = floating remote signalling contact

Lightning / surge protection for information technology

Optimised protection concepts prevent damage to information and data technology systems. In this context, condition monitoring is indispensable for the safe operation and availability of wind turbines which is ensured by the LifeCheck® feature with RFID technology. Remote monitoring for example is also possible via wireless network.

BLITZDUCTOR®

Universal combined arrester* for data lines, bus systems, measured value transmission, temperature measuring devices, heating systems and weather sensors. The modular BLITZDUCTOR XT features an integrated LifeCheck® function.

Type	Part No.
BXT ML2 BD 180	920 300 / 920 247
BXT ML2 BE HFS 5	920 300 / 920 270
BXT ML2 BE S 24	920 300 / 920 224
BXT ML2 BD S 24	920 300 / 920 244
BVT ALD 36	918 408

LifeCheck® arrester monitoring with RFID technology

DEHNrecord SCM XT monitors up to 10 arresters in a monitoring group, while DEHNrecord MCM XT monitors up to 150 arresters in networked monitoring groups. DRC SCM and DRC MCM: Visual fault indication and indication via remote signalling contact*.

Type	Part No.
DRC MCM XT	910 695
DRC SCM XT	910 696

DEHNpatch class E / POE+

Universal surge arrester for Ethernet** and similar applications in structured cabling systems according to class E up to 250 MHz.

Type	Part No.
DPA M CLE RJ45B 48	929 121

* Vibration and shock-tested according to EN 60068-2
** PoE+ according to IEEE 802.3at

External lightning protection for measurement equipment and signalling devices

Air-termination systems from DEHN protect wind measurement equipment and aircraft warning lights mounted on the nacelle from direct lightning strikes.

HVI®Conductor

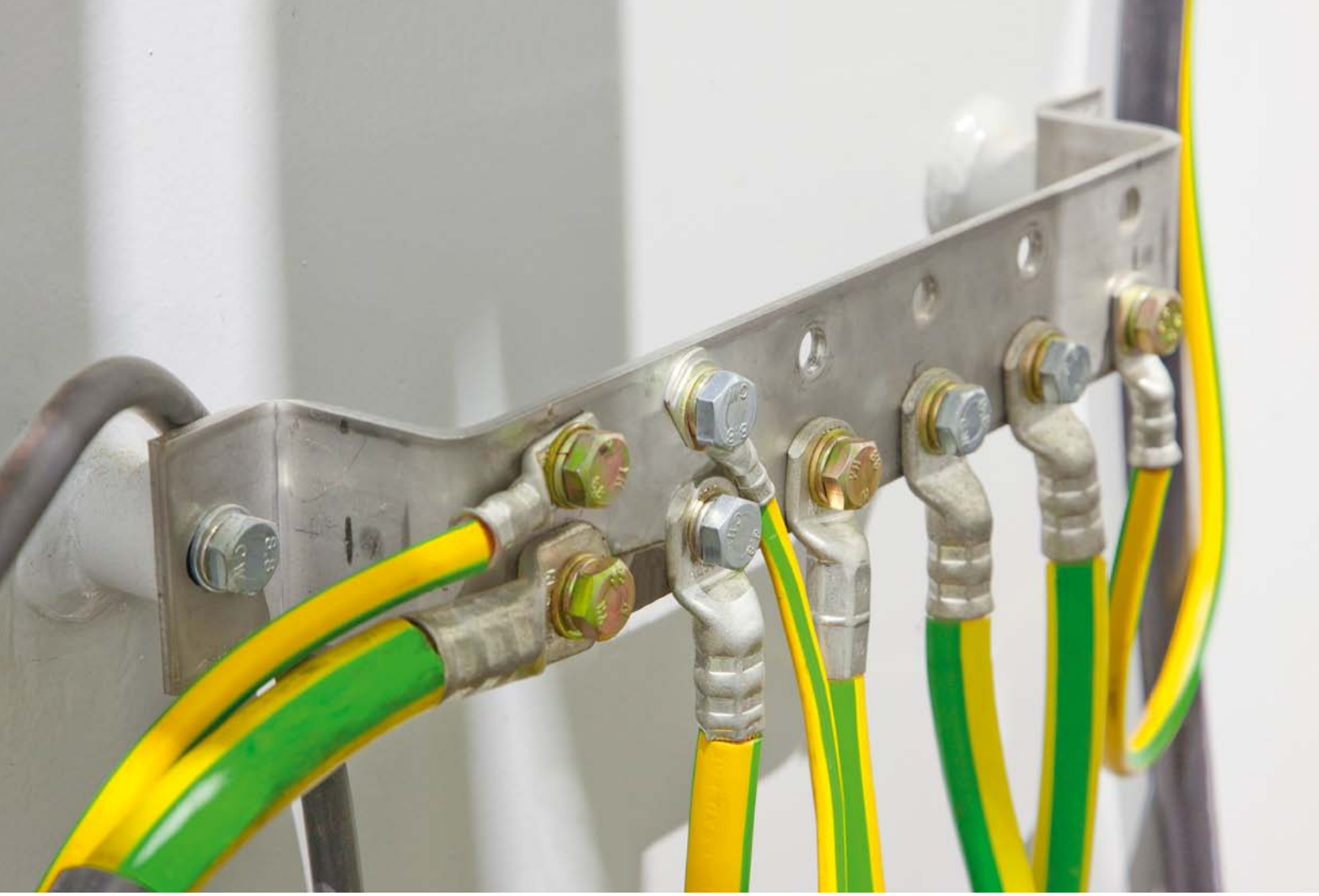
High-voltage-resistant insulated down conductor keeps the separation distance from conductive parts in compliance with IEC 62305-3.

