

MONITOR

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Renewable energies
intelligently networked



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Dear Reader,

Much has happened since the last edition of the Monitor. Parts of the Arab world are in a state of upheaval and Japan was hit by earthquakes, tsunami and nuclear explosions. Our sympathy is with those who are directly or indirectly affected. There is also unrest in domestic policy that is causing heated discussion. Until recently the nation was debating about the former Minister of Defence whereas the pros and cons of nuclear power became the nation's centre topic now.

Photovoltaics is seen by some as being an unavoidable ecological component of the energy mix, and by others as a subsidy-swallowing monster that is driving energy costs up. What is correspondingly unclear is how the key German market will develop after stepped cuts in subsidies. In this respect, something that is often overlooked is what is actually at stake: nothing less than the prevention or rather alleviation of the climatic catastrophe – and an alternative to nuclear power.

The same applies to electro-mobility which is criticised for being too expensive and too inefficient. This may well apply to this young technology but what is also applicable is the fact that oil reserves are finite. It is not a question of technological advantages and disadvantages, but rather about maintaining a certain level of mobility.

Bender positions itself clearly within the field of renewable energies and electro-mobility. As a global brand leader for monitoring technology in photovoltaics as well as in unearthed industrial grids, Bender offers unique solutions for the neuralgic areas where power grid, self-generation plants and vehicle batteries come together.

We hope that you find this issue an interesting read.

Yours

Dirk Pieler
CEO

IMPRINT

Publisher:

Dipl.-Ing. W. BENDER GmbH & Co. KG.
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35305 Grünberg / Germany
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Photos:

Bender Archiv, esb Archiv, S!Designment, EDAG Group Fulda, Schodo GmbH, Agentur für Erneuerbare Energien Berlin, Universitätsklinikum Würzburg, Bender Indien
www.fotolia.com: @photlook, @3dtool, @shockfactor, @Thomas Otto, @electriceye, @andrea lehmkuhl, @Gina Sanders, @dkimages, @gradt, www.iStock.de: @gchutka, @2Beboy_Ltd, @leeser87

Print:

Druckhaus Bechstein, Wetzlar, Germany



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The principle of the combined power plant: Renewable energies intelligently networked

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Can renewable energies provide a reliable supply of electricity, even if there is no wind or if the sun is not shining? With a combined regenerative power plant scientists at the Fraunhofer Institute for Wind Energy and Energy System Technology IWES have shown that complete supply solely from renewable energies is possible given intelligent control ...

The Insulation is what counts

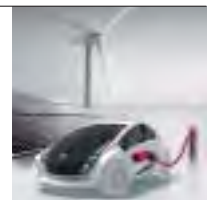
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Standardisation has a key role to play in e-mobility and also in electrical safety. It is therefore imperative to take a closer look into this subject related, various ISO (International Standards Organisation), IEC (International Electrotechnical Commission) and DIN VDE standards and regulations ...

EDAG Group Partner of the International Mobility Industry

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As the world's largest independent development partner, the EDAG Group develops series-production solutions for the sustainable mobility of the future. The range of services covers the entire value chain ...

Can renewable energies provide a reliable supply of electricity, even if there is no wind or if the sun is not shining? With a combined regenerative power plant scientists at the Fraunhofer Institute for Wind Energy and Energy System Technology IWES have shown that complete supply solely from renewable energies is possible given intelligent control. With a new combined power plant, "combined power plant 2", they now want to prove that sun, wind and the like can also contribute to the stability of the electricity grid.





The principle of the
combined power plant:

Renewable energies intelligently networked

The semi-circular office building is made entirely of glass, the panes are anchored in grey concrete. The only spot of colour: on the ground floor a bright red door leads to a matching colour lift. Nothing gives the impression that behind the long corridors of offices and server rooms there is a control centre for a very special power plant. The Fraunhofer Institute for Wind Energy and Energy System Technology (IWES) is based in Koenigstor 59, in the south west of Kassel. And it is here that the individual elements of the combined regenerative power plant come together: as early as 2006 and 2007 the IWES researchers collected weather and consumption data, calculated generation potential and power plant outputs, and connected wind turbines, solar installations and biogas turbines all over Germany together into a network. Now they are working on the second stage: “combined power plant 2” is intended to test the stability of a grid supplied one hundred percent with renewable energies.



Combined power plant 2

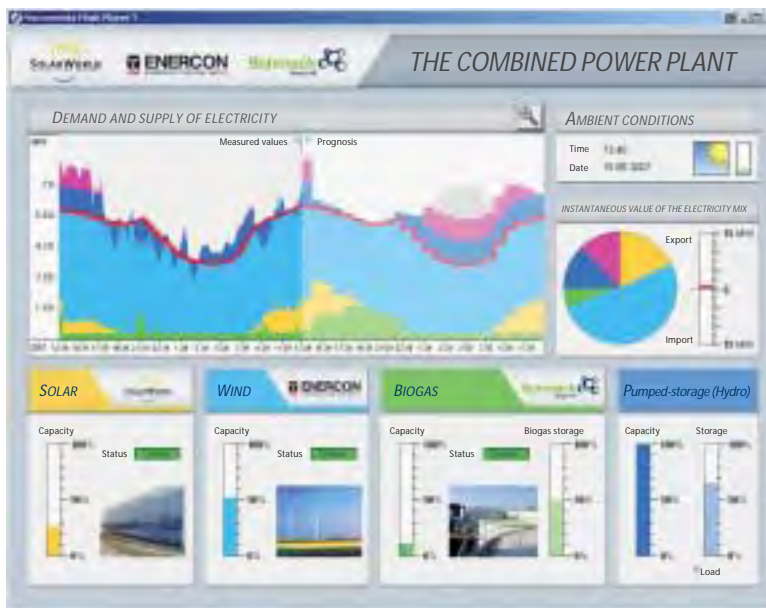


▶▶▶ “Behind the combined power plant is the idea of linking the fluctuating electricity generation from wind turbines and solar installations with combined heat and power plants so that the electricity demand can be covered around the clock and in any weather”, says Dr. Kurt Rohrig, Deputy Director of the IWES. The institute launched the project together with the companies Enercon, Schmack Biogas and SolarWorld, as well as with the support of the German Federal Ministry for the Environment. “With it we have shown that the supply of electricity from renewable energies is dependable and reliable – and that even if there is no wind the lights will not go out in Germany.”

This is how the principle of the combined power plant works: the load profile, i.e. the expected in electricity demand in Germany, is forecast by scientists more than a year in advance, including all the fluctuations in demand over the day and between the seasons. Scaled at 1 : 10,000 this forecast forms the starting point for the control of a virtual power plant comprising three wind parks, 20 photovoltaic installations and three biogas turbines. The installations are distributed all over Germany and connected to the control centre in Kassel via the Internet. Measured values are retrieved, schedules calculated and individual power plants controlled via a central server.

To cover the electricity demand, first the fluctuating supply of electricity from the wind turbines and solar installations is included. With the aid of the forecasts from the Deutscher Wetterdienst (German meteorological service - DWD) for the wind strength and global solar radiation it is possible to very reliably calculate the energy contribution from these installations. “With an accuracy of over 90 percent the wind forecasts for the different hub heights are in the acceptable range for at least the next day”, says Kai Biermann, energy meteorologist at the Deutscher Wetterdienst in Hamburg. Together with the IWES the expected wind is converted into a power forecast for the coming days. The forecast for the solar power is currently more difficult. Photovoltaic installations are spread over a larger area than wind parks and passing clouds make the analysis more difficult. “However a lot of work is also in progress on forecasting the global solar radiation to improve the model forecasts and measurements, and in the process the quality of the power forecasts”, affirms Biermann.

The supply forecasts for wind turbines and solar installations form the basis for the schedules for the biogas plants, which can be regulated as required. Their combined heat and power plants can spring





into action if there is no wind and save biogas in periods of plentiful wind. If the actual electricity generated from the wind and the sun varies despite an accurate weather forecast, their power output is adjusted using measured data accurate to the minute. The renewable power plants are supplemented if necessary by the simulation of pump-storage capacity and the exchange of power using European interconnections, also in the scale of 1: 10,000.

The combined power plant has proven itself in the scientists' models and also in live operation. For project manager Rohrig what is possible on a small scale is therefore also feasible on a large scale: "Complete supply from 100 percent renewable energies is technically possible." However, he also identifies areas in which research and innovation is still required: the inclusion of storage capacity is one of these areas, as is the specific control of the electricity consumption and ensuring the stability of the grid with a growing portion of renewable energies.

Model projects all over Germany are attempting to provide answers to these questions. In Aachen and Mannheim, in Cuxhaven and Karlsruhe, in the district of Harz and in the Ruhr, the interaction of decentral power plants, consumers and storage technologies is being trialled with the aid of modern communication technologies. The six model regions are subsidised with a total of 60 million euros by the German Federal Ministry for the Environment as part of the "E-Energy" technology program.

In the project in Cuxhaven, eTelligence, for example, a virtual market place connects the protagonists involved in the supply of electricity. Here renewable power plants are also linked in a network and controlled as a group. There are also bulk consumers who provide the important equalisation and storage function. Such as Kühlhaus GmbH, an organisation that stores many hundreds of tons of deep-frozen fish in the harbour in Cuxhaven. One of its cold stores operates in the group with a wind park, a biogas plant and a solar installation. If there



is a stiff breeze, the refrigerating machines start up and reduce the temperature by a few minus degrees. If the wind drops, the consumption is reduced. And thanks to good insulation, the temperature only increases by around one degree per day without harming the deep-frozen fish. Currently the project consortium around the Oldenburg-based EWE AG is checking whether the sewage treatment works in Cuxhaven could also be integrated into the virtual power plant. In future the energy-intensive biological purification could start when there is a large amount of wind power in the grid. "Our objective is to bring together locally the generation and the consumption of electricity. This has the advantage of avoiding transmission losses and addressing possible shortages on the grid", stated project director Dr. Tanja Schmedes at the annual E-Energy congress.





