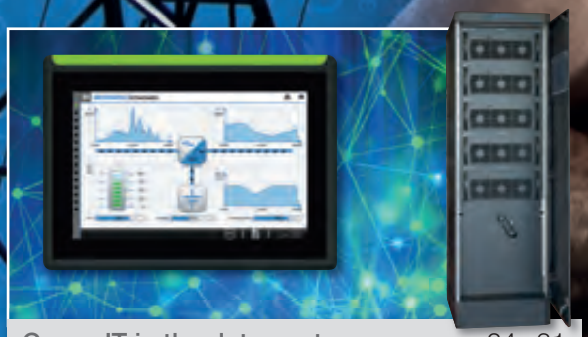
POWERnews

Q1/2023

Customer Magazine

informative · up-to-date · pioneering

Strengthen resilience secure mains availability



BENNING

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Editorial

Dear Readers,

The secure supply of energy is an essential part of our well-being. The concept of changing times as expressed by German Federal Chancellor Olaf Scholz includes the awareness that Europe needs to work towards greater resilience in business and in Society. But what is it that reflects this type of robustness or resilience? – A prerequisite for resilience will be that we expand our approach. Expand it from focussing just on efficiency. A resilient system is one that's flexible. On that principle, the system will provide redundancies and will embody diversity. Accordingly, if one thing fails, then something else steps in: one route has been blocked and so a different route is taken. Any strategy for resilience must be based on the capacity for change and for adapting to the new reality.
An example of this way of thinking – when applied to the energy economy – could consist of a combined, crisis-proof European sustainable energy policy. This will include expanding our import infrastructure to include LPG (liquid propane gas) and the logical exploitation of sustainable energy sources.

In this issue of POWER news, we'll be describing how our power supply systems have contributed to the secure operation of a liquid propane gas terminal on the Croatian island of Krk, illustrating how our range of electrical machinery has contributed to a secure future with green energy for hydroelectric power stations that were constructed halfway through the 20th century. We also need to expedite the transfer to new energy sources. In fact, the quicker we can move over to sustainable energy sources and enhance our efficiency with energy, the quicker we'll gain the keys for success. In this context, you'll be able to read how green IT is applied efficiently, reliably and cost-effectively in a datacentre in conjunction with our ENERTRONIC modular SE UPS systems, and find out the scope for upgrading to the hybrid ENERTRONIC modular storage system in conjunction with renewable energy sources.

In this issue, too, we'll be describing how a smart charging station management system such as Next Battery Selector Dynamic can help to extend battery service life, ensuring cost-effective operation of a battery pool for floor conveyors using a system that's sparing with resources. We'll tell you more about our calibration centre for test and metrology instrumentation, and we'll go on to look at the advantages of having calibration performed directly by the manufacturer. The benefits include rapid availability, work safety and saving on the cost of unnecessary travel.

We wish you very enjoyable reading and we look forward to receiving your feedback.

Dietmar Papenfort

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Contents

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Longer battery life due to consistent frequency of use

The charging station management with the Next Battery Selector Dynamic ensures the economical and resource-saving operation of your battery pool.

During each charging and discharging process, the battery temperature increases significantly due to electrochemical reactions within the battery. This means that when the batteries' charging and discharging cycles follow in quick succession without sufficient cooling phases, there is a risk of overheating. This must be avoided, as it reduces the service life and the achievable discharge cycles of traction batteries.

For an economical and trouble-free operation of the industrial trucks, it is important to always observe the cooling phases and use all drive batteries present in the battery pool in a balanced way.

POWER news (PN) spoke about this topic with Peter Hoeptner, Sales Manager Traction for BENNING, at LogiMAT 2022.

PN: Mr. Hoeptner, in addition to the charging stations, wallboxes and BELATRON chargers, you have placed a trade fair focus on charging station management with the Next Battery Selector Dynamic.

Why do you see a need for action here? The problematic impact of excessive battery temperatures on battery life has been known for a long time, right? ➔

> ***"The Next Battery Selector Dynamic activates only one indicator light at a time, so the responsible personnel can see at a glance which battery to use next."***
>
> *Peter Hoeptner,*
> *Sales Manager Traction, BENNING*

Hoeptner: Yes, in theory, but in practice this is not always taken into account. We have found that the frequency of use of the individual drive batteries varies greatly, especially in cross-shift operation.

Usually, when the batteries are changed, those in the front area of the charging station are used in preference to batteries housed in the middle and rear areas.

Thus, the battery life and the associated cooling phase in the charging station after a full charge also varies considerably. In parallel, the number of charge-discharge cycles for the individual batteries will deviate more and more from each other over time.

PN: That means, using the entire battery pool in a balanced way would reduce the temperature rise, since the pause times are distributed among all batteries after the end of the charging process, allowing the batteries to cool off?

Hoeptner: Exactly, but using the exchangeable batteries at a steady frequency is only possible if the order of use of the fully charged batteries is specified to the personnel across shifts.

This is where the Next Battery Selector Dynamic comes in. It ensures that all batteries are used in the order of their switch-off time after a full charge.

PN: Especially in battery rooms with many charging stations, it is definitely not always easy for vehicle operators to keep track of everything. How do you ensure that they can clearly identify which battery to use next?

Hoeptner: An indicator light should be installed clearly visible at each charging point to signal the fully charged battery with the oldest cut-off time in each case.
If the personnel changes the battery and →

The signal lamp and charging plug are built into a square profile.
This ergonomic arrangement above the battery simplifies battery replacement.

BELATRON UC

All BELATRON chargers are available either in a wall/charging rack mountable unit, or in a charging cabinet that can be easily fixed to the floor in the charging room.

If the BELATRON chargers cannot be installed on a wall or shelf, it is possible to use a BELATRON UC system.
This space-saving charging cabinet offers the greatest possible energy density in a footprint of only 60 x 60 cm. BELATRON UC systems can also be equipped with the Next Battery Selector Dynamic.

The NBS Dynamic can manage more than 250 different battery groups. BELATRON chargers with the multivoltage option automatically assign themselves to the correct NBS group without user intervention.

disconnects this battery from the charger, the system immediately activates the indicator light of the next battery to be used at the charging station.
Since the Next Battery Selector Dynamic only activates one indicator light at a time, the responsible personnel can see at a glance which battery to use next. This way, the correct battery is always selected, even with a large number of charging points in a confined space.

PN: On the exhibition wall, we can see an image of a smartphone in connection with a charging station controlled by the NBS Dynamic. What is this all about?

Hoeptner: Using the optional BELATRON monitor software, users can view the upcoming sequence of use, or the next battery to be used, on a mobile terminal or via a large screen in the charging room.
This helps keep your charging stations uncluttered and contributes to a faster battery change. But this is only one part of the additional value of this software. We developed BELATRON monitor to provide smart data monitoring of all charging parameters for the operators of our BELATRON chargers.
In addition to charging station management, the software offers a perfect overview of the charging station. Important charger statuses are visualised in a user-friendly manner and can be used to evaluate charger utilisation.