Type	Part No.
HVI®Conductor I, black	819 020
HVI®Conductor I, grey	819 023

DEHNiso Combi set

Robust and ready-to-mount complete unit

Type	Part No.
GRP/Al supporting tube	105 300
Stainless steel air-termination tip	105 071

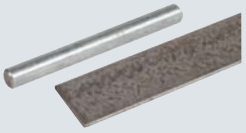


Protection of the tower base, foundation and equipotential bonding system

An earth-termination system is required to protect electrical operating and lightning protection systems. The earth-termination system is connected to the main earthing busbar (MEB) via the terminals on the earth-termination system. The main earthing busbar, in turn, is connected to equipment and surge protective devices.

Equipotential bonding and earthing

Type	Part No.
Equipotential bonding bar	472 139



Type	Part No.
Round wire „Rd“ Ø 10 mm	800 010
Strip „Fl“ 30 x 3,5	810 335

Type	Part No.
Fixed earthing terminal of type M	478 011

Type	Part No.
Cross unit	318 201

Type	Part No.
Connecting clamp	308 030
U-clamp	308 045

Safe working during service operation

We offer adequate equipment for dead or live working according to the five safety rules.

1. Disconnect completely

Switching sticks, fuse tongs, protective gloves

Type	Part No.
Switching stick	763 611
Fuse tong	765 041
Protective glove of size 10	785 798

2. Secure against re-connection

Insulating plugs, insulating blades, lock-out systems

Type	Part No.
Insulating plug	785 640
Insulating blade	785 642
Lock-out system	785 637

3. Verify that the installation is dead

PHE III voltage detectors, DEHNcap A voltage indicators

Type	Part No.
PHE III voltage detector	767 733
DEHNcap A	767 111

4. Carry out earthing and short-circuiting

Earthing and short-circuiting devices, configure your earthing and short-circuiting devices online: www.dehn.de/en/euk

Type	Part No.
EKV3+1 70 R three-pole earthing and short-circuiting device	VVYCLAF
Earthing stick	761 002

Our tests and services ensure that your devices and equipment fulfil the most stringent technical requirements and safety standards.

5. Provide protection against adjacent live parts

Protective shutter for protection against adjacent live parts

Type	Part No.
Protective shutter	763 211

Personal protective equipment

Helmets and face shields with clip, protective gloves, protective trousers and jackets

Type	Part No.
Helmet and face shield	785 740
Protective glove	785 798
DEHNcare jacket APJ 52	785 772
DEHNcare trousers APT 52	785 782

Rescuing electrified victims

Rescue rods for rescuing persons up to a weight of approximately 100 kg from the live working zone

Type	Part No.
RST 36 2000 rescue rod	766 042

Long-standing experience in wind turbine concepts

Wind turbines place special demands on lightning and surge protection that must be taken into account already at the design stage. The protection concept and correct dimensioning of surge protective devices are important prerequisites for the safe operation of wind turbines.

A lightning and surge protection concept must be integrated in the overall protection concept of a wind turbine. The earth-termination system concept, for example, must be matched with the external and internal lightning protection measures. When selecting arresters, energy coordination of the different arrester stages must be observed for the internal lightning protection concept to ensure that even sensitive terminal equipment is protected. To achieve the protection goals, special applications of certain lightning and surge protective devices may be required. An overall protection concept requires that a lot of information is collected and centrally evaluated to ensure the availability of the wind turbine.