The integration into the grid of renewable energies is the focus of a new research project at the Fraunhofer IWES. With “combined power plant 2” Dr. Kurt Rohrig and his team want to study how a completely regenerative supply of electricity affects the stability of electricity grids. Nine partners from commerce and science are involved, also the German Federal Ministry for the Environment. In the new project wind turbines, solar installations and biogas plants will be linked together again. However “combined power plant 2” goes a step further: it is intended to show which grid services renewable energies can provide. Whether reactive power, frequency or voltage stability: many technical prerequisites for the stability of electricity grids can and must already be met by renewable energies. For all new wind turbines this has been mandatory since the last update to the “Erneuerbare-Energien-Gesetz” (German law on renewable energy) imposes new responsibilities. They must, for example, be able to reduce their effective power within one minute or make a contribution to a stable voltage on the grid at any time.

“Combined power plant 2” is now to demonstrate that even 100 percent renewable energies combined with electricity storage can provide stable grids, without any fossil power plant capacity whatsoever. For this purpose initial scenarios are being developed and potential compared at the IWES. In a second step in the coming year wind parks, solar installations and biogas power plants distributed all over Germany will be connected together to test the scientist’s models in real weather conditions. Then the control centre behind the inconspicuous glass facade will start to operate again. ■

*Undine Ziller
Agentur für Erneuerbare Energien, Berlin*



Combined power plant 2



CURRENT DEVELOPMENT STATE OF RENEWABLE ENERGIES

Wind and solar energy, biomass, hydro power and geothermal energy currently cover 17 per cent of the electricity demand. According to the German Energy and Water Association BDEW, wind power has a 6 per cent share. Bioenergy contributes about 5 per cent. Hydro power provides approximately 3 per cent, photovoltaic around 2 per cent and waste incineration plants cover about 1 per cent of the electricity demand. It is the Federal Government’s objective to increase the share of renewable energies to the supply of energy to 35 per cent by 2020. Federal Environment Agency’s experts even expect an increase of up to 100 per cent by 2050.

The Insulation is what counts

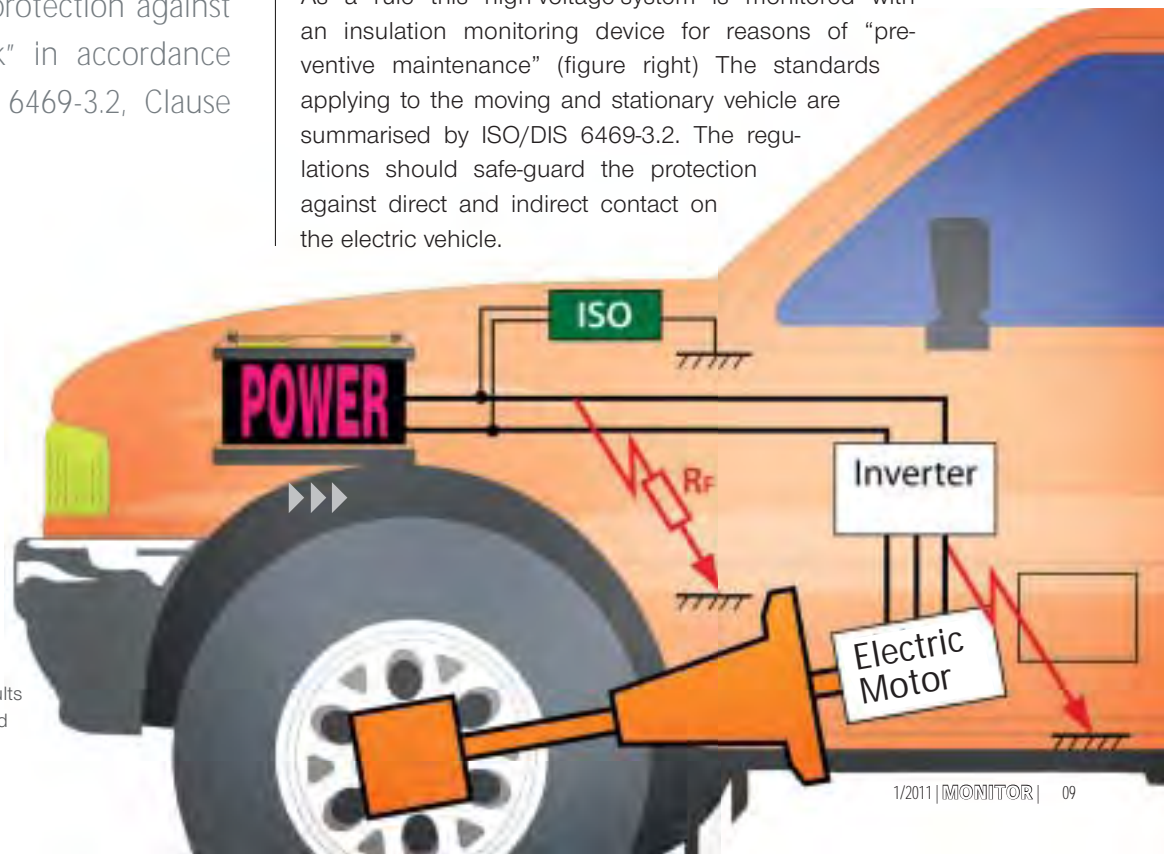
Standardisation has a key role to play in e-mobility and also in electrical safety. It is therefore imperative to take a closer look into this subject related, various ISO (International Standards Organisation), IEC (International Electrotechnical Commission) and DIN VDE standards and regulations, see frame 1. In particular, attention must be paid to the “protection against electric shock” in accordance with ISO/DIS 6469-3.2, Clause 7.1 (frame 2).

Similar to general electrical installations

fundamental protection scenarios can also be translated to the electric vehicle. Protection against electric shock ...

- ... in the moving vehicle
- ... in the stationary e-vehicle
- ... on charging the e-vehicle
- ... on working on the e-vehicle (e. g. maintenance)
- ... in the event of an accident with an e-vehicle.

The majority of automotive manufacturers install an insulated DC system in the e-vehicle, called the high-voltage-system (HV), which supplies the high-voltage consumers. As a rule this high-voltage-system is monitored with an insulation monitoring device for reasons of “preventive maintenance” (figure right) The standards applying to the moving and stationary vehicle are summarised by ISO/DIS 6469-3.2. The regulations should safe-guard the protection against direct and indirect contact on the electric vehicle.



An insulation monitoring device detects insulation faults in hybrid vehicles and e-vehicles

Standards situation according to ISO/DIS 6469-3.2: 2010-06

Protection of persons against electric shock, Clause 7.1 General

Clause 7 Measures and requirements for the protection of persons against electric shock

7.1 General

Protective measures against electric shock shall comprise of:

- basic protection
- measures for protection under single fault conditions.

Electrically propelled road vehicles – Safety specification – Part 3: Protection of persons against electric shock

Measures for protection on the occurrence of a first fault, Clause 7.3

The protection under first fault conditions states that the following protective measures should be applied:

- periodic or continuous monitoring of the insulation resistance
- double or reinforced insulation
- layer of barriers/enclosures in addition to the basic protection.

▶▶▶ **For charging the e-vehicle** reference is made to other current international standards. It is noteworthy that here ISO/DIS 6469-3.2 is stated for the protective measures on-board the e-vehicle and IEC 60364-4-41 for the protective measures outside the e-vehicle. The reason: The protective measures must reconcile the existing types of system and the protective devices of the supplying system and of the supplying HV-system.

An example of a charger (type of system) is shown on page 11; others are conceivable. The at first glance unusual consequence of this analysis: For safely charging an e-vehicle, the type of system based on the type of earth connection of the supplying system must be considered. In other words: the type of system based on the type of earth connection forms the basis for the analysis of protective measures in relation to the high-voltage-system in the e-vehicle!

The relevant types of system are TT, TN and IT systems. The conductive parts (housing or chassis) of the equipment in an IT system are connected as in a TN system.

The system to be supplied (isolated high-voltage-system) in the e-vehicle can be comparable to an IT system. Crucial for this analysis of protection is the physical arrangement and design of the “charger” (see diagram on page 12).

If the charger is installed in the e-vehicle with simple separation (“on-board-charger”), two systems which are separated from each other and with different system types must be taken into account for the fault evaluation in regards to the protection against electric shock. In this case protection against electric shock is to be ensured using a residual current protective device (RCD) of type A.

If the charger in the e-vehicle is without simple separation, a joint system with AC and DC components has to be considered for the fault evaluation. In this case, protection against electric shock is possible with a residual current

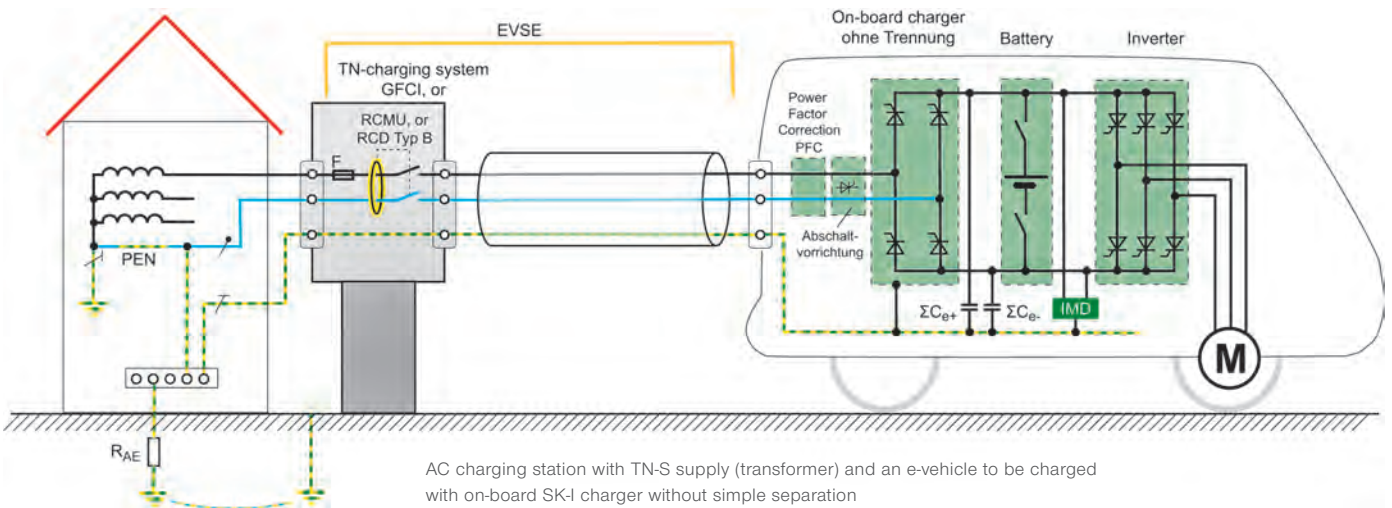


Insulation monitoring device for an e-vehicle

protective device (RCD) of type B. Here other devices are also conceivable, e.g. residual current monitoring units (RCMU), similar to those used for photovoltaic installations, in accordance with DIN V VDE 0126-1-1 (VDE V 0126-1-1):2006-02.

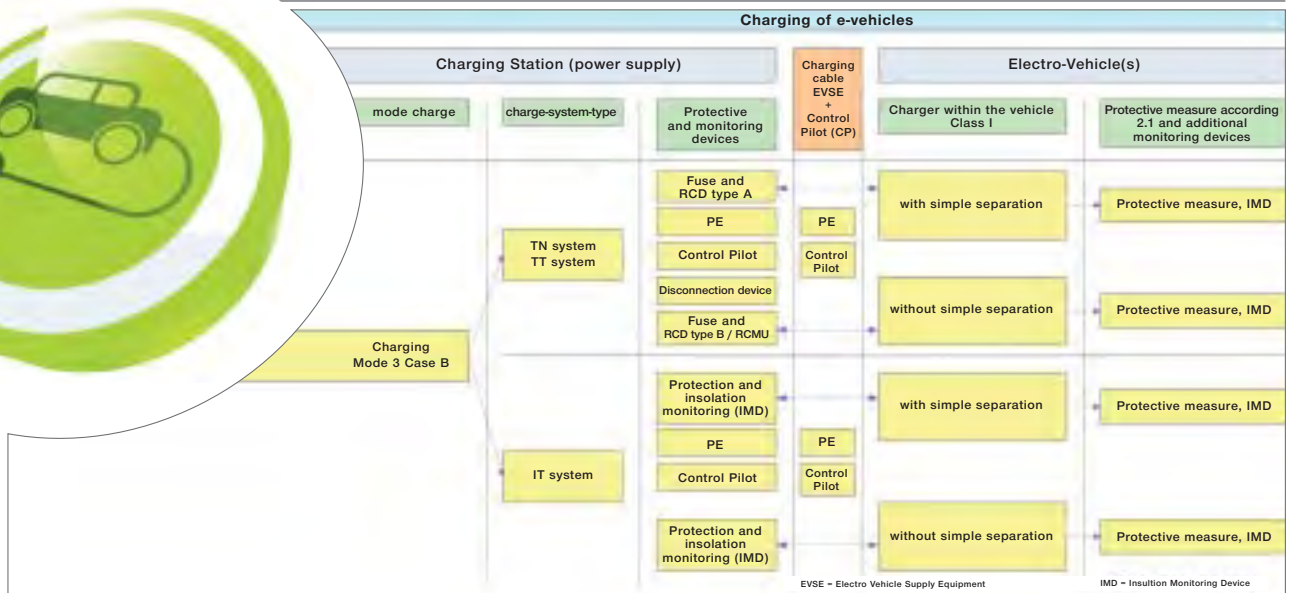
The design of the supply to the charging device as an IT system with insulation monitoring offers advantages in relation to protecting people touching the e-vehicle from outside the e-vehicle against touch voltages. The standard IEC 61851-1/FDIS also refers to this aspect: “Where power supply circuits that are galvanically separated from mains and are galvanically isolated from earth, electrical isolation between the isolated circuits and earth, and between the isolated circuits and exposed conductive parts of vehicle and EVSE shall be monitored. When a fault condition related to the electrical isolation is detected, the power supply circuits shall be automatically de-energized or disconnected by the EVSE.”

On the technical and normative sides of the project “Electro-mobility”, a project with considerable future potential, significant efforts have been made to provide protection against electric shock. The electrical equipment of e-vehicles



AC charging station with TN-S supply (transformer) and an e-vehicle to be charged with on-board SK-I charger without simple separation

Charging e-vehicles using charging cable EVSE with control pilot for TN, TT and IT charging system.



and of charging stations of the future depends on many factors. Reference has been made to the significance of the types of system, the protective devices and monitoring devices. Here the possible coupling of AC and DC systems during charging is of particular significance. The type of protective devices and/or monitoring devices applied, will be decided by the design of

the future charger as an on-board or off-board version. The question of the functional safety of equipment in e-charging stations must also be finally clarified.

Safety while working on the e-vehicle (for example during maintenance) involves checking the state of the insulation of the high-voltage-system installed in the e-vehicle before work begins. Sufficiently high insulation

Standards situation regarding the electrical safety of equipment for charging

DIN VDE 0100-410 (VDE 0100-410): 2007-06,
Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock

DIN EN 61140 (VDE 0140-1): 2007-03,
Protection against electric shock – Common aspects for installation and equipment; Definition 3.23: simple separation – separation between circuits or between a circuit and earth by means of basic insulation

DIN V VDE 0126-1-1 (VDE 0126-1-1): 2006-2,
Automatic switching device between a generator parallel to the system and the public low-voltage grid (original title translated)

New Project: DIN VDE 0100-722 (VDE 0100-722)
(Responsibility: DKE, AK 221.1.11)
Errichten von Niederspannungsanlagen – Teil 7-722: Anforderungen für Betriebsstätten, Räume und Anlagen besonderer Art – Speisung von E- Fahrzeugen

International:
(Responsibility: IEC, TC64)
Project: IEC PNW 64-1714 Ed. 1.0, IEC 60364- 7-722: Low voltage electrical installations: Requirements for special installations or locations – Supply of electric vehicles

IEC 61851-1, ed2.0: 2010-11,
Electric vehicle conductive charging system – Part 1: General requirements.



values will ensure protection on indirect contact (protection under fault conditions). In case of a fault, equipment for insulation fault location can be useful. The electrically skilled persons in the vehicle workshops must be particularly well trained and familiarized with the potentials hazards.

Safety in case of an accident with an e-vehicle:

The prerequisites stated for working on the e-vehicle apply here as well. Because of possible direct contact with the high-voltage-system particular care is required. ■

Dipl.-Ing. Wolfgang Hofheinz, CTO



CONCLUSION

Particularly during the analysis of the protective measures, the attention should be focused on where the supplying AC systems meet with the DC systems in the e-vehicle. These (problem) situations are familiar in the photovoltaic sector for years. Not all possible solutions have yet been discussed. While considering charging station safety, a possible alternative to universal AC/DC current-sensitive residual current protective devices (RCD) of type B could be the application of residual current monitoring units (RCMU) according to DIN V VDE 0126-1-1 (VDE V 0126-1-1), which have proven themselves over a number of years in the photovoltaic sector. In the field of electro-mobility further considerations and risk assessments are required in relation to protection against electric shock. If the current on-board charger in the e-vehicle is exchanged with an off-board charger, the protective measures for charging have to be reevaluated.



Wolfgang Hofheinz new Chairman of the DKE

PROFESSIONAL CAREER

Wolfgang Hofheinz started his professional life in 1962 at Deutsche Philips GmbH in Wetzlar, in 1972 he joined AEG-Telefunken in Heilbronn as a development engineer. Since 1975 he has been with the Bender Group, since 1995 as Managing Director. Wolfgang Hofheinz has been involved in many of the DKE's committees for almost 30 years, in 2008 he received the "DKE-Nadel" for his services to electro-technical standardisation, in 2006 he received the IEC 1906 Award.



AN INTERVIEW WITH HERR HOFHEINZ

Dipl.-Ing. Wolfgang Hofheinz (63), General Manager of Bender GmbH in Gruenberg, has been elected the new Chairman of the DKE German Commission for Electrical, Electronic & Information Technologies of DIN and VDE. On 1 January 2011 he took over as the successor to Dr.-Ing. E.h. Dietmar Harting, who retired from his position as DKE Chairman after twelve years.

What are the most important trends that will significantly affect Germany in the coming year?

Trends will be topics such as renewable energies and electric mobility; these issues will play an important role and we should be involved. Due to the complexity of future electrical supply systems, system quality will also become increasingly important. Attention should of course also be paid to creating and safeguarding of jobs in these areas.

What do you want to achieve with the DKE over the next 4 years?

It is with great pleasure that I have been heavily involved in the DKE since 1982 and I would like the DKE to become even better known. We must reach more students and experts, an aspect that in my view still has not been achieved to an adequate degree. The DKE should be actively involved in engineering training and vocational training. Students should be involved in standardisation even during their studies, as it is an exciting and above all important field. Standardisation also plays a crucial role at Bender in Gruenberg, where I have worked for 36 years. For the DKE I would like know-ledge of standardisation to be further advanced among the public, among businesses, and above all among small and medium-sized enterprises in the coming four years. In our global world I also consider the international collaboration activities of the DKE, currently with India, to be necessary. They should be further expanded.

Which innovative topics are important for the DKE from your point of view?

These are new topics such as photovoltaics, wind power, the co-generation of heat and power, where Germany is a leader. However, innovations in more “traditional” areas, for instance electrotechnology in machine tool manufacture, electrotechnology on railways and in electrical medical equipment, must also not be ignored under any circumstances.

How do you view current developments at the IEC and CENELEC?

Germany's international activities should be intensified. With the Chairmanship held by a German representative, specifically the IEC presidency of Prof. Dr.-Ing. Klaus Wucherer, we are well on the way. Above all we need more German experts from medium-sized enterprises involved in the IEC and CENELEC; there are unfortunately far too few. Often smaller and medium-sized businesses do not have the drive or the means to become involved in international standardisation work.

There will be some changes in the DKE due to the change management process. How do you deal with change?

If changes within a business are creative and bring a new impetus, they are always beneficial. At Bender we are in a continuous process of change, we must react to changes on the market and our experience with change has only been good.

What value is placed on standardisation in your business?

At Bender we consider involvement in national and international standardisation to be a recipe for strategic success. Standardisation has made a significant contribution to the success of our business. Of course it costs a business time and money if staff are involved in standardisation, however the success justifies the expense.

From your point of view how could the IEC and CENELEC focus even more on the special needs of the electrotechnology sector?

It would be good for us if we had more German experts from all areas of electrotechnology who were involved internationally in standardisation work. We should address in particular the topics of photovoltaics and electric mobility and define a direction internationally. The topic of protection against electric shock also continues to be very relevant, as in some countries the use of earthing has still not be implemented.



STANDARDISATION IS FUTURE



What significance do you attribute to standardisation in general for society?

Its significance is considerably greater than is generally known in society. Without standardisation, a plug would not fit in the wall socket, a lamp would not fit in the light fitting, and no batteries would fit in the remote control. Without standardisation, electrical equipment would be neither practical nor safe. It can be fulfilling, fun and at the same time a social obligation for enthusiastic engineers to make their specialist knowledge available in the service of the general public to work on standardisation and to shape the markets of the future. ■

VDE Verband der Elektrotechnik Elektronik Informationstechnik e.V., Frankfurt/M.

Which measures could the DKE take to further increase the satisfaction of the technical experts (customer satisfaction survey)?

I hear only good comments from the many committees in which I am involved. Nevertheless, the results of the survey must be examined very carefully and it is necessary to work on the weak points.

Where do you see the task of industrial associations and trade associations in relation to standardisation and their interaction with the small and medium-sized enterprises?

Associations such as ZVEI and ZVEH should play a pioneering role here. In small businesses in the trades, for example, the subject of standardisation is sometimes viewed negatively. Here we must also continue to be active in the DKE, as some businesses shy away from the usage of standards if they are formulated in a manner that is too complicated for them. For the novice standards user, the standards are often difficult to understand. The search for frequently required standards is still difficult in some areas and questions are often asked about the latest status of the related standard. The associations should provide support with spreading knowledge about standardisation.

ABOUT THE DKE

The VDE-run DKE German Commission for Electrical, Electronic & Information Technologies of DIN and VDE prepares standards and safety regulations for electrical, electronic and information technologies. It represents German interests in the European Committee for Electrotechnical Standardization (CENELEC) and the International Electrotechnical Commission (IEC). Around 3,500 experts from commerce, science and government prepare the VDE rules and regulations in the DKE. The VDE regulations are today largely based on European standards of which 80 percent are the result of international standardisation work by the IEC.



Voltage relays for the complete protection of grid and electrical power generation plants with renewable energies



VMD423

New approvals for VMD423 voltage relay

When using renewable energies, such as photovoltaic plants, it is essential to install an "automatic disconnection device" between the electrical power generation plant which is connected in parallel to the grid and the public low voltage grid for safety reasons.

The technical requirements for this automatic disconnection device are stipulated in the current edition of the DIN V VDE V 0126-1-1 (VDE V 0126-1-1):2006-02. The 3 phase VMD423-D-2 voltage relay series is offered as the optimum solution for meeting the required monitoring tasks laid down in this standard. Although transient frequency peaks of ≥ 50.2 Hz are detected, this does not necessarily cause the private electrical power generation plant to be isolated from the network when the switch-off time of 200 ms required in the DIN standard is maintained. Thus, the operator does not experience any accidental loss of revenue. The plant is also safely disconnected if the voltage frequency exceeds or drops below the maximum voltage frequency

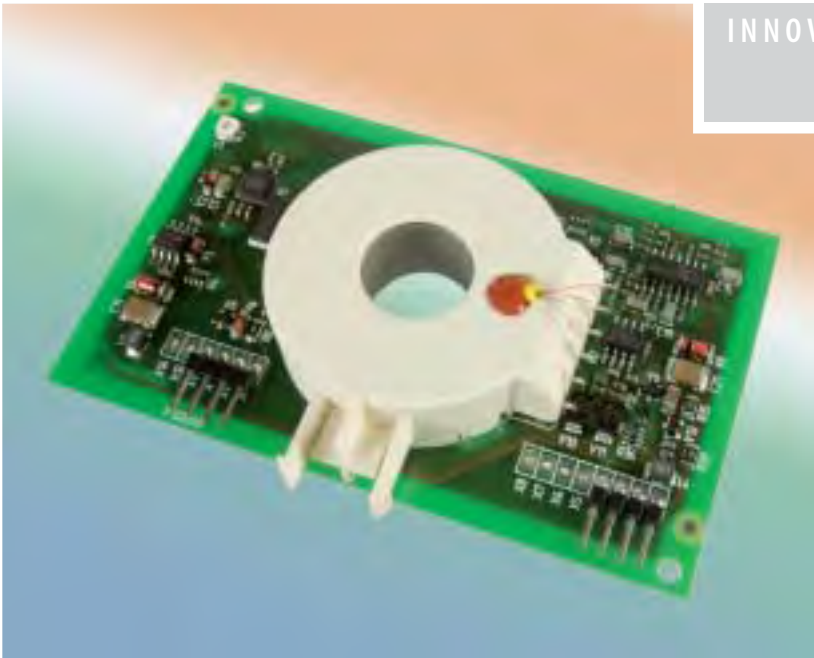
ranges or if the system detects the formation of isolated networks or hazardous discharge interference – protection of the grid and plant is therefore guaranteed.

As an additional safety measure, clearance certificates are available from an independent testing institute. These are

- DIN V VDE V 0126-1-1:2006-02 (Germany, France and Scandinavia)
- ENEL grid connection guideline 2009 (Italy)
- C10/11 – 05.2009 (Belgium)
- DIN V VDE V 0126-1-1:2006-02 (Czech Republic)
DIN EN 50438:2007.

Another major benefit for users is the default settings. This significantly reduces the set-up and commissioning time. All settings can be protected from unauthorised access by a transparent cover, thus providing increased protection against manipulation. ■

Dipl.-Ing. Marc Euker, MTS



Universal AC/DC sensitive residual current monitoring module RCMB100



RCMB100

The start of photovoltaic installations with transformerless inverters

The photovoltaic (PV) boom in Germany started when the “Erneuerbare-Energien-Gesetz” (known as the EEG for short, the German law on renewable energy) came into force in 2004. At this time inverters with transformers were almost always used, even though the superiority of a transformerless inverter was clear.

In the case of inverters with transformers, there is no electrically conductive connection between the two electrical circuits due to the electrical isolation. The DC and AC circuit or the PV generator and the supply system form separate independent electrical circuits. In terms of safety this situation is clearly advantageous, however the transformer absorbs energy so the efficiency of the installation drops.

Efficiency was and is the crucial factor for the successful introduction of PV technology in the electricity supply infrastructure. The greater the efficiency the lower the subsidies required. The ultimate goal is to achieve

“grid parity” through continuous improvements, i.e. PV installations that generate energy that is no more expensive than the average cost of the other energy sources on the grid.



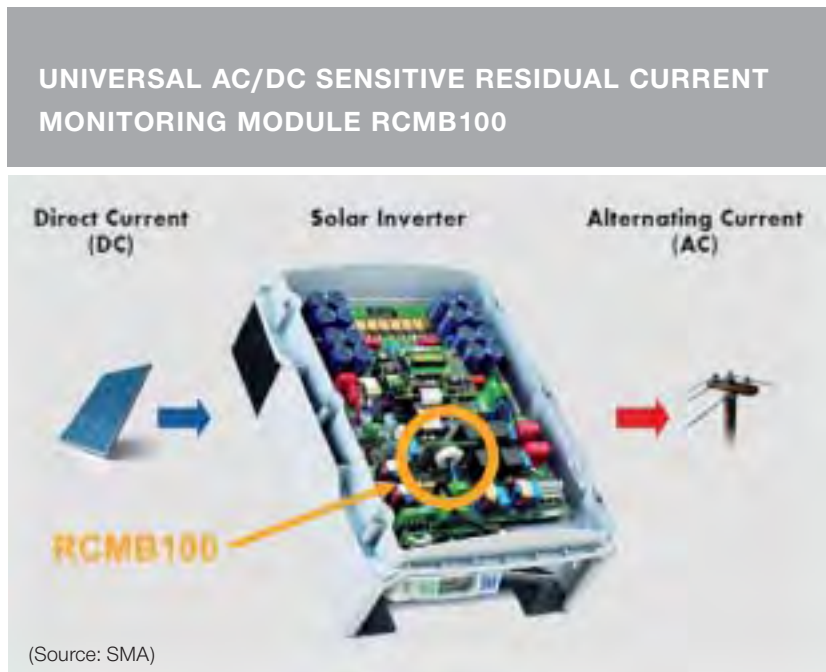
This fact that technology exists with a capability to increase the overall performance of a photovoltaic installation by approx. 4% caused quite stir. Bender took the idea of developing additional protection to supplement the basic insulation and turned it into a task. The problem was clearly defined at this time: "if due to a fault, e.g. damaged insulation, there is contact between a live cable and an earthed person, a dangerous fault current could flow through this person".

The result of this development was the "universal AC/DC sensitive residual current monitoring module" with the identifier RCMB100. This module placed the spotlight on the manufacture and usage of transformerless photovoltaic inverters. The universal AC/DC sensitive RCMB100 does not replace any existing product, as it essentially represents new technology.

The RCMB100 is insensitive to external interference and satisfies the highest requirements in relation to temperature stability.

The occurrence of a fault current between the solar generator and supply system will result, in accordance with DIN V VDE V 0126-1-1 (VDE V 0126-1-1):2006-02, in the shut down of the photovoltaic inverter in the conditions stated in the table below.

MAXIMUM SHUT DOWN TIMES	
r.m.s. value of the fault current / (mA)	Shut down time / (s)
30	0,3
60	0,15
150	0,04



The residual current actually measured is available at terminal X1 on the RCMB100 as a proportional output voltage (0.150 V/DC – 4.85 V/DC). The output voltages < 150 mV/DC or > 4.85 V/DC also signal not only a short circuit or an open circuit, but also a possible fault in the residual current monitoring module.

Terminal X12 is used to determine if the measuring range is exceeded. If the range is exceeded by >150 mA, a signal is output on the switched output X12. In addition, the RCMB100 implements the shut down times required in the current DIN V VDE V 0126-1-1 (Table) on the analogue outputs X1 and X12.

The product is appropriate for the measurement and protection task in accordance with DIN V VDE V 0126-1-1. This technical innovation for transformerless inverters has been used million-fold in PV installations in Germany and all over the world. The related economic and above all ecological consequences are very significant. A new market was created.

With the RCMB100 the requirements on transformerless inverters in accordance with the present DIN V VDE V 0126-1-1 are monitored. Due to this development the installation-related efficiency increased by approx. 4 % while making it possible to use transformerless inverters without the need for further considerations. ■

Dipl.-Ing. Marc Euker, MTS



TECHNICAL APPLICATION



The Bender A-ISOMETER® of type IRDH275W-4925 is under a cover in the boot.



An electric MINI

Impressive driving experience and electrical safety in the MINI E – a driving report by Reinhard Piehl



The MINI E developed by BMW impressively shows how something really great can come from something small. The car is specifically designed as a purely electric vehicle and is not a hybrid. Completely emission-free, but definitely suitable for everyday use and with impressive performance it is therefore the ideal city car, as has been conformed by test projects up to now. BMW is relying on safety technology from Bender for the particularly high requirements on the electrical safety.





With the MINI E, BMW is the first of the large automotive manufacturers to build a purely electric vehicle based on state-of-the-art lithium-ion technology. Currently the vehicle concept is undergoing extensive testing in various pilot projects in the USA, Great Britain, Berlin and Munich, and is providing important information for the development of the Megacity Vehicle, which will come on the market in 2013 under a BMW sub-brand. In collaboration with the Vattenfall and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the BMW Group has set up a pilot project in Berlin that is developing and testing the necessary infrastructure for purely electric vehicles. In this project 50 MINI E will be used everyday by independent test persons over a period of two years.

Charging instead of refuelling

On December 2, 2010 I had the exclusive opportunity to check out such a MINI E during a test drive. After Matthias Kluck from BMW System Testing had welcomed me, he immediately showed me the coveted objects. They were parked in front of the FIZ building, two MINI E with the striking e-emblem and the stylised connector. The two MINI E 450 and 559 vehicles were connected to a charging station and externally look exactly the same as the models fitted with combustion engines – only there is no exhaust system.

After Matthias Kluck had described the technical details of the vehicles to me (see information box), the test drive could start. As always the interior trim defined the initial impression of the vehicle. The interior designed in “Interchange Yellow” is intended to stand for energy and innovation; it appears modern and efficient. The tachometer otherwise normally fitted has been modified into a so-called chargeometer. Here information such as the charge state of the batteries, the mileage and the range remaining can be read; this is the most important information in the cockpit during everyday usage.

Sports car feeling at the traffic lights

Get in, start, press the accelerator and be decidedly surprised! The asynchronous motor produces its maximum torque in such a short time that it almost takes your breath away. The max. torque is available almost from standstill. This characteristic was particularly apparent on pulling away at the traffic lights: immediately the other road users were only to be seen in the rear-view mirror. A real driving pleasure!

Back at the BMW FIZ building Matthias Kluck showed me the inner workings of the MINI E. The air-pressurised high-voltage electrical control unit is housed in a protective housing in the engine compartment. The asynchronous motor itself is underneath this housing. The lithium ion battery is in the middle of the vehicle, where the two rear seats would be normally. The two cooling units for the batteries are on the protective housing. Our Bender A-ISOMETER® of type IRDH275W-4925 is located under a cover in the approx. 60-litre boot; it indicated a value of 570 kΩ. It is responsible for monitoring the entire on-board electrical system and therefore ensures the vehicle is electrically safe.

At this point I would like to express my thanks to Maryam Romaini from MINI E co-ordination logistics LI-C and Matthias Kluck who made it possible for me to test drive the MINI E.

Safety for the future

This special test drive left a deep impression on me and I am very excited about further technological developments in the area of pure electric vehicles. Without doubt a market of the future with enormous growth potential. We at Bender as declared specialists for electrical safety have been involved in this market from the start and are therefore in an excellent position for the future. ■

*Reinhard Piehl
Tech. Office Munich*

THE TECHNICAL DATA AT A GLANCE

Power output:	150 kW/204 HP
Torque:	220 Nm
Weight:	1,465 kg
Acceleration:	8.5 s (0-100 km/h)
Top speed:	152 km/h
Range:	250 km under ideal conditions or 168 under normal driving conditions
Battery:	Lithium ion; 35 kWh; air-cooled, each battery unit is monitored separately.
Charging times:	2.4 hours with 230 V and 50 A 3.8 hours with 230 V and 32 A 10.1 hours with 230 V and 12 A

Protecting the public grid from faults in private electrical power generation plants,

TECHNICAL APPLICATION

using Lohrer Lumpenmühle as an example

Reliable hydroelectric power



The number of private electrical power generation plants, such as combined heat and power plants, wind power, hydropower and photovoltaic plants, which supply electricity to the public low voltage grid, is steadily increasing. A mandatory voltage and frequency monitor is therefore required for decoupling the grid from the private electrical power generation plants to ensure the safety of people, installations and grid. At the Lumpenmühle in Lohr am Main hydroelectric power plant, Bender equipment is used to monitor the voltage.

Since the grid operator is usually unable to intervene in the control of local electrical power plants, a suitable monitoring device must be installed for reliable isolation at the transfer point between the grid and the plant. For example, if the public grid is switched off for maintenance, the isolation device prevents the feeding of electrical power into the grid, which would be dangerous for the maintenance personnel.

Defined safety ...

DIN V VDE V 0126-1-1 (VDE V 0126-1-1):2006-02 clearly stipulates the requirements on an automatic disconnection device between an electrical power generation plant connected in parallel to the grid and the public grid. The "Lumpenmühle" in Lohr am Main hydroelectric power plant, which is a run-off river plant fitted with a so-called DIVE turbine, must also have this automatic disconnection device fitted. The DIVE concept, with the new turbine-generator-converter, is a new technology representing a minor revolution in hydroelectric power stations.



... for innovative technology

Now, for the first time even small heads (up to 2 m) can be covered efficiently by a double regulated arrangement of the compact variable speed turbine and generator under water. Since the turbine is virtually invisible and silent on site, it can also be used in built-up areas. The plant installed at Lohr generates 60 kW with a head of 3.0 m and an average flow rate of 2.0 m³/s. The variable-speed facilitates much more efficient power conversion.

Founded in 2006, Schodo GmbH operates in, among other things, the field of electrical engineering equipment for hydroelectric power plants with outputs of 50 kW to 1 MW. The company designs, develops and manufactures all the electrical equipment from the power dissipation systems to the turbine and peripheral control systems. Schodo GmbH designed the entire control and power electronic system for the Lumpenmühle hydroelectric power plant, as well as the grid connection and grid feed. In addition to the automatic power control system for the plant a sophisticated visualisation and remote monitoring system via a GSM modem has also been installed.

If the plant exceeds or drops below the above parameters, or if there is a fault, it must be disconnected from the public grid at the interface between the system and the public grid. A Bender Type VMD423 monitoring relay has therefore been installed at the Lumpenmühle hydroelectric power plant.

Reliable network decoupling

Using a VMD423 voltage and frequency-monitoring relay in private electrical power generation plants guarantees fast and safe isolation from the grid in the event of a fault or failure or of non-compliance with the threshold values. It is also capable of multifunctional adjustment in relation to the voltage and frequency monitor and meets the requirements of the various public utilities and energy companies.

The threshold values laid down in the VDE standard in terms of frequency and voltage allow a frequency

range of 47.5 Hz to 51.5 Hz and a voltage range of 80% - 115% of rated voltage U_n . In the event that the frequency or voltage exceeds or falls below the limits, shutdown is mandatory within 200 ms.

Mode of operation

The Type VMD423 three-phase voltage relays monitor the voltage and the frequency. If the voltage or frequency exceeds or drops below the definable limits it switches an alarm relay within 80 ms (response according to VDEW). Over-voltage, measured as an average over a period of 10 minutes switches the alarm relay. The response values are preset in accordance with the current DIN V VDE V 0126-1-1.

The latest measured values are indicated permanently on the LC display. The measured value triggering the switching of the alarm relays is stored in the memory. Since the start-up and release times are adjustable, the requirements of the network operators, such as the device-specific start-up phase and transient voltage changes etc., can be catered for.

This, with the aid of the VMD423, offers many advantages for the Lumpenmühle operator including the following:

- High reliability
- Quick and easy commissioning because the response values are preset and standardised
- Perfect information from the large LC display
- Proven technology, which is also used by major energy companies such as E.ON, RWE and Vattenfall.
- Standard and network operator-specific behaviour at the transfer point to the public grid.

The VMD423 is a cost-effective solution for grid monitoring. The devices are used in hydroelectric power plants such as Lumpenmühle in Lohr and photovoltaic systems. They also provide electrical safety in wind power plants and combined heat and power plants. ■

*Dipl.-Ing. Heiner Carnein
Techn. Office Hessen*



Modernisation of the railway signaling systems in India

Railway network in India is the 2nd largest network in Asian subcontinent just behind China and 4th largest network in the world. Daily about 3423 trains runs through Indian Railway network. Indian Railways has more than 64,015 km (39,777 miles) railway network with about 6,909 stations, carrying 6.2 Billion passengers per year, highest in the world.

A giant on its way towards the future



“Railway signaling” is a control and monitoring system used to control railway traffic safely, essentially to prevent trains from colliding. Furthermore, trains cannot stop quickly, and frequently operate at speeds that do not enable them to stop within sighting distance of the driver. A minor malfunction in signaling system due to earth leakage/fault will cause a catastrophe which is unimaginable, leading to loss of life of thousands.

Apart from meeting the basic requirement of necessary safety in train operation, modern railway signaling plays an important role in determining the capacity of track section. The capacity decides the number of trains that can run on a single day in a section. By proper and efficient signaling the capacity can be increased to a considerable extent without resorting to costlier alternatives.



From oil candle to relay

The first train was installed in India in Mumbai in 1853 by British engineers. The railway network and signaling system in India further evolved in similar lines of railway system in Britain, which is still followed in India. However the developments in USA and Europe are now incorporated in the railway system in India. The railway signaling system evolved from the manual system using oil candles with coloured glass filters, further induction of electric lights and contacts and currently computer based programmable complex and efficient signaling and interlocking systems keeping in line with latest development in science and technology. Similar to British Railways, various types of ungrounded (IT system) low voltage power supplies viz. 110 V AC/DC, 60 V AC/DC, 24 V AC/DC and 6V AC/DC with maximum operating current of 150 mA to 200 mA per circuit is currently used.

The advantages of IT system are to increase the availability and reliability of signaling circuits. First earth fault does not affect the required functions of the system. The various signal and switching circuits include Track Point Switches, Track Motors, Signal Control Relays and Signaling Lamps. The design now generally conforms to national and international standards. The railway signaling system in India have now ranging from 4-5 relay racks in a small signaling station to tens of relay racks in a large station. Majority of the cables associated with the above mentioned circuits are outdoor and run along railway tracks to a distance of 2 to 3 km either buried or over ground. They are exposed to the harsh weather and unfavorable environment and human induced damage and theft. These affect their insulation resistance and are subject to deterioration in the harsh environment over a period of time. This leads to mal-operation and unreliable operation of signal systems.

India being a labour intensive country and Indian Railways a completely government controlled company having the philosophy to support employment has a large pool of human labour. Most of the maintenance jobs are manual with prescribed preventive maintenance schedule. This leads to high failure rates with corrective maintenance as a standard method of maintenance procedure. With growing economy at fast pace and a need for reliable, safe and efficient infrastructure like railways, malfunctions and failure in signaling system will jeopardize the essence of safety, reliability and efficiency of railway system and may cause horrible railway accidents. A need for continuous monitoring of the health of signaling system to aid in predictive and preventive maintenance without shutdown is the need of the day.

Real-time monitoring

US, British and European in-house railway standards recommend continuous monitoring of the insulation resistance of the signaling circuits to ensure reliable, efficient and safe movement of trains. Currently railway signaling system uses electronic relays, electronic power supplies, programmable computer systems and communication circuits which are inherent source of EMI. The monitoring system should work in presence of such electrical noises without spurious operation and indications (EMI/EMC qualified). Further they should conform to the latest standard IEC 61557-8 for insulation monitoring system and IEC 61557-9 for fault location system and shall be EMC qualified as per IEC 61326 or equivalent.

Railway signaling system in India till date did not have any international standard qualified continuously monitoring facility for monitoring of insulation level





of the circuits online. Only indigenously developed basic insulation monitoring system not conforming to any international standards was used and still in use. It totally depends upon periodic manual checking of insulation level in stipulated time interval. This led to many malfunctions and failures in signaling circuits causing appreciable down time and affecting smooth running of trains and jeopardizing safety. Therefore an international standard qualified on-line insulation monitoring and fault location system is the need for railway signaling system in India.

Complex demands ...

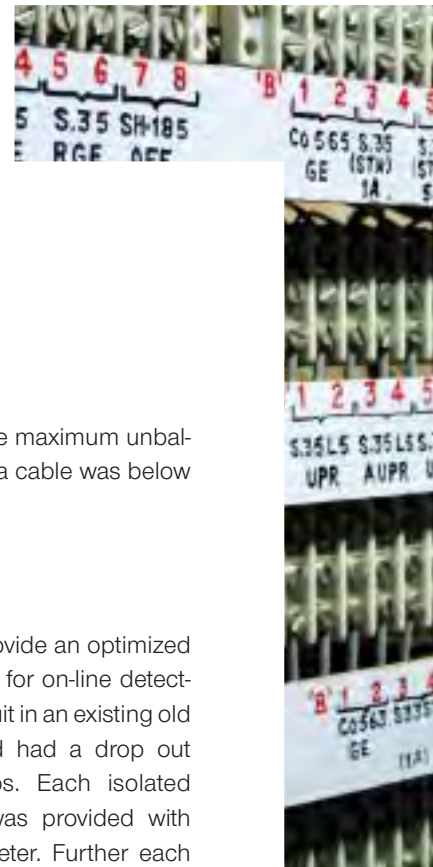
With technical support from Bender India for the first time Bender solution was implemented in some of the existing railway signaling stations in India. Typical railway signaling system in India consists of various ungrounded isolated power supplies viz. 110 VAC 3-phase for Track motors, Main Signaling, Shunt Signaling, 110 VDC for Track Point Control and 60 VDC for Relays, 24 VDC for Flashers and Axle Counters and 12 VDC for Communication. Further the individual circuits are passed through relay and interlocking circuits/racks in the signal room and run to the outside field via a terminal distribution frame located in signal room along the railway tracks through multi-core PVC cables.

A typical signal station may have 50 to 60 cables going out of the signal station. Any single cable may have circuits of different system voltages. Further the circuits in the cable are such that one wire of the circuit may pass through one cable and the return wire in other cable. Therefore the normal operation residual current was not zero in any cable. Signal cir-

cuits being low power the maximum unbalance/residual current in a cable was below 4 to 5 Amps.

... simple solution

The challenge was to provide an optimized solution with lowest cost for on-line detecting fault in individual circuit in an existing old station. The relays used had a drop out current of 40 milliamps. Each isolated power supply system was provided with its own IRDH575 A-Isometer. Further each outgoing cable was installed with appropriate Bender Current Transformer suitable for the cable diameter. For cost considerations closed core Bender CTs were provided but created a lot of installation problems and time consuming due to the requirement of shut down for opening the existing cable connections. In all future old installations we have now finalized to install Bender split core CTs which has made life very easy and less time consuming without reducing any sensitivity and reliability. For newly designed stations closed core CTs will be preferred for cost considerations. Bender CTs being designed to operate even in presence of residual current below 10 Amps, there was no problem in operation of fault location system and the system performed reliably with the required sensitivity even in presence of residual current of about 5 Amps. Based on the number of CTs, the required numbers of EDS460-D Insulation Fault Evaluators were used.





Retrofitting during operation

All the IRDH575 and EDS460-D were interconnected via RS-485 BMS network for control and transfer of information. In this way we could identify which power supply system had a fault and which of the outgoing cable in the field was faulty. Based on the information of the circuits of the faulty power supply passing through the faulty cable, only those limited number of circuits in the cable of the faulty power supply was checked manually with portable EDS3090 to identify the actual faulty circuit. This was done within few minutes of fault alarm on IRDH575 and EDS460-D on-line without the need of shut down. The solution provided the railways state of the art on-line insulation monitoring and fault location system monitoring continuously 24 x 7 without any spurious alarms.

*P. K. Bhattacharyya, Chief Representative, Bender India
S. Goswami, Senior Marketing Manager, Bender India*

ROAD AHEAD

With the initial success in implementation in Indian Railways and moved by the excellent Bender technology and performance and its R&D efforts, Research Designs and Standards Organization (RDSO) the main decision making authority on system design and requirements of Indian Railway signaling system is in process of standardizing on Bender insulation monitoring and fault location solution in Indian Railway Signaling System through out the country. Work has already been completed in some stations in Western as well as in Northern Railways. This is just a beginning of Bender solution in Indian Railways. We have a very wide road ahead. ■

Bespoke system control technology for Uniklinik Wuerzburg
(Wuerzburg university hospital)

Data display for more safety

In hospitals increased attention is paid to the safety of people and installations. Any technical malfunction could place lives at risk. The safety of the building services forms the basis for the safety of the medical technology used to care for the patients. Due to the university's very good experience with OPC* technology from *esb elektro systembau bender* in the new centre for operative medicine, a modernised fault management system has been implemented in the entire hospital, also using products from *esb*.

* Standardised software interface that makes it possible to exchange data between applications from different manufacturers in automation technology.





The Uniklinikum Wuerzburg with its 5,337 staff has a total of 1,433 beds and provides complete medical care at a trans-regional level. In 19 clinics with outpatient departments and three independent outpatient departments, almost 200,000 outpatients and over 50,000 inpatients are treated annually. Such a large and complex array of buildings can only be effectively managed centrally.

Proven technology ...

The first central fault management system was set up decades ago to monitor refrigerators and incubators containing important scientific results. Based on the ATARI ST, which appeared for the first time in 1992, a cross-building control system was set up. Fault indicator contacts from a wide range of electrotechnical plant were gradually connected to this system, as were the contacts from the Bender IT systems. The information was combined in the control room and used for the coordination of technicians to rectify faults and document the operating states via a log printer.

... with new tasks

In 2005 it was clear that this technology, proven but outdated for new technical requirements, had reached its limits and needed to be replaced.

As each new building is equipped with more and more technology that is also increasingly sensitive, it was necessary to plan and install a more powerful system. During the construction of the new centre for operative medicine (ZOM) a PC-based notification system was planned and set up by *esb*. Due to the operator's good experience with this initial island solution, the Staatliche Bauamt Wuerzburg (Wuerzburg State Construction Office) developed, together with the hospital's technical department and *esb*, a concept for a new fault management system with central control room.

The task was to include the old system with all its signals, as well as to implement additional signals and fully integrate existing Bender installations.

The following requirements were placed on the new system:

- graphic display of data in schematics and floor plans,
- display of the information in a hierarchical form,
- features for forwarding events,
- permanent storage of log book files so that operating states at any time can be verified,
- support for condition-orientated maintenance by means of the transmission of analogue values,
- evaluation of the utilisation of individual parts of the plants by means of the transmission of load states,
- possibility for the operator to modify and expand the system at any time,
- universal alarm modules so that other electrical plants can be integrated,
- specific management of the control personnel by means of the storage of event-dependent priorities for the rectification of faults,
- usage of existing infrastructure (LAN) for cross-site systems,
- management of control personnel by means of prioritised event-dependent instructions in the case of a fault and
- generation of a technician's control slip.

The requirements on planning and installation were therefore much higher than for the previous new buildings, as to connect together the individual buildings the related Bender bus systems in the individual buildings had to be expanded to form one large bus system. For this purpose the indicator and operator panel addresses and programming had to be modified; the firmware in all the indicator and operator panels also had to be updated. Thanks to consistent and sustained product updating, it was even possible to integrate first generation indicator and operator panels in the new system by using updated firmware.





TECHNICAL APPLICATION



the decentral computers only display the related signals from the specific related Bender bus systems, all signals are passed to the main computer. The OPC servers installed on the computers are able to poll all Bender bus system lines simultaneously and to make available all data for display.

Help with self-help

For system maintenance and to be able to independently expand the system as necessary, several employees from the hospital's technical department were trained in our seminar rooms in Gruenberg. As a result the hospital is able to support and expand the system on its own. The integration of the data as well as the design of the user interface and overviews were realised by *esb* in close collaboration with the technical department.

▶▶ Installation with the buildings in use

The company Elektro Pixis, Gerbrunn configured the existing power system between the individual buildings and installed the cables that were missing. Due to careful planning and meticulous implementation, it was possible to carry out the installation work with the buildings still in use and without major interruption.

Using the proven indicator and operator panel assemblies BM400 from *esb* it was possible to integrate the fault information into the Bender bus system at the related points and provide the information on both the external and internal bus. Depending on the requirements profile, the alarm modules were integrated into a surface mounted housing or directly in the existing switch cabinets on DIN rails. Here the issue time and again was to find customer-specific and application-specific solutions.

Full control

The main control room computer currently displays 5,239 data points, expansion to up to 10,000 data points is possible without problems.

Dedicated decentral data displays are installed in three buildings and are linked to the main control computer via the TCP-IP network. While

Thanks to the OPC solution from *esb* the hospital is now able to utilise the existing personnel resources in the technical department even more effectively. At the same time the availability of the technical plant is better, as degradation in insulation values is detected immediately and can be rectified as quickly as necessary to suit the hazard involved.

The example of the Uniklinikum Wuerzburg impressively shows how with *esb*, a partner for bespoke data display systems, significantly more complex and state-of-the-art system control technology can be realised without additional effort on the part of the personnel responsible for operation and maintenance. The customer obtains solutions exactly tailored to the related needs – all from a single source. ■

*Bernd Häuslein, Techn. Office Nuremberg
Henry Rauschenberg, esb
Guido Horst, esb*

THE *esb*-DATA DISPLAY IN FIGURES:

- 78 TM indicator and operator panels
- 80 alarm modules
- 170 IT systems
- 85 SMI472
- 188 switches
- 5,658 data points
- 5,239 data points displayed
- 6 external BMS buses
- 3 software OPC servers
- 1 hardware OPC server (FTC).



FUTURE

New buildings for new challenges

In the future we also want to offer our customers innovative, high quality products and open up new markets. Due to our successful efforts in recent years, our staff numbers and production figures have increased continuously, despite the economic crisis. Expansion has become essential.

Last year a sound planning concept was prepared; this concept is intended to address our space requirements for the years to come. With “Deutsche Projektbau” as the planner, a team of expert architects primarily specialised in the conceptual design, planning and erection of industrial buildings and office buildings was engaged. This team can draw on a broad pool of experience.

A holistic concept for the design, floor space and use has been prepared jointly so that current and future business and production-related requirements can be addressed. The objective is to combine all essential areas of the company (development, production, warehousing and material management, office and administration, central social area and central parking close to the place of work) on one site.

The design of the new buildings does not only optimise production-related processes and logistic processes, it also offers a “green courtyard” with a social area including a large cafeteria for all employees.

Already at the very beginning of the planning stage, high value was placed on ecological construction and high energy efficiency. The modern, environment-friendly materials to be used as well as the utilisation of alternative

energies in the form of photovoltaic installations on the roofs and a combined heat and power plant will ensure technically state-of-the-art construction.

The integration of Bender technology in the power supply for the company’s new buildings will ensure the highest possible electrical safety and interruption-free operating processes. At the same time these installations will provide a practical testing area for the company’s technology.

The planning for the first construction phase has been defined precisely by the project team, comprising the architects from “Deutsche Projektbau” and various specialist planners, as well members of the internal senior management and production management, along with the head of QM and building services. As a result, the planning application for the construction of a production building with an area of 3,500 m² was submitted at the end of 2010.

For the further realization, five construction phases have been defined – depending on feasibility and priority – which will be realised in the coming years, so that on completion of the entire construction project there will be approx. 7,500 m² of new office space and 4,700 m² of new production area. ■

Sabine Bender-Suhr, CFO



Well prepared for the future

– new structure at elektro systembau bender

During 2010, *esb* elektro systembau bender has put great efforts into the move to the newly constructed premises in Gruenberg. The company's steady growth during recent years and the increasing number of employees have led to an inevitable need to enlarge the company premises for administration and production.



The new premises were finally complete in October after two years of construction and were officially opened together with customers, business partners and employees. All guests had the opportunity to personally inspect the building and to learn about the activities of the individual employees and departments.

However, the celebrations in October were not limited to the new building – they also included the founding of *bendersystembau GmbH* and *digidirect GmbH*. *esb* Managing Director and proprietor Christian Bender also restructured the company in order to meet the demands of the market and to serve customers best.

bendersystembau is the expert partner for planners, installers, switchgear and control-gear builders, and operators when it comes to design, planning, consulting, construction and commissioning for the installation of power-supply systems in buildings. With their unique expertise that is

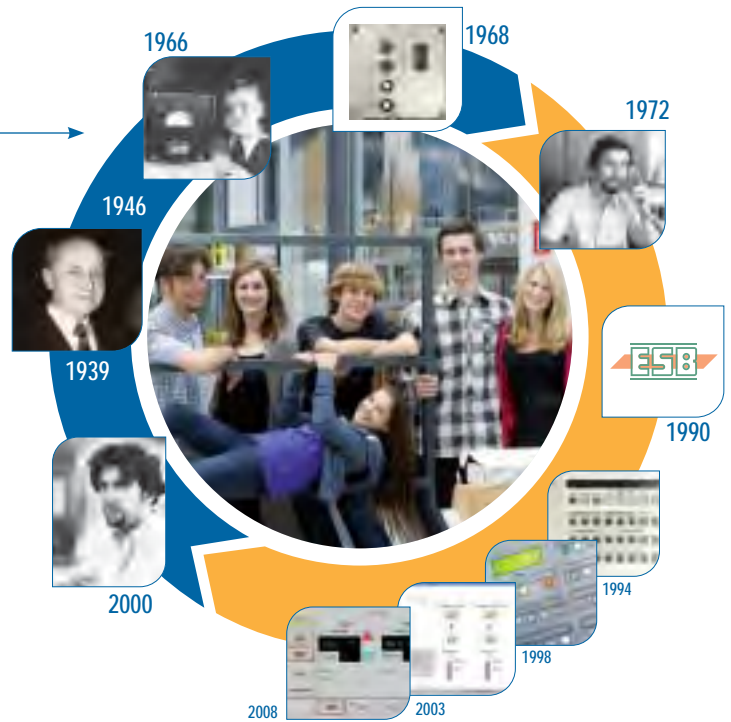


bendersystembau

shown in the company's product portfolio, bender-systembau's experienced project engineers provide assistance and support all the way from the planning stage to commissioning. The ultimate goal is to offer customers technically and commercially optimised solutions during development.



Furthermore, the already existing company *esb elektro systembau bender* as manufacturer is in the position to support the customers during project implementation. For example, switchgear and control gear builders can arrange for *esb* to prefabricate so-called "Group 2 distributors" for operating rooms and intensive care units in order to receive them ready-wired, on equipment racks so that they can integrate them directly into the switchgear. Switchgear and control gear builders can obtain the new "ATiCS" switching unit and the necessary training directly from Bender or choose to have it pre-wired. The last option may be advantageous from the point of view of utilisation or complexity, depending on the customer's situation.



digidirect® all you can print

A further company founded is *digidirect GmbH*. The former printing press manufacturing and film technology departments are concentrating on the development, production and marketing of digital printing systems. In this case, *esb* produces the films for the built-in panels. *digidirect* also produces individual printing machines for photo-realistic digital prints on flexible and rigid surfaces such as vinyl, PVC, corrugated cardboard, aluminium, stone, glass, acrylic, ceramic, wood, and all kinds of three-dimensional objects. ■

Christian Bender, Managing Director



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Introduction of an integrated management system based on QM/UM in 2011

Sustainable, environmentally aware and quality-orientated thinking has induced the Bender corporate group to implement an additional UM system in accordance with 14001 in the existing QM system in accordance with 9001.

The integrated management system covers the areas quality, environment, health and safety. With the introduction of the system the organisation is addressing existing requirements and in this way contributing to the protection of the environment with a view to an improved quality of life.

The objective is to have this integrated QM/UM system audited and certified by DNV (Det Norske Veritas) by September 2011.

In January initial preliminary discussions were held with an external consulting organisation. The following tasks to achieve certification were derived from these discussions:

- Preparation of a corporate policy as a mission statement for the management of the organisation
- Preparation of an environment program in which the environment objectives and their specific implementation are defined
- Expansion of our existing processes to cover aspects of relevance for the environment such as waste control, handling and storage of hazardous substances etc.
- Identification of all aspects directly related to the environment, e.g., avoidance, recovery, recycling of solid waste and other waste, utilisation of natural resources and raw materials (including energy), local phenomena (noise, vibration, odours, dust, aesthetic considerations etc.),
- Identification of all aspects indirectly related to the environment, e.g., product-related effects (design, development, packaging, usage and recycling/disposal of waste), composition of the product range, management decisions and planning decisions
- Evaluation of all effects on the environment in categories A, B and C
- Assessment of and compliance with the stipulations defined by law, e.g., laws on electrical products (RoHS, WEEE), GefahrstoffVO (German ordinance on hazardous substances), BetriebssicherheitsVO (German ordinance on health and safety); ArbSchG (German law on labour protection),
- Definition of tasks, responsibilities and authority related to the protection of the environment
- Organisation in case of emergencies and emergency measures
- Disaster plans (evacuation plans)
- Preparation of an integrated QM/UM manual.

Bender is already addressing environmental requirements during the planning and realisation of the new buildings by utilising regenerative energies, taking into account the co-generation of heat and power, complying with statutory requirements, as well as following the EnEV (EnergieeinsparungsVO 2009 - German ordinance of energy saving). The results are significantly better than the statutory requirements. The construction of the new buildings will also create space and working conditions that will make it possible to design a smooth work process and therefore also to apply the principles of "5S workplace organisation".

Melitta Heydt, T-QME



As the world's largest independent development partner, the EDAG Group develops series-production solutions for the sustainable mobility of the future. The range of services covers the entire value chain from the development process for products and production plants, to plant engineering and (small-scale) series production.



EDAG Group Partner of the International Mobility Industry



The strength of this development partner of the international mobility industry founded in 1969 is networked engineering: With its holistic understanding of vehicles and production plants, the EDAG group is the leading partner and can offer the fusion of product and production in development, including realisation in plant engineering, with added value. This successful concept of integrated engineering with associated plant engineering and (small-scale) series production has taken the company beyond the automotive industry to the aerospace, commercial vehicle, railway and renewable energies sectors in recent years.