The data remains locally stored at all times and does not leave the company. Access can be implemented both as a stand-alone solution and via the customer network.

PN: You just mentioned integration into the customer network. Does this include communication with energy management systems?

Hoeptner: BELATRON chargers can be equipped with an optional interface that allows energy management systems to read out charging parameters and process them easily. With this information, it is possible for companies to automate processes such as load shedding to avoid peak loads.

PN: Let's stay on the topic of connectivity. How are the chargers connected to the NBS Dynamic system?

Hoeptner: Our current BELATRON chargers have two optional NBS ports, which allow for effortless networking of the chargers with each other using RJ45 patch cables. This connection is significantly more stable and less susceptible to interference than radio connections.

PN: How flexible is the system? What options are there if the company grows, the vehicle fleet is increased and accordingly more charging points are needed?

Hoeptner: Thanks to the connections with plug-in technology, the NBS Dynamic System can be easily scaled at any time. For this purpose, only the new BELATRON charger is plugged into the existing structure with a patch cable.

The chargers each have two RJ45 ports, so integration between two already existing

Advantages and added value of the NBS Dynamic System

- Optimises the use of exchangeable batteries
- Secures the order of use after full charge
- Avoids selection errors thanks to unique indicator lights
- Reduces maintenance costs
- Integration of existing BELATRON chargers possible
- Flexible expansion at any time (pay as you grow)
- Data monitoring (optional)

- **Longer battery life**
- **Minimised operating costs**
- **Sustainable usage of resources**

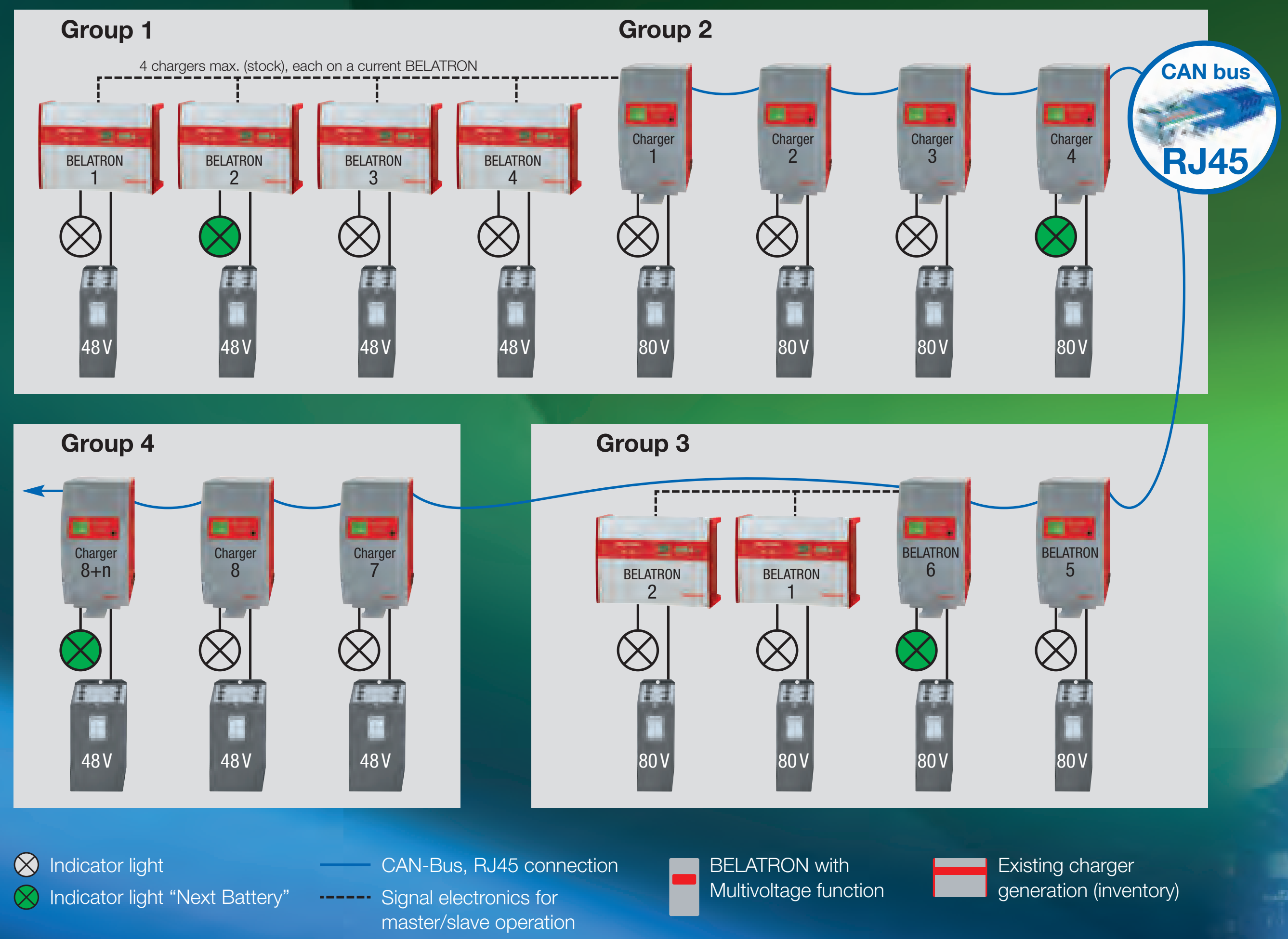
Smart data monitoring (optional), keep an eye on all charging parameters at all times

chargers is also possible. This creates additional flexibility in the charging room design.

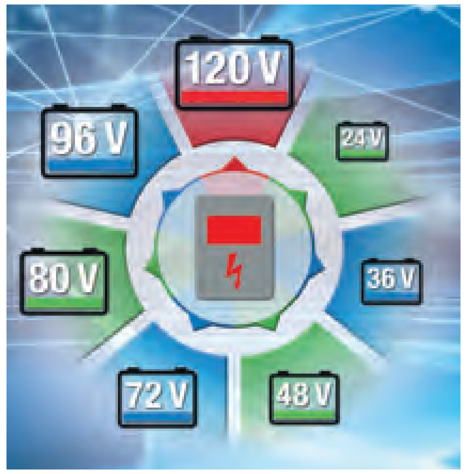
PN: That sounds very simple indeed. But what about the device settings? I assume that the chargers must always be assigned to exactly one battery type or battery voltage?

Hoeptner: Our BELATRON chargers have an optional multivoltage function that allows for charging a wide range of batteries (Editor's note: 24 V, 48 V, 80 V, 120 V and 36 V, 72 V, 96 V). As batteries of different voltages are also assigned to different NBS groups, our BELATRON chargers with multivoltage option automatically assign themselves to the correct NBS Dynamic group, ensuring that the correct charging location is always displayed for use with the next battery.

PN: We are talking about new chargers here. What are the possibilities for implementing the NBS Dynamic later on in existing charging stations? →



BENNING trade fair appearance at LogiMAT 2022 and the fully animated charging station that can be explored in virtual reality with VR glasses



Batteries of different voltages are assigned to different NBS groups. The BELATRON chargers with the multivoltage option automatically assign themselves to the correct NBS Dynamic group.

Usually there are already chargers on site; do these have to be completely replaced?

Hoeptner: The NBS Dynamic is downward compatible. If there are already older BELATRON chargers on site that do not have an NBS Dynamic interface, these can be easily integrated via a clever bus connection concept.
We retrofit the existing devices with relay contacts and then integrate them into the new NBS Dynamic via a bus coupler. This reduces investment costs and makes it easy to get started.

However, it should be fundamentally checked and evaluated whether replacing the old devices with modern BELATRON chargers would not be more economical in the long run due to the higher efficiencies, new software and communication interfaces – we were just talking about energy management.

PN: Are you also alluding to a holistic view of such a project?

Hoeptner: Well, tailored suits just fit perfectly! – The same applies to custom made charging processes and stations. Customised solutions are created according to the needs of the customer and thus achieve added value. A holistic approach at the beginning of the project guarantees that the system will meet the customer's needs perfectly, conserve resources and be operated economically.
At the same time, it is a matter of simple aspects, such as the optimal use of space. Let's assume that the charging room will not be changed due to the high structural engineering requirements.

Nevertheless, additional chargers are needed, but there is not enough installation space for them either on the walls or on the shelves.

In this case, we use the BELATRON UC system. This space-saving charging cabinet offers the greatest possible energy density in a footprint of only 60 x 60 cm. The system is modular and the number of 19" BELATRON charging modules can be flexibly adapted to requirements. BELATRON UC systems can of course also be equipped with the NBS Dynamic.

PN: During the interview, we repeatedly see visitors walking around the stand with VR glasses or their mobile phones. What is the meaning of that?

Hoeptner: We thought about how we could ideally present such a large system with its complete functionality. This was not only about a trade fair presentation, but also about the presentation on our website and when visiting customers. Unlike products such as our BELATRON charger or our liflex NG battery, which we can simply bring along with us, this is not possible with the NBS Dynamic.
A product demonstration for a reference customer also always involves a great deal of organisational effort due to scheduling, safety briefings, etc.

Therefore, we decided to build a completely animated charging station on a scale of 1:1 in virtual reality and make it available online.

All visitors need is internet access, VR glasses, a mobile phone or tablet to enter the hall. They can move around freely inside and experience the battery change live or look at the units in detail – without even having to download an app.

PN: We would like to try that out right away. Mr Hoeptner, thank you very much for the informative interview. ◻

Entering the charging station in AR

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Scan the QR code for further information

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Bridge to Krk Island at sunset

A contribution to the security of gas supply in the European Union

BENNING power supplies secure critical loads at the LNG terminal on the Croatian island of Krk, also known as the “Golden Island”.

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The EU is considered the largest importer of natural gas in the world.*1 About a quarter of the EU’s energy consumption is currently based on natural gas, which amounts to a total demand of about 400 billion cubic metres. Only about 10% of gas demand is currently met by domestic gas production. In terms of energy security and competitiveness, diversification of supply sources is therefore a high priority.

The most important distribution methods to Europe are pipelines and the sea. The expedition takes place in the liquid (sea route) or gaseous (pipeline) aggregate state.
In order to better store and transport the natural gas by sea, it is cooled to about -162°C and liquefied. So-called “liquefied natural gas” (LNG) takes up about 600 times less volume. Once it arrives at the landing point by ship, it is gasified again and distributed via the gas networks in the same way as the gas that reaches Europe via pipeline.

The EU’s current LNG import capacity could cover around 40% of current demand, but only around 80 billion cubic metres of LNG were imported into the EU in 2021. This is partly because not all EU countries have access to a regional gas hub with a wide range of supplying sources, including LNG.

Developing the necessary regionally distributed LNG landing facilities can make the EU more resilient to possible supply disruptions from individual gas suppliers. This is because LNG can be sourced globally from many different supplier countries.

In addition to the strategic aspects, as with all infrastructure measures, economic viability is also of great importance. In the construction of LNG terminals, floating storage and regasification units (FSRUs) are a flexible and profitable alternative to pure onshore terminals. *1

Such an LNG terminal was commissioned in 2021 by the company LNG Croatia LLC on the Croatian island of Krk. The only facility of its kind in Croatia to date strengthens the security of gas supply, especially for the Central and South-Eastern European EU states.

On behalf of the general contractor, the Croatian BENNING subsidiary was responsible for the project planning, production and installation of the power supply system intended to protect the critical loads and also supplied the NiCd battery strings required to bridge blackouts.

The power supply system is located in the central control building on the landside part of the LNG terminal, which also includes the jetty head, the dolphins for the FSRUs and LNG tankers, the high-pressure unloading arms and the fire-fighting system.
The NiCd batteries placed on special racks that are housed in a battery room with a ventilation system that complies with safety standards. →

LNG terminal in Omišalj on the island of Krk (right side)

Photo: © LNG Hrvatska d.o.o.

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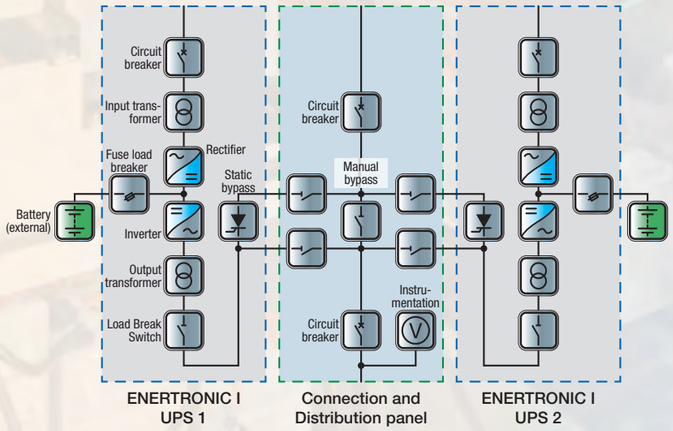
Photo: © LNG Hrvatska d.o.o.

*1 https://energy.ec.europa.eu/topics/oil-gas-and-coal/liquefied-natural-gas_en

"We like to compare our UPS systems to a referee at a sporting event. It is essential that he is present, but it is best not to notice him."

Krešimir Kaurić,
Head of subsidiary BENNING in Croatia

Single line diagram of the power supply system



BENNING – Quality and service for the world market

Subsidiary

The 356 NiCd battery cells in the battery room with a total capacity of 460 Ah

The power supply system installed by BENNING is specially designed for use in harsh industrial environments such as the oil and gas industry. It guarantees an uninterrupted power supply to the critical loads of the LNG terminal 365 days a year, around the clock. These include, for example, the SCADA system and the LNG control stations. If these systems were to fail, the complete monitoring and control of the LNG terminal would be affected.

In order to eliminate this risk, the power supply system has a completely 1+1 redundant design. It is based on two identical UPS systems of the type ENERTRONIC I, each with a capacity of 30 kVA and an output frequency of 60 Hz. The ENERTRONIC I UPS complies with the highest UPS classification VFI SS 111 according to IEC / EN 62040-3 and thus offers maximum supply reliability.

Each UPS cabinet contains its own input and output transformer, rectifier, inverter and static bypass. It thereby fulfils all the technical specifications required by the customer.
A third cabinet, located between the UPS systems, accommodates the connection and distribution panel as well as the manual bypass. Each UPS system has a separate battery string consisting of 178 cells with a total capacity of 460 Ah. This ensures a bridging time of 240 minutes with an assumed load of 22 kW.

However, this static UPS system not only has the goal of supplying the connected loads with energy continuously and without interruption, but also achieves a significant improvement in voltage and frequency quality compared to the normal grid.

Highest quality required

Construction work on the LNG terminal's control building began in May 2020.

In parallel, the contracted EPC company (EPC = Engineering, Procurement and Construction) was looking for a reliable partner to manufacture and install the planned power supply system.

BENNING has well-established itself in the Croatian oil and gas sector over the past two decades with many successful projects. The company is considered a reliable business partner with high quality standards. Especially in the field of power supply, the company realised a large number of 110 V DC reference projects to its credit. These include, for example, power supplies for transformer stations or for use in the refinery sector.

Accordingly, BENNING also received this request. After designing a possible solution, the Croatian subsidiary submitted a compehensive offer in November 2020. In addition to the economic aspects, the customer was convinced that the solution proposed by BENNING could fulfil all the desired technical requirements. The "Made in Germany" manufacturing and the availability of a local BENNING service centre also had a positive effect on the awarding of the contract. Although the robust power supply system is designed for a long service life, regular proactive maintenance contributes to increased safety and economical operation.

In the following 15 weeks after receiving the order, the detailed clarification of all technical parameters began, followed by the production of the power supply in the Bocholt factory. Delivery and installation took place and the power supply system went into operation soon after the installation was finished.

Security through proactive service

In the meantime, the LNG terminal in Omišalj has been in operation for more than a year and the first agreed proactive maintenance of the power supply was carried out by the BENNING service team in June 2022. A five-hour measurement of the battery capacities also took place within this framework. The globally positioned BENNING service organisation is not only available for planned maintenance processes.
It also reacts quickly and reliably if a malfunction is imminent or actually occurs. For this purpose, it also relies on a long-term stock of spare parts.

Utilisation of the terminal increases daily

Against the backdrop of the current geopolitical situation, the capacity utilisation of the LNG terminal is continuously increasing. In the future, this could develop into a regional gas hub. An expansion of the LNG terminal is currently under discussion.

With this LNG project realised in Croatia, BENNING has once again proven that it is a reliable partner in the field of power supply for critical infrastructures. It supports its customers worldwide already during the planning phase and offers appropriate economic and technical solutions for an uninterruptible power supply.
Decades of experience in engineering, manufacturing and installation guarantee trustworthy and sustainable quality. ◻

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Scan the QR code for further information

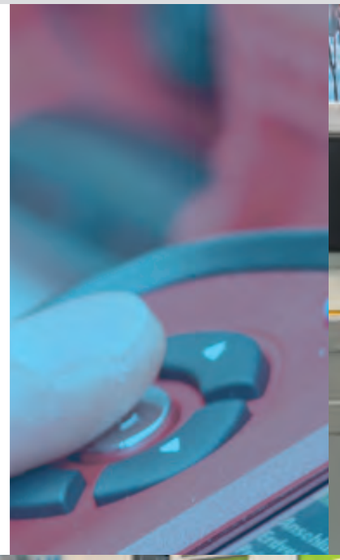
Calibrating your measuring instruments directly at the manufacturer

Factory calibrations of testing, measuring and safety testing instruments guarantee quality and safety for use in industry, trade and service.

The development and production of the world-famous DUSPOL® and DUTEST® testing devices began as early as 1948. Over the years, we broadened the product range to form a comprehensive family of testing and measuring devices that are valued by experts all over the world as reliable quality products. It now includes voltage, continuity and rotary field direction testers, digital multimeters and current clamps as well as safety test devices.

Background image: © #252619669 Zffoto/stock.adobe.com

Installation tester BENNING IT 200



BENNING calibration laboratory in Bocholt, Germany (top and left)

Simply book your BENNING factory calibration by scanning the QR code and filling in the online form.

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BENNING products are internationally renowned for their innovative developments and consistent manufacturing quality. We base their design and execution on the requirements of professional users.
We at BENNING use only the highest-quality components in the manufacture of our testing, measuring and safety testing devices. This leads to minimal manufacturing tolerances and slows down the natural ageing process of the devices. However, not all devices are the same and none are completely drift-free in the long run.

Calibration offers you safety

Of course, BENNING, as the manufacturer, guarantees compliance with the technical specifications and accuracy of information listed in the operating instructions for the first year after the delivery date. However, the user is responsible for all subsequent recalibrations during the product's service life.

Factory calibration is performed to check the functionality of measuring devices. It is required as soon as evaluative measurements become necessary. For instance, this is the case on test benches or in test areas of production companies.

If, due to incorrect measurements, intermediate or final products delivered are outside the specified tolerances, this can have far-reaching, economic consequences for the manufacturer.

As a result, expensive product recalls will usually be unavoidable. Therefore, within the framework of quality management (e.g. ISO 9001, section 7.6), regular calibration of the measuring equipment is provided for. The focus is on quality.

Other, important reasons result from safety aspects. Let us consider, for example, installation testers or VDE test devices that test service providers use to check the electrical safety of their customers' equipment. These measurements serve to ensure occupational safety. The aim is to prevent personal injury, e.g. due to electric shock. For this, regular calibration is essential. →

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BENNING

"Our customers have taken good note of the fast response times, especially as they often don't have second or third units available."

Christian Schmeing, After Sales Service, BENNING

The factory calibration of the instrument testers BENNING ST 750 A / ST 755 / ST 760 and the installation testers IT 115 / IT 130 includes the installation of current updates.

A comprehensive certificate documents that all manufacturer specifications and all measured values were checked.

These devices include the installation testers BENNING IT 101 / IT 115 / IT 130 / IT 200, which are used for the safety testing of electrical installations according to the standard DIN VDE 0100 and the international standard DIN IEC 60364, and the device testers BENNING ST 755 / ST 760, which can be used for the safe and time-saving testing of equipment according to DGUV regulation 3 according to DIN VDE 0701-0702 as well as electrical medical devices according to VDE 0751-1.

Aim of the calibration

Those who measure a lot, will measure a lot of rubbish. – This common saying makes us think. When we measure, we want to be able to trust the results. Does a measurement make any sense at all otherwise? This is where the calibration comes in. The goal is to identify and document any deviation in a meter's reading from the true reading, the established "normal". The proper condition of the measuring instrument to be calibrated can be documented if the tested measured values are within the limit values specified in the decision rules. In contrast to verification, calibration takes place without changing the measuring device.

