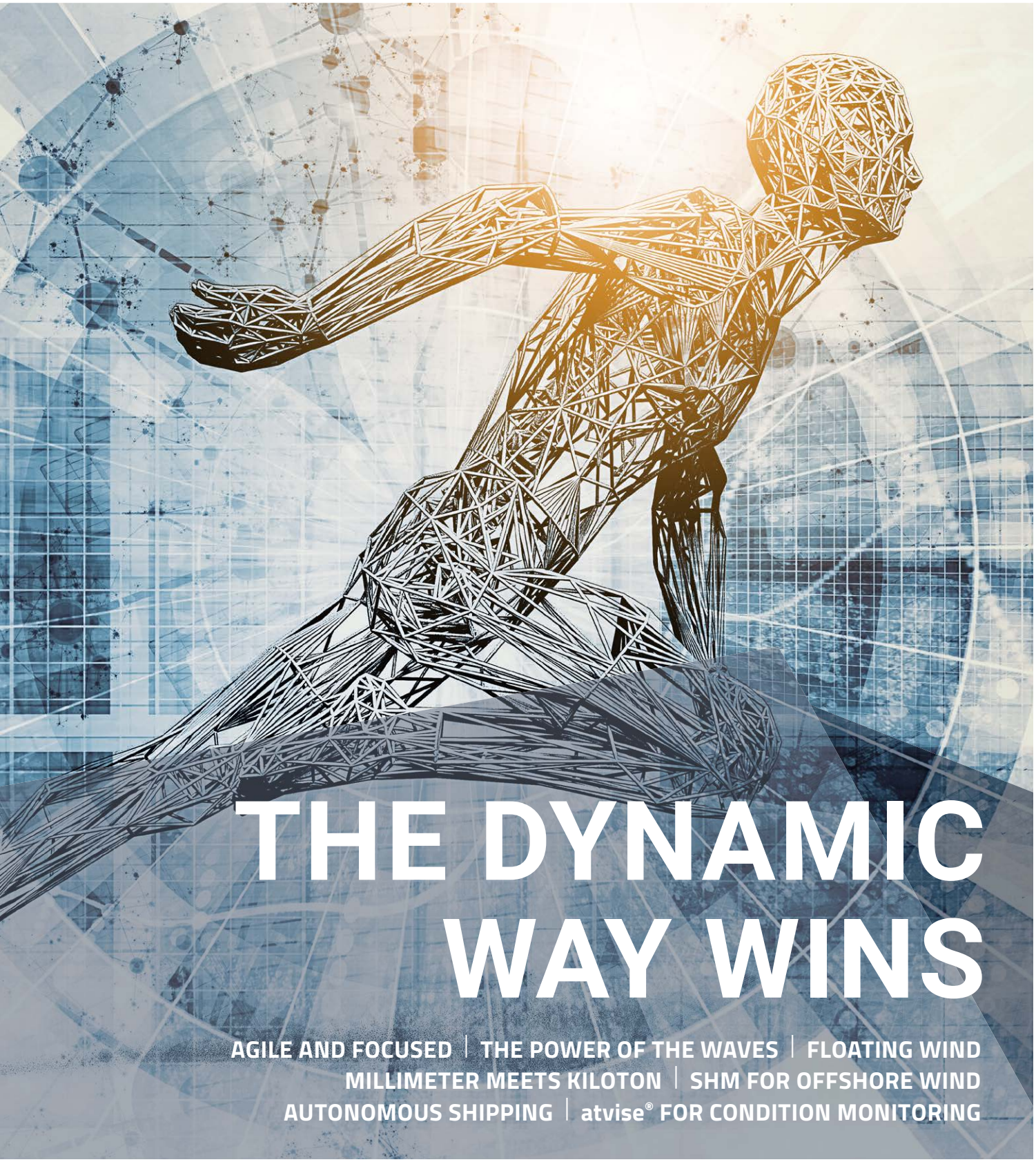
real.times

The Bachmann Customer Magazine 11 | 2024



THE DYNAMIC WAY WINS

AGILE AND FOCUSED | THE POWER OF THE WAVES | FLOATING WIND
MILLIMETER MEETS KILOTON | SHM FOR OFFSHORE WIND
AUTONOMOUS SHIPPING | atvise® FOR CONDITION MONITORING

Pragmatism is required.

Our operating environment is becoming increasingly complex and we feel the growing momentum towards change. Looking at the climate and the environment, decisions are becoming urgent. We have been aware of this situation for some time. But are we acting accordingly?

I get the impression that many areas of our society still cling to old ways. And I ask myself, is this simply a strategic declaration of bankruptcy in the fight against climate change and the restructuring of our energy supply?

Once again, the difference lies between politics and industry. For businesses, this is not about short-term voter interest and winning votes, but about securing our existence in the long term. Organizations must make pragmatic decisions about the future today, and work consistently towards one goal.

To achieve this takes a healthy degree of agility and a long-term approach, something that politics sorely lacks. Instead, politicians get trapped in never-ending deliberations, plans, regulations and amendments, issues, bans and orders – obscuring the real challenges. As a result, the biggest focus is often dedicated to the minutiae, with the important issues forgotten and ignored.

We need stability to operate securely, but politicians are in the driving seat. This is why they must think carefully about the potential impact of new regulations. Pragmatic decision making with a view to the big picture isn't just a "nice to have" – it is essential for the European economy and for job preservation in that economy. And it is only possible with attractive framework conditions, innovation, and the consistent pursuit of future trends, which I believe includes both the energy transition as well as the mobility transition.

Even considering current conditions, we must not become paralyzed. The way I see it, staying true to our entrepreneurial values is even more critical during challenging times. Not just in our ideas, but in our actions. Such values must become part of our DNA – they must drive our innermost workings. Change doesn't just happen – it takes hard work and dedication.

In this issue of real.times, we have tried once again to share our best practices and show how change can succeed. This successful change comes down to our customers, who are both living and enabling it. I hope you enjoy reading.

Yours sincerely,

Bernhard Zangerl
CEO Bachmann electronic

MAIN THEME

ENERGY

MARITIME

Imprint

Publisher	Bachmann electronic GmbH, Kreuzäckerweg 33, 6800 Feldkirch, Austria, www.bachmann.info
Responsible for the Content	Stephan Unger (v. i. S. d. P.)
Editorial Work and Implementation	Stephan Unger, Antonija Markovic, Karin Berger, Frank Fladerer Thomas Knäple, Simon Mayr, up! consulting ag
Photo Credit	Adobe Stock, ADS van STIGT, Alfred Wegener Institut, Bachmann electronic, Calwave, Clipper Windpower, CorPower Ocean, DLR, DOTI, Dredge Yard, EMODnet, FoamaTec, gertvanderros.com, HYCOM B.V., Longroad Energy, MAN Energy Solutions, RHC-Automation, Robert Beckmann/ChatGPT, RWTH Aachen, Untrakdrover over CC-BY-SA-3.0, Verhoef Elektrotechniek, Voith Turbo, W2E, WBR, WEMAG, WLV-NB

INDUSTRY

ENGINEERING

KNOWLEDGE

PRODUCT NEWS

Interview

AGILE AND FOCUSED

The global environment has changed, fostering uncertainty and increasing potential risk. But, if you take a closer look, there are also opportunities, says Bernhard Zangerl, CEO of Bachmann electronic. We interviewed him to find out more.

Mr. Zangerl, you talk about risk, but also the opportunities that arise from change. Where is your current focus?

Like everyone else, I am concerned about geopolitical upheaval and the resulting changes to global conditions that affect us all. Everything seems uncertain right now. A common approach is to retreat, believing that building walls will solve the problem, but that is never good for the economy.

Burying your head in the sand won't work. We have to look to the future and try to anticipate its course. This entails making plans about how we can respond to changing situations as quickly and appropriately as possible. For me, the key concepts are "agility" and "focus".

And yes, if you look closely, there are opportunities. I see them, for example, in every area of energy supply, as well as the development of environmentally friendly ship propulsion systems. Or in industry, which must improve energy and operational efficiency. These issues will remain with us for decades to come, regardless of other external factors and influences that will come our way.

Can you give some examples of current obstacles?

One that affects us in particular is the ongoing trade disputes between Europe, the United States and China. This is a difficult balancing act – if you lean too far in one direction, you risk a negative response form the other side, and vice versa.

We are really feeling this in China, thanks to increasing political pressure on local manufacturers to work with as many local products as possible. Or in our business relations with the US and China, for example, where certain US-built chips can no longer be used in Chinese critical infrastructure. And vice versa, Chinese-made chips cannot be used in the US. Here, we are really talking about individual components – this is the required level of detail.

The market environment is becoming more complex, with change coming thick and fast. And, all of a sudden, we see a significant impact – as with the dramatic rise in energy prices. This kind of change is everything but straightforward, but it can quickly spell the end for some companies.

So, how do we respond?

In my view, it is not just the responsibility of the business community, but above all the political community.

Instead of creating barriers, it would make more sense to establish reasonable trading conditions. Trade restrictions and tariffs are not the answer. After all, every economic area of our world is now directly or indirectly interdependent – in one way or another. And if we continue to create barriers, everyone will lose out in the end. I think if these issues could be mutually resolved, we would see benefit on a global level. Then we could finally focus on the issues that really affect all of us, such as combating climate change and providing clean, renewable energy.

This is another challenge, not only for politicians, but for us all: Through our efforts to combat climate change, we must navigate towards a common goal, one that has no relation to party-political ideologies. We see a constant stream of new laws and regulations – banning one technology today and another tomorrow, promoting one and then another. I often feel that we are incapable of finding and implementing pragmatic solutions. Instead, we produce extreme regulations, which are so problematic and impractical that we end up having to backtrack. So, if the environment is already challenging, then let's not make it any more complicated than absolutely necessary. Constant zigzagging costs a lot of energy, time and money.

How do you and Bachmann deal with these challenges?

In my view, it is important to anticipate and work towards a sensible technological solution. In the long run, I am convinced that the most technologically feasible and rational solutions will prevail. Of course, it is the nature of change to find arguments for and against it. Change resistance is not an uncommon phenomenon, leading to a lot of pressure to do nothing. But, in my opinion, doing nothing is the only strategy that is definitely wrong.

One advantage of our products is that they are flexible and versatile. They can be integrated into a wind turbine, a combined heat and power plant, or in a hydropower plant. The problem is, if our products are used to build the wrong type of energy systems, costing more instead of less, then the question arises: Who will foot the bill? Ultimately, it is the consumer, through higher electricity prices. And that's not just individuals, but also companies. And that, in turn, affects the competitiveness of the entire European Economic Area on an international level.

Of course, energy costs are not solely responsible, the cost of labor also has a major impact. I sometimes wonder

» It would make more sense to focus on fair trading conditions, not on building walls. «

Bernhard Zangerl
CEO Bachmann electronic

if politicians have really understood the economic impact of a universal basic income, or reduced working hours with full compensation. Have they lost touch with reality? I have the feeling that not everyone understands the fragility of our prosperity here in Europe. We live in luxury built over decades by previous generations. But there is no guarantee that things will remain as they are.

Is that why you and Bachmann are seeking alternatives beyond European borders?

Of course, we need to be strategic. We need to anticipate our response if Europe, or another region, suddenly takes off or shuts down. Outside of Europe we are looking to China, India and the US, where we are exploring every option, including local production.

This is a kind of life insurance for global entrepreneurs. Operating solely within one region or industry is a high-risk strategy. Just look at ups and downs experienced by wind turbine manufacturers due to unrealized expansion plans. It is absolutely life-threatening. Industries can be forced to lay off thousands of workers that they know they will need again very soon after.

So, it comes down to the question of how we remain successful in the market, in spite of political and bureaucratic conditions or a particular cost situation. This includes options such as local production or even local development. Such considerations are essential for entrepreneurial survival. Rejecting the possibility of change would be the biggest risk.

You advocate global cooperation. But would it really be such a problem if we just took care of ourselves?

At the moment we are witnessing the politics of outrage. But what we need in times like these is actually closer cooperation between different political sides: A search for reasonable compromise. It is time to focus on the economic outcome, on the big picture. Companies are much more global than 20 or 30 years ago, and they have to

secure this position to remain successful. We can't isolate ourselves because everything is so interconnected. However, ideological interests often dominate this issue, with healthy pragmatism getting lost.

How are you working to secure the future of Bachmann?

We are doing very well and are on the right track. Our customer industries actually offer more opportunities than risks, and this brings us back to the original question. We will continue to think globally and try to overcome the hurdles we face from all sides as quickly and effectively as possible.

Our strategic goal to offer the market not only products, but above all our solutions expertise, is bearing fruit. Consistent development towards this goal has always been and remains a challenge, because it requires deep organizational change. Series business is very different from project business. Today, if we couldn't do that, it would be much more difficult for us to differentiate ourselves.

We are continually trying to anticipate where the journey will take us over the coming years – what we need to prepare for, and what decisions we need to make today to ensure success in five years' time. It's hard, but you can't always plan for the worst. It takes entrepreneurial courage, because without it, change is impossible.

It's important for us to remain open and agile, and to maintain a healthy degree of flexibility – without losing focus. This allows us to react quickly, without having to abandon our overriding goals.

However, all this would remain empty words if it were not supported by our employees. Encouraging and empowering each individual to create a culture of change and action is the foundation that makes it all possible. In my opinion, this also leads to growth for every individual, and for all of us as a company.

Thank you for your time.

THE CALL OF THE NORTH – BACHMANN IN NORWAY

Bachmann electronic has expanded its international footprint with a new branch in Norway. The office is located in the Norwegian capital Oslo.

The decision to open a subsidiary in Norway did not occur by chance. Bachmann has been operating there since 2014, and Norway is a global technological and innovate powerhouse, particularly in the maritime industry. A major shipping nation, Norway boasts the sixth largest merchant fleet in the world. The shift towards sustainable solutions and innovation in the marine industry is leading to increasing demand for programmable logic controllers (PLCs). These factors make Norway a significant market for Bachmann electronic.

Jonas Helness, Oslo office manager and Key Account Manager, brings a great deal of industry experience. With prior roles at Autic Systems and Siemens, he has worked as a Sales Engineer and Account Manager as well as a Key Account Manager. For Helness, Bachmann electronic stands out with its high-quality products and excellent support. "I was impressed by the positive and open company culture," he says. "The people at Bachmann are approachable, cheerful and direct in their communication. That's important for me to be successful in sales and to feel comfortable in my professional life."

The new Oslo branch is initially staffed by three employees – two engineers and Helness as Key Account Manager and Office Manager. Two more employees will join the branch over the next few years.

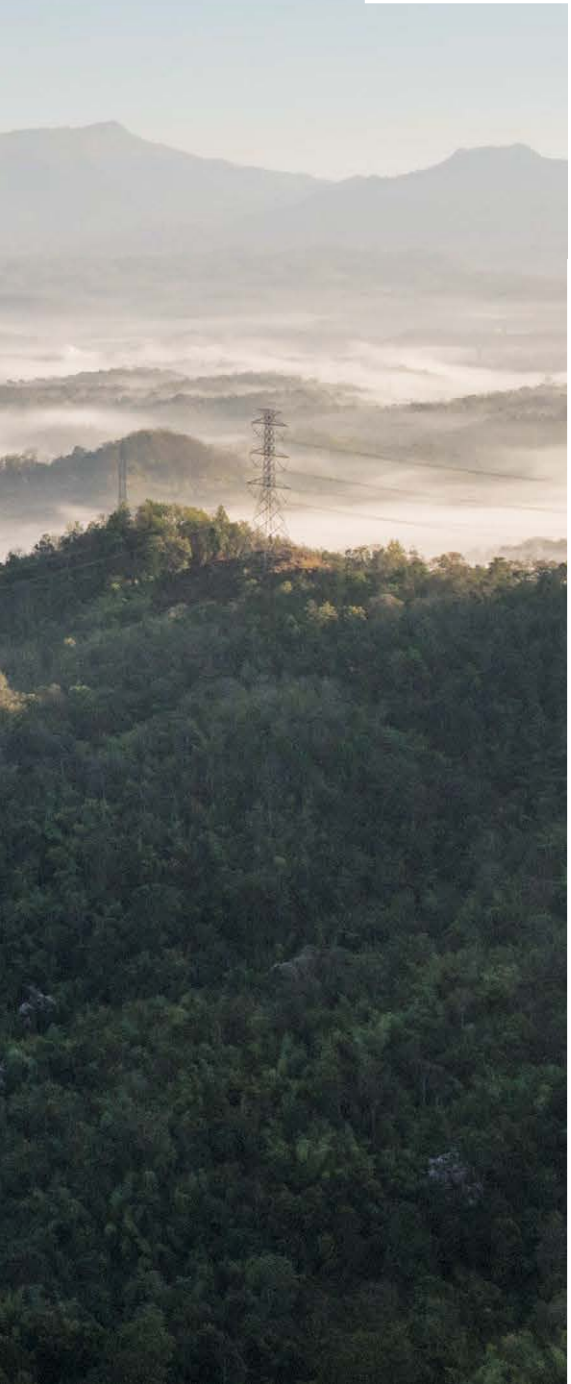

»Agility has
to be visible.«

Energy management

FIRST TO THE FUTURE

By 2030, 80% of Germany's electricity will come from renewable sources. As the number of market entrants, interfaces, communication channels and control options rapidly increase, so will the complexity of the energy supply. This will lead to new requirements for generation and consumption systems. Bachmann's Smart Power Plant Controller will help MAN Augsburg to meet these requirements.

MAN has made a voluntary commitment to reduce absolute CO_2 emissions at its own production sites by 50% by 2030, compared with 2018. To this end, MAN is pursuing a centrally coordinated program to increase power generation. Another photovoltaic system will enter operation at the Augsburg plant in 2024. And more are planned.



The next decade will see a gradual shutdown of large fossil fuel power plants – part of the energy revolution. Demand for electricity will be increasingly covered by renewable energy sources. However, the volatility of renewables requires a sufficient number of large controllable loads and generation units in the grid to ensure stability. Studies by German transmission system operators have identified a load management potential of up to 4 GW, which could be switched off or redirected as required through appropriate demand-side management (DSM) over the coming years.

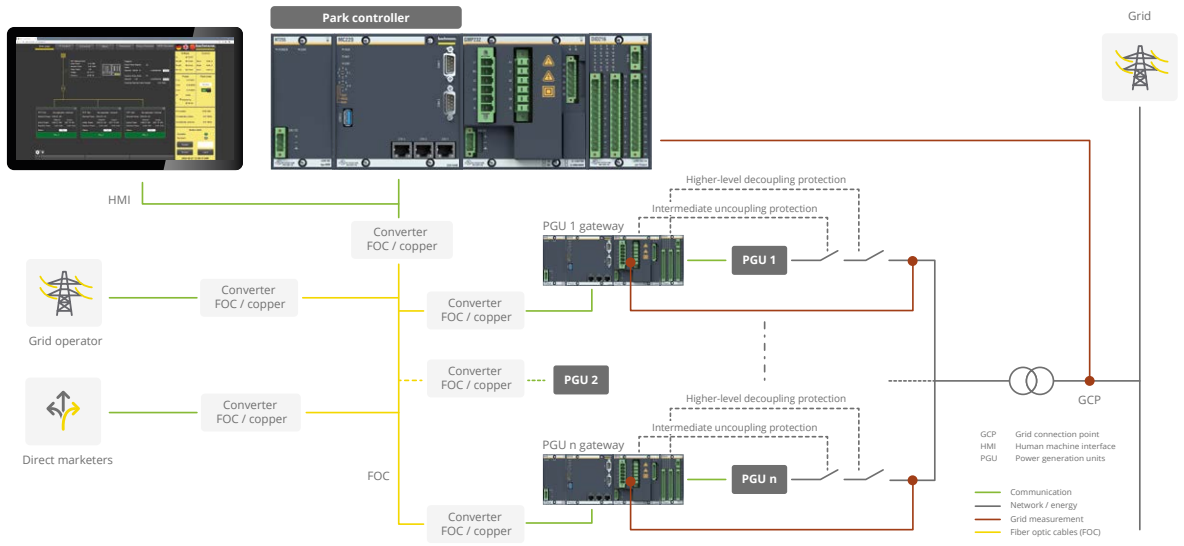
Electrification continues

Further to this shift in power generation, companies like MAN are hard at work looking for solutions to electrify the supply of process heat. After all, around 75% of industrial greenhouse gas emissions can be attributed to this phenomenon, primarily found in the production of steel, metal, glass or paper and in the chemical industry. Technologies that cross multiple industries such as heating, air conditioning and ventilation (HVAC), lighting and data centers also offer load management potential.

"This is a Herculean task for a large production site, and we don't know what the demands will be over in the coming years," says Michael Kramer, Head of Energy Systems, Work Services Production at MAN Energy Solutions in Augsburg. "In the past, networks were managed purely from a commercial point of view, but in the future, we have to focus on energy availability. We must be able to manage the networks much more dynamically than we do today."

A pioneer stands up to the challenge

A Volkswagen subsidiary, MAN Energy Solutions is aware of its role



The Bachmann park controller can manage up to 100 power generation units (PGUs).
PGUs are connected to MAN via standardized gateways, which can be quickly parameterized for the respective PGU.

as a pioneer within the Volkswagen key industries, and its responsibility for identifying solutions that enable sustainable progress. Michael Kramer has also taken on this task for the energy management at the Augsburg site: "Our corporate goal is to halve CO_2 emissions at our global production sites by 2030. But, in order to achieve this, we have to set a course today that prepares us, as a manufacturing company, for the upcoming changes in energy supply."

His assessment of the situation delivers one challenge: "In the future, there will be a large number of energy producers, storage facilities, and large loads to control. Climate legislation and building regulations require the expansion of rooftop photovoltaics. VDE-AR-4110/4120 requires the central control of car and truck charging stations. To prevent voltage dips, it may be necessary to coordinate startup of different drives. And so on and so forth. These are just some of the players. We can't name all that will come along," explains the engineer.

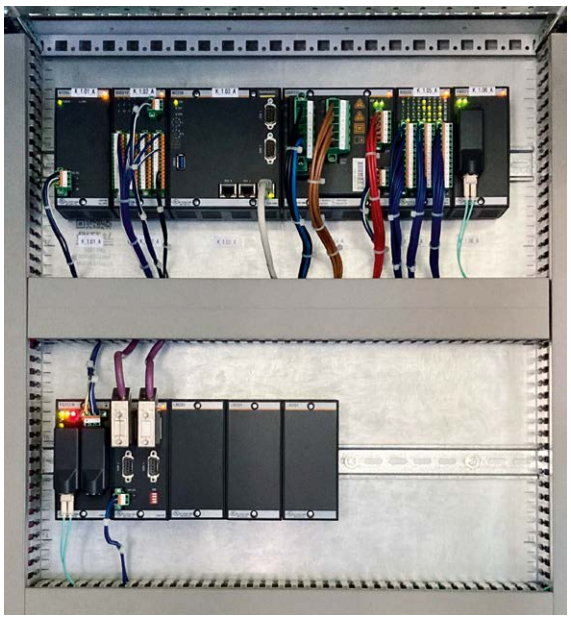
Searching for a solution

Kramer and his team set out to explore how such a transformation could succeed on site. The facts were clear: MAN had to meet the regulatory and legal grid connection requirements at all times. And, despite the challenging conditions, operations management had to remain efficient, sustainable and economical. Today, these two requirements are separated by standards: VDE-AR-N 4110/4120 defines the requirements for grid stability based on power supply and delivery, while the Energy Industry Act sets average power values that define energy optimization.

"We were looking for a system that could combine both requirements and be future-proof enough to allow us to integrate several dozen generation units over the next few years, but not all at once. At the same time, it had to be open enough to provide us with the information we need to control a conglomerate of relevant loads that are still largely unmanageable." This task brought Kramer to Bachmann.

Bachmann park controller for the production site

Kramer has now implemented a redundant park controller based on the M200 control system: The functions of the Bachmann Smart Power Plant Controller, certified according to VDE-AR-N 4110/4120, enable MAN to certify the power generation of the entire site and connect it to the power grid. The process is based on power generation gateways which integrate the individual power generation units (PGU) and secure their protection against decoupling. The theoretical limit of 100



With this control system, implemented on the M200 controller, MAN can certify the power generation of the entire Augsburg site and to connect it to the power grid.

PGUs is unlikely to be reached in the foreseeable future, but Kramer still sees it as a crucial aspect: "Bachmann is one of the few suppliers whose systems already meet these requirements.

The integration of the system was tested together with Bachmann on two large PV roof systems at the Augsburg site. Kramer praises the partnership: "All parties worked together to develop a solution that allowed an in-depth connection between our existing load management and the power generation. The system openness really stands out.

Just the beginning...

The most important component is already in place: A platform that combines the different systems and requirements of network operators and the energy industry. But for Kramer, this is just the beginning: "We have a standard on which to build. We are continuing to add further functions to integrate generators in a system-friendly way and for the efficient control of energy consumers." And Bachmann is by his side.

» Network management has to become much more dynamic than it is today. «

Michael Kramer
Head of Energy Plants,
Work Services Production,
MAN Energy Solutions

MAN ENERGY SOLUTIONS

- Leading global supplier of large diesel and gas engines and turbo machinery
- Headquartered in Augsburg, Germany
- Approximately 15,000 employees at more than 140 locations worldwide

www.man-es.com

Autonomous shipping

ROLLED OUT

Based in Heidenheim, Germany, Voith has been perfecting the Voith Schneider Propeller (VSP) for almost 100 years. Recently, an electric version of the propulsion system (eVSP) has become available, optionally featuring roll stabilization (VRS). Supported by Bachmann technology, the VRS effectively dampens ship roll movements caused by sea conditions.

The Voith Schneider Propeller combines propulsion and steering into one. This propulsion technology allows very fine thrust control and extremely fast changes in thrust direction, giving VSP-equipped ships maximum maneuverability. When a ship is equipped with two or more VSPs, it can move in any direction – even horizontally. Harbor tugs, ferries, yachts, and supply and service vessels for offshore platforms and wind turbines all rely on this type of propulsion. It is especially interesting for wind turbines because it allows ships to hold their position against wind, currents, and waves.

Farewell to rollers – innovative system for smoother ship maneuvers

Rolling is the term given to rotation of a ship around its longitudinal axis. In rough seas, safe maneuvering can become almost impossible. Not so with the Voith Roll Stabilization System (VRS). System sensors detect rolling motion and control the propellers to counteract it. Up to 90 percent of roll motion can be compensated, both at a standstill and at full speed. "This not only increases safety during maneuvering and passenger transfer, but also makes a decisive contribution to the comfort of passengers and crew," says Andreas Leger, Development Engineer Controls, Innovation & Technology in the Rail & Marine Division of the Voith Group, as he explains the key advantages of the innovative system.

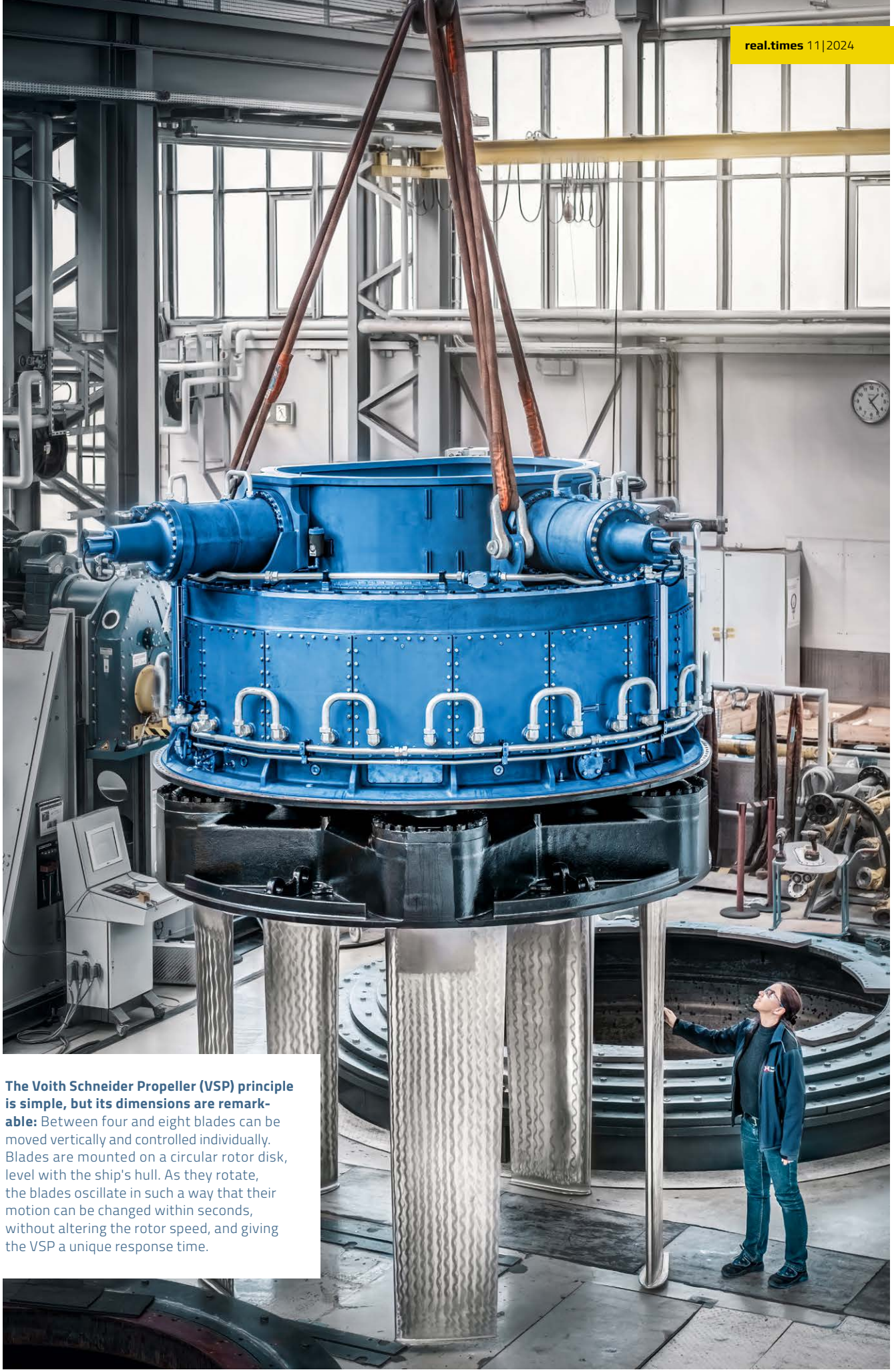
Above all, the VRS significantly expands the range of applications for working vessels: ships equipped with this system can continue to operate in high waves, whereas vessels without this system would no longer be able to dock at an offshore platform or wind turbine, and would have to remain in port to wait for better conditions.

Fully automated – with just one controller

In the past, VSPs were controlled mechanically: levers were connected from the bridge to the engine room via linkages or complex hydraulics to adjust the blades. "It was practically impossible to counteract roll," recalls Andreas Leger. The development of the electric VSP opened up new possibilities for the engineers: "We were able to incorporate our own ideas for roll stabilization and link them directly to drive control," explanins the development engineer. This not only enabled highly complex control, but also saved resources: "Roll stabilization is implemented on the existing Bachmann M200 system for VSP control. This saves the customer an additional control cabinet, and we can commission and maintain the entire system with our own technicians," says Andreas Leger.

Getting there faster with Bachmann

For the development of the complex control algorithms, Voith uses MATLAB®/Simulink®. "This saves us a lot of time because we can access an extensive library of validated filter and control blocks that we would otherwise have



The Voith Schneider Propeller (VSP) principle is simple, but its dimensions are remarkable: Between four and eight blades can be moved vertically and controlled individually. Blades are mounted on a circular rotor disk, level with the ship's hull. As they rotate, the blades oscillate in such a way that their motion can be changed within seconds, without altering the rotor speed, and giving the VSP a unique response time.

A ship equipped with two or more Voith Schneider Propellers (VSP) can move in any direction – even horizontally. The VSP combines propulsion and steering and can generate thrust in any direction. Thanks to short response times to steering commands, the VSP enables fast, safe and precise maneuvering, even under challenging conditions.

At almost 90 meters in length, the Edda Breeze is a Commissioning Service Operation Vessel and will be deployed to the 400 MW Bard Offshore 1 wind farm – off the German North Sea coastline. The vessel is equipped with two VSPs.

Voith roll stabilization prevents rolling even in high waves. This video shows the impressive effects of the VSP during docking at an offshore wind turbine:

VOITH TURBO

– Headquarters in Heidenheim (DE)

– Intelligent drive solutions and systems specialist

– Division of the Voith Group, founded in 1867, with more than 20,000 employees in over 60 countries

www.voith.com

to program ourselves," says Andreas Leger, highlighting one factor that saves precious R&D time. With the help of M-Target for Simulink®, Voith could automatically generate the program code from the simulation and implement it directly on the M200 controller: "Starting with an initial feasibility study, we made rapid progress and, in the end, we could verify software components directly on the model ship – without needing any another programming language."

Conversely, Leger also used M-Target for Simulink® for monitoring during the development phase – directly connecting to the controller and feeding live system values back into the simulation environment. At the shipyard and during commissioning, however, the engineers work with Bachmann's Scope 3 to get a real-time overview, analyze signals, and optimize parameters. This was a clear advantage for Leger: "The controller can be programmed in many different ways, depending on the requirements of a particular application, or previous knowledge of the technicians involved."

The extensive on-board filtering capabilities of the Bachmann AIO208 I/O modules, used to connect the sensors, should also not be underestimated. Voith uses them to pre-filter signals and avoid aliasing problems.

The autonomous vessel is becoming reality

Ships equipped with the Voith Schneider Propeller and roll stabilization bring us ever closed to autonomous shipping: The aim is not only accurate vessel steering, it is also to maintain one, stable position. What used to require immense mechanical effort and incredible skill on the bridge is now performed by intelligent control systems that take vessel maneuverability to the next level.

atvise® scada

A SAFE BET

Group elevated tank in St. Margarethen.

Wasserleitungsverband Nördliches Burgenland (WLV NB) supplies 66 municipalities with drinking water. Water consumption in the supplied area has risen sharply over recent years, and the network and systems have been expanded accordingly. To ensure reliable, long-term operation, WLV NB required a flexible SCADA system that would also meet constantly increasing security requirements. WLV had been working with Bachmann's atvise® for several years to monitor operating data. Over the course of the development, the existing SCADA component, including automation, also had to be integrated into atvise®.

Rising water consumption

With an annual system feed-in of approx. 15 million cubic meters of water, and a total pipeline length of around 3,000 km, WLV NB is one of the largest suppliers of drinking water in Austria. Due to population growth and, not least, climate change, the pipeline network has been expanded to meet increasing demand for water. RHC automation introduced a new long-term database solution in 2018 to cope with the associated complexity. The system integrator selected atvise®, from Bachmann, as its interface: "Visualization with this web-based solution the employees responsible to view relevant operating data on any web-enabled device and in any browser," explains Roland Hirschmann, owner of RHC automation. With the introduction of atvise®, WLV NB can now identify pipe bursts and other anomalies with just a few clicks.

Step-by-step SCADA switch

This delivered a future-proof monitoring solution and long-term data archive. However, WLV NB's outdated SCADA system could no longer ensure reliable and NIS-compliant operation in the future, especially as the OEM was no longer on the market. WLV NB was searching for a replacement. atvise® was already in use for operational data monitoring – so it made sense to consider this software for the new SCADA system, says Hirschmann, describing the considerations at the time. Moreover, he already had positive experience with atvise® as a SCADA solution with long-term database systems at other customers.

To give WLV NB an initial impression of the SCADA capabilities of atvise®, Hirschmann took a station that was connected to the existing control system via the IEC 104 protocol, and connected it in

The Kittsee waterworks combines the latest technology with modern architecture.

parallel to atvise®. "This was followed by a few more stations for building and barrier control. It quickly became clear to us: atvise® was the new SCADA system for WLV NB," recalls the owner of RHC automation.

About one hundred stations, featuring several thousand data points physically recorded in the field, will be gradually integrated into the new SCADA system by mid-2025. During the final stage, components will be connected to atvise® via IEC 104, OPC UA and Modbus.

Special feature: radio

Ninety percent of WLV NB's outstations are connected to the SCADA system via radio. "The flat Burgenland topology makes it possible to cover large areas with elevated radio systems," says Hirschmann, describing a special communication feature at WLV NB. In most cases, there are no cable connections between elevated tanks and pumping stations. At WLV NB, higher-level automation functions have to be carried out almost exclusively via the SCADA system.

Some scenarios were unavoidable during the changeover, such as when an elevated tank was still connected to the old system, while the associated pumping station was already implemented in the new system. In such cases, the current level of the elevated tank was fed into atvise® from the long-term database via OPC UA. This was to ensure continuous automation with minimal interruptions, and enabled pumps to be controlled automatically via the SCADA system. "Parallel operation like this is a great advantage because we don't have to change everything over simultaneously. If an outstation is replaced on the hardware side, it is pre-configured prior to delivery, so that operations are only interrupted for a very short time during commissioning," says Hirschmann.

Full overview

atvise® provides WLV NB with an extremely flexible monitoring and SCADA solution: thanks to web technology, internet services – such as Google Maps or weather data – can also be integrated with the operating data monitoring from atvise®, alongside camera images and other external data sources. "All nitrate measuring points in the supply area are mapped and integrated with Google Maps. By selecting station points on the map, the corresponding trend curves can be directly called up, with geographical correlations recorded at the same time," says the engineer. The web-based solution offers significantly more trend display functions than most desktop installations.

Key factor: security

As well as usability, there was a strong focus on the security of the new SCADA system – not least due to the NIS 2 directive, which defines strict cyber security requirements for critical infrastructure. Successful penetration and vulnerability tests confirm the implementation of comprehensive security measures in atvise®.

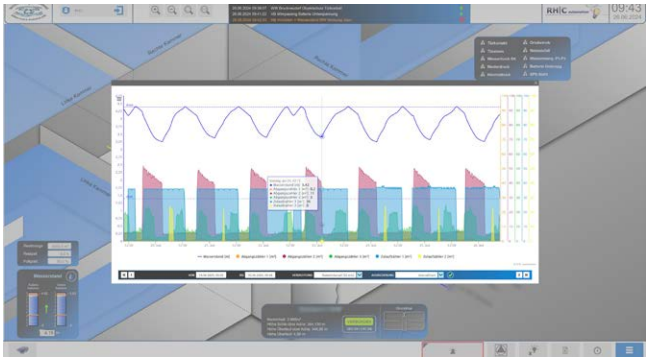
Due to security requirements, WLV NB uses two separate atvise® systems: Firstly, an IT-focused monitoring system for statistical data analysis from long-term archiving, and secondly, a strictly separate environment for operational

technology processes, which serves as a SCADA system and is also connected to the long-term database.

The production data monitoring system is available to a large number of IT network users, whereby user authentication is carried out via an Active Directory-based single sign-on, with authorizations transferred automatically from Windows authentication on a group basis. The SCADA system in the OT network, on the other hand, can only be accessed via the control room workstation, or via strictly limited VPN access with two-factor authentication. In both systems, access authorization within the visualization can be further restricted on a user-specific basis – thanks to the fine-grained access control provided by atvise®.

Communication between control center and outstations also takes place via VPN connections, which are superimposed on the radio transmission. Firewalls and intrusion detection systems provide additional operational security. In addition, atvise® has introduced and documented clear password guidelines for the SCADA system. For increased reliability, atvise® instances are installed redundantly on two physical servers. "We have established a solution that means WLV NB can look forward to future expansion with complete peace of mind," concludes the engineer.

Everything in view: Approximately 100 station visuals are displayed three-dimensionally and approximately to scale with atvise®.



Quick analysis: With one click, WLV accesses a clear value trend – thanks to atvise®.

» Web-based atvise® enables the employees responsible to view relevant operating data on any web-enabled device in any browser. «

Roland Hirschmann
Owner von RHC automation

WASSERLEITUNGS VERBAND (WLV) NÖRDLICHES BURGENLAND

– Water supply for around 180,000 people from groundwater and spring water

– 14.92 million m³ water supply in 2023

– 2,974 km total pipeline length, 114,972 m³ storage volume, 52 wells and springs, 62 tanks, 30 pressure boosters

www.wasserleitungsverband.at

Ocean energy

THE POWER OF THE WAVES

The ocean is one gigantic energy storage system: With an estimated 80,000 TWh per year, it represents an incredible potential for diversifying renewable energy sources and reducing CO_2 emissions. Current estimates place most of that potential in wave energy. But the challenges are not to be underestimated. And this is why these highly successful pilot projects are based on Bachmann technology.

CorPower Ocean from Sweden uses point absorbers in its wave farm to harvest wave energy.

The major appeal of wave energy is that it is virtually inexhaustible and, unlike volatile wind and solar power, is permanently available. Although still in its infancy, wave energy could one day make a significant contribution to a stable, reliable and sustainable power grid.

Different technologies and principles

Four different system concepts are currently under exploration: In regions with strong ocean currents or pronounced tides, such as the coasts of the United Kingdom, Canada, and France, the goal is to use underwater turbines to convert tidal current kinetic energy into electricity.

Osmotic power plants (salinity gradient power plants) use the difference in salinity between fresh water and seawater. These are built, for example, where rivers flow into the sea, and use the hydration energy of the salt ions. This form of energy is also known as "blue gold".

In tropical regions, thermal power plants that use the temperature difference between warm surface water and cold deep water to generate electricity (Ocean Thermal Energy Conversion, or OTEC) are becoming increasingly popular. A 2020 study by the International Renewable Energy Agency (IRENA) estimated the global energy potential of these systems, similar to heat pumps, at 44,000 TWh per year. However, we still need significant technological advances to make such systems economically viable.

The potential of wave energy, however, seems more tangible: its global theoretical capacity is estimated at 29,500 TWh per year, roughly equivalent to our entire global electricity consumption.

Promising technologies

Five principles in particular are currently attracting attention for the use of wave energy: Point absorbers are floating devices that use vertical wave motion to generate electricity. Oscillating Water Columns (OWCs) compress and decompress the air above a column of water, using wave motion to drive a turbine. Attenuators are elongated devices that lie in the same direction as the waves, using their up and down motion. Overtopping devices, on the other hand, direct water down a ramp into a reservoir and use the difference in elevation to generate electricity, similar to small hydroelectric plants. Companies such as CalWave in California are successfully using the oscillating attenuators principle to harvest the

Californian company CalWave harnesses the energy of wave motion with submersible metal platforms – with Bachmann inside!

CORPOWER OCEAN

– Headquartered in Stockholm, Sweden. Offices in Portugal, Norway and Scotland

– Develops, builds and installs turnkey solutions for harnessing clean energy from ocean waves

www.corpowerocean.com

CALWAVE

– Headquartered in Oakland, California

– Develops, builds and installs reliable and cost-effective technologies that harness ocean waves for a sustainable energy supply

www.calwave.energy

energy of underwater wave movement with submersible metal platforms (see article "Oceans of Potential", real.times 11.2022).

Major challenges

Wave energy systems still have many challenges to overcome. Such systems are being tested and developed at a small number of test sites around the world. In addition to cost and economics, grid integration must also be addressed. The impact of these systems on marine ecosystems is not yet fully understood and requires further investigation. Possible negative effects must be minimized and sustainable solutions developed.

In addition, many countries have implemented complex approval procedures and extensive regulatory requirements, which have slowed expansion and dampened the excitement seen in previous years. Many companies working in this exciting field have not survived.

Extreme environmental conditions

Shaft power systems must withstand harsh environmental conditions such as storms and saltwater corrosion. Temperature fluctuations, shock, and vibration also stress components. Difficult access requires high system reliability and durability.

The development of robust and low-maintenance materials and designs is therefore essential, so it is no surprise to see Bachmann leading the field, with the most renowned research partners in California and Australia relying on the expertise of the Vorarlberg-based company. They appreciate not only the versatility and robust component design, but also the unparalleled openness of the M200 and M100 controller and I/O systems. Another invaluable advantage for researchers is that they can use M-Target for Simulink® to generate software applications directly from Simulink® and input them directly to the controller during testing.

Industrialization requires stable conditions

Wave energy is on a promising path, but one that still requires considerable research and development efforts. Without a clear political framework and support, such a complex technology cannot be brought to series production.

Some island nations, such as the Faroe Islands, Orkney Islands and Tahiti, have already set their own targets: they want to become completely reliant on renewable ocean energy by 2030 and so end the import of expensive fossil fuels by ship.

If it can overcome the technical, economic and regulatory hurdles, wave energy could make an important contribution to a sustainable energy supply and help reduce dependence on fossil fuels. Cooperation between science, industry and politics is crucial to take full advantage of this potential. Bachmann is ready and waiting!

Bundled competence

A NEW WIND ARISES

Longroad Energy operates 165 wind turbines at its Milford wind farm in Utah, providing a total power output of 306 MW. After about 15 years of operation, maintenance has become more expensive and spare parts for some turbines are becoming scarce. Longroad was looking for a solution that would promote safe and efficient operations for many more years. This gave Bachmann the chance to demonstrate its full wind energy expertise: Park controller, complete turbine controller retrofit, SCADA retrofit with higher-level remote operation control (SMCS) and condition monitoring were part of the comprehensive turnkey solution.

With Bachmann's comprehensive wind expertise, Longroad Energy always has a complete overview of the 107 GE and 58 Clipper wind turbines at Milford Park from its operations center.

Overall competence makes the difference

Located near the small town of Milford in Beaver County, Utah, the Longroad Energy wind farm consists of fifty-seven GE 1.5 SLE, 11 GE 1.5 ESS, 39 GE 1.5 XLE turbines, and fifty-eight Clipper Liberty 2.5 turbines. The operator wanted to control and monitor the entire wind farm safely and efficiently from its operations center. The plan was to use a modern SCADA platform design incorporating the latest cyber security measures, while delivering complete access to assets. Bachmann had a good reputation at Longroad due to its control systems in the GE wind turbines: "Thanks to the reliability of our control systems, Longroad trusted us to contribute our entire wind power expertise to their project," says Nicholas Waters, Longroad Key Account Manager at Bachmann electronic.

Higher reliability and productivity in three days

The control system was replaced to ensure continuous and safe turbine operation. The Bachmann M200 control system was used in combination with the GMP232 module for power monitoring and grid protection. The turbine control system is connected via 'bluecom' – an Ethernet-based, real-time protocol from Bachmann – to the master park controller, which was also implemented by Bachmann.

In addition, the goal was to reduce gearbox load and thus increase the reliability of the Clipper turbines. "Experience shows that asymmetrical stresses occur on the gearbox of this type of turbine, which can lead to problems after a few years of operation," explains Matthew Mays, project manager and condition monitoring expert at Bachmann electronic. Therefore, real-time condition monitoring of the entire drive train was integrated into the retrofit solution, with existing sensors remaining in use. "The complete renewal of the turbine control system, including commissioning, took a maximum of three days per system – that's remarkably fast," Mays continues.

SCADA Master Control System: one for all

Existing Bachmann controllers installed in the GE turbines were updated with a state-of-the-art processor, enabling them to be integrated into the new Wind Power SCADA (WPS) system. Thanks to the SCADA retrofit, Longroad now maintains a full overview of the entire hybrid park from its operations center. All GE and Clipper wind turbines, as well as the complete Milford Park cascaded SPPC park controllers, can be conveniently displayed in a common user interface. Key parameters, such as individual turbine yield, are summed and displayed as an overall park key figure. "Our open solution supports both IEC 61400-25 and IEC

61850, and thanks to the uniform data format, it's now easy to compare different plant parameters. This also makes it easy to integrate third-party solutions," Nicholas Waters explains the advantages.

Convenient and secure, near and far

"Bachmann's solution ensures we can continue to operate Milford 1 and 2 for years to come, while having a controller and partner capable of innovating and improving operations," says Longroad Energy's Jeremy Law, who is pleased with the system's performance and potential. On top of that, the team now works in line with the latest cybersecurity standards, utilizing two-factor authentication, among other features. Another major benefit for Longroad: a uniform look & feel for service personnel when maintaining the GE and Clipper plants. Thanks to the M1 WebMI pro visualization software, engineers no longer encounter various, manufacturer-specific interfaces. The open, web-based solution has significantly increased efficiency during maintenance operations.

Reliably into the future

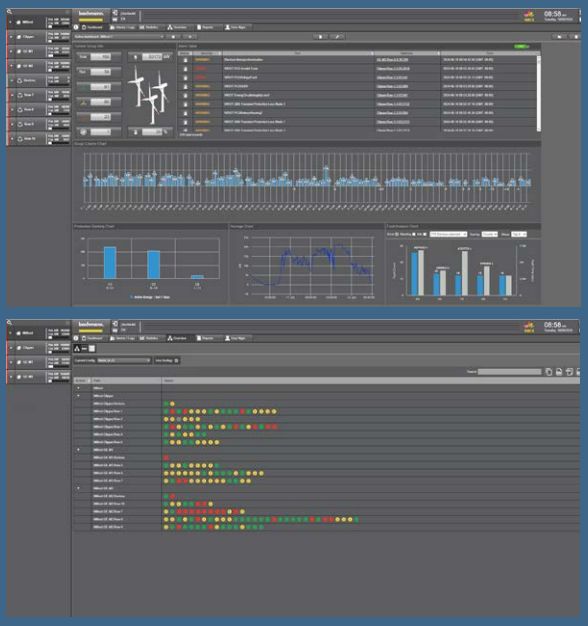
Thanks to Bachmann's complete solution, Longroad can be confident that Milford Park will productively deliver energy for many years to come. "With the modular approach and standardized communication of our solution, it will be easy to expand sensors or inputs/outputs for new functions in the future," concludes Waters. And if spare parts are required, Longroad is in the best hands with Bachmann.

LONGROAD ENERGY

– Headquarters in Boston, Massachusetts, offices in Maine and California

– Development, operation and management of wind, solar and storage projects in North America

www.longroadenergy.com

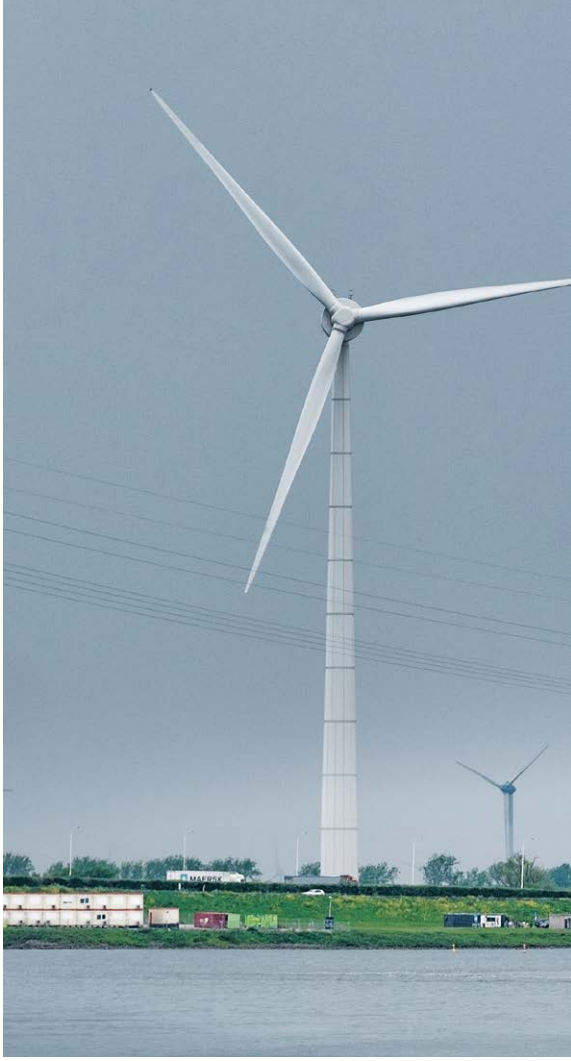


Bachmann's SCADA Master Control System shows the status of all turbines at a glance – also in hybrid parks. Key parameters are automatically summarized.

SCADA MASTER CONTROL SYSTEM (SMCS)

Until now, the number of SCADA servers required was determined by wind park size. With the SCADA Master Control System (SMCS), Bachmann facilitates the setup of a cascaded SCADA system. Data from the various park SCADAs is correlated and conveniently summarized in a user interface with clear displays. This makes it easy to assign alarms to the park and the respective turbine – even if the entire asset comprises several hundred turbines.

In addition to the clear display, the SMCS also allows detailed analyses of individual park turbines directly from the Master Control System. Thanks to web technology, it is possible to jump to the underlying WPS servers, or even directly to the turbine visualization, via quickly accessible links. There, for example, analyses are available via webMI pro using the Scope 3 software oscilloscope. Sophisticated user management and clear rights assignment ensure the highest security standards.



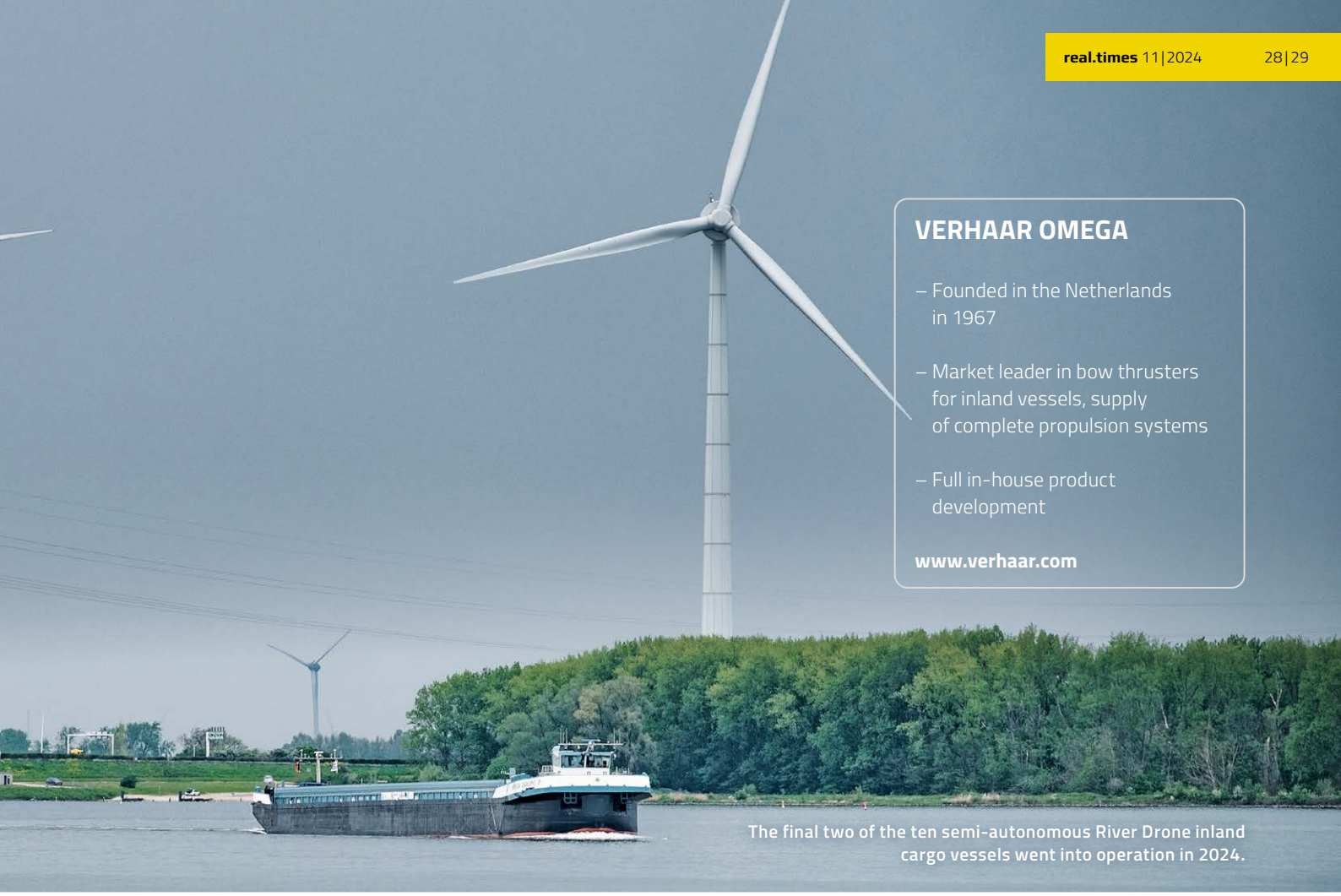
Autonomous shipping

JUST LIKE MAGIC

Autonomous driving is not only a hot topic for road transport: It has great potential for inland waterway transportation, particularly in terms of efficiency and safety. This has led to significant investment in the research and development behind self-driving inland waterway vessels. Admittedly, there are still a few nautical miles to go before inland navigation becomes completely automated. However, semi-autonomous operation has already arrived – as demonstrated by the ten River Drones operated with Bachmann technology.

European rivers and canals are home to around 8,000 inland waterway vessels, used to transport goods of all kinds. The (partially) automated navigation on board these ships offers great potential: On the one hand, it can counteract the increasing shortage of qualified nautical personnel. An office job in the control center could be more attractive for future barge captains than a job on board. In addition, it is sometimes possible to steer more than one cargo ship at a time. And on the other hand, safety levels can be increased, as human error is ruled out by autonomous operation.

Companies from all European countries where inland navigation plays a key role are working intensively on the transformation towards autonomous operation – not least the joint project FernBin, in which Bachmann is also indirectly involved as part of the navigation platform of a remote-controlled research vessel.



The final two of the ten semi-autonomous River Drone inland cargo vessels went into operation in 2024.

Remote control becomes autonomy

The Central Commission for the Navigation of the Rhine (CCNR) classifies automated navigation into defined levels, very similar to those used in road transport: At automation level 1 (steering assistance), the ship is steered automatically in a specific context; at level 2 (partial automation), it is also propelled automatically. In both cases, the captain performs the remaining dynamic navigation tasks. The third level (conditional automation) also includes an automatic system for continuous collision avoidance in specific scenarios. In this case, all dynamic navigation tasks are performed by the ship, and the captain only has to react in case of system failures. With high automation – level four – the ship reacts automatically to specific malfunctions without the need for human intervention. The final level is autonomous, i.e. completely independent operation, where human intervention is no longer necessary.

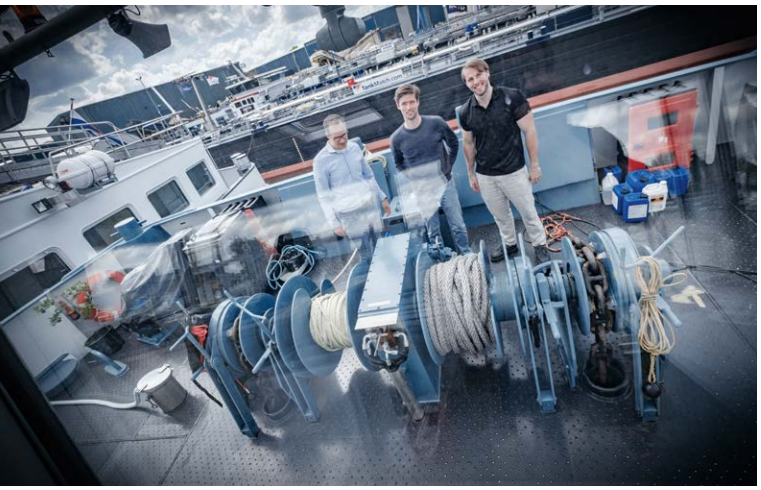
A nebulous journey

The framework conditions for the successful implementation of (semi-)autonomous navigation are simpler in inland shipping compared to international maritime shipping: The environmental influences are relatively constant, and the mobile internet connection is much more stable. The latter is a basic prerequisite for secure data transmission, via which the onboard systems can be reliably and remotely controlled. Other technical requirements are no longer a significant hurdle: Digital waterways data is usually available, as are sensors to monitor the surroundings. And, thanks to the proven 99.96% availability of Bachmann's established M200 system, failure-proof and, above all, cyber-secure control technology is at hand.

One key hurdle, however, is the legal framework, which has not yet been sufficiently clarified. If two manned ships collide, the question of liability is usually clear. However, if a captain is no longer on board, a liability dispute could arise. And not only in the area of owner liability: Product liability must also be clarified. In the event of system malfunction, is liability transferred to the manufacturer of the ship or the manufacturer of the autonomous control system? Clear legal regulations must first be established, which can be applied across national borders.

Visible progress

There are still some open questions to be answered before fully autonomous inland navigation is possible. However, the semi-autonomous navigation of inland vessels is making rapid progress. And Bachmann is right at the forefront: In



Pleased with the efficient collaboration and good results: Joeri ten Napel and Mike Clevers from Bachmann, with Wilbert Paans from Verhaar Omega.

One crew member is on board to supervise. However, the River Drones are controlled entirely from land.

Belgium, ten remote-controlled inland cargo vessels have gone into operation over the last two years to serve the port of Antwerp. The 106-meter-long River Drones, from shipping company Naval, transport both dry cargo and containers. All navigation and communication tasks are carried out from a land-based control center: maneuvering through waters and lock passages, mooring and casting off, as well as radio communication with other ships and authorities. The shore-based operating personnel have the same certifications that required for an on-board captain. One crew member is on board to monitor operations.

Surroundings are recorded by two radar systems, five lidar sensors that measure distance and speed using light waves, various microphones and thirteen cameras including night vision and infrared systems. All data is transmitted to the control center in real time via a 4G/5G connection. This provides operating personnel on land with all the information they need to safely operate the ship. All data is reliably logged.

Climate-friendly drive

The River Drones are operated with two modern 550 kW EQUADRIVE drives from Verhaar Omega. Two bow thrusters from the same manufacturer each deliver 420 kW.

The patented, fully electric pod drive can be rotated by up to 360 degrees. The version installed on the River Drones allows a rotation of 2x110 degrees. The EQUADRIVE is directly driven and therefore does not require a gearbox. “This means there are no mechanical losses, which leads to greater efficiency,” explains Wilbert Paans, electrical engineer at Verhaar Omega. It also reduces maintenance costs and ensures quieter operation.

Safe maneuvers

The drives and bow thrusters are controlled and monitored by Bachmann’s maritime-certified M200 control system. An MX207 processor with a DIO248 and an AIO216 I/O module is used for each of the EQUADRIVE drives. The bow thrusters are controlled using the same processor, as well as a DIO280 I/O and an RS204 interface module. “All important drive information is recorded in a common database. The personnel on land always have an overview of drive, power, temperature changes, vibration levels and much more,” says Ronald Epskamp, Manager Business Unit Maritime at Bachmann.

Efficient development

The experts from Verhaar Omega and Bachmann were able to complete the control system for the EQUADRIVE drive within one year. The collaboration and development of the application went smoothly, confirms Epskamp. Verhaar Omega is pleased: “We have put a lot of energy into this development together in a short space of time. Now we can sit back and enjoy the great results.”

Neumayer Station III is located on the edge of the Arctic mainland and is built on 250 meters of thick floating ice. Despite the inhospitable environment, the share of renewable energy in the station's energy balance is to be significantly increased by the increased use of wind and solar energy, as well as geothermal energy.

Bachmann SHM in Antarctica

ENERGY AT THE FROZEN END OF THE EARTH

70°40' south, 8°16' west – a point on the edge of Antarctica. And what lies there? The Ekström Ice Shelf, Atka Bay, on the northeastern Weddell Sea. Despite its surreal name, this location is in fact an epicenter of German polar research.

The continent of Antarktika, the land mass within the Antarctic, is almost 13.2 million km² in size and about 37 times the size of Germany – an infinity of white. A glance out of the window reveals the inhospitableness of this place: snow and ice covers everything. The lowest temperature recorded here was minus 50.2 degrees Celsius, with windspeeds of up to 150 kilometers per hour. But inside the Neumayer Station III it is warm. This research station is the base for German Antarctic research, and the inside temperature is kept at an ambient 20°C to provide a comfortable working and living environment for up to 60 people. Their survival depends upon a stable supply of energy.

You might believe that renewable energy has no place in a frozen wasteland. However, Antarctic research shows that such energy can be produced even under the most extreme conditions. And Bachmann has begun to make a small but important contribution, helping this research team to produce sustainable energy.

Neumayer Station III is growing

Ice crunches underfoot as Peter Köhler inspects the huge hydraulic props that support the station. The graduate engineer is technical coordinator of Neumayer Station III. He has been acting as an expedition leader for about three months so far this season, exchanging his office in the idyllic harbor district of Bremerhaven for a place in one of the most inhospitable regions on Earth.

Neumayer Station III is built on a platform above the snow's surface. The research facility, operated by the Alfred Wegener Institute (AWI), stands on 16 stilts. Technicians are able to raise and lower the station with a hydraulic lifting device, compensating for the annual snowfall of about one meter. The facility grows with the snow cover, and the platform is always about six meters above the ice.

Inside the protective shell, the platform holds more than 100 containers with different functions over two levels, one above the other: living and sleeping quarters, a hospital, kitchen, mess, radio room and sanitary facilities. The power center is housed in its own two-story container. The corridors are on the rough, functional side; somewhat reminiscent of the atmosphere in a hospital. But researchers and staff make themselves as comfortable as conditions allow.

Researchers strive for a diesel-free future

As the hydraulic props slowly lift Neumayer Station III to its new height, under the watchful eye of Peter Köhler, a diesel engine purrs in the station's generator room. The facility's energy supply, which is occupied year-round, has thus far been based mainly on diesel generators. However, the price of high reliability is the polluting emissions from burning fossil fuels. The three diesel generators, each with an output of 160 kW, previously consumed between 350 and 500 tons of diesel per year, releasing about a million tons of carbon dioxide into the atmosphere in the name of research. But that is now changing. A sophisticated energy concept would reduce diesel consumption by almost half, as Peter Köhler explains to Bachmann.

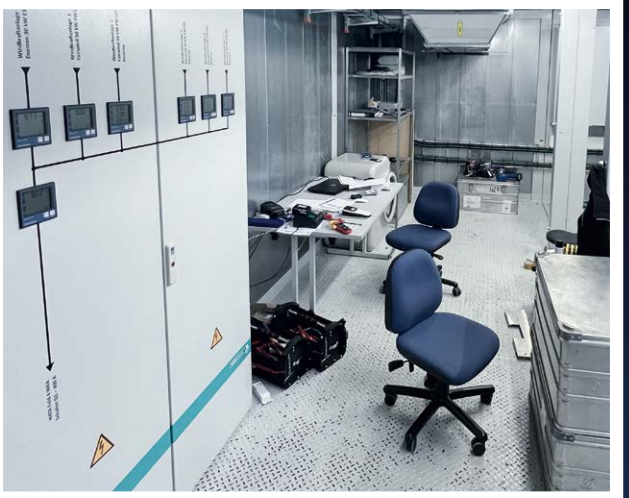
A logistical challenge

To date, three diesel-powered BHWK units, an emergency CHP unit and a 30-kilowatt horizontal-axis wind turbine have backed up the energy supply at Neumayer III. The next update will take five years – mainly due to logistical challenges:

Every year in late summer, the icebreaker Polarstern departs from Bremerhaven on an Antarctic expedition, crosses half the globe, and delivers all equipment during a research trip lasting several months. Time available for outdoor work in the Antarctic is extremely limited: everything must be done during the so-called summer season, which is between November and February. During the polar winter, it gets darker and emptier: between May and September, only a cook, three engineers, a doctor and four scientists remain on site. They form the winter team, where an icy polar night reigns.

Many measures taken to convert the research station's energy supply are essentially a pilot project. This also includes a vertical-axis wind turbine. The turbine supports the station's combined heat and power (CHP) plant with a renewable output of up to 50 kilowatts and complements the old horizontal system, which was faced with many technical problems in the extreme weather conditions.

The penguin colony near Neumayer Station III is an idyllic scene, dressed in white, with icebergs in shades of blue as its boundaries.



In some places, the Antarctic looks quite normal. The sub-distribution board for the wind turbines and battery storage could be located anywhere in the world.

Vertical, not horizontal

The new wind turbine is an H-type wind generator with a vertical rotation axis. As an H-type wind generator, the system can effectively use wind from all directions without adjustment to the rotor blades or the nacelle needing to be tracked. The rotor diameter is 10 m. Electricity is produced from low wind speeds of 2 m/s, up to 25 m/s in stormy conditions. According to calculations by the Alfred Wegener Institute, the first turbine alone will save 11,300 liters of diesel per year.

Annual snowfall is also an enormous challenge for wind energy. Crane capacities are limited, and weather conditions are harsh. The wind turbine had to be lightweight, robust and adjustable.

The snowfall challenge was solved by a star-shaped foundation grounded in the snow. With a total weight of around 8 tons, the turbine is so light that every year it can be lifted to the correct height for the snowfall by a crawler crane. The foundation sinks deeper into the firm snow with each raise. To compensate, standardized elevation elements are inserted between the conically tapering tower element and the foundation star.

Two more wind turbines of the same design are already in the planning, with a further two possible in future, making five wind turbines with a capacity of 50 kW each.

Measurement data for follow-up systems

Construction of the new turbines is based on data collected by a structural health monitoring (SHM) system that was developed, manufactured, and supplied by Bachmann.

This system collects measurement data on natural frequency, inclination and acceleration RMS values from the tower of the new Neumayer Station III wind turbine. “We see this as an initial success,” says Peter Köhler of the experience gained so far, which consistently provides new insights to him and his team.

The harsh environmental conditions and extreme temperature requirements call for particularly robust hardware and sensors. Bachmann’s 2D

The Neumayer Station III, operated by the Alfred Wegener Institute, is supported by 16 stilts. Technicians regularly raise the station with a hydraulic lifting device to compensate for annual snow accumulation of about one meter.

MEMS acceleration sensors collect measurement data to monitor the wind turbine under the rugged Antarctic conditions. Bachmann technology is designed for continuous operation at temperatures from -30° to +60°C and can withstand temperature extremes from -40° to +70°C.

Specially developed for the cold

Measurement data is recorded by a twelve-channel GIO212 CC universal input/output module. A MC212 CC processor is also installed in the switch cabinet on the tower of the wind turbine: "CC" stands for "Cold Climate".

The SHM system sensor data in Antarctica is first transmitted via Ethernet link to the polar station intranet, and then later sent by satellite to Europe, where it is systematically evaluated by Bachmann partner P.E. Concepts. Data recorded during the first year of operation is currently undergoing evaluation.

"We expect to get a statement about the selected tower design and whether our initial forecasts are accurate," explains Köhler. With these findings, the design of subsequent wind turbines can be optimized. However, Köhler is confident that no major changes will be necessary: "We expect to confirm the safe operation of the turbine on the newly developed tower."

The "WebLog Expert" software is used for data evaluation and for reporting. Bachmann's browser-based software tool enables a detailed analysis of vibration data and access to the configuration of the system parameters for Bachmann hardware using a standard web browser.

Facade to be clad with solar elements

The findings from the measurement data are currently being incorporated into the design of the second Neumayer III wind turbine, to be built during the 2024/2025 summer season. The work is planned for the period between November 2024 and February 2025.

But the complex energy concept of Neumayer Station III extends much further than wind turbines: in future, the station's façade will also play an important role in the generation of renewable energy. It will be equipped with photovoltaic elements to supply 53 kWp. Given local wind conditions, this is also a tricky task. A battery storage system with a capacity of 500 kW/h will be installed to buffer the energy. In addition, there will be a thermal storage system: a water tank with a capacity of 10 m^3. Last, but not least, existing CHP units will be replaced by two large and two smaller new CHP units. All this will ensure sustainable energy supply in the future.

One last look out the window: Outside, the wind whistles, snow flurries rise up. Inside, it is warm and comfortable. Modern, reliable technology ensures that things stay that way, and that researchers can continue with their vital work.

ALFRED-WEGENER-INSTITUT

– Coordinates Germany's polar research and provides ships and stations for international science

– Operates Neumayer Station III, named after the German explorer Georg von Neumayer

www.awi.de

Flexible automation for maritime applications

MASTERS OF ADAPTATION

System integrator Verhoef Elektrotechniek from Sliedrecht in the Netherlands implements turnkey electrotechnical systems for their customers in the maritime industry. This requires genuine engineering expertise, as every single project is unique. Bachmann's flexible hardware and software solutions ensure cost-optimized integration with rapid implementation.

Thanks to the PVA208 proportional valve amplifier modules, Dredge Yard's dredging vessels do not require hydraulic amplifier cards. This not only saves hardware costs and space in the control cabinet; the settings are easier to manage.

Verhoef Elektrotechniek offers customers a wide range of electrotechnical services for maritime and land-based installations. For the maritime sector, Verhoef Elektrotechniek realizes easy-to-operate, low-maintenance system solutions. As well as integration, the engineering team also develops and installs complete drive and control systems for every type of vessel.

Experience counts

Verhoef Elektrotechniek originally relied on different automation providers. However, supply constraints and increasing prices became a significant challenge, recalls Erwin Ströhmeijer, Senior Software Engineer at Verhoef Elektrotechniek.

The software engineer already had good experience with Bachmann in his former role with Bakker Sliedrecht. And so, Verhoef Elektrotechniek approached Bachmann. "Our collaboration began with the control of compact dredgers from Dredge Yard. And that went really well," says Ströhmeijer. Verhoef Elektrotechniek were the first to use the PVA208 proportional valve amplifier module for maritime vessels. For them, this module is unique because, on the one hand, there is no need to control a hydraulic amplifier in order to regulate the oil flow. And on the other hand, the tedious and difficult-to-measure settings in the amplifier card are no longer necessary. "With the PVA208, we can directly operate the hydraulic system actuator – in a controllable and verified manner. This saves our customers hardware, space in the cabinet and, ultimately, money," says Edwin van den Dool, Sales Manager at Verhoef Elektrotechniek, highlighting the benefits.

For the compact dredgers from Dredge Yard, the experts use a single Bachmann MX207 processor. "This compact processor family is fast enough for most tasks in our small and medium-sized projects," says Ströhmeijer. For larger ships, up to three CPUs from the MC series are used, depending on the scope of the project.

» Whenever we have the opportunity to use Bachmann solutions, we do so. They’re our first choice. «

Edwin van den Dool
Sales Manager at Verhoef Elektrotechniek

Gearbox test bench implemented by Verhoef Elektrotechniek: Whereas testing used to be documented manually by the operating personnel, customers now automatically receive a detailed PDF report of the complete test, including clutch engagement and disengagement trends thanks to WebMI pro and Scope 3. © ADS van STIGT

Flexibility is key

Verhoef Elektrotechniek's projects have very diverse requirements. Even with smaller dredgers, complexity is not to be underestimated, explains Edwin van den Dool. The control of these ships would be just as complex as their large counterparts. Here too, battery and power management systems, fuel monitoring and the correct load distribution would have to be implemented.

Accordingly, customized new developments are often required. This requires open and flexible solutions with comprehensive communication capabilities. The support of various bus systems such as CAN (J1939), Profinet or Modbus in the M200 system is therefore extremely helpful for Verhoef Elektrotechniek during project implementation, says the Senior Software Engineer: "We have Profinet encoders, controllers that are connected via CAN bus and Modbus fuel meters. This needs flexible solutions. The good thing is: Even if we need more performance, Bachmann offers the necessary flexibility with larger controllers."

Full insight

WebMI pro is used for visualization in the majority of Verhoef Elektrotechniek's projects. Erwin Ströhmeijer and his team also develop their own components for the Bachmann software: "With dredgers, for example, capturing the density and flow rate of the collected mixture of sand and water is an important piece of information. These parameters provide information on production. The programming was challenging but, together with Bachmann, we managed it." In the meantime, Verhoef Elektrotechniek also uses the intelligent functions of atvise® for monitoring systems such as the fuel monitoring of ships.

First choice

Over the last two years, Verhoef Elektrotechniek has experienced significant growth and made major progress in the field of control technology. Their OEM supplier is beyond question: "Whenever we have the opportunity to use Bachmann solutions, we do so. They're our first choice," emphasizes Edwin van den Dool.

As well as the solutions themselves, this is largely thanks to strong and direct collaboration between the two parties. They work very closely and very well together, says Erwin Ströhmeijer: "As soon as we develop a new type of application, we approach Bachmann to discuss the best implementation. There is a lot of positive energy in our collaboration."

Reliable delivery times are another reason why Bachmann is trusted. During the COVID-19 pandemic, Verhoef Elektrotechniek saw delivery times of a few weeks or even days. This was also a strong argument for Verhoef Elektrotechniek's customers to adopt Bachmann solutions.

Moving forward together

Verhoef Elektrotechniek's projects are becoming larger and more complex. Nevertheless, the system integrator can relax because, with a partner like Bachmann, they are confident about mitigating every potential risk. And Bachmann is fully supportive, as Joeri ten Napel, Key Account Manager Marine & Offshore, makes clear: "One of the great strengths of the specialists at Verhoef Elektrotechniek is that they know exactly what they are capable of – and can make clear group decisions. That boosts progress. Verhoef Elektrotechniek does not stop at a vision. Being able to participate in this development transparently and openly is a real pleasure for us. Today and in the future."

VERHOEF ELEKTROTECHNIEK

– Founded in 1954 as Verhoef Elektrotechniek (ETB), merged with Europe Marine Control (EMC) in 2017

– One-stop shop with a wide range of electrotechnical services for customers

– Based in Sliedrecht (Netherlands), 55 employees

www.verhoefemc.com/en

Thanks to the perfectly synchronized hydraulic solution from Hycom, the Mammoet Mega Jack 5200 system can safely lift dozens of kilotons. The cylinders repeatedly lift the assembly one meter into the air. A stable base is then inserted mechanically, onto which the structure can be set down.

Precise synchronization

MILLIMETER MEETS KILOTON

Mammoet jack solutions lift extremely heavy structures high into the air. The multiple hydraulic cylinders required must lift thousands of tons with millimeter precision and perfect synchronization to ensure safety on site. Based on the M200 control system from Bachmann, system integrator Hycom B.V. from Enschede (former Hydrodynamics B.V. Netherlands) developed a hydraulic system that matches these requirements perfectly.

Hycom specializes in the development and production of advanced hydraulic systems. The company was founded in 1974 and, in 2013, was fully integrated into the Hydac International Group. Hycom customers include renowned international shipyards, dredging companies and offshore plant manufacturers. One of these customers is Mammoet, with its Mega Jack 5200 jack-up system.

This revolutionary solution enables extremely large and heavy superstructures to be lifted efficiently and safely. It increases safety for Mammoet's customers, as much of the work can be carried out in advance at ground level. It also reduces construction costs and speeds up assembly. Theoretically, the turnkey system has an unrestricted lifting capacity thanks to an unlimited number of powerful jack towers. The Mega Jack 5200 has been used to lift structures weighing over 40,000 tons.

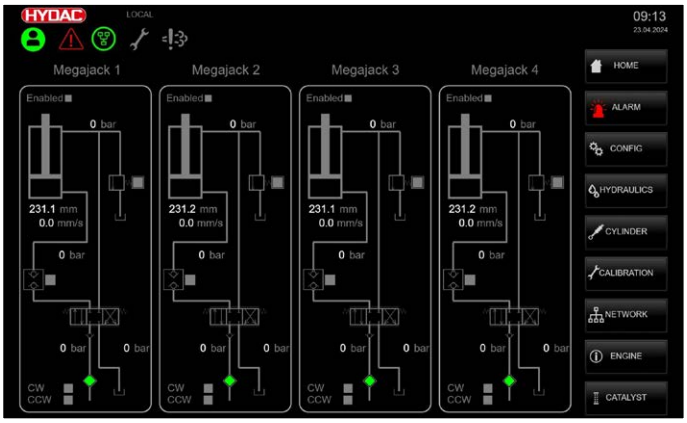
Undesirable complexity

Hycom was assigned to optimize the existing hydraulic control system of the Mammoet lifting system. "The previous system had one major disadvantage: A jack tower consisting of four cylinders was realized by two combined dual-axis

» With this solution, 40 or more cylinders can be lifted with a maximum tolerance of half a millimeter. «

Roy Beverdam
General Manager of Hycom B.V.

Four lifting cylinders are moved synchronously by a Bachmann controller. The total number of these jack combinations is theoretically unlimited and increases depending on the weight and size of the lifted structure.



Clearly visualized: With WebMI pro, Mammoet gains deep insights into the individual details for each cylinder.

controllers, each with its own control system, interfaces and software solution. If several jack towers were required for a project, system complexity increased enormously. It was therefore very difficult for Mammoet to determine exactly where the problem was when something was not working as it should," explains Roy Beverdam, Hycom General Manager.

Precise synchronization

Hycom developed a new control concept in less than three months. Their specialists had already had a positive experience with Bachmann during other projects, which is why they selected Bachmann's real-time systems for precise control and synchronization of the jack towers in this safety-critical application. Each tower now has its own Bachmann automation system to precisely control the cylinders and all associated components, as well as the diesel unit. In turn, every tower controller is networked via a central main controller. "This makes it easy to move 40 cylinders or more, with a maximum tolerance of half a millimeter," says Roy Beverdam, impressed by the precision.

An MX207 processor with ISI222 positioning module, a PVA208 proportional valve amplifier, an AIO216 universal analog input/output module and a DIO232 digital input/output module are used for each of the sub-controls. Communication takes place via CAN bus using the CANopen master module CM202.

Everything in sight

The system is designed for remote operation via a central Human Machine Interface. The tower controls are visualized directly on the M200 controller with the SCADA web interface WebMI pro. If required, this gives Mammoet in-depth insights into the details of each individual cylinder – right down to the exact status of the hydraulic valves, which also play a central role in safe lifting and precise control. "Helpfully, we can use flow diagrams to see exactly which parts of our systems are currently active and which are inactive," says Roy Beverdam.

Scope 3 has also proven to be extremely valuable, adds Roel Ymker, Application Engineer at Hycom: "The Scope function is really great. It helps a lot with commissioning and troubleshooting. We can examine every channel in detail and analyze the results in MATLAB Simulink®."

Intelligent software

Normally, special stand-alone axis controllers are required to reliably control all possible load scenarios,

says Roel Ymker: "However, these involve a high process load. Thanks to Bachmann, we could use our own software to solve all calculations directly on the controller. This allowed us to create a complete, integrated solution."

Thanks to the flexibility of the application program implementation by Hycom, the integration of various diesel units is simple and straightforward. An important software detail is the load control: "To keep the structure stable, you have to slowly increase the forces before the load is lifted for the first time. Depending on the position, the load is shimmed to achieve a level lift lifting," explains Roel Ymker, adding: "Another challenge was the dynamics. Initially, it was necessary to adjust the control parameters after every few meters lifted, as the dynamics of the system change with its height." An electronic pressure compensator was therefore installed so that the system could be operated with the same parameters, regardless of height.

And the journey continues

Hycom is already working on their next projects with Bachmann, such as the construction of the Fehmarnbelt tunnel between Denmark and Germany – the longest underwater tunnel in the world, due to be completed in 2029. The specialists are responsible for the exact positioning of 89 tunnel elements on the seabed. This is where millimeters meet kilometers, as the required positioning accuracy is just 15 mm, with a tunnel length of 18 km. Communication takes place via the bluecom open real-time transmission protocol.

Video:
Mega Jack 5200 in action

HYCOM B.V.

– Specialized in the development and production of advanced hydraulic systems and associated control systems

– Founded in 1974, since 2013 part of the Hydac International Group with over 10,000 employees worldwide

– Headquartered in Apeldoorn, the Netherlands

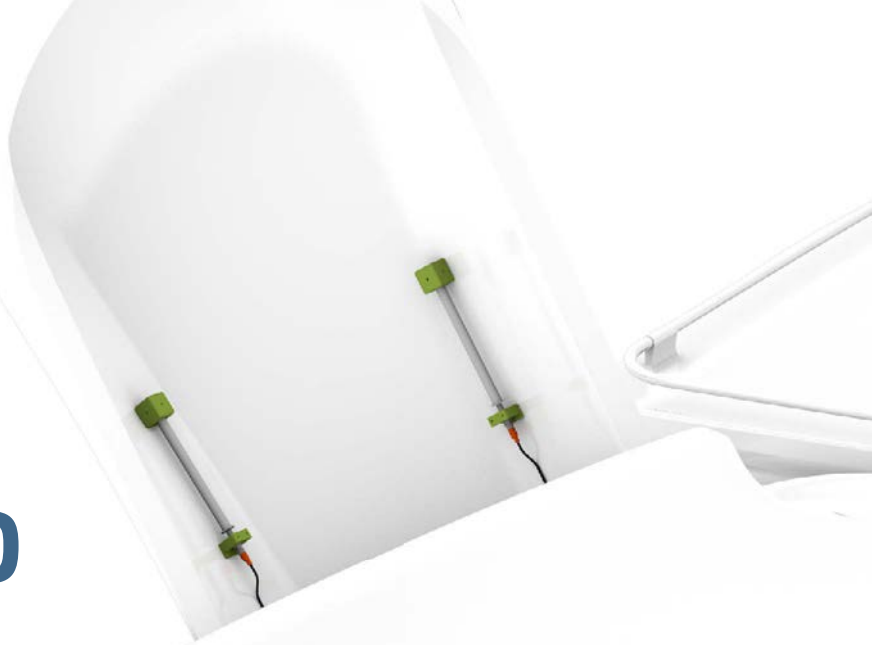
www.hycom.nl

» With Bachmann, we were able to use our own software to solve all calculations directly on the controller. This let us create a complete, integrated solution. «

Roel Ymker
Application Engineer at Hycom B.V.

Rotor Blade Monitoring

UNLOADED IN THE WIND



Modern wind turbine rotor blades can reach over 70 meters long and weigh 15 tons or more, often exposing them to extreme dynamic loads which, in the worst case, can damage the blade. For the earliest possible detection of potential damage, the Chinese CRRC Shandong Wind Power Co., Ltd. relies on the blade load measurement system from Bachmann.

Damage to the rotor blades of a wind turbine is a critical event. Severe damage can lead to the destruction of the blade, or even the entire wind turbine, creating a major potential hazard. Repairs then become time-consuming and cost-intensive, the turbine is at a standstill for an extended period, and loss of yield is significant.

Maintaining the structural integrity of rotor blades is not only crucial for turbine safety, but also to maximize energy yield: rotor blade damage impairs aerodynamic efficiency and reduces electricity production. "With permanent structural monitoring, minor damage can be detected and repaired at the earliest possible stage, avoiding expensive repairs or the replacement of entire rotor blades," says Yanhao Xu, General Manager of Bachmann electronic Technical Services (Shanghai) Co.

Precise load detection with cantilever sensors

CRRC Shandong Wind Power Co, Ltd, one of the leading Chinese manufacturers of large-scale wind turbines, opted for the Bachmann system to record the forces acting on the rotor blades in real time and reduce them if necessary.

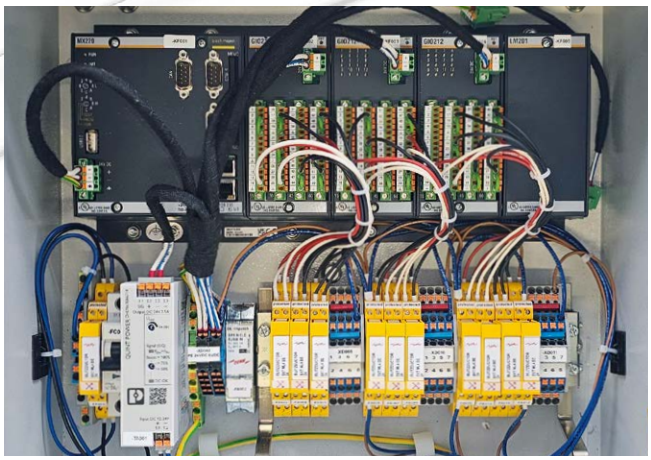
The CLS300 cantilever sensors were the decisive factor in favor of Bachmann. Their long-term stability, simple installation and unproblematic commissioning, especially when compared with the standard fiber optic sensors on the market, convinced the engineers at the Chinese wind energy specialist.

Complete Bachmann system

"We supply CRRC Shandong Wind Power Co., Ltd. with a complete blade load measurement solution. This includes the installation and cabling of the CLS300 sensors, including the control cabinet, as well as signal filter and calibration, and calculation of blade loads," Yanhao Xu describes the Bachmann solution. Two CLS300 sensors are installed near the hub of each of the three rotor blades and cabled to the hub control cabinet, where signals are fed to the GIO212 – a Bachmann M200 series module with an MX207 processor. The blade load values are transmitted from sensors to the wind turbine's main controller system via a CANopen field bus, where they are compared in real time with the manufacturer's design values. If the calculated values exceed a limit value, then blade load is reduced by repositioning the rotor blades in relation to the wind (pitch).

Low maintenance costs

Another important aspect in selecting the CLS300 sensors was the significantly lower follow-up costs. Unlike optical sensors, they can be easily reattached following

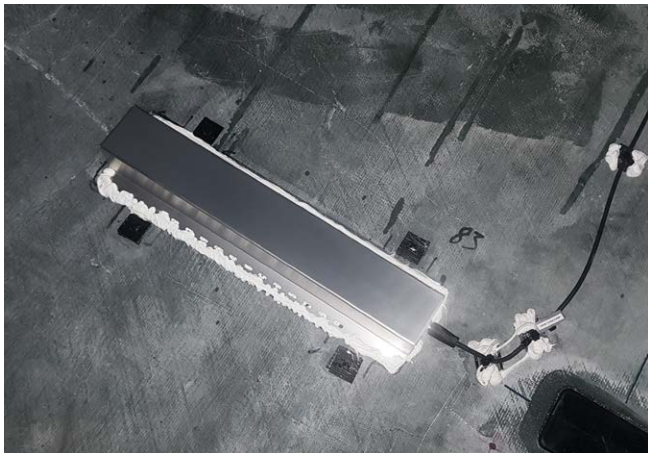


The blade load measurement control system is housed in a compact control cabinet in the wind turbine hub.

maintenance. Replacement of the sensor itself is extremely unlikely: "The sensor is well-protected and is not subject to external forces, making it very long-lasting," explains Yanhao Xu.

Focus on economic efficiency

For CRRC Shandong Wind Power Co., Ltd., the system contributes to a longer service life with lower turbine maintenance costs and, therefore, to the sustainability and economic efficiency of wind energy. As wind turbines continue to grow in size, the system also makes it possible to comply with increasingly stringent regulatory requirements on safety.



Quick installation suitable for series production: The CLS300 cantilever sensors are supplied pre-assembled on a mounting rail for simple adhesive mounting.

CANTILEVER-SENSOR

The CLS300 sensor unit, consisting of a cantilever clamped on one side and a proximity sensor on the opposite side, enables the conversion of a strain measurement into a simple distance measurement. Due to the inductive displacement measurement, the CLS300 is not subject to any mechanical deformation. The measurement principle therefore also guarantees the sensors long-term stability. *More on this on p. 64/65*

CRRC SHANDONG WIND POWER CO., LTD.

– One of the largest wind power equipment manufacturers in China

– Founded in 2009, subsidiary of CRRC Co. Ltd.

– Headquartered in Shandong (CN)

– More than 3.000 employees

www.crrcshandong.com

»The future is shaped by agility, curiosity and experience.«

Efficient engineering

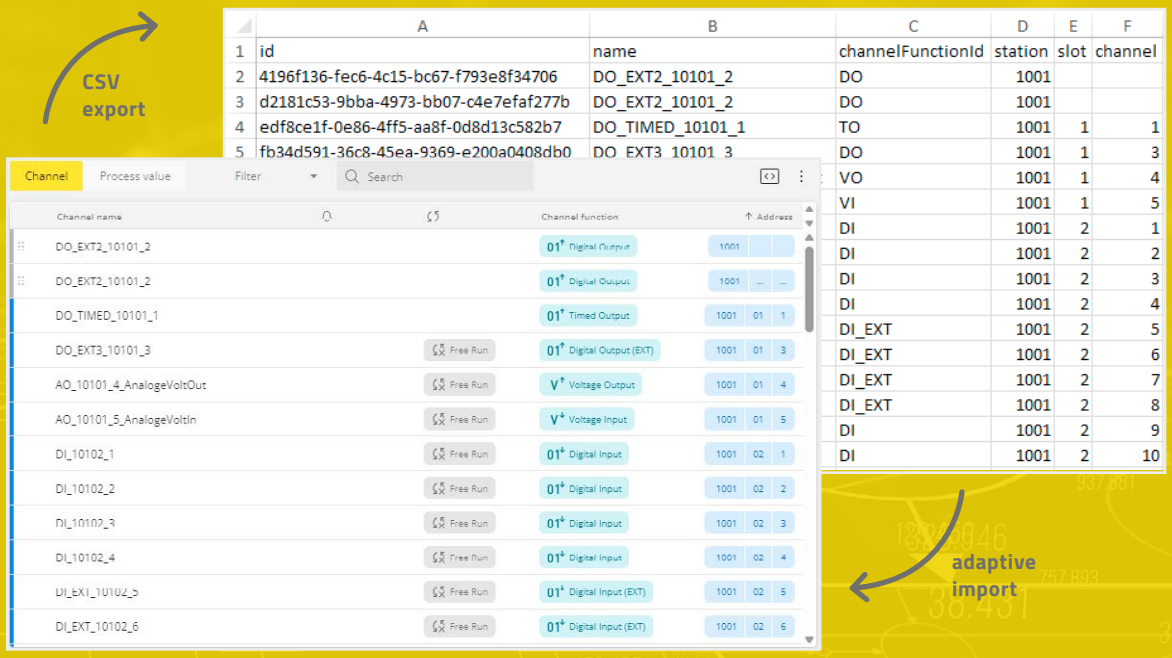
TURBO BOOST CONFIGURATION

Brand new system, full integration, tried-and-tested environment: Engineering and configuration of Bachmann's flexible M100 I/O modules can be undertaken in the familiar SolutionCenter interface. A whole package of helpful and convenient functions ensure a high level of processing efficiency – especially during initial configuration.

Channel configuration in no time – and without hardware

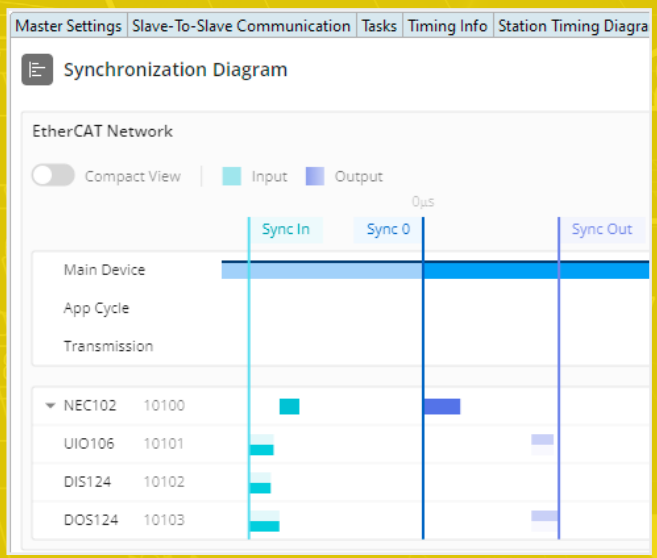
The all-new station and channel configurator simplifies the configuration of M100 I/O stations: On the one hand, the split-screen view provides a graphical interpretation of the real controller hardware, showing available, configured, and active PINs. On the other hand, the opposite display contains a context-dependent channel list with functions, addresses, process values and synchronization settings. Several helpful filter and search options provide a quick overview. The most important functions are accessible via icons, without cluttering the display visual. Navigation within the channel list and quick parameter changes are straightforward and can be done on the keyboard.

Bachmann UX experts have also taken care to make detailed channel configuration as simple and intuitive as possible. A wiring diagram, which shows the electrical function and PINs, helps with electrical diagnostics. Depending on the selected channel function, signal parameters are displayed with appropriate labels.



	A	B	C	D	E	F
1	id	name	channelFunctionId	station	slot	channel
2	4196f136-fec6-4c15-bc67-f793e8f34706	DO_EXT2_10101_2	DO	1001		
3	d2181c53-9bba-4973-bb07-c4e7efaf277b	DO_EXT2_10101_2	DO	1001		
4	edf8ce1f-0e86-4ff5-aa8f-0d8d13c582b7	DO_TIMED_10101_1	TO	1001	1	1
5	fb34d591-36c8-45ea-9369-e200a0408db0	DO_EXT3_10101_3	DO	1001	1	3
			VO	1001	1	4
			VI	1001	1	5
			DI	1001	2	1
			DI	1001	2	2
			DI	1001	2	3
			DI	1001	2	4
			DI_EXT	1001	2	5
			DI_EXT	1001	2	6
			DI_EXT	1001	2	7
			DI_EXT	1001	2	8
			DI	1001	2	9
			DI	1001	2	10

Efficient: Channel lists can be exported at the touch of a button as CSV files and quickly edited with external tools. The adaptive CSV import updates existing channel parameters in the list and adds new channels. If required, channels can be automatically assigned to existing hardware modules with one click.



Much simpler diagnostics: The synchronization diagram collects signal processing times for all M100 stations and modules in the EtherCAT network, and informs users about reliable signal transmission within the cycle time.

Extremely helpful: The final I/O hardware is not required to preconfigure channels as the configuration is stored on the main device. This means that configuration can be done at an early stage, even if the hardware is not yet available.

Quickly edit large lists

Channel lists can contain hundreds of entries. This is where the CSV import and export feature comes in handy. It allows you to exchange and edit channel lists, including channel labels, functions, and hardware addresses, with electrical design tools and various editors. Additional lines or channels can be added quickly and easily.

Subsequent SolutionCenter imports is adaptive: As new channels are added to the file, they are also added to the SolutionCenter. Any alterations to channel labels or existing channel functions are transferred to the configuration and updated. This makes it quick and easy to incorporate channel parameters that have been subsequently updated, such as channel labels changed due to updated schematics.

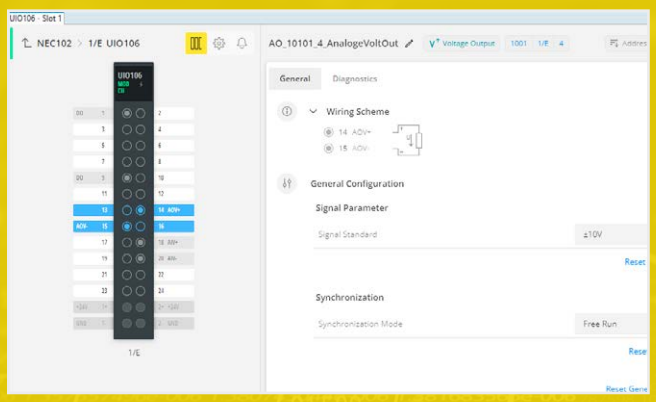
Securely map channels to hardware

SolutionCenter helps prevent misconfigurations when assigning channels to hardware. A channel can only be assigned to modules that provide the selected channel function. You can also drag and drop a channel into the graphical hardware view. Again, channels can only be assigned to PINs that support this function.

SolutionCenter offers another time-saving channel assignment feature: channel lists of any length can be automatically assigned to available hardware at the touch of a button. The SolutionCenter makes an assignment suggestion, which is accepted after confirmation. This is especially helpful when configuring a system for the first time and can save a lot of time.

Safely stay in the cycle

When connecting M100 I/O stations via EtherCAT, a special function provides a transparent view of the transmission cycle and the amount of transmitted data. The synchronization diagram shows the cycle time and signal acquisition times



Clear, detailed configuration: A schematic shows electrical function and PINs. Signal parameters are appropriately labeled, simplifying diagnostics.

atvise® in the cloud

A BETTER VIEW FROM ABOVE

Thanks to container operation and a consistent client concept, platform-independent atvise® can be used securely as a higher-level IoT service. A central atvise® instance in the cloud serves as a data hub and provides operators with targeted, bundled data from a variety of structures and systems.

Consistent multi-client capability

Powerful user management with a finely tuned authorization concept ensures increased security. Encrypted, user-specific OPC UA data source connections are established for visualization actions, allowing seamless tracking. OPC UA Alarms and Conditions allow direct use of data source alarms, significantly reducing engineering efforts.