Since 2005 the EDAG Group has successfully positioned an independent process consultancy with engineering skills focused on software houses in the market.





COSTUMER PORTRAIT

▶▶▶ Based on the experience of their worldwide activities, EDAG IT as an external IT service provider offers innovative, demand-orientated, and practical solutions for IT infrastructure and IT applications.

Since 2007 the EDAG Group has also offered comprehensive personnel services in the “technology & development”, “office & service” and “trades & skilled work” segments with its subsidiary ED WORK.

Integral development partner for the international automotive industry – Today’s comprehensive range of services for the development of complete vehicles and production plants is the result of 40 years of experience in the automotive industry. In product development EDAG offers all relevant development-related services along the value chain. From styling, development (bodyshell, interior, doors, covers, bonnet and boot lid, electrics/electronics), simulation (digital product), up to the validation of functional characteristics (safety, acoustics, handling) to the overall vehicle development.

Due to the close collaboration with the production division, developments can be validated from models to roadworthy prototypes. The range of services offered



by the production division has been expanded continuously in recent years to cover small-scale series production.

The emphasis is on the small-scale series production of plastic parts by the subsidiary AKTec, the small-scale series production of bodysells and sheet metal parts on the production site in Eisenach, and the construction of vehicles with special armouring on the production site in Ingolstadt. The subsidiary WMU in Hann, Muenden, EDAG also offers series production of pressed structural parts.

The second central pillar of the services offered by EDAG is the development and the manufacture of complete production plants with emphasis on the areas bodysell manufacture and assembly plant, as well as the supply of state-of-the-art production equipment and technology. In this sector, EDAG with its subsidiary FFT EDAG Produktionssysteme GmbH & Co. KG has been a recognised turn-key partner of the automotive industry for international projects for more than 4 decades.

Product and production for the aerospace industry

Since 2000 the EDAG Group has been working for manufacturers and suppliers in the aerospace industry. Today we have more than 500 employees in our subsidiaries ELAN GmbH and Mühlenberg Interiors GmbH & Co. KG.

Since 2008 ELAN GmbH is one of the 24 suppliers across Europe with the status "Preferred Supplier" for EADS (Airbus parent company). ELAN GmbH provides continuous development competence starting with concept development, design (primary structure, carbon fibre parts, system integration), all the way to functional, virtual prototypes and production planning. The development teams have direct access to the test and production facilities of the international group so that findings from validation and production can directly be integrated in the development process.

Plant engineering constitutes another major focus for EDAG in the aerospace sector. For this reason the joint venture DEAS (Dürr EDAG Aircraft Systems GmbH) was founded by Dürr AG and EDAG in 2008. This enabled both organisations to further expand their aircraft business and to continue their successful collaboration in the area of aircraft production and aerospace plant engineering. As the third part of the Aerospace division the company Mühlenberg Interiors GmbH & Co. KG offers the manufacture of high quality cabin trim and benefits by using the



development portfolio of ELAN GmbH for this task. At the beginning of 2007, the division succeeded in becoming a module supplier in the cabin area due to Mühlenberg Interiors GmbH & Co. KG Mühlenberg is a certified development, manufacturing and maintenance organisation for aircraft interiors (on-board kitchen, storage lockers, lightweight aircraft parts, etc.) for passenger, VIP and freight aircrafts.

Development competence for the railways – In the middle of 2009 with the completion of the bundling of the activities in the area of the railway industry into an independent Rail GmbH, the EDAG Group transferred its existing core competence in product development, production plant development, plant engineering and small-scale series production to the railway transport industry and offers, along with the emphasis on model making and prototype manufacture, also customer-orientated solutions in the form of advanced concepts on the topics of lightweight design and passenger information systems.

Development services for the renewable energies sector – In the new field of wind power and

photovoltaic, the EDAG Group offers its specialist competence in all areas of engineering and in the efficient organisation of the development process. The EDAG Group is the only organisation in the wind power sector that can contribute its skills and special knowledge from its main automotive and aerospace fields of activity to the development of wind power plants and ensure the success of the projects with process management and quality management.

Based on many years of experience in complete production plants, the EDAG Group can offer profound support in increasing the level of automation to manufacturers of photovoltaic installations.

Worldwide presence – The EDAG Group employs more than 6,600 people worldwide and has more than 45 international locations to provide personal support to its customers. On all international sites EDAG combines the German management philosophy with local requirements and conditions. Employees from the respective country ensure the best possible grasp of customer expectations in these markets. Besides the support to German customers in these markets, the initiation of local business relationships has highest priority. ■

Christoph Horvath, EDAG Group, Fulda

Dipl.-Ing. Michael Schmitz

Sales Director Bender Germany



PROFESSIONAL CAREER:

- 1988 – 1991 Training as energy electronics technician, HÜLS AG Werk Troisdorf
- 1991 – 1992 Fachoberschule für Technik (Technical college) in Hennef
Qualification: Advanced technical college entrance qualification
- 1992 – 1996 Course on general electrotechnology , Rheinische Fachhochschule (RFH) (Rheinish university of applied sciences) Cologne
- 1996 – 2010 BARTEC GmbH – Sales engineer for components and systems in potentially explosive atmospheres, technical office, Cologne
 - 2001-2007 Head of the technical office, Cologne
 - 2007 -2010 Head of sales D/A/CH
- Since Juli 2010 Sales Director Bender Germany

Herr Schmitz, you are the the new Sales Director for Bender Germany. How would you define the key areas of your task?

Rapid technological progress is making product development times and product cycles ever shorter, and creating a broad, continuously increasing product range, as well as to some extent new markets and applications. To be able to address the continuously changing needs of our customers, intensive communication with customers is imperative.

How does one become Sales Director in such a family business so full of tradition like Bender?

After 14 years in a medium-sized business I was looking for something new and for a professional change. My objective was to take over the responsibility for sales in a sound medium-sized family business with tradition and good prospects for the future. Bender was looking for a successor for this position and after a few meetings we arrived at a mutually acceptable and sustainable basis for working together.

As the new Sales Director you are taking over the established structures of your predecessor, Herr Feigl. How are you tackling this challenge?

Of course it is difficult to do justice to the standards set by an excellent predecessor who was in the company for 26 years. However, on the other hand this situation makes a lot of other issues easier. Over the years Herr Feigl has built up a very good team both in-house and on the road. Luckily he continues to support sales with seminars and training courses, particularly in the area of hospital standards. The structures created by Herr Feigl that have become established over the years are therefore an excellent basis for the further development of sales.

Which topics do you regard as the most important for you and your function as Sales Director?

A central issue for me is to strengthen and expand the relationships with our customers and to orientate ourselves more on their needs. In general I feel the quality of communication is the crucial factor for the quality of customer ties. I want to further broaden issues for which Bender is already known; these include in particular high quality products, individual solutions, excellent service and short reaction times. In addition, we will further expand our communication channels particularly at inter-regional level.

Sales is definitely one of the parts of a business with the most intensive communication. You have already indicated that both the external and the internal communication must function smoothly. How are you addressing this topic?

Within the 11 technical offices that provide nationwide on-site support to our customers in Germany and the in-house sales team, transparent and therefore effective communication is required. We process customer projects from all over Germany and sometimes also from abroad.

Currently we are moving forward with a CRM system as a tool to support sales; the implementation of this tool is currently in progress. And as already mentioned: despite all the tools and technology, the focus is on people. If the atmosphere between the individual protagonists is good, it permeates through the structures and our customers, and our staff are also pleased to come to us.

Every member of the sales staff maintains an entire network of contacts. How do you deal with this network and refresh contacts?

For me customer-proximity is important, it is the basis for good communication and at the end of the day both sides profit from it: the customer always has a point of contact and we at Bender have direct and prompt feedback on the needs of the customer, i.e. the market. Overall this situation results in an optimised product range for the needs of the market and a high level of customer satisfaction. In addition, the customer has the certainty that he can talk to me or us at any time if he has special requirements for bespoke solutions. For this reason I regularly visit our customers with our sales staff on the road.

In addition, I use trade fairs where it is possible to make numerous interesting contacts. Particularly during the somewhat less formal conversations at trade fairs the interchange is often very informative.

An increasing number of manufacturing companies and their sales partners are adopting just-in-time solutions. What is your opinion on classic stock holding?

It is very important to serve our customers promptly, also in case of custom solutions. In close dialogue with our production we ensure maximum possible availability at assembly level. Due to the current situation in the area of component procurement it is, however, sometimes difficult to always optimally meet customer wishes and our own standards. For many of our customers, quick delivery within a few days is important to avoid possibly costly downtimes. To meet this need we want and must keep stock.

Technical innovations are coming with increasing speed. Even the most basic things, such as the supply of energy, are in a state of constant accelerating change. How do you see Bender's position in such turbulent markets?

Power system safety will always be required, particularly as systems grow with alternative sources of energy. The electricity grids are becoming increasingly unstable and difficult for the grid operators to manage due to these many small, medium and large supply points. The requirements in this area will also further increase in the future, not least due to actuarial constraints and new safety standards. As a result there is an increasing demand for corresponding safety technology. Thanks to our know-how and our products that are known for their very high reliability and dependability, our solutions are in use at many important German utilities and also at many regional utilities, and are in increasing demand.

Also the continuing microelectrification is causing the markets to call for solutions for a stable supply of power, as the new electronic assemblies are susceptible to interference in relation to voltage spikes and voltage dips. Keywords such as EMC and high availability are an issue for every organisation that operates information technology systems. Our universal AC/DC sensitive residual current monitoring is excellently suited to the task of ensuring availability in sensitive systems and will be continuously further developed in close co-operation with our customers and adapted to current needs. Due to intensive customer support we have our ear very close to the markets and are therefore in a position to be able to bring new solutions onto the market in a very short time. Internally the issue is to react as quickly as possible to new requirements with new production processes and ever more demanding quality assurance mechanisms. The prospects for the future at Bender are therefore better than good! ■

Herr Schmitz, we thank you for the interview.

Timothy Hörl

BENDER Group

The Bender Group with its main office in Gruenberg/Hesse has 56 agencies with over 500 employees worldwide.



Worldwide for Electrical Safety

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