BENNING carries out the factory calibration in our calibration laboratory in Bocholt, Germany. The change in calibration regulations and standards has led to increased demand in recent years. The generous expansion of our laboratory's capacity in 2021 takes this into account and ensures that calibrations can be carried out within a short lead time. Along with their shipped device, customers receive a comprehensive certificate documenting the verification of all manufacturer specifications and all values measured during calibration.

Short processing times

"Our customers have taken good note of the fast response times, especially as they often don't have second or third units available." says Christian Schmeing (After Sales Service, BENNING).
He adds: "Should it become apparent during calibration that the functionality of the device is impaired and that measurements can no longer be guaranteed in conformity with the standards, we as the manufacturer can immediately offer to repair or replace the device.
There will be no need to search for another contact person or supplier for a replacement unit, which significantly minimises customer downtime."

Bottom line

In summary, depending on the requirements for the planned measurements, there are various reasons to calibrate or regularly recalibrate testing, measuring, and safety testing equipment. These include:

- Compliance with regulations and standards
- Consistent product quality in manufacturing processes
- Safety aspects

For users and service providers who need to have their measuring instruments calibrated, commissioning factory calibration directly from the manufacturer offers many advantages, such as:

- Simple, uncomplicated processing
- A calibration laboratory with integrated quality management and sophisticated equipment
- Competent contact persons for repair and replacement
- Precise performance, including detailed documentation of the calibration result
- Short-notice returns

Book calibrations online conveniently and easily

The BENNING calibration portal (https://calibration.benning.de) offers our customers in Germany a simple and convenient way to book calibration processing online at any time.

We will expand and further optimise these processes in the future, in order to reduce processing times for our customers. This is another building block within the proactive BENNING 360° Service concept. ◻

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Forggensee in Bavaria, Germany

Hydropower – tried and tested for thousands of years; more modern than ever before

Emission-free, controllable, base load capable and reliable: hydropower electricity generation is your ideal companion alongside the volatile feed-in from wind and solar energy.

The power supply must be reliably accessible 24/7.*1 Hydroelectric power makes a vital contribution to this. While wind and sun are subject to strong fluctuations as energy suppliers, electricity from hydropower is always available.

This means that the required amounts of electricity can be fed into the grid within seconds to compensate for the gaps from the volatile feed-in of wind and solar energy.

With the expansion of wind and solar energy, providing this primary control energy is becoming more important every day in order to ensure the normal frequency of 50 Hz in the power grid. The Uniper Company operates 22 run-of-river power plants on the Lech River, a tributary of the Danube River, as well as the Rosshaupten storage power plant on the lake Forggensee.

With an overall expansion capacity of around 260 megawatts, around 1.1 billion kilowatt hours of electricity are generated per year.*2 This can theoretically supply around 366 000 households with electricity.
At the same time, around 634 000 tons of CO_2 are saved, compared to generating energy from fossil fuels. →

*1 https://www.uniper.energy/sites/default/files/2022-04/broschure_kraftwerksgruppe_lech.pdf
*2 https://www.uniper.energy/germany/power-plants-germany/lech-hydropower-group

Photo: © Uniper Kraftwerke

Lech barrage 10
Epfach*3

Built: 1947 – 1950
Power generated: 8.3 MW at 8.5 m drop height
Energy generation: 6 straflo turbines and generators
Expansion flow rate: 120 m³/s
Control work capacity: 40 726 MWh/year

Photo: © Uniper Kraftwerke

Lech barrage 7
Finsterau*4

Built: 1947 – 1950
Power generated: 7.7 MW at 8.0 m drop height
Energy generation: 6 straflo turbines and generators
Expansion flow rate: 120 m³/s
Control work capacity: 37 079 MWh/year

*3 https://dewiki.de/Lexikon/Lechstaustufe_10_–_Epfach
*4 https://de.wikipedia.org/wiki/Lechstaustufe_7_–_Finsterau
*5 https://www.uniper.energy/sites/default/files/2022-04/broschure_kraftwerksgruppe_lech.pdf

*Locations of the run-of-river power plants Epfach and Finsterau*5*

Insertion of coils in the BENNING repair workshop in Bocholt, Germany

To ensure that safe and sustainable energy will continue to be generated on the Lech in the future, Uniper is continuously investing in the maintenance and efficiency of the plants.

As part of this work, plans were made to overhaul three generators at the Epfach and Finsterau hydroelectric power stations built between 1947 and 1950. Corresponding tenders were sent out by Uniper at the beginning of February 2022 to various companies specializing in such challenges.

Reliable and flexible partner

The BENNING Electrical Machines Division (BeM) has been repairing generators and motors since the 1930s.

This division therefore has decades of experience and references in the construction, reproduction and repair of e-machines for a wide variety of industries. These include the steel and aluminium processing industry, mining, oil, gas and petrochemicals, railways and power generation.

In the past, BENNING has already repaired several hydroelectric generators on behalf of Uniper. In particular, the high flexibility in the implementation phase, without making compromises in occupational safety and quality, convinced the client. As a result, BENNING was also asked to submit an offer in February.

BENNING's planning know-how and the cost-effectiveness of the submitted offer convinced Uniper. After inspecting the systems and creating an assembly concept, the order was placed for the renovation of three hydroelectric power generators from two different power plants.

In order to minimise downtime and the resulting power generation losses, the three generators were going to be modernised between March and August. It was planned in such a way because in these months the level of the Lech falls, and with it the generation of energy.
The order stipulated that towards the end of the summer the generators would be put back into operation so that the capacity of the two power plants could be fully utilised again when the river levels rose in the autumn.

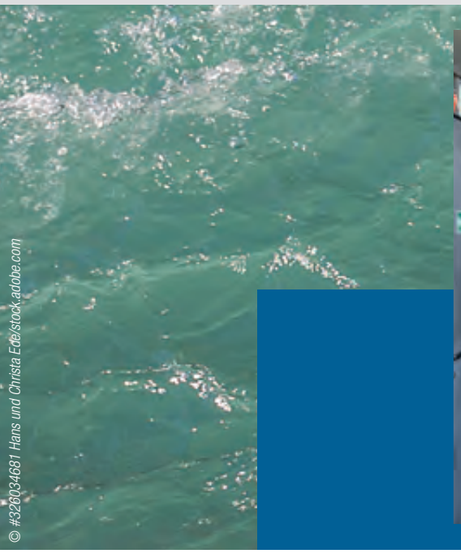
The BeM project team began reassembling the newly wound generator stator and rotor poles on July 11, 2022, so that the generators were able to start operating again as planned in August.

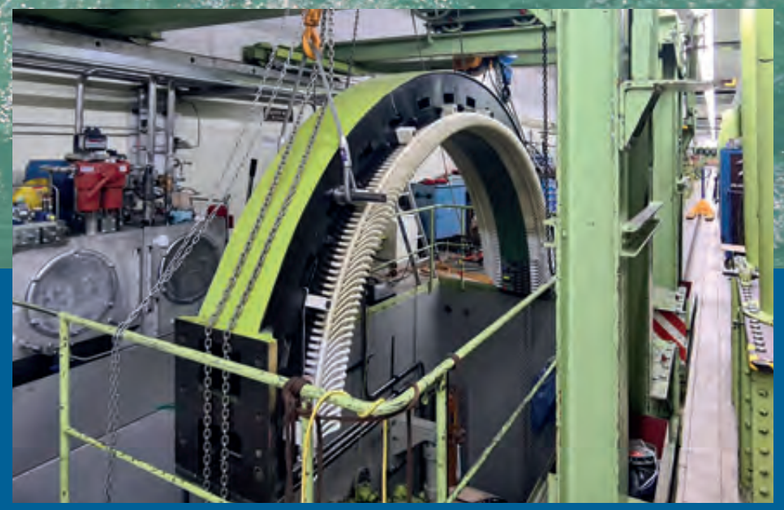
The team manufactured three new stator laminations from modern, low-loss dynamo laminations in the repair shop in Bocholt beforehand. Each package consists of approx. 8000 sheet metal segments manufactured using the laser cutting process.

Using modern equipment, the BeM team produced 1500 new high-voltage coils in a short time and inserted them into the grooves of the generator stator, which have an internal diameter of more than 3 metres. Technical expertise, craftsmanship and the use of state-of-the-art materials and insulating materials now ensure an increase in efficiency, high operational reliability and a long service life for the machines. →

The reconditioned segments before being transported back to the Lech River

> ***“Since occupational health and safety are of the highest priority for both us and our customer, a rescue exercise was carried out at the Finsterau hydroelectric power plant before dismantling began. This involved simulating the rescue of an unconscious employee, who had to be transported safely and as quickly as possible to the power station gate from the power station basement using recovery equipment.”***
>
> *Matthias Loerwink,*
> *BENNING, Electrical Machines Division*





The 256 km long Lech river has its source in Vorarlberg, Austria and flows into the Danube river in southern Bavaria.*9 There is a height difference of 1 500 meters*10 between its source and the mouth, which is used by 23 barrages to generate natural electricity from hydropower.

Its turquoise to jade green water is magically fascinating. The Lech owes this colour to the high mineral content that the river dissolves from its stones, as well as to the low water temperature.

Challenges during disassembly and reassembly

The power plants each have six Straflo turbines.*6/*7 In this construction, the rotor of the generator and the rotor of the turbine form a complete unit.*8
A separate shaft is not planned. The excitation winding is located in the rotating ring that the turbine blades carry. Therefore, this type of generator does not have a classic flywheel. The stator winding is built into the turbine housing.

Due to the Straflo concept, there were special requirements for the disassembly and later reassembly processes of the generator. Since the rotor had to remain in the power plant due to the design, the BENNING technicians dismantled the rotor poles on site.

Beforehand, the generator stators had to be split into their two shells in the power plant and the lower half swung out under the rotor. The stator shells and the dismantled rotor poles were then transported to the Bocholt plant for refurbishment.

During the reassembly, the BENNING Service Team first reinstalled the refurbished rotor poles in order to then swivel in the lower-lying generator shell under the rotor. Due to their design, the stator halves had to be assembled on site so that the last coils of the 6 kV stator windings could only be installed and electrically connected during reassembly.

For this purpose, the BeM team has special mobile equipment, since both the insertion of the last coils and the later curing of the resin posed a special challenge for the technicians on site.

The reinstalled generators showed optimal values in the acceptance measurements and confirmed the success of the generator repairs. The tests carried out included not only the measurement of electrical parameters and load characteristics, but also the determination of the thermal limit values as well as the noise and vibration values.

This means that the full feed-in capacity is again available at the Epfach and Finsterau run-of-river power plants, so that the sustainably generated electricity will continue to make an important contribution to the energy transition in the future. ◻

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*6 https://de.wikipedia.org/wiki/Lechstaustufe_10_–_Epfach
*7 https://de.wikipedia.org/wiki/Lechstaustufe_7_–_Finsterau
*8 https://de.wikipedia.org/wiki/Kaplan-Turbine#Straflo-Turbine

*9 https://de.wikipedia.org/wiki/Lech
*10 https://www.wasserqualität-trinkwasserqualität.de/wasser-qualitaet/fluesse/lech

Green-IT in the data centre – What potential does the UPS system offer?

With the Leipzig 2 data centre, envia TEL GmbH relies on quality and safety made in Germany and thus offers its customers high availability combined with resource-saving operation.

2 Photos: © envia TEL GmbH

Driven by digitisation, the amount of data that then needs to be managed is constantly growing. IT trends such as cloud computing, artificial intelligence, metaverses and streaming are increasingly driving up the power consumption of data centres. When it comes to making data centres more energy-efficient, operators have tended to first invest in servers with processors that are as economical as possible, and in efficient air conditioning.

For some time now, there has been an increased focus on potential savings using smart power supplies. Equipped with intelligent control software, these systems continuously adapt their own consumption to the current workload of the data centre.

They are optimised to automatically set hardware that is not currently required to energy-saving mode without jeopardising the secure operation of the data centre.

They assume energy management functions, offer options for the integration of energy storage systems or the procurement of sustainably generated energy from photovoltaic and wind power plants.

Energy consumption reduced to a minimum

With the ENERTRONIC modular SE UPS system, BENNING has already established a UPS system on the market for several years that meets the requirements for resource-saving and fail-safe operation.
This software-controlled system puts UPS modules that are not required to supply the current load into a kind of “sleep mode”. In doing so, their own consumption is reduced to a minimum without restricting safe double-converter operation. If the load conditions change suddenly, the modules are activated and deliver the full load within less than two milliseconds. →

Photo: © envia TEL GmbH

envia TEL GmbH (envia TEL) is a 100 percent subsidiary of envia Mitteldeutsche Energie (enviaM) based in Markkleeberg in Saxony, Germany. This company is the leading regional telecommunications service provider and network operator in Central Germany and offers products and services across the entire spectrum of telecommunications, services for network operators and cyber security solutions.

Using the data centre campus Leipzig, envia TEL operates one of the most modern data centre locations in Europe and offers space for 60 000 servers on an area of 3 000 square meters.

99.99996 % availability

For 2 years now, 2 redundant ENERTRONIC modular SE systems, each with 1.2 MVA, have also been protecting the Leipzig 2 data centre from network disruptions.
The high-performance data centre operated by envia TEL GmbH in Taucha, just outside Leipzig is certified according to the EN50600 VK3 standard and classified as highly available.
It currently includes 1 000 m² of server space and another 1 000 m² of server space for future expansions.

The services focus on housing, hosting, cloud services and collocation. The customer structure is diverse. It includes companies from the industrial and infrastructure segments as well as from telecommunications. Some of them have outsourced their entire IT to the data centre. These customers rely on the high availability guaranteed by envia TEL, because a failure would significantly affect the entire business operation and could cause enormous economic damage.

From this, we can draw the following conclusions with regard to power supply systems: The guaranteed availability of the UPS system is the most important quality feature. How reliable they are depends largely on the reliability of the modules used. The topology and the way the modules are configured, however, are equally important.

The ENERTRONIC modular SE achieves an outstanding availability of 99.99996%, often referred to as “six-nine” reliability. This corresponds to a maximum downtime of less than 13 seconds per year.

Learning from experience

As the name “Datacenter Leipzig 2” implies, it is the second data centre on the data centre campus in Taucha. A few years ago, envia TEL constructed the Leipzig 1 data centre. At that time, it was equipped with diesel-dynamic UPS monoblock systems, which still supply the data centre today, still adhering to the highest availability requirements.

However, these monolithic systems have various disadvantages in terms of flexibility, energy efficiency and economy compared to current modular UPS systems.

For example, the entire capacity required for the final expansion of the data centre must be installed right from the start. This requires a comparatively higher initial investment, and the UPS systems are only used to a low extent over a long period of time. They are therefore operated outside of their optimum efficiency. The result is higher power losses and lower energy efficiency.

Holistic view

When the “Datacenter Leipzig 1” had reached about 70% of its maximum server capacity, envia TEL began planning another data centre in 2017. Based on the findings from operating the previous diesel-dynamic UPS systems, the goal was to now use modular UPS technology.
BENNING and envia TEL had already established a business relationships in the field of telecom power supplies, BENNING also received the corresponding call for bids in 2018. With commitment and a high degree of customer orientation, the BENNING project team then developed various concepts with regard to possible system configurations, flexible performance design (pay as you grow), economical operation and optimal use of space when installing on site. In extensive benchmarks, envia TEL compared both the monetary aspects of the initial installation, the total cost of ownership (TCO) and the technical parameters of the various UPS providers. Advantages and disadvantages were compared and a wide variety of scenarios were run through.

Smart system efficiency

Data centres are said to be major consumers of electrical energy. Accordingly, envia TEL wanted an intelligent, energy-efficient power supply system whose self-consumption is optimally adapted to the dynamically changing capacity utilisation of the data centre at all times.

With the user-selectable and individually configurable operating mode SEOO (System Energy Optimized Operation), the ENERTRONIC modular SE meets precisely these requirements. The system automatically and intelligently guarantees the highest system availability while having the lowest operating costs. To do this, the software continuously determines the number of modules required for safe and economical operation and puts all others into a state of controlled inactivity. Nevertheless, these modules are also permanently available in order to supply the critical load without interruption if required (e.g. in the event of a load increase).

In addition, the installed system performance can grow in parallel to the expansion of the data centre. This eliminates the risk of overinvestment from day one, because the system only includes the exact number of modules that are required to achieve the maximum system performance required and to create redundancy. If the required power increases or decreases, modules can be easily added or removed (hot swap).

Small footprint

The customer was also impressed by the power density (415 kW/m²), which is unique for this UPS class, and by the small space requirement. The entire air flow of the UPS system is discharged through the system roof, or optionally through the rear.

All settings, service and maintenance work are carried out from the front. This means that very space-saving and flexible arrangements are possible at the installation site, because the UPS systems can easily be placed back to back, lined up against a wall or in a corner.

No single point of failure

BENNING was also able to score in terms of system availability. The power supply system operates as a fully redundant UPS system in which the parallel architecture of the modules has been successfully decentralised, resulting in a UPS system without a single point of failure. →

Six-nine reliability

Due to the high number of system components in a modular UPS system, we assume a Mean Time Between Failures (MTBF) of 500 000 hours in our equation below.

However, since each UPS module in this topology represents a complete and fully functional power supply system that can be hot-swapped in less than ten minutes while the entire system is in operation, the Mean Time To Repair (MTTR) is one very impressive value of only 0.17 hours.

The following therefore applies to system availability:

Availability = MTBF / (MTBF + MTTR)

= MTBF / (MTBF + MTTR)
= 500 000 / (500 000 + 0.17)
= 500 000 / (500 000.17)
= 99.99996 %
= 0.21024 minutes / year

* Source: cf. detailed article on the availability calculation of power supplies in POWER news 08/2017

The UPS system is scalable and can grow as the data centre expands

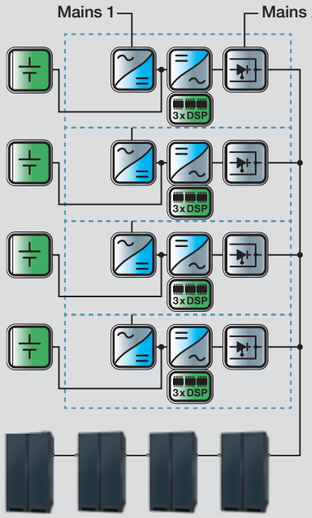
"After the global supply bottlenecks as a result of the corona pandemic and the ongoing risks for the supply chains, choosing the ENERTRONIC modular SE made in Germany has once again proven to be the right decision."

Michael Freitag,
Project manager new data centre Leipzig 2,
envia TEL

Photo: © envia TEL GmbH

The monitoring and control unit (MCU) allows the system to be connected to EMS from a wide variety of software manufacturers with a large number of supported protocols and interfaces. The system controller (MCU 3000) built into the cabinet door of the power supply system has a 10.4" touch display.
This display view shows the operating status of an ENERTRONIC modular Storage.

Decentralised parallel architecture



UPS system design as DPA (Decentralised Parallel Architecture) - there is no single point of failure due to complete redundancy.

For this purpose, all critical components, including the bypass and control units, are located at the module level and in some cases there is additional redundancy in the design. To increase system availability, the implemented multiple master technology also enables each module to switch automatically to master or slave operation.

High delivery performance

From the benchmarks and scenarios, the concept developed by the BENNING project team emerged as the winner and won the call for bids.

The BENNING team was commissioned by the electrical engineering general contractor at the beginning of 2020. As early as May of the same year, the technicians from the regional BENNING service branch in Dahlewitz in Brandenburg, Germany installed the two ENERTRONIC modular SE systems and the battery strings required for the specified bridging time. The Monitoring Control Unit 3000 (MCU 3000) is used for simple, intuitive operation and remote monitoring.

Commissioning followed in June, and the systems were initially only equipped with the number of power modules actually required for the current critical load. In the future, more modules will be continuously retrofitted in line with the expansion of the data centre.

Green IT – Fit for Future

According to envia TEL, the power supply for the data centres is already 100 percent from renewable energies. Should a PV or wind power plant be integrated directly into the supply of the data centre in the future as part of the Green IT idea, this is also possible with the ENERTRONIC modular SE.

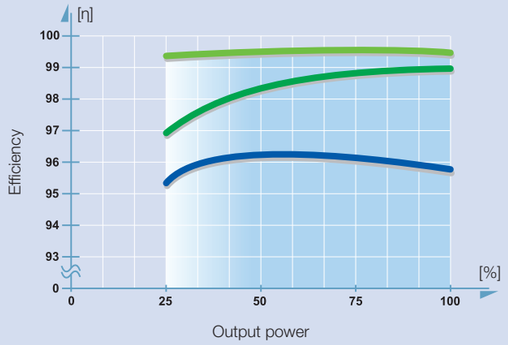
For this purpose, BENNING has already successfully established the hybrid UPS energy storage system ENERTRONIC modular Storage on the market.
It enables the integration of renewable energy sources such as PV systems, the provision of fast charging energy for electric vehicles and peak load capping, so-called peak shaving, to avoid high energy costs due to peak loads.

This is good news for all operators of ENERTRONIC modular SE UPS systems, as these systems can make full use of the energy storage functions as part of an upgrade. Consequently, envia TEL is excellently positioned for the future. →

UPS room of the data centre in Taucha, Germany

Main focus: Optimal system size, investment costs and Total Cost of Ownership

Ronald Metzig,
Head of Office East, Germany
BENNING



Power supply systems for IT applications usually have a service life of 10 – 20 years. Choosing the right system size at the time of installation is therefore of great relevance. If at some point the installed system proves to be too small, it will have to be upgraded or replaced. This measure can involve very high investment costs.

If, on the other hand, the newly installed system were too large – i.e. overdimensioned – investment capital would have been wasted in a system with lower energy efficiency and higher operating and maintenance costs. Both have a significant impact on the total cost of ownership / TCO. In an interview with POWER news (PN), Ronald Metzig analyses the economic aspects.

PN: Mr. Metzig, we sometimes hear the statement: "Our UPS systems are scalable and can grow with the requirements." What is behind this statement?

Metzig: Dynamically changing requirements and the necessary change in system and server technology make it almost impossible to reliably predict the required performance and the optimal system size over a period of 10 to 20 years. For this reason, almost all systems are overdimensioned at the time of installation.

What turns out to be profitable for the system manufacturer, on the other hand, means that there is a high probability of overinvestment for the operator, and that higher maintenance and service costs will arise during the operating phase.

PN: So the only way to minimize TCO would be to install a UPS system that has the right power at all times?

Metzig: Yes, that would be the ideal goal, but let's break it down further. In a power supply system, three main factors influence the TCO:

- Initial investment costs
- Power losses, a function of system efficiency
- Maintenance and repair costs

The problem is that these factors influence each other. They must therefore be considered together and optimised holistically in order to minimize the TCO.

PN: You mentioned the initial investment costs. We know that this market is highly competitive. But the main task of the UPS is to protect the critical load, isn't quality and price like two boxers in a ring?

Metzig: A nice metaphor, but yes, that's unfortunately the case. We therefore always advise, when comparing systems, to question whether the system with the lowest initial investment costs also uses the highest quality components and works just as energy-efficiently. If this is not the case, the operating costs incurred afterwards could be higher than necessary. It would also be likely that high maintenance and repair costs are associated with it.

PN: You brought up the topic of energy efficiency and probably also mean the performance losses mentioned before. Can you give us an example of that?

Metzig: Let's assume a critical load of 1 000 kW for the sake of simplicity. Reducing the system efficiency by 1% already causes a power loss of 10 kW. If you extrapolate this for a whole year, there is a loss of 87 600 kWh with operation 24 hours a day, 365 days a year. With a term of 20 years, this corresponds to 1 752 000 kWh. As you can see, the energy efficiency of the system has a greater impact on the TCO than the initial investment costs.

PN: If you look at this loss, it certainly makes sense for an operator to take a detailed look at the efficiency curves of the various UPS systems, doesn't it?

Metzig: It's nice that you're talking about curves, because unfortunately, excuse me for saying that, the maximum efficiency point is often put forward for marketing reasons. However, what really matters is the degree of efficiency. Or even better, the assessment of the different efficiency curves that result from the different operating modes between which the UPS system can switch.

Basically, it should be ensured that the power supply system always works in the optimum range of its efficiency curve. With almost all modern "transformerless" UPS systems, the efficiency curve increases to approx. 30% of the output performance rises steeply and then runs relatively flat. In normal operation, an efficiency of > 95% is reached early on, but the optimal system efficiency (> 96%) is in a power range of 40% to 60%.

If you were to overdimension a system right from the start and therefore only operate it at about 30% of its possible output at the beginning, the loss of 1% mentioned in our equation above would already result.

PN: So you are counting on the so-called normal operation here. In your project with envia TEL you describe the SEOO mode of ENERTRONIC modular SE. In addition to the automatic shutdown of modules that are not required, is there also a difference in the efficiency curve?

Metzig: Yes, two things intertwine here. The system efficiency in SEOO mode, for example, is already 95.8% with an output power of 25%. If the UPS system manages to operate the entire system continuously in the optimal efficiency window by automatically switching modules on and off, the efficiency can be increased by about 3% compared to an initially overdimensioned system.

PN: But doesn't this advantage of 3% disappear when the data centre later reaches its maximum capacity?

Metzig: That's not entirely true, the advantage is only reduced. On the one hand, such an expansion process usually takes place over many years, on the other hand you have to consider that the loads in a data centre fluctuate very dynamically over the course of the day and week. With the SEOO operating mode, we ensure that, depending on the performance requirement, only the number of modules actually required is operated. In this way, we always stay within the ideal efficiency window. This accounts for a general efficiency advantage of about 2%.

PN: So basically simple maths, it seems to us. But let's now talk briefly about the maintenance and repair costs you mentioned at the beginning. What should an operator pay particular attention to here?

Metzig: All UPS systems consist of electrical and mechanical components that are subject to a limited useful life. In order for the power supply system to be able to ensure the required availability over an operating period of 10 – 20 years, regular maintenance and, if necessary, replacement of components is required.
If, as indicated before, a system that was inexpensive at the time of the initial investment may have lower quality components, the maintenance costs incurred during the planned service life will probably also be higher as the components have to be serviced or replaced more frequently.
Therefore, it makes sense to talk to your UPS supplier about the various maintenance options and the expected maintenance costs before you make your purchase. In addition, the operator should find out exactly what the proximity to the manufacturer's nearest service location looks like. The same applies when stocking spare parts, as the current situation is teaching us.

PN: Mr. Metzig, thank you very much for your clear explanations. Our takeaway from the conversation is that a system that is sized perfectly for the critical load from day one and can increase or decrease its performance according to the critical load guarantees the lowest TCO.
The initial investment cost of a system is not the only determining factor when it comes to TCO. Instead, energy efficiency and ongoing maintenance costs greatly affect the total cost of ownership of the system. Our conclusion: All three factors are equally important and must therefore be taken into consideration equally. ◻

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Fairs, events and exhibitions
2023

elektrotechnik
08.02. – 10.02. in Dortmund/Germany

PROMAT
20.03. – 23.03. in Chicago/USA

eltefa
28.03. – 30.03. in Stuttgart/Germany

RENEXPO INTERHYDRO
30.03. – 31.03. in Salzburg/Austria

LogiMAT
25.04. – 27.04. in Stuttgart/Germany

ELFACK
09.05. – 12.05. in Gothenburg/Sweden

MedtecLIVE
23.05. – 25.05. in Nuremberg/Germany

eltec
23.05. – 25.05. in Nuremberg/Germany

THE SMARTER E EUROPE/EES
14.06. – 16.06. in Munich/Germany

SPS
14.11. – 16.11. in Nuremberg/Germany

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