MAGAZINE FOR ELECTRICAL SAFETY

MONITOR

14

ISOMETER® iso685-D:
Safety is evident!
Innovation in the area of insulation monitoring

BENDER Group

editorial

Dear Reader,

in this MONITOR we have, as always, brought together information from our business activities. The highlight of this issue is our new insulation monitoring device ISOMETER® iso685 that we will present for the first time at Light + Building in Frankfurt and the Hannover Messe. In this device we have combined decades experience with a large number of new ideas. I would like to cordially invite you to take a look at this device at one of the shows.

Fittingly, in this MONITOR we have placed the emphasis on insulation monitoring: in the earthed system (TN/TT system) using residual current technology and in the unearthed system (IT system) using ISOMETER® technology.

We we are of the opinion that the time of "flying blind" in electrical installations should be over. In the case of sophisticated electrical installations a fault should not only become apparent as a result of a shutdown, instead it should be detected and located earlier to prevent an unplanned interruption. The conclusion is: insulation monitoring makes systems safer and more cost-effective.

Unearthed systems should have a much more important role in future than they have today. The advantages and disadvantages of the IT system are examined in this issue and it is clear that the IT system offers significant advantages – advantages that can now be better exploited than ever due to the new ISOMETER® iso685.

Yours,

Dirk Pieler
CEO

IMPRINT

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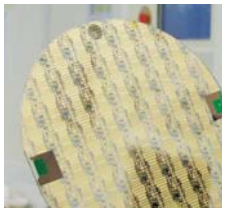

The new dimension in insulation monitoring

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The general view of the electrical supply is mostly simply that "electricity comes out of the wall socket". This easy to understand, but very superficial statement, also reflects a lack of concern among the population about electrical safety ...

IT system ensures electrical safety at the Munich Airport

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Interview with Herr Dipl.-Ing. Karl Edelmann from TÜV Süd in Munich, technical assessor specialising in: the independent and neutral assessment of power supply systems in industrial facilities and industrial systems with the objective of the reliable, safe and cost-effective design of these systems ...

Enjoy the technology of tomorrow already today

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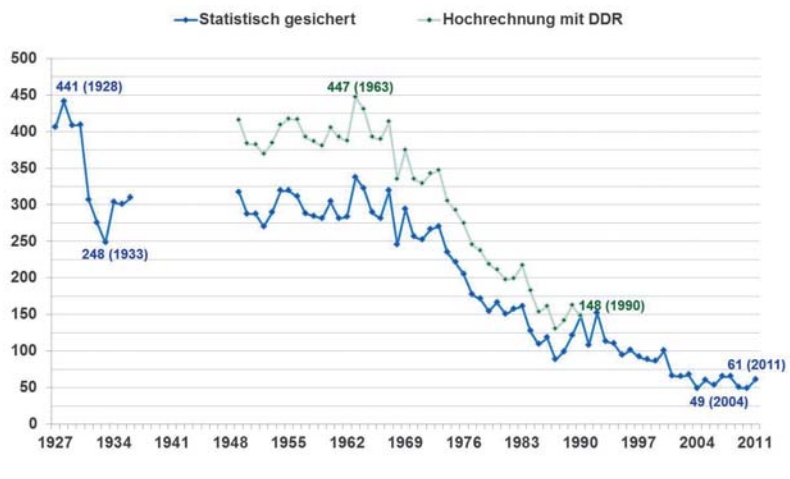
Since the founding of the company we have been on the move for our customers 24 hours a day, 365 days a year for four decades. We live and work in buildings and institutions that are places of life, daily work, business, and also places of relaxation and invigoration, in addition, they provide an environment for regeneration and recovery ...

FEATURE

The new dimensio in insulation monitoring

The general view of the electrical supply is mostly simply that "electricity comes out of the wall socket". This easy to understand, but very superficial statement, also reflects a lack of concern among the population about electrical safety. The specialist world has been treading new ground in the areas of power generation, power distribution, safety and the related applications for decades. For this reason, the related standards are continuously revised, new standards written and scientific findings implemented, for example on protection against electric shock. It is due to these developments that, among other issues, fatalities due to electrical power have reduced significantly in recent decades (Figure 1).

FIGURE 1:
Causes of death statistics, electrical accidents
(source: Information from the Institute zur Erforschung elektrischer Unfälle (German institute for research into electrical accidents), BG ETEM)



The research institutes, the manufacturing industries, the trades, the related associations and developers of the standards in the electrical engineering area have contributed to this situation in various ways. An aspect where there is still room for improvement is greater attention to the topic of "standardisation in electrical engineering and protection against electric shock" in the curricula at the universities of applied sciences, for example, as already implemented by at University of Applied Sciences Mittelhessen in Wetzlar.

The change in energy policy is one of the most urgent topics for the new German government. For this purpose, approximately 600 experts discussed the future supply of energy at the VDE ENERGY SUMMIT 2013. During a subsequent press conference the VDE Verband der Elektrotechnik Elektronik und Informationstechnik e.V. presented a new document that gives

a clear overview of the development of the change in energy policy up to 2050. The brochure provides information on new energy distribution systems, "smart grids", energy storage and electric mobility. The current problem areas of electrical energy supply such as energy transport, for instance, are also addressed.

Under the leadership of the DKE – German Commission for Electrical, Electronic & Information Technologies of DIN and VDE – comprehensive road maps, in particular in the areas of "smart grids", electric mobility and Industry 4.0, are currently in preparation and undergoing publication in standardisation forums and in this way important implementation groundwork undertaken.

However, a key element of all the tasks related to the future is to design the actual power supply systems to be as safe as technically possible. In Germany the DIN VDE 0100 (VDE 0100) "Low-voltage electrical installations" series of standards plays an important role here. Group 400 in this series tackles different aspects of protective measures. Protection against electric shock is defined in part 410.

The standard DIN VDE 0100-410 (VDE 0100-410) contains relevant requirements for the installer on safety precautions and protective measures for protection against electric shock, including basic protection and fault protection for individuals and livestock. The standard also addresses the application and co-ordination of the requirements in relation to external effects. Requirements for the usage of additional protection are stated in specific cases.

„**However, a key element of all the tasks related to the future is** to design the actual power supply systems to be as safe as technically possible."

The DIN VDE 0100 (VDE 0100) series of standards forms the guidelines for the installation of electrical systems in what is termed the low voltage range for 230 V and 400 V AC systems. During the current and future further development of the series of standards, low-voltage DC systems will also be taken into account, as these will be used more frequently in future.

In this internationally harmonised series of standard both the type of earthing of the power supply systems and the selection of the protective and monitoring devices are described. The terms TN, TT and IT system for the types of system became established across Europe some time ago. The abbreviations "RCD" for residual current devices and "IMD" for insulation monitoring device have also become established in the specialist literature.

The unearthed IT system is a form of power supply that has seen a significant upturn in recent decades. From the few early applications known in the mining and medical sectors, today there are many applications for this type of system. Unearthed IT systems are essential where particularly high system availability is required and a power failure on the first insulation fault or earth fault is unacceptable. The usage of an IT system is also almost ideal for applications in which DC components are to be expected on the occurrence of an insulation fault.

IT systems are excellently suited to today's applications, for instance, in photovoltaics or electric mobility, and are to be found in the following standards for example:

- DIN VDE 0100-712 (VDE 0100-712): Low-voltage electrical installations - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems.

The special requirements in this part are to be applied to electrical installations for PV power supply systems including systems with AC modules.

- DIN VDE 0100-722 (VDE 0100-722): Low-voltage electrical installations - Part 7-722: Requirements for special installations or locations - Supply of electric vehicle.

This standard contains requirements on the supply of power for electric vehicles.

- Draft ETSI EN 301 605 Environmental Engineering (EE); Earthing and bonding of 400 VDC data and telecom (ICT) equipment.

This standard is used in computer centres and telecommunications facilities with a 400 V DC supply.

Unearthed IT systems are also increasingly used in applications where significant system leakage capacitances are to be expected or where a low earthing resistance cannot be achieved.

The prerequisite for the exploitation of the advantage of the protection against failure despite an insulation fault or a direct earth

fault in unearthed systems is the monitoring of the active conductor in relation to the protective earth conductor using an insulation monitoring device (IMD). This type of monitoring is addressed in the German standard DIN VDE 0100-410 (VDE 0100-410): 2007-06 in section 411.6.
More detailed information on the selection of insulation monitoring devices is to be found in:

- DIN VDE 0100- 530 (VDE 0100-530): 2011-06, Low-voltage electrical installations - Part 530: Selection and erection of electrical equipment – Switchgear and controlgear, section 538.3.

The development of international standards is also following the increased usage of insulation monitoring devices (IMDs). The international standard IEC 61557-8 is already available in its 3rd revision and takes into account recent findings in photovoltaics with a new annex on IMDs for photovoltaic applications. The title of this standard is: IEC 61557-8, Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - Insulation monitoring devices for IT systems; and it corresponds to the draft German standard E DIN EN 61557-8 (E VDE 0413-8): 2013-08, Elektrische Sicherheit in Niederspannungsnetzen bis AC 1000 V und DC 1500 V – Geräte zum Prüfen, Messen oder Überwachen von Schutzmaßnahmen.

However, a further important development is to be seen in the standardisation activities at the IEC (International Electrotechnical Commission) – the requirements on the functional safety of IMDs in IT systems. For future applications a standard has been prepared with the German title: DIN EN 61557-15 (VDE 0413-15): Elektrische Sicherheit in Niederspannungsnetzen bis AC 1000 V und DC 1500 V - Geräte zum Prüfen, Messen oder Überwachen von Schutzmaßnahmen - Teil 15: Anforderungen zur Funktionalen Sicherheit von Isolationsüberwachungsgeräten in IT-Systemen und von Einrichtungen zur Isolationsfehlersuche in IT-Systemen. The application area is described as follows:

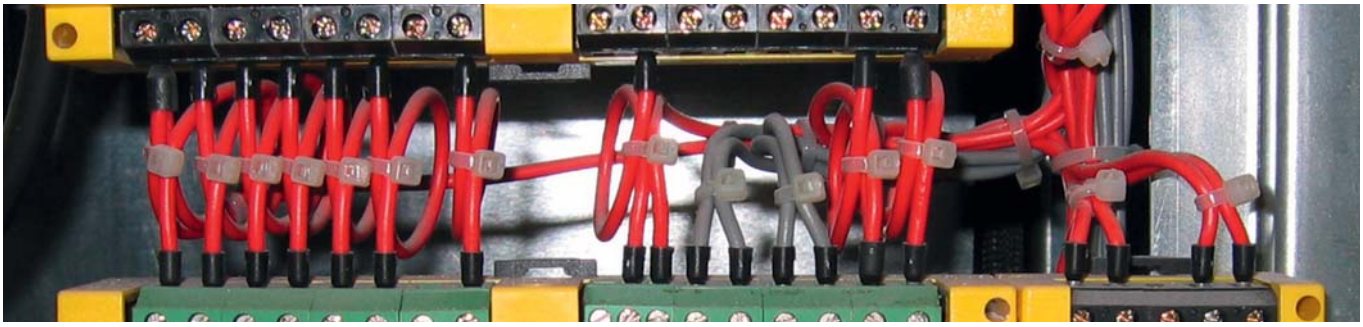
This part of IEC 61557 defines requirements for the realisation of the functional safety of insulation monitoring devices (IMD) in accordance with IEC 61557-8 and of insulation fault location systems (IFLS) in accordance with IEC 61557-9 for phase 10 of the lifecycle in accordance with IEC 61508-1. These devices contain safety-related functions for IT systems.

IMDs and IFLS are not protective devices, but they are part of the protective measure in IT systems. The functions in IMDs and IFLS, such as the continuous monitoring of the insulation resistance of an unearthed IT system and the localisation of insulation faults in part of the system, can however be considered safety functions that are part of the protective measures in IT systems.

This standard can only be applied to IMDs and IFLS that include safety functions with SIL 1 and SIL 2. Higher SILs are not specified in this standard, as they are generally not necessary for IMDs and IFLS in IT systems.

Compliance with this standard can be necessary if functional safety is required for IMDs or IFLS in the related application in the IT system. However, the standard does not define that a specific level of functional safety in accordance with this standard is always required for these devices. ■

Dipl.-Ing. Wolfgang Hofheinz
Chair of the DKE
(DKE German Commission for Electrical, Electronic & Information Technologies of DIN and VDE)



Why the IT system is often the best choice for power supply systems of all types

Let us start initially with a clear commitment:
the IT system ("unearthed system") is a type of system infrequently used compared to the TN or TT system ("earthed system") – but it would often be the better alternative.

So why is the worse alternative accepted in practice? The answer is probably: habit, convenience, ignorance. Many electrical planners are unfamiliar with the IT system. It is barely touched upon in universities and training centres. The earthed system has therefore become increasingly widespread. The IT system is used infrequently and then above all only where its advantages are essential, e.g. in operating theatres and intensive care stations, or in railway signalling systems. Why? Because we are talking about human lives. But shouldn't it always be a concern in our power supply systems?

Let us take a look at the advantages and disadvantages of the IT system:

FIRST ADVANTAGE: inherently safe – small difference, big impact

The IT system primarily differs from the TN or TT system in the electrical connection between earth and the star point on the transformer that supplies the system. This connection is present on earthed systems, on unearthed systems it is left out. As an alternative to the supply transformer, an IT system

can also comprise another source of power, for instance, a battery. In the unearthed system all-pole protection of all active conductors is necessary. The same applies to the N conductor, if installed. Since in a single-phase system none of the two conductors are earthed, there will be two live conductors instead of a classical “Phase and neutral”.

What is then the big difference in the impact if there is only such a small difference in the implementation? If an uninsulated live conductor or a conductive enclosure is touched on a live load, NOTHING happens with an intact unearthed system. Why? Because a current can only flow in a circuit and the circuit has not been closed as the star point of the transformer has not been earthed. It is like a bird on a high voltage overhead power line, you are safe. What is the situation on the earthed system? In this case a closed circuit is set-up in advance and, to a certain degree, is just waiting for the fault. If in this case a person touches a live conductor, a fault current immediately flows through the person due to the low impedance connection to the supply transformer. This situation would be dangerous without functional protection equipment. This circuit is protected via fuses and residual current devices (also called RCDs) such that, in the event of a fault, shutdown occurs quickly enough so the person is not seriously harmed. To make sure that this protection also functions, the protection equipment must be regularly checked. For instance, the functionality of RCDs in electrical installations must be tested every six months – also in private households. But how often is this check actually made?

The IT system offers inherent protection against touch voltages. The only exception here are AC systems with very high system leakage capacitances and asymmetric loads. Possible measures in these cases are, firstly, division into smaller subsystems and, secondly, the measurement of the capacitance and the calculation of the maximum current through the body in the event of a fault, which is possible using the new insulation monitoring device ISOMETER® iso685. It goes without saying that insulation faults must be rectified promptly to keep the system safe, even in the IT system.

SECOND ADVANTAGE:
fault localisation

It is possible to locate insulation faults during operation or in de-energised condition using so-called insulation fault location systems (IFLS). Permanently installed devices and mobile devices are available for this purpose. Fault location is in principle also possible in earthed systems using residual current monitoring (RCM) technology. However, with the restriction that this technology only works in energised systems and, unlike in the IT system, remains restricted to asymmetric insulation faults.

THIRD ADVANTAGE:
no undesirable service interruptions

As stated above, the IT system is inherently safe. This situation means, almost as a side effect, that in the event of an insulation fault – even if there is a dead earth fault – shutdown is not necessary. This is also the reason why IT systems are stipulated, e.g., in intensive care units. In the event of an insulation fault, the supply to life-supporting equipment is maintained. The IT system is in general, excellently suited to all applications in which shutdowns are undesirable, would have serious consequences or would cause high costs – in the process industry, in computer centres, in automation and, in principle, everywhere. Control circuits of all types are particularly important. Control errors and failures in control circuits – for example in a substation or in a nuclear power station – can have serious consequences. Based on the information provided by the insulation monitoring device it is possible to plan long-term servicing and maintenance work in the IT system and avoid unplanned service calls to rectify malfunctions.

FOURTH ADVANTAGE:
early detection of deteriorations

A further key advantage is that deteriorations in the level of insulation can be detected immediately. In an earthed system fault currents can be resolved in the single-digit milliamp range using sophisticated residual current monitoring (RCM) technology – but no further. This situation means detection of the deterioration of the insulation below 40 kΩ at a mains voltage of 400 V and a resolution of 10 mA, if it were possible to select only the ohmic portion of the residual current. This is a significant improvement compared to an unearthed system not being monitored that unexpectedly shuts down. In the IT system an insulation value of 40 kΩ corresponds to the recommended primary response value. It is possible to measure in the megaohm range and above in the IT system – which signifies a factor of at least 1,000 compared to the earthed system. Therefore, deteriorations in the insulation can be measured and rectified very early.

FIFTH ADVANTAGE:
detection of symmetrical faults

In an IT system it is possible to detect symmetrical faults using an actively measuring insulation monitoring device in accordance with IEC 61557-8. Symmetrical faults are deteriorations in the insulation of a similar order of magnitude on all phase conductors. Such faults are not unusual. For example, the insulation figures in photovoltaic installations often deteriorate to a similar degree on the positive and negative side.

SIXTH ADVANTAGE:
measurements in DC systems

RCDs for pure DC systems such as battery systems are not currently available. Possible options are either devices for residual current monitoring (RCM) with a DC supply voltage or implementation as an IT system with insulation monitoring. In DC systems the ISOMETER® iso685 also offers the advantage that it indicates whether the fault is on the positive or negative side.

SEVENTH ADVANTAGE:
measurement in mixed AC systems with DC components

If there are battery systems, inverters, switch mode power supplies etc. in the AC system, DC fault currents are possible. The widespread RCDs of type A for pure AC systems are unsuitable here. In the earthed system it is only possible to use RCDs of type B or it must be ensured by other means that the system is shut down on the occurrence of DC currents above 6 mA. An appropriate alternative is to operate the installation as an unearthed system and to monitor it using an insulation monitoring device.

EIGHTH ADVANTAGE:
offline monitoring

As an insulation monitoring device in accordance with IEC 61557-8 measures actively in the IT system, it can also monitor completely de-energised IT or TN systems. This aspect is important, for example, for railway points heating, fire extinguishing pumps on ships, redundant cooling systems in nuclear power stations. In this way it is also possible to detect an insulation fault on a heater for railway points in summer so it can be repaired in good time. Otherwise, the fault would only be found on switching on in the winter – in the form of the immediate failure of the installation exactly when it is needed.

NINTH ADVANTAGE: closing the gap between the periodic tests

The insulation monitoring device stipulated for the IT system continuously monitors the insulation value. Conversely, during the periodic tests (keyword BGV A3 test) only the instantaneous state of the insulation is measured. This state can deteriorate dramatically immediately after the test and remain unnoticed for a long time. Continuous monitoring by means of the additional usage of residual current monitoring systems (RCM technology) is also possible in the earthed system.

ISOMETER® iso685

TENTH ADVANTAGE:
prevention of fire

Insulation faults in electrical installations are the most common cause of fire. The probability of fire in the IT system is much lower. Firstly, insulation faults can be detected and rectified at an early stage in their evolution. Secondly, as there is no low impedance return path, a current large enough to cause a fire does not flow in the event of an insulation fault. The restriction to systems that do not have an excessively system leakage capacitance also applies here.

ELEVENTH ADVANTAGE:
long-term view

The new ISOMETERs® iso685 and iso1685 are able to record a full set of system parameters with date and time information over many years. In conjunction with other recorded system information, this aspect permits event-based fault analysis and makes it easier to find and rectify faults that occur sporadically; it also improves the information available for making decisions on future investments. The evaluation can be undertaken in the device itself or via Ethernet.

TWELFTH ADVANTAGE:
safe handling of non-linear loads, in particular inverters

These days systems contain ever fewer linear (ohmic) loads. The incandescent lamp has been replaced with energy-saving lamps or LEDs, computers and television are connected to the system via switch mode power supplies, the washing machine contains an inverter and frequency converters are used in large numbers for motors in industry. A powerful insulation monitoring device in the IT system has no problem with these issues and correctly measures the insulation value for the entire system. The IT system is particularly suitable for usage with inverters, as in the event of a serious insulation fault in the link circuit on large inverter drives in an IT system, damage to the inductive elements or supplying generators and transformers due to DC currents and the related saturation effects in iron cores cannot occur. The ISOMETER® iso685 was developed for monitoring systems with frequency converters and makes it possible to logically link system parameters to shut down drives automatically in a critical system state. Differentiation between faults in the link circuit and on the motor side in inverter drives is possible in the iso685 without additional expense or other equipment.

THIRTEENTH ADVANTAGE:
no stray currents

Stray currents often cause problems in earthed systems. These are currents that do not flow via the L, N and PE conductor, but find other paths. They cause corrosion and pitting on pipes, lightning protection systems, ball bearings, foundation earths and other conductive components. They can also result in the destruction of screens on signal cables and even fire; as a consequence magnetic field interference can occur that causes problems in IT and communication systems. As the return path to the transformer's star point is not closed in the unearthed system, stray currents cannot propagate in unearthed systems.

ISOMETER® isoPV1685

FOURTEENTH ADVANTAGE:

more stable in the event of transients

In IEC 62109-1:2010 the possibility of reducing the overvoltage category from CAT IV to CAT III by means of isolation using isolating transformers, optocouplers or similar electrical isolation is described because transients do not cause such high currents as in earthed systems. The practical consequence is that components in the electrical loads in the IT system are subjected less to voltage spikes and as result have a longer service life.

Coupling device
AGH-PV-3

ISOMETER® isoPV

Now let us look at the disadvantages of the IT system:

FIRST DISADVANTAGE:

IT systems should not be too large

Very large IT systems can become confusing and have an undesirably high system leakage capacitance. It is therefore recommended to divide very large IT systems into separate units using isolating transformers, which can cause additional costs and power losses that, however, overall are mostly negligible. The division into electrically isolated subsystems also has advantages, such as the filtering effect in relation to interference or the possibility to specifically adjust the voltages to the loads supplied. What constitutes a large system must be evaluated in the specific case and depends on the system parameters. For instance, the world's largest PV fields can be monitored entirely by individual ISOMETERs® of type isoPV. Which means that a single ISOMETER® does not miss a faulty connector, a damaged cable or a damaged PV module, despite an installation the size of ten football pitches or more.

SECOND DISADVANTAGE:

voltage increase in the event of insulation faults

In an IT system with insulation faults on one conductor, the line-to-line voltages on the other conductors increase in relation to the earth potential. In the event of a dead earth fault on a conductor in the 230 V system, the voltages on the other conductors increase in relation to the earth potential to approx. 400 V. System components on which the potential in relation to earth is an issue, in particular Y capacitors and overvoltage limiters, should therefore be suitable for the maximum rated voltage. Voltage increase can be avoided when the secondary side of the transformer is connected in Delta mode. ■

Dr. Dirk Pieler, CEO Bender

CONCLUSION:

The IT system has many advantages over earthed systems and is suitable not only for the high requirements in operating theatres or in nuclear power stations, but practically everywhere. In many cases these days this system is not considered at all, even though it would be the better choice. The latest generation of insulation monitoring devices also offers many economical and technical advantages that benefit the operator. Sometimes the costs for an insulation monitoring device are used as an argument against an IT system, however, the opposite is the case: in view of the advantages listed above and their economical effects, usage in the commercial sector is always worthwhile!

Interview with Herr Dipl.-Ing. Karl Edelmann from TÜV Süd in Munich, technical assessor specialising in: the independent and neutral assessment of power supply systems in industrial facilities and industrial systems with the objective of the reliable, safe and cost-effective design of these systems.

IT system ensures electrical safety at the Munich Airport

Herr Edelmann you travel all over the world for TÜV, including Mexico, Chile, China, Singapore, the Bosporus in Turkey and India. But you also have an interesting project in your home city.
Yes, I also work in Munich, including at Munich Airport. I have supported this project, which is my baby so to speak, since 1987. At that time aircraft still took off and landed from the old airport in Riem with the resulting noise and other problems for the people who lived there.

However, before the new airport outside Munich could go into operation, it first had to be planned, approved and built. In particular during the approval and construction phase I worked as an assessor in the broadest sense for the approval authorities. Since then I have been more or less married to Munich Airport.

During the latest construction project there that is currently in progress, the modification of a luggage sorting hall into the satellite terminal, the following question arose some years ago: how can we meet the new requirements in relation to protection against electric shock in the low voltage power system while at the same time meeting the requirements on the reliable supply of power also in relation to high availability?

The issue in the new satellite terminal is therefore the reliable supply of electrical power and high availability. How were we able to solve this issue?!

Well, this question is easy and difficult to answer at the same time. The starting point for the entire discussion was the entry into force in Germany of a standard that describes the protection against electric shock in low voltage systems. I am talking about DIN VDE 0100-410 (VDE 0100-410):2007-06.

Among other aspects in this standard a requirement on the additional protection of certain electrical circuits, including those for wall outlets up to 20 A, is formulated that prescribes the mandatory usage of residual current devices.

Exceptions to this requirement are possible that, however, are not formulated very precisely and are therefore the source of discussion. The majority of operating organisations, like Munich Airport, therefore install residual current devices with a rated residual current of 30 mA.

For the "Satellite terminal" project the operating organisation and the planner expressed concerns that there is a certain risk due to the high sensitivity of the residual current devices. It must not be forgotten that a large number of electronic devices are operated in the electrical circuits these days; these devices contain a large number of capacitive loads that can cause the residual current circuit breakers to trip. If this were to happen in the satellite terminal and as a result the power supply to the check-in desks were to be interrupted, it would result in a state of chaos.

After an extended discussion with the operating organisation, it was decided: why not make use of the exception formulated in the standard for compliance with the protective measures not just by means of direct shutdown using a residual current device, but also by means of an unearthed power supply (IT system) with insulation monitoring and signalling. Here it is to be ensured that the permissible continuous touch voltage of 50 V is not exceeded due to the leakage currents that occur on an initial short-circuit to an exposed-conductive part. However, as a rule this aspect is always to be met in a building installation.

Once these concerns had been dispelled, a few calculations were made. What is the way forward then? A transformer with a power of 20-25 kVA would perhaps be very practical, especially as it would have the advantage that if such a system transformer were to have a malfunction the whole building would not be affected, but only a specific well-defined area. The behaviour of an IT system in earth fault conditions was also defined and taken into account during these studies. In the event of an earth fault in an IT system the fault-free conductors can be at the line-to-line voltage in relation to earth. This situation would in turn also have disastrous consequences for the supply to the check-in desks. As due to the first earth fault a complete three-phase system, that is the equipment connected to it, would be destroyed by overvoltage. 400 V to earth could occur in the extreme case. The EMC interference suppressors are generally not designed for this high voltage. This problem was solved by the specification of a line-to-line voltage of 230 V. In the event of an earth fault a maximum of 230 V then occurs and all AC equipment must be insulated for 250 V to earth.

This is then the technical solution and I was pleased when this proposal was also accepted and implemented by the planner and client.

If you make a pure cost comparison, the IT system is more expensive than the solution with residual current circuit breakers. However, in my opinion this aspect should not be viewed so simply, instead it is necessary to consider in addition to the installation costs, also the overall operating costs and, ultimately, also the costs in the event of the failure of the supply of power.

A further argument is that the function of residual current devices must be regularly checked! This check requires a large amount of effort in relation to schedule co-ordination and can only be undertaken at night in such an installation in the airport.

On an IT system with insulation monitoring this requirement does not exist. The installations constantly monitor themselves and signal a fault as a minimum on a reduction in the minimum insulation resistance. As such it is in my opinion a very good system for increasing availability while complying with the safety requirements stipulated in the standards, and would also be recommendable for many other applications.

In practice I often discuss this topic with customers and very often find that customers are very surprised that this solution (IT system with insulation monitoring), as is used at Munich Airport, is employed at all outside hospitals, or that this application is allowed. Yes, it is allowed practically everywhere protective measures against electric shock are required.

Can I then take it from what you have said that this pilot project will be imitated in other projects?

Yes, definitely. Personally, I would like to see more of this type of installations built. As the faults occurring in a small, manageable system always remain restricted to a relatively small area. So I only really see clear advantages. There is a little more effort during installation, but this then clearly pays for itself during subsequent operation. So, if I am asked, I recommend everyone to at least give this solution detailed consideration.

Herr Edelmann, I would like to thank you for the interesting chat. – Where are you going on your next trip?

To Istanbul for the final functional measurement on the power supply for the Marmaray project*. ■

Reinhard Piehl, Bender
Technical Office Munich

*__Note:__ The Marmaray project links Europe and Asia: in 2013 Turkey opened the first transcontinental tunnel 56 metres under the sea.

"Passive" insulation monitoring devices were considered state-of-the-art until well into the 20th century. These devices, however, only were used for "checking the insulation" of unearthed power supply systems which until the seventies were called "protective conductor systems". For a long time it was common practice to use these devices in the mining sector.

Bender celebrates 75 years of ISOMETER®

The father of active insulation monitoring

The breakthrough to "active" insulation monitoring came in 1939 with the publication of a patent for "Insulation monitoring and earth fault display devices for three-phase installations by Dipl.-Ing Walther Bender. Since then, Walther Bender has been seen as the "father of active insulation monitoring".

Standards in changing times ...

The first device standard for insulation monitoring devices was published in January 1973 as DIN 57413 part 2 (VDE 0413 part 2). A new part 8 was drafted in 1984 to meet changing system requirements. The follow-up standard DIN VDE 0413 part 8 combines parts 2 and 8 into a new part 8 and was published in Germany in May 1998 under the title "Insulation monitoring devices for IT networks". IEC 61557-8, the first international standard, appeared in 1997. 10 years later in 2007, this standard was reworked to incorporate a few improvements. Based on a steady rise in numbers of unearthed systems (IT systems), there was increasing demand for fault localisation for this type of system. In 2009, German standard DIN EN 61557-9 (VDE 0413-9) was published under the title of "Equipment for insulation fault location in IT systems". Currently, both the standard for insulation monitoring devices and the one for equipment for insulation fault location are being reworked at an international level with a view to provisional publication in late 2014.

... technology that keeps pace

The technology of insulation monitoring devices also developed quickly. Until the 1960s, the technology used was almost exclusively superimposed measuring voltage. But it was not only the measurement technology for insulation monitoring devices which has changed, the nature of the IT systems and applications had also been subject to huge changes. Many new applications have been added. The inverter technology brought attention to possible direct current faults, i.e. insulation faults behind rectifier elements. A device technology was then developed which was also able to detect insulation faults behind rectifiers. This was followed by pulse superimposition technology, which was superseded by "pulse code measurement technology". The EMC wiring frequently required necessitates new measurement technologies for insulation monitoring devices with high system leakage capacitances. PV systems also need to be able to cope with leakage capacitances into the µF range. These requirements have consistently followed developments for Bender insulation monitoring device. Bender will continue to set the standards in this area into the future.

Innovation and standardisation

At Bender, intensive consideration of new applications has led to a series of patent applications. Modern applications in photovoltaics and electro-mobility have led the way in producing new patent applications from Bender. But Bender is also continuing to research other applications and new patent applications will follow. ■

Dipl.-Ing. Wolfgang Hofheinz
Chair of the DKE

ISOMETER® iso685 of 2014

2014

A-ISOMETER® IRDH275 of 2003

2003

A-ISOMETER® IRDH265 of 1994

1994

A-ISOMETER® IRG113Yb von 1974

1974

A-ISOMETER® 107TM40 of 1970

1970

A-ISOMETER® 2132P of 1953

1953

Ur-ISOMETER® of 1939

1939

Certificate of granting the first patent of 1939

INNOVATIVE **PRODUCTS**

Innovation in the area of insulation monitoring

Safety is evident!

The new insulation monitoring device **ISOMETER® iso685-D** for unearthed AC, AC/DC and DC power supplies (IT systems) nominal AC/DC 0…690 V and DC 0…1000 V.

With the new insulation monitoring device iso685-D, Bender is focusing on a new innovative series of insulation monitoring devices that are state-of-the-art in relation to reliability, measuring technique, operability and design.