DEHN has long-standing experience in protection concepts for complex systems, especially in the field of wind energy. The advantages are quite obvious: Systematic lightning and surge protection prevents downtime and saves maintenance and repair costs. This ensures a continuous energy yield even in the event of lightning strikes and surges. For economic reasons, the protection concept must be implemented already at the design stage to avoid expensive repair and retrofit measures at a later time. Only a properly working overall system ensures fast ROI.

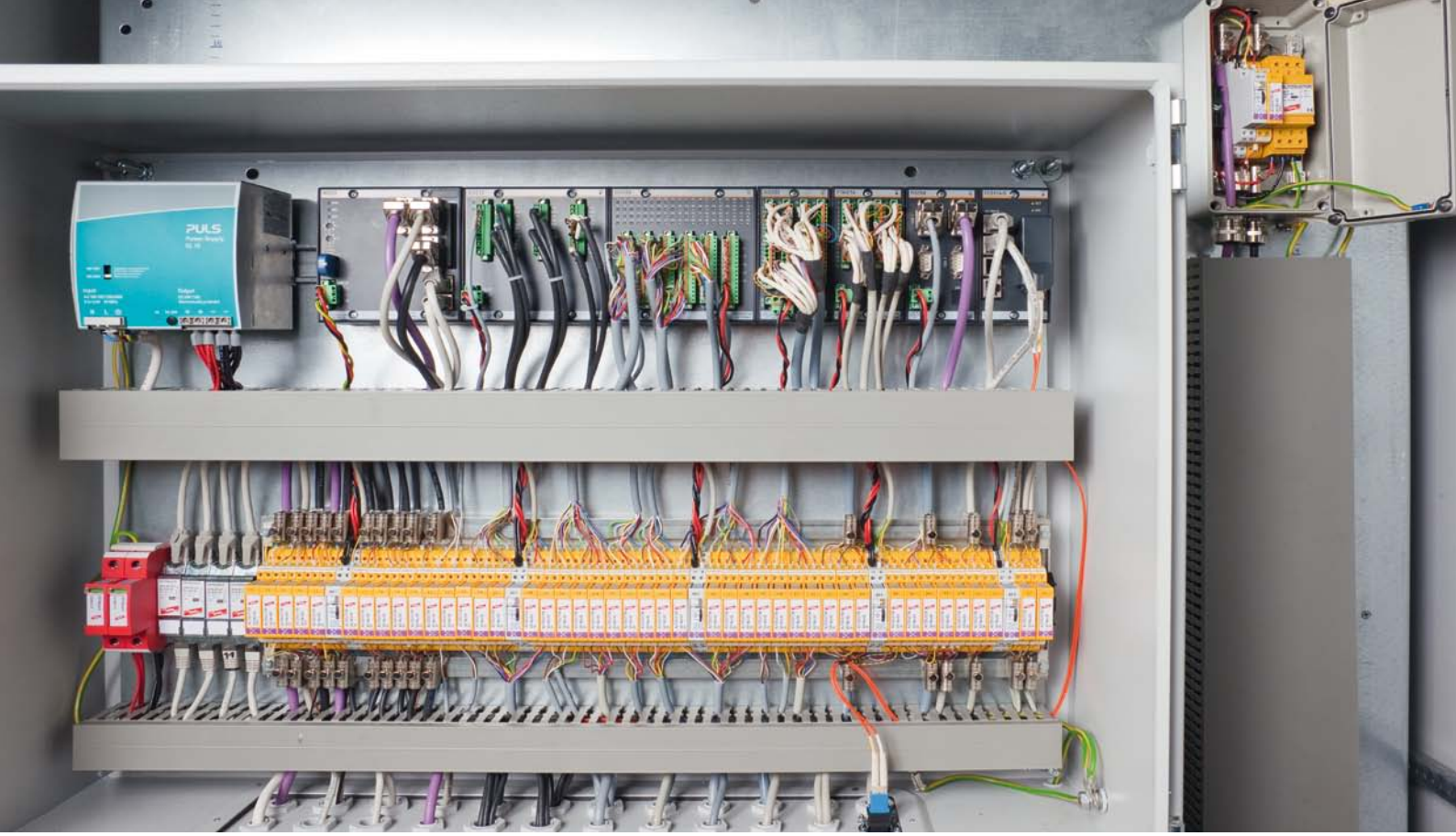
We develop customised solutions suited to your needs. Please do not hesitate to contact us: info@dehn.de

DEHN products used in a steel and concrete hybrid tower

A new generation of wind turbines with greater tower heights, larger rotor diameters and a nominal capacity of more than three megawatts was introduced on the market. The innovative hybrid tower system from the Max Bögl group, which is among the five largest German construction companies, is an ideal solution for wind turbines with large hub heights.

MAX BÖGL
Progress is built on Ideas.

The hybrid tower system from Max Bögl allows hub heights up to 150 m above ground and a total wind turbine height of 200 m including the rotor. In close cooperation with its in-house steel and plant construction and R&D department, Max Bögl, one of the leading manufacturers of prefabricated components in Germany, realised a hybrid tower consisting of a combination of precast concrete and steel elements. The hybrid tower was adapted and a sophisticated prototype was developed together with leading international wind turbine manufacturers and DEHN, the high-class lightning and surge protection provider. Among other things, DEHN has been closely involved in the development of the earthing concept. Today numerous DEHN products are used in these hybrid towers.



Protection concepts for onshore and offshore wind turbines

The globally active company Bachmann electronic offers complete system solutions for automation technology. The high-tech company dominates the automation market in the field of wind energy. In cooperation with Bachmann electronic, DEHN developed a concept for protecting the controller from surge damage.

Functional safety in the tower is quite differently assessed by wind turbine manufacturers. Modern solutions with programmable safety controllers, however, allow to implement functions that go far beyond the typical EMERGENCY OFF chain: Safe remote monitoring and maintenance in combination with intelligently used redundancies do not only ensure availability, they may even improve it.

The protection concept developed by Bachmann electronic and DEHN is a complete safety package including the protection of all Bachmann interfaces. Depending on the evaluation unit, the sensors situated in different lightning protection zones are monitored and protected by BLITZDUCTOR XT arresters from DEHN. The condition monitoring system allows to detect overloaded arresters in time and to indicate imminent failure. Up to 10 arresters can be monitored at the same time by means of the DEHNrecord DRC MCM XT module. The operating state of the arresters can be evaluated at any time via the controller.

Bachmann electronic and DEHN place a high degree of importance to system availability. For this reason, all important interfaces are protected. This protection concept is already successfully implemented under harshest conditions for onshore and offshore wind turbines.

bachmann.

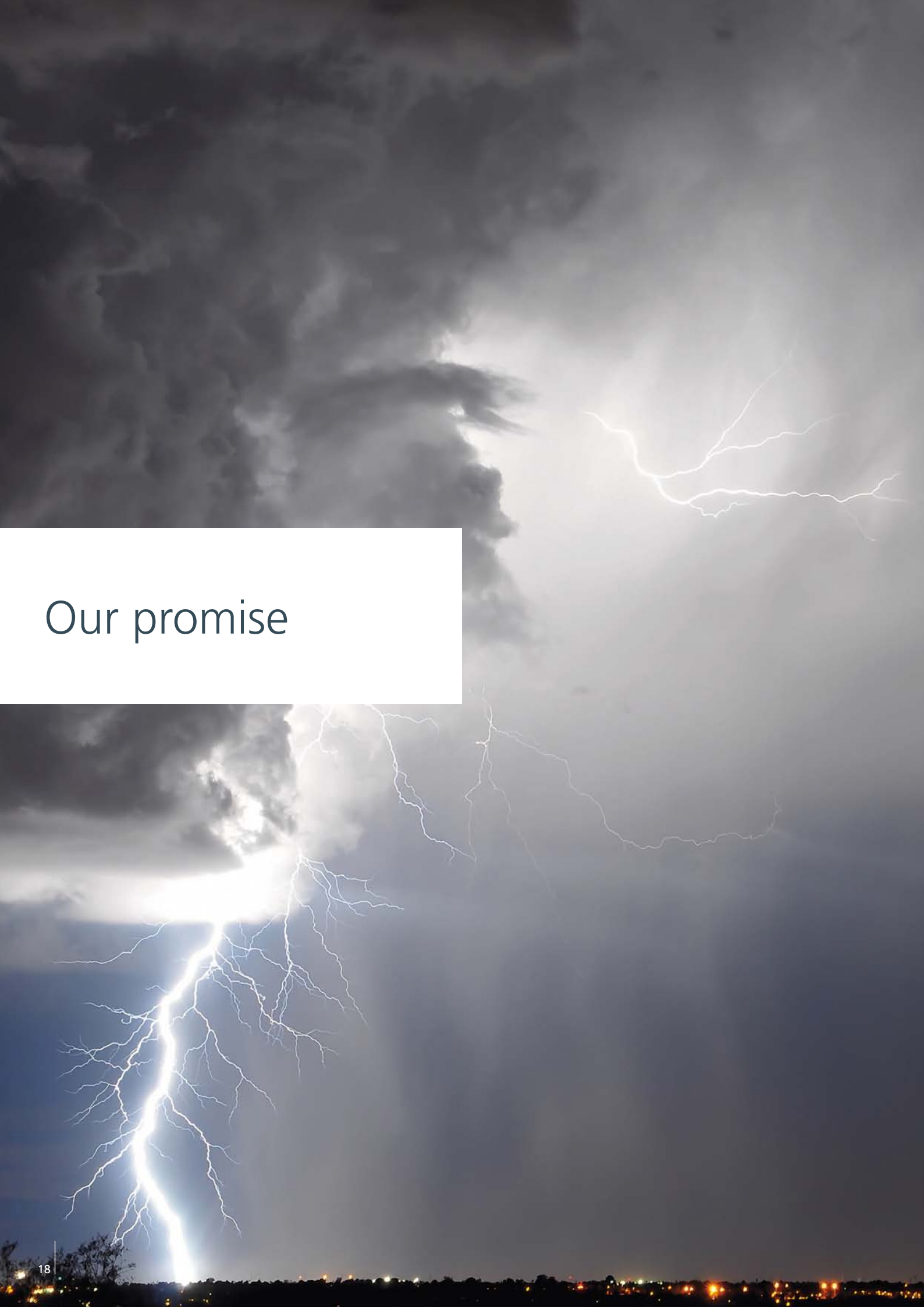
Field test in the DEHN laboratory

The lightning current carrying capability of the system components of a wind turbine is tested in the laboratory. We conduct such tests for our customers in our in-house laboratory. Tests in our impulse current laboratory show whether the selected protection measures are effective.

We offer engineering and test services for wind turbine manufacturers such as:

- Lightning current tests on bearings and gearboxes of the mechanical drive train
- High current tests on the receptors and down conductors of rotor blades
- System-level immunity tests of important control systems such as the pitch control or aircraft warning light
- Tests on customer-specific prewired connection units to protect the electrical installation

Our laboratory is equipped with high-performance and modern devices. Tests are performed in compliance with the latest national and international standards: Due to our representation on standardisation committees over decades, our employees are always up-to-date with the latest standards and technical basics. We use this knowledge for our engineering and test services, thus making protection concepts for wind turbines feasible. Our aim is to ensure long-term operation and availability of wind turbines.



Our promise

DEHN protects

Our key objective is to protect material assets and workers. It was our pioneering spirit and innovative ideas that have defined our company for more than 100 years and made us a market leader with more than 1,400 employees. Our products and developments reflect our market feasibility, commitment and ideas.

As early as in 1923 our founder Hans Dehn started production of external lightning protection and earthing components to optimise the protection of buildings and installations. In 1954, we launched the first series of surge protective devices. Constant further development of these devices ensures safe operation and permanent availability of electrical and electronic installations. Also in the 1950s, our third sector, safety equipment, was added to our portfolio.

The Bavarian town of Neumarkt is the heart of our activities where product managers and developers advance our protection technologies. Here we manufacture our high-quality safety products.

We offer the best solution

Our concern is to be a reliable and fair partner for our industrial, commercial and technical customers all over the world. To this end, we always focus on the best solution to protection problems. Our sales teams in Germany and our global network of 11 subsidiaries as well as more than 70 international sales partners are committed to competent and customer-oriented distribution of our products. Proximity and close contact with our customers is of utmost importance to us, be it on-site support by our experienced field staff team, our telephone hotline or personal contact at trade fairs.

In hundreds of seminars, workshops and conferences held every year throughout the world we impart practical knowledge on products and solutions. Our specialised book "Lightning Protection Guide" and our brochures will broaden your practical knowledge. Or visit us at www.dehn.de for information around the clock.

Surge Protection
Lightning Protection
Safety Equipment
DEHN protects.

DEHN + SÖHNE
GmbH + Co.KG.

Hans-Dehn-Str. 1
Postfach 1640
92306 Neumarkt
Germany

Tel. +49 9181 906-0
Fax +49 9181 906-1100
info@dehn.de
www.dehn.de

www.dehn.de/ds/ds103e

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