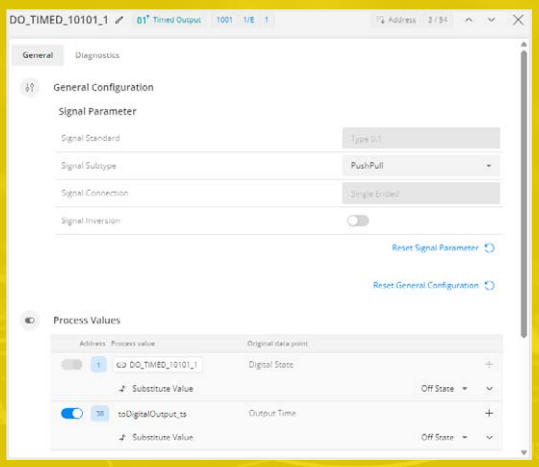
Targeted and reduced presentation

Thanks to individually assigned permissions, each user can access their relevant atvise® user interface pages. The home page can also be customized. Local operators and service teams will always find their user interface compact, individually configured, and showing only the systems available to them, even when hundreds of systems distributed worldwide are managed in one, central atvise® instance.

of all M100 stations and modules. This makes it immediately clear if the data volume of all signals cannot be transmitted within the cycle time. Data can then be specifically reduced and optimized. Compared to a physical measurement, this overview greatly simplifies synchronization diagnostics.

Intuitive application integration

Channel labels, which are now easier and faster to define, can be used 1:1 as variables in the application as usual. Alternatively, IEC61131-3 compliant I/O addressing can still be used.



Distributed high-precision clocks: In every module, highly accurate and synchronized clocks enable precise timing for time-critical events. For example, outputs can be switched in a time-controlled and autonomous manner, or input edges can be measured. Time stamps available on the hardware reduce transmission efforts.

SCADA as a service

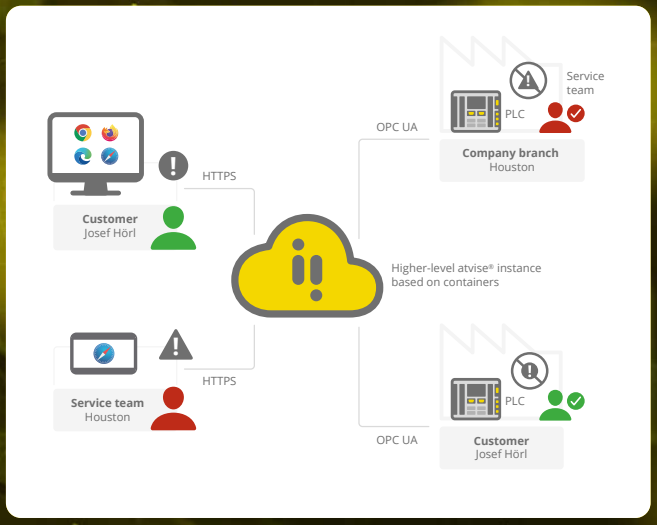
With atvise®, system integrators can offer their visualization as a SCADA-as-a-Service solution and dynamically generate atvise® instances on a container basis in their own cloud for a variety of customer projects. This eliminates the need for hardware commissioning at the customer's site, and atvise® can be configured at the push of a button.

If required, Bachmann is happy to customize the central IoT platform and define details such as optimally displayed responsive views or dynamic processes when generating plant structures.

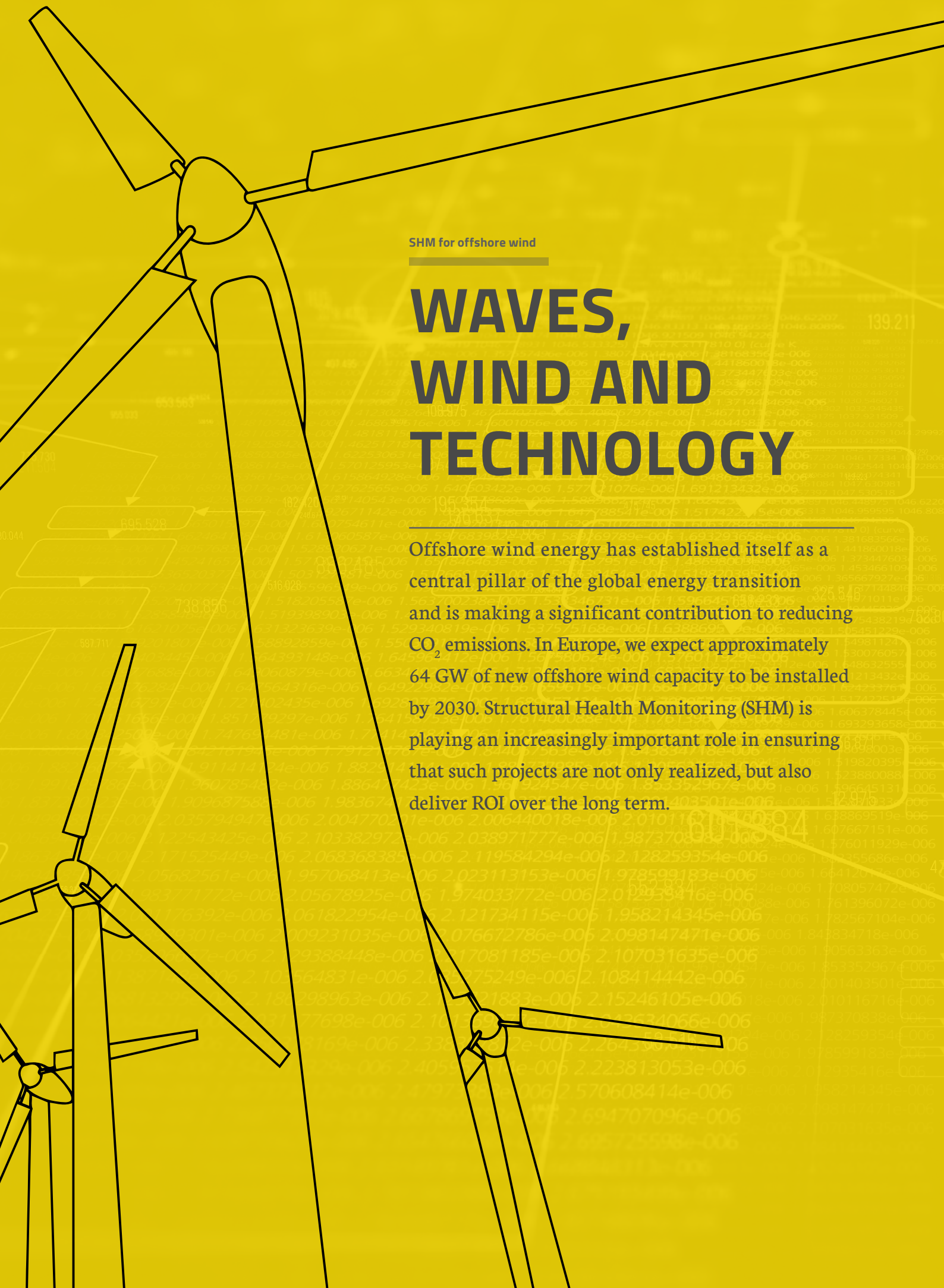
Secure authentication

With version 3.10, login options have also been expanded: atvise® now supports two-factor authentication. This means that common smartphone authenticator apps can be used for secure browser login. Alternatively, the second login factor can be sent by e-mail.

In addition: Version 3.10 of the atvise® builder comes with new usability features, and the redundancy extension package further simplifies handling of important functions such as hot standby mode for even more reliability.



To each their own: Secure, user-specific connections to the data source via OPC UA ensure seamless tracking and enable a consistent authorization concept.



SHM for offshore wind

WAVES, WIND AND TECHNOLOGY

Offshore wind energy has established itself as a central pillar of the global energy transition and is making a significant contribution to reducing CO_2 emissions. In Europe, we expect approximately 64 GW of new offshore wind capacity to be installed by 2030. Structural Health Monitoring (SHM) is playing an increasingly important role in ensuring that such projects are not only realized, but also deliver ROI over the long term.

Since an accident at the Alpha Ventus wind farm, where a wind turbine nacelle collapsed into the sea, operators have become increasingly aware of the importance of Structural Health Monitoring (SHM). The incident could have been easily and cost-effectively avoided with SHM.

SHM not only enables the monitoring and early detection of structural problems, but also helps to maximize the design life of wind turbines, which is now up to 35 years or more.

Ensuring economic success

The levelized cost of electricity (LCOE) is a key metric used to assess the economics of offshore projects. Lower LCOE generally means higher profitability. However, factors such as the lifetime of turbines and the calculated interest rate also play a decisive role. Faced with higher financing costs, it is essential for project developers and operators to present investors with a plausible and well-founded strategy that ensures project success. An optimized operation and maintenance strategy, supported by SHM, is a central component.

SHM grows in significance

SHM is becoming increasingly important as the capacity of offshore wind turbines continues to grow. In 2023, the average capacity of new turbines will exceed 9.7 GW. This increase has been achieved, in part, with the use of longer rotor blades and high-performance, lightweight drivetrain components. However, this means a reduction in structural safety factors, increasing the risk of failure and damage. In addition, practical experience has shown that the natural frequencies derived from the model design often deviate significantly from actual operating frequencies, for example in the case of fixed bottom foundations, depending on the geological seabed conditions. As such, it cannot be ruled out that, turbines are being operated in unsuitable locations. As a result, excessive aging and wear of both structural and mechanical components is to be expected, ultimately leading to higher costs.

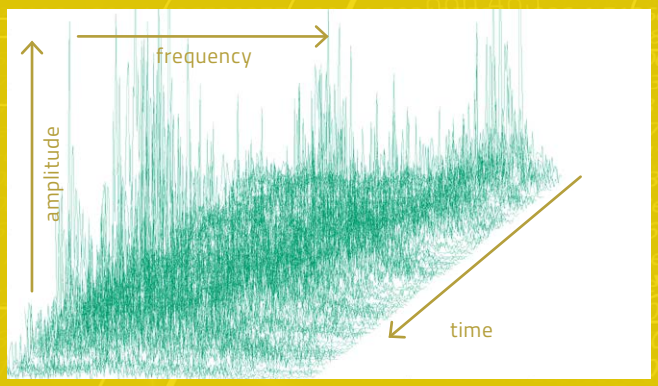
From condition monitoring to SHM

Condition monitoring systems (CMS) based on structural resonances have become indispensable for the early detection of faults in the machine components of the drivetrain. They have now become standard and are an essential part of any maintenance strategy, especially in offshore wind turbines. The further development of these systems into comprehensive SHM, which also monitors structural changes in the turbines, is therefore a clear trend.

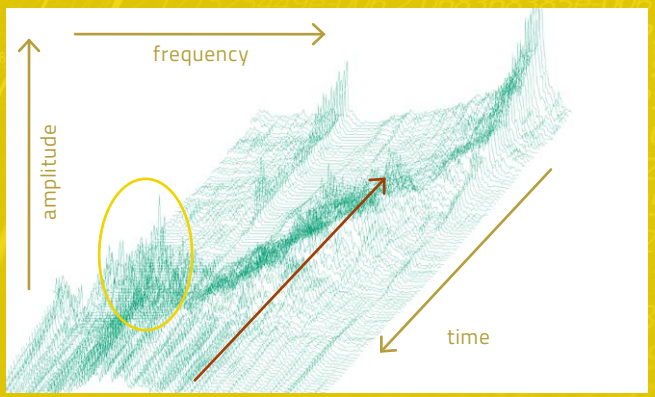
The evolution towards SHM is enabled by the use of new mathematical analysis methods and enhanced hardware. Examples are the integration of 3D MEMS sensors or the use of the CLS cantilever sensors developed by Bachmann. These sensors detect the finest structural changes and provide essential data for precise condition monitoring.

» We often see turbines operating in unsuitable locations. «

Holger Fritsch
Bachmann Monitoring GmbH



Raw waterfall spectrum of the structure-borne sound sensors installed in the drivetrain of a damaged wind turbine.



Natural frequency spectrum extracted from the total frequency spectrum: The pronounced structural change is clearly visible (red arrow). The failure, due to a fracture in the structure (yellow circle), would have been detected with a method patented by Bachmann.

Real risk

One event particularly emphasizes the importance of SHM: in April 2018, the nacelle of AV07 at the Alpha Ventus wind farm – Germany's first offshore research wind farm – collapsed into the sea. The cause was initially unclear, and every turbine of that type was shut down as a precaution. The consequential costs of this damage were considerable and reached a significant order of magnitude due to the subsequent measures required.

The turbines in question were equipped with CMS during production, but the main function was to detect faults in the gearboxes and bearings. These systems were not designed to monitor structural changes in the nacelle. After this catastrophic structural failure, the question arose as to whether the sensors installed on the drivetrain could have predicted the damage, and thus prevented such an incident.

In addition to the financial impact, such events pose a significant safety risk. Two weeks before the accident, divers had been performing maintenance on the foundations of this very facility. If the accident had occurred at this time, it could have been fatal – making the urgency of comprehensive structural monitoring even clearer.

Patented extension

The typical frequency patterns provided by structural resonance sensors are evaluated to assess the condition of drivetrain components. These so-called kinematic frequencies are characterized by, among other things, their

dependence on speed. In contrast, so-called natural frequencies (structural frequencies) reflect the characteristics of the system design. However, kinematic and natural frequencies are superimposed. Without special measures, the resulting frequency spectra are difficult to interpret, making early fault detection more difficult.

While analyzing existing CMS data of the damaged wind turbine, Bachmann's Professor Michael Schulz found a mathematically sound way to separate the speed-dependent kinematic frequencies from the natural frequencies of the structure. The effectiveness of this method, for which a patent application has been filed, has already been proven in several significant cases. In the case of the aforementioned wind turbines, for example, it would have been possible to avoid an expensive structural retrofit, the effectiveness of which was also uncertain. By installing just one additional sensor to ensure data quality, results of the analysis would be improved even further. The cost of this sensor was significantly less than the planned retrofit.

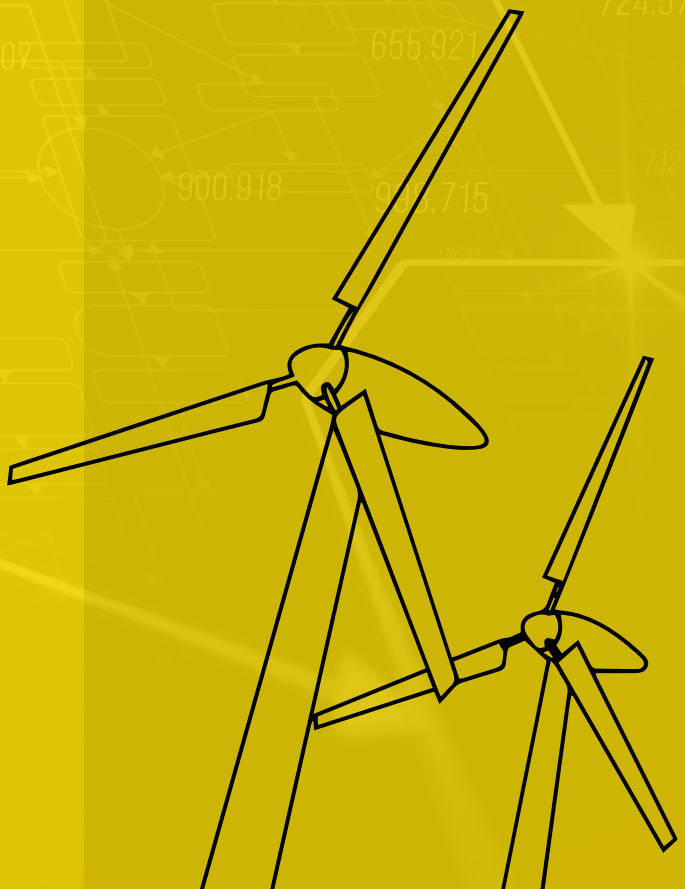
Lower costs, higher safety, more efficiency

This example clearly shows how SHM extensions to existing CMS systems can not only reduce costs, but also increase the safety and efficiency of wind turbines. Today, such systems are no longer just theoretical, but have proven themselves in the field. They have proven to be particularly valuable in detecting anomalies, for example when monitoring hybrid towers or comparing the behavior of different turbines within one wind park.

As a result, SHM/CMS systems can not only minimize the risk of yield loss, but also extend the life of the equipment and increase its economic efficiency. The cost of investment in such systems has also fallen: They now represent just a fraction of the system's total cost.

The future of offshore wind will be driven by innovative technologies that combine safety, efficiency and profitability.

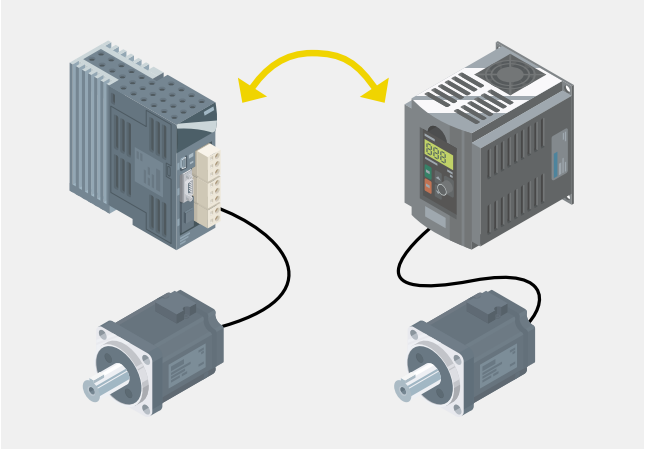
While analyzing data from the crashed Alpha Ventus nacelle, Bachmann's Professor Michael Schulz developed a mathematically sound method of separating the speed-dependent kinematic frequencies from the structure's natural frequencies.



»Focus is what leads to advanced, in-depth solutions.«

DRIVE MIDDLEWARE: MORE DRIVE POWER, MORE INDEPENDENCE

With Bachmann controller and motion solutions, motion axes can be moved easily and precisely positioned using electric drives from a variety of manufacturers. Thanks to intermediate Drive Middleware, users can develop their applications independently from the OEM. Further servo drives from Festo, Yaskawa and Schneider Electric are now supported, with initial applications already implemented by Bachmann customers.



Bachmann's Drive Middleware enables users to create applications regardless of drive manufacturer.

Opens new markets: FoamaTec uses a drive newly supported by Schneider Electric for synchronous operation of a clamping unit for large particle foam machines.

Drive Middleware from Bachmann abstracts fieldbus drives by encapsulating the drive state machine, as well as referencing routines and manufacturer-specific drive properties. This provides developers with an interface to their user program that is independent from the drive. Basic automation speed is enhanced and commissioning time reduced. Drive Middleware leads to future flexibility: Drives can be replaced at any time without adjusting the motion application.

Festo drive amplifier: probe positioning at Dorst Technologies

Festo's single-phase or three-phase CMMT-AS drive amplifier for the control of servo motors is now supported. Dorst Technologies uses this type for the precise measurement of pressed components. A measuring probe is moved along the x and y axes by two Festo drives. Both axes are moved along the desired motion path via Bachmann's M-SMC.

"M-SMC and Drive Middleware make the development of standard applications really easy for us. With the provided motion functionality, we save a lot of development time, and have been able to completely redesign our machine prices. Drive Middleware also enables us to use the customer's preferred drive manufacturer, without modifying the application. This is a great benefit for us," says Kilian Abeltshauser, Software Programmer and Application Expert at Dorst Technologies. "We initially created a template with the most important commands, such as target and speed specification or jog operation. These tested code segments can be recombined for new applications, allowing completely different applications to be implemented very quickly, including the preferred drive manufacturer as requested by the customer."

Schneider Electric servo drive, FoamaTec clamping unit

Drive Middleware now supports the LXM32M drive amplifier from Schneider Electric, which supports single- and three-phase connections. FoamaTec uses this type of drive, for example, to position the clamping unit of a particle foam machine for packaging production. The mold is closed via two synchronously operated EtherCAT drives, before the particle foam is inserted, heated and solidified. "The drives have to run perfectly in sync, otherwise the mold and machine could be destroyed," explains FoamaTec Managing Director, Eugen Laubach. The clamping unit is actuated via toggle levers so that torque does not change linearly over the distance traveled. This requires a reliable real-time system that reacts precisely to varying torque requirements. However, this is no problem with the Bachmann controller, says the Managing Director. "Thanks to the synchronous operation with the new drive type, we can now manufacture larger products, which opens up a new market segment. And with Drive Middleware, it only took a few simple steps to get the system working with the new drive," says a delighted Eugen Laubach.

Yaskawa drive amplifier: Filler shoe positioning at Dorst Technologies

The third drive amplifier in the group is produced by Yaskawa. While previously only the 230 V version of the SGD7S EtherCAT drive was integrated into Drive Middleware, the larger 400 V version, which can move heavier masses, is now also supported. Dorst Technologies already uses this amplifier in metal powder presses. Here, for example, the filler shoe is electrically driven according to a parameterizable motion profile. This allows molds to be uniformly filled with metal powder, which leads to consistent quality in the production of blanks and components, even in the most complex press shapes.

DRIVE MIDDLEWARE

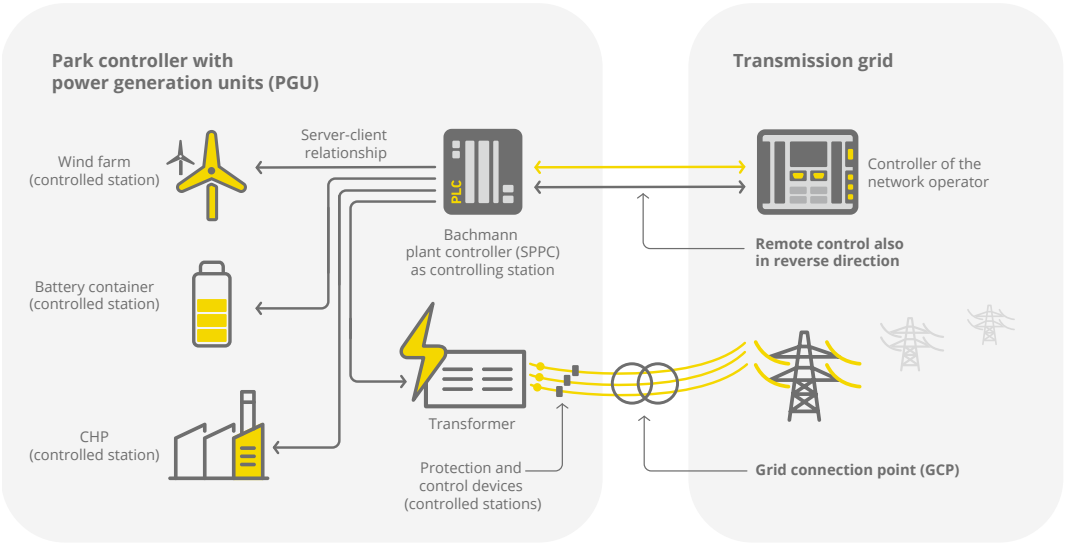
- Standardized motion application programming, independent of drive manufacturer and fieldbus Programmierung von Motion-Applikationen
- Quick commissioning, thanks to pre-defined drive descriptions
- Integration in Bachmann motion controllers M-SMC, M-SHAFT and M-CNC
- Model-based development thanks to integration in M-Target for Simulink®

M-SMC SOFTWARE MOTION CONTROL

- Software module for controlling, regulating and monitoring motion axes
- Operation of single axes or synchronized multi-axis movement
- Jerk-optimized motion profiles
- Numerous methods for axle synchronization (gearing)
- Configuration and diagnostics in SolutionCenter
- Commissioning interface (SMC monitor)
- Library for IEC 61131-3 PLC programs

FLEXIBLE TELECONTROL: AUTONOMOUS. AND NETWORKED.

Robust systems are achievable with modularization and clearly defined tasks. For system integrators working with critical infrastructure, Bachmann offers an exceptionally flexible portfolio of telecontrol products, allowing manufactures to offer a modular concept for their equipment.



Flexible communication required – hierarchically within the system, and at the same level between systems. Not a problem with Bachmann's communication products.

The telecontrol connection concept found on the Bachmann control system aligns with the principle that control algorithms, business logic and sequence control are programmed independently from telecontrol and communication. Operation and visualization are performed either via a local HMI, a SCADA system, or via one of several possible telecontrol drives.

Spoilt for choice

Decisions about which protocol to use often falls to the plant operator. It's hard to find a comparable range of telecontrol options on the market to those offered by Bachmann: Versions -101, -103 and -104 of the IEC 60870 standard are supported. IEC 61850 connectivity enables MMS and GOOSE. DNP3 can be used over TCP and serial. Although Modbus is not a telecontrol protocol, it is often used for this purpose: At Bachmann, either in the serial variants ASCII and RTU, or via Ethernet (TCP and UDP). All standards are available for both master and slave operation.

Defined information flow

In telecontrol, each unit, such as an energy generation system or a circuit breaker, is considered an autonomous system. Data is exchanged between them: Measured variables, default values and status information are defined during project planning.

Data volumes are therefore known in advance and can be anticipated. They are also relatively small. In contrast to big data, the exchange takes place via clearly defined relationships and hierarchies within a system.

Security by design

The data transmission and associated data points are as precisely fixed as a wire between two terminals. Anything that is not defined will not be transmitted and so cannot influence anything else. Telecontrol protocols therefore also make an important contribution to improving cyber security in critical infrastructures. A serial connection makes cyber attacks considerably more difficult, especially at system transition points such as the grid transfer point between wind farm and grid operator. This is because operator networks and IT systems remain completely separate. For this reason, the serial IEC 60870-5-101 protocol is often still used in new systems, even though the same functions would be Internet-enabled with the -104 protocol.

M100 BUS COUPLER: THE POWER OF THREE

With the M100 I/O system, Bachmann has deliberately reduced the number of variants, instead offering a wide range of functions on the I/O module. The M100 bus couplers for individual fieldbus systems make these functions available regardless of the fieldbus, and configuration is always carried out in the same tool - with the same look and feel.

Three different bus couplers will soon be available for the M100 I/O system fieldbus connection: In addition to the currently available EtherCAT coupler NEC102, two new modules for CANopen and Profinet bus connection will be released in 2025. Now nothing stands in the way of easy M100 I/O station integration into the three most common fieldbus environments in industrial automation.

The bus couplers follow the M100 I/O system philosophy: They offer state-of-the-art IT security, combined with durable hardware for continuous use in challenging environments and unmanned systems. LEDs provide intuitive information about overall station status. Additional fieldbus LEDs for 'RUN' and 'ERROR' show standardized colors and flashing patterns for the respective fieldbus. EtherCAT and Profinet stations receive addresses from the master during start-up. For the CANopen bus coupler, the address is still set via hardware switches.

Fieldbus-related features such as bandwidth, addressing, missing station handling, or synchronization options do change. However, basic configurator operation remains unchanged and consistent.

Troubleshooting information such as operating counters, diagnostic telegrams or emergency messages are provided to the fieldbus master according to the standard. In addition, further information can be collected via a local USB-C connection. Important data such as startup information, messages from the fieldbus stack, status changes in the local status machine, or changes in connection quality are stored in the logbook.

With its new bus coupler modules, the M100 I/O system can be quickly connected to the three most common types of fieldbus in industrial automation.

More flexibility with reverse direction

Classic hierarchy concepts are not always suitable for system transitions: In some cases, a telecontrol client must also send a status message, or a server must request values from the client. However, it is important to maintain a clear chain of cause and effect within system operations. IEC 60870 defines a reverse direction for this purpose. Bachmann facilitates individual definition of each data point in the configuration.

Certified telecontrol solutions – constantly improving

Bachmann's experienced application engineers are in close contact with global OEM suppliers. The reliability and flexibility of Bachmann's carefully developed telecontrol products is proven by their daily practical application in many customer projects. TÜV and DNV agree: numerous customers have already received device certification – both IEC 61850 and IEC 60870. Because, even when it's Bachmann inside, it doesn't always say it on the outside.

CONDITION MONITORING: EXPERT. RELIABLE. COST-EFFECTIVE.

The profitability of wind turbines is determined by productivity and availability. Operators are seeking to optimize maintenance to deliver the highest reliability at the lowest cost. Condition monitoring supports maintenance decisions, identifies potential cost savings and avoids unforeseen failures. But should you do it yourself? Bachmann Monitoring is ready to help you decide.

Bachmann remote monitoring teams have an enormous wealth of experience. Employees are comprehensively trained and accredited. Thanks to many years of experience withall major turbine types, they have a broad now ledge of a wide range of fault types and consequences.

Do it yourself vs employing a third party. Decision-makers are always faced with this question when a new task lies outside the core competence of an organization. There is rarely a single answer to this question, as the perfect solution is all too often dependent on many factors. This is also the case with condition monitoring.

Challenging task

Monitoring the condition of wind turbines is a complex art. A wide variety of sensors are installed at selected points on the drive train, rotor blades and tower. These sensors deliver a continuous stream of raw data. Without appropriate

processing, the data is worthless. Only after processing is it possible to visualize and interpret the numerous possible effects of small changes over time on certain sensor readings, and to assess the potential consequences.

In addition, condition monitoring analysts are working with increasingly complex calculation methods to predict the impact of a small change in measurement data on the wind turbine. These algorithms are trained and continuously checked using years of data from many different wind turbine types.

Complex interaction

In addition to the hardware and software for monitoring, and a suitable visualization tool, specialist knowledge is also required: Above all, this includes expertise in vibration analysis. However, such expertise requires not only advanced training, but also experience working with a large number of turbines over a long period of time to understand the actual meaning and significance of changes in the data. Furthermore, if the analyst is familiar with the type of turbine being monitored, they will deliver more precise information about the most likely failure mechanisms. At the same time, prior experience helps to assess whether and, if so, which remedial measures can be implemented, either on site or through a more in-depth remote intervention.

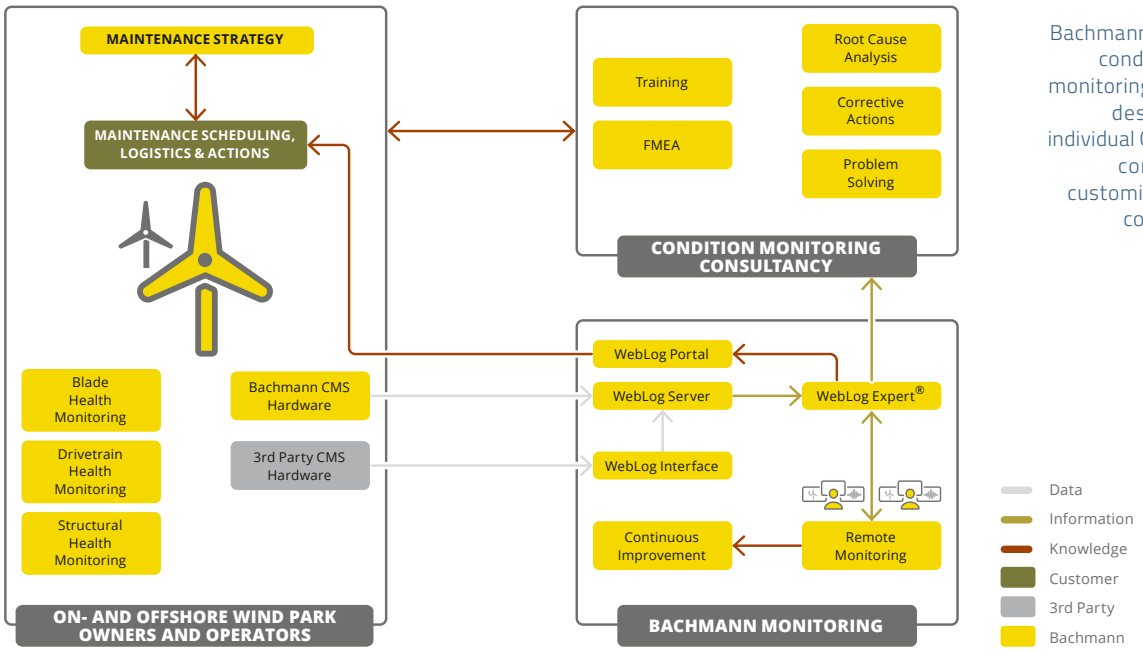
In-house or external?

Operators with a large and growing number of turbines usually look for in-house solutions to monitor their installation. However, if there are only a few systems to be monitored, a complete service from an external partner such as Bachmann Monitoring may be the preferred solution. In this scenario, monitoring experts can carry out all condition monitoring processes on behalf of the operator, providing recommendations to the team responsible for on-site maintenance.

Individual support levels

However, hybrid models are also conceivable, in which the operator defines the desired level of support from the external provider. After all, there may only be one piece of the puzzle missing for consistent and complete in-house performance – such as sufficient resources, infrastructure and tools, or the corresponding specialist knowledge.

A considerable reduction in the burden on in-house resources can be achieved by outsourcing data screening. For example, Bachmann Monitoring offers a service that includes hosting data and the daily routine processes for checking data quality and eliminating false alarms.



Bachmann offers expertise in condition and structural monitoring. Depending on the desired support level, individual CMS services can be combined to create a customized monitoring and consultancy package.

Transparent monitoring and maximum data security are at the heart of Bachmann's condition monitoring services. Customers receive full access to all CMS data and a complete status overview of their systems.

Only new information relating to machinery condition are passed to the operator's support team. Bachmann Monitoring's approved training package can help the operator's team gain the required technical knowledge of vibration analysis.

Alternatively, if operators wish to establish their own monitoring, without having to invest in the necessary, cost-intensive IT infrastructure, then Bachmann's pure data hosting is the ideal solution: In a cloud solution, operators take full responsibility for their own condition monitoring. If they decide to take on data hosting at a later date, Bachmann offers the necessary tools, including licensing packages and technical support.

Reliable partnership

The decision to bring condition monitoring in-house is complex, and there is no one-size-fits-all solution. For an operator who wants to retain control over the condition monitoring of their wind turbines, a hybrid solution could be the best possible option. With Bachmann Monitoring, they can rely on transparent system monitoring and maximum data security. With full access to all monitoring data, they have a complete overview of the status of their turbines, can make their own decisions and implement their own monitoring strategy. In particularly difficult cases, however, they can fall back on the advice or support of a proven service partner.

b.guard

Remote monitoring services from Bachmann:
Dedicated specialists provide operators with all diagnostic data in a clearly structured format.

M100 HIGH-DENSITY MODULES: MAKE WAY!

With their slim design, Bachmann's intelligent M100 I/O system modules already save a lot of space. However, the HD (High Density) modules, available from mid-2025, set a new standard in channel density. With up to 1.5 times the number of channels packed into the same space as standard modules, the HD versions simplify the implementation of applications where there is limited space in the control cabinet.

MX200 PROCESSOR SERIES: SMALL BUT POWERFUL

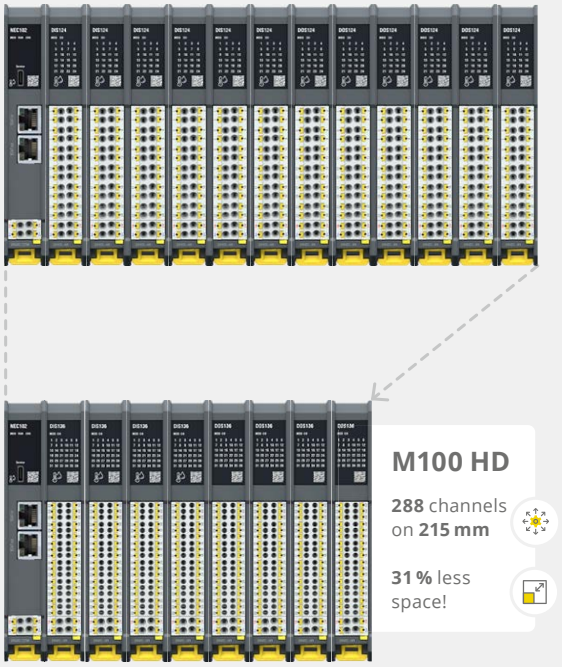
The third generation of Bachmann's compact MX200 processor series will be released in the first half of 2025. It features modern industrial CPUs, a new operating system, more memory and a secure Trusted Platform Module – and is ready for the future!

The second-generation MX207, MX213 and MX220 will be replaced by the MX208, MX214 and MX221 modules. The new MX215 processor module features more Ethernet and CAN interfaces than the MX214 CPU.

The new DIS136, DOS136 (each with 36 channels, compared with 24 in the standard version), AIO116 (16 channels instead of 12) and UIO108 (8 channels instead of 6) digital and analog I/O modules enable extremely compact I/O configurations. They are specifically designed for applications that need to process a large number of digital or analog I/O signals. Extended climate versions will also be available.

Bachmann's HD modules offer the same intelligent functions already appreciated by users of the standard M100 I/O modules – PWM, counters, timestamps, oversampling and direct module-to-module communication.

The condensed modules reduce system costs and help to make manufacturers more competitive: Material and assembly costs can be reduced, and control cabinets can be designed more compactly, which is particularly beneficial in applications with limited space. Reduced heat dissipation protects the hardware inside the cabinet and even extends its life.



Limited space? The M100 I/O system high-density modules open up a new dimension in the compression of I/O channels. The standard modules (above) and HD modules (below) have the same number of channels and functions.

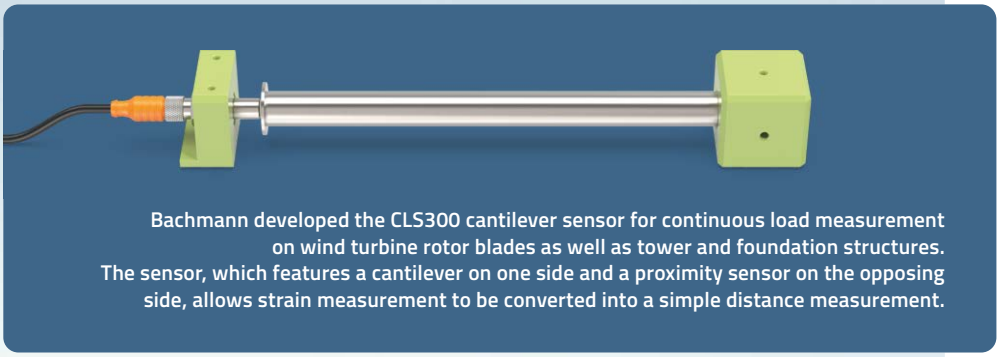
An integrated power supply provides power to the controller and the connected I/O system. The latest Intel® industrial CPUs easily meet the increasing performance requirements of the future.

The operating system behind the next-generation MX series is based on VxWorks 7, which is already in use with the MC series. Enabling the secure storage of keys and passwords on the integrated Trusted Platform Module (TPM 2.0). If the processor reaches its available resources limit, for example as applications become larger, it is simple to switch to a more powerful controller unit from Bachmann's MC or MH series.

Whereas mass storage was previously provided by a CompactFlash card, the next generation relies on a microSD card with a capacity of up to 256 GB. The card can also be transferred to other MX or MC processor modules.

With this next generation of processors, up to 2 GB of onboard memory is now available for applications and data. The DDR4 memory has also been increased to 512 MB or 1 GB, depending on the processor. The modern USB 3.0 interface enables faster updates and increases the speed of servicing.

The design hasn't changed, but the MX200 processor series has been enhanced on the inside. The result: more performance, more flexibility, and more security.



Bachmann developed the CLS300 cantilever sensor for continuous load measurement on wind turbine rotor blades as well as tower and foundation structures. The sensor, which features a cantilever on one side and a proximity sensor on the opposing side, allows strain measurement to be converted into a simple distance measurement.

CLS300: LOWER COSTS, HIGHER PROFITS

Bachmann's CLS300 cantilever sensors are easy to install, cost effective and durable. It comes as no surprise that an increasing number of wind turbine manufacturers are adopting them as the standard sensor for blade load measurement. The CLS delivers even more potential savings when used simultaneously for ice detection and structural monitoring to avoid unplanned downtime.

In modern, multi-megawatt wind turbines, the pitch angle of individual rotor blades can be independently adjusted. This is to keep turbines optimally aligned with the wind at all times and, therefore, optimize yield. The technique is referred to as Individual Pitch Control (IPC) and it facilitates the optimal coordination between turbine design and operating strategy, significantly reducing energy generation costs and increasing yield thanks to the optimal relationship between wind direction and rotor blades. IPC is particularly necessary with increasingly large blade diameters because, due to varying wind speeds and directions, a variety of aerodynamic forces act on individual blades depending on their height. The resulting asymmetric loads on blades, hub and tower can be reduced by adjusting the individual blades. Without an individual approach to counter these forces, all load-bearing structural components would need to be larger, driving up costs and reducing yields. Today's turbines therefore require reliable, continuous blade load sensors and appropriate local turbine control.

Robust blade load sensors are a must have

Sensors are critical components of the turbine: If they fail, load- or yield-optimized IPC operation is no longer possible, which leads directly to performance losses. Within the partial-load range, an operator can lose up to ten percent of predicted Annual Energy Production (AEP). If the rated turbine output has to be reduced, this can deplete AEP by up to 30 percent. If turbines cannot be operated with IPC due to inadequate blade load sensors, turbine manufacturers are at risk of customer complaints due to turbine damage. This can quickly become very costly.

With Bachmann's cantilever sensors, wind turbine manufacturers are taken care of. In contrast to traditional fiber optic sensors, the simple and robust sensor technology does not require sensitive and expensive optical-electrical converters in the hub: CLS sensors can be wired directly to the pitch controller. This makes installation faster and

reduces errors. Correct strain gauge application previously required a great deal of experience and care, as well as appropriate test equipment to get them up and running. This made commissioning in the field, for example after maintenance, a costly challenge.

CLS sensors are durable and stable over the long term because they measure without contact and, therefore, are not subject to loads. Bonded strain gauges, on the other hand, are constantly exposed to changes in load that age not only the strain gauge itself, but also its adhesive bond to the rotor blade. Due to the measuring principle, both have a major influence on results, which over time makes measurements increasingly subject to error.

Reliability is key

The selected sensor technology has a significant impact on the reliability and availability of blade load measurement. Long-term experience demonstrates that, due to their design and direct connection to the control system, cantilever sensors have an availability of 99.9 percent. Fiber optic sensors are expected to have a lower availability, approximately 97 percent, due to the effects of aging. This also applies to the opto-electrical converters required by the measurement principle, leading to an overall system availability of just 94% or less. In the event of repairs, re-commissioning is significantly more complex than with the CLS.

CLS sensor adds value

Bachmann's CLS sensor technology promises further potential savings in the future, as recorded loads also document the turbine load history, the basis of optimized lifecycle decision making. Knowing the actual loads that have been applied to blades over the life of the system can be a critical factor in determining whether to extend the life of the entire system.

Detecting anomalies

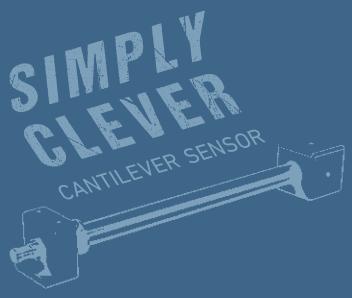
Above all, Bachmann is committed to the ongoing development of structural health monitoring (SHM). "From our perspective, this has become a very important issue for new turbines," says Holger Fritsch, Managing Director of Bachmann Monitoring GmbH. "For example, it's rare to see a new turbine delivered without problems with rotor blades, either due to production or transportation." This is understandable, as modern rotor blades are getting longer and longer – often well over 100 meters in length. "We are therefore currently investigating how the CLS sensor measurement data can help us to detect structural anomalies in rotor blades at the earliest possible stage and, if necessary, even to precisely locate damaged areas," explains Holger Fritsch. Earlier detection of unexpected damage or changes makes maintenance planning much more straightforward.

Simply cheaper

Bachmann cantilever sensors are not only cheaper than fiber-optic sensors; installation, commissioning and maintenance costs are also lower. This means significant cost savings for the OEM.

But CLS sensors also deliver a considerable advantage to operators: In the long term, system operation is more reliable and stable, which saves costs and, above all, secures yield.

CLS sensor in practice – more on p. 42/43



The rugged CLS300 design offers significant advantages over conventional sensor technologies:

- The force-free measuring principle guarantees long-term stability
- The output signal is unaffected by the mechanical aging of either the sensor or the adhesive bond
- A longer reference distance minimizes the influence of any local inhomogeneities occurring in the blade composite materials
- Pre-attaching the sensor unit to a mounting rail makes installation easy and ideal for volume production

atvise® scada: atvise® FOR CONDITION MONITORING

atvise® scada is a powerful and flexible visualization tool. Combined with a Bachmann M200 controller, vibration and speed sensors, and a specially developed software application, atvise® can now be used as a universal solution for condition monitoring – online and offline.

atvise® scada is already widely used as a data analysis tool for condition monitoring applications. The possibilities offered by server-side JavaScript programming have proven their worth, for example to collect information from multiple sources and correlate it using any algorithm. In this way, condition-based maintenance tools can be created in atvise®. These can be, for example, trend analyzes based on statistical properties of the data, which connect a wide variety of parameters and extract meaningful factors to heat maps, which in turn provide clear information about defined machine KPIs.

Proven system

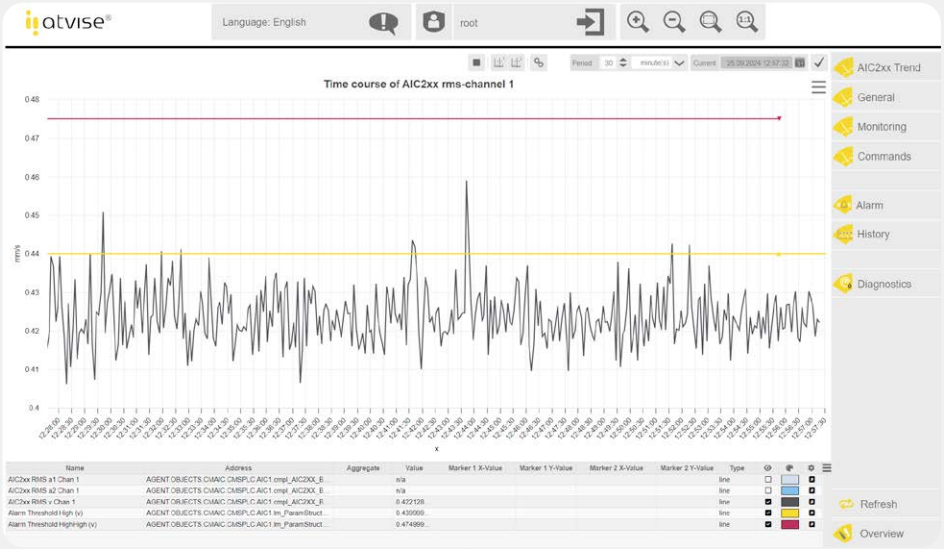
Based on other standard hardware and software components from Bachmann, this scalable solution records vibration data and expands the possibilities of condition monitoring with atvise®. In addition to the M2xx CPU, one or more AIC2xx modules from the Bachmann M200 system are used as a controller unit to connect vibration and speed sensors.

This optimizes the system for monitoring individual machines as well as for fleet management. atvise® scada 150CCD (or higher) is supplemented by a condition monitoring module and can also be supplied as a bundle with a Bachmann OT1315 panel PC.

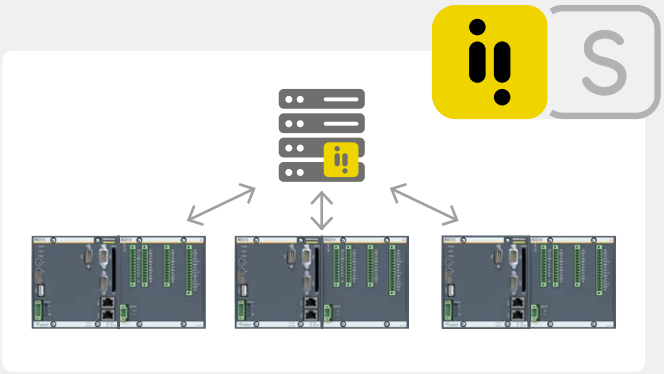
The software application developed for Bachmann's automation system covers data acquisition, the generation of high-frequency wave files for analysis, and communication with atvise® scada via OPC UA. atvise® can be installed locally on the system or in the cloud, and measurement data is processed online or offline in accordance with ISO 20816.

Vibration-based monitoring

Together with the system parameters already available in atvise®, the acquisition of additional vibration data can significantly improve both the accuracy of machine condition and its behavior in the future. If necessary, conclusions can also be drawn about product quality produced by the customer.



Vibrations in full view: High-resolution overview of measurement channels. To analyze past events, you can switch between live/mixed and historical mode at any time.



Bachmann has extended its atvise® scada with a simple solution for basic condition monitoring; it can now be installed with the CMS module on an industrial PC. At controller level, one or more Bachmann M200 controllers, equipped with the CMSSTD software module, are used for data processing, with up to four AIC2xx modules connecting the sensors.

The atvise® condition monitoring module comes with a complete, preconfigured visualization in the standard web browser, which supports the entire system configuration, including threshold setting. Vibration diagram overviews, RMS value selection and display, trends in different variations, the usual atvise® alarm and history tables, as well as total PLC system status are also included – along with much more.

The module can also initiate a trigger to record and save vibration data as a high-frequency wav file. In the event of an alarm, this will save measurement data that was buffered ten seconds prior to the event and, depending on the configuration, recorded for a corresponding time period. This information is then available for further analysis in atvise® scada. With the atvise® powerful scripting engine as an additional tool, there is enormous potential for machine learning and AI.

Predictive maintenance

Bachmann complements atvise® scada with a simple solution for basic condition monitoring. Further functional development of this setup, for example towards predictive maintenance, is possible with the additional services of Bachmann Monitoring GmbH.

» We have been working with atvise® for over 10 years to visualize and control our off-shore high-pressure pumps and chemical injection units. In an initial pilot project, we are now also taking vibration information into account. This allows us to successfully monitor the quality of fluids and the downhole pumping operations cement, which is directly related to the sys-tem condition.. «

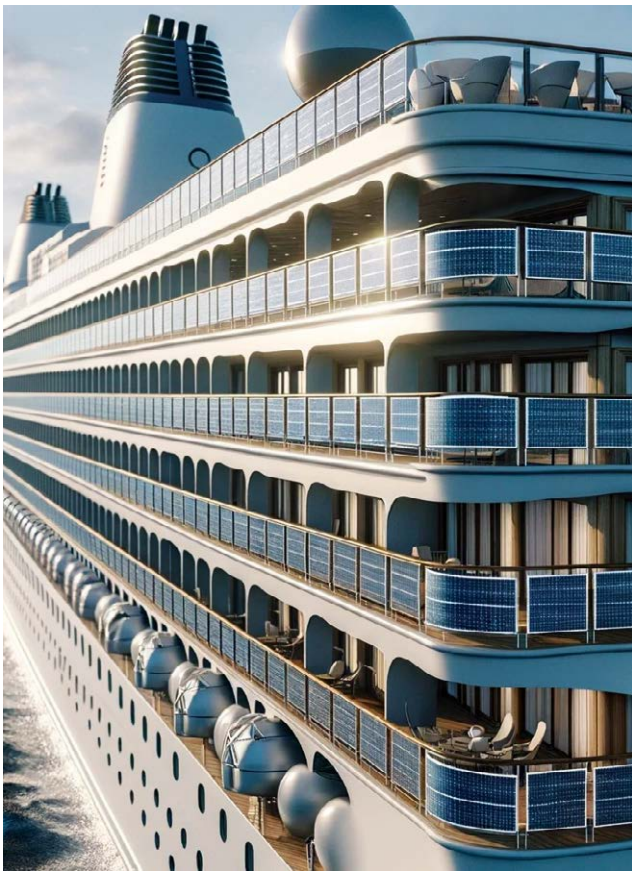
Tom Andre Larsson
Managing Director, ecco it,
Norwegian offshore platform system integrator

»When it is focused, agility leads to truly great things.«

Green shipping

SUNCATCHER

How can the future of shipping become climate-neutral and environmental? Shipping companies worldwide are focused on this very question. But how much potential is there in renewable energy? And how can it efficiently be fed into the ship's energy network? The German Aerospace Center (DLR) is investigating these questions at its Institutes for Maritime Energy Systems and Networked Energy Systems.



This is how photovoltaics could be implemented on a cruise ship: Balcony cladding is covered with solar panels.

One approach to reducing fuel consumption and, with it, CO_2 emissions is the use of energy from photovoltaics (PV). A ship's large hull and superstructure are ideal for the installation of solar panels. However, the side of a ship, as the largest flat surface, is excluded due to technical and practical limitations. The structural integration of PV systems into the vertical hull is complex and difficult to implement, especially given the mechanical loads that large vessels undergo at sea. The resulting bending and torsion, combined with the corrosive effects of seawater, would quickly damage a rigid PV system.

PV is application-dependent

On inland waterways, however, the sun roofs of leisure boats, or the covers of bulk carriers, make an ideal mounting surface for PV. "Some of these are already in use," explains Dr. Robert Beckmann, researcher at the DLR Institute of Networked Energy Systems. However, his primary concern is how to feed solar energy into the ship's energy network.

In a large-scale project, Beckmann is working with renowned shipyards, research institutes and industrial partners to investigate potential for creating up an on-board, DC-based energy network. "SuSy" (Sustainable DC Systems for Ships) is investigating approaches for the simple integration of alternative energy sources, including photovoltaics, fuel cells or batteries, as well as consumers such as lighting or ship electronics into the grid. The goal is to achieve a high degree of flexibility in energy flow control and the operation of generators and consumers.

PV reduces fuel consumption

One initial focus area for SuSy is on the hotel sector on cruise ships. The photovoltaic use of the balcony cladding of passenger cabins was recently modeled. On a cruise ship such as the AIDAnova, which carries around 6,000 passengers, around 4,400 m^2 of surface area could be developed – enough for an installed solar power output of around 880 kWp. "Compared to the ship's engine power of

60 MW, this may seem insignificant. But it definitely contributes to a reduction in fuel consumption," says Beckmann.

Beckmann and his team wanted to know more. Using historical irradiation data from the European satellite service Copernicus, they simulated the photovoltaic output of a virtual Caribbean cruise. The team compared this with the simulated energy consumption profile of passenger cabins within one deck fire zone of the ship: "We collected about 590 kWh from the sun during the passage, with energy requirements of 2,900 kWh for the 45 passenger cabins in the area. That's 20 percent," says Robert Beckmann.

DC has many advantages

At DLR, the benefits of an on-board DC grid are not only seen in the low-loss integration of renewable PV energy, but also in the variable-speed operation of the ship's engines: "You don't have to adapt to a grid frequency, so you're not tied to a constant speed, and can therefore run the engines closer to the optimum operating point, which reduces energy consumption," explains the engineer. Another important aspect is the much simpler integration of DC components into the power grid – with space and weight savings of up to 30 percent, as well as less wiring.

Wanted: The DC energy management system

What exactly such a decentralized generator network would look like in concrete terms is the subject of research at DLR. "We are primarily investigating the possibilities of on-board load distribution and flow control. This is one of the major challenges facing DC technology. We are not only looking for an efficient network, but above all a resilient one, in which an individual generator can fail but others will assume their tasks, or their load," says Beckmann, describing the central issue.

Together with the Technical University of Hamburg, he is currently working on a modular simulation system to run through a wide range of load scenarios. The clear goal is to develop a vessel energy management system that is optimized for the use of power generators from weather-dependent, decentralized production. This system will also serve as a basis for the development of the necessary industrial components.

» Even small amounts of renewable energy, such as from our 'balcony PV', reduce fuel consumption. «

Dr.-Ing. Robert Beckmann
Research associate at the Institute of Networked Energy Systems at the German Aerospace Center (DLR) in Oldenburg (Germany)

The NESTEC Grid Laboratory at DLR simulates and investigates energy management and grid control for power grids with a total power of up to 1 MVA and up to 25 grid nodes. ©DLR

Grid integration

SMART SOLUTIONS REQUIRED

The energy transition poses significant challenges for distribution grid operators. The efficient integration of renewable energy sources requires the comprehensive transformation of many systems and processes. Intermittent power supplies also require measures to ensure grid stability, such as the use of energy storage systems. These are just two of the topics we discussed with Jost Broichmann, Managing Director of WBR Solar- und Energietechnik GmbH.

» What makes the Bachmann system such a smart solution is that it also serves as the system control unit and as a certified protection device. «

Jost Broichmann
Managing Director of WBR Solar- und Energietechnik GmbH

Mr. Broichmann, the increasing use of renewable energy creates new tasks and challenges for the grid. Based on your experience, where do you see the most urgent need for action?

Jost Broichmann: At every point where the energy transition meets the grid, we will have to make a lot of changes to infrastructure. You can't simply add photovoltaics on mass – you have to look at local grids. In many cases, transformers are outdated and at least 30 years old. In addition, it is not always possible to adapt switchgear to the new protection requirements. When we think of grid expansion, we often think of the large transmission grids, but much more needs to be done at lower grid levels. Where we have a transformer station today, I see an energy storage station with a one-megawatt hour capacity in future. The whole thing will be compact, no bigger than a local grid transformer today. This will create the necessary flexibility in the grid.

Battery storage is expensive. How will this affect the cost of energy in future?

There are two factors to consider here. The first is the falling price of batteries. Ten years ago, lithium-ion batteries cost about 730 Euros per kilowatt-hour; today, we pay about 130 euros per kilowatt-hour. New sodium-ion batteries represent another quantum leap: Chinese manufacturers promise costs of 30 euros/kWh by the end of the decade. In addition, these batteries deliver power even at sub-zero temperatures, production is not as dependent on rare and conflict-prone raw materials, and they are less flammable. The second issue is the continued increase in grid fees due to the necessary infrastructural investment. It must be said that, in many regions, the cost of a stored kilowatt hour is already lower than the grid fee associated with purchasing it. In other words, if I generate and store the electricity myself, it will definitely be cheaper than buying it.

What is the role of battery storage when it comes to supply security?

When we talk about power outages, we usually think of an abstract blackout. Recent history shows us very different, unforeseen scenarios, such as the arson attack on a 110 kV pylon line in Brandenburg. Severe weather events are also increasingly common. I remember storm Xavier in 2017, which left up to 35,000 customers in the Schwerin district without power, some of them for several days. In such an agricultural region, this can lead to disaster – feeding animals and milking cows is not possible. If this continues over several days, milk production drops and does not recover quickly, leading to a significant and sustained loss of milk supply. These situations are avoidable with battery storage.

On the other hand, electricity storage helps close the gap between the expansion of renewable energy and the expansion of the grid. Placed at appropriate grid locations, energy storage solutions temporarily store locally generated electricity for local use, without overloading a weak grid during peak times.

Battery storage station at Schwerin-based energy supplier WEMAG, with a primary control power of 500 kW and a capacity of 925 kWh.

» In many regions, the cost of storing a kilowatt hour is less than the grid fee associated with its purchase. «

Jost Broichmann
Managing Director of WBR Solar- und Energietechnik GmbH

What does such a solution look like?

This kind of intermediary buffer not only has to provide temporary storage, it must also be able to support the grid and ensure local supply. A battery alone is not enough. Such a system needs an intelligent control system and, naturally, a great deal of electronics. Our systems run on Bachmann solutions, implemented by the company SCADA Automation. An M200 controller not only manages battery charging, but also generates marketing signals, so that the system can be integrated into an electricity market design, for example via the VHPready signal (Virtual Heat and Power Ready). At the same time, as a certified EZA controller, it secures the connection to the grid operator's control technology, and can combine several storage or generation units. Not to mention protection from decoupling and grid resynchronization functions following island operation.

What makes the Bachmann system such a smart solution is that it also serves as the system control unit and as a certified protection device. This means you have one less device to install and maintain, and you save space.

Design of the network, and the resulting network participant requirements, are not yet fully defined. The market is in a state of flux. What if you have to incorporate new requirements in a few years' time and the manufacturer is no longer in the market?

We have already experienced this scenario, as the initial battery power plant manufacturers have now

Agricultural businesses are increasingly facing the challenge of integrating PV systems into their energy supply. The farm's power grid transforms into a small virtual power plant with numerous generators, storage systems, and consumers.

disappeared from the market. There was no demand for EZA controllers 10 years ago, but there is now. This requires modernization, which can be achieved with the aforementioned Bachmann system, which also offers the appropriate level of redundancy, including bumpless switching of the EZA controller, which is a requirement for critical systems.

Not to mention the increasing demands for cyber security. Many of these systems contribute to critical infrastructure. This requires software updates, constant research into potential security gaps, and ongoing adaptation of security scenarios. It also requires regular modernization.

Can you give us an example of the challenges of updating an existing system?

Let's take the retrofit of a farm that has been generating electricity from its biogas production in a combined heat and power (CHP) plant. Such plants are ten or fifteen years old, or even older, and will reach the end of their life cycle in the next few years.

In addition, traditional round-the-clock operation no longer fits the design of modern electricity markets. In many cases, these operators now want to equip their rooftops with photovoltaic (PV) systems for their own use. And energy storage makes sense here, too. However, this quickly turns into a small virtual power plant. As the farm digitalization progresses, questions arise about the optimization of self-consumption and even energy management. For example, it doesn't make sense to draw on the CHP if you have a large surplus from the PV system, compared to the current demand. And that raises other questions, such as communication between different parts of the system. Often you don't even know the exacting routing of power lines on the farm.

With WBR, we act as an integration partner for tasks like these and are pleased that, together with our partners at SCADA Automation, we have access to a correspondingly flexible Bachmann system that can realize such requirements.

Thank you for the interview.

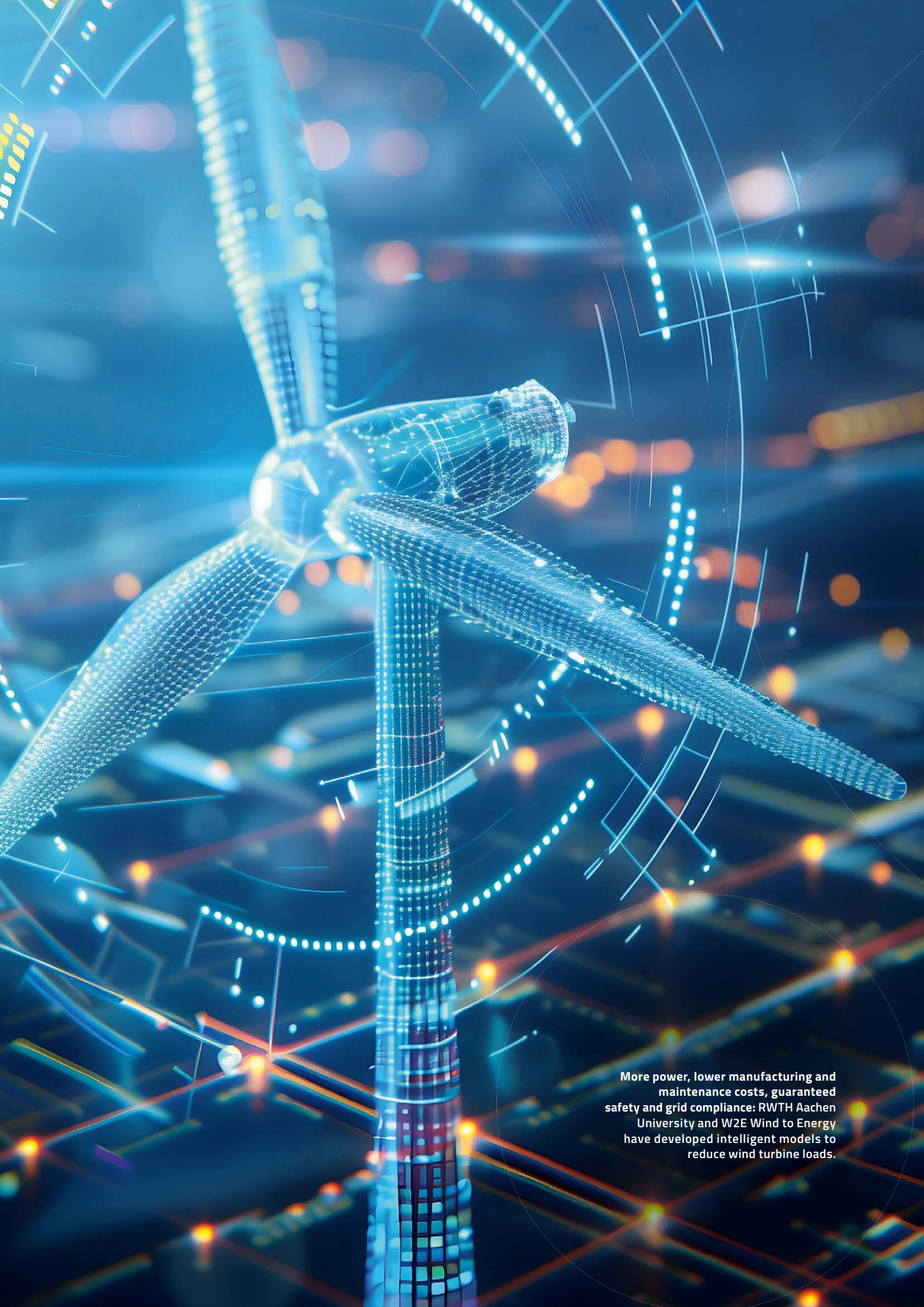
WBR SOLAR- UND ENERGIETECHNIK GMBH

– Headquarters in Leezen (Germany)

– Designs and installs private and commercial PV systems

– Develops individual energy concepts to efficiently integrate existing or new systems into the power grid

www.wbr-energie.de



More power, lower manufacturing and maintenance costs, guaranteed safety and grid compliance: RWTH Aachen University and W2E Wind to Energy have developed intelligent models to reduce wind turbine loads.

Machine learning

INTELLIGENT CONTROL

The primary design objective for a wind turbine is to optimize the cost of energy (COE); the ratio of total cost to annual energy supply. The goal is not only maximum performance, but also minimum manufacturing and maintenance costs, while ensuring safety and grid compliance. In the IntelliWind research project, RWTH Aachen University and wind turbine developer W2E Wind to Energy from Rostock, Germany, are using machine learning methods to reach this goal. We interviewed the project partners.

» Using M-Target for Simulink®, we easily transferred code generated in Simulink® to the Bachmann controller, and then verified it in the field on a 3 MW wind turbine. This was an important step in validating this innovative controller design, with a view to series production. «

Andreas Klein, M.Sc.
Research assistant at the Institute for Control Engineering at RWTH Aachen University

From left to right: Andreas Klein, Jeffrey Stegink, Harry Hoffmann

You are collaborating on research into intelligent models for self-optimizing load reduction in wind turbines. What's behind this?

Prof. Dr. János Zierath, W2E: As the rated power, and with it the rotor diameter and hub height of modern wind turbines increase, so do demands on the structural integrity of the plant. Therefore, appropriate control strategies are applied to reduce load amplitudes in the rotor and tower through electronic control interventions, which can also lead to material savings.

However, conventional control strategies are reaching their limits. For this reason, Model Predictive Control (MPC) possibilities have been explored in the past. MPC is well suited for wind turbine applications because it can combine multiple, even conflicting, control objectives and constraints into a single optimization problem.

We have now improved the MPC by integrating a regression model based on machine learning. With this improvement, the controller now proactively adjusts blade pitch angle and generator torque to minimize load changes on the wind turbine, thus reducing the risk of long-term wear and damage.

Can you describe the development process?

Andreas Klein, RWTH Aachen: The algorithms we used originate from the IntelliWind research project (see Factbox). We used MATLAB® to train the data-based model, which maps the dynamic states of the internal MPC prediction model to change in thrust acting on the rotor. Using Simulink® and MATLAB®'s Model Predictive Control Toolbox™, we designed the controller and tested it extensively in a simulation. We then used M-Target for Simulink® to import the code, generated in

Simulink®, to Bachmann's MH230 controller for live verification on a 3 MW wind turbine developed by W2E Wind to Energy. This was an important step towards validating this innovative controller design ready for series production.

What were the challenges?

The performance and stability of an MPC is strongly influenced by the accuracy and reliability of the prediction model. The higher the desired model accuracy, the more computationally intensive the MPC will typically be. To solve this trade-off between accuracy and computational intensity, we used a data-based model, specifically a local linear neuro-fuzzy model (LLNFM)[1]. We used an LLNFM because it represents non-linear relationships but has manageable complexity compared to other machine learning methods. This makes it easier to interpret results, which is particularly advantageous in control engineering applications where minimizing the risk of potential system damage is a key concern. We trained this model with data generated using the alaska/Wind[2]) software, in which we modeled and simulated internal loads of the entire system based on external wind forces.

What were the results in reality and what are the next steps?

Prof. Dr. János Zierath, W2E: We ran numerous simulations with our controller design at various wind speeds, which gave us confidence. So, finally we imported it to the Bachmann controller on one of our own wind turbines to evaluate robustness under real operating conditions.

The field tests went well, confirming stable operation of the wind turbines in the partial load and full load range. We were able to show that it is possible to extend advanced MPC algorithms with machine learning in wind turbines. On this basis, we will be able to test more complex machine learning algorithms in future experiments to further improve the controller and, with that, to optimize wind turbine operation.

Thank you for these insights.

» With the Bachmann controller, we could show how machine learning can be used to extend model predictive control of wind turbines. «

Prof. Dr. János Zierath
Research Coordinator and company representative at W2E Wind to Energy GmbH

[1] Information on the MATLAB® Toolbox for Local Model Networks:

[2] More about the software alaska/Wind:

INTELLIWIND

The goal of the IntelliWind project is to identify wind turbine system behavior in a data-driven manner using AI-based regression, and to investigate how this can be used in model-based control processes as a supplement to physical modeling. The project is funded by the German Federal Ministry of Education and Research (BMBF), project code 01IS22028A/B.

Find out more here:

Bachmann Technology Symposium

TOMORROW'S ENERGY SUPPLY – MASTERING COMPLEXITY

For the second time, Bachmann hosted its technology symposium at the International Maritime Museum in Hamburg's Speicherstadt. More than sixty participants exchanged views on current land- and sea-based energy supply. The event also provided ample opportunity for informal discussion and exchange.

Gabriel Schwanzer, Chief of Marketing, Sales and Automation at Bachmann electronic, opened the symposium with a question: Are terms such as 'energy transition', 'smart grid', 'blackout', 'sector coupling', 'energy transformation' and 'energy autonomy' just buzzwords, or is there something more behind them? "We are dedicating our symposium to these issues, whether on land or at sea," said Schwanzer. "We want to try to build bridges between the renewable energy sectors and the shipping industry. Our goal is to identify synergies and jointly develop new ways to implement a modern energy supply.

Solutions for complex energy systems

Understanding how industries work. Identifying needs. Creating added value, so that customers can identify their unique selling points: "These three considerations guide us in our work," emphasized Michael Backhaus, Industry Manager Renewable Energies, and Dirk Knollmann, Key Account Manager Maritime DACH at Bachmann electronic, in their prologue.

As a whole, a ship can be more complex than a village. This requires an energy system that meets many requirements and ensures that not only the propulsion system, but also the entire on-board infrastructure, remains available. "In the past, if you needed more power, you could add a fossil-fueled generator," said Kollmann. "This is no longer possible, as vessels must often comply with strict emission limits when entering a port, for example." Michael Backhaus emphasized how the industries can benefit from one another: "Renewable energies are no longer 'just' integrated into a supply. They form networks, and ensure stability and availability."

A community – self-sufficient and off the grid

What happens when you cut off an entire community from the grid? The first speaker of the day, Michael Krug, Head of System Development at SMA Solar Technology AG, kicked off his presentation with this scenario. He highlighted a 2019 research project, whereby the public utilities of the municipality of Bordesholm (Schleswig-Holstein, Germany), together with the Technical University of Cologne, simulated a large-scale power outage. For one hour, the Bordesholm community was disconnected from the European grid via the synchronous coupling switch. Households, businesses and institutions were then uninterruptedly supplied with electricity – using energy from a 15 MW battery storage

» We don't have to wait for anything; the energy transition is achievable with existing technology. «

Frank Grewe
CTO and member of the Management Board of 2G Energy AG

system and renewable generators such as photovoltaic systems, biomass, and combined heat and power plants. "This project has shown that entire regions can be supplied with 100% renewable energy," summarized Krug. He emphasized that, as the share of renewable energy increases, grid-connected battery storage solutions support the energy transition by assuming increasing responsibility for grid stability. In addition, Bordesholm also benefits economically from the provision of primary control reserve and energy arbitrage with its battery storage system: it can purchase energy when tariffs are low, store it temporarily, and sell it back to the grid when tariffs increase.

PV at sea

To demonstrate how a hybrid energy concept can be implemented, Dr. Robert Beckmann from the Institute for Networked Energy Systems at the German Aerospace Center (DLR) in Oldenburg, Germany, used the hypothetical example of a PV panel installation on a cruise ship. Although there are only a few suitable areas on such a vessel, it was possible to demonstrate that a PV installation can achieve significant fuel savings. Beckmann's team is also researching a DC power supply to efficiently feed PV-generated electricity into the power grid. This will make it easier to integrate alternative energy sources and consumers such as batteries, fuel cells, photovoltaics, lighting, and electronics, while increasing the flexibility of energy management and more efficient operation (see also the article on page 70).

Energy platforms of the future

"If networks are operated more dynamically in the future, large industrial consumers will be faced with completely new, previously unknown challenges: They will need loads that can be switched off and postponed," said Michael Kramer, Head of Energy Systems, Work Services Production at MAN Energy Solutions SE, at the start of his presentation. While networks used to be managed on a purely commercial basis, they must increasingly be geared towards energy availability. He highlighted that laws and standards are already defining this framework. As examples, he cited the mandatory use of photovoltaics in new buildings, and the control requirements for charging stations in industrial networks. We therefore urgently need to think about how the grid-oriented management of controllable consumers can succeed in the future. "The challenges are growing because of the increasing number of interface players,"

Kramer emphasized. MAN has put the first pilot plants into operation at its Augsburg site, and Kramer expects several dozen generation units to be added in the coming years. To this end, MAN has created a technical platform on which the various systems, as well as the requirements of network operators and the energy industry, can be combined. The core of this platform is a redundant power plant controller, which was implemented on the basis of the Bachmann M200 controller system. This is based on gateways that integrate generation units and provide decoupling protection (see also the article on page 12).

» If you want to design a ship to be energy efficient, you can't just focus on electrical energy, you have to include the thermal and mechanical energy on board. «

Robert Balla-Nostitz
R&D Maritim, besecke GmbH & Co. KG

Precise calculations

Robert Balla-Nostitz from besecke GmbH & Co. KG in Bremen, Germany, presented a tool for designing electrical and hybrid ship systems using maritime energy simulation. Using the MarESiS (Maritime Energy Simulation System) simulation software developed by his company, the engineer detailed current challenges in simulating vessel generators that precisely align with real consumer profiles on board a vessel. To date, this has been done based on the energy balance of a few typical operating modes, in which consumers are assigned simultaneity factors to describe their power requirements in the respective operating mode. The disadvantage of this method is that it provides an estimate of the maximum required power, but without an energy analysis. "The result is therefore quite opaque and far removed from real ship operations," explained Robert Balla-Nostitz. With MarESiS, besecke GmbH is taking a different approach: The company is working with a model that describes the ship's operation and accounts for not only the operating mode, but also events such as use of the kitchen or events, as well as external influences such as temperature or passenger numbers.

Swimming in DC?

The Institute for Electrical Energy Technology (IEET) at the Technical University of Hamburg-Harburg is also researching DC network topologies. Their aim is to improve the operational efficiency of modern marine energy networks and contribute to the reduction of emissions. Christoph Klie, research associate at IEET, compared typical AC and DC grid topologies, explaining how cleverly designed DC grids can reduce the total mass and optimize the overall efficiency of a ship's power supply. His institute has developed an Energy Benchmarking Toolbox (ETB) to evaluate the reliability and fault tolerance of various topologies, in addition to reducing material requirements and cost. In a graphical environment, the effects of potential failures can be evaluated using load flow and power supply analyses. It is even possible to generate a bill of materials (BOM) for the selected topology based on a technology catalog.

Economical converters

In a technology-oriented presentation, Dr. Stefan Büchner of M&P Motion Control and Power Electronics in Dresden, Germany, classified the power supply-related tasks of power electronic converters. He compared the use of isolated converters with the connection of parallel converters in a single unit and in a network. If the former are explicitly required for components with lower resistance to insulation, or between different network types, parallel converters overcome the limitations of the limited power of output stages. They also score points wherever redundancy is required as well as

with their modularity. This makes them more economical than individual power classes. “Parallelism also delivers other advantages," explained Dr. Büchner, because such a setup allows synchronous control and regulation of power modules, as well as symmetrical load distribution to the various generators or storage units in the grid. Büchner prefers droop control with an external offset specification, provided by an external master, based on the averaged currents of all components involved. He then presented an application where this task was performed by a Bachmann M200 controller.

Hydrogen in CHP

"There is no more efficient way to use molecules than in decentralized combined heat and power (CHP),” Frank Grewe, CTO and board member of 2G Energy AG in Heek (Germany), summarized his presentation with this statement. Using examples and studies, he showed that around 430 GW of renewable energy capacity should be installed by 2040. With peak demand of about 80 GW, this corresponds to and overcapicity of five times the required amount. However, backbone technologies are necessary to ensure that sufficient capacity remains available, even during periods of low demand. Grewe sees great potential in cogeneration, which could potentially close the renewable energy gap. At the same time, decentralized CHP plant operation could reduce grid expansion costs at lower grid levels. Stadtwerk Haßfurt, for example, is pursuing this approach. The town of 15,000 people has already installed wind and PV systems to meet about 220 percent of its electricity needs. Haßfurt feeds the surplus into electrolysers, producing green hydrogen as a storage medium. The entire plant is operated according to the electricity market. The CHP unit used to convert hydrogen into electricity has an electrical output of 170 kW. Frank Grewe highlighted that current 2G Energy CHP units, which are mostly fueled by natural gas or biogas, would be fully suitable for operation with hydrogen. The cost of conversion would be about 15 percent of the original investment in the cogeneration unit as part of an overhaul.

The future of battery storage

In the final presentation, Jost Broichmann, Managing Director of WBR Solar- und Energietechnik GmbH, emphasized the need for infrastructural changes to the supply grid. Local grids are often operated with completely outdated transformers and switchgear that cannot be adapted to modern protection requirements. He is therefore considering energy storage stations, no larger than a local grid transformer, to help support the grid in a decentralized manner in the future, and to reduce the costs of a large-scale grid conversion. According to Broichmann, grid fees today are already higher than the cost of a stored kilowatt-hour of energy, meaning a return on investment within a reasonable time period. He also sees potential for energy storage systems in the expansion of agricultural operations, which are increasingly facing the challenge of integrating PV systems into their energy supply, as well as adapting biogas production from 24/7 operation to today's electricity market design (see our interview with Jost Broichmann on page 72).

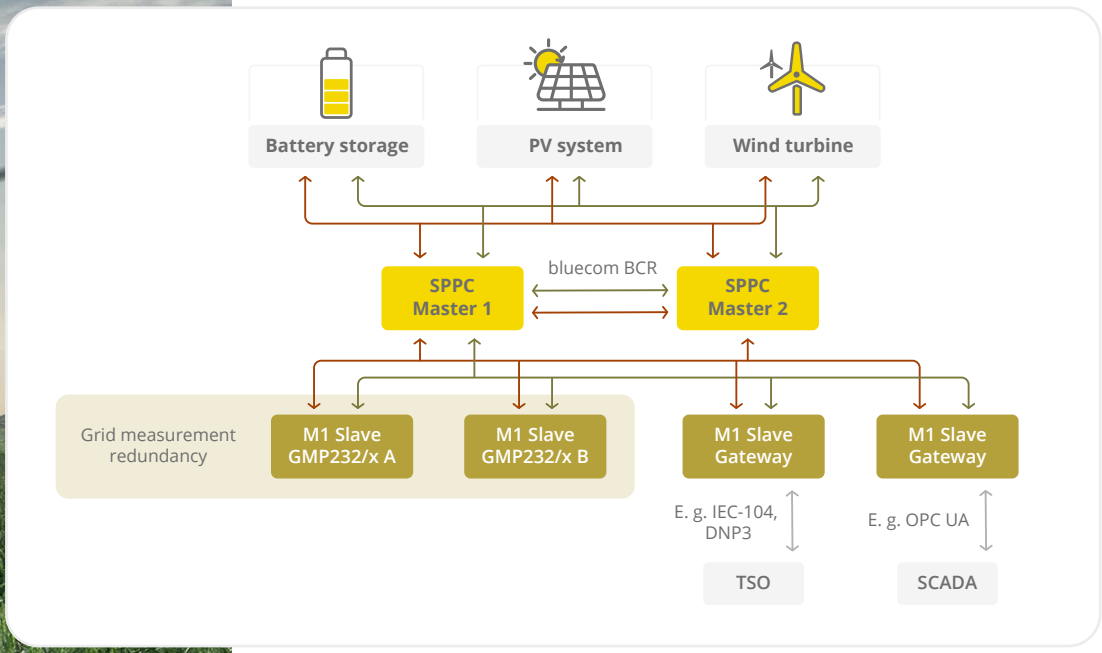
Enthusiastic participants

"Great", "very informative presentations", "good discussions in a great atmosphere" – these are just three of the many positive reactions from participants at the 2nd Bachmann Technology Symposium in Hamburg. Once again, speakers were able to address topics currently on the minds of those responsible for shipbuilding and land-based energy supply. "We can solve these challenges much more easily if we work together," said Gabriel Schwanzer, summarizing event program: "Learning from each other benefits everyone."

Smart Power Plant Controller extension

REDUNDANT CONTROL OF CRITICAL INFRASTRUCTURE

Operators of critical infrastructure in the energy supply sector are doing whatever they can to increase resilience. To ensure reliable and stable power grids, utility providers need to make all relevant systems redundant, provided there is a reasonable cost-benefit ratio. This includes power plant control. Bachmann's Smart Power Plant Controller (SPPC) is currently undergoing expansion and will soon include a redundancy function.



Increase supply reliability, increase yield: Example redundancy topology with the Bachmann Smart Power Plant Controller.

Higher reliability for energy parks

With double component design, energy park operators can ensure the safe operation of systems such as wind turbines, PV systems and battery storage systems. However, network component and inter-system connection redundancy alone is not sufficient to ensure a reliable, fail-safe power supply. Instead, every supply-related component of the energy park must be mirrored. This includes, for example, the power supply for control systems, sensors and SCADA system servers. If one of these components is not redundant and fails, complete system redundancy cannot be achieved.

The more critical the system, the more important redundancy becomes.

If a controller fails, but a spare controller is available in the network topology, the changeover takes place within a defined time period. This cold standby redundancy is automatic, but not uninterrupted. With this type of redundancy solution, power supply can be restored after a failure of one of the components involved. However, to be uninterrupted, the switchover must be bumpless, with all parameters and system conditions adopted automatically (hot standby redundancy).

The future of redundancy is customized

Bachmann is currently expanding the proven Smart Power Plant Controller (SPPC) to include redundancy functions, including redundant network measurement with the GMP232 module. All expansion stages are supported, from pure network redundancy to bumpless hot standby switching from one SPPC to another – including the exact transfer of current control status.

Initial project implementations have already taken place, and the redundancy function will soon be available as an optional feature for the SPPC.

Conventional offshore systems reach their limits at water depths of 60 meters. For deeper waters, the floating platform solution is expected to grow rapidly in the coming years.

Floating wind

WIND POWER LEARNS TO SWIM

Offshore wind power is an important part of the energy transition. However, traditional fixed wind turbine foundations cannot be cost-effectively anchored in deep water. Floating offshore wind (FOW) offers a solution.

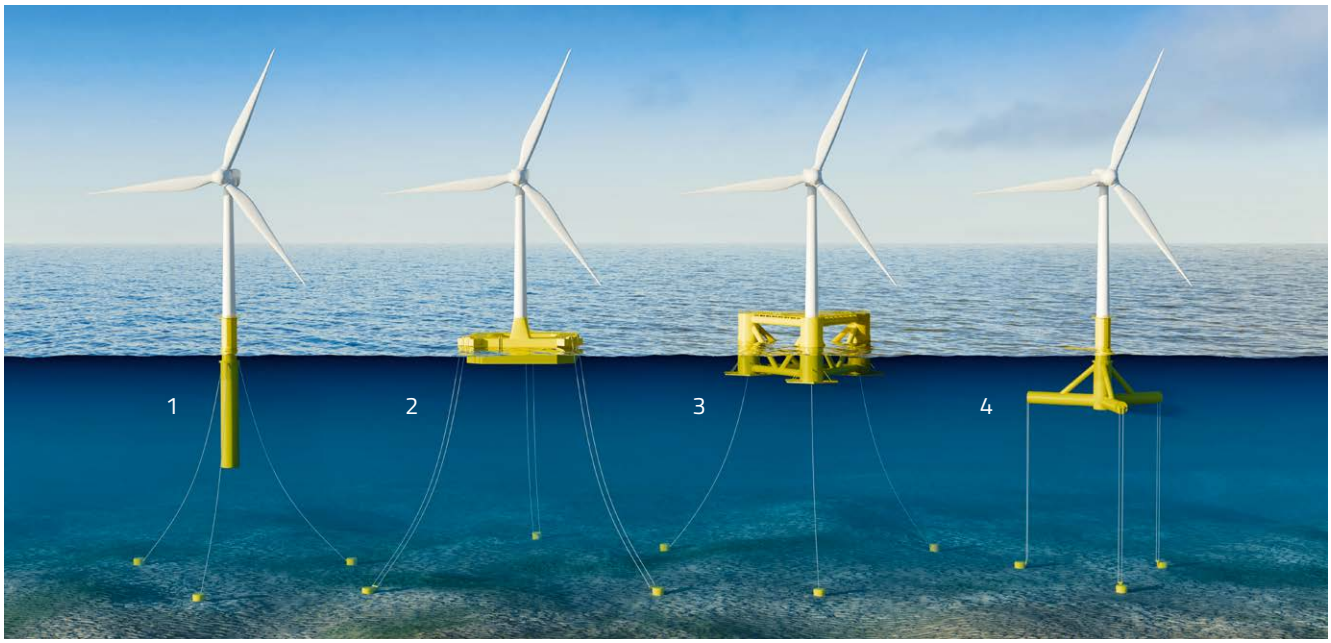
Potential and benefits

Floating offshore wind allows wind farms to be installed in deeper waters, further away from the shore. Wind conditions are often better there – and 80 percent of potential offshore sites, both in Europe and worldwide, are deeper than 60 meters. These sites are unsuitable for fixed bottom foundations (FBF).

Another advantage of FOW is its reduced environmental impact. Floating foundations have less impact on the environment, protecting marine life. If produced on a large-scale in the future, manufacturing costs are expected to fall significantly, reducing the cost of a megawatt-hour from 200 Euros/MWh today to around 40-60 Euros/MWh by 2030, thanks to economies of scale and industrialization.

Technical challenges

But there are technical challenges: Floating platforms must be able to withstand extreme environmental conditions. These platforms require durable, corrosion-resistant materials that are also lightweight and cost-effective. Stability in storms with high wave loads is also a concern.



Current floating pilot projects are investigating four main system approaches: (1) spar buoy, (2) barge, (3) semi-submersible, and (4) tension leg platform (TLP).

Different approaches

There are four main types of floating platform system:

- **Spar buoy:** A long cylinder filled with ballast provides stability.
- **Barge platforms:** Large platforms that rely on surface area to provide stability.
- **Semi-submersibles:** Three cylinders that form a triangular framework for buoyancy.
- **Tension Leg Platform (TLP):** A central buoyancy body stabilized by tendons with vertical tension.

Secure anchorage

Floating platforms must be securely anchored. In most cases, multi-point mooring systems stabilize the position. In this case, as in fixed installations, the turbine aligns with the wind through nacelle rotation. In contrast, single-point anchoring allows the entire platform to rotate with the tower into the wind, which places special requirements on the safe routing of power cables.

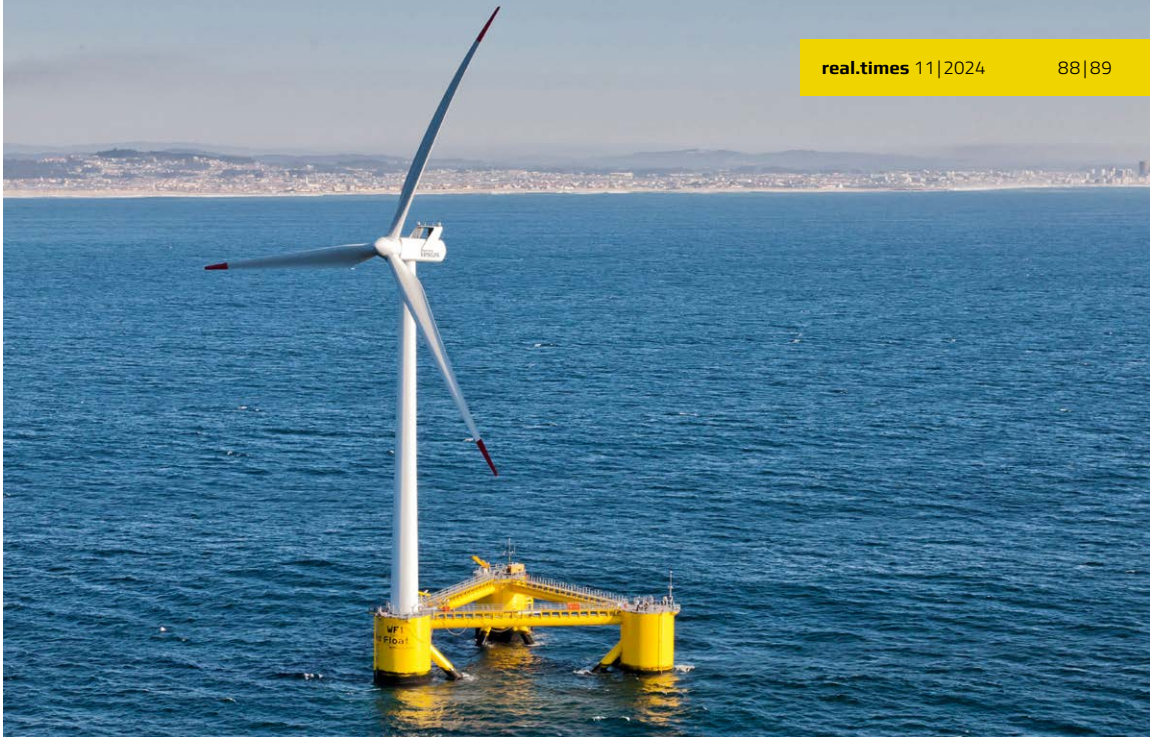
Highly available control system

Control systems must be robust and highly available. Storms and high waves pose new challenges that require a reliable control system. Floating platform superstructures, in particular, as well as the machine and load-bearing structural elements of the wind turbine are exposed to significantly higher dynamic loads. This affects not only the basic design, but requires new concepts for control, regulation and monitoring.

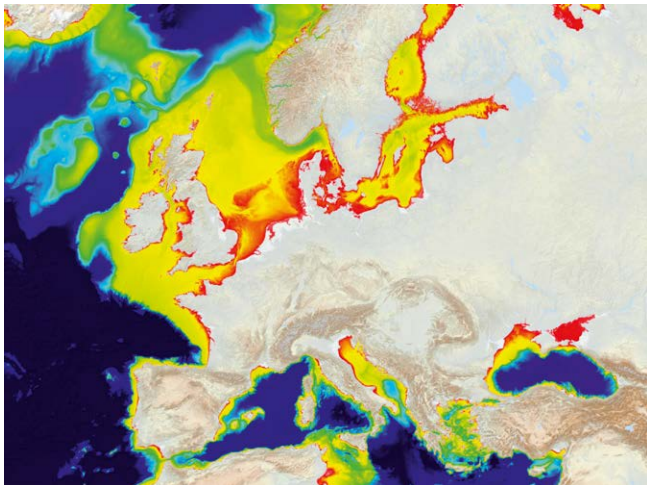
Advanced Structural Health Monitoring

Structural Health Monitoring (SHM) is also essential to ensure the safety and efficiency of the turbines over their lifetime. Such offshore projects are currently planned to operate for 35 years or more. The associated structural challenges require innovative sensor-based measurement concepts. These provide data for digital twins, which enable, among other things, long-term assessments of the aging and fatigue of structural elements. In addition to long-term diagnostics from highly specialized experts, permanent online monitoring is also necessary to record the effects of extreme events – such as typhoons, monster waves or collisions – and to trigger targeted in-depth diagnostics.

Bachmann's online structural health monitoring systems provide real-time data on structural load and motion. "Permanent online monitoring of structures and SHM parameters, some of which are generated using new mathematical methods, is one of Bachmann's strengths," says Marc Thomsen, Product Manager SHM at Bachmann Monitoring. "Experience



The 2 MW WindFloat turbine project (EDP Renewables), installed in 2011, is a semi-submersible about 5 km off the coast of Agucadoura, Portugal.



Approximately 80% of potential offshore wind energy sites in European are deeper than 60 meters. These sites cannot be economically developed with traditional foundations and are better suited for the use of floating wind platforms.

has shown us that real structures often deviate significantly from their designed properties in some important structural parameters, such as natural frequencies. The consequences can lead to unexpected and very expensive damage, or extremely shortened service life for investors and operators.

Promising future

The R&D progress made so far and the positive results from pilot projects are promising. In spite of technical and operational challenges, floating wind offers enormous potential for the expansion of offshore wind energy. Bachmann is already hard at work solving these challenges in current offshore projects worldwide.

» Sophisticated SHM is especially important for innovative designs and developments. Experience has shown us that real-life structures often deviate from their design. «

Marc Thomsen
Product Manager SHM at Bachmann Monitoring

EXHIBITIONS AND EVENTS

INDUSTRY

ALL ABOUT AUTOMATION

Friedrichshafen, Germany
25. - 26.02.2025
Booth: B2-610

WIND

DISTRIBUTECH

Dallas, Texas, USA
25. - 27.03.2025
Booth: 6664

RENEWABLE ENERGY

VOLTA-X

Stuttgart, Germany
25. - 27.03.2025
Booth: 9E20

MARITIME

SEA ASIA

Singapore, Singapore
25. - 27.03.2025

WIND

WIND EUROPE

Copenhagen, Denmark
08. - 10.04.2025
Booth: C1-C110

RENEWABLE ENERGY

EES EUROPE

Munich, Germany
07. - 09.05.2025
Booth: B1.119

RENEWABLE ENERGY

BHKW JAHRESKONGRESS

Dresden, Germany
13. - 14.05.2025

INDUSTRY

SPS ITALIA

Parma, Italy
13. - 15.05.2025

MARITIME

3RD TECHNOLOGY SYMPOSIUM

Hamburg, Germany
14. - 15.05.2025
Booth: Deck 10 – Maritimes Museum

WIND

CLEANPOWER

Phoenix, AZ, USA
19. - 21.05.2025
Booth: 1917

MARITIME

NOR-SHIPPING

Oslo, Norway
02. - 06.06.2025

INDUSTRY

ALL ABOUT AUTOMATION

Hamburg, Germany
03. - 04.06.2025
Booth: B6.131

WIND

ROSTOCK WIND

Rostock, Germany
August 2025

WIND

HUSUM WIND

Husum, Germany
16. - 19.09.2025
Booth: 5B07

INDUSTRY

ALL ABOUT AUTOMATION

Düsseldorf, Germany
17. - 18.09.2025

WIND

WINDERGY INDIA

Chennai, India
October 2025

WIND

CHINA WINDPOWER

Beijing, China
October 2025

MARITIME

KORMARINE

Busan, South Korea
21. - 24.10.2025
Booth: Holland Pavillon

MARITIME

EUROPORT

Rotterdam, The Netherlands
04. - 07.11.2025
Booth: 1.1512

WIND

WINDENERGIETAGE

Potsdam, Germany
12. - 14.11.2025

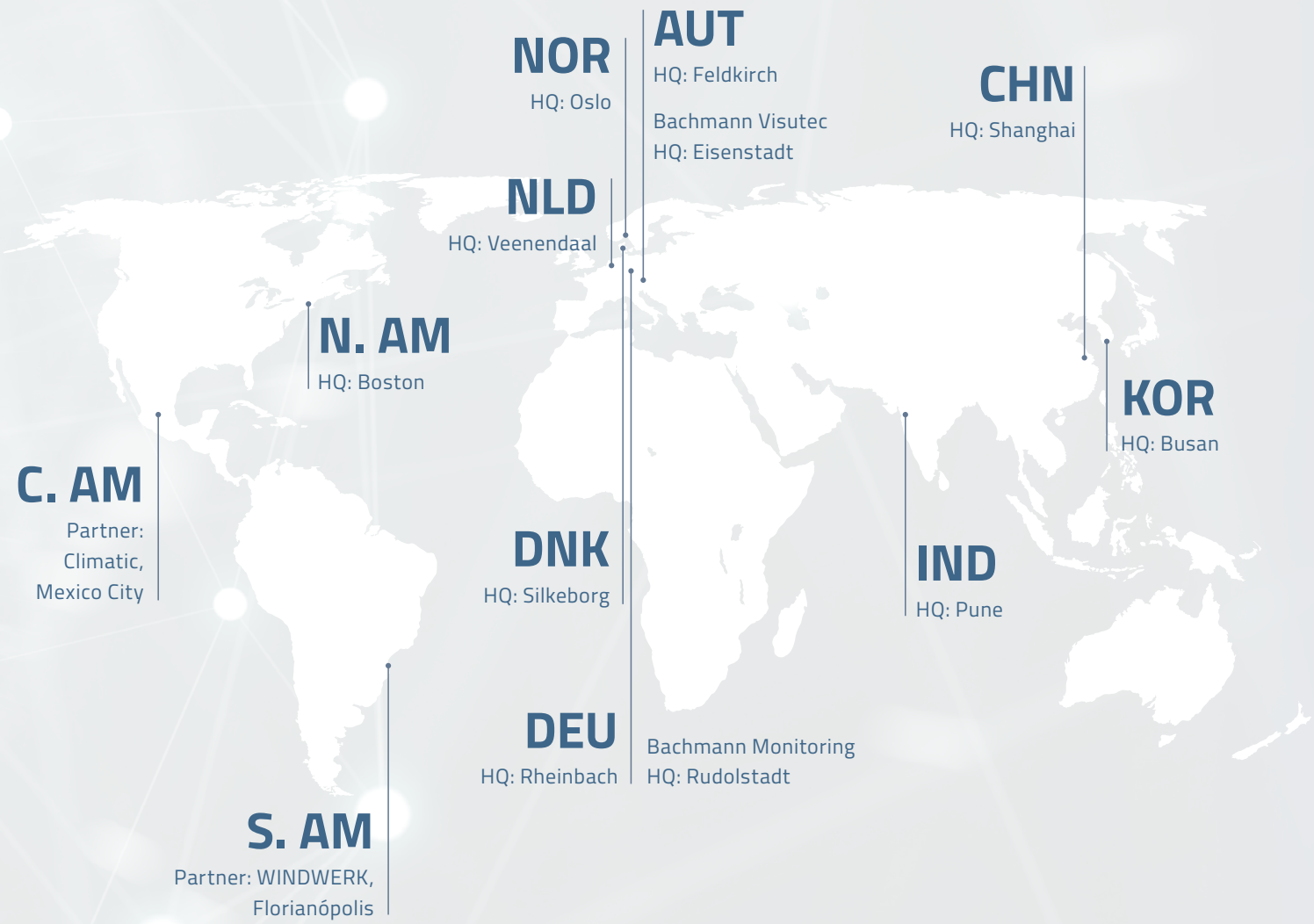
INDUSTRY

SPS

Nuremberg, Germany
25. - 27.11.2025

Find out more about upcoming events on our website.

GLOBALLY PRESENT



atvise® DISTRIBUTION AND SYSTEM INTEGRATION PARTNERS

Bulgaria
China
Germany
Finland
France
Greece
Italy
Croatia
Latin America
Middle East
North Africa
Norway
Austria
Switzerland
Slovenia
Spain
South Africa
South Korea
Türkiye
Vietnam

bachmann.

www.bachmann.info