Over the last two decades a large number of customer-specific variants of the IRDHx75 series have been developed. With the development of a new ISOMETER® generation it is now possible to cover comprehensively this broad spectrum of applications and, at the same time, to already take into account to a broad extent the requirements to be expected in the future.

A broad platform concept has been implemented with the iso685. The platform comprising hardware and software elements makes it possible to configure different devices with varying requirements in a modular manner and in this way to react quickly to customer requirements.

For the first time a high-resolution display is used in a monitoring device from Bender for the indication of the measured values as well as for making device settings. This display makes it possible to indicate the changes in the insulation values over time using a graph, the isoGraph. In this way the insulation value trend can be estimated and corresponding measures initiated.

The integrated data loggers save both the measured values and the device error and alarm messages in their entirety for the recommended device service life (up to 10 years) with exact allocation of date and time. Event-based fault analysis is therefore possible in conjunction with additionally acquired system measured data.

Due to the internal resistance of 124 kΩ and a maximum measuring voltage of ± 50 V the measuring current is only ± 400 µA. By means of pre-defined measurement profiles the iso685-D can be very easily adjusted to the system to be monitored. Special profiles for inverter applications already include integrated suppression of interfering system fluctuations. The measuring voltage is also adapted to the application based on the profile.

Systems with leakage capacitances of up to 1000 µF can be monitored using the iso685-D. Continuous monitoring of the protective earth conductor as well as the improved measuring technique, which ensures the insulation faults and the system leakage capacitance are measured more accurately and more quickly, provide additional safety.

Unlike the insulation monitoring device of type IRDH275, the iso685 provides continuous coupling monitoring as well as a voltage and frequency measurement on the system to be monitored due to the coupling to all active conductors. Systems up to max. DC 1150 V can be monitored without additional couplers.

A commissioning wizard also simplifies initial commissioning. In this way it is ensured the device is correctly set up for the installation and safe monitoring is ensured. Similar to the consumer sector, there are specific prompts and pre-settings for the most important parameters for the optimal configuration of the ISOMETER®.

Three digital inputs, two digital outputs as well as an analogue output are available as interfaces. The digital inputs and outputs can be programmed as required and can therefore be adapted to the measuring task and the related signals necessary. The analogue output can be operated either as a current output or as a voltage output in various operating modes. The RS-485 interface also makes measured values available on the BMS bus for other display devices and the values can be read. The parameters can also be set via the bus.

Due to the Ethernet interface incorporated, if necessary Bender service can provide support during configuration, troubleshooting and/or fault analysis via a secure VPN tunnel provided by the customer. Furthermore, the usage of plug-type terminals ensures efficient installation.

As insulation fault location, particularly in large installations, is becoming increasingly important for proactive maintenance, future variants will also support insulation fault location along with expanded functions. ■

Dipl.-Ing. Jörg Irzinger, Bender
T-MIS (Monitoring IT systems)

PEM735

Bender completes the Power Quality and Energy Measurement (PEM) portfolio

With the completion of the **PEM735,** a comprehensive class A1) power distribution network analyser, Bender is expanding its range of universal measuring devices. The PEM735 monitors the power quality in accordance with DIN EN 50160. Such a measurement at the point of common coupling makes it possible to evaluate the "ambient conditions" for electrical equipment in relation to the voltage.

Power quality phenomena are often the cause of failures in process installations or premature material fatigue. Increased harmonics or irregular voltage fluctuations, so-called flicker, can also affect the expected service life of electrical equipment. With a class A power quality analyser all relevant characteristics of the voltage can be monitored and evaluated. The measurement and analysis features range from the frequency, through harmonics, to transient events and flicker.

Due to the high sampling rate of the PEM735, high frequency harmonics caused, for instance, by inverters can be measured. If power quality events occur, for example voltage fluctuations or transients, the PEM735 records high-resolution current and voltage waveforms. The data are stored locally in a memory with a capacity of 1 GB. The measurement results can be accessed via 5.8“ colour display on the device or via fieldbus communication such as Modbus; they can also be displayed on a PC workstation via a web server. The device also supports other formats for data export such as COMTRADE or PQDIF. IEC 618503)-compliant communication is also supported. ■

Dipl.-Wirt.-Ing. Michael Faust, Bender T-MTS (Monitoring TN/TT systems)

1) DIN EN 61000-4-30 (VDE0847-4-30) Electromagnetic compatibility – Part 4-30: Testing and measurement techniques – Power quality measurement methods
2) DIN EN 50160 Voltage characteristics of electricity supplied by public distribution networks
3) DIN EN 61850 Communication networks and systems in substations

DATEV eG in Nuremberg – a multi-generation environment

Facts and performance data

Host systems:
40.435 MIPS
- 2 IBM 2827 H66
- 2 IBM 2818-M10 ICF

Server systems
- 1.167 Unix-Server
- 5.704 Windows

Storage:
20,7 PB to
- Magnetic disk drive and magnetic tape disks

Storage:
20,7 PB to
- 40 Laser printers
- 5 Colour printers

Order picking/shipment:
- 14 Mio commissions annually summarized: 10 Mio mailings

Stand: June 2013

Facts and performance data

- Current

Total	**40.331.920kWh**
Power generation systems (CHP)	667.300 kWh
Total	**40.888.220 kWh**

- Heating

Total	**24.616.530 kWh**

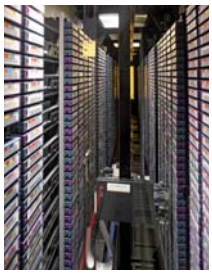
- Areas

Building areas	**209.267 m²**

Upgraded RCMS devices operate harmoniously with the older generations in one of the largest computer centres in Germany

Simply the fact that DATEV eG has been featured time and again in this magazine is a clear indication of the usage here of Bender technology from a wide range of generations. The organisation operates one of the largest computer centres in Germany and protection against failures is particularly important. The focus of the highly complex power supply system is clearly on residual current technology and, as such, all the generations of the RCMS device series are in use. During the installation of further current generation RCMS devices, the development of new IT protocols and new visualisation features, the gateways have also been modernised.

The DATEV eG computer centre has almost 20.7 petabytes of storage space (20,700,000 gigabytes!), 4 mainframe computers, around 6800 high-performance servers, thousands of desktop PCs and dozens of high-performance laser printers that print several million forms every month. The network infrastructure is equally impressive: every day on average more than 500,000 user systems remotely log on to the mainframe computers in the computer centre. Beyond the pure exchange and processing of data, DATEV offers an expanding range of services to tax consultants, professional practices, institutions and businesses.



Uncontrolled shutdown impossible

If, in addition to this enormous IT installation, the peripheral equipment such as the 14 enveloping machines, 8 packaging machines, 8 franking systems, 14 picking systems, plastic sheet welding system, indoor and outdoor lighting systems, office printers, scanners, coffee machines etc. are taken into consideration, the complex requirements that must be met by a permanent residual current monitoring system (RCMS) in such a large and heterogeneous installation quickly become clear. The uncontrolled shutdown of the power system is impossible in such an environment! A sudden power failure would have devastating effects on the processes and on the reliability – and of course on the costs. The full consequences of such a shutdown only become clear if not only the work at DATEV eG, but also the work at its clients is considered. The losses then multiply.
Increasing safety, reducing costs

During its search for a suitable form of residual current monitoring, DATEV decided for the tried-and-tested RCMS from Bender. It continuously monitors the residual current in an electrical installation and warns if an adjustable residual current is exceeded. Due to the exactly adjustable threshold values, the RCMS helps both during troubleshooting and during preventive maintenance. As not only the response value but also the time delay can be adjusted, known sources of errors, e.g. the peak pulse on switching on and off the outdoor lighting, as well as transient faults can be masked. As such the RCMS can be adapted exactly to the related situation in an electrical installation. Furthermore, the test effort necessary in accordance with BGVA3 is significantly reduced!

Monitoring via browser

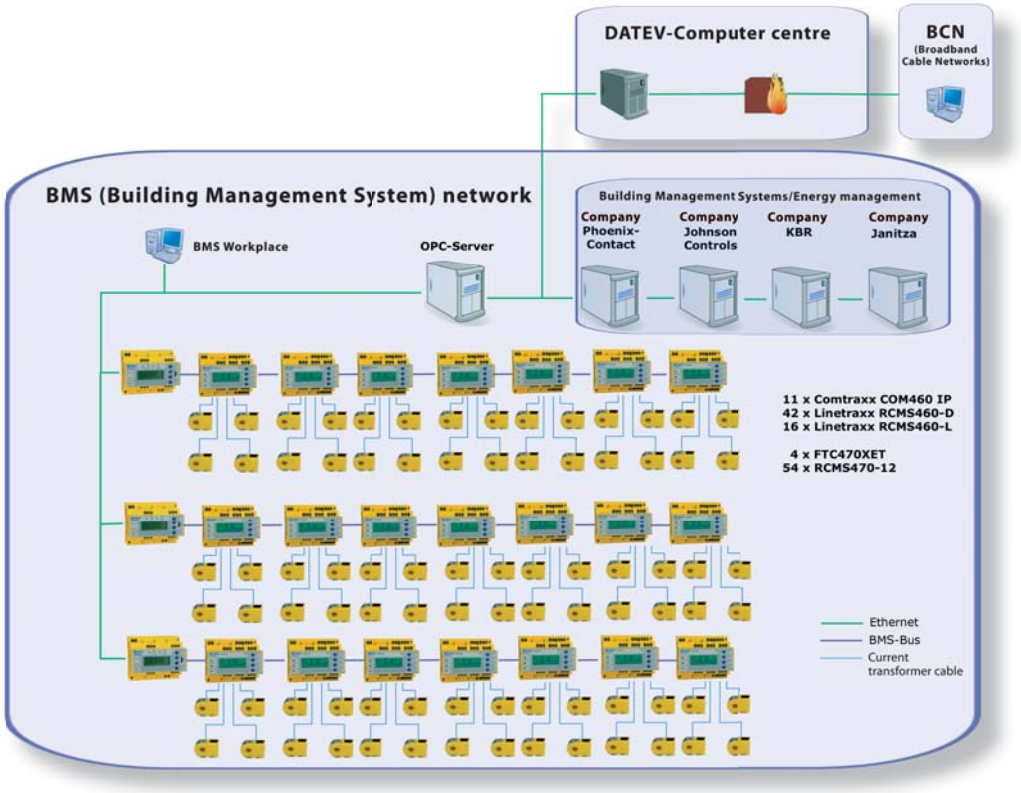
If a residual current exceeds a defined threshold value, the RCMS sends a warning to the building control system. The fault is displayed on the monitoring PCs and indicated in the control centre from where a member of the service staff can immediately take action. A data visualisation computer with a history memory for 650 fault messages does not require any special software for visualisation, instead only a standard browser as installed on every computer is used.

Growing requirements

Over time the number of installations and distribution systems equipped has increased, as with the increasing number of electrical loads and the increasing complexity of the installation, the requirements on the system safety technology also increase. As such up to now Bender has installed 58 RCMS460 and 54 RCMS470-12 in the DATEV computer centre.

From the start the customer's concept has also been focused on the visualisation of data from the devices and their states. For this reason an FTC470XET was used initially. The integrated OPC server was able to operate the control system from Johnson Controls as appropriate.

Due to the continuously increasing number of measuring points, the first-generation gateways came up



against their limits. The COM460IP therefore arrived just at the right time. This new, significantly more powerful version is now able to take over the functions of the FTC470XET and also offers new and improved functions. A major advantage is the downward compatibility of the gateways, an aspect that is not a matter of course in today's technical world. As such, Bender has ensured that all devices continue to speak the same protocol language and can be remotely configured. The dialogue between the generations, something that is often not straightforward in real life, has been facilitated in an exemplary fashion by Bender.

Scalable solutions for future-proofing

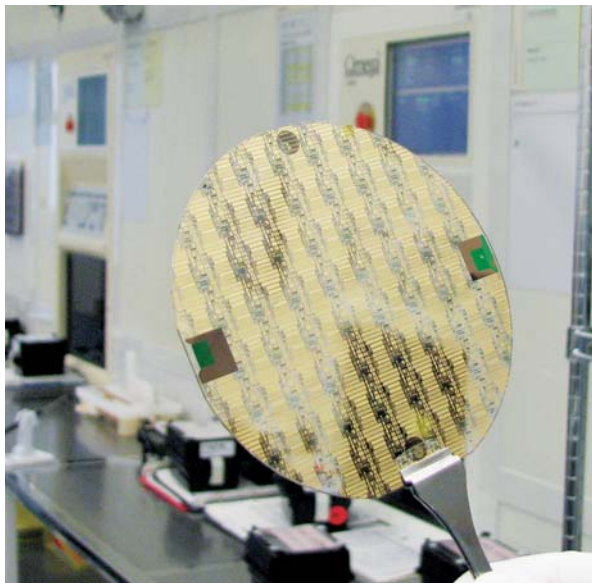
The adaptation to the existing OPC topology has been realised using a Modbus-TCP-to-OPC protocol converter configured by Bender. A configuration tool now also enables the customer to make changes independently, quickly and conveniently in the event of modifications. A future-proof solution, as this software is installed on a PC. The performance of the solution can therefore be scaled by means of the hardware used. Virtualisation is also possible. The above-average requirement at DATEV eG on the safety of the data can be met in full.

Due to the modern gateway technology our customer has a solution that is easy to administrate and powerful. The operation of the installations is eased by the support provided during troubleshooting, the simplification of the documentation of installation states and the early detection of faults in the electrical installation. As a result the processes can be designed more efficiently. Service calls outside working hours are reduced to an absolute minimum due to the perfectly maintained installation.

Security of investment due to downward compatibility

Currently eight COM460IP are used productively at DATEV eG. These operate not only the control system via OPC. The integrated web server provides the maintenance staff based on site with quick and convenient access to all Bender devices. The latest, fully downwardly compatible product in this large family ensures that all the information is available reliably to the operating organisation. This product policy gives our customers security of investment. ■

Bernd Häuslein, Bender, Technical Office Nuremberg
Ralf Döderlein - DATEV eG



Residual current monitoring at UMS increases plant availability and significantly simplifies the periodic test in accordance with BGV A3

More safety and lower costs in manufacturing

With approx. 170 employees, UMS (United Monolithic Semiconductors) in Ulm develops, produces and markets various components and integrated circuits for the telecommunications, aerospace, defence and automotive sectors, as well as for industrial applications. For the reliable supply of power in the manufacturing areas with, at the same time, reduced maintenance effort and fewer personnel, UMS decided on electrical safety technology from Bender.

Typical UMS products are for instance power amplifiers, low-noise amplifiers, mixers, multipliers, dividers, phase shifters, converters, oscillators and highly integrated multifunction circuits. The production of these high-quality, complex semiconductor circuits on GaAs and GaN wafer material places very high requirements on the manufacturing plants and their power supply. Power failures can result in wafer losses, production downtime and machinery faults, or as a minimum high machinery qualification effort – that is they can result in high costs.

To protect against these risks and to address statutory provisions, a two-pronged approach is taken to electrical reliability and safety. All portable devices are regularly checked in accordance with BGV A3 at varying intervals. This approach is not possible for fixed semiconductor production plants due to the complexity; these plants comprise a large number of individual components (control system, pump stands, heating, air-conditioning,...) and this approach would result in significant plant downtime for the testing. For this reason the principle of "continuous monitoring" is applied. As maintenance on the machinery is undertaken by specialist personnel, this combination ensures a high level of reliability.

By means of the residual current monitoring system RCMS it is possible for the electrician to determine practical test intervals for the insulation measurement in accordance with BGV A 3 and to define them to suit the application. Personnel resources and therefore costs can be significantly optimised in this manner. At the same time plant availability is increased and greater protection of personnel and against fire ensured. EMC interference due to additional N-PE connections and interference currents on screen and earth cables are also reliably and promptly located.

In the meantime the entire plant has been equipped with Bender technology by in-house personnel. In total 15 residual current monitors of type RCMS460 as well as 90 measuring current transformers of size W35 are used. A gateway (currently still the FTC470XET, soon to be the COM460 IP) provides continuous information on the states in the power supply area. In this way the technical personnel are able to check all system states from a PC anywhere in the intranet. The error states logged are regularly checked manually.

united monolithic semiconductors

The advantages for UMS on the usage of residual current monitors and gateways:

- Early detection of faults
- Faster fault location
- Visual support during troubleshooting
- Security of investment due to full downward compatibility
- Easy administration
- Reduced maintenance effort
- Reduced test effort in accordance with BGV A3
- Significant reduction in personnel resources
- Greater safety for personnel and machinery
- Better protection against fire
- Increased reliability.

The plant equipped in this manner therefore ensures that the production infrastructure at UMS operates reliably and also ensures that less maintenance effort is required and problems can be rectified without interruption in the event of a fault. In this way it was possible to increase safety, reduce risk and minimise costs.

For their support in the preparation of this article, many thanks to Herr Raphael Ehrbrecht and Herr Joachim Endel from United Monolithic Semiconductors GmbH. ■

Jürgen Eisfeld, Bender Technical Office Stuttgart

Indicate – Signal – Operate – Communicate

Electrical safety at the highest level

Clínica Alemana in Santiago de Chile "The German Hospital of Santiago" is reputed to be one of the most modern hospitals in Latin America. It is located in the eastern sector of Santiago de Chile with two facilities: one on Avenida Vitacura and the other in La Dehesa. The hospital facilities span over 100.000 square meters, including 350 inpatient beds and 18 operating rooms. Today Clínica Alemana, with more than 700 medical professionals and a staff of 3.000 people, takes pride in providing high-quality services to over 35,000 inpatients each year. It established itself as one of the first private health care facilities in the country.

In the year 1918 the German community in Chile opened the first Clínica Alemana. A long list of successful pioneering activities in the healthcare field, made the German-Chilean community proud of this initiative. In 1970 the building was sold to the Bank's Pension Fund. A new building opened to the public in March 1973. Since then, Clínica Alemana has been a leader in the field of private health care, pursuing and ongoing medical development as its main priority. In 1999 a new medical center was built in the Clínica Alemana, located in the La Dehesa. In 2005 the construction of a new 16-storey building began in Vitacura. The building, designed to make diagnoses, was opened in 2006.

When our CEO, Dr. Pieler, visited Santiago de Chile in November 2013, one of the customers we met was Clínica Alemana. He mentioned to me that this was the first hospital installation he saw in the entire world with insulation monitoring and insu-

lation fault location in group two rooms by Bender, residual current monitoring for TN-Systems by Bender, power quality analysers by Bender and Condition Monitor CP700. All devices are integrated in the CP700 touch control panel for convenient system handling and overview.

So far away from headquarters this was highly motivating information for us. Especially as we set up the new office in Santiago de Chile as recent as beginning of 2013. Meanwhile, there are similar systems installed all over the world, however, apparently we were the first!

Beginning of 2013 a project for seven new surgery theatres started. The hospital is already equipped with Bender insulation monitoring systems and the hospital operators are very satisfied with the quality and reliability of the systems in place. When we introduced the extended system approach to them they immediately saw the potential and were excited about the opportunity. Together with our local distributor, TECMEL, we designed, built and commissioned the system.

The complete system is equipped with:

- 1 condition monitor CP700
- 12 power analysers PEM333
- 10 insulation monitors 107TD47
- 10 fault location units EDS461 + CTs
- 10 fault location injector PGH473
- 7 MK2430-12
- 1 MK2430-11

The CP700 is installed in the main switchgear and simultaneously the same information as visible on the CP700 is distributed throughout the hospital via private Wi-Fi-signal. So maintenance staff can monitor the status of the electrical system with computers or smart devices. In practical terms it means that if an insulation fault appears or maybe a rise of the 3rd harmonic staff is receiving an alarm via e-mail on the computer or smart phone.

Clínica Alemana is highly satisfied with the system and recommending Bender to other hospital designers and consultants in Latin America. Finally – as progress must never stop – the chief electrical engineer of Clínica Alemana is planning to upgrade the older Bender systems in place following the same approach and design. ■

Sergio Julian, Bender Chile

Integration of monitoring devices for direct fault current detection

$I_{\Delta n} \geq$ DC 6 mA

in the solar charging station at the University of Applied Sciences Bingen

Prof. Dr. Plumhoff and Timo Thomas have been researching the area of system interactions in electric mobility since January 2013. Due to the increasing usage of power electronics equipment, which includes the charging electronics for every electric vehicle, the topic of system load due to system interaction is becoming increasingly important. Above all, the centre of attention here is the topic of harmonics. Due to the steadily increasing loads producing harmonics in a very wide range of areas of the supply of electrical power, a re-think will be necessary on both the side of the energy producer and of the energy user.

A goal of the study on the analysis of charging processes in various electric vehicles is to evaluate the quality of the electrical power distribution system in relation to system interactions. For this purpose, twenty different electric vehicles were brought to the University of Applied Sciences Bingen over the one-year period of the research project to check their charging behaviour when connected to the university's charging station. A number of questions arose during this research activity. Can the sinusoidal waveform be seen? What charging powers are actually achieved? Are there transient switch-on spikes at the start of the charging process? How high is the harmonic load due to current harmonics from the vehicles connected to the system? The issue was to answer all these questions during the study.

FIGURE 1:
Current and voltage on the phase conductors in instantaneous values from E-Mobil-16

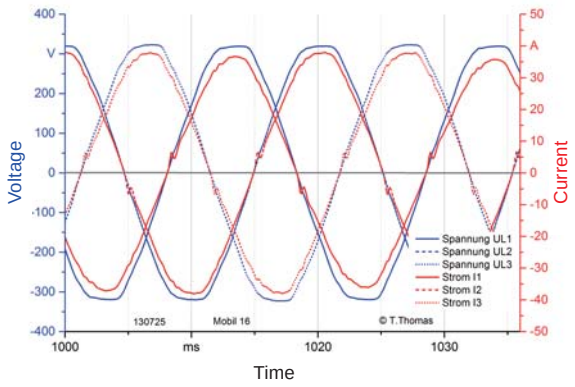


FIGURE 2:
Harmonic spectrum of the measured current harmonics from E-Mobil-16 compared to the interference emission limits in accordance with DIN EN 61000-3-12

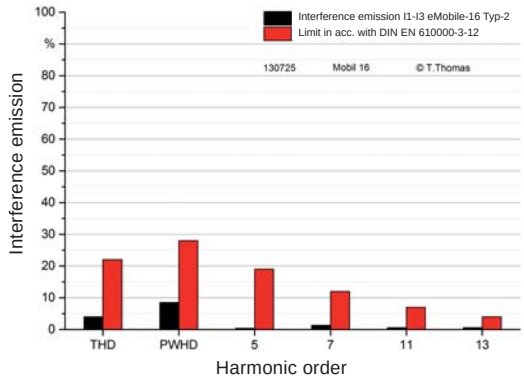


FIGURE 3:
Current and voltage on the phase conductors in instantaneous values from E-Mobil-12

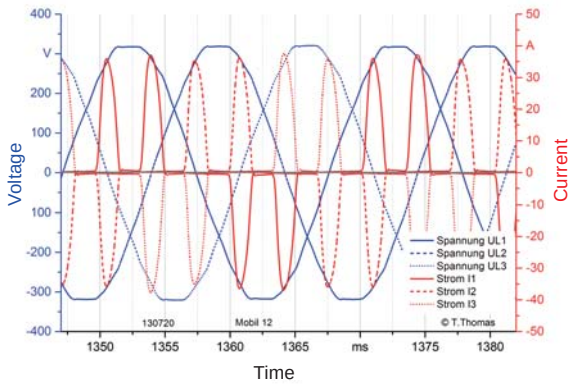
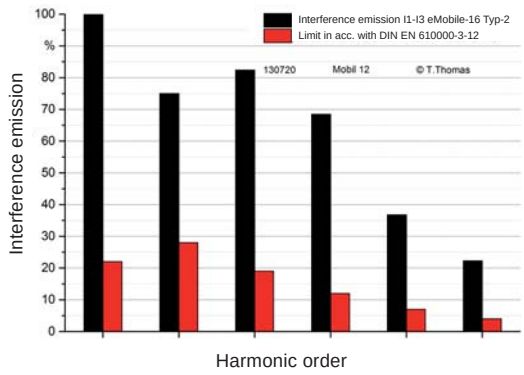
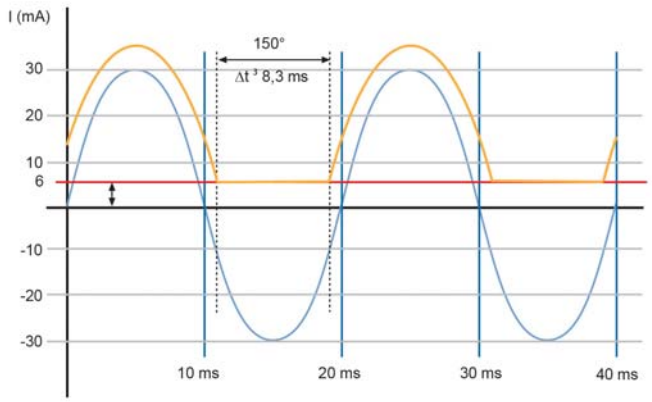


FIGURE 4:
Harmonic spectrum of the measured current harmonics from E-Mobil-12 compared to the interference emission limits in accordance with DIN EN 61000-3-12



The first contact with Frank Mehling and Florian Habel from Bender took place in May 2013 as a result of the announcement of the research of Prof. Dr. Plumhoff and Timo Thomas. During an initial meeting the various measurement results and the measuring techniques were compared. In the following figures the curve for one period of current and voltage, in instantaneous values, on two vehicles charged using three-phases can be seen. Figure 1 shows a relatively minor phase offset between current and voltage as well as a negligible small harmonic content on the current in accordance with DIN EN 61000-3-12 (Figure 2) for the coupling point at the charging station in the university. Figure 3, on the other hand, shows a clear variation of the current curve from an ideal sine wave. The current curve is probably due to the unfiltered rectification of the three-phase AC. The harmonic content of the individual harmonic currents from Figure 3 is very high. The complete limit spectrum in accordance with DIN EN 61000-3-12 is infringed (Figure 4).

FIGURE 5:
Definition direct fault currents $I_{\Delta n} \geq$ DC 6 mA



As a result of the joint discussions, the topic of monitoring DC fault currents $I_{\Delta n} \geq$ DC 6 mA arose. Residual current devices of type A in accordance with IEC 61008-1/IEC 61009-1 are only designed to trigger in case of sinusoidal or pulsating fault currents. In case of direct fault currents in the range $I_{\Delta n} \geq$ DC 6 mA, both the response time and the response value can be degraded on the usage of type A residual current devices (Figure 5).

To prevent this situation arising, residual current devices of type B or a suitable measure must be employed. This measure is the detection of direct fault currents in the range $I_{\Delta n} \geq$ DC 6 mA using the residual current monitor RCMB420EC manufactured by Bender with subsequent safe interruption of the charging process. To permit the testing of the devices also under real application conditions, two prototypes were integrated in the university's charging station (Figure 6) and one in the subdistribution

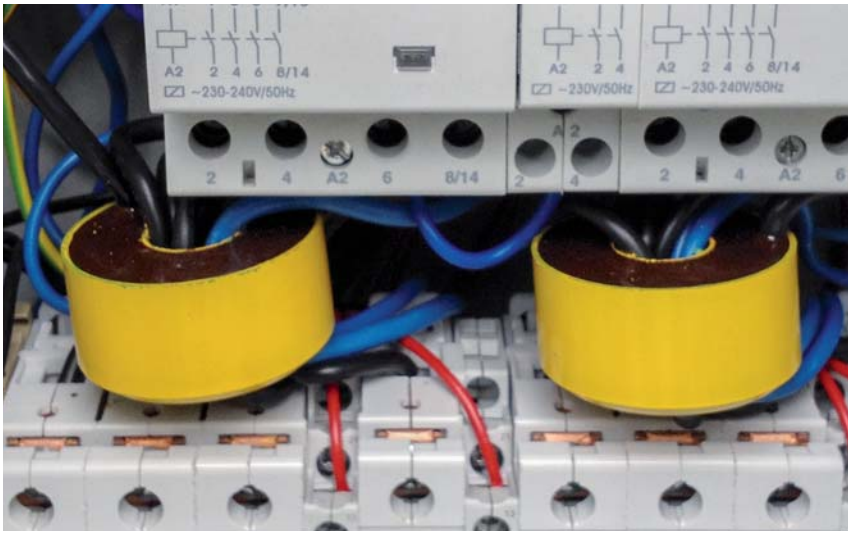
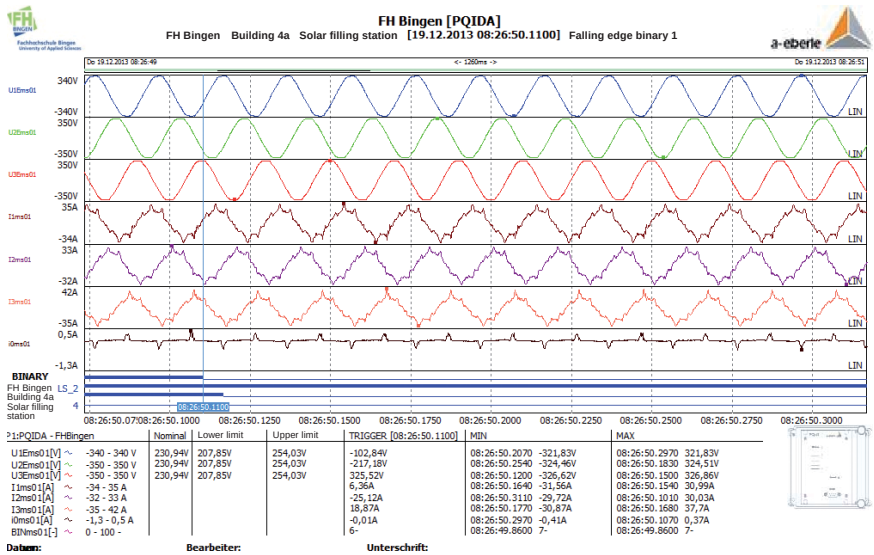


Figure 6: RCMB 420 EC 2 channels

Figure 7: RCMB 420 EC 1 channel

FIGURE 8:
Instantaneous values for the currents and voltages as well as the binary switching states during a charging process E-Mobil-17



Key, binary signal recording

LS_1:	Charging point 1
LS_2:	Charging point 2
UV_LS:	Charging station sub-distribution system
High level:	
Low level:	

system for the solar filling station (Figure 7) at the University of Applied Sciences Bingen.

If one of these devices signals a fault current ≥ DC 6 mA, a fault record in the form of an oscillogram of a specific duration and a 10-ms effective value record (Figure 8) are recorded using a power quality interface manufactured by A-Eberle. The switching state of the signal contact on the residual current monitor RCMB420EC over time can be seen in these fault records.

In the example from Figure 8 an electric vehicle producing a direct fault current ≥ DC 6 mA during the charging process causes the recording to trigger. It can be clearly seen that both residual current monitors, at charging point 1 on the solar charging station as well as at the subdistribution system for the solar filling station, respond to the direct fault current.

For the electrical engineering students in specialist area 2 at the University of Applied Sciences Bingen this new topic, among other issues together with the topic of system interactions, is producing new subjects for theses and projects related to the topic of safety and system monitoring at charging stations for electric vehicles. ■

Timo Thomas, B.Eng., FH Bingen
Prof. Dr.-Ing. Peter A. Plumhoff, FH Bingen
Dipl.-Ing. Frank Mehling, Bender, T-MIS (Monitoring IT systems)
Florian Habel, B.Eng., Bender, T-MTS-RD (Monitoring TN/TT systems-R&D)

Safety ensured by residual current monitoring

Fire protection in roof-mounted photovoltaic systems

Southern California Edison (SCE) is an electrical utility company supplying roughly 14 million people with power. As part of California's renewable energy mix mandate, SCE owns and operates multiple large scale solar arrays in the megawatt range. Many of these systems are installed on large warehouses whose flat roof is ideally suited for placing large number of PV panels.

It is not uncommon for these so called PV arrays to approach sizes of 3 megawatts or even more. A system of this magnitude stretches easily over an area that resembles a couple football fields. 15000 panels or more per installation are very common, so it is no wonder that electrical failures do occur on a frequent basis.

