real.times

ESCAPE ROUTE: TECHNOLOGY

CLIMATE CHANGE | **VERTICAL-AXIS WIND TURBINES**
POWER-TO-GAS-TO-POWER | **EMISSION-FREE SHIPPING** | **STRUCTURAL**
HEALTH MONITORING | **LISA COMMUNITY** | **ARTIFICIAL INTELLIGENCE**

»Ready and Waiting!«

In December 2020, EU leaders agreed to a reduction of the EU's greenhouse gas emissions of at least 55 percent by 2030 compared to 1990. This was preceded by a proposal from the European Commission, published together with an extended impact assessment as part of the so-called 2030 Climate Target Plan. This may seem cynical, but in light of the devastating environmental disasters that hit large parts of Europe early this summer, this step was long overdue.

It's great to have a plan. But now it's time for action! Measures to combat climate change are lagging and time is running out. There is an ongoing lack of transparency from politicians when it comes to presenting the facts. Is this because they don't want to, or because they can't? From my perspective, it is irresponsible to continue to suggest that clean energy technologies and renewable heat generation are not ready. They have been ready for a long time, requiring only expansion in one area or another, which is unsurprising when political and regulatory hurdles prevent widespread project deployment, thereby deterring the necessary investment.

The net-zero roadmaps recently published by the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA) assign particular responsibility to wind energy. Together with photovoltaics, wind plays a central role in the decarbonization of our energy supply. However, with the current 'wait and see' policy, we are not making progress: annual wind utilization alone must quadruple in the next 10 years if we want to achieve these net-zero targets.
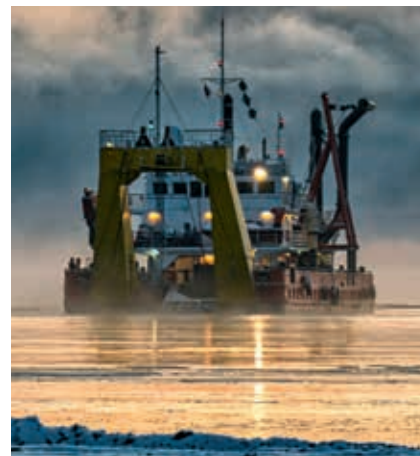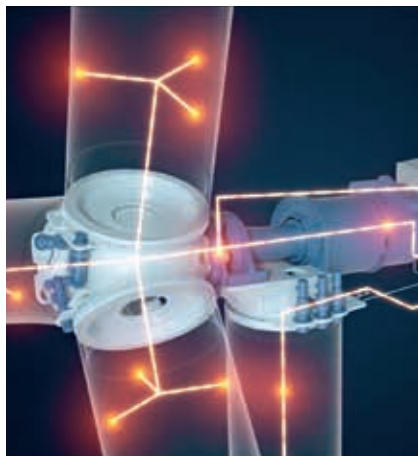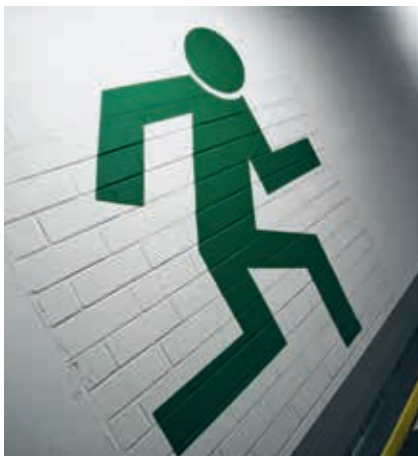
In July this year, Bachmann electronic joined other leading industrial companies and globally active associations in addressing G20 government leaders with an urgent request to work towards a decisive and immediate policy change, and to make renewable energies a priority. We need an integrative policy that promotes a transition, especially in terms of the labor market.

However, the increasing replacement of fossil fuels with renewables is only one side of the coin. We must also evaluate how we can use existing resources economically. The question we must ask ourselves is: how can existing resources be used in an energy-efficient, resource-saving manner, over a long period of time? This applies to every industry and sector; maybe even every aspect of life. At Bachmann, we have been dedicated to this topic for a long time. Not only with a focus on long-term availability and sustainable component materials, but also by developing methods and tools that keep plants operating for as long as possible and at an ideal operating point corresponding to the plant condition. With the same methods, we prevent failures and excessive wear by detecting emerging malfunctions at an early stage, which can be corrected in good time and at optimal cost. The keywords here are 'condition monitoring' and 'predictive analytics and maintenance'. We have dedicated the current issue of real.times to these topics in particular. I hope you enjoy reading.

With warm regards,

Bernhard Zangerl
CEO Bachmann electronic

MAIN THEME

ENERGY

MARITIME

INDUSTRY

ENGINEERING

PRODUCT NEWS

Climate Change

EFFICIENCY POWERED BY KNOWLEDGE

Sustainability is surely one of the most pressing issues of our time and it affects every single one of us. When it comes to conserving finite resources; optimizing the energy efficiency of industrial manufacturing; and reducing greenhouse gas emissions, companies, public sector organizations, and private individuals must collectively improve. These improvements must also be achieved within a feasible cost framework. Bachmann is committed to developing the technological solutions required to meet this challenge.

Bachmann has been supplying technology for the intelligent control of machinery for over 50 years – in renewable energies, particularly wind, in industry, and in maritime applications. Due to increasing complexity, the effects of climate change, and the growing scarcity of resources, plant operators are being confronted with ever more urgent questions: How can resources be conserved? How can plant efficiency be sustainably optimized? And, how can plant life cycle, maintenance, and operating costs be reduced?

Automation with Total Added Value

"The key to answering these questions lies in controller-integrated measurement technology, and in machine and demand-orientated process monitoring," says Daniel Pfeifer, Technology Director at Bachmann electronic. The long-term goal is optimal efficiency based on knowledge: "In this way, we support our customers by optimizing plant operations, reducing downtime and preventing collateral damage."

To this end, Bachmann has continuously expanded its competencies over the previous decades: with Bachmann Monitoring GmbH in Rudolstadt (Germany), Bachmann Visutec in Eisenstadt (Austria), Airwerk GmbH in Emstek (Germany), and most recently through the acquisition of German tech start-up Indalyz Monitoring & Prognostics, led by renowned physicist Professor Michael Schulz.

A New Approach to Condition Monitoring

Bachmann's research and development team is constantly pushing the boundaries of Condition Monitoring by utilizing machine learning and artificial intelligence (AI). Thanks to completely new mathematical algorithms, knowledge can be extracted from data that is impossible to manually process. This facilitates a brand-new approach to high-quality diagnostics: the prediction accuracy of potential plant malfunctions increases, and the reliability of early fault detection drastically improves. "Machine operators are therefore alerted to impending problems long before any damage occurs," explains Daniel Pfeifer. Maintenance planning becomes easier and safer for service organizations, and machines can be maintained in a targeted and cost-effective manner, remaining productive for longer. For expensive and production-critical machines, or those that can only be reached at considerable expense, such as offshore wind turbines, this is critical.

However, Bachmann doesn't generate added value simply by installing more sensors. Quite the opposite: "Our approach is to replace sensors with intelligence," says Holger Fritsch, Managing Director of Bachmann Monitoring GmbH. Prof. Schulz's team is breaking new ground in Condition Monitoring. Their data analysis methods allow the identification of new, meta-level patterns. The collected insights can then be transferred to other, identical plants or similar system configurations. Furthermore, these methods can be applied to a huge range of machines – from heavy industry to energy farms.

»Bachmann is committed to holistic machine, structure and maintenance monitoring.«

"This is an important step in bringing about a broader, more complete application of Condition Monitoring," says Fritsch, describing the company's strategic goal.

Extending Service Life

Sustainability and resource efficiency also mean extending the service life of productive plants beyond the predicted lifespan. Often, however, there is a lack of reliable data to confirm the corresponding functional and operational safety. And for critical infrastructures, including wind turbines, this information is required for operating licenses. Such requirements are not fulfilled by classic diagnostic models alone – but, when combined with new analytical methods, they can be: "This can be solved on a fundamental, mathematical level," Fritsch confirms.

Even during operation, Condition Monitoring processes extend machine service life by detecting critical operating states, returning plants to safe operating states, and thereby avoiding machine and structural overload. Corresponding characteristic values can also be condensed, and maintenance strategies optimized: "Ergo, plant maintenance can be carried out only when absolutely necessary and as late as possible," says Daniel Pfeifer. Necessary servicing can then be planned in advance and at a convenient time for the plant, and operators can get the longest possible service life out of their components. For the competitive generation of electricity from renewables, this is significant progress: plants remain on the grid for longer, yields increase, and costs decrease.

A Sizeable Offer

Bachmann is committed to holistic machine, structure and maintenance monitoring. In wind energy, the company already has the widest range of products on the market, offering solutions for drivetrain monitoring, structural health monitoring, and rotor blade monitoring. In addition, a global team of experts provide round-the-clock monitoring services, supporting customers with detailed root cause analysis.

Bachmann is sending a clear signal to the industry: "We are planning for significant growth and will continue to strategically strengthen our expertise in order to achieve this," states Bernhard Zangerl, CEO of Bachmann electronic. "Resource conservation and sustainability are deeply anchored our DNA and this approach further emphasizes our commitment."

BACHMANN: TECHNOLOGY MANAGEMENT LEADER

In August 2021, Dipl. Eng. Daniel Pfeifer took up the new position of Technology Director at Bachmann. "When it comes to future topics and challenges across our industries, we want to assign an even higher priority to product development," says CEO Bernhard Zangerl, who is very positive about the appointment of the 44-year-old Tirolean. "In addition to coordinating the Bachmann Group's hardware and software development centers, Daniel's primary objective will be to provide further impetus for the transfer and integration of new technologies into industrial, maritime and renewable energy applications. This also includes application-oriented research alongside our partners at international universities."

Daniel Pfeifer holds a degree in electrical engineering and has more than 15 years of experience in development and development management, most recently as Head of Electrical Engineering at Vorarlberg's renowned cableway manufacturer, Doppelmayr. "Process and machine automation is becoming increasingly complex and combining subsystems is becoming more and more of a challenge. Our goal is to support our customers with the right system architectures, as well as flexible, integrated components, as they prepare for the oncoming challenges," says Daniel Pfeifer, outlining one of his most important personal objectives.

We wish Daniel a very warm welcome to the team!

»Courage and
a pioneering spirit
lead to real
alternatives.«
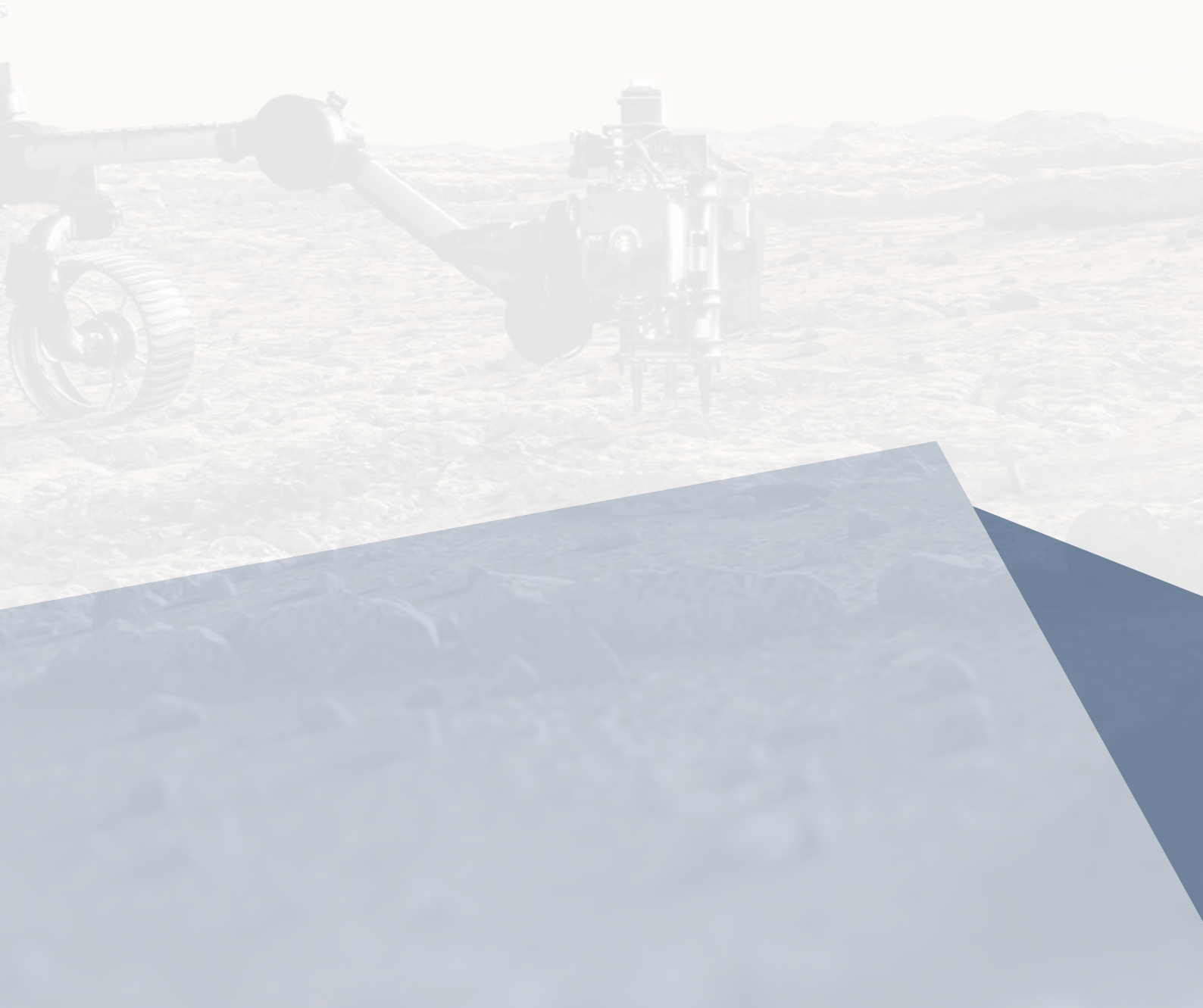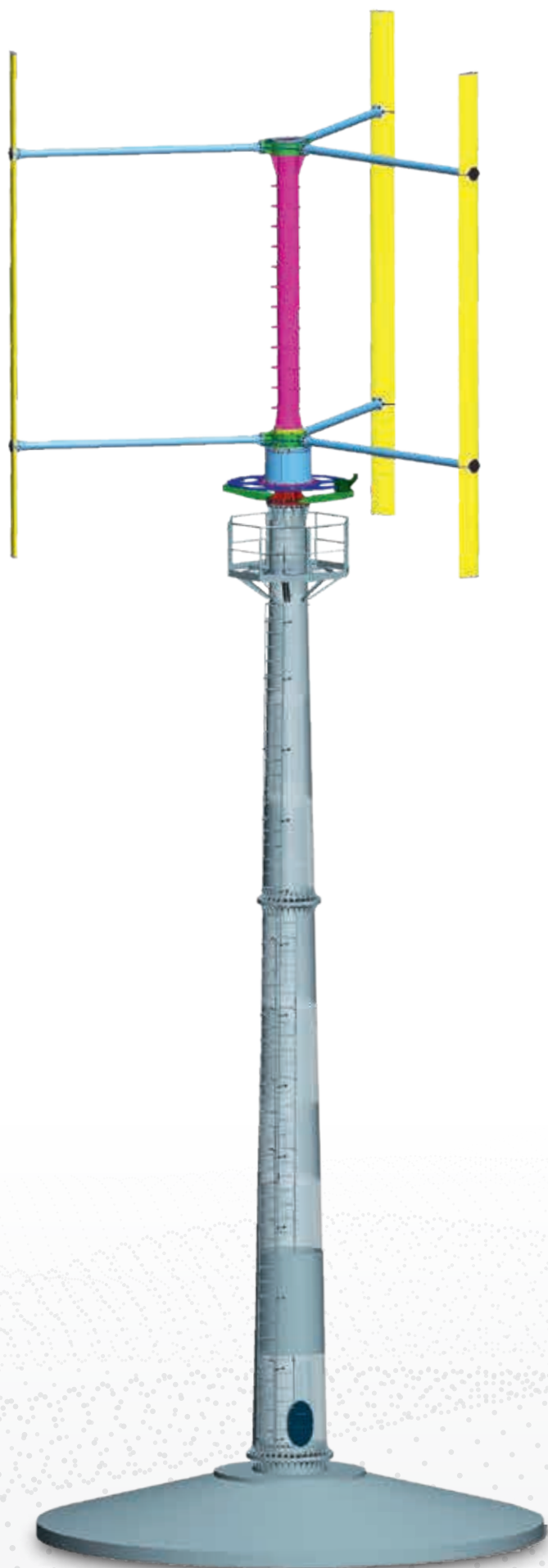
WINDS OF CHANGE

Vertical-axis wind turbines (VAWTs) are outnumbered by their horizontal-axis counterparts. Horizontal construction delivers higher electricity yield with lower mechanical loads. However, vertical-axis turbines are more versatile and have lower maintenance costs. Tri-Power New Energy has set itself an ambitious goal: the Beijing-based company aims to build the first VAWT approved to feed the Chinese power grid for regions with turbulent wind conditions.

Slightly less efficient than horizontal-axis wind turbines but more versatile: the VAWT with Darrieus design from Tri-Power New Energy.

Tri-Power New Energy specializes in the research and development of on- and offshore wind turbines. The company primarily produces large horizontal-axis turbines for regions with low wind speeds and offers its customers a wide range of services.

Utilizing Wind Energy in the City

The company aims to expand its business to include vertical-axis wind turbines (power range from 1 to 100 kW). Their structure makes them ideal for areas with turbulent wind conditions. VAWTs also emit little noise, which makes them attractive for use in cities.

For this application the company has already developed a vertical-axis turbine with an output of 20 kW. The stable wind turbine, with an H-bar design and straight blades, is IEC 61400-2:2013 compliant and will be the first to be approved for grid feed in China.

Perfectly Configured

As with the horizontal-axis models, the mechanics, electrical systems, and controls were developed entirely in-house and are fully harmonized. The outcome is an extremely economical and reliable system. "VAWTs are low maintenance. In contrast to horizontal-axis turbines, they do not require a yaw system, as they produce electricity regardless of wind direction. In addition, there is no need for pitch control. Components that require more intensive maintenance, such as the generator, are located close to the ground, which makes service easier." says Professor Xinwei Cui, General Manager at Tri-Power New Energy.

Reliable Operation

For variable speed operation, the company uses a direct-drive permanent magnet synchronous generator. Tri-Power New Energy's vertical-axis turbine is controlled with a Bachmann M1 controller and a compact MX213 processor module. During development, the company relied on SolutionCenter as user-friendly engineering software.

According to Prof. Cui, whilst vertical-axis system construction is far more straightforward compared to that of horizontal-axis turbines, some challenges still remain. Due to the system design, blades cannot be moved out of the wind during storms. Tri-Power New Energy therefore had to pay close attention to safety systems during development. "The design and control of the brake system in particular turned out to be challenging. But, together with Bachmann, we succeeded in designing a sophisticated system for this as well," the General Manager happily concludes.

To control the vertical-axis turbine Tri-power New Energy relies on Bachmann's M1 automation system, developed with SolutionCenter engineering software

TRI-POWER NEW ENERGY

– Based in Beijing

– Specializes in the research and development of on- and offshore wind turbines

– Primarily a producer of large horizontal-axis wind turbines, Tri-Power New Energy offers a wide range of products and services

ELECTROLYSIS

Electrolysis splits demineralized water (H_2O) into oxygen (O_2) and hydrogen (H_2). The oxygen is released and the hydrogen delivered to a storage tank. The process takes place at temperatures from 60 to 80°C and a pressure of about 35 bar.

AGENITOR H$_2$

2G's agenitor H_2 hydrogen CHP unit is available with electrical outputs of up to 360 kW and thermal outputs of up to 371 kW. The overall efficiency is over 80%. In addition to pure hydrogen, it is adaptable for use with a wide range of gases. The agenitor H_2 was awarded the prestigious 'Innovation Award' from the GAS (German Agricultural Society) in 2021 and was the only innovation to be awarded the gold medal.

Hydrogen supply on the agenitor H_2-CHP

Power-to-Gas-to-Power

A SMART COMBINATION

Based in Heek, Germany, 2G Energy AG is a leading international manufacturer of combined heat and power plants (CHP) for decentralized electricity and heat provision. For more than 10 years, 2G Energy plants have relied on the Bachmann M1 automation platform. This also applies to their latest venture: the world's first combined heat and power plant to run on pure hydrogen, constructed in the Bavarian town of Hassfurt, Germany.

The Key to Energy Transition

Electricity from renewable energies is highly volatile. When the sun shines and the wind blows, there is usually too much; when there is a lull, there is too little. Technologies that enable the long-term storage of large amounts of energy, even from renewable sources, are becoming increasingly important for ensuring a secure supply. Power-to-gas plants play a key role: In the event of an oversupply, instead of shutting down power generators or taking them off the grid completely, surpluses are used to operate electrolyzers that produce hydrogen. This can be used to fill suitable storage facilities or mixed directly with natural gas in the gas network.

The municipal utility of Hassfurt in Lower Franconia operates exactly this system: since 2016, they have been producing green hydrogen in a power-to-gas plant. A PEM (polymer electrolyte membrane) electrolyzer, with a peak output of 1.25 megawatts, converts surplus electricity from wind and solar power plants.

This hydrogen, often referred to as 'windgas', is then fed into 2G Energy's hydrogen CHP unit, which converts the energy into electricity or heat as needed. Electricity is absorbed by the city's power grid, and heat is fed into a local heating network to supply public buildings and an industrial plant.

Complete Grid Compatibility

First and foremost, PEM electrolyzers are extremely responsive and follow load changes almost instantaneously. They can be switched from standby to full-load
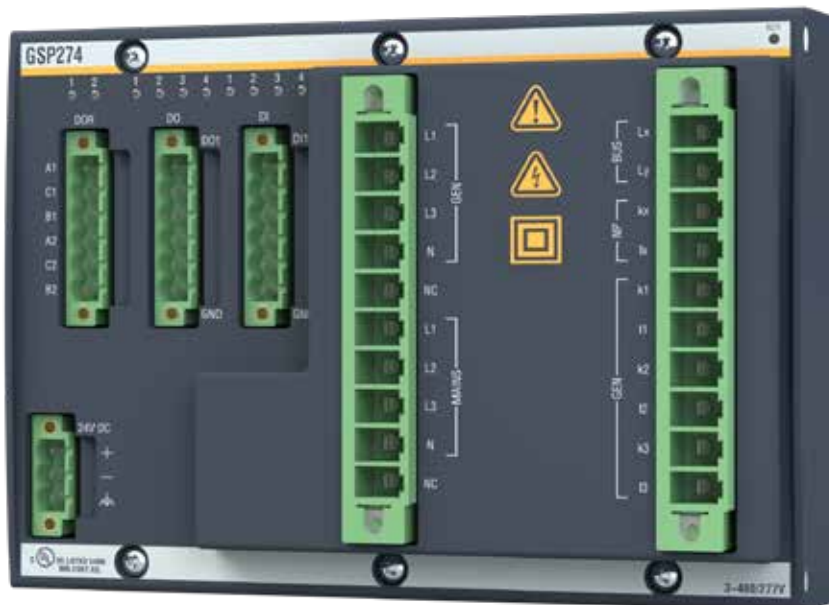
operation within seconds, stabilizing grid frequency and preventing an overload. Since the hydrogen CHP also demonstrates high dynamics, real 'control energy' is available from the overall system of power-to-gas and gas-to-power. This compensates for power surpluses and shortfalls from renewables in the local balancing group or in the main distribution grid. When waste heat from the CHP is also fed into the local heating network, its overall efficiency increases to well over 80 percent.

"This application shows how existing technologies can drive the energy transition forward," says Frank Grewe, CTO at 2G Energy, enthusiastically. In contrast to the previous practice of adding hydrogen to the natural gas grid, the cogeneration plant allows for reverse power generation via a hydrogen-powered gas engine, without fossil fuel components. The hydrogen storage currently available in Hassfurt enables around 15 hours of continuous CHP operation.

An Emission-Free Future

The plant is part of a Stadtwerk Hassfurt GmbH research project. The project is investigating the system conditions and operational behavior of the H_2-CHP in conjunction with the P2G plant. In the meantime, 2G Energy has also set up other CHP unit projects in Germany, the UK, Japan and on the Arabian Peninsula. The most effective operations strategies are still in development, as well as technically- and economically-optimized operational modes for the system, Grewe says. "Even if the overall P2G2P (power-to-gas and gas-to-power) efficiency is currently below 50 percent, the system already demonstrates how bidirectional sector coupling can succeed with full grid efficiency."

This type of configuration utilizes electricity that would otherwise be curtailed, further reducing the importance of this figure. The combined heat and power plant converts green hydrogen back into electricity, thereby putting surplus renewable energy to good use on site. Windgas plants are therefore an important building block for a successful energy transition. And so, this smart combination is paving the way to an emissions-free future.

2G ENERGY AG

– Headquartered in Heek, Germany

– More than 650 employees worldwide

– Listed on the stock exchange since 2007

– One of the leading international suppliers of combined heat and power plants. The company has installed more than 6,500 plants around the world.

www.2g-energy.com

Condition Monitoring for Gearboxes

THE FUTURE STARTS NOW

REINTJES is renowned for the production of high-quality, reliable maritime gearboxes – built for many years of continuous operation. The Hamelin-based company relies on continuous condition monitoring for early fault detection and failure prevention. With initial monitoring systems already in operation, the maritime specialists are now exploring AI solutions and data comparison across entire fleets.

> »Thanks to Bachmann's CMS, we can
> regularly provide our customers
> with clear directions and proactively alert
> them to impending malfunctions.«

Marco Warnebold,
Condition Monitoring Engineer, REINTJES GmbH

Gearboxes in View

The reliable operation of maritime vessel gearboxes is one of Reintjes' main priorities. For Marco Warnebold, Condition Monitoring Engineer at Reintjes, continuous condition monitoring is the key: "By monitoring relevant process parameters, we gain a better understanding of the real-world operating conditions of our gearboxes and can use this know-how to optimize future developments. We can also identify potential problems at an early stage." The timely procurement of replacement parts, as well as quicker response times for on-site interventions, leads to higher vessel availability.

Reintjes continuously stores and monitors process parameters using Bachmann's Condition Monitoring System (CMS), which is visualized on a web-based dashboard. Standard monitoring can be expanded to include vibration monitoring and analysis. "Thanks to the accurate recording of highly dynamic vibrations, we can localize any problems and identify their causes," says Warnebold, highlighting a significant advantage of the Bachmann solution. Customers are provided with regular reports, including clear recommendations and timely information on impending malfunctions. Reintjes carries out vibration signal evaluation, which can then be independently evaluated by Bachmann's remote monitoring service.

If required, Reintjes offers additional monitoring possibilities with highly dynamic torque monitoring and oil quality monitoring. "Accurate, up-to-date oil condition monitoring allows customers to optimize and extend cost-intensive oil change intervals. In addition, this avoids the use of aged oil, reducing wear," explains Warnebold.

Practical Experience

Reintjes has been producing condition-monitored gearboxes since 2018. For CMS, the company relies on Bachmann's cost-effective and compact MX213. The GIO212 ensures compatibility with all common sensors. "This allows us to flexibly adapt our systems to the required application," says Warnebold. With the AIC214 module, Reintjes precisely records the structure-borne noise of up to two gearboxes, including the automatic calculation of RMS values. "The whole system is modular and expandable to several machines – ideal for more complex systems. For example, on a high-speed ferry that operates between Tenerife and Gran Canaria, we use two CMS systems to monitor four gearboxes," explains Warnebold.

The acquisition of reliable trend analyses proved a challenge during the first CMS implementation. Reintjes had to account for dynamic driving conditions, as well as changing speeds and torques, through targeted classifications. But complex gearbox kinematics also placed high demands on developers, especially as the engine and ship propellers also exert a considerable influence on gearbox vibration behavior.

A Simple and Comprehensive Overview

Reintjes's goal is to offer a monitoring solution that easily integrates into customer systems. With this in mind, Marco Warnebold values the M1 controller's extensive fieldbus protocol support and flexible interfaces: "Thanks to Bachmann's solution, our customers receive important operational information directly to control room monitors, removing the need for additional visualization units."

A current priority for Reintjes is the development of a supplementary web-based dashboard. This will act as a management tool, as well as providing various statistical operation evaluations, without the need for additional software. "This dashboard can include statistics on load profiles, efficiency and much more," says Marco Warnebold. Among other applications, it can be used to monitor the frequency of driving mode selection, when the last filter change took place, or when the next scheduled oil change is due. The range of functions can be easily expanded, depending on the availability of relevant sensors.

Learn and Improve

Reintjes sees a great deal of untapped potential in Bachmann's CMS. The company is now working intensively on future monitoring concepts: "Once sufficient systems are in operation, we could compare entire fleets with corresponding machine learning algorithms and gearbox digital twins," suggests Warnebold. Hendrik Harting, Head of

Validation & Automation at Reintjes, is certain that this will ultimately benefit ship operators: "For every gearbox, we know the design, gearing data, and date of manufacture. If we can compare the performance of a particular assembly with similar systems on other ships, we can provide operators with specific, customized advice to maximize the service life of gear components."

Bachmann is also constantly working on new, more accurate approaches to predict the condition of Reintjes gearboxes. For example, using artificial intelligence to explore the separation of kinematic frequencies and structural natural frequencies, in order to obtain reliable structural condition information. However, according to Holger Fritsch, Managing Director of Bachmann Monitoring, structural health monitoring is only one of many research avenues: "We are currently working on a synthetically-generated speed indication. This would allow gearbox manufacturers to dispense with tachometers, thus eliminating a potential error source."

Successful pilot project: Continuous monitoring has been in use on the Liinsand ferry gearbox since 2018. REINTJES has been constantly developing its CMS solution ever since.

REINTJES GMBH

– Founded in 1879 and head-quartered in Hameln, Germany

– Employs over 500 people

– An international group of companies specializing in propulsion technology: REINTJES manufactures marine gearboxes for main drives, dredger gearboxes, pod drives for yachts, hybrid drive systems, along with turbo gearboxes for gas and steam turbines and compressors.

www.reintjes-gears.de

AI FOR AIR COMPRESSORS

MacGregor, part of Finnish corporation Cargotec, specializes in maritime equipment solutions. For many years, the company has provided remote monitoring solutions for the maritime industry. Together with Bachmann, MacGregor has now developed a platform that goes even further: a system that maximizes air compressor performance by providing operational recommendations to the crew.

Since 2013, MacGregor has offered remote crane equipment checks and technical consultations. But for the company's engineers, this didn't go far enough: their goal was to equip machines with advanced monitoring systems that could predict maintenance requirements. This demanded a system that could recognize patterns in equipment behavior and, through a combination of extensive experience, technical expertise, and AI, identify anomalies indicative of failure. OnWatch Scout is MacGregor's solution.

A Challenging Concept

The creation of clear, understandable action instructions requires continuous status monitoring that can identify current and future failures. This calls for sensor technology able to identify anomalies, wear and tear, and their causes. In addition, the generation of clear performance indicators, as well as maintenance recommendations, places high demands on software. "On-board operators have to be guided through challenging operating and repair processes with concrete, actionable advice and detailed, step-by-step instructions," says Dr. Eng. Jörg Peschke, Director Drives and Controls, Digitalization and Business Transformation at MacGregor Group, describing the concept behind OnWatch Scout.

Limitations of Previous Analytics

During concept development for the air compressor monitoring system, it became apparent that the technical approach of vibration monitoring and spectrum analysis would be unable to generate the necessary unique identifiers for a number of different fault sources. MacGregor, however, was undeterred – together with experts from Bachmann Monitoring, unique attributes for fault detection and wear analysis were finally developed.

In the field of structure-borne noise analysis, many of the diagnostic approaches used to date have been based on broadband characteristic values, such as the formation of RMS values in specific frequency ranges. The RMS value is associated with the energy value of the signal and is thus a strong indicator of fundamental changes to machine condition. In most cases, however, the value is too ambiguous for accurate fault localization, and can only be used to prevent the most serious accidents and consequential damage.

It is therefore unsuitable for more in-depth diagnosis and early fault detection. Instead, frequency-selective methods have proven successful for early fault detection, for example in rolling bearings and gears. In this case, the fundamental frequency amplitudes of moving components are monitored, as are their harmonics. For certain diagnoses, characteristic values for sidebands can also be generated. To account for variable speeds, which can lead to amplitude value distortion, sensor signals are subjected to order analysis.

There are, however, specific challenges associated with air compressor monitoring. Many air compressors contain plain bearings, which cannot be monitored in the same way as roller bearings. Additional important components, such as inlet and outlet valves, also need to be monitored.

New Methods

The methods of classical vibration analysis were therefore extended through a diagnosis based on shape filters.

At a glance: OnWatch Scout gives on-board users a quick overview of air compressor condition.

»The on-board operator is guided through difficult operational and repair processes with concrete, actionable advice and detailed step-by-step instructions.«

Dr. Eng. Jörg Peschke,
Director Drives and Controls,
Digitalisation and Business Transformation,
MacGregor Group

Building on narrowband frequency analysis, and using a vector concept for parallel filtering and scale-free vibration characteristic calculation, shape parameters are used to obtain information on both amplitude and phase. "The results are robust, largely interference-insensitive scalar values for 'anomaly detection' in the function of machine and plant components," explains Holger Fritsch, Managing Director of Bachmann Monitoring GmbH. With the moments method, all data and signals (pressure, temperature, speed, structure-borne noise and others) can also be used to detect anomalies in operating behavior.

Security by Design

"This is where the strength of Bachmann's solution becomes clear," says Dr. Peschke. " Condition Monitoring technology is an integral component of the M1 automation solution for our compressors. Essentially, this means that all relevant process variables are immediately available for diagnostics." As various computer processes are integrated into the M1 solution, no additional hardware is required to separate operating functions, such as control of the air compressor, and information functions such as Condition Monitoring and data transmissions.

Online and Offline

Data transmission from on-board compressors to Bachmann's certified diagnostic center is not always possible whilst vessels are at sea. In this scenario, the on-board controller aggregates data, where it can be used for visualizations. MacGregor uses the results of such analyses to generate action instructions on-board.

Huge Benefits

OnWatch Scout is vital tool for crew: it reduces unplanned equipment failures and the associated costs and inefficiencies, and it is also effective in preventing serious damage. To mitigate damage impact, companies have previously stock-piled materials and deployed personnel to minimize the effects and prevent

further outages. "The OnWatch Scout system optimizes traditional processes by preserving function and operability, and by extending performance and asset life in a cost-effective manner," explains Dr. Peschke. For him, the platform holds enormous potential. For MacGregor, it is the foundation of a symbiotic business model where company and customer succeed through effective collaboration.

MACGREGOR

– Employs around 2,000 people

– Achieved sales of
  642 million Euros in 2020

– Part of the Finnish corporation
  Cargotec

– Leading provider of
  maritime cargo and cargo
  handling solutions

www.macgregor.com

RELIABLE VENTILATION

Condition monitoring through vibration analysis enables intelligent maintenance scheduling and the optimization of service costs. So far, so good. However, assumed complexity when it comes to asset monitoring still creates a barrier to its implementation for many manufacturers. Stork, based in the Netherlands, is an exception. Stork uses Bachmann technology to monitor rotating equipment in diverse environments across a wide range of industrial sectors. With this approach, Stork ensures transparency for their clients, whilst also optimizing internal operations.

Always on the Look-Out

Stork ensures the availability of critical equipment with its operations and maintenance service, as well as numerous in-house repair centers. The company strives to minimize client risk and to lower the cost of maintenance. To achieve this, they rely on highly trained staff with extensive experience, with working methods regularly scrutinized. "We aim for continuous improvement for our customers, which is why we are constantly seeking innovative processes," explains Floor Beugels, Operations Manager for machine diagnostics, lubrication services, and non-destructive testing at Stork.

Higher Transparency – Lower Maintenance Costs

With Bachmann's Condition Monitoring System (CMS), the international company now offers customers online monitoring of operating equipment. Applied for the first time in a tunnel ventilation system, