real.times

The Bachmann Customer Magazine 11 | 2023

OUR REALITY: COLLABORATION

TAKE ACTION. BUT MAKE IT REALISTIC. | COMPLETE RETROFIT SOLUTION FOR TURBINES
FUTURE-ORIENTED TRAINING VESSEL | SMART MAINTENANCE
MODERN MACHINE VISUALIZATION | FIRST-HAND KNOWLEDGE

Take action.

But make it realistic.

One of the techniques you learn in the world of work is that goals should be SMART. The European 135-Gigawatt expansion target for offshore wind energy is certainly Specific, Measurable, Achievable and Timely. But it is the R that poses a problem – a target like this must above all be Realistic. We have our doubts.

Germany's 30 GW share of the planned 135-Gigawatt expansion requires the construction of over 2,000 state-of-the-art wind turbines within the next seven years. But 2,000 new turbines also require foundations and about 100 specialized ships. The logistics involved are highly complex, involving significant onshore infrastructure including bridges, roads, warehouses and port facilities. But the detailed planning has only just begun. Without the estimated 25,000 full-time professionals that still need to be recruited and trained. Does this sound realistic?

We are trying to secure energy supplies and simultaneously stop climate change. That's the goal. That is where we agree. It is an immense task that our society can only solve together – this also seems to be a given. But I wonder how we can ever achieve it if the focus is only ever on each individual situation, and not the big picture. Whether this is intentional remains to be seen.

Overcoming a crisis requires more than just willingness to change. Discussion and words are all well and good. But we also have to take action. And we have to take it in a coordinated, targeted and cohesive manner. It also needs to be realistic.

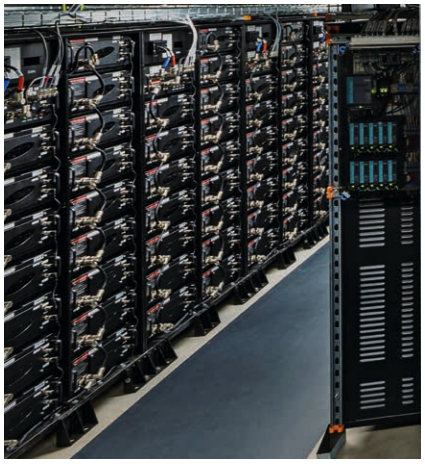
You might sometimes think that reality is multifaceted. But in fact, it isn't. There is only one reality. Everything else is wishful thinking. Or assumptions – often superficial, populist and without sound expertise. That's why we need to focus on reality. We need to communicate with one another to find achievable solutions – and get to work on them. As soon as possible.

In this issue of real.times, you will find our realistic solutions, as well as those implemented by our customers. Along with much more.

I wish you an exciting read.

Yours sincerely,

Bernhard Zangerl
CEO Bachmann electronic



MAIN THEME

ENERGY

MARITIME

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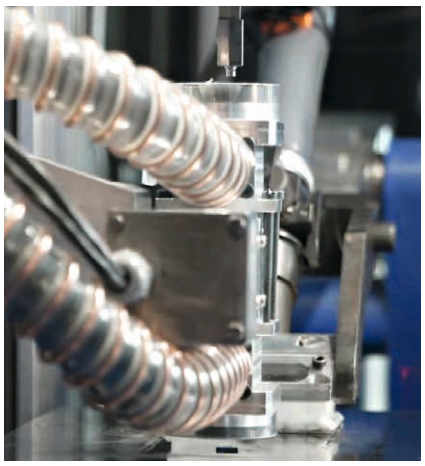


INDUSTRY

ENGINEERING

KNOWLEDGE

PRODUCT NEWS

Interview

FREEDOM. AND CONSENSUS.

Raw material shortages, trade conflicts, inflation. This is the reality that companies are currently facing. And that's not the end of it. Medium-sized companies are well positioned to face these challenges. For the most part at least. But maintaining this position is and will remain a Herculean task that can only be achieved with everyone working together. But our politicians are not exactly helping, says Bernhard Zangerl, CEO of Bachmann electronic.

We spoke to him to hear his thoughts.

» Shifting the focus to consensus, instead of confrontation, would be a big step in the right direction. «

Bernhard Zangerl
CEO Bachmann electronic GmbH

Mr. Zangerl, companies have to face reality. You say that to "survive", we need to collaborate. But that's not what's happening?

The interdependencies created by globalization have been strongly highlighted thanks to recent conflicts and political crises. It doesn't matter if we focus on secure energy supplies, the availability of components manufactured in Asia, or raw materials extracted in countries with questionable power structures. Many have suffered massively, and many still are. Everyone agrees that something needs to change. But I question whether our society is prepared to accept the consequences.

It seemed like the call for state intervention went out immediately – demands for subsidies, price caps on electricity, and so on. But that seems to me like the wrong approach. Where should these subsidies come from? After all, the state is nothing more than the sum of its people. We can't create prosperity by redistributing wealth that doesn't exist. In my opinion, society needs to wake up to this fact.

Industry, especially small- and medium-sized enterprises, are responsible for more than half of created value. And they need an environment in which they can be competitive internationally. This is the only way to secure national prosperity.

What are your predictions?

The fact is that for many years we have lived beyond our means. We have ignored reality. We have consumed more resources than the planet can regenerate, often without having the means to pay for what we have consumed. It is human nature to want more and more and need more and more. In our affluent society, we place a high value on material wealth; we want everything to be cheaper and better. But, in reality, there are natural limits: From raw materials to the availability of energy. And then there are problems like climate change, pollution, and more. We cannot ignore those either.

Global challenges, such as the recent pandemic, clearly highlight that our political systems are poorly positioned when it comes to the timely management of a crisis situation. These systems are an apparatus optimized to manage the status quo, where everything works in harmony; and they are sluggish and slow.

The flood of EU regulations, all of which make sense in theory, attests to this. In practice, however, they often equate to nothing more than a mountain of paperwork.

But society needs rules, doesn't it?

When it comes to the deeper meaning behind such rules, I agree. It's just the implementation, which usually means passing on responsibility to industry and businesses, that I find counterproductive. The direct impact of the rule itself is minimal, but there are significant knock-on effects for many companies and individuals. A good example is the General Data Protection Regulation. Or the Supply Chain Act. How can a medium-sized company control which raw materials are mined from where? And how can a medium-sized company dictate the buying behavior of its own suppliers? This is a utopian approach, and completely out of touch with today's reality.

Of course, it's true that we're bringing chip production back to Europe, which will solve bottlenecks and increase the resilience of our economy. But the reality is that this will take a very long time. And in the meantime, the world keeps on turning. In the future, we as a company will still be faced with the challenge of having to buy from the world's strongest suppliers. The alternative would be to remain competitive in Europe, but nowhere else. Politicians need to understand this reality. And the framework they build must take this into account.

If the common goal is to overcome a challenge, what are the 'steering mechanisms' that will lead us there?

If a rule is introduced and non-compliance punished, then people will find ways to avoid it. The familiar attempts at greenwashing, even for processes and products that are ecologically questionable, clearly demonstrate this phenomenon.

The EU is currently working on more than 160 new regulations. This is a further step towards complete over-bureaucratization, and there are no indications that this approach is slowing down – if anything it is gaining momentum. And that's why I am for a different approach – encouraging people to change their behavior on an individual level, rather than creating more regulations on political level. In other words, we need to answer the question of how individual citizens, or individual companies, can develop the will to act. For me, that is always the superior approach: incentivizing people to take action for themselves.

Cash is one steering mechanism. Making it expensive to consume a particular resource, or rewarding the creation of a valuable resource, can have a strong influence on behavior. At the same time, we can create a framework for both a fulfilling lifestyle and a successful economy. The two are ultimately interrelated.

At the same time, I completely oppose the idea that the state exists to solve every problem. I am convinced that companies, particularly medium-sized ones, are extremely robust, extraordinarily creative, and committed to managing crisis situations. Sometimes they just need a little more freedom. Obsessive overregulation is a hinderance to economic recovery and makes us weaker on the international stage.

And what can we do to change things?

Shifting the focus to consensus, instead of confrontation, would be a big step in the right direction. I think this is what moves society forwards. However, this requires a willingness to empathize, to compromise, and to reshape existing models.

This applies to the often antagonistic, uncooperative relationship between companies and trade unions. But it is also a major challenge when it comes to the generational transition within companies. I believe the solution lies in building a bridge between the invaluable experience of the past, on the one hand, and the forward-looking mindset of the next generation, on the other. Perhaps self-sacrifice will start to take on meaning once again. Nothing should be taken for granted just because it is there.

In any case, I am convinced that those who do not change will sooner or later find themselves backed into a corner. That's why we have to accept reality, adapt and adjust our habits accordingly, and ultimately shape a successful future. And we need to do it today. This applies to us as a company, and to us as a society. In that regard, I think that Bachmann electronic is making good progress already.

Thank you very much for the interview.

»It's good to talk, of course. But we also need to take action.«

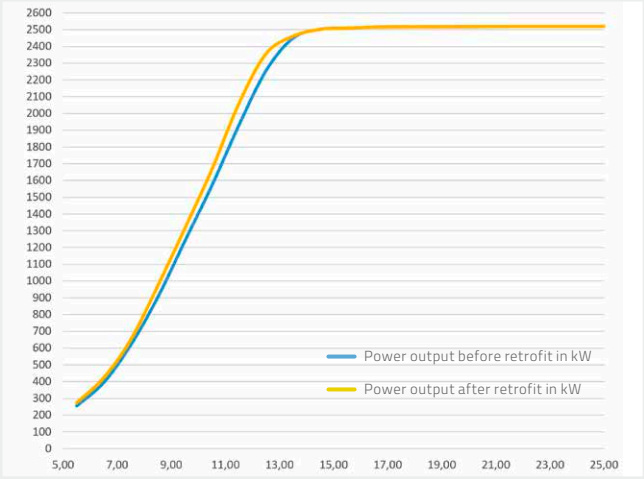
Often seen in the USA: Clipper plants. If, as in this case, spare parts are no longer available, then a control system retrofit extends service life and ensures necessary security levels.

Complete retrofit solution for turbines

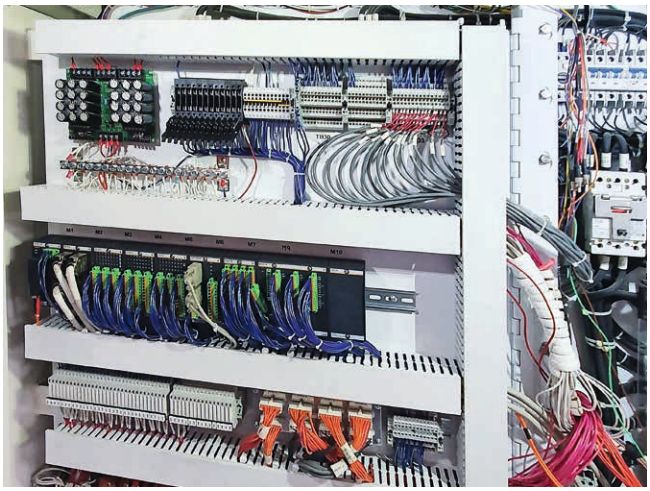
HIGHER YIELDS FROM THE OFFSET

3 days. This is the longest it takes to equip wind turbines for the future. The retrofitting of almost sixty Clipper Liberty 2.5 wind turbines with Bachmann's complete retrofit solution demonstrates just how quickly operators can increase yields while extending the service life of their plants.

The operation of older wind turbines (WTGs) is complex and expensive: failures increase and spare parts may no longer be available. System access and parameterization options are limited, as is adapting software to different types of spare parts, such as sensors. Optimizing operations is difficult, resulting in rising operating costs and declining revenues. Bachmann's complete retrofit solution is the answer.



3% more yield: The intelligent control algorithms behind the retrofit solution take the current condition of rotor blades into account. This increases the tip speed ratio (TSR). The result: up to 3% increase in annual energy production.



Moving into the future with ease: Thanks to the fully prepared, 1x1 m "swing panels", the retrofit solution is installed in no time at all. This ensures a safe, reproducible rollout of all systems.

Extended lifetime

Bachmann equipped 58 2.5 MW Clipper plants with a new, modular turbine controller. The turbines themselves are state-of-the-art but spare parts are no longer available due to manufacturer insolvency. The new control system facilitates longer service life. At the same time, spare part availability is secured for years to come. In addition, the solution enables the adjustment of turbine parameters, for example to reduce load on the turbine as it ages.

Higher transparency, lower downtime

The software has also been updated to the latest technology: M1 WebMI pro provides efficient, on-site turbine visualizations via any web browser, and Wind Power SCADA allows remote web-based turbine control and monitoring. Speed, pitch and power setpoint can be easily adjusted according to current wind loads and matched with grid capacity via the Smart Power Plant Controller. Furthermore, the wind tracking system and rotor brake can be manually controlled. Remote reset and self-start routines automatically restart turbine operations following any malfunctions.

Manageable maintenance

A fully integrated Condition Monitoring System for the entire drivetrain improves predictions about future turbine condition and optimizes O&M strategies. Visits to the site are thereby reduced. Transparent engineering tools improve efficiency during maintenance.

Rapid implementation

Installation and commissioning of the Clipper retrofits was completed in less than 72 hours. The pre-prepared control cabinet panels are partly to thank, facilitating a simple plug-and-play installation. This ensures a secure rollout of all turbines that can be implemented with minimal downtime.

Bachmann's intelligent installation app supports the install team with a quick, reliable implementation. Technicians are guided step by step through the installation and commissioning process, at the same time documenting their progress and creating an acceptance protocol.

Ready for the future

The efficient retrofit solution ensures the productive and fully compliant operation of existing wind turbines for many more years. Thanks to the flexible hardware concept, operators can expand the controller functions whenever they choose: Additional I/O channels are available, for example, for the integration of more sensors to realize sophisticated control algorithms and further optimize the power curve.

Watch the video of the rollout.

Smart Power Plant Controller

ELECTRIFYING VACATION ISLAND

Increasing from 1.1 GW of installed renewable energy capacity today to 6 GW by 2029: TERNA ENERGY has big ambitions in Greece. Some of this energy is supplied by 17 newly constructed wind farms on Euboea Island. 330 MW will be transported from there to the mainland via a submarine cable. The Smart Power Plant Controller (SPPC) delivers the required grid stability.

New dimension

Built by TERNA ENERGY, Kafireas wind farm is the largest in Greece to date. It includes a total of 101 wind turbines from Vestas and Enercon, which feed into the grid via three substations. These substations convert the voltage from 33 to 150 kV and are connected in star topology. Energy is transported to the city of Lavrio on the mainland, near Athens, via a 72-km submarine cable.

To ensure smooth operations in the future, the plant operator wanted to participate in the implementation and configuration of the grid control solution right from the outset: "We do a lot ourselves – from project planning based on long-term wind measurements, environmental studies and licensing, to the construction and maintenance of the plants. We accompany our projects throughout their entire life cycle," says Dimitrios Karadimos, Electrical Project Engineer at plant operator TERNA ENERGY.

The mountainous terrain made construction and on-site operations a challenge.

Clear decision

For the measurement, control, and protection of the grid, TERNA ENERGY chose the Smart Power Plant Controller from Bachmann. For Dimitrios, it was the obvious choice: "From day one of the collaboration, we recognized that Bachmann offers a solution with which we can co-determine the process and the project out-come. This is not a black box that will incur costs with every small change in the future." The project engineer knows that a solution with these advantages is extremely hard to find in the wind sector.

Positive previous experience with Bachmann retrofits, as well as the fact that Vestas also relies on Bachmann hardware in the installed power plant controllers, reinforced the decision.

Special situation

Each of the three substations has been equipped with a Smart Power Plant Controller, which regulates the connected wind farms. Marius Kaspar, Project Manager of the Smart Power Plant Controller at Bachmann, recalls the challenges during the planning phase: "One feature of this project is the distributed grid measurement at the main station in Evangelismos. The other two substations, in Omalies and Stavros, are not directly connected to the grid. They are merged on the busbar in the Evangelismos station, where energy is then fed into the grid. To correctly determine energy coming from wind parks that are directly connected to the Evangelismos site, we could not just measure at the grid connection point. Otherwise, we would have also incorporated energy from the other two substations." Therefore, the SPPC in Evangelismos separately measures the outputs of the two transformers in the substation with two GMP232 modules, and then aggregates the determined sizes.

3-step plan

TERNA ENERGY decided to carry out commissioning in three stages, gradually gaining more independence. The controller in Evangelismos was put into operation on site together with Bachmann experts. At the same time, TERNA ENERGY specialists received training in the applied systems and how to implement them efficiently. "The personal exchange was very helpful. This helped everyone involved to

Energy from the Evangelismos main substation is fed into the grid via a submarine cable. Total energy from all three substations converges here on a double busbar. To accurately determine the energy generated in Evangelismos, grid measurement is carried out using two GMP232 modules directly at the two transformers, before the busbars. Additional grid monitoring takes place at the other two substations, Omalies and Stavros.

» Thanks to the many supported protocols, the SPPC was easy to implement into our overall system. «

Dimitrios Karadimos
Electrical Project Engineer, Terna Energy

better understand the plant and the systems," says Dimitrios Karadimos, with confidence. At the Omalies station, Bachmann supported the commissioning carried out by TERNA ENERGY remotely. The operator then implemented the third controller in Stavros completely autonomously, with Bachmann providing only light assistance.

Certified operation

Thanks to the VDE-AR-N 4110 and 4120 certified SPPC, TERNA ENERGY operates the plant park in compliance with the applicable grid connection regulations for power generators. "In Greece, the grid operator prescribes German standards. For Bachmann, it was very easy to understand the requirements and provide us with the necessary documents. That was crucial," explains the project engineer. Moreover, thanks to the SPPC, TERNA ENERGY was able to do without a static VAR compensator for reactive power control. The long submarine cable creates a lot of electrical stress on the Evangelismos substation. With the Bachmann solution, TERNA ENERGY is nevertheless able to ensure an undisturbed energy flow and a stable grid operation. The reactive power can be precisely regulated, and the voltage within the TERNA ENERGY network can be controlled with the required accuracy.

Easy implementation, easy operation

It is important for the plant operator to be able to quickly understand and easily operate the applied systems. This is where the SPPC shines: "With its user-friendly interface, we can uniformly operate different technologies from many wind farms on Euboea." In addition, TERNA ENERGY places great value on the precise monitoring of its turbines. For this purpose, they rely on a higher-level data acquisition system. "The multiple protocols supported by Bachmann mean that every system speaks the same language, and allowed the SPPC to be easily implemented into our overall system." says the engineer, satisfied.

Secure future

TERNA ENERGY always uses the latest technology in their projects. An in-house IT department ensures the highest possible levels of cyber security for the critical infrastructure. "Bachmann's solutions offer many beneficial security features." The entire system is protected via TLS. In addition to encrypted access, user management has also been set up. All commands and parameters are precisely logged on the system for 18 months. This allows for precise analysis, even if the connection from the SCADA system to the controllers is temporarily interrupted.

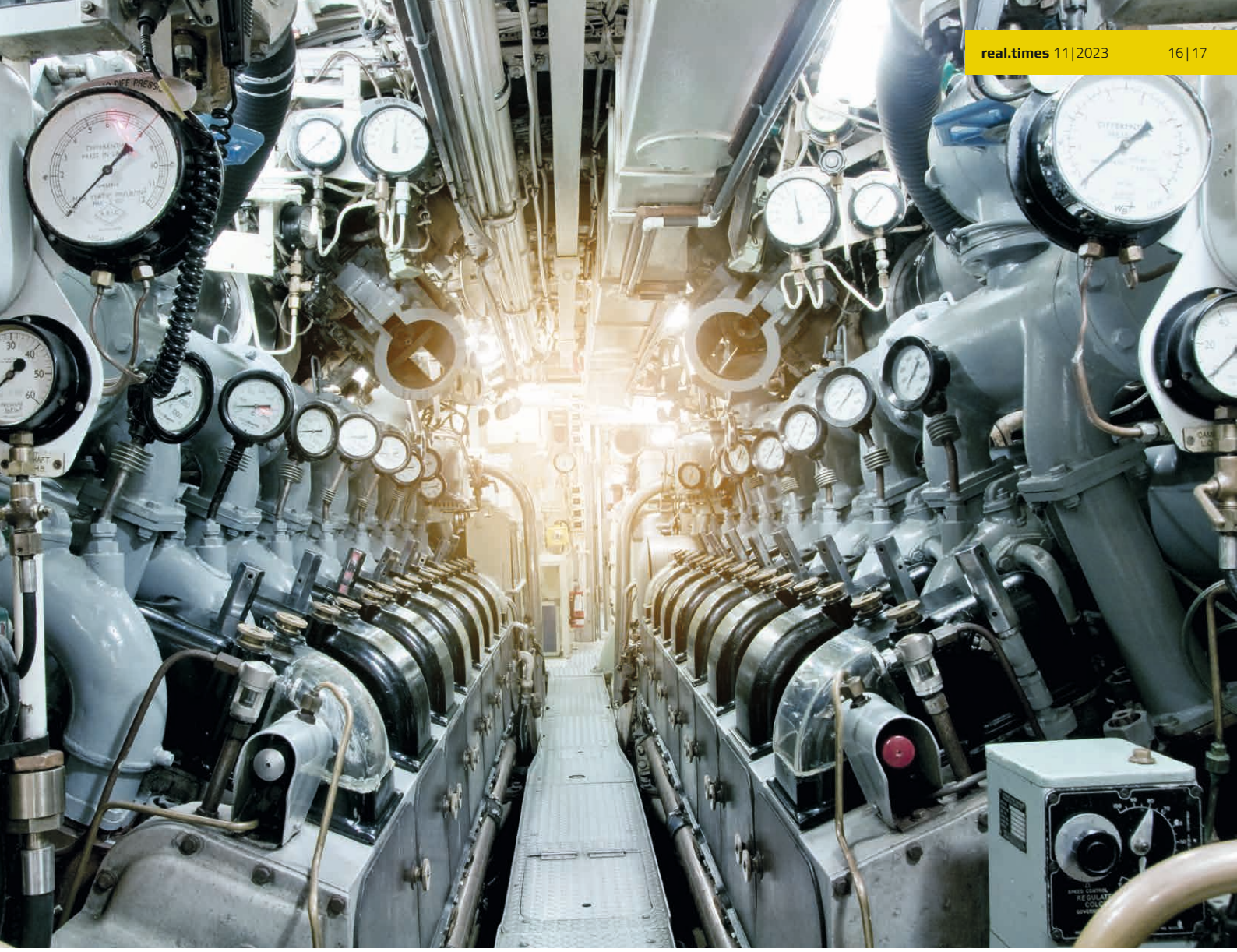
Ambitious goals

All tests with the grid operator are expected to be completed by the end of the year, whereby 330 MW will become available to the grid. TERNA ENERGY already has big plans for the future, including other renewable energy sources. These include photovoltaic systems as well as pumped storage projects. And to that, Dimitrios Karadimos simply says, "I don't think we have seen the last of our Bachmann colleagues."

TERNA ENERGY

- One of the leading energy suppliers in Greece
- Headquartered in Athens, Greece
- Diversified portfolio of exclusively renewable energies with focus on wind power

www.terna-energy.com



Emission-free shipping

ON COURSE TO THE ENGINE ROOM OF THE FUTURE

If it wants to achieve global climate targets , then the maritime sector must make the transition to clean energy. The EU has defined clear targets that support this. The Maritime Research Institute Nederland (MARIN) is researching solutions at its 'Zero Emissions Lab' (ZEL) and testing the engine rooms of the future.

» Raster's work is a real complement to ours because of their qualifications and expertise in the field of safety.«

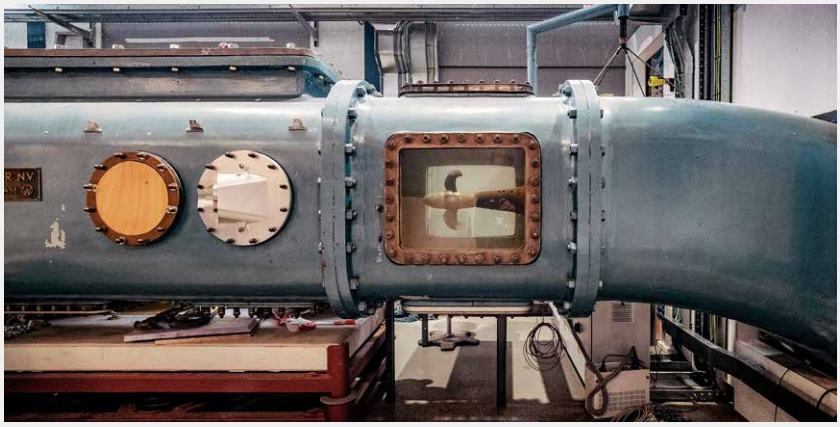
Joeri ten Napel
Key Account Manager, Bachmann electronic

RASTER INDUSTRIAL AUTOMATION

– System integrator for advanced production and process automation and functional safety systems

– A company of the ICT-Group based in Dreumel, The Netherlands

www.ict.eu/en/raster-industrial-automation



The cavitation tunnel propeller is driven by two motors on the ship's shaft system.

MARIN started working on the Zero Emissions Lab concept, a facility for configuring and testing the propulsion performance of climate-neutral or zero-emission ships, back in 2017. To plan and realize the ZEL, MARIN brought together maritime automation experts from Bachmann electronic and system integrator Raster Industrial Automation. Part of the ICT Group, Raster specializes in high-quality, functional safety systems and sophisticated production and process automation.

Overcoming technical limits

In the age of automation, the possibilities can seem limitless. Translating requests and requirements into technically feasible, safe and sustainable solutions was nevertheless challenging in this case. There was nothing comparable to ZEL, meaning no examples or empirical data. "Fortunately, Raster is great at even reinventing the wheel when they have to," says Joeri ten Napel, Key Account Manager at Bachmann electronic. "The team specializes in developing custom solutions."

Raster initially assisted MARIN by defining the safety requirements that were to be specified in the software. Then a system was developed that could integrate the energy and hydrodrive systems, and enable the realistic coupling of the drive hydrodynamics with the energy supply. Energy is distributed to the consumer loads via a 700-volt DC bus. All power source types can be connected to the DC bus, for example fuel cells, batteries, supercapacitors or generators. The supporting systems, such as the inverter and the transformer for the 400 V AC power supply, are also connected to the DC bus. Electric motors on the ship's shaft system, which drive a propeller in a cavitation tunnel, provide the connection to the hydrodynamics.

»Bachmann proved to be an excellent partner for this project. We received extensive support with determining the necessary adjustments to make the system technically feasible.«

Martijn Kooij
Managing Director, Raster Industrial Automation

Project meeting at MARIN's Zero Emisions Lab: Exchange between project partners (from left: Martijn Kooij (Raster Industrial Automation), Joeri ten Napel (Bachmann electronic), Rob van Rooijen (Raster Industrial Automation).

MARIN – MARITIME RESEARCH INSTITUTE NEDERLAND

– Leading institute for hydrodynamic research and maritime technology

– Located in Wageningen, The Netherlands

www.marin.nl

Software for energy source modeling

There is no space for additional hardware in the ZEL. To ensure flexibility for future test configurations, despite lack of space, one of three electric motors is specifically designed to emulate different combustion engines. Depending on the modeling, this can be used to simulate power generation from the use of various advanced fuels, such as compressed hydrogen or methanol. "MARIN can load models with different characteristics into the system, maintaining the necessary energy source flexibility," explains Rob van Rooijen, Senior Software Engineer at Raster.

Balancing flexibility and safety

The experts at Raster designed the system using the modularity of Bachmann's extensive product range.

The complex control topology in the ZEL comprises 17 CPUs from the Bachmann MC200 series. The main control system has a redundant design with four CPUs and a safety controller, which are located on the starboard and port sides of a ship. The current total of seven different consumer loads or energy sources each have their own controller.

Coordinating all these subsystems was a major challenge: "Raster did an excellent job of creating the flexibility MARIN wanted within the software architecture, which ensures both machine and process reliability," says Joeri ten Napel, Key Account Manager at Bachmann.

With this setup, with its Zero Emission Lab MARIN has created the optimal conditions for making informed decisions along the journey to zero-emissions shipping.

Innovative energy storage solutions

EXPANDING TOGETHER

Grow faster than the market. This is the goal set by innovative, Netherlands-based energy solutions manufacturer Alfen N.V. This goal also applies to its energy storage systems business unit. In addition to future-proof products, an efficient supply chain management process and reliable partners are also key requirements in order for the company to realize its ambitions.

For industrial applications with power greater than 1 MW, Alfen offers the modular expandable solution TheBattery Elements as an End-2-End solution, including local grid embedding and network integration.

Battery storage systems play a critical role in the efficient use of renewable energies. They perform tasks such as peak load management, balancing supply and demand for grid stability, and relieving the load on transmission and distribution grids. As a result, investment in the expansion of power grid infrastructure can be reduced. With the rapid growth of renewables, the energy storage solutions market is growing fast, and smart solutions are in high demand.

Innovative energy storage

Alfen's storage solutions are known for their performance and flexibility. They can easily be integrated into existing energy systems or infrastructures and adapted to customer needs. With the stationary energy storage system The-Battery Elements, Alfen offers an End-2-End solution for industrial applications. The system can be scaled up to several hundred megawatts using modular outdoor units

TheBattery Mobile X: The mobile storage solution from Alfen offers up to 720 kWh of energy and 270 kW of power packed into a 10-foot ISO standard container.

ALFEN N.V.

- Specialist in innovative energy solutions, including modular energy storage systems.
- Experience as a system integrator with a wide range of self-developed products
- Based in Almere, the Netherlands

alfen.com

or standard containers. For mobile applications, the battery storage system TheBattery Mobile X provides reliable energy. A custom-programmed intelligent software shows system performance and enables remote, real-time access to the energy storage solutions. The application also gives customers access to operations such as frequency control, load management, energy trading, and autonomous grid management.

When it comes to control system engineering, experts at Alfen rely on the reliable, robust products from Bachmann. In addition to the rapid M200 series processors, high-precision grid measurement and protection modules are also in use.

Challenging growth

From 2017 to 2022, the listed company recorded an average annual growth of more than 40%. And the company intends to grow further. Sales are predicted to rise to at least one billion Euros between 2025 and 2027. "For us, growth does not come as a surprise. We understand the market and have a good sense of how it will develop. The pipeline of qualified leads and order intake continues to develop in a healthy manner, making demand predictable," explains Jelle van Zalm, Strategic Buyer at Alfen.

Scalable supply chain

Such growth requires a well-designed purchasing process and close collaboration with suppliers. To avoid shortages, the energy storage manufacturer assesses demand monthly and coordinates directly with Bachmann. Bachmann can then react quickly to changes, even at short notice, and Alfen can be confident that their controllers for customer projects will always be delivered on time. "Despite our massive growth, and the global shortage of electronics, Bachmann has been a reliable partner, delivering all components on the agreed delivery dates." van Zalm summarizes.

» Despite our massive growth and the global electronics shortage. Bachmann has been a reliable partner, delivering all components on the agreed delivery dates. «

Jelle van Zalm
Strategic Buyer, Alfen N.V.

Successful retrofit

REJUVENATING A BATTERY STORAGE POWER PLANT

The plant's battery storage center.

When it was connected to the grid in 2014, the Schwerin-Lankow plant was the largest battery storage plant in Europe. Since its expansion in 2017, the plant has provided the energy market with 10 megawatts of primary control power, thus helping to stabilize the grid. After almost ten years of operation, plant operator WEMAG decided it was time for a makeover.

Retrofitting with existing plant technology

WEMAG places high demands on the system technology behind the plant. To prepare the battery storage plant for future technical developments, the company decided to overhaul the IT systems, including the associated infrastructure, as well as all controlling, monitoring and operating software. However, the company wanted to keep as much of the plant architecture as possible: batteries, inverters, transformers and medium-voltage switchgear were to remain untouched. The operators brought in experts from SCADA-Automation to carry out this task. The Brandenburg-based company, with offices in Berlin, specializes in automation technology for battery storage systems.

Future-oriented development

When it came to the design of the new plant control system, as well as the power plant control station, WEMAG's ideas were very specific: In order to create a uniform base for every battery system in the company portfolio, the SCADA-Automation team had to use the existing battery storage systems (WBS) solutions, previously developed for WEMAG, as a foundation. They were already working with Bachmann controllers. "Our experience working with WEMAG on other projects was of course an advantage here. With Bachmann systems, it was also possible for us to efficiently develop a customized control solution for the battery storage systems," Jens Ramlow explains.

Reliable hardware

Before the retrofit, the power plant was operated with a soft PLC program. SCADA-Automation focuses on maximum availability and stability, so the existing server-heavy control system was converted to a hardware-based solution. "Bachmann products enable us to build on future-proof and standard-compliant industrial communication technologies, simplifying operations and supporting a wide tempera-

»The availability Bachmann delivers is really worth highlighting. When you ask for something, it's there on time – including the hardware. We don't take that for granted.«

Jens Ramlow
Founder and Managing Director of SCADA-Automation

ture and voltage range. Cooling can also be dispensed with, as can a high-maintenance software package," says Jens Ramlow, explaining the SCADA automation approach. Control of the Lankow power plant's battery inverter units was developed on the M200 control system with the MX220 CPU. Different control logics were programmed for three different battery-inverter combinations.

Certified plant control

The power plant is controlled by the Bachmann Smart Power Plant Controller, which is certified in accordance with VDE-AR-N-4110/4120. A redundant operating solution, which features two MC212 processor modules and one SPPC, was developed together with Bachmann. This solution ensures a reliable supply of primary control energy. The GMP232 module is still used for precise frequency measurement. In order to map the specific requirements of the Schwerin-Lankow battery storage power plant, SCADA-Automation has extended the plant controller with its own software modules, including for grid formation in island mode, or for power and marketing distribution.

Renewal during operation

The operator wanted to keep plant downtime to a minimum, so SCADA-Automation individually tested all 18 battery inverter units in advance while they were operating. This made commissioning the new control and operating platform of the Schwerin-Lankow battery storage power plant highly efficient. The plant went back online after just one week. A successful retrofitting story for everyone involved.

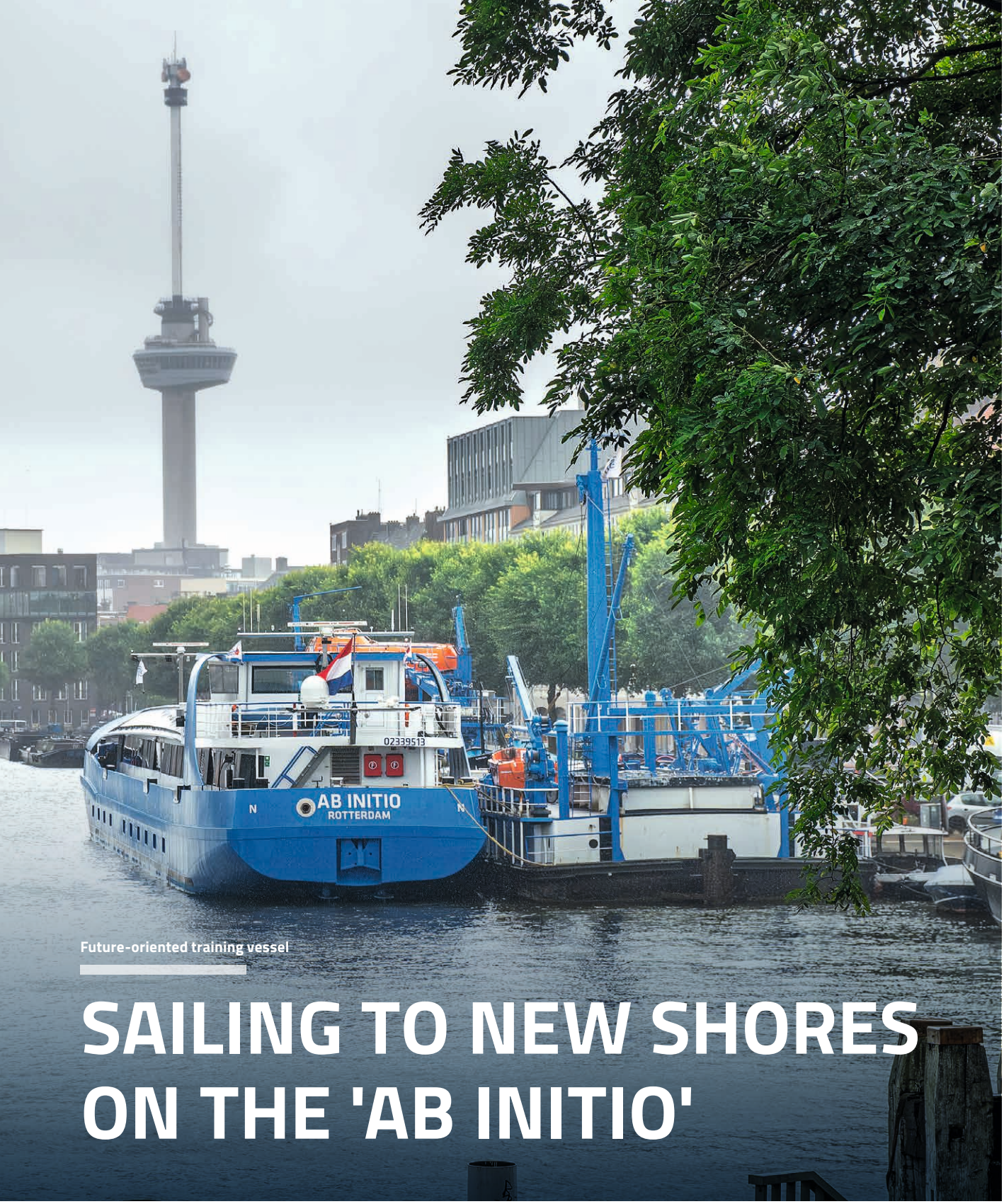
WEMAG's battery storage power plant in Schwerin-Lankow.

SCADA-AUTOMATION

– System integrator for control system and automation solutions in industrial plants for power generation and production as well as energy management for businesses

– Based in Brandenburg, Germany, offices in Berlin

www.scada-automation.com



Future-oriented training vessel

SAILING TO NEW SHORES ON THE 'AB INITIO'

The AB INITIO has been operating as the STC Group's new training vessel in Rotterdam port since fall 2022. This state-of-the-art inland vessel is considered a prime example of sustainable ship design. Recyclable materials were used during construction, the hybrid propulsion system is prepared for future fuel types, and part of the energy for passenger operation is generated from solar power. This exceptional project was made possible thanks to the contribution of many different partners.

Futuristic and modern

With a length of 67 meters and width of 8.2 meters, the AB INITIO not only provides accommodation and communal space for 39 passengers, but also houses an innovative field laboratory for the exploration of new technologies in the maritime sector. The futuristic-looking design was developed and tested together with students. Thanks to 200 m² of solar paneling, the AB INITIO can generate its own energy. The ship is powered by an electric motor, with power currently supplied by two diesel generators and on-board batteries. The batteries can be recharged by the generators, or in the port via a corresponding charging system, allowing the AB INITIO to cover short distances without any emissions whatsoever.

The AB INITIO bridge: After clearance by the captain, students can also observe the controls from ashore.

Reliable technology

Oechies Elektroniek, Rotterdam-based pioneer in the field of electric drive technology in inland shipping, was enlisted for the planning and installation of the electric propulsion, as well as the control and automation of the technical systems. Oechies addressed the AB INITIO's complex energy management the with the help of Bachmann's compact and environmentally robust M200 controllers.

For operation and monitoring, browser-based M1 webMI software is directly integrated on the controller. This allows for the safe visual remote access demanded by the STC Group. As a result, students in the classroom have the exact same view as the captain on the bridge.

Alternative hydrogen

When the ship was designed in 2018, diesel-electric hybrid propulsion was one of the most advanced alternatives to the traditional diesel engine. However, the AB INITIO needed to be prepared for innovation in the field of emission-free fuels. Straightforward generator replacement or the addition of new technologies was therefore taken into account during vessel construction. Currently, experts from Oechies and the STC Group are working together to install a 45 kW hydrogen fuel cell to increase the range during emission-free operation.

Challenging approval process

Hydrogen is already being successfully used as an alternative fuel on transport ships. However, there is not yet a standardized approval process for use on passenger ships like the AB INITIO. Instead, it requires a rather complex EU exception approval procedure. "We hope to complete this procedure by the end of 2023," says Bram van Hengel, Commercial Technician at Oechies Electrotechniek.

Technologies for tomorrow

With the STC Group's AB INITIO, trainees in the maritime sector have an attractive, sustainable, and future-proof ship packed with the latest technology. For companies, the on-board research laboratory offers ideal conditions to equip the maritime industry for the future.

More about the project.

OECHIES ELEKTROTECHNIEK

– Installation company specializing in the electrification of the propulsion of inland vessels.

– Manages the design and installation of complete electrical systems for new ships and modernizations.

– Based in Rotterdam, The Netherlands

www.oechies.nl

Reducing emissions

CANOPÉE TRANSPORTER SAILS INTO THE FUTURE OF MARITIME

As a state-of-the-art transport vessel, the Canopée has been specially designed to transport rockets, components and satellites for the European Space Agency (ESA). In future, it will transport all parts of the Ariane 6 launcher from Europe to the spaceport in French Guiana. The ESA specifications for the ship's construction were challenging on many levels.

Much emphasis was placed on the freighter's design in order to ensure that all parts of the rocket could be transported in a single trip, and that the sensitive cargo would arrive safely at the spaceport in French Guiana. The Canopée therefore needed to be able to navigate the narrow and shallow Kourou River. In addition, the ship had to be equipped with the most modern technologies for an emission-free and economical journey.

Pioneering transport ship

The result is a 121-meter-long and 22-meter-wide transport ship with a river draught of only 3.80 meters. What makes the Canopée so special, however, are the four electrically adjustable and retractable articulated wings, each 363 m2 in size, which act as sails. These contribute significantly to the reduction of fuel consumption and harmful emissions. In addition to sail propulsion, the ship is also equipped with diesel engines.

Certified hardware

The Canopée's electrical installations, energy management system and engine room alarm system were developed by Netherlands-based C-Systems B.V. This young and dynamic company specializes in the implementation of intelligent control and software systems in shipbuilding, among other applications. Robust Bachmann processor modules from the M200 series, certified for maritime use, are an important part of the C-System development.

Simple redundancy

OPC UA-based software atvise® scada acts as a combined SCADA system and HMI. The simple redundancy setup and the atvise® connect communication interfaces played an influencing role. "With just a few clicks, we were able to configure a fully redundant system with intelligent data management. Due to the existing interfaces, it was easily possible to securely integrate additional ship systems without any problems. This was very impressive and saved us a lot of time," explains Jeroen Nobel, Lead engineer at C-Systems.

Complex alarm system

In total, there are around 1,200 alarm points on the transport vessel and up to 600 recorded data points. In addition to analyzing real-time data, a number of trend alarms have also been implemented. In this case, the system checks a parameter's current value and compares it with the historical trend. To do this, the system needs data covering a previous time period. However, storage space on a ship is usually limited. "The challenge

was to minimize stored data without losing actuality and accuracy," says Nobel. "With the alarm system we developed, we can store data for 12 months," he continues.

Reliable partner

Construction of the Canopée was on a tight schedule. It was therefore important for C-Systems to have a reliable partner on side. "We knew Bachmann from other projects. The products and support are excellent and the delivery times unbeatable. That's why we chose Bachmann," explains Arco Boon, Managing Director at C-Systems.

The Canopée has successfully completed its first transatlantic crossings – albeit without sails. However, the installation of the so-called 'wing sails' is already in full swing and is expected to be completed in autumn 2023. This is truly an enormous step forward towards zero-emission shipping.

C-SYSTEMS B.V.

– Specialized in the development and supply of complete electrical and hydraulic controls for all kind of vessels such as offshore vessel, dredging vessels or inland tankers.

– Based in Hardinxveld-Giessendam, The Netherlands

www.c-systems.nl

Ariane 6 on board: The transport ship Canopée on its way to the ESA spaceport Kourou in French Guiana

atvise® scada

SAFE PASSAGE

The construction of the Cuxhaven sea lock in the 1960s provided access to a new fishing port. The aim was to protect the harbor from ocean tides. At the same time, the connected lock system protects both port and city from storm surges. The operating technology was completely replaced in 2022 – with atvise® scada from Bachmann.

The Cuxhaven sea lock is 190 meters long, 24 meters wide and 9 meters deep. The facility has three lock gates, one each in the outer, middle and inland sections. The special feature here is that both the upper and lower lock gates also function as bridges for road traffic. To open the gates, the bridges are raised and the lock gate slides underneath the road – a spectacular feature that has attracted thousands of visitors over recent decades. In addition to shipping traffic, the lock keeper must also monitor civilian traffic, which is made possible with the help of sophisticated video surveillance.

Future proof control

Due to its role in flood protection, the Cuxhaven sea lock is defined as critical infrastructure. In order to maintain operational safety, particularly against a background of constantly increasing traffic, the control system had to be replaced. Spare parts were no longer available and operator Niedersachsen Ports faced various challenges. Firstly, the main control station had to be connected redundantly in accordance with the latest safety standards. The system is connected by fiber optics and located a few kilometers away at the harbor master's office. One server is located there, a second one is installed at the lock tower in the second (emergency) control station. At the same time, the new solution had to be able to integrate the existing lock technology, as well as numerous surveillance cameras.

Safety first

So, they were in need of a future-proof SCADA solution that could be designed redundantly and worked via the web. "The redundant system design was our first priority, because the lock has to function at all times in the event of an impending flood," says Jürgen Höpcke, Technology Project Manager at Niedersachsen Ports. Due to its critical status, the lock can always be closed in an emergency, even by hand: "If the control or visualization system goes down, then we can go to the control station in the lock tower and bypass the PLC manually," explains Höpcke. "If that doesn't work, then, as a last resort, we can throw a belt on the drive and connect the motor directly to the lock mechanics." At that moment, only one thing matters: Closing the gates, no matter what, to secure the port and facilities behind it.

Modern meets antique

Another challenge was to combine the existing drive technology, which is over 60 years old, with modern operating logic. The door operators are controlled by a Ward-Leonard system. This electric motor speed control is an old but extremely robust and stable technology. Replacing it would be extremely costly, and would also involve shutting down operations. In addition to the electrical components, the drivetrains on both gates would have to be replaced.

Comprehensive risk assessment

Despite the demand for economic efficiency, the top priority was and is system safety and reliability. "The risk assessment and coordination of the entire sys-tem was carried out in accordance with the Machinery Directive 2006/42/EC and with a correspon-ding Failure Mode and Effects Analysis (FMEA)," explains Jan Block from HIT Hafen- und Industrietechnik, the project's system integrator. Each gate therefore has its own fail-safe control system and can be operat-ed completely autonomously.

Familiar operation

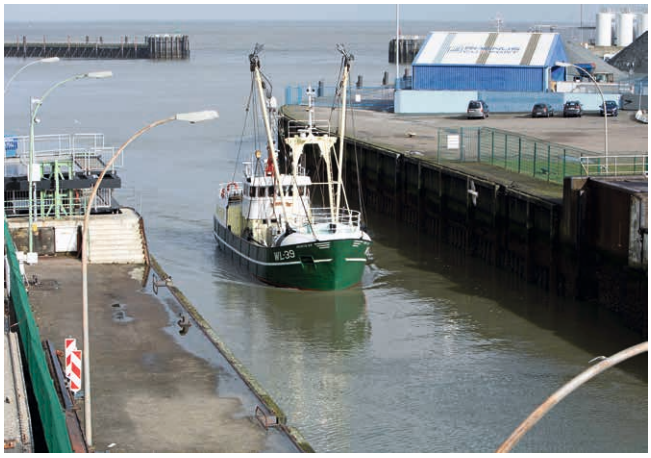
Security issues were also a top priority in the operating technology. Therefore, operation from outside the company network was deliberately excluded: "It's about cyber security, but it's just as much about availability and operability, which can't be guaranteed with an ex-ternal workstation," says Jürgen Höpcke.

The implemented SCADA system was based on atvise® from Bachmann, which really shows its strengths here: "There are several points of operation within the facility that require a visualization of the lock. This is much easier with pure web technology, and it is also equipped for the future," says Jens Schürmann, owner of the engineering office JSEngineering, which planned and implemented the system. "In addition, atvise® delivers a strong database platform, making it easier for us to carry out the necessary operational data logging." Schürmann was impressed by the openness of atvise®, which enabled him to base the user interfaces very closely on previous versions: "This not only increases operator acceptance of the new solution, but also definitely improves safety. A familiar environment is of great help in a stressful situation."

More than expected

"I think we did a good job," says Jürgen Höpcke. "We have a future-proof platform that we could get familiar with very quickly. Every participant had the flexibility to respond to requests throughout the project. This allowed us to make some additional gains, for example with new displays that we could not visualize at all in the old control panel view. And we found that any problems were solved extremely quickly."

The Cuxhaven sea lock control room: Several operators can work simultaneously thanks to atvise® web technology.



A ship entering the Cuxhaven sea lock.

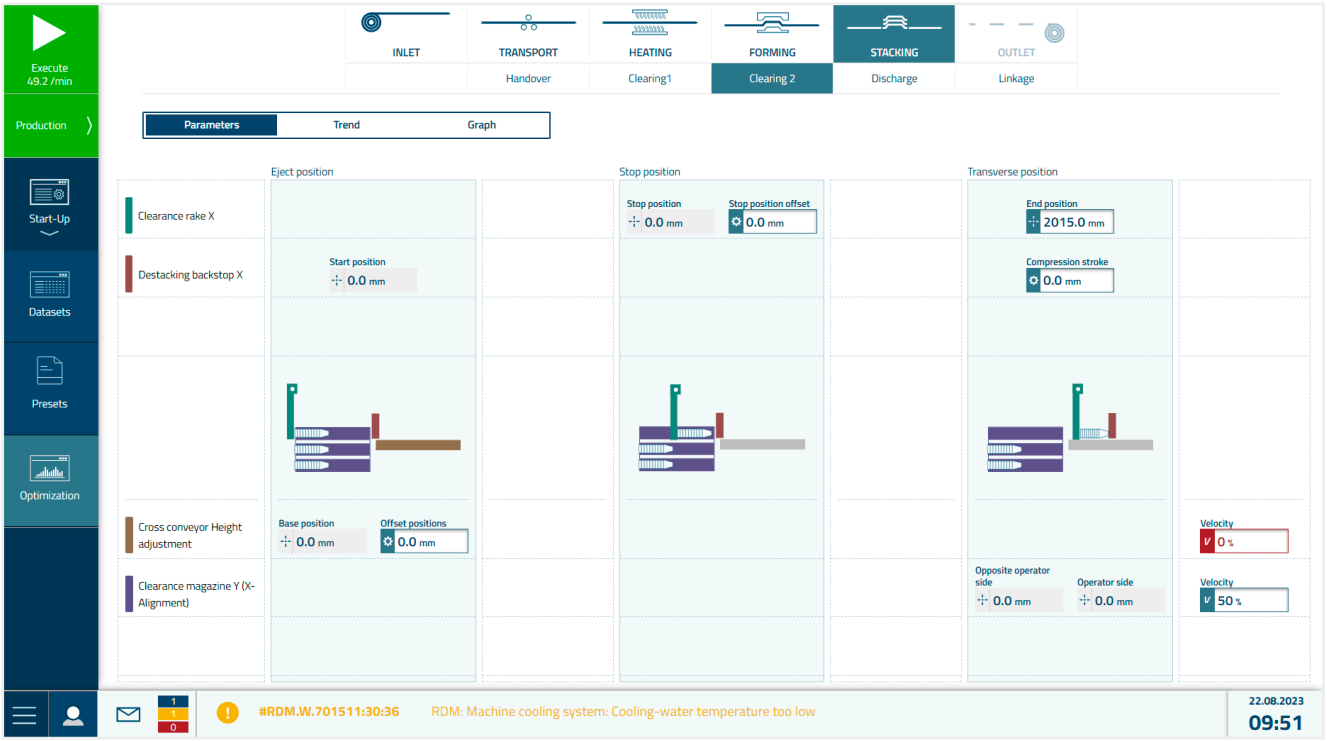
NIEDERSACHSEN PORTS

– Largest operator of public sea ports in Germany

– 15 ports, 27.3 million tons of cargo handled (2022)

– Around 660 employees

www.nports.de



New operating software 'ILLIG EasyTOUCH' offers intuitive user interface during the operation of thermoforming and packaging machines.

Modern machine visualization

FLEXIBLE OPERATING SOFTWARE FOR HIGHER USER-FRIENDLINESS

When it comes to improving industrial productivity, efficiency and safety, machine visualizations have an important role to play. Attractively designed and intuitive user interfaces are increasingly replacing purely technical developments. Illig Maschinenbau GmbH & Co KG, the global leading manufacturer of thermoforming and packaging systems, rose to this challenge and began to fundamentally readdress the visualization concept of its machines.

Illig kicked off this technically challenging project at the start of 2022. But their experts had already put a lot of thought into restructuring the numerous functions and operating modes of their machines. One major goal was to increase system user-friendliness with smooth human-machine interaction. Another important concern was to simplify the internal visualization configuration for the machines' various technical features and options. Another requirement was for easier integration of existing plants into the customer value chain.

Open visualization software

Illig started an extensive evaluation process in search of the ideal software. The product had to be scalable and flexible – to be able to react quickly to future requirements. Their experts paid particular attention to a web-based implementation, expandability, openness to third-party systems, and the scope of included functions. "We evaluated several solutions. In the end, Bachmann's OPC UA-based web visualization solution atvise®, with its open system architecture, was what convinced us," says Dr. Andreas Moser, Head of Software Development at Illig.

Flexible construction kit

atvise® open interfaces also enable the simple integration of various UI frameworks; a crucial point in this case. "By including React as a framework, we were able to decouple the machine logic from the software's business logic, meaning that high-level language developers can also be involved in programming the visualization," explains Dr. Moser. The advantage: Programmers do not need to know anything about the machines, or the controllers, and the usual training was not necessary.

Finally, configuration files for the various technical features of the machines are simply transferred to atvise® software via an import/export function, or read from there. Linking components and the connection to the control system takes place in atvise®. "When the machines are delivered, the only visualizations on display are those that are relevant for each respective machine," says the development manager.

Uniform operating concept

During the development of new operating software ILLIG EasyTOUCH, emphasis was placed on simplifying the operation of every Illig machine. The user interface now reflects the different applications required by operating personnel. Thus, there are different menus for production employees, machine equipment operators, or maintenance personnel. Users are shown individually relevant information as soon as they log in. The necessary authorizations and role definitions were implemented using atvise® standard functions, and they can be easily extended and adapted by the customer. The atvise® OPC UA interface also allows individual customer needs to be quickly addressed. Third-party systems and machines can therefore be quickly integrated into Illig's operating concept.

Ambitious schedule

The project schedule was very ambitious. There were just four months between the kickoff at the beginning of 2022 and the presentation of the first functioning prototype. In the meantime, every component for the construction kit is available. "With our software concept, different developers can work on several levels simultaneously. Each team member can concentrate on his or her individual field. This enabled us to keep to the schedule," says Dr. Moser. "Support from Bachmann experts during the atvise® programming, and their quick response to questions and necessary extensions, was also very helpful."

Illig is now working at full speed on visualizing the internal machine configuration in atvise® for up to 60 options per machine family. All Illig machines are to be delivered with the new ILLIG EasyTOUCH operating software and hardware as early as 2024. In the future, operating personnel will be able to operate any and every Illig machine without additional training.

ILLIG GROUP

– Leading global supplier of thermoforming and packaging systems as well as mold systems for carton board, paper and plastics

– Headquarters in Heilbronn, Germany

www.illig.de

M-CNC

NOT ONE SPECK OF DUST

Used as cutting materials in machining technology, indexable inserts are tool parts pressed from carbide powder. They are manufactured by powder presses and fully integrated production cells, such as the FlexCell from Dorst Technologies. The productivity and quality delivered by these systems is unmatched. Bachmann's M-CNC software module has a central role to play.

Small carbide parts that are required in large quantities, such as indexable inserts, are manufactured in high-performance automatic presses and integrated production cells from Dorst Technologies. During this process, metal powder is pressed into the required shape under high pressure. Part geometries differ depending on the application and contours must be accurate to the micrometer.

Highest precision. For every single part.

Dorst Technologies, based in Kochel am See (DE), is the leading international provider of powder presses. When it comes to process efficiency, flexibility and, above all, precision, they are the strongest player in the market. For Dorst developers, every single, small detail counts: "Cleaning the press plungers is a major factor for repeated high quality and low tool wear – it has to be perfect," explains Peter Blankenhagen, Head of Development at Dorst. After a certain number of pressings, powder dust accumulates and must be removed. The big challenge is minimal interruption of the press process. This is the only way to achieve a high output rate. Nevertheless, cleaning the punches, some of which have complex shapes, must be executed without any remaining residue.

Perfection. Even while cleaning.

Within the FlexCell integrated production cell, cleaning is undertaken by a fully integrated handling unit. It guides the brushes and suction devices along the press tools throughout the cleaning process. This is where experts at Dorst saw considerable room for improvement: "Standard systems move the brushes along simple circular or rectangular paths around the tool components," says Thomas Seidl, Head of Applications at Dorst, describing their limitations. The goal with the new FlexCell was unrestricted movement of the rotating brushes within a three-dimensional space, as well as being able to accurately follow the contours of even the most complicated shapes.

The integrated brushes clean any shape, no matter how complex, close to the contour, removing a powder residue from the pressing area.

FlexCell16: The fully integrated production cells from Dorst feature an innovative cleaning system that guarantees the perfect press every time.

M-CNC: THE READY-TO-USE CNC SOLUTION

M-CNC is a path movement software module with Cartesian 3-axis system in three-dimensional space. M-CNC calculates the resulting path profiles of the three individual axes from the path to be traversed, which is specified according to DIN 66025. It takes into account achievable velocities, accelerations and decelerations.

Target positions can be specified by a loaded CNC program or via the CNC monitor. Its commissioning interface allows for complete parameterization and manual operation of the M-CNC software module.

In conjunction with Bachmann electronic, he considered how this goal could be achieved. "And in such a way that plant operators could define cleaning paths simply and store them with the press programs," says Thomas Seidl, describing one of the specifications. The collaboration with Bachmann is a close one, as confirmed by Peter Blankenhagen. The two parties meet, exchange ideas, and always find ways to further optimize plants through the interaction of Dorst technologies and the possibilities of the Bachmann M200 controller – making them even more user-friendly.

Customized. And fast.

Bachmann was commissioned to develop a suitable application and prepare it for serial production. The application would have to meet the specifications from Dorst for the tool cleaner upgrade. Bertram Gohm, application engineer at Bachmann electronic, took on this task: "The application uses the M-CNC software module, which defines the motion axes path profiles for part removal." In the cleaning program, customers can now create a separate CNC file for every level to be cleaned. During the cleaning process, the profiles are then traversed in a defined sequence. "One of the great advantages here is that the operator can create or adapt the CNC program in a familiar programming environment – and the machine understands it," adds Bertram Gohm.

For Dorst, the collaboration turned out perfectly, as Thomas Seidl is happy to confirm: "It was only the second iteration of the application developed by Bachmann that we chose to release." This was made possible through close cooperation with his Bachmann counterpart: "Bachmann promptly implemented our requirements while we were testing the development version." The application was ready for serial production within less than two months; the source code was handed over to Dorst – and implemented on the machine controller.

Ahead of the competition.

Dorst FlexCell production systems already benefit from unsurpassed functionality and precision. The machines not only deposit pressed parts more accurately than comparable systems on the market, they also produce higher part quality with less tool wear. This is because they can remove even the last speck of unwanted dust from the presses. "The development of the tool cleaner was a showcase project for me," adds Peter Blankenhagen.

DORST TECHNOLOGIES

– Founded in 1860, headquarters in Kochel am See, Germany

– Internationally leading machine supplier for the manufacture of ceramic and powder metallurgical products

www.dorst-technologies.com

Automated marine gearbox

MORE COMFORT, HIGHER SAFETY

Directional changes put a particular strain on traditional hydraulic-actuated marine transmissions: Gear changes are abrupt as rotating masses must accelerate in the opposite direction within a short period of time. With Bachmann's support, REINTJES GmbH, based in Hameln, Germany, has developed an automated marine reverse transmission that precisely regulates hydraulic pressure on the clutch plates and facilitates smooth gear shifting.

REINTJES GMBH

– Founded in 1879, based in Hameln, Germany

– Internationally active group of companies

– Over 500 employees worldwide

– Product portfolio includes marine and industrial gear units and related services

www.reintjes-gears.de

The challenge lies in the fact that conventional, hydraulic-actuated marine transmission clutches are subject to various external factors. These include, for example, ambient temperature, which also determines oil viscosity in the hydraulics, as well as mechanical elements that are subject to wear and system-related inertias. This makes it impossible to exactly reproduce the bite point. The result: shocks during gear shifting that stress both the transmission and the entire driveline.

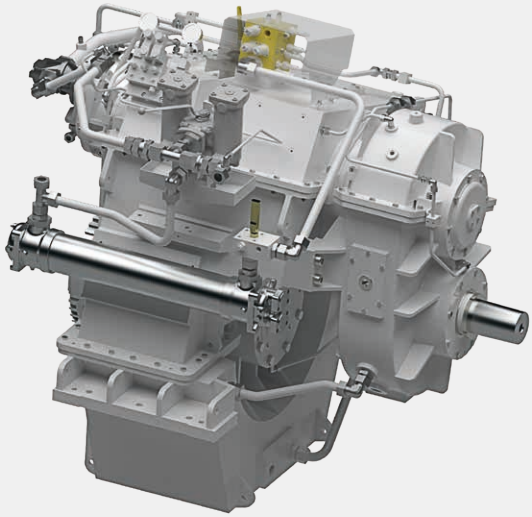
Technological progress

REINTJES is taking an innovative new approach: The classic hydraulic shift components have been minimized, and the clutch control implemented with proportional valves. This eliminates inherent variable inertias, and the bite point can be approached precisely and with repeated accuracy. Based on Bachmann's M200 control system, REINTJES developed the 'Gearbox-Automation (GBX-A)', a modular system that automatically optimizes the coupling process, thus enabling a more protective mode of operation.

How the control lever is operated – in simple terms, whether it is moved quickly or more moderately – determines the shift characteristics automatically selected by the GBX-A. This kind of situational gear shifting has the advantage that, during normal operations, it is the only way to maximize smooth engagement of the clutch – that is also gentle on the transmission. "In dangerous situations, of course, the clutch is engaged without delay, which won't immediately damage the system, but is not system-friendly – you wouldn't want to drive like that every day," explains Norman Klippel, Technical Subproject Manager Automation at REINTJES.

Perfectly customizable and easy to handle

The GBX-A has a modular design and can be configured via predefined parameters. The Bachmann OT1200 terminal can be used to activate or deactivate any functions, as well as to adjust parameterization, without specialist programming knowledge. Thanks to an integrated calibration function, the clutch control can be perfectly adapted to any drivetrain. Recalibration is automatic, and current clutch status is visualized on the GBX-A terminal.



REINTJES' 'Gearbox-Automation (GBX-A)' is a stand-alone marine gearbox clutch control system. It communicates with the ship's control system via a fieldbus.

The REINTJES system also logs historical data on request, paving the way for condition monitoring and the development of an optimized maintenance strategy. For example, gear changes can be analyzed and compared within the same fleet to optimize vessel operation and maintenance schedules.

Exactly as required

REINTJES uses Bachmann's proportional valve amplifier, the PVA204, which can connect up to four coils, to control the proportional valves. Due to current control, any change in valve coil temperature will not influence the valve position. Up to 20 interpolation points are available for characteristic curve correction per coil, which enables highly accurate linearization. "For the perfect component fit, we needed to adapt the PVA module firmware. And Bachmann took care of it for us," says Norman Klippel.

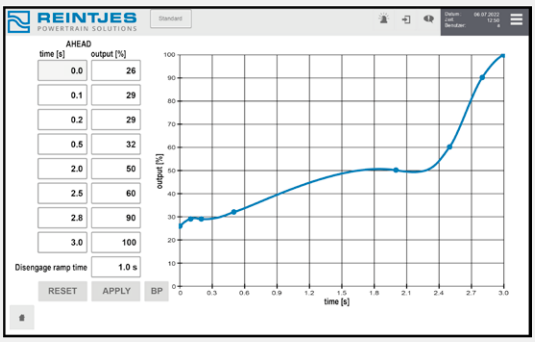
The PVA204 and PVA208 modules allow direct control of four or eight proportional valves, without amplifiers, with one coil, bipolar or with dual coils.

Six classifications covered

Compared with conventional shipbuilding, the REINTJES system is unique because it covers the five largest classifications: Bureau Veritas (BV), Lloyd's Register of Shipping (LR), American Bureau of Shipping (ABS), Det Norske Veritas (DNV) and Registro Italiano Navale (RINA). "A major advantage for us was that the Bachmann system components already had all the necessary certifications in the maritime sector," says the REINTJES sub-project manager.

The transmission of the future

The GBX-A does not simply increase transmission control system automation. It also significantly contributes to an increase in ship availability and a reduction of lifecycle costs. Gentle shifting extends the service life of the entire drivetrain, while condition monitoring enables targeted maintenance and reduces downtime in the shipyard.



The GBX-A detects maneuver type, based on operation of the control lever, and automatically selects optimum gear shifting. During normal operations, this enables the gentlest possible clutch engagement for the transmission.

»We shouldn't take anything for granted.«

OpenBridge 5.0, the latest edition of the world's only open-source maritime design system.

Safe and energy-efficient shipping

OPEN ZERO

INTUITIVE USER INTERFACES FOR ENVIRONMENTALLY FRIENDLY TECHNOLOGIES

Environmentally friendly shipping is developing rapidly: voyage optimization systems; hybrid, electric and battery systems; low-emission fuels; and wind- and wave-assisted propulsion systems are finding their way onto more and more ships. This is exhausting for crews, who must be able to deal with a multitude of different systems and acquire cross-contextual knowledge. Clear and standardized user interfaces are of vital importance for crew members to continue to make energy-conscious and safe decisions.

Bachmann is an active member of the "OpenZero" research project, which is currently creating the world's first open UI design system for environmental technology in the maritime sector. OpenZero builds on open-source design guideline "OpenBridge", which is used to design next-generation maritime workplaces that will ease the burden on bridge crew during day-to-day operations. Bachmann has contributed from the very beginning.

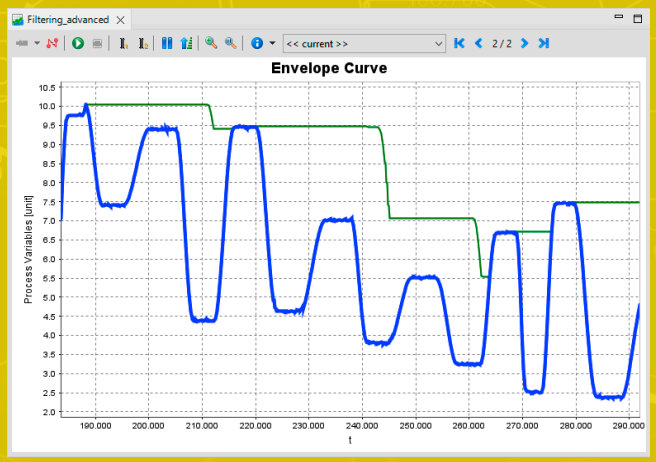
With our renewable energy management and control expertise, we are making a decisive contribution to the OpenZero templates for maritime user interfaces. Applications include, in particular, engine room and engine control room systems, wind-assisted, hybrid and battery-powered propulsion systems, drives with alternative low-emission fuels, and systems for the reduction of air resistance.

New features for Scope 3

FULLY IN THE PICTURE

When it comes to the commissioning and troubleshooting of automated systems, transparent state and process information is essential for success. The 'Scope 3' software oscilloscope makes time signal characteristics visible, and allows them to be set in relation to other process variables. Data is recorded on the Bachmann control system, and then visualized and analyzed in SolutionCenter.

In the latest version, Scope3 provides a wide range of additional calculation functions for examining recorded signals, allowing them to be evaluated even more quickly and easily. The enhancements are available in SolutionCenter from version 2.73.



Moving maximum: Just one of many new online and offline calculation functions that improve the efficiency of signal characteristic analysis in Scope 3.

Depending on the applied algorithm, calculations can be executed online as soon as recording begins. Prerecorded data is therefore included in the calculation within a defined window. New functions include various averaging functions and the determination of minimum and maximum values. If a moving window is applied, and the evaluation is recalculated at each sampling stage, making it easily possible to envelope the path of the signal between the minimum and maximal value.

Alternatively, completed recording calculations are also available. The advantage being that the entire signal curve can be included in the calculation. This allows the DC component of the curve to be removed, for example. In addition, a linear compensation line can be placed between two points, or a linear regression filter can be applied to the complete time series.

Any striking characteristic values of recorded signals are compactly summarized in a new trend information window. This list is enriched with statistical data such as minimum value, maximum value and standard deviation. Values can be calculated across the display, as well as between two cursors. This makes the analysis of interesting results even faster.

So, there we have it: Update right away!

Automatic data alignment with M-Target for Simulink®

QUICKLY AND RELIABLY EXCHANGE STRUCTURES BETWEEN DIFFERENT PROGRAMMING LANGUAGES

Recent releases of M-Target for Simulink® delivered multiple improvements. First and foremost: The automatic data alignment of stored structures. This facilitates an easier exchange of structures between different applications, even if they were created using different programming languages. Engineering speed increases and, at the same time, the accuracy of data interpretation improves.

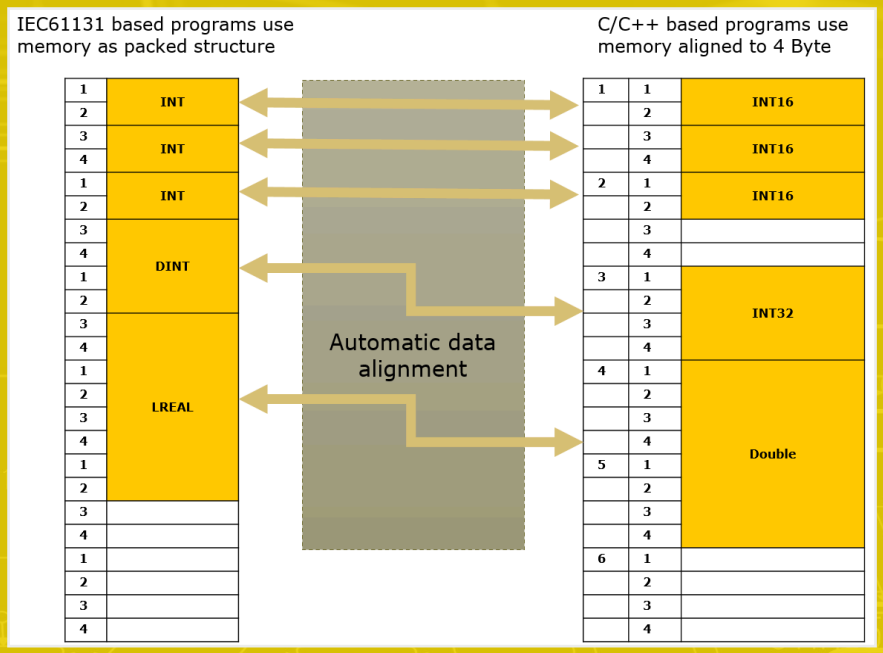
The M200 control system supports diverse programming languages. This versatility has many advantages when applications are first created. However, different languages use different memory allocation. If data structures are exchanged between different applications, then problems can occur. IEC-61131-3 applications, for example, store structures in packed form without gaps in memory. Programs written with high-level languages such as C/C++, on the other hand, use a 4-byte alignment, which can lead to gaps in memory. If these two programs exchange data via the same memory, there is a risk that the transferred data will be interpreted incorrectly.

Faster, more reliable development

M-Target for Simulink® now makes engineering significantly more convenient: The new SVI server block offers automatic data alignment for structure exchange with other application programs. This means that dummy variables no longer have to be manually inserted as so-called 'padding bytes' on the IEC61131-3 program side in order to artificially achieve a 4-byte alignment. This increases efficiency during development, because the variables contained in the structure can be moved and replaced as required. Nevertheless, the transferred values are interpreted correctly by both application sides – without having to worry about the resulting alignment.

Easy co-simulation with SimConnect

A similar issue arises when exchanging data during co-simulation. The Simulink® model on the Windows PC uses another alignment with 8-byte blocks. To make the transfer as efficient as possible, all variables are exchanged in a Simulink® bus or structure between the Simulink® model and the application on the M200 controller. Following the release of M-Target V2.60, SimConnect blocks also offer automatic data alignment between the M200 control system and the Windows PC, further increasing the speed of co-simulation with correct variable exchange. As we know, co-simulation can be very helpful if, for example, generating code for the

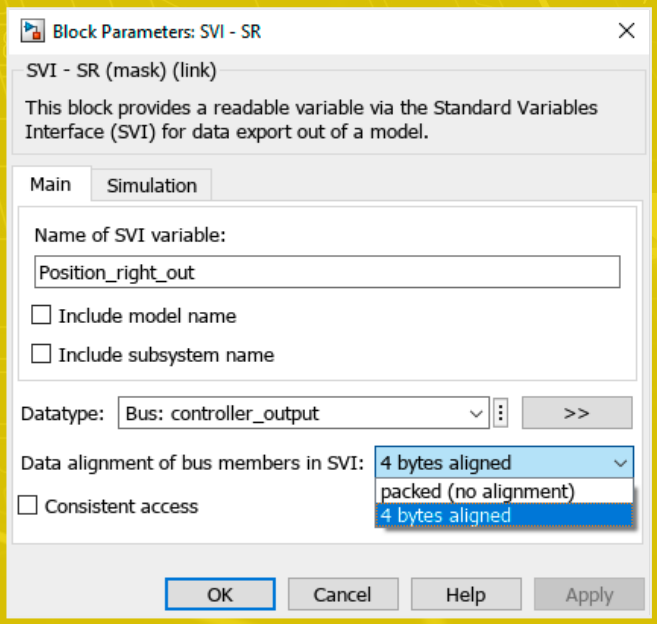


Automatic data alignment enables the correct interpretation of structure content exchanged between applications. The manual creation of artificial variables ('padding bytes') to achieve the same memory allocation is thus no longer necessary, even when data is exchanged between programs based on IEC61131 and C/C++. This avoids errors and saves a lot of engineering time.

M200 control system is not possible due to missing simulation model source code. Read more about this on page 78 .

And much more

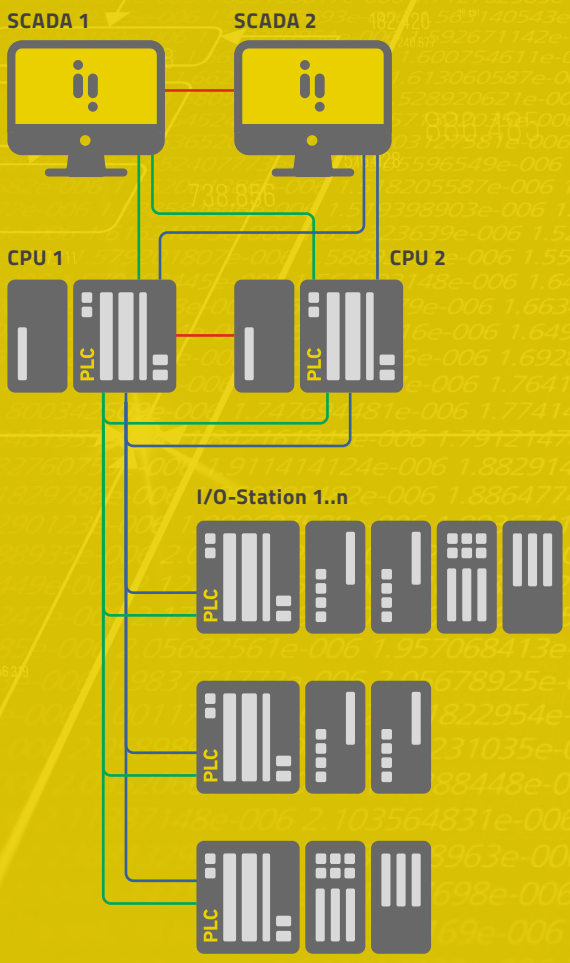
Further M-Target for Simulink® innovations: Thanks to new blocks in the Bachmann library, EtherCAT device parameters can now be adapted directly from the user program. This means, for example, that a maximum enabled torque can be set in the drive depending on the operating state. In addition, variables and data types can now be managed in Simulink® Data Dictionaries. This allows parameter values to be stored separately from the Simulink® model application code. For example, the same control code can be used for two different types of wind turbine – the appropriate parameters are set by loading the corresponding data dictionary.



Configuration at the SVI server block to provide the data for other applications as 'packed' or with 4-byte alignment.

ONE OF TWO = HIGH AVAILABILITY

Redundancy has many forms. In the simplest case, a spare computer is stored in the warehouse and can be put into operation when required. The most comprehensive option is controller redundancy with synchronous bumpless transfer in the event of any faults. Bachmann offers a proven solution from sensor to SCADA. The configurator has recently been updated with new and improved options.



With standard components: The two redundant CPUs, which process the same application logic, can be mounted together or apart. Only one extra network connection is required between them (in red). The two CPUs have diagonal access to the two distinct I/O networks (in green and blue respectively).

Redundant controllers are considered the peak of automation. They usually require special CPU designs, bus couplers and network components. But it's much simpler with the M200 system, as the entire redundancy application is built using standard components. This applies to hardware components as well as development tools.

There are no special network infrastructure requirements. There is usually a network already in place on vessels, in road tunnels, or in power plants. The installed switches already meet the minimum industry requirements and support prioritized VLAN. This means that the requirements for installing M200 redundancy are already met.

Topology

The two redundant CPUs, which process the same application logic, can be mounted together or apart. If both CPUs are installed in the same cabinet, the operator has a failsafe solution in the event of a hardware defect. In critical infrastructures, this is usually insufficient. On ships, for example, designers usually go one step further and install completely separate networks on the port and starboard sides, with one of two redundant control CPUs operating on either side. This setup not only protects against hardware failures, but also against external influences such as water, fire or partial power failure.

Master connections

Only one additional network connection is required between the redundant CPUs. This is used to program and configure both CPUs during commissioning. The service technician can therefore centrally access both CPUs with a laptop – to set up,

test and debug the application. Necessary tools are included in the standard installation of the Bachmann SolutionCenter.

During operation, the same master-master connection is used for a cyclic, synchronous comparison of process images. The system knows which is the active master ('primary master') and automatically checks that the process image provided by the secondary CPU matches the master at all times. This is because the same control logic generates the same process output image from the same process input image. Deviations are expected only in exceptional cases. Any deviation is categorized as an error, displayed, and automatically corrected before the next PLC cycle.

Synchronous signal acquisition on the I/O stations, as well as simultaneous processing on both CPUs, is triggered by the Ethernet-based protocol 'bluecom', which transmits data in prioritized VLAN packets. Even if no exact time source such as PTP, SNTP or GPS is available, the overall system runs synchronously – right down to the logbook time stamps.

Physically separated networks

The I/O stations, which feature an Ethernet coupler and M200 I/O modules, are connected via two independent networks. This is to avoid any possibility of a Single Point of Failure, which would impact both networks. For example, independent networks cannot use the same switch – if it failed, then the entire system would be paralyzed.

Both CPUs have diagonal access to the two separate I/O networks. The generous M200 CPUs provide multiple Ethernet ports. If they are already in use elsewhere, then the CPU connection adjustments can be logically combined with another I/O network connection via the same cable.

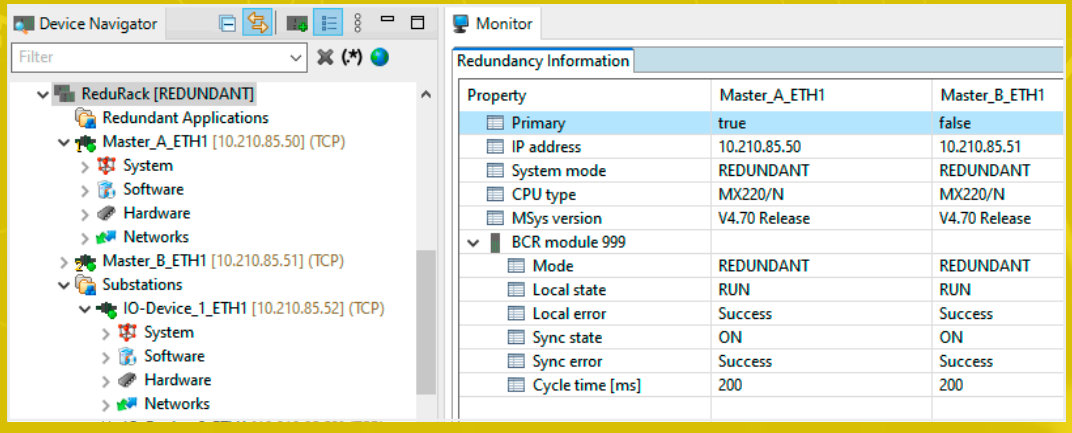
SCADA included

Bachmann facilitates redundancy not only for open and closed-loop control, allowing it to be designed with high availability from the sensor to the PLC logic, but also for operations, monitoring and process archiving. Two autonomously managed atvise® scada systems, with diagonal connection to both CPUs, guarantee ongoing process control despite any faults in the network.

Extended application fields

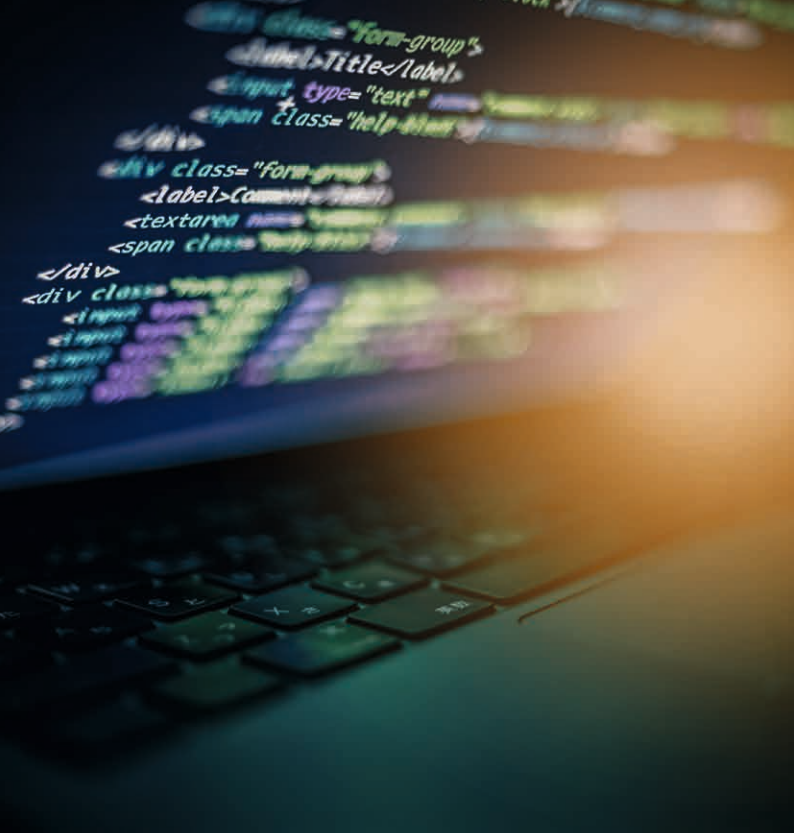
Redundancy systems have long been state of the art for critical shipping applications. Redundant CPU control applications are also increasing in virtual power plants with redundant feed-in controllers, in infrastructure projects, in water management, and in wind turbines.

The cost of failure for a hard-to-reach, fully automated plant, or even the subsequent cost of failure of critical infrastructure, is high. The M200 system provides a redundant control solution built using standard components – a significant advantage compared to other systems on the market.



A clear overview: The SolutionCenter configurator offers new functionalities for establishing the redundancy solution.

»Sometimes
you need a little bit
more freedom.«

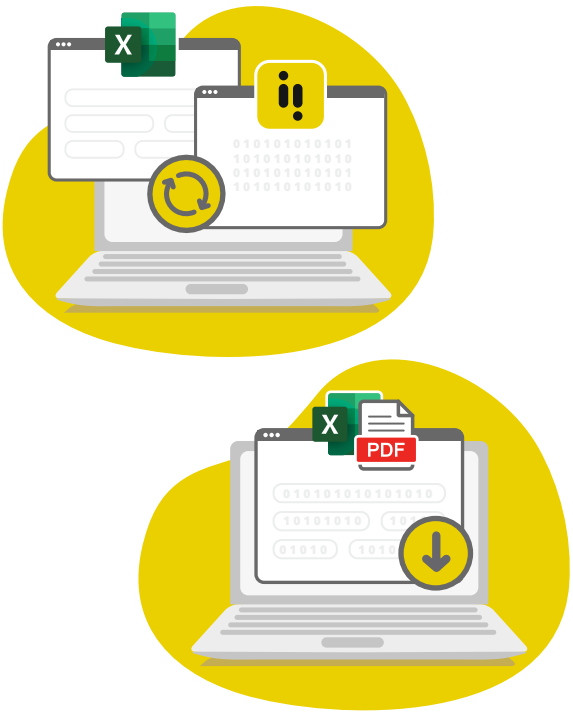


NEW PROGRAMMING LANGUAGE: TEST AND CONFIGURE FASTER WITH PYTHON

The Python programming language has a simple syntax and comes with an extensive set of standard libraries. And there is a correspondingly large community using the open-source language for data analysis, and, increasingly, for machine learning applications as well.

Bachmann has extended the m1com library for Windows and Linux to include Python. The programming language can now be used to access the automation system via the console, or directly from the SolutionCenter. Compared to remote procedure calls in C programming languages, Python scripts make it very easy to read and process data on the PC. This saves valuable time when automating complex processes and performing automated software tests. The language also lends itself to the efficient configuration of large machine series with scripts.

Python can be easily added to the m1com DLL via the Python Package Installer.



atvise® REPORTING: CLICK AND GO!

A meaningful report with just one click! Sounds good, doesn't it? For atvise® users, this is what's become possible thanks to the latest software release.

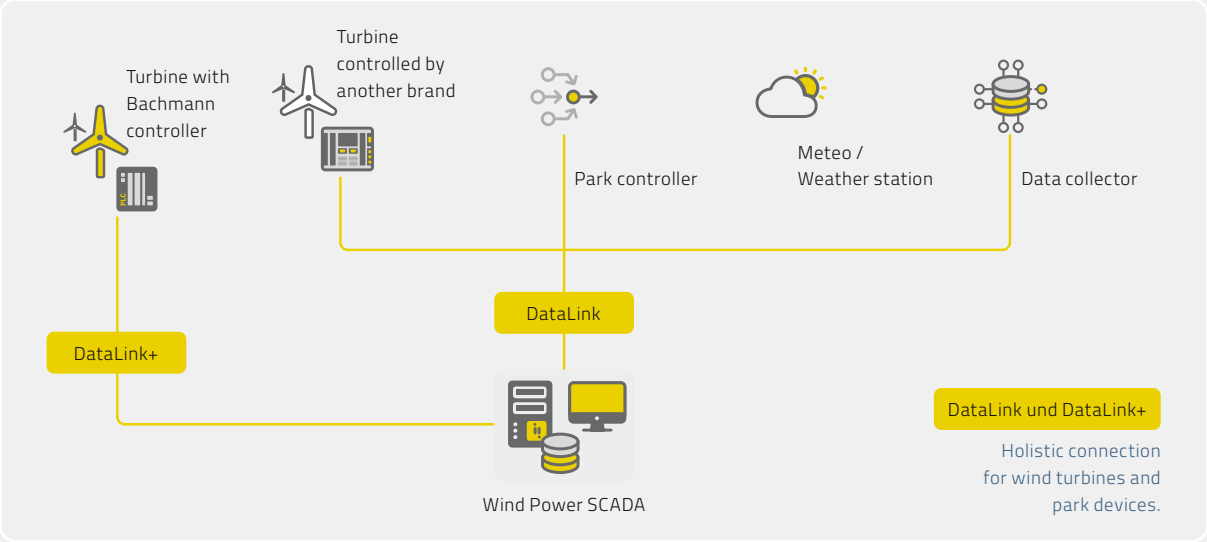
atvise® v3.9.2 shines with a reporting tool that generates reports in the background, and then delivers them automatically. The template is created as a worksheet in the most popular of all spreadsheet software: Microsoft Excel. Layout, headers and footers can be created according to user requirements or according to a design specification, and tables, graphics and diagrams can be added as required. Data points from the atvise® project are stored in the desired Excel spreadsheet cells – done!

Live values, historical data columns and alarm notifications can be directly processed and displayed in the created template. Automated report generation can be configured directly in a web browser. Time intervals can be individually assigned, and either .pdf and .xlsx be selected as output format.

It doesn't get much easier than atvise®: analyze, optimize – and reduce costs!

COMMUNICATION WITH THIRD-PARTY SOLUTIONS: INDEPENDENCE AT LAST!

Thanks to DataLink, a universal software gateway, Wind Power SCADA (WPS) can now easily communicate with turbine controllers and SCADA systems from third-party suppliers. Operators of wind turbines from a range of different suppliers can now take advantage of WPS for their entire wind farm.



Management, control and maintenance, easier than ever: DataLink and DataLink+ put an end to proprietary protocols and different user interfaces.

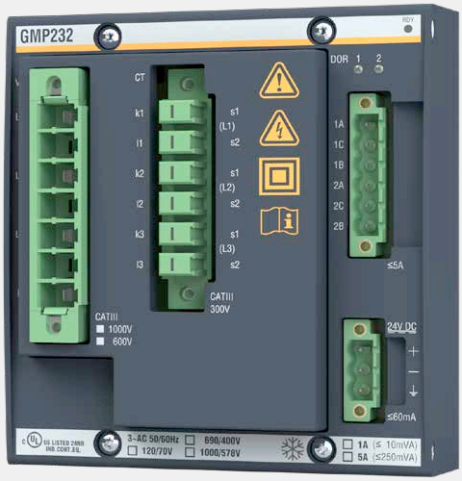
The IEC-61400-25-based solution simplifies cooperation between park operators and independent service companies. As long as they have the appropriate user rights, the latter can use WPS to easily service the entire park and send commands to the plants. Management and control of all operating equipment in one SCADA environment significantly reduces both maintenance efforts and system costs. Modern, up-to-date security standards and access rights management also minimize the risk of cyberattacks.

With SCADA retrofit solution DataLink+, even plants with older Bachmann controllers can be easily integrated into the SCADA system. If required, turbines are equipped with a modern CPU, future-proofing their equipment. Depending on plant type, operators benefit from an extended range of functions, and can evaluate additional data provided by the automation manufacturer. If communication between the controller and SCADA breaks down, events are logged for up to two weeks and stored on the controller. Stored data is automatically sent to the SCADA server database as soon as the connection is back up and running.

Thanks to DataLink and DataLink+, WPS displays live values from all park installations and stores historical data, including alarms, from different types of installation – in the same database. This makes data analysis a great deal simpler.

GRID MEASUREMENT AND GRID PROTECTION: IT DOESN'T GET ANY SAFER (OR EASIER)

The controller-integrated GMP232 grid measurement and protection module from Bachmann electronic is a major success story. Already in use in thousands of plants worldwide, the module has now been upgraded once more. The latest version, the GMP232/x2, defiantly ticks all the boxes and fulfills even the highest requirements from grid operators.



GMP232/x2: Grid measurement and protection for generation plants

The GMP232/x2 offers new measuring ranges and protective functions and is certified according to EN50549-2:2020.

- Controller-integrated, direct connection up to 1,000 V (CAT III)
- High-precision frequency measurement (≤ 1 mHz)
- Wide measuring and overload ranges
- Low latency and high refresh rate
- Integrated fault recording and event logging
- Conformity with all relevant standards for safety and grid integration
- Classification for marine and offshore applications (IACS E10 Rev.7., BV, ABS, LR, DNV·GL, KR, RINA, NK)

The volatility of power generation from renewable sources poses major challenges for network operators. To ensure frequency stability, they need high-precision measurement systems that register even the slightest deviations and enable rapid intervention. With frequency measurement accuracy of ≤ 1 mHz, and current and voltage measurement of maximum 0.1 %, the GMP232/x2 meets even the most stringent grid operator requirements.

The frequency measurement was specially designed to cope with an unstable converter environment and the occurrence of common network faults. Depending on requirements, applications can access direct, highly dynamic frequency data, frequency data with inhibited interference, or averaged frequency data.

1,000 V

The insulation concept was completely revised to enable the accurate and cost-effective measurement and protection of large low-voltage generators or critical grid suppliers. The GMP 232/x2 supports rated voltages up to the medium-voltage limit of 1,000 V. In this voltage range, operators benefit from 45% higher power transmission capacity compared to the 690 V variant, without having to increase cable cross-sections. This saves copper and reduces transformer and installation costs, and installation can be carried out by low-voltage installers.

Selective protection

An extension to the current measurement range makes it possible to activate protective functions even more selectively in the event of massive faults. The measurement signal and the associated control capability are fully retained during any transient run-up phases or during faults. Current measurements up to five times the rated current, and a short-term overload capability of up to 250 A (up to 0.25 s), also help to analyze events more effectively. The GMP232's integrated fault recorder and event log provide support.

The voltage overload ranges have also been extended to 3637 Vrms (up to 1 s), ensuring continuous protection and control even after massive mains or system failures.

Extensive functionality

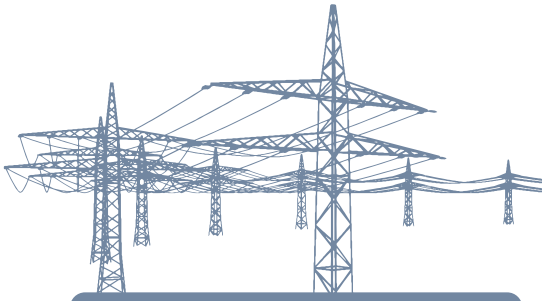
The GMP232/x2 contains around 50 configurable protective functions to protect the grid and generating unit in the event of defined deviations in voltage, frequency, phase (vector shift) or exchange capacity. Particularly noteworthy is the addition of positive sequence low-voltage protection, zero sequence overvoltage protection, and negative sequence overvoltage protection.

Certified according to EN50549-2

The GMP232/x2 complies with all relevant standards and directives for generating units and plants, including the new harmonized European standard EN50549-2, which regulates generator connection to medium-voltage distribution networks. Generators equipped with the GMP232/x2 therefore also comply with the Network Code on Requirements for Generators (RfG NC), which describes the network connection requirements for power generators.

Two worlds, one product

As a system that is completely integrated into the control system, the GMP232 can't be beaten when it comes to installation and commissioning. The module perfectly connects the world of energy with the world of automation, and can be easily integrated into any plant/manufacturer constellation. Plant operators benefit from much higher flexibility compared with dedicated individual measuring devices – and save significant costs.



EN 50549-2: CHECK!

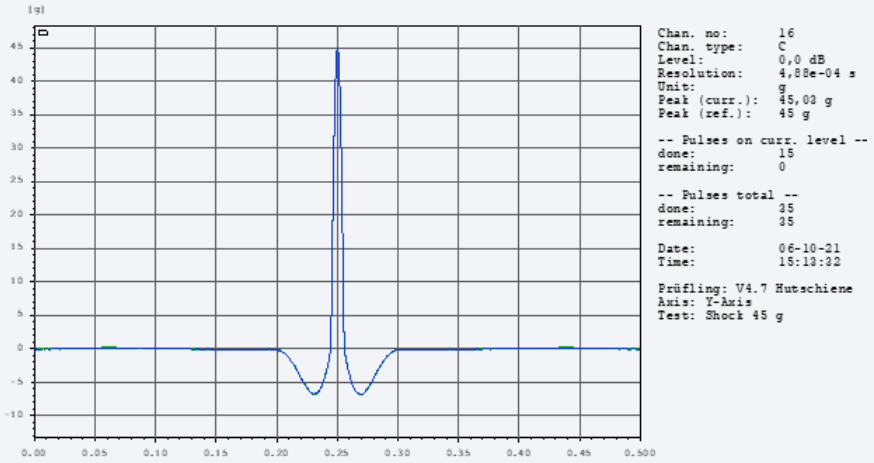
The relevance of small and medium-sized generation plants continues to increase. If newly built, they have to be able to support the grid in the event of future faults. This is why requirements on generation capacity are increasing. In the event of a fault, these plants must be automatically disconnected from the grid within milliseconds.

EN 50549-2:2020 specifies the relevant technical requirements for the protective functions and operating characteristics during parallel operation of generating plants on medium-voltage networks. Application rules described in the standard simultaneously implement the European Network Code 'Requirements for Generators (RfG NC)'.

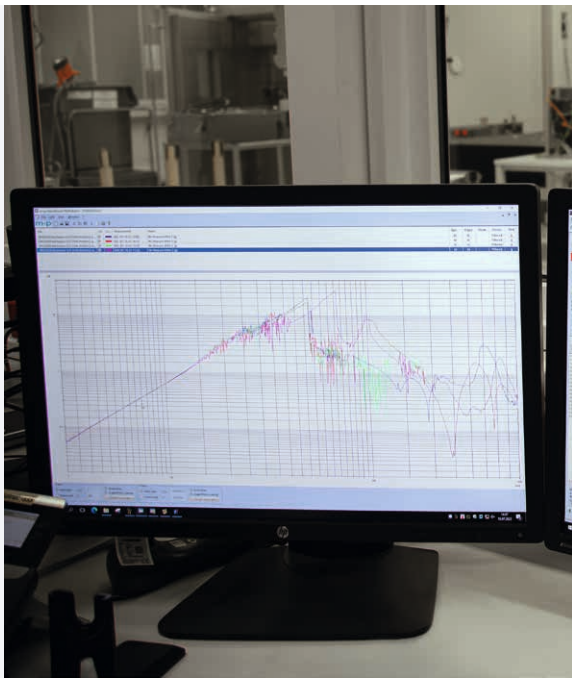
In future, generators intended for connection to, and operation on, the medium-voltage grid must be equipped with compliant grid protection. The GMP232/x2 grid measurement and protection module is certified in accordance with EN 50549-2:2020. Equipped systems fully meet this requirement.

PRODUCT QUALITY: UNBREAKABLE

Shock and vibration tests serve to demonstrate that a device can withstand the demands and stresses it may experience during its life cycle. Bachmann pushes these tests to their limit.



Experimental shock loads of more than 40 times acceleration due to gravity (40 g) guarantee reliability and availability even under the most difficult conditions.



Control cabinets mounted on drive machines or generators without complete mechanical separation are exposed to constant vibrations. Bachmann systems are used on presses, in wind turbine nacelles, in driverless transport systems, on ships, and in very exposed locations where vibrations are caused by high wind turbulence. "This is disastrous, especially at the point of contact," says Burkhard Martin, M100 I/O project manager at Bachmann.

Mechanical hardening

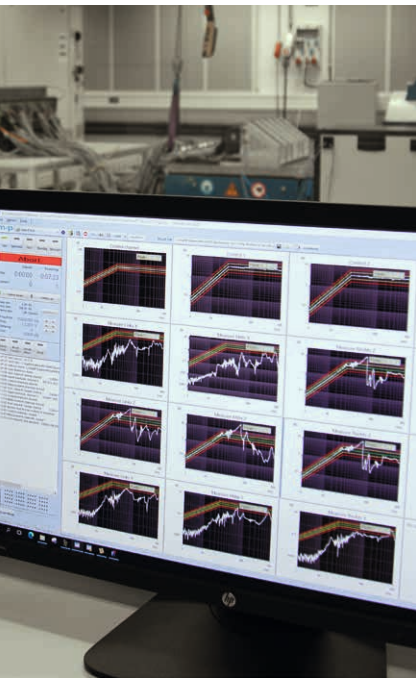
During the development phase, shock and vibration tests are used to expose all products to acceleration values far exceeding those reached in the real world. Exposure to such loads allows the detection and remedy of any weak points or defects in the design or components.

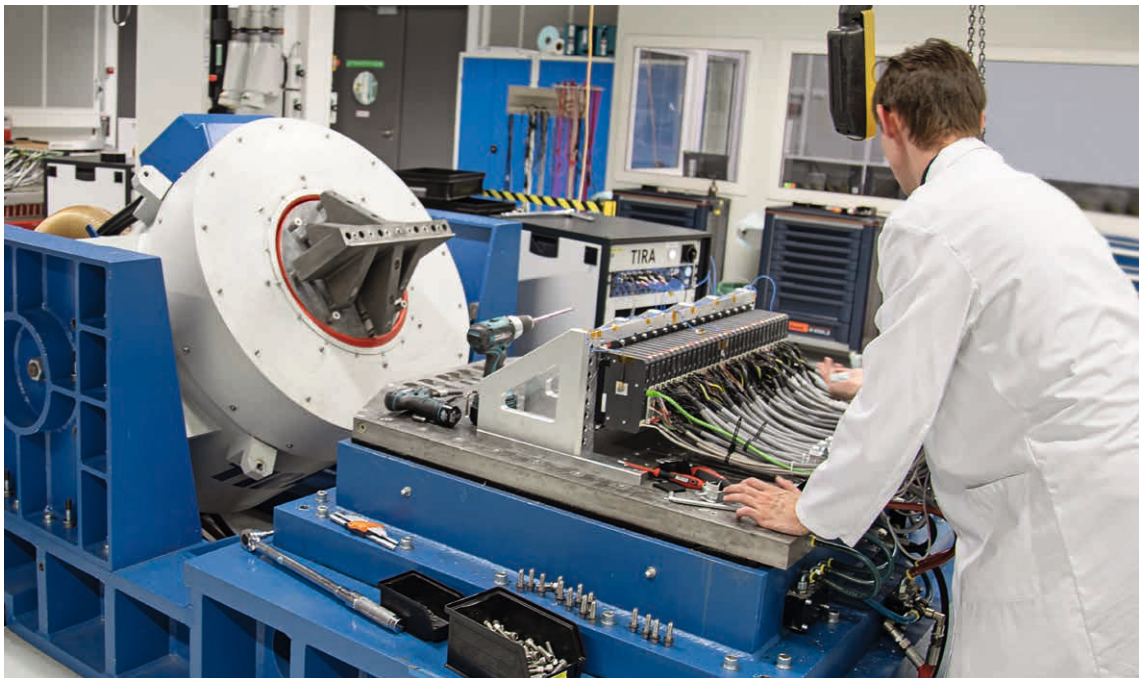
Pure stress

Modules undergo a whole series of grueling tests. These tests simulate loads and shocks of more than 40 times acceleration due to gravity (40 g). In another series of tests, each product must endure 1,000 shocks with an acceleration of 20 g in every spatial direction. In addition, vibration tests subject them to continuous vibration for around seven hours per axis at frequencies of 10 to 200 Hz. "And, even after that, the hardware doesn't fall apart; it continues to meet the performance requirements expected by our customers," says Martin.

Burkhard Martin is often asked why products are subjected to such high stresses, which are extremely unlikely to occur in the real world. "Compared to the service life of our products, the test phases are much shorter," explains the project manager. "Stressing hardware far beyond normal levels is comparable with greatly accelerated aging. Such tests therefore provide valuable information regarding general long-term stability." In principle, such robustness helps to extend service life and increase reliability, even in relatively standard locations. In addition, customers don't have much to do to make the installation location electronically suitable. They can also expect higher availability and fewer malfunctions. "And all of this leads to lower costs."

In a lengthy series of tests, Bachmann modules are subjected to continuous stress through vibration and shock.





Robustness in detail

These tests resulted in many detailed improvements during the development phase of the M100 I/O System. Each individual module is installed in a robust and EMC-safe metal housing, which is securely attached to a stable rear panel with a vibration-resistant fixing. Cables are connected directly to the module via reliable, spring-loaded terminals, and connectors are equipped with a vibration-proof 'lock & release' mechanism. Bachmann can thus guarantee shock resistance up to 30 g, and vibration robustness up to 6 g.

A dependable reputation

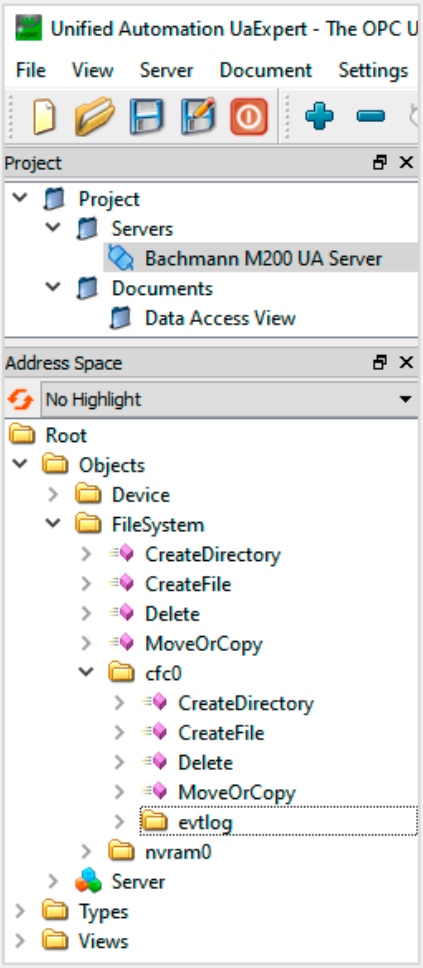
Bachmann systems are renowned for their reliability and durability. Bachmann uses shock and vibration tests to identify potential problems – before devices are launched to the market. "This is how we continuously improve our product quality, which not only ensures that we meet the requirements of our various customer markets, but that we exceed them as well," concludes Burkhard Martin.

» Devices that can withstand significantly higher mechanical loads than required have a longer service life and higher reliability, even in locations with moderate loads. «

Burkhard Martin
Project Manager M100 I/O System
at Bachmann electronic

OPC UA FILE TRANSFER: GOODBYE TO FTP!

The progressive standardization of OPC UA is continuously providing solutions for new and additional industrial communication tasks. Originally, OPC UA (like its predecessor OPC Classic) was invented to exchange manufacturer-independent process data between devices. But there is more to it: OPC UA connection already provides the most up-to-date security – so why not use it as much as possible?



File transfer with OPC UA on the Bachmann M200 controller: Logged-in users see only the folders and files that they are permitted to see. (Screenshot from the free-to-use OCP UA Client UaExpert).

Protecting data against theft, manipulation and forgery is essential for both critical infrastructure and industrial systems. Open machine access without checking access rights is now only accepted in a small number of industries, but interfaces are still becoming increasingly standardized. A dedicated operator PC is no longer necessary: Anyone who gains network access to a machine can usually make changes using tools from a Windows PC, or freeware Internet programs – whether as required, by accident, or even with malicious intent.

Insecure FTP

The venerable File Transfer Protocol (FTP) standard is an example of what not to do. FTP requires no login, and is not encrypted. Current security standards, on the other hand, demand end-to-end encryption. The PC's preinstalled web browser is a sufficient file access tool, although user rights management options on the FTP server are few and far between.

On the other hand, a protocol that covers many use cases with one-time user authentication has many advantages. A single, multi-purpose login makes life easier for users and administrators, because it reduces the total number of keys with access to the system.

File sharing today?

In the age of generic cloud interfaces and data models, working with files may seem antiquated. However, files are still an excellent solution for the consistent exchange of related information in both directions: Trend records, fault records, and manufacturing logs should be moved from the process to the archive; configuration parameters, software updates, and recipes should be defined from a central location and rolled out to distributed systems. File copying is therefore still a very popular solution, because system behavior can be tested well in advance, and the possibility of errors during execution is low.

Transfer via OPC UA

In addition to Data Access and Alarms+Conditions, the Bachmann M200 controller's current OPC UA server version now also offers file transfer in accordance with Chapter 20 of the OPC UA standard. During implementation, the solution was seamlessly integrated into the M200 safety concepts. OPC client controller login determines the user-dependent access rights for data processing and also offers corresponding file access extensions, in order to specify rights for reading and writing the controller storage media, depending on the user. This functionality also applies to OPC UA – when browsing, the OPC UA Client user only sees the files where they have read access at minimum. To change or copy files, however, the user needs write access to the file system.

INTELLIGENT I/O INTERFACES: THE DIGITAL PROFESSIONALS

More than two thirds of all sensor and actuator signals are typically transmitted digitally. It is therefore important to connect them to the automation system in the most process- and cost-optimized way. The M100 I/O System comes with seven different types of digital I/O modules to fulfil the various requirements. We present some of their highlights.

Module types with a single-wire connection offer a maximum channel density of up to 24 channels per I/O slot. Sensor-specific connection cables can be directly connected to the modules with two- or three-wire connection. This saves shunting, reduces wiring costs and simplifies troubleshooting and maintenance.

Uncompromising performance

Fieldbus synchronous sample cycles up to 100µs, and optional oversampling, are suited to even the fastest machine clocks. The highly accurate, synchronized clock on each I/O module allows input sampling timing and consistent setting of multiple outputs to be set precisely and at an optimal distance from the fieldbus cycle. This increases process quality and boosts efficiency, especially for widely distributed stations.

Time stamps at 10ns intervals enable precise time margin measurement and the evaluation of event sequences. For precise pre-controls or pre-triggers, outputs can also be redirected from the fieldbus cycle at a particular, defined time. This increases the precision of process control and raises cycle times, even with slower bus cycles.

Integrated added value

All digital input modules have up to 4 counter units, eliminating the need for expensive special counters or position encoder modules for simpler counting tasks. External contactors can also be dispensed with for many applications in the lower power range: PWM-capable digital outputs can be connected several times in parallel, thus allowing the manipulation of switchable load currents.

A winner in price / performance

For relevant special functions that are directly integrated, powerful, and cost-efficient thanks to state-of-the-art, highly robust technology: See the M100 I/O Series digital modules. Automation engineers will be delighted.

Everything on hand

The module's 2D QR code, which can be read with any standard smartphone, not only contains information on the device designation, article and serial number. It also refers to a comprehensive information system via a web link: the data sheet, connection diagram, user manual and much more are just one click away.

The facts

Number of channels:	24 / 12 / 8
Connection:	1- / 2- / 3-wire per channel
Inputs:	IEC61131-2 type 1/3
Outputs:	IEC61131-2 type 0,5 and 2, can be connected in parallel
Functions:	Pulse stretching, counter, timestamp, PWM

More on this topic is provided on our website.

INTELLIGENT I/O INTERFACES: THE ALL-ROUNDER

The compact UIO106 Universal Module covers a wide range of functions within the low signal range and, therefore, significantly reduces both variant diversity and required space in the control cabinet. The freely configurable channels simplify project planning and ensure an uncomplicated commissioning process. Complete redesign of the engineering workflow saves additional time. Bachmann's all-rounder offers cost savings par excellence.

Stay flexible

The UIO106 combines I/O automation functions usually used for small signals. Each channel can be configured as an input or output, either analog or digital. A wide range of additional functions contribute to its enormous versatility, including a counter, encoder, pulse width modulation, stepper motor output stage control, and temperature or resistance measurement. The module reduces the number of variants, simplifying spare parts inventory and reducing storage and maintenance costs.

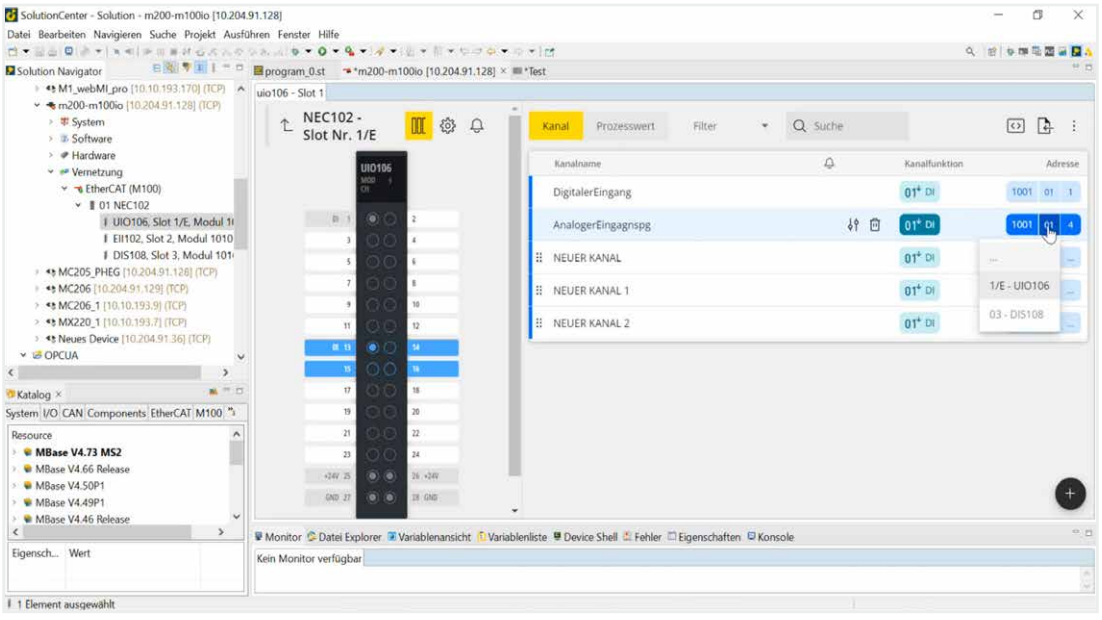
Save space, time and costs

The UIO106 shows its greatest strength in applications requiring only a few signals with different signal types. Using different module types, with unassigned channels, becomes unnecessary. This reduces the total cost of the automation solution and saves space in the control cabinet. It also creates flexibility during commissioning, especially if more, or different, signal types are identified than originally planned.

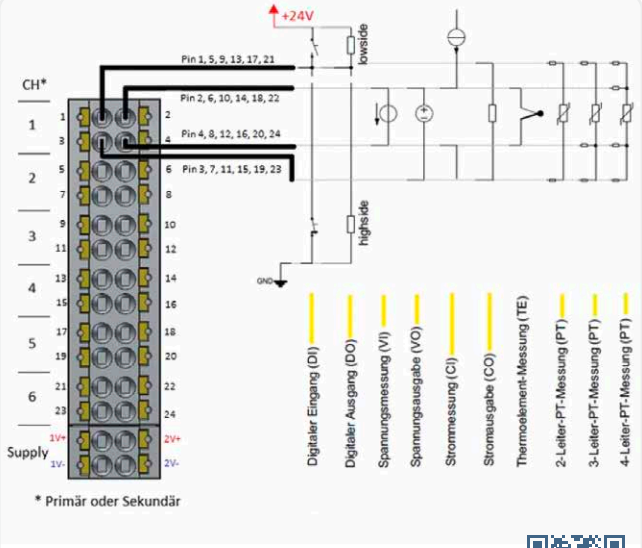
Heading safely into the future

Digital signal oversampling of up to 8 µs, and up to 100 µs for analog signals, provides security for future applications with constantly increasing clock rates. This also enables network detection for PQ applications, as well as detecting the exact time a fault occurred. The I/O module also supports 3- and 4-wire measurement technology, eliminating any influence of the connecting cable on the measured results. At the same time, this reduces the amount of switching required. The UIO106 is highly flexible: This is the future of low-cost automation.

In addition: The AIO104/I analog input/output module has the same analog signal functions as the UIO106 module, but also offers single-channel separated I/Os. Through the decoupling of potential points of error, they improve signal quality and increase operational reliability.



New configurator saves engineering time: import signal lists at the click of a button, assign modules and channels via 'drag & drop', and configure channel details with ease thanks to filters and drop-down menus.



For more information about the UI106 Universal Module, please visit our website.

Incomparable versatility

Up to 6 channels can be freely configured with the slim UIO106 and used either for digital and/or analog inputs/outputs. In addition, 6 further I/O channels with restricted signal types are available, meaning that incremental encoders can be connected without the requirement for a separate module, for example.

The facts

Number of channels:	12 (6 analog/digital inputs/outputs, 6 additional I/O channels with restricted signal types)
Connection:	single wire, or 2-/3-/4-wire for Pt100/ Pt1000 signals
Inputs:	DI, counter, encoder, AI current/voltage, Pt100, Pt1000, TC
Outputs:	DO, PWM, stepper motor output stage control, AO current/voltage
Additional functions:	synchronous clocks, latch, sync out, direct module-to-module communication, parallel DO connection, diagnostics

More information on the full range of analog M100 I/O modules can be found on our website.

ENGINEERING MADE EASY

Importable channel lists

The new SolutionCenter engineering software configurator ensures future security thanks to web technology. Configuration is now channel-centric: pre-generated signal lists, including names and signal types, can be imported as a CSV file with a simple mouse click. This approach saves a lot of time, especially for applications with a high number of signals. Signals can be easily distributed to modules that with unused capacity – also using 'drag & drop'.

Convenient engineering

If the user moves the mouse over a listed signal, then the assigned pins are highlighted on the graphical module display. Lists can be sorted and filtered according to a variety of attributes, allowing rapid processing of the desired channels. Detailed channel configuration can be carried out using a drop-down menu in no time. Additional functionalities, such as value comparison limits or latch settings, can also be set there. Existing configurations can be exported as a CSV file to edit the configuration parameters.

Quick troubleshooting

Users remain up to date about the exact status of every channel of every module thanks to comprehensive diagnostic functions: Depending on the configuration, each channel can detect short circuiting, line breaks and overheating. If the defined value range is exceeded or undershot, then users will be informed. A central diagnostics window speeds up subsequent troubleshooting. It shows all information, warnings and alarms on a substation and offers the possibility to 'jump' directly to the detected error.

Smart all-rounder

The modules inform the Solution Center about their existing functionalities. If machines are expanded at a later date with new modules with pre-existing new features, then these functions can also be used without having to update the engineering software. Compatibility between existing and new modules is thereby ensured.

MINIMUM RESPONSE TIMES: THE ENCODER ELITE

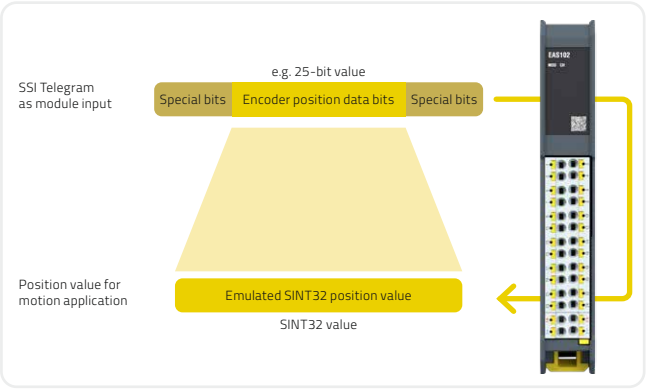
The M100 Series functional modules score highly in performance and precision, as well as flexible expansion options. Users are choosing the right system today for the high-end applications of the future.

EAS102: The absolute encoder professional

The EAS102 simultaneously evaluates up to two absolute encoders. With this type of encoder, the correct position is identified as soon as the machine is switched on. This removes the need for axis referencing and saves valuable time. In addition, any risk of collision during referencing is avoided, when several machine motion axes interlock.

With SSI (Sychronous Serial Interface), the position is determined in the encoder and transmitted to the evaluation module in coded form. EAS102 acquisition input can be freely adapted to the encoder in use. Thus, the number of transmitted position data bits, as well as the amount of leading and trailing special bits, can be easily adjusted. Within the module, a complete 32-bit value – a common format for motion applications – can be emulated based on the encoder position and then passed on to the CPU.

This facilitates the creation of a future-proof and encoder-independent application. When paired with the fieldbus-synchronous position data polling, precise position control can be realized.



Maximum future-proofing: Thanks to the flexible evaluation of SSI telegrams, the number of encoder data bits, as well as leading and trailing special bits, can be adapted to the absolute encoder. Extending the position value to 32 bits enables motion application programming independent from encoders.

In addition to the position value, further encoder diagnostic data can be communicated via configurable special bits. Even datagram protection using a parity check can be implemented with a mouse click. Data transmission takes place with a clock frequency of up to 2 MHz. In future, additional absolute encoder protocols will be added with a simple firmware upgrade.

The direction of counting in the encoder can be adapted to its mounting position via the DIR output at the EAS102 module. A SET output is also available for the required initial referencing. Furthermore, digitally transmitted encoder errors can be detected directly via a separate input. The 5V and 24V encoder supply allows complete, uncomplicated encoder wiring directly on the connection terminals of the EAS102 module.

EII102: The high-speed all-rounder

The EII102 combines extremely fast edge counting , period and pulse duration measurement , as well as the evaluation of incremental encoders in a single module. Furthermore, the module enables an immediate response to both external and internal events. Removing fieldbus delays makes applications much faster than the realizing reactions directly on the CPU. To this end, the module directly captures requests to latch or reference the encoder's actual position, enable counting or monitors encoder errors through digital control inputs. The encoder signals used are configurable: a single module covers different levels for single-wire (TTL/HTL,) and differential signal transmissions (RS422 / HTL differential), as well as a wide variety of track combinations (A, B to A, B, Z + inverted). This allows the EII102 to connect a wide range of sensor types. The creation and maintenance of applications is significantly simplified, and inventory costs are reduced. Terminal-integrated sensor supplies for 5 V and 24 V also ensure cleaner and faster wiring.

Count rapidly, measure time and determine position the EII102 acquires up to 32 MHz input signals with quadrature evaluation. This allows higher incremental encoder resolutions, even at high motion speeds and makes the EII102 suitable for highly demanding motion control and handling applications. The high signal frequencies guar-

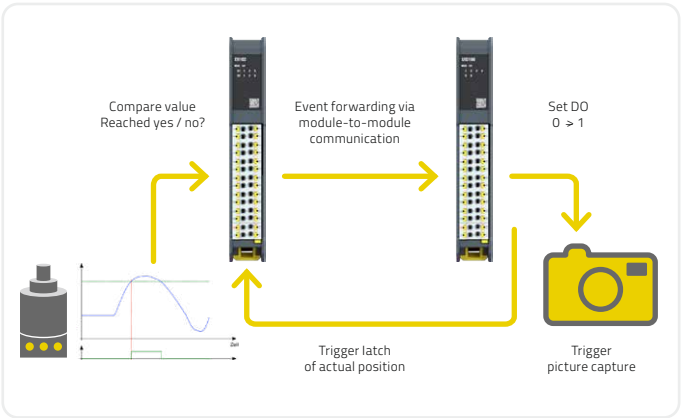
antee maximum process accuracy, even at higher cycle rates, which also increases the efficiency of the machine.

Based on the acquired encoder signal, speed can be calculated directly on the module and made available to applications. Processing on the EII102 enables precise determination of speed over the entire possible range, making the signal ideally suited for closed-loop control.

However, the EII102 inputs module can also be used to precisely evaluate individual signals from a photoelectric sensor or a pulse generator. Through pulse counting, for example, quantity of manufactured products can be determined.

If, on the other hand, time between the two input edges of a simple pulse generator is measured, it is possible to infer a rotation rate. The measurement is performed with an accuracy of 10 ns. For a shaft with asymmetrically arranged pulse generating cams, only one and the same identical cam can be evaluated per revolution. This is achieved by using the frequency divider functionality.

By measuring the time difference between two cams located at opposite ends of a rotating shaft, torsion can be determined – with the same EII102 module.



Signal processing at top speed: Module-to-module communication allows process state reactions in the µs range. Total module costs are simultaneously optimized thanks to channel sharing with neighboring modules.

MODULE-TO-MODULE COMMUNICATION

Two hardware modules adjacently mounted on the backplane can directly exchange information thanks to module-to-module communication – a feature of the M100 Series. If, for example, the actual position reaches a configured comparison value, then this function switches a digital output on the neighboring module almost immediately initiating a response from the machine. Reactions to a particular process status are extremely fast because of the direct transmission of information, instead of the path via the fieldbus and the CPU. This enables high-end motion applications. In addition, module costs can be optimized using neighboring module channels, as maximum I/O functionality does not always have to be available 'on board'.

Application 1:

A linear axis picks up a die using a suction cup. While moving to a target location, the exact position of the component must be measured and included in the target position. For this purpose, the position comparison value is placed directly in the recording area of a camera. If the axis crosses the recording area, then the comparison value function triggers a digital output on the neighboring module via module-to-module communication. Only 2 µs elapse between a positive edge at the position counter input and the switching of an output at the neighboring module. The activated output in turn triggers image acquisition by the camera. In addition, the actual position is stored in the EII102 latch register. The exact position of the die can be calculated by comparing the image measurement with the position stored in the latch register. This achieves impressive positioning accuracy of less than 10 µm at a speed of over 10 m/s.

Application 2:

Pellets are manufactured from powder on a rotary table at high speed. If one pellet does not meet the set quality criteria, then it must be ejected. In this case, the position comparison value is set to a position, where the faulty pellet is located directly in front of a pneumatic outlet nozzle. When the pellet is in this position, a digital output of the neighboring module is triggered via module-to-module communication, which releases the nozzle. This enables high product quality despite a high rotary table speed.

atvise® scada: EVEN MORE UNDER THE HOOD

With the release v3.9, Bachmann is once again expanding the atvise® scada portfolio. The new version makes engineering even more efficient, increases security, and improves the user-friendliness of realization, expansion, and use of visualization applications.

Click for a different language

Control element and command translations are time-consuming and sometimes require multiple rounds of corrections. The suggestions automatically generated by atvise®, including a preview function, facilitate translations free from typing errors and misinterpretations. With its extended translation function, version 3.9 software not only saves an enormous amount of time, but also ensures consistently high-quality translation. External language databases can also be applied.

Not just easy on the eye

Three new functions were also added to the code editor: Expanded, comprehensive syntax check, support for modern versions of ECMAScript, and code folding. Better code styling not only improves the look, but above all it provides a better overview. These convenient functions also provide programming security – and thus also increase the efficiency of development.

Fit for container virtualization

As of version 3.9, atvise® scada supports container-virtualized environments. Operation in container structures saves resources and facilitates individual editing of processes that run in parallel, which reduces system costs.

Even more safety

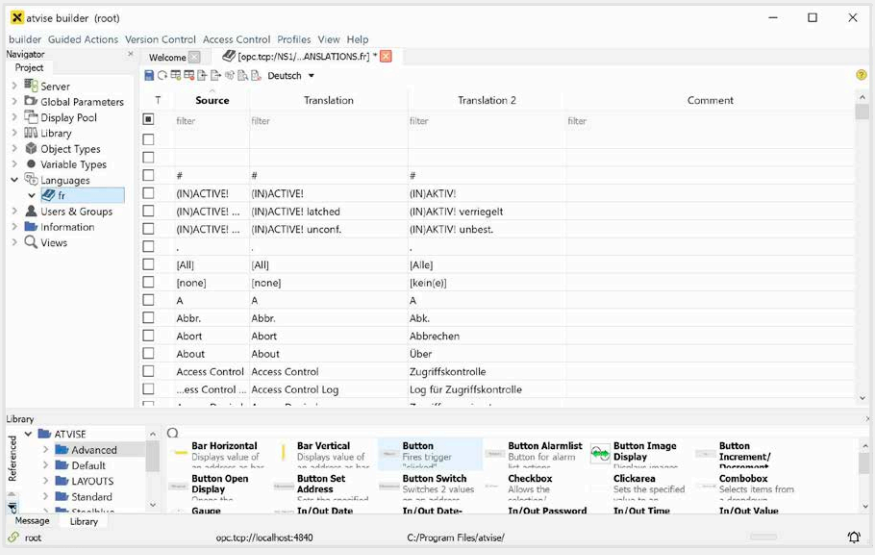
Achieving maximum cyber security is a top priority for Bachmann's development team. The new release increases protection once again: Configuration options for login and password handling have been expanded, as has the password policy, including complexity, expiry or account blocking settings. At the same time, users benefit from more convenient user management. "We are aware that IT security is like walking the tightrope," says Florian Blümel, Team Leader Sales & Automation. "Work processes must remain efficient, but with absolutely no room for attack." atvise® masters this challenge with flying colors, as an independent penetration test recently showed (see article on page 61).

Transparency at its best

The functionality of the atvise® SMTP client has also been expanded: Files can now be attached to e-mails, allowing extensive data packages, interpreted additional information and much more to be sent directly. This supports automated information flow and thus creates a foundation of unprecedented data transparency.

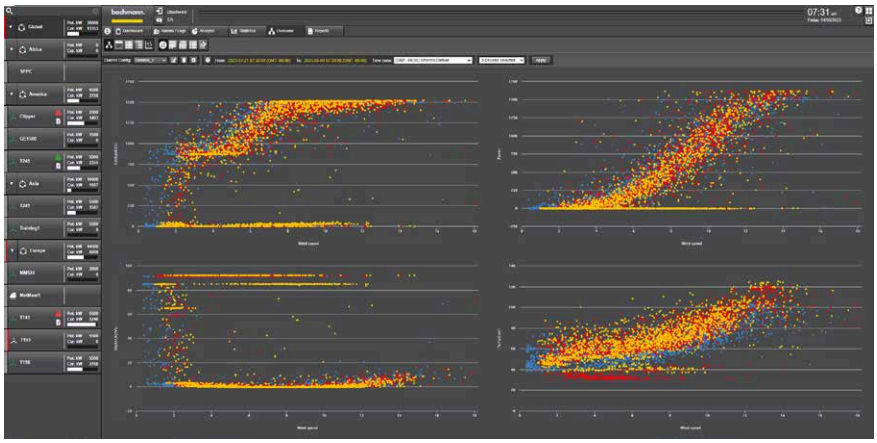
With version 3.9, Bachmann has once again implemented features that were inspired by customers. Visualization applications are even more secure, and engineering productivity is recognizably higher. The release is available to download for all atvise® users.

The much-extended translation function delivers enormous time savings and ensures consistently high-quality translation.

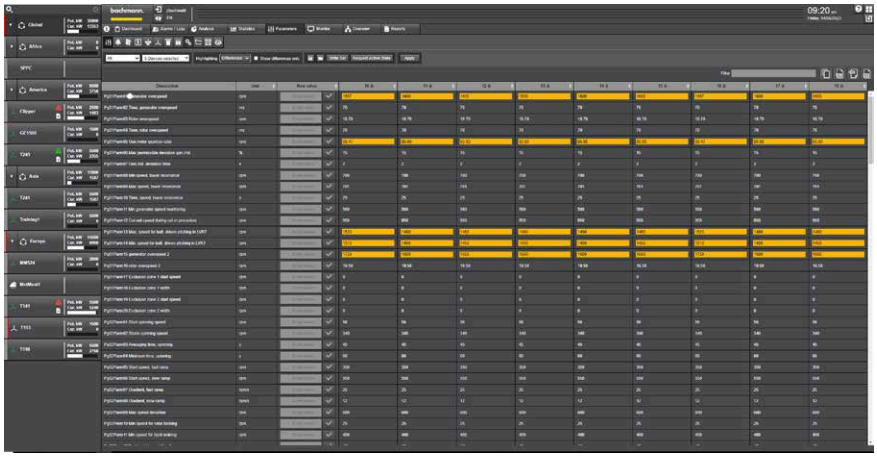


COMPARING PLANTS WITH WIND POWER SCADA: HYBRID FARMS UNDER TOTAL CONTROL

With Wind Power SCADA (WPS) 4.0, comparing different wind turbines within one wind park is child's play. Furthermore, the latest version contains a wide range of improvements.



Individual comparison charts.



Parameter comparison.

Individual comparison charts

On XY diagrams, data collected from different types of turbine within one park can be displayed together. Any major deviations are quickly identified with the help of a scatter diagram. If required, average values can be visualized. Values displayed on the two axes can be freely selected. Predefined plots can also be easily included. In this way, operators can record individual KPIs for their park.

New group dashboard

A new widget is available in WPS 4.0 to display group characteristics. Up to four channels from every plant within the park can be clearly compared using bar charts. The display is updated in real time. This allows the current park performance to be determined at a glance, and any irregularities quickly addressed.

Complete parameter comparison

With this new view, plant information from the entire group or park can be easily compared and any differences clearly highlighted. This allows operators to maintain an overview of set plant parameters within the park. Both characteristic values and deviations can be saved on the WPS server. If required, a previously saved set of parameters can be loaded and applied, individually or as a set, to selected plants or the entire park.

Absolute freedom

With WPS 4.0, events and the resulting effects can be defined on a user-specific basis. If, for example, a certain alarm occurs, or a variable reaches a defined limit, then a specified action will be triggered – for example, the system is stopped or a report is generated. Also new are notes and symbols that can be placed anywhere, header columns in tables that can be individually configured, and a free choice of average value channels that can be saved automatically. In addition, statistical evaluations and snapshot displays have been expanded, and the Smart Power Plant Controller is now fully supported.

VOLTAGE REGULATIONS SPPC 2.0: READY FOR THE USA

Bachmann's Smart Power Plant Controller combines extensive active and reactive PGU power control functions with web-based operation, powerful hardware and the latest security standards.

With version 2.0, SPPC control methods have been expanded specifically to meet US grid requirements. The SPPC now supports closed-loop voltage control, line loss compensation for voltage control (where there are long distances between the park controller and the point of common coupling), and the Q(U) characteristic. Active and reactive power can also be limited following any system deviations.

Commissioning and monitoring visualizations have been extended with the new functions. The SPPC can also be fully integrated in Bachmann's Wind Power SCADA via OPC UA with immediate effect.

Together with MATLAB® Simulink, the SPPC already supports a powerful simulation environment. In the future, simulation and analysis can be carried out with established PowerFactory software from DIgSilent. Likewise, generic functional mock-up unit models (FMUs) can also be used in simulation environments.

atvise® WEB VISUALIZATION: SECURITY WITHOUT COMPROMISE

The cybersecurity of atvise® was recently assessed though a Penetration and Vulnerability Test, carried out by independent security experts. Using a wide range of recognized test methods, experts diagnosed an extremely high level of security functions, without a single critical deficiency.

IT security is one of the central requirements of Industry 4.0 – and not something to be left to chance. At Bachmann, an in-house committee ensures the permanent, systematic testing and evaluation of potential product and process vulnerabilities. Experts use CVE scores ('Common Vulnerabilities or Exposures'), for example, to assess the severity of vulnerabilities and to better understand them. For development and patch management, this leads to priority lists that are structured according to which potentially exploitable vulnerabilities must be quickly fixed. Each atvise® release also undergoes numerous automated security tests across multiple layers, up to and including the simulation of entire SCADA environments.

State-of-the-art

atvise® can draw on the most up-to-date technologies and mechanisms to ensure secure data and communication encryption. System access is handled extremely restrictively: The Access Control module is a fine-tuned authorization management system integrated across all interfaces. This secures individual access, is anchored in the core and makes circumvention impossible.

Security by design

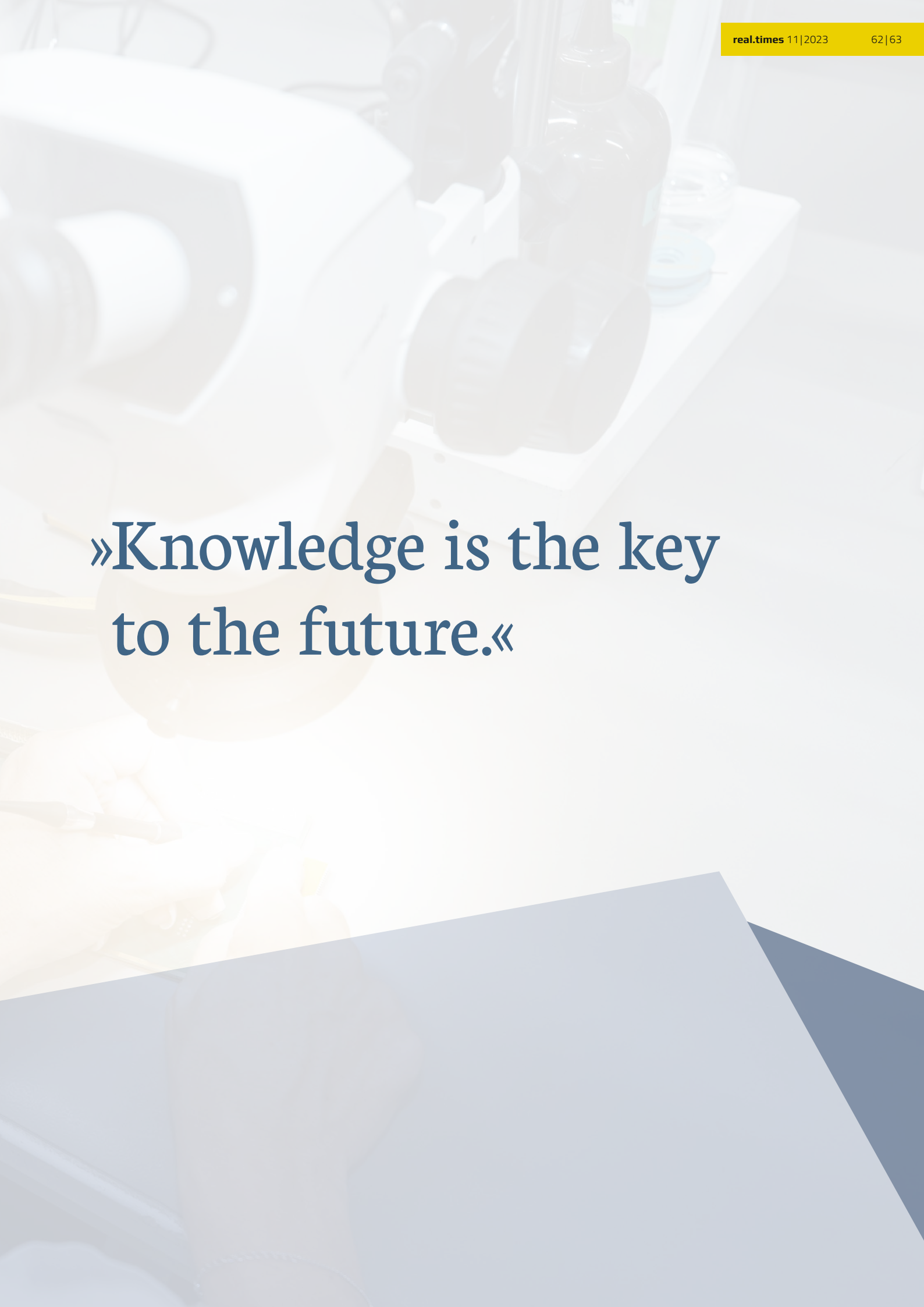
As part of a voluntary audit, Bachmann recently commissioned external specialists to carry out a comprehensive test of the atvise® web server and the internal security mechanisms. During this process, atvise® was certified with a high level of self-protection: With sophisticated rights management and data rate limit implementations, atvise® comes with important self-protection mechanisms right out of the box. Florian Bogner, CEO of the auditing company Bee IT Security Consulting, sums it up in one sentence: "It is clear that the focus was on security right from the beginning of the development phase."

Outstanding security

A planned approach to possible risks is a matter of course for Bachmann. That is why hardware and software protection is fully integrated into the Bachmann product lifecycle. Not surprisingly, the results of the audit were remarkable: In accordance with the OWASP Testing Guide, established among experts, around 90 different tests were carried out during the atvise® review. And more than 95 percent of them were completely fulfilled. Users can rest assured: atvise® is ideally equipped for critical applications.

»It became obvious during the security review that there was a clear focus on security during development. This is evident, for example, in the sophisticated rights management and the self-protective implementation of data rate limits.«

Florian Bogner
CEO, Bee IT Security Consulting GmbH



»Knowledge is the key to the future.«

Sharing know how

FIRST-HAND KNOWLEDGE

From an introduction to the Bachmann product range, to tips & tricks and industry-specific topics – Bachmann's YouTube channel provides first-hand knowledge – absolutely free of charge.

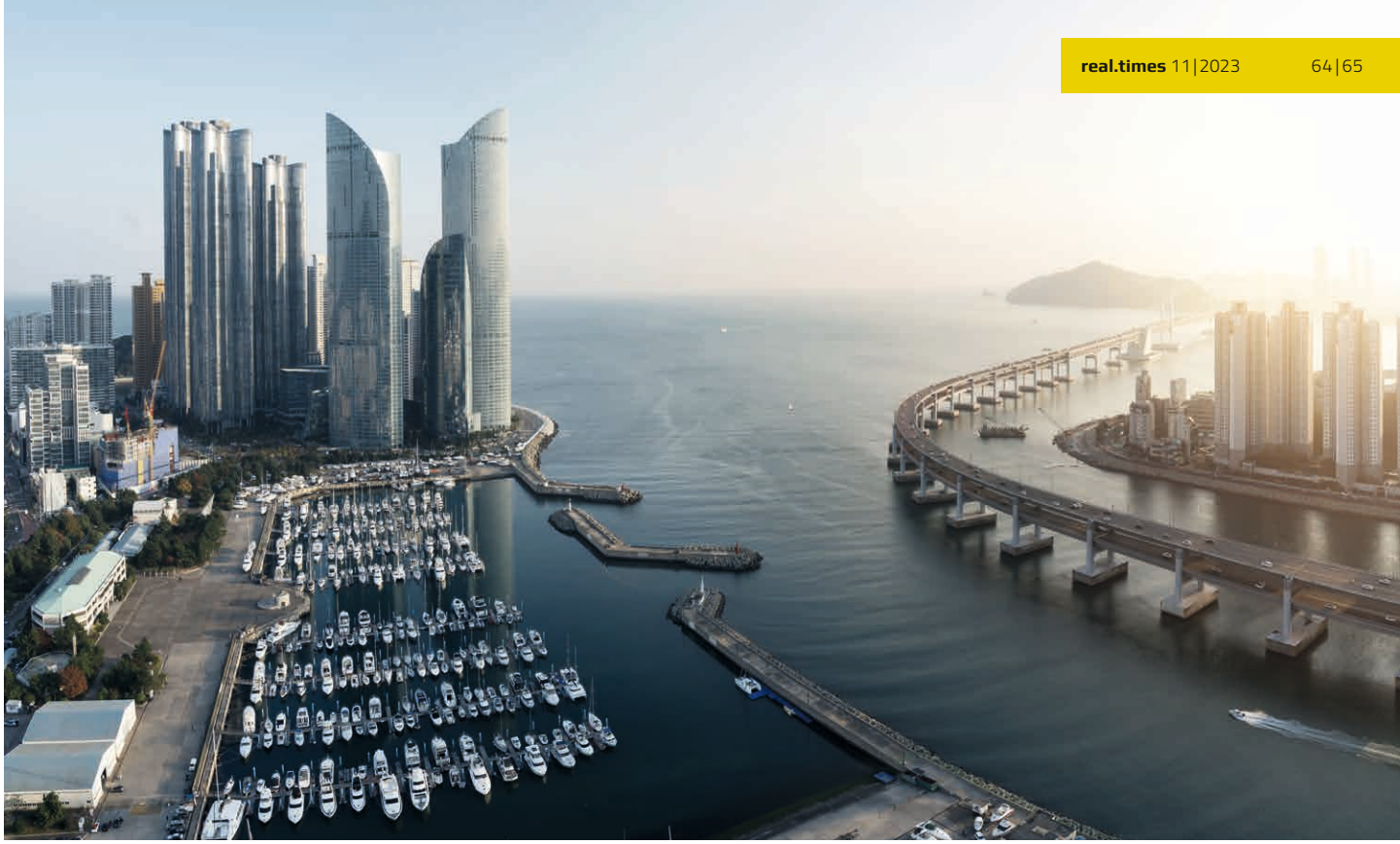
Bachmann YouTube videos cover a range of topics and explain complex concepts in an entertaining way. The Bachmann Training video series, for example, is dedicated to the operation of products such as SolutionCenter, PLC Developer, Scope3 and WebMI. In the 'Introduction to Smart Maintenance' series, our experts do a deep dive into condition monitoring. Terms are concisely explained, and working methods, as well as approaches to solutions, are clearly presented.

The YouTube channel is constantly being expanded and provides the possibility of looking into interesting topics, anywhere, anytime.

Stay up-to-date and follow us on YouTube.

»By sharing knowledge, we unlock new opportunities, empower others and create an environment for innovation and growth.«

Bachmann electronic GmbH



Bachmann continues its international expansion with its Maritime business unit.

Maritime

ON-SITE, WORLDWIDE

Even if a controller is purchased and installed in Europe, it may end up in use on the other side of the world. This is business as usual for Bachmann's Maritime business unit. And the team's global presence, alongside its multiple partners, ensures that their customers receive the level of support they need.

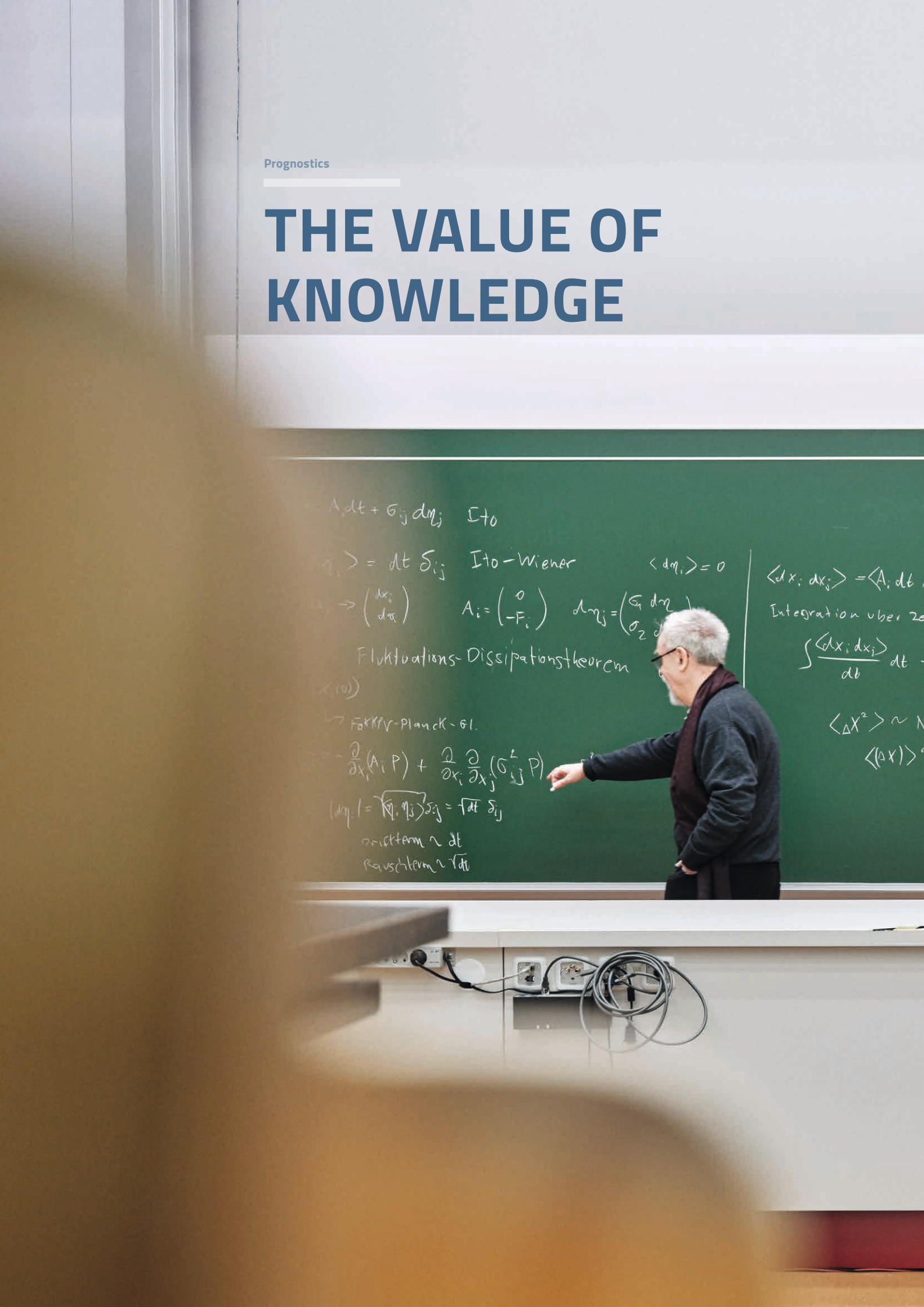
More and more customers in increasingly far-away countries are starting to rely on Bachmann technology and expertise. Bachmann opened its own office in South Korea just over two years ago: "Only with local employees can we understand the market in the right context and act appropriately," says Ronald Epskamp, Head of Business Unit Maritime. South Korea is home to some of the world's largest and most advanced shipyards. The Korean shipbuilding industry is known for innovation and research and development.

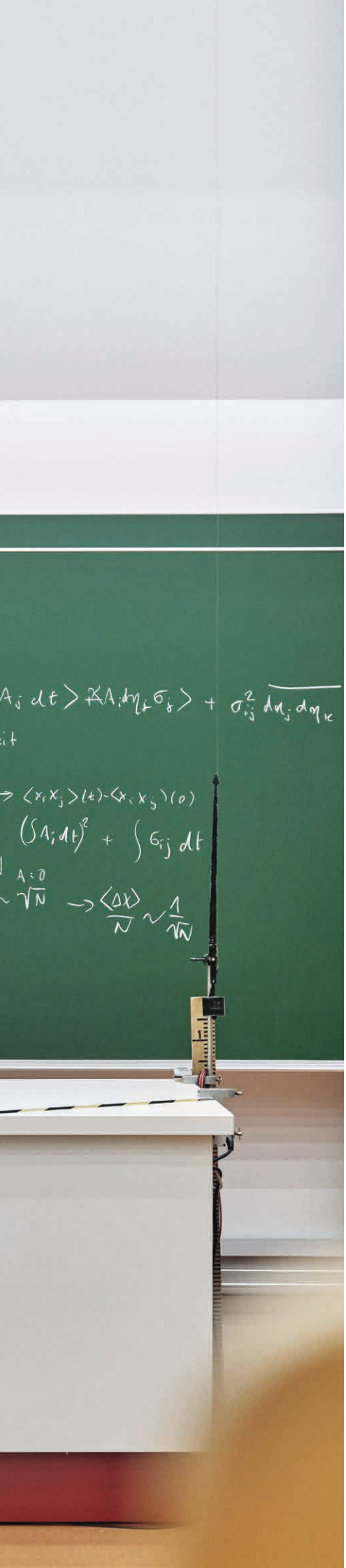
The business unit is already targeting more new markets. These include Dubai, where Bachmann exhibited at the Seatrade Maritime Middle East fair for the first time last May. UAE shipyards are currently positioning themselves to convert diesel-powered ships into hybrid drive solutions. Other target markets include Indonesia, where Epskamp and his team will present Bachmann controller solutions at the Indonesia Maritime Expo in the fall.

"Regardless of whether it's on our doorstep in Europe, in Asia or anywhere else in the world, our customers can rely on the same levels of service," says Ronald Epskamp. "And if the best way to achieve this is with our own, local office, then that is what we will do."

Prognostics

THE VALUE OF KNOWLEDGE





Energieversorgung Halle (EVH) supplies district heating and electricity cogenerated by two gas power plants. However, the most economically optimized use of the plants requires heat to be produced as close as possible to demand. Simultaneously, the generated electricity must be sold on the energy market under optimum conditions. Heat demand forecasting is therefore the most important variable. With the support of Bachmann Monitoring, EVH completely redesigned its consumption forecasting process. The team was led by Professor Michael Schulz. We talked to him about the models he built for EVH as well as their potential application in other fields.

Professor Schulz, can you briefly outline the forecasting model you developed for EV Halle?

Gladly. First of all, I would like to provide a little background on the mathematics and physics involved: The heat forecast program we designed is a process forecast, differentiating it from the more common status forecasts. It is based, among other things, on the continuous measurement of relevant process data. This is, for example, the operating data of the power plants and heat distribution stations, weather condition measurements from internal weather stations, and local, third-party weather forecasts. It continuously provides dynamic predictions about heat consumption and future operating data over a specified time period. This can be over six hours or up to ten days, depending on requirements.

Our prognosis considers the complete hydrodynamic transport dynamics in the entire pipeline system – this includes the energy, entropy and flow dynamics in the local district heating network, as well as the effect of the power plants as energy sources, and the heat transfer stations as extraction sources. From a mathematical point of view, the forecasting program contains a set of feedback algorithms for continuous error reduction and optimal process control. The prediction algorithm is self-learning, based on evolutionary, sometimes called genetic, methods, as well as feedback neural networks. These in turn reconstruct the optimal dynamics of the district heating network, fully accounting for thermodynamic and hydrodynamic balances, as well as fundamental laws.

Combining these procedures is relatively new and, as far as I am aware, being used for the first time at this level of detail at EVH.

Generally speaking, which forecasts is your approach best suited to?

This type of forecasting is suitable for any process where the sequence can be strictly algebraized, and where any measurement errors won't destroy the physical deterministic structure. The latter problem is solved by the fact that the built-in physical laws and technical rules drive any measurement-related forecast deviations back to the optimal situation – within a short period of time. This is also referred to as an attractive process.

And it opens up possible applications for all kinds of networks; from district heating, electricity, and chemical infrastructure to geothermal energy. In the latter case, I am referring primarily to deep geothermal energy, in which a reservoir of hot water is exploited through various extraction points. However, it is just as easy to forecast virtual flows, such as cash and financial items, or even insurance values. In this case, only the physical-technical rules would have to be substituted with 'not quite so fundamental' financial-mathematical laws.

However, long-term and irreversible condition changes, such as the aging of machines or the anticipation of machine damage, cannot be predicted using this method. Spatial structures, such as changes in geological structures in the subsurface alongside test drilling sites, also cannot be predicted with this method.

What data is specifically required for your process?

We need data that is available continuously, or at least in a regular cycle, that adequately describes the forecasted system. In our model at EVH, these are the flow and return temperatures, as well as the volume flows at the power plants, heat transfer stations, and other feed-in or extraction points. These can be, for example, solar fields and wind turbines for the operation of city heat pumps. In addition, we have weather condition measurements, such as temperature, wind speed, global irradiation, air humidity and air pressure.

Could this method be used to forecast energy requirements using a volatile energy source, for example renewable energy with sector coupling?

The EVH forecasts refer to thermal energy. And it doesn't matter which energy sources are used; gas turbines in the power plant, solar fields, the heat pumps of coupled wind energy, or the heat storage facilities available on the grid. Since the climatic conditions often fluctuate quite strongly, the required energy quantities are very volatile. Due to its mathematical structure and relatively high degree of deterministic processes in heat or power generation, the forecasting system can handle volatile quantities with sufficient accuracy.

In this context, the question arises: could a power plant's demand-driven operational model be changed to a revenue-driven model? Was that a topic at EVH?

The question of a demand-driven vs a profit-oriented process is always determined by how the products are used. As a civil task, thermal energy generation is always demand-driven, as is the case with EVH. But their power plants can simultaneously generate electrical energy, which is sold on the electricity market. And this is where profit comes into play. On the one hand, the generation of electrical energy is directly linked to the generation of thermal energy via the second law of thermodynamics. If the amount of heat generated in the next period can be accurately forecasted, then the electricity exchange can be reliably informed about an upcoming quantity of electrical energy. At EVH, this period currently covers a little over a day. On the one hand, this allows an optimal calculation of current electricity purchase prices and, on the other hand, the avoidance of severe contractual penalties that could result from exceeding or falling short of the agreed electricity volumes.

In some respects, thermal energy generation is also profit-driven, at least in part. This applies, for example, to the purchase of raw materials, which in Halle is currently natural

gas, but will be green hydrogen in the future. Likewise, heat storage facility charging and discharging can be optimized, and the sun and wind can be better utilized during suitable weather conditions. And, last but not least, optimizing process control can generate higher yields.

How can the forecasts be used to optimize process control?

Classic forecasts belong to open-loop methods. The results have no influence on the process, only on downstream events. For example, a weather forecast does not affect meteorological events, but it does affect agriculture, shipping, and vacation planning. It was a similar story at EVH. The forecasts were to be used primarily for trading on the electricity exchange, which has no discernible impact on the heat generation process. EVH's desire to use the forecasts to optimize operations management required changing the algorithm to a closed-loop method.

When process forecasts are used to control that same process, then any time the forecast deviates from actual operating parameters, which is unavoidable, can lead to unwanted changes in the operating parameters for the subsequent time period. Under certain circumstances, the error continues to accumulate. Therefore, the forecast must provide suitable feedback back into to the process.

In control theory, this is called the feedback term. It was only through the determination and coupling of this term into the previous algorithm that our method became a prognosis system that could be used to control the heating process. Each type of controller requires exactly one control objective, without which the feedback term cannot be constructed. In fact, the control objective was constructed hierarchically, primarily pursuing a demand-driven process, but within the appropriate range of profit margin.

How does EVH's system deal with short-term changes, for example manual interventions or price changes on the spot market?

This question is multilayered. Short-term, manual interventions in operations management, such as repairs, are quickly detected due to the algorithm's closed-loop structure. These are taken into account for the next forecast. The current record for this to take place is 15 minutes. Due to system inertia, several hours may pass before this manipulation is fully detected. This delay is down to the fact that the hot water in the primary circuit needs up to 8 hours until it arrives back at the power plant in a cool state – and that our influence on this hot water within the network is limited. However, this additional error nevertheless remains marginal.

As a rule, the thermal energy spot market is out of the question for local district suppliers. Over the medium term, EVH always trades electrical energy based on pre-arranged prices. However, with a short-term forecast over a 5-minute period or more, trading on the spot market could become a possibility. But this would require different integrated feedback term settings. Resource conservation is, however, part of the feedback algorithm. So, this also comes down to the controller, based on the forecast algorithm.

How did EVH deal with geopolitical upheavals such as 2022's gas crisis? These affect not only the availability of raw materials, but also consumer behavior. Can the models be recalibrated?

The rapid change in private, commercial and local district heating behavior due to the partial loss of natural gas supplies from spring 2022, and thus the significantly increased prices for it, made it necessary to improve the associated learning algorithm. In future, the changed heating behavior will be evaluated regionally, according to approximately 50 supply areas with urban Halle. Accordingly, the learned parameters that describe heat consumption will then be corrected. This is currently a manual process, taking place once or twice a year, but in the future it will become automatic.

Thank you very much for the interview and the insights, Professor Schulz.

Further information and background can also be found in the 'Automated optimization' article in real.times, issue 11.2021.

USING DATA INTELLIGENTLY

In the modern industrial landscape, continuous optimization of production processes is a crucial factor for competitiveness and success. A significant contribution to this optimization is provided by intelligent maintenance ('Smart Maintenance'). Dr. Andrea Coraddu is conducting research at the Delft University of Technology (TU Delft) on the digital twins of ships and offshore wind turbines. By combining artificial intelligence (AI), big data, and predictive analytics, he can detect signs of wear and potential disruptions to marine assets early on. We had a conversation with him.

Dr. Coraddu, how can a digital twin be used to develop smart maintenance strategies?

Digital twins can play a crucial role in predicting the condition of offshore systems. This includes, for example, ship hulls, propellers, or the mooring lines of floating offshore wind turbines. By creating a virtual image of these systems and simulating real conditions, digital twins can help engineers monitor performance, predict failures, and thus optimize maintenance schedules.

Can you give us a specific, current example?

One significant issue is the buildup of detritus on a ship's hull or propulsion propeller. The accumulation of microorganisms, plants, and animals on surfaces below the waterline is known as biofouling. As it increases over time, hull resistance increases. Propeller efficiency decreases, and with it the speed of the ship. Maintaining the desired speed therefore requires more engine power. But more engine power means more fuel – and an increase in CO_2 emissions. Even a 1 mm thick layer of accumulated biofouling or lime deposits on a propeller noticeably increases surface roughness. Figures show that polishing a propeller can generate fuel savings of 6 to 12 percent. That's a lot, considering that the costs of fuel today account for about 40 to 60 percent of total shipping costs. Therefore, being able to recognize and describe these relationships more precisely really pays off.

How did you approach this issue?

First of all, we had to answer the question of how to detect relevant biofouling; relevant in this context meaning a reduction in vessel performance. Assessing a ship's performance decline due to biofouling on the hull and propeller is a challenge due to other variables such as wind, waves, currents, and varying efficiency of the propulsion engines. Additionally, any decision about when to clean the propeller and the hull also depends on the performance losses the ship operator or charterer is willing to accept. There is therefore no fixed timeframe for cleaning.

So, we decided to create a data-driven digital twin of the ship to predict loss of speed due to biofouling. To estimate this loss, we leveraged vast amounts of information collected by the onboard monitoring system's sensors, combined with the latest advances in shallow and deep learning. Today, we can affirm that the loss of speed assessed through our methods, for example the one based on Deep Extreme Learning Machines, offers an accurate representation of the hull's condition and propeller biofouling at any given point in time.

What does this mean for smart maintenance?

This information could be used to optimize the planning of maintenance measures. The cleaning of the hull and propeller is typically carried out at fixed intervals or in conjunction with other maintenance work. In practice, it could be carried out more (or less) frequently, depending on the actual condition of the hull and propeller. This would be based on criteria aimed at minimizing costs, fuel consumption, and emissions.

We also imagine that the proposed method could be used in the design phase to evaluate new technologies or ship components in terms of their energy and fuel efficiency. Here I am thinking of the development of new propeller geometries or assessing the benefits of using sails.

Thank you very much Dr. Coraddu.

Dr. Coraddu provided interesting insights into the use of digital twins for optimized maintenance planning at the Bachmann Technology Symposium on Offshore in May 2023.

Life Time Extension (LTE)

TOO YOUNG TO DIE

A significant number of Europe's onshore wind turbines are more than 15 years old. With a design lifetime period of 20 years as standard, operating licenses will start to expire over the coming years. Will these turbines need to be decommissioned? Or is there potential to continue operations? These are the questions operators are asking themselves. Bachmann has the answers.

LiTE*plus*

The Bachmann Solution

Around 30 percent of onshore wind turbines (WTGs) in Germany are facing shutdown within the coming years, meaning that around 12 GW of installed capacity would be removed from the grid, one by one. In Spain and Denmark, more than half of existing turbines will soon reach the end of their design life.

Economic life extension?

When the original service life (as specified in the type certificate) is reached, the operating license of a turbine expires. For its operators, this raises the question: What should we do? Dismantle the turbine without a replacement, or erect a new one, ideally with a higher output? The buzzword here is repowering. But this will only be possible at very limited locations; official requirements, such as extended minimum distance regulations, make it very difficult, if not impossible. In addition, resource bottlenecks and long lead times also come into play, not to mention the shortage of personnel and materials needed for construction.

Ambitious climate protection targets require a rapid conversion of our energy supply to renewable sources. It follows that the sustainable use of existing generation capacities will play an increasingly important role. Although the probability of fatigue-related damage increases towards the end of their design life, older plants often still have remaining lifetime.

This raises the question of whether Lifetime Extension (LTE) is possible, and what conditions would allow for continued safe and economical operation of the WTG.

Surveyance for operation extension

When a wind turbine is erected, it receives an operating permit for the duration of its intended service life, based on the manufacturer's type certificate. In the past, this was usually 20 years. Within the design lifetime, the stability of a turbine usually corresponds to its type certificate, provided that the turbine is operated and maintained within its operating limits and in compliance with the manufacturer's maintenance instructions.

Any extension of the operational lifetime of a plant beyond the originally prescribed design life requires a continued operations permit. The required 'Assessment and Verification of the Lifetime Extension' (BPW) report is carried out by accredited experts and consists of two parts: The practical part, which corresponds to the familiar 'Recurring Inspection' (RI) already carried out regularly during operations. The second, analytical, part is undertaken by load calculation specialists such as P. E. Concepts GmbH, based in Essen, Germany. Matthias Saathoff, Team Lead Loads & Lifetime Extension at P. E. Concepts, outlines the scope of their services: "We calculate the remaining useful lifetime of the main plant components, assess risks, and support the surveyors with creating an action plan. This describes the steps required for the wind turbine to continue to operate safely in the future."

The resulting continued operation report is the basis of an application to the relevant licensing authority for an extension to the operating license.

Condition assessment

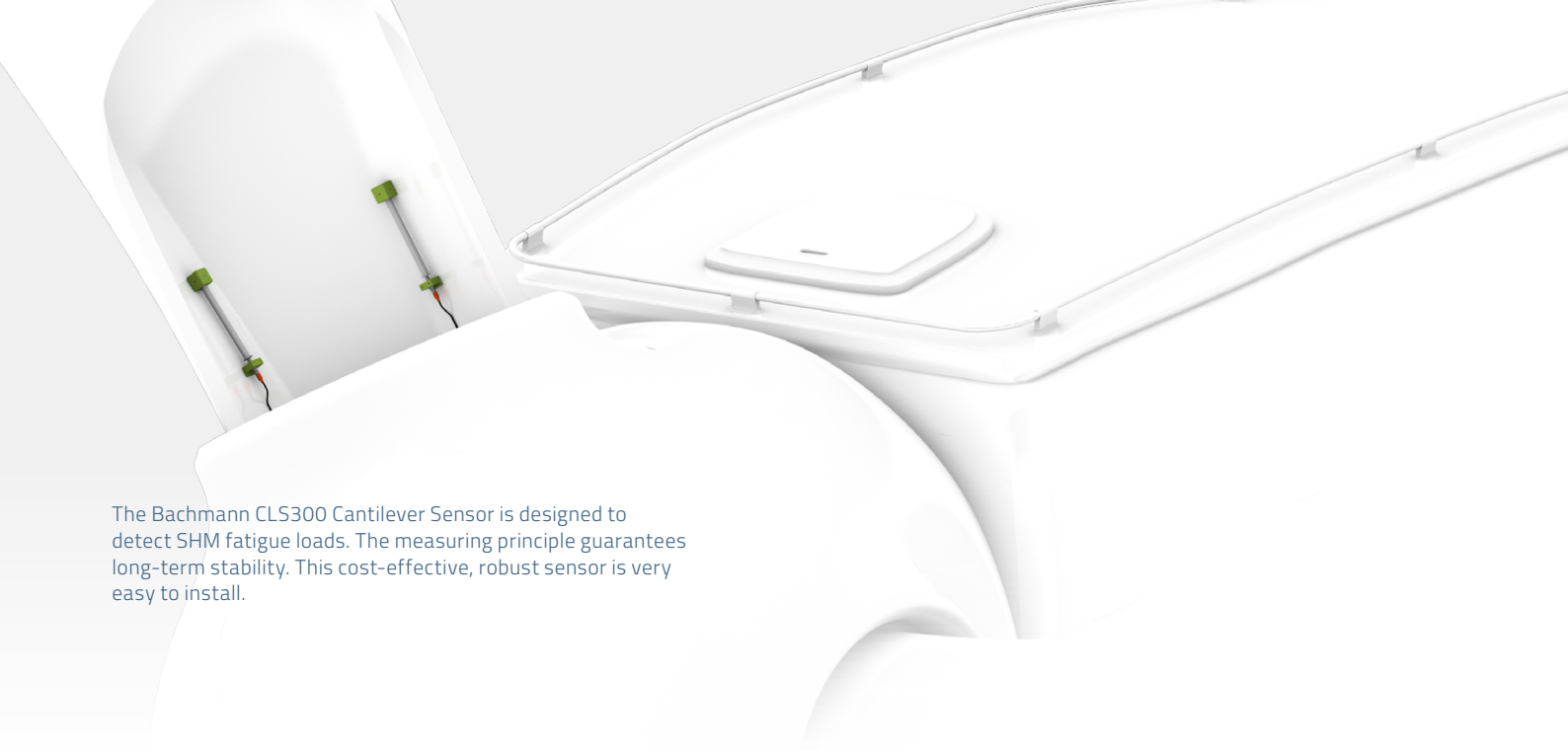
Technological and digital advances, as well as condition-based maintenance, improve the reliability, performance and longevity of existing wind turbines. Thanks to mandatory inspections carried out at regular intervals by independent experts, visible damage is detected, assessed and, if necessary, repaired.

Nevertheless, stability related structures and components age without any visible or measurable signs. We call this fatigue. The influence of which is therefore determined by calculations in the analytical part of the lifetime extension test. "You can neither see nor directly measure how much a material has aged during operations," says Marc Thomsen, Product Manager at Bachmann Monitoring. "Therefore, assessors must account for fatigue mathematically by determining load cycles experienced by the material and using them to calculate fatigue state. However, load measurement data is often unavailable, in which case load calculation is based on (often incomplete) operating data from SCADA systems, resulting in conservative assumptions about the fatigue state of the plant."

In the analytical part of an in-service inspection, experts can use appropriate data to determine whether a component has been exposed to lower loads than assumed during its design. If such data is unavailable, then every site-specific load the turbine has ever been exposed to must be determined, applying very high safety factors, based on wind conditions and other available information (such as the SCADA system). Although this conservative approach often extends the lifetime of the turbine, provided certain requirements are fulfilled such as component replacement and recurring inspections, esidual life potential often remains unutilized.

Making the most of potential life

Together with the experts, Bachmann aims to leverage this potential by introducing measurement-based analytical assessment to the optimized BPW. This approach would use actual measured load data instead of the estimated site-specific loads based on SCADA data. This enables load calcula-



The Bachmann CLS300 Cantilever Sensor is designed to detect SHM fatigue loads. The measuring principle guarantees long-term stability. This cost-effective, robust sensor is very easy to install.

tion experts during the analytical part of LTE assessment to determine available remaining service life with less conservative assumptions, allowing existing potential lifetime to be safely exploited. Remaining lifetimes are often significantly extended, compared to conventional LTE assessments. Furthermore, it avoids unnecessary measures and requirements, such as the replacement or further inspections of components.

Extensive assessment criteria

At present, further operation testing is carried out according to the 'Basic Principles for Performing an Assessment and Verification of the Lifetime Extension of Onshore Wind Energy Converters (BPW)' from the Bundesverband WindEnergie e.V. (BWE). Furthermore, corresponding regulations are currently in development; DNV is working on DNV-ST-0262 ('Life time extension of wind turbines') and IEC will soon release its TS 61400-28 ('Wind energy generation systems – Part 28: Through life management and life extension of wind power assets').

The analytical part of the report assesses structural components relevant to stability, i.e., those that transfer wind loads from the rotor blade to the foundation. This assessment is based on a comparison between the conditions assumed in the design and those that the turbine or the corresponding component actually experienced on site. "We refer to the external conditions, as well as the operating conditions of the plant itself," says Matthias Saathoff. "Based on this we calculate loads, derive fatigue levels of various components and, in turn, calculate remaining service life."

Quantifying loads

External conditions are calculated according to statistical values derived from existing plant operating data and various other sources. These include, for example, wind direction and frequency information, as well as the intensity of turbulence. "This also means that such an assessment must be individually calculated for each turbine," says Matthias Saathoff. "Turbulence, in particular, has a major impact on structural fatigue. And here, even within a park, there are very large load differences between individual turbines due to the impact of neighboring turbines." In addition to these parameters, the frequency of critical operating conditions is also evaluated and considered when calculating fatigue loads.

Evaluate uncertainties

The design life reserves assigned by the manufacturer in the type certificate are in part required by standards, but they also leave room for variation in plant design. Ideally, the on-site loads for an individual plant should be lower than the loads in the type test, resulting in potential remaining useful lifetime. "Because the standard BPW can only estimate site-specific loads based on relatively crude model assumptions about wind conditions and operations, there are inevitably large uncertainties that must be accounted for with high safety factors. This conservative approach often leaves existing potential unutilized," says the expert.

Reduce uncertainties

The next goal is to reduce these uncertainties, and the required safety factors, by means of a measurement-based approach that makes optimum use of existing design reserves. "Basically, you can only improve accuracy, and thereby safety, if you have the most precise knowledge possible of actual plant conditions," explains Marc Thomsen. "In this context, the acquisition of load measurement data improves the overall input data for determining park-specific loads during the analytical part of lifetime extension testing."

Structural Health Monitoring provides the foundation

This topic has occupied the Product Manager for some time. He is responsible for 'Structural Health Monitoring (SHM)', a recent expansion of the Bachmann Monitoring CMS product portfolio for wind turbines. Bachmann's Cantilever Sensors (CLS) have made it possible to reliably and straightforwardly record not only rotor blade loads, but also loads on the turbine tower and foundation structures. "Continuous CLS signal recording provides data that can be used to assess the plant-specific remaining service life of structural components," says Thomsen.

Ideally, such sensors would have been installed when the turbine was erected, making the turbine's entire load history available. "Offshore, a certain number of turbines within a wind farm are always equipped with measuring systems. However, for new projects, operators are recognizing the benefits and are increasingly equipping every single turbine," says Thomsen. Any potential lifetime extension for an offshore wind turbine plays a major role for investors right from the start. Therefore, strain and acceleration measurement sensors are often installed at different heights of the tower and foundation structure. "You can use these to calculate loads, directly evaluate the entire structure, and draw conclusions about overall fatigue state."

Anticipate the past

The more measurement data we have about the history of a plant, the more we know about the loads it has experienced, and the more precisely we can forecast its continued operation. This awareness was not there 15 years ago. That's why you don't find such technology in older onshore wind farms, so there isn't a solid database of load data to fall back on.

Measuring backwards into the past is impossible, so the experts at Bachmann and P. E. Concept had to find solutions that would allow Saathoff's structural evaluation model to be 'calibrated' with current data.

"Of course, measurement data collected towards the end of the service life doesn't represent the entire history," says Thomsen. But the longer you measure, the less conservative the assumptions become. And the closer you are to reality, the more precisely you can map loads to which the turbine was really subjected. "At this point, we just have to live with compromises," says Thomsen. Even if measurement data is only collected temporarily, perhaps over six months, while you can't completely reproduce or reconstruct the past, it's definitely an improvement on relying solely on SCADA data and theoretical wind models, he explains. Another advantage is continuous ongoing plant monitoring, says Thomsen: "You are no longer flying blind during extended operation. If something changes, you have the chance to identify it immediately and reduce risk during the lifetime extension phase.

Continuous load data also enables better planning, especially regarding economic decision making during the period of lifetime extension. Furthermore, the impact of any changes to the wind park layout (such as expansions or repowering) that affect individual turbine loads, and therefore remaining lifetime, can be minimized, reducing operational constraints and related loss of yield.

Durable sensor technology

Bachmann measurement technology is not only easy and inexpensive to install; it is also extremely stable over the long term: "Strain gauges are often used for structural monitoring. They are suitable for temporary, short-term measurements, but never for 20 years. This measurement technology is sensitive – it ages and is not very robust," explains Marc Thomsen.

The Cantilever Sensors (CLS) from Bachmann, on the other hand, are easy to install, inexpensive and durable. Because the adhesive connections and the sensor element itself do not have any impact on the forces at work on the turbine, any potential aging won't influence measurement results. In addition, the CLS measures over a significantly longer distance than a classic strain gauge. This reduces the influence of any local inhomogeneities at the point of measurement.

In addition to robust sensor technology, Bachmann deliberately opted for easy-to-install components when designing the measuring system, which can be installed with minimum effort, for example during the course of a practical lifetime extension assessment. "Overall, we deliver a lean, low-cost solution that is particularly suitable for older and smaller plants."

Properly prepared data

The Bachmann SHM toolbox is an extensive one. In addition to the measurement modules for data acquisition, companies like P. E. Concepts appreciate Bachmann's expertise in data preparation: "We get exactly what we need," Mathias Saathoff is pleased to say, adding: "We don't have to dig through a mound of measurement data, we get it from Bachmann in exactly the right format to feed into our load calculations relatively easily."

Bachmann's 'Structural Health Monitoring Software (CMSSHM)' is a software plug-in that enables not only the recording of raw data, but also further processing. Methods such as rainflow counting are used to determine damage-equivalent loads, which enables ongoing assessment of the fatigue state of the structure. It is also possible to synchronize with existing SCADA data.
"This is exactly what we need for our calculations," says Matthias Saathoff.

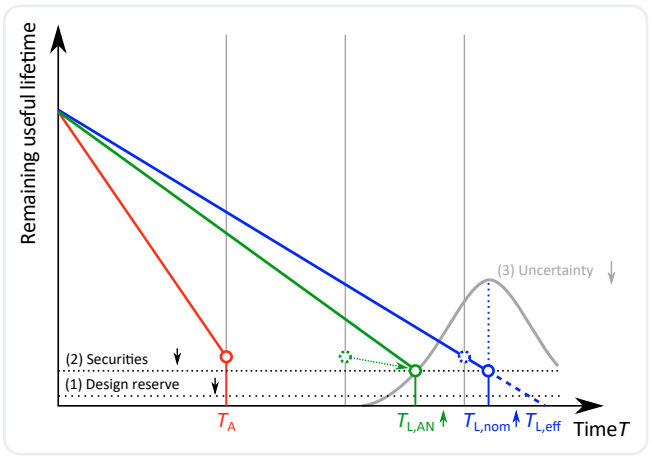
Lifetime Extension

Continuing to operate wind turbines beyond their intended end of life not only keeps up the pace of the energy transition in times of resource scarcity;
it also reduces waste from decommissioning and preserves the local economic benefits of existing plants.

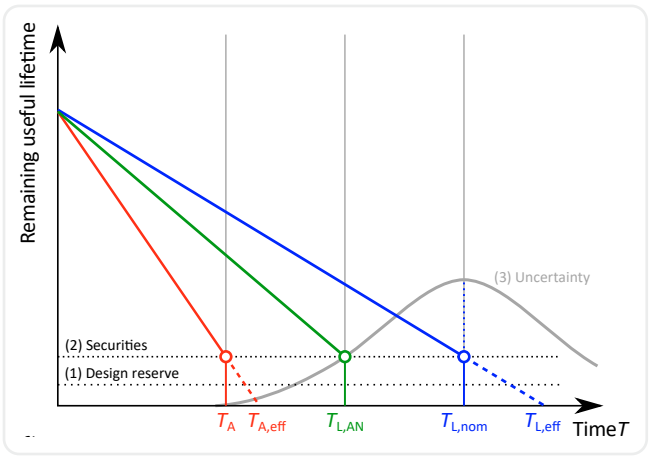
Plant surveyance is therefore extremely important. The more precise the information on which experts can base their analyses, the easier and more reliably they can identify potential remaining service life. Structural health monitoring provides decisive value add. In addition, it improves safety throughout the period of extended lifetime.

Bachmann is equipped with the technology and know-how to identify remaining potential lifetime according to solid data

T_A ..... Design lifetime (type certificate)
$T_{A,eff}$ ..... Effective design lifetime
$T_{L,nom}$ ..... Site-specific computable lifetime
$T_{L,eff}$ ..... Effective, actual lifetime
$T_{L,AN}$ ..... Calculated lifetime



The analytical assessment is built on uncertainties.
Design reserves, safety reserves and uncertainties in the modeling process generate a conservative assessment of remaining service life.



If measured data on the load on the structure are available, then uncertainties can be reduced, allowing a less conservative calculation of remaining service life.

Real LTE

A COMPLETELY NEW IMAGE

The background

The operator of an onshore 1.5 MW wind turbine, which often faced difficult site conditions, investigated whether the turbine could remain connected to the grid after the expiration of its operating licenses (at the end of the design life). For this purpose, the operator commissioned a surveyor to provide a life extension analysis based on the available data: Plant documentation was reviewed, SCADA data analyzed and wind assessments evaluated. The result was that further operation of the turbine was impossible due to the high turbulence intensity to which it was subjected, its 20-year service life, the number of rotor revolutions, etc. No lifetime extension could be granted because the remaining service life of the tower and foundation came out at zero – due to fatigue.

Nonetheless, at least seven years of remaining lifetime was calculated for other load-bearing components, such as blade roots, bearing bolts or rotor shafts (Fig., left column "Conventional LTE Assessment without Bachmann Load Data ").

Analytical reporting, beyond the standard

The operator then commissioned P.E. Concepts to prepare an extended analytical assessment based on measurement data, in which Bachmann's technology and expertise came into play: Measurement technology was installed at selected positions on the base of the tower, which was used to record structural loads over a six-month period, following which the data was processed for analytical assessment. "Put simply, we were able to correct our previous assumptions about the plant's history by correlating the load and operating data recorded within the measurement campaign," says Matthias Saathoff, Team Lead Loads & Lifetime Extension at P.E. Concepts. It then became possible to make more precise statements about the loads the WTG actually encountered during its years of operation. "Our goal is to reduce uncertainty and identify design reserves. With the load measurements and corresponding data from the SCADA system, we can calculate reserves much less conservatively," emphasizes Saathoff.

Based on the information in the type test and their structural calculations, the experts were able to determine that existing design reserves in the tower and foundation promised at least another 20 years of operation, contrary to the conventional assessment. Reserves were also identified for other components (Fig., right column "LTE Assessment optimized with Bachmann Load Data").

From zero to eight. Or even eleven.

The new results show that lifetime extension is not limited by the tower and foundation, but rather by the blade bearing bolts. Their values remained almost unchanged at just under eight years in the recalculation, since fatigue here relates mostly to the known number of rotor revolutions. "Instead of having to dismantle the turbine, the measurement-based assessment provides the basis for at least eight years of extended lifetime. Replacing the blade bearing bolts would increase it to around 11 years," says Marc Thomsen, Product Manager at Bachmann Monitoring. With Bachmann's help, the experts uncovered a remarkable potential for turbine lifetime extension.

Without the extension of the analytical report with actual measurements, the wind turbine would have been dismantled: The remaining service life for the tower and foundation came out at zero. After measurement, these values were adjusted.

Component	Remaining service life	
	before Measurement	after Measurement
Blade root	6.9	11.9
Blade bearing bolts	7.3	**7.9**
Hub	7.3	**11.3**
Rotor shaft	18.8	>20
Main frame	>20	>20
Yaw bearing bolts	8.0	>20
Tower & Foundation	**0.0**	>20
Other	>20	>20

Co-simulation with M-Target for Simulink®

HARDWARE-IN-THE-LOOP WITH EXTERNAL SIMULATION COMPONENTS

Continuous plant optimization is a must for any manufacturer wanting to survive today's competitive global market environment. As to how – the best answers can be found much faster with the consistent, model-based development of control and automation solutions. Co-simulation now enables developers to integrate external simulation components into their hardware-in-the-loop test bench. This expands options or testing, increases the quality of software, and further reduces time-to-market.

Better automation solutions in less time

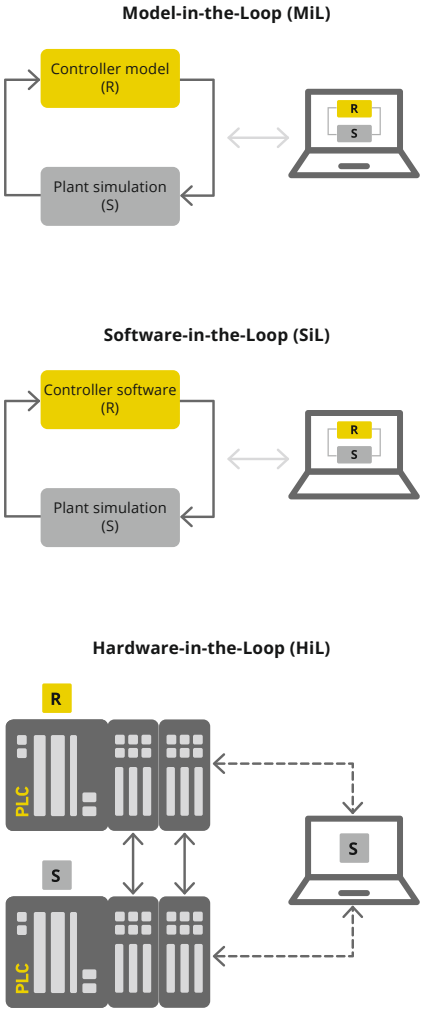
Verifying new control and automation algorithms under real operating conditions and interruptions often requires a great deal of effort. In addition, physical access to a real plant is a prerequisite. Model-based development provides an answer, enabling the simulation of relevant plant conditions and deviations – such as ambient temperature, ocean waves, electrical load situation in the supply network, or wind turbulence. Hardware and software can thus be reproducibly tested under real conditions before commissioning. It becomes easier to understand processes and to detect errors earlier, therefore significantly reducing the duration and cost of commissioning. Furthermore, there is no risk of damage to the plant, or even plant destruction, while verifying its response to dangerous operating conditions.

Three test levels

In model-based development, a distinction is made between three test levels: Model-in-the-Loop (MiL), Software-in-the-Loop (SiL) and Hardware-in-the-Loop (HiL).

With MiL, the controller and plant model are simulated and tested together on a development PC. With SiL, the control program is compiled into control code and tested on the development PC using the plant model. This makes it possible to verify plant functionality under all operating conditions, as well as the build process, along with the integration of external code sources.

Hardware-in-the-loop goes one step further, whereby hardware and software are subjected to a combined test. Control program and other applications, such as visualization, logging or operational management, are executed in real time directly on the target system: a Bachmann controller. The plant model is also transferred to a real-time controller, closing the loop with the control and automation program. This test checks overall functionality on the selected target system, including the exchange of data between sub-applications, required CPU performance and I/O channel access. This test increases the safety and robustness of the entire automation solution.



The three test levels of model-based development: model-in-the-loop, software-in-the-loop and hardware-in-the-loop – the latter with optional interface control for even more realistic and flexible plant simulation.

Co-simulation with SimConnect blocks

If the selected plant model contains code from a third-party supplier, but with missing sources, then it isn't possible to generate a program that can be executed on a real-time controller. Co-simulation helps: During the hardware-in-the-loop test bench, the plant model is still processed in MATLAB®/Simulink® on an external engineering PC, and it then exchanges data with the Bachmann controller control program via the new SimConnect blocks. The advantage here is that, thanks to the PC or server hardware, computing power can be scaled according to model complexity. If bus or structural elements are exchanged between PC and controller, the M-Target for Simulink® SimConnect interface automatically takes into account differing variable storage in the memory of each system. Read more about this on page 40.

Even closer to reality

If an interface controller is connected between the target controller and the simulation PC during HiL setup, then it is possible to check the input/output interface of the individual channels. The advantages of SimConnect still apply.

With this advanced approach to model-based development, time to market is reduced to a minimum and, at the same time, the automation solution has been thoroughly tested before it is rolled out.

You will find further details about this assembly on our website.

Bachmann's Offshore Symposium

SOLVING CHALLENGES TOGETHER

"The wind energy and maritime industries must stand together." This is how Gabriel Schwanzer, Chief Marketing, Sales and Automation and Director Business Unit Wind at Bachmann electronic opened the company's inaugural 'Offshore Technology Symposium'. In May this year, around 100 participants took part in the invaluable exchange of knowledge and experience. The two days at Hamburg's historic 'Speicherbau' were characterized by exciting insights, inspiring discussions, valuable networking, and an ambient environment.

»The wind energy and maritime industries must stand together.«

Gabriel Schwanzer
Chief Marketing, Sales and Automation and
Director Business Unit Wind, Bachmann electronic

A necessary addition of more than 30 GW of capacity in wind – in Europe, per year. How this can be achieved under current conditions is the question bothering Schwanzer. There is a global shortage of tens of thousands of workers, for both manufacturers and operators, compounded by ongoing demographic developments. Material shortages and unstable supply chains are adding to the problem. It is therefore critical to make better use of existing resources and, wherever possible, to use them for longer and increase their availability. This dilemma can only be solved, if at all, through collaboration, said Schwanzer, introducing the Bachmann initiative: "With the Offshore Technology Symposium, we want to get things rolling, work together, learn from each other, and explore the opportunities available to both industries collectively."

The order of the day: Optimization

Holger Fritsch, Managing Director of Bachmann Monitoring, took up the idea in his introductory presentation, where he clarified once again the situation facing offshore industries today. In addition to personnel and specialist ships, up to 1,300 tons of material per GW are required to build a wind turbine – enormous amounts when measured against the European offshore expansion target of 135 GW by 2030. This is not only an unimaginable quantity, he said, but it includes materials also necessary for other growth industries, such as electromobility, and whose procurement is often challenging due to geopolitical disruptions. "If we can't construct the required number plants because we lack materials and personnel, then we have to make better use of existing ones," explained Holger Fritsch. Operating conditions have to be optimized, wear reduced and energy losses minimized. There are two drivers here, said Fritsch: "First, we should try to use existing resources more efficiently, and second, we should consider how we can extend the lifetime of existing plants." His calculations are impressive: If it were possible to achieve a yield only 5% higher with existing turbines, we would eliminate the need for 620 new 6-MW-class wind turbines – saving over 3 million tons of materials.

Knowledge-based maintenance

Selecting the appropriate maintenance strategy often has a decisive influence on plant productivity and, with it, profitability. David Futter, Head of Condition Monitoring Consultancy at Bachmann Monitoring, compared the three well-known strategies of reactive, preventive and condition-based maintenance and discussed their advantages and disadvantages. His plea was for a fourth way: knowledge-based maintenance, or 'Smart Maintenance'. It has enormous potential, he argued, because it supports planning, reduces unnecessary work and prevents unplanned downtime. Condition Monitoring Systems (CMS) have a role to play, but only a small one when it comes to the overall strategy, emphasized Futter. Only when the data provided by a CMS is appropriately contextu-

alized – availability of personnel and materials, weather conditions, etc. – does knowledge emerge. "For the analysis, you still a specialist with good knowledge of the plant and the on-site conditions," said the monitoring expert, adding, "Reviews are important to see if what you have selected and implemented is really providing benefits."

Dr. Andrea Coraddu, Associate Professor in the Department of Maritime and Transport Engineering at Delft University of Technology (TU Delft), later echoed these thoughts. He emphasized that data is essentially just facts without context. However, information emerges when these facts are considered alongside one another. "This is how we build knowledge. And if we use this to derive principles, we can we identify the source of emerging faults and damages, and counteract them accordingly," said the scientist. In his view, digital twins therefore play an important role in predictions about the condition of plants (see interview with Dr. Coraddu on page 70). "By creating a virtual system image and simulating real-world conditions, digital twins can help engineers monitor performance, predict failures and optimize maintenance schedules," said Dr. Coraddu.

The stakeholder view

In the subsequent discussion between energy suppliers, investors, plant operators and manufacturers, attendees agreed that there is no way around Smart Maintenance (SM). Without this strategy, economic plant operation is no longer possible. Every turbine failure equates to losses, for wind farm operators as well as for the owners of specialist vessels. They are often subject to heavy fines when ships, or parts of the turbine, are unavailable. However, participants also agreed that there is an urgent need for harmonization, or better standardization, of data access and usage. On the one hand, this would create operational reliability through standardized criteria, and at the same time help to create economic advantage. Today, system suppliers often aim to collect their own data without sharing it, leaving plant owners with multiple different access points. And this raises the question of who bears the costs if something goes wrong: The respective manufacturer, or the provider responsible for monitoring. This is one more reason why SM is a Herculean task; and it is important to consolidate this knowledge.

Practice and future

The second part of the symposium built a bridge to the practice and future of Smart Maintenance. Matthias Saathoff, Team Lead Loads & Lifetime Extension at P. E. Concepts, initially posed a question that all wind turbine operators ask themselves: Is it possible to significantly extend turbine operating lifetimes, and, if so, how? For safety reasons, operating licenses are calculated with conservative reserves. Saathoff showed how, with access to the right data, it is possible to prove that continued operation remains safe. This includes existing data, for example from the SCADA system, from meteorology or condition and maintenance reports from the

»Everyone has a couple of plants; and manufacturers think for themselves. We have to communicate with one another to make real progress. It was interesting to see that our challenges in the maritime sector are much more challenging than for wind turbines. Where turbines are of the same type, we have almost no two ships which are constructed identically. And even if we do, one shipowner rarely owns two of the same. That's why it's important to collaborate. And events like this help a lot, because you find a wealth of experience to draw on.«

Louis Zander
Director Sales & Service Hamburg,
REINTJES Group

»Analysis still requires a specialist with good knowledge of the plant and on-site conditions.«

David Futter
Department Leader
Condition Monitoring Consultancy
at Bachmann Monitoring

»Only when we use our knowledge to understand principles, can we identify the source of faults or damage, and counteract them accordingly.«

Dr. Andrea Coraddu
Associate Professor at Delft University of Technology (TU Delft) in the Department of Maritime and Transport Engineering

»Making data accessible is one thing. The problem is the absence of standards. We have a common goal, and therefore need to develop a common view. An event like this is helpful for that.«

Dr. Meik Schlechtingen
Teamleader Condition Monitoring & Structural Health Monitoring bei EnBW

turbine. But it also includes also data from a structural analysis of the tower and foundation. The latter could likely be achieved via measurement campaigns, but this would only represent snapshots. It would be better to install Structural Health Monitoring (SHM)systems from the outset. This makes it easier to prove that on-site loads during the operating period were smaller than those anticipated by design conditions. "Fatigue cannot be measured, but with SHM, we can detect load cycles," said Saathoff. This measurement data can be transferred to a model, compared with other plant layouts, and conclusions can be drawn about other components that are not directly measurable, he added. Matthias Saathoff also mentioned Smart Maintenance: "It can be used to locate highly stressed components, determine where failures often occur, and identify problems. That provides the basis for risk assessment." Finally, Saathoff used examples from two real plants to show how, based on data, a few extra years of continued operation could be easily achieved with the targeted replacement of critical components.

Assessing probabilities of default

Matthias Vittinghoff, Key Account Manager Service Central and Eastern Europe at ZF Group, presented a possible approach to reducing the Levelized Cost of Electricity (LCoE) with the help of data, based on their service offering 'Thrive'. This proactive concept combines data analysis with ZF transmissions know-how and uses it to estimate the probability of component failure – in advance. Targeted action recommendations are also derived from fault messages, making it easier to plan on-site inspections and, if necessary, to procure spare parts well in advance. Vittinghoff offered concrete figures: "Due to the optimized and automated CMS warning processing and service execution alone, the annual energy production (AEP) at park level can be improved by up to 0.4%."

Innovative products

Finally, research institutions and manufacturers offered interesting insights into novel smart maintenance product solutions. The Fraunhofer Institute presented Q-Bo®, a system for the energy-autonomous monitoring of bolted joints. Energy supply for sensors and radio transmission is a demanding task. This is achieved via solar cells or thermoelectric converters, enabling wireless installation and eliminating the need to change batteries. The Microsensys company then demonstrated possibilities for the wireless integration of RFID elements.

The company eolotec presented an approach for optimizing critical blade and main bearings on wind turbines. It showed how bearings can be replaced without the use of a cost-intensive crane. In the subsequent presentation, a specialist from Dr. E. Horn once again highlighted the importance of consistent and valid measured values for condition-based maintenance. This is the only way to optimize operations across all systems and ensure overall functionality. And this is ultimately a prerequisite for digitalization, for example with regard to maritime routing or autonomous vessel control.

Is AI art?

The series of presentations was concluded by Prof. Dr. Martin Huhn from the Lübeck University of Technology with the provocative question: "Artificial intelligence – is it art, or could it disappear? He showed how AI is already an integral part of condition monitoring and that its importance is increasing as data volumes grow. He tried to illustrate the question of the limits of AI using ChatGPT. In his opinion, there is an urgent need for new specializations in mechanical engineering studies with 'Data Science for Engineers', because the domain knowledge of mechanical engineering is required. He made a bold statement: "It's easier to teach AI algorithms to a mechanical engineer than it is to teach mechanical engineering to an AI expert." He concluded by warning the auditorium that it was imperative to consider the medium- and long-term implications of the further development of AI. The German Ethics Council provides a good basis.

Critical security?

Advancing digitalization, condition monitoring, smart maintenance, structural health monitoring and AI were just a few of the keywords openly discussed by symposium attendees – in the context of offshore applications. More and more data is being collected, and so it was not surprising that the concluding panel discussion was dominated by questions like: How do we combine data from countless measuring systems? How do we use data correctly? How do we achieve high data quality? And above all, how do we achieve the necessary data security? From these issues, the latter, cybersecurity, has first priority. It was noted that a large number of OT installations are still based on old technology. Here in particular, the industry will have to position itself to ensure appropriate system resilience. And, last but not least, appropriate training and further education are required to raise awareness among employees and to lead them towards the future.

Success all round

For the participants, the Technology Symposium in Hamburg was undoubtedly a great success. Technological possibilities were explored together, discussions were held and, last but not least, new contacts were made. The insights and impulses gained by participants during these two days will certainly contribute to further advancement of the industry, paving the way for a more efficient, safer and more sustainable offshore energy supply.

»If we are already struggling to erect as many plants as we want due to missing materials and personnel, then we need to make more of what we already have.«

Holger Fritsch
Managing Director of Bachmann Monitoring GmbH

Inside Bachmann

THROUGH THE WAVES AND INTO THE AIR

The job description for the Bachmann offshore crew is to equip existing wind turbines with new sensor and monitoring technology. They complete the installation, document everything, and ensure that the collected measurement data provides exactly what's needed for safe and economical turbine operation. Furthermore: Their experience in the field is then fed back into the ongoing development of systems and solutions at Bachmann. We accompanied the team for a day during their assignment in the North Sea.

Thomas Stauche is on the ladder mounting a new sensor. He is happy and relaxed – despite being about 100 meters up the tower of a wind turbine. Just a few days ago he was in Japan, now he's in Germany, more precisely: he's in the middle of the North Sea. Thomas is part of the Bachmann offshore team, which works on offshore pilot plants worldwide. The team consists of five people. Technicians, engineers, allrounders – that's probably the best way to describe the squad. "We could do with a few more of this kind of employee. But all-round specialists are very rare on the labor market," laments Holger Fritsch, Managing Director at Bachmann Monitoring, the competence center for condition monitoring within the Bachmann Group.

Danger. Everywhere.

Despite the calm that Thomas radiates, working on a wind turbine brings with it a large serving of thrills and risks. Even though everyone is well secured when working at height, and they have all completed the appropriate training, working on an offshore turbine remains dangerous. Special care and caution are required with each move and every step.

In particular, one of the greatest potential hazards is moving between the ship or helicopter and the wind turbine. You don't just need to be physically fit; you need to have your head in the right place if you want to make it safely onto the wind turbine.

Today's approach to the Nordsee One wind farm is already turbulent: With a swell of more than three meters, there was talk of canceling the trip to the farm. After some delays, the gods on high give us the all clear. The trip involves an hour-long ride through the North Sea waves. Then comes the risky crossing onto the rig: the ship's captain holds the bow against the monopile at full thrust. And here we find a ladder. The ship rises and falls, squeaking and crashing to the rhythm of the waves – swell is just at the limit for a permissible climb. On the command of the boarding chief, we set off to "3-2-1": grabbing the ladder and making the 20-meter climb to the supply platform as fast as possible. The first five or six steps must be climbed quickly and safely, otherwise the ship will catch you on the next wave. Thomas wouldn't want to do any other job. For him, this is where future technology and modern adventure combine into a fulfilling symbiosis.

Adventure? Adventure!

It's rare for a real-life system to conform to the original plans, which can be challenging when the team arrives on site: "You have to be able to improvise," says Frank Köllner. Sometimes the ladder is mounted in a different place in the tower. And you have to be prepared for unexpected mid-levels and unmarked obstacles. In such cases, cable routing has to be rearranged without further ado, which involves selecting new mounting surfaces. "None of this would be too dramatic if you could step outside to your service van for a moment and grab some additional materials," laughs Frank. "But out here, it's just the open sea." All the materials the team brings with them have to fit; connecting cables are sized almost to the meter. Things get particularly tricky if parts are missing and continuing to work is no longer possible: A whole day can be lost. Days at sea are expensive, and every minute at the plant counts.

Experience. In every product.

The team's offshore turbine experience is invaluable because it gets fed back into Bachmann's R&D, helping to make the products what they are: Solutions that exactly meet the requirements on site. Durable, reliable products with efficient, uncomplicated installation and commissioning. This is the only way for the installation crew to meet the tight time windows available.

The fruits of this experience are visible, for example, in the development of the Bachmann Cantilever Sensor (CLS). As well as long-term stability, the biggest emphasis was on simple installation. Why? Well, anyone who has ever retrofitted a sensor 140 meters up a rotor blade at sea during wind force 5 to 6 knows exactly why: The turbine wobbles and sways so much that exact mounting with conventional material is impossible. For many sensors on the market, installation is extremely time-consuming and also prone to error – often due to the installation accuracy required by the system. Moreover, components just don't stand up to the harsh field of application. "The CLS just does it better," grins Thomas Stauche , who is currently connecting a cable to the sensor. "I can easily attach it even during poor conditions, and it is extremely robust."

No failures. Year on year.

In the end, only one thing really matters to the operator: How cost-effective is the solution? In addition to low capital expenditure, operators demand low installation and commissioning costs. It goes without saying that everything has to run smoothly for many years, with no breakdowns.

Operators therefore appreciate teams like Bachmann's, who take a holistic view of the entire retrofit, conversion or initial installation, ensuring that systems function right from the start. "A supposedly cost-effective sensor and system solution can quickly lead to one or two days of additional installation work," Holger Fritsch notes. "This blows away the supposed cost advantage of cheaper hardware."

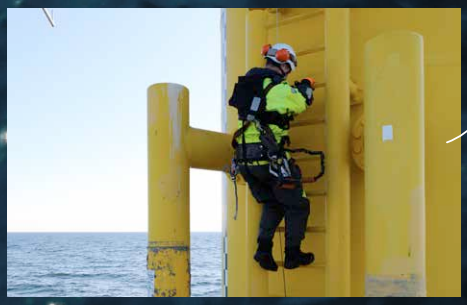
Our customers. Our partners.

With more than 50 years of experience in the world of automation, and over 20 years in the field of wind power plants, Bachmann stands out with its future-proof and robust installations. From the overall automation solution, to the energy management system; from the transfer of energy into the grid, to the tailor-made structural monitoring solution – more than 140,000 installed systems and connected services worldwide pretty much speak for themselves.

With Bachmann. For a secure energy future.

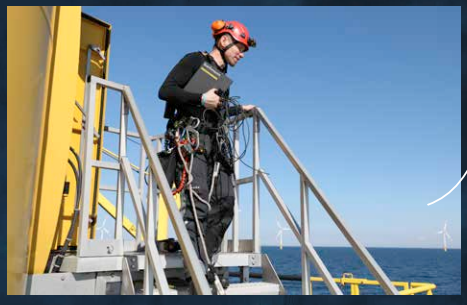
Nordsee One ahead:
The commute for Bachmann's offshore crew.

Thumbs up:
Crew and material are safely delivered to the facility.



"3–2–1"
– and up the ladder as fast as possible. Going from supply ship to wind turbine is one of the most critical moments.

Completely relaxed, despite being 100 meters above "ground":
Thomas Stauche from Bachmann's offshore team mounts a Cantilever Sensor inside the wind turbine tower.



"You have to be able to improvise here."
Dipl.-Ing. Frank Koellner, Manager Customer and Project Services at Bachmann Monitoring

EXHIBITIONS AND EVENTS

INDUSTRY

ALL ABOUT AUTOMATION
Hamburg, Germany
17. - 18.01.2024
Booth: OG-209

WIND

O&M AND SAFETY CONFERENCE
Coronado, San Diego, USA
21. - 23.02.2024

MARITIME

ASIA PACIFIC MARITIME
Singapore, Singapore
13. - 15.03.2024

RENEWABLE ENERGY

VOLTA-XCHANGE
Stuttgart, Germany
14.03.2024

WIND

WINDEUROPE
Bilbao, Spain
20. - 22.03.2024
Booth: 1-B100

MARITIME

SEA JAPAN
Tokyo, Japan
10. - 12.04.2024

MARITIME WIND

2. TECHNOLOGIE-SYMPOSIUM
Hamburg, Germany
(Date not defined yet)

WIND

CLEANPOWER
Minneapolis, MN, USA
06. - 09.05.2024
Booth: 1220

INDUSTRY

ALL ABOUT AUTOMATION
Heilbronn, Germany
15. - 16.05.2024

WIND

MICROGRID CONFERENCE
Baltimore, MD, USA
15. - 16.05.2024

INDUSTRY

SPS ITALIA
Parma, Italy
28. - 30.05.2024

MARITIME

ELECTRIC & HYBRID MARINE
Amsterdam, The Netherlands
18. - 20.06.2024

RENEWABLE ENERGY

EES EUROPE
Munich, Germany
19. - 21.06.2024

WIND

ROSTOCK WIND
Rostock, Germany
09.08.2024

MARITIME

SMM
Hamburg, Germany
03. - 06.09.2024

WIND

WINDENERGY
Hamburg, Germany
24. - 27.09.2024
Booth: A4.219

WIND

CHINA WIND POWER
Beijing, China
October 2024
(Date not defined yet)

WIND

BRAZIL WINDPOWER
Sao Paulo, Brasil
22. - 24.10.2024

WIND

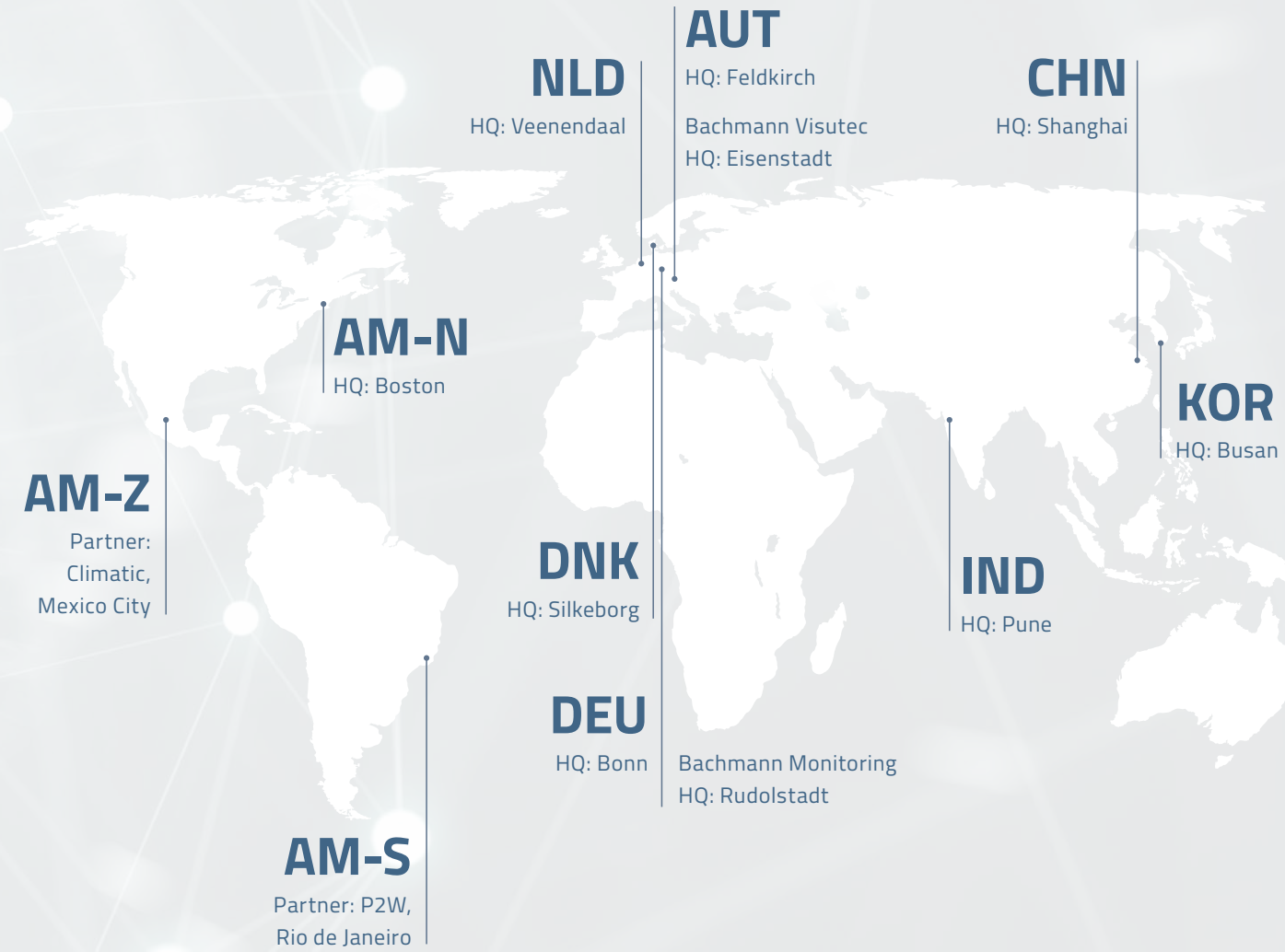
WINDENERGIETAGE
Linstow, Germany
05. - 07.11.2024
Booth: 156

INDUSTRY

SPS
Nuremberg, Germany
12. - 14.11.2024

Find out more about upcoming events on our website.

GLOBALLY PRESENT



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