A recent series of roof top fires caused the PV industry to take a second look at the electrical safety aspects of the installation. It was uncovered by leading industry experts that certain situations can lead to almost undetectable amounts of leakage currents that sooner or later can be responsible for arcing, sparking or subsequent fire damage.

Fortunately for the industry, Bender had the right solution to measure and mitigate the hazardous issue. The Bender residual current monitors, RCMA423 and residual current monitoring systems RCMS460 are currently the industry standard for rooftop solar leak current detection.

SCE and the Solar ABC group tested the Bender technology extensively during the first half of 2013. It was then decided to retrofit all of the commercial existing systems to ensure safe and sound power production. And other companies are following suit as well.

Not only SCEs, but pretty much every single larger installation in the USA is wired in the same fashion as a grounded system. To establish a grounded system, it is common practice to bond the negative power conductor at the inverter to ground. Especially in very extensive plants it is difficult to recognise potential residual currents. Beside the number and length of cabling, this has often caused, above all, environmental influences like solar radiation, moisture, dirt, aging or mechanical damages to cables and plug connectors, the occurrence of residual currents. If a residual current occurs, it is typically the inverters job to shut the power off. One major caveat of course is, that it is impossible to turn the power on the roof off as long as the sun is shining. Therefore, it is of the highest

importance that the photovoltaic system is permanently monitored in order to display the occurrence of residual currents as early as possible so that the problem can be solved as soon as possible.

This especially when PV installations are in the vicinity of the public. This could be the roof of a school, a warehouse, carports or large scale distribution center, such as the Dietze and Watson Freezer unit. D&W operated a 300000 square foot refrigerated warehouse in Delanco, New Jersey which unfortunately burned down a few weeks ago. The verdict on the cause of the fire is still out, but unfortunately when there is solar on the roof, it immediately gives the PV industry a bad reputation and causes the public to question these types of installations.

Other events that produced negative impacts were the Bakersfield and the Mount Holly PV fires. In Bakersfield, California one morning smoke was seen rising from the roof of a big box store, home to a 383 kW PV array. It did not take long for the first responders to find eight solar panels burning on the roof. Fortunately for the owner of the building, the fire had not been able yet to penetrate through the metal roof into the warehouse area below.

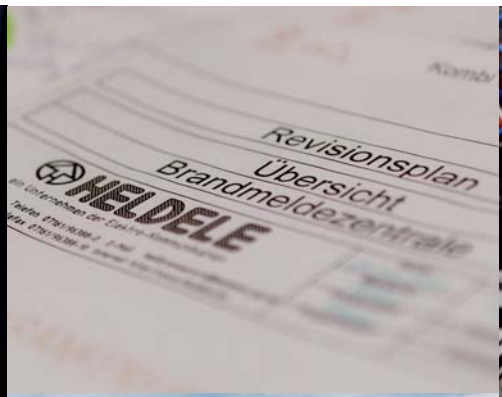
In the case of Mount Holly it was an unfortunate Gypsum plant that experienced a similar fate in Northern Carolina. The owner of the power system, Duke Energy actually went so far to shut down not only the Mount Holly location, but all the solar power installations under its umbrella until the very last one was equipped with Bender residual current monitoring technology for fast fault detection.

Thanks to Bender all these retrofitted systems were soon allowed to be back online. This is a great success story, where Bender technology plays an important part in ensuring safe and secure green power generation. ■

Torsten Gruhn, Bender Inc. USA

HELDELE
GÖPPINGEN

CUSTOMER**PORTRAIT**

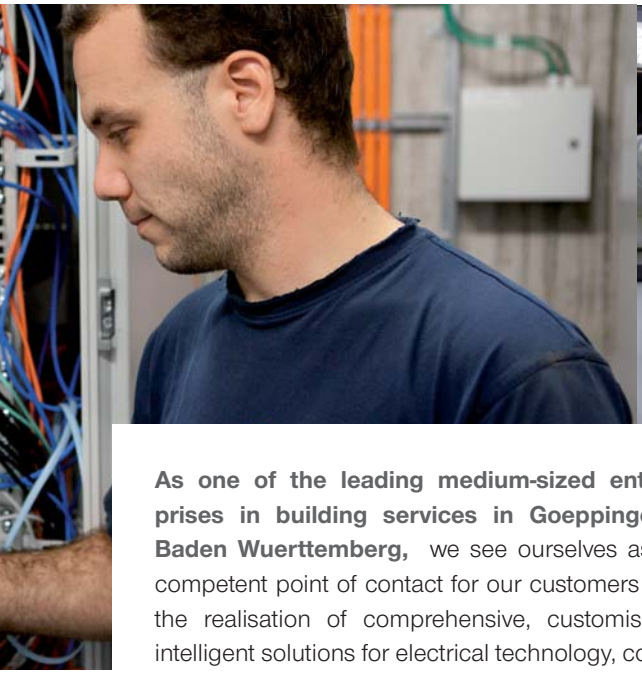


Experience the advantages and achievements of the future
now with "Elektro-Heldele GmbH Goeppingen".

Enjoy the technology of tomorrow already today

Since the founding of the company we have been on the move for our customers 24 hours a day, 365 days a year for four decades. We live and work in buildings and institutions that are places of life, daily work, business, and also places of relaxation and invigoration, in addition, they provide an environment for regeneration and recovery. The requirements and wishes related to utilisation, comfort, technical functionality and also cost-effective operation are correspondingly high.

„We place great value on
continuous further training and also on training young people,
our talent of tomorrow and the old-hands of the day-after-tomorrow."



As one of the leading medium-sized enterprises in building services in Goeppingen, Baden Wuerttemberg, we see ourselves as a competent point of contact for our customers for the realisation of comprehensive, customised, intelligent solutions for electrical technology, communications technology, network technology and regenerative forms of energy always in harmony with the customer's specific requirements and needs. During this process our customers receive specialist planning advice that yields an optimal cost and usage-orientated project definition. The top priority here is the overall economic benefit of the concept planned and the most economical and environment-friendly operation of the building and the system.

Seventy employees, always excellently trained and highly motivated, stand for our success. With their knowledge, their experience and their skills they realise your projects with a partnership-based approach, direct communication and a great deal of creativity and flexibility. To keep their skills and the specialist knowledge always up to date and at a high level, we place great value on continuous further training and also on training young people, our talent of tomorrow and the old-hands of the day-after-tomorrow.

For some three decades Elektro-Heldele GmbH has been a competent and dependable partner for call light systems in hospitals, nursing homes for the elderly and related establishments, as well as a complete service provider for building services in the stated segments. Here we are conscious of the high level of responsibility if it is necessary to undertake modifications and changes while the hospital is in use. However, it is particularly this issue that makes such establishments interesting for us as a competent service provider.

In the area of hospital-specific call light systems we have maintained partnerships with renowned manufacturers and market leaders for years; our system engineers are certified and continuously trained on their products. In this segment there is a very

HELDELE GÖPPINGEN

detailed exchange of information with the development departments at the manufacturers - the recipient of this synergy is the customer and organisation operating such medical or care establishments.

Project description

From 2010 to 2012 we had a difficult task involving a significant level of responsibility at a local clinic. The complete call light system was to be renewed and replaced while the hospital with a total of 820 beds remained in operation.

For this process the task was clearly and unambiguously formulated: during the upgrade phase there was not allowed to be any degradation in the safety-relevant functions of the existing call light system in the building. The scheduling and subsequent implementation were undertaken in successively cleared, self-contained care groups where the individual call light components were then removed and installed, and a complex management control centre set up with which the states and alarm messages are processed and forwarded as necessary. At the same time a 100 % functional interim control centre for the old system still installed in parallel had to be set up with the same management.

One of the highest priorities was the heart alarm that had to function autonomously and 100 % in both systems during all phases of the work. This aspect was realised by linking the related control centre to a high level alarm server with the aid of which alarms were sent to the related departments in the hospital without delay, in the case of a heart alarm to the duty resuscitation team.

Key points/data on the realisation of the project:

Approx. 5,000 devices of varying origin in the old call light system and approx. 60 km of cables and wires were removed and disposed of. During the new installation work approx. 68 km of new cables and wires were laid, almost 1,000 fire-proof fittings installed. In relation to the components of the call light system a total of seven control centres, 60 nurse stations, 800 room terminals with intercom function, 860 room signal lights, 900 patient control units, 900 bed modules and around 1,150 call and cancel pushbuttons were installed.

The system was placed in operation in sections by care group with final overall commissioning and connection to the newly installed control centres. With the technology installed both central operation via a permanently staffed COM centre with central control and decentral operation are possible at any time to permit the nursing staff the greatest possible flexibility.

The overall duration of the project was almost two years with an average team of seven staff. ■

Frank Scheibele
Senior Management Heldele branch office Goeppingen

EXHIBITIONS 2014 DATES

EXHIBITIONS INTERNATIONAL

Expo Ferroviaria 2014
Railway Technology, Products and Systems
01.04. - 03.04.2014
Location: Lingotto Fiere Exhibition Centre Turin, Italy
www.expoferroviaria.com

Sustainability Live 2014
01.04. - 03.04.2014
Location: NEC Birmingham, UK www.sustainabilitylive.com

ePOWER China 2014
08.04. - 10.04.2014 Location: Shanghai, China
Booth 6F37 www.epower-china.cn

Northern Ireland IHEEM 2014
Conference & Exhibition
21.05. - 22.05.2014 Location: County Down, Northern Ireland
www.iheem.org.uk/northern-ireland

Expomin 2014
21.04. - 25.04.2014 Location: Santiago, Chile
Hall 2, Booth 568-2B www.expomin.cl

Elektro
26.05. - 29.05.2014
Location: Moscow, Russia www.elektro-expo.ru

Canadian Mining Expo
28.05. - 29.05.2014 Location: Timmins, Ontario, Canada
Booth A2-UD-18 htttp//canadianminingexpo.com

Hospital Build & Infrastructure China 2014
14.06. - 16.06.2014
Location: Nanjing, China www.chinaexhibition.com

Electric Electric & Hybrid Marine World Expo 2014
24.06. - 26.06.2014 Location: Amsterdam, Netherlands
Hall 11 Booth 1550 www.electricandhybridmarineworldexpo.com

Expomina
10.09. - 12.09.2014
Location: Lima, Peru www.expominaperu.com

CHES 2014
Canadian Hospital Engineering Society
28.09. - 30.09.2014
Location: St. John, New Brunswick, Canada www.ches.org

IHEEM Healthcare Estates 2014
07.10. - 8.10.2014
Location: Manchester Centra, UK www.healthcare-estates.com

AUTOMATION 2014
15.10. - 18.10.2014
Location: Mumbai, India www.iedcommunications.com

MATELEC 2014
28.10. - 31.10.2014
Location: Madrid, Spain www.ifema.es

Intersolar 2014 India
18.11. - 20.11.2014
Location: Mumbai, India www.intersolar.in

Electric Networks
02.12. - 05.12.2014
Location: Moscow, Russia www.expoelectroseti.ru

EXHIBITIONS NATIONAL

HANNOVER MESSE
07.04. - 11.04.2014
Location: Hanover, Germany
Hall 12 / Booth D66 www.hannovermesse.de

Intersolar
The world's largest Exhibition for the Solar Industry
04.06. - 06.06.2014
Location: Munich, Germany www.intersolar.de

belektro
Trade Fair for Electrical engineering, Electronics and Lighting
15.10. - 17.10.2014
Location: Berlin, Germany www.belektro.de

eCarTec
Leading Fair for Electric and Hybrid-Mobility
21.10. - 23.10.2014
Location: Munich, Germany www.ecartec.de

MEDICA
World Forum for Medicin
12.11. - 15.11.2014
Location: Duesseldorf, Germany www.medica.de

SPS/IPC/DRIVES
Electric Automation – Systems & Components
25.11. - 27.11.2014
Location: Nuremberg, Germany
www.mesago.de/de/SPS/home.htm

INTERVIEW

Christine Sehrt, C.P.M. (Certified Purchasing Manager)

Head Supply Chain Management Bender Group

SHORT CAREER HISTORY

Christine Sehrt, C.P.M.

Head
Supply Chain Management Bender Group

Qualified in industrial business administration (Gepr. Industriefachwirtin (IHK))

Executive education at the European Business School, Wiesbaden and the Institute for Supply Management, USA with qualification as Dipl. Einkaufsleiterin (EBS) and Certified Purchasing Manager (C.P.M.)

Extensive experience in purchasing & logistics

Specific knowledge of the medium-sized enterprise sector in the beverage sector, IT, automotive and electrical industry

Frau Sehrt, for which specific tasks are you responsible as Head of Supply Chain Management in the Bender Group?

Allow me at this point to explain briefly the term "Supply Chain Management" (SCM).

SCM is the holistic organisation and control of value chains. For this purpose we have combined the purchasing and logistics functions into one area that we then divided into operative and strategic task areas.

The main task of operative purchasing is the timely, cost-conscious procurement of goods and services for the Gruenberg and Siersleben sites in accordance with requirements.

The focus of strategic purchasing is on the establishment and implementation of product group and supplier strategies for the Bender Group derived from the corporate strategy and purchasing strategy. Other key issues are supplier management, procurement market research, control of material costs together with development and production, as well as the administration of contracts with suppliers.

Our logistics on the Gruenberg site co-ordinate the flow of goods from receipt and placing in store, through internal material supply, to shipment to our customers.

A key task in the project management for SCM is the continuous improvement of the material and information flows and the related processes in collaboration with the specialist areas, Bender Group members and suppliers.

Bender is well-known for its ability to innovate and its uncompromising quality standards. What do these aspects mean for your area and how do you address them?

Especially in strategic purchasing we place particular attention on active supplier support with regular supplier assessment and in this way document continuous supplier development. The objective here is the expansion of strategic business partnerships by establishing preferred suppliers. It is important to exploit the potential of these partners to further strengthen Bender in relation to its competences in innovation, technology and quality, and at the same time to ensure cost-conscious procurement that can react as necessary.

In addition, there is the early involvement of strategic purchasing in new product developments so that the previously described market potential and experience in supplier relationships can flow into the process already at the start of development.

Ensuring consistent quality, particularly in the international environment, and purchasing materials from dependable sources must be a major challenge particularly in relation to the global procurement markets. How do you address this issue in Bender purchasing?

This issue can indeed be a challenge. However, due to procurement from familiar, approved purchasing sources, our supplier and product qualification processes, as

„**It is important to exploit the potential of these partners** to further strengthen Bender in relation to its competences in innovation, technology and quality, and at the same time to ensure cost-conscious procurement that can react as necessary."

well as the continuous monitoring of the quality of our bought-in parts we are, in my opinion, well-positioned to be able to counter these risks in a preventive manner.
For instance for key items we have defined a supplier approval process that involves an initial on-site supplier assessment during which we view and assess in particular the raw material, personal, quality, production, logistics, customer processes at the suppliers. Furthermore, we carry out regular supplier assessments during which we place great importance on delivery and quality performance and for this purpose hold regular meetings and make regular on-site visits to our suppliers to develop and implement joint improvement potential.
There are also contractual agreements in which we place obligations on our suppliers in relation to quality, delivery capability, assurance of the delivery quality and other aspects of importance for us.

The purchasing area is also dependent on the market and accordingly is in constant motion. Competitive pressure and the pressure on prices are enormous – aspects that also apply to Bender's position as a seller. What ideas and strategies do you have on the back burner for a sustainable and competitive purchasing policy?
As we are more frequently in a seller's market than in a buyer's market due to the volume we procure and the often difficult to plan project business, it is necessary to counter this unfavourable initial position with appropriate purchasing strategies. This aspect starts, for instance, in new projects with an exact definition of the requirements, through early supplier involvement and consideration of targets costs and total costs, to make or buy decisions.
In addition, volume bundling and the usage of supplier concentration as well as further standardisation with the definition of preferred parts provide important leverage. The preparation of logistic concepts and general agreements with suppliers offer us further potential and are very important to ensure the supply chain is capable of reacting as necessary, particularly for us with smaller and medium batch sizes.
With the expansion of our Chinese subsidiary and the related increased local presence we will also in future have the possibility of placing greater focus on the supplier market in Asia in relation to global sourcing.
As such we see many possible ways in which we can make our contribution to corporate success despite the difficult situation on the market.

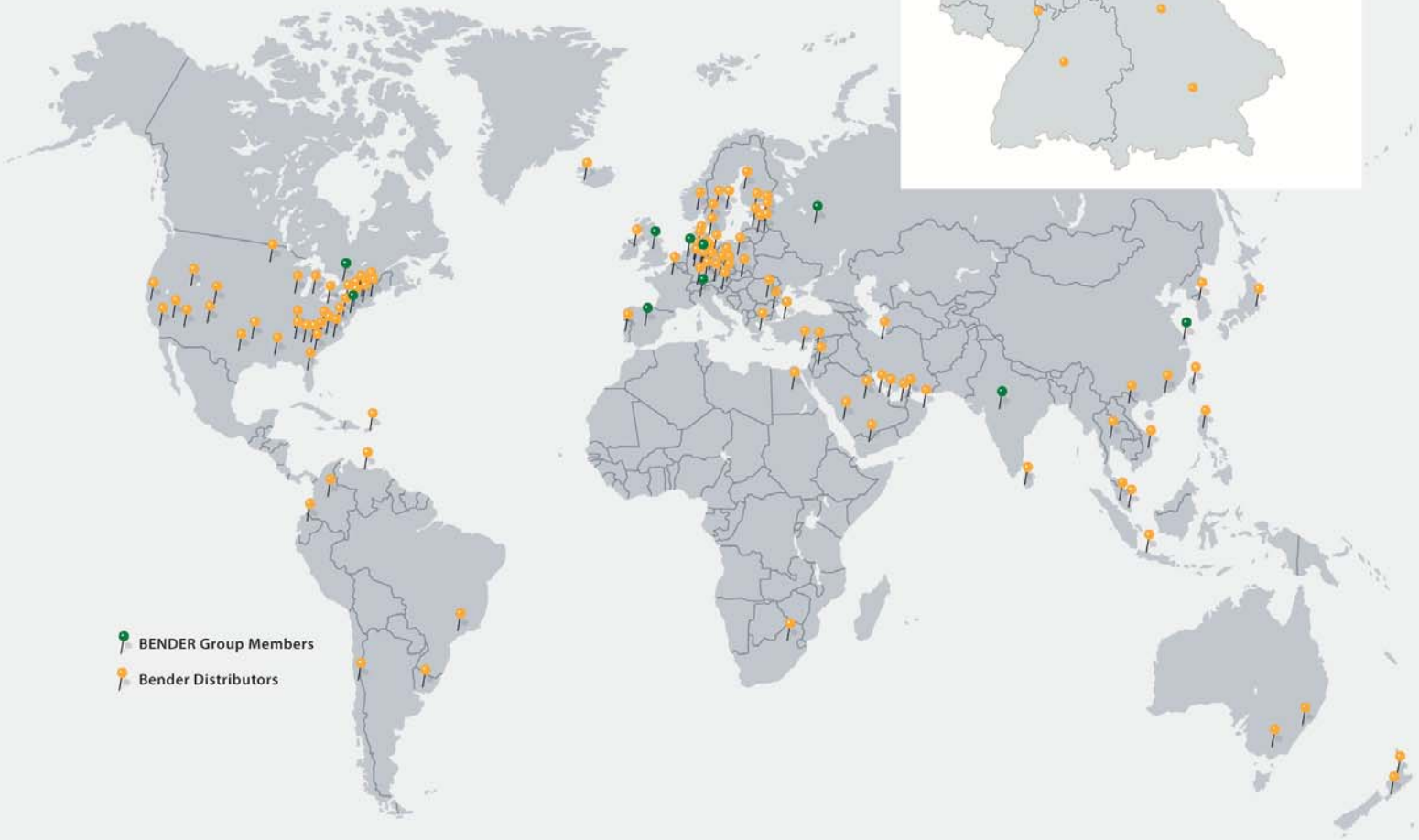
You have many topics on your agenda of which a number have already been initiated. Some of these have significant effects on internal processes or place new requirements on familiar processes. Changes can be confronted with obstruction. How do you achieve acceptance among those involved internally?
So that these objectives are successfully implemented, for me the first priority is communication. There must be an active exchange both with the specialist areas and subsidiaries as well as with our suppliers to analyse initial situations and requirements, to coordinate tasks and objectives and then to work jointly on implementation.
A key factor is the implementation of the tasks using efficient, standardised processes. The issue here is to exploit and further expand the potential of IT for increased electronic processing. For this purpose we have established a continuous improvement process that is supported by all our colleagues in the SCM area.
In addition to this process, in SCM project management we have defined a roadmap for our future supply chain; this roadmap comprises a large number of sub-projects and we are now working step-by-step on their implementation. An example of this aspect is the introduction of regular forecast meetings with colleagues from sales and operation planning, as well as the development of a standardised control system for new products with the support of our ERP system.
You can therefore see that we in SCM are involved in very varied topics and tasks and have a quasi interface function to all areas of the organisation. This diversity of tasks necessitates excellent employee qualifications. Therefore, we are willingly promoting personnel development so that we in the team can and will jointly master the tasks and challenges ahead of us.
Let me close on this topic with a quotation from Henry Ford "Coming together is a beginning, keeping together is progress, working together is success." – and we are happy to do this in the interest of our customers.

Frau Sehrt, thank you for the conversation. ■

Timothy Hörl, Dreipass

BENDER Group

The Bender Group with its main office in Gruenberg/Hesse has 70 agencies with more than 600 employees worldwide.



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Power in Electrical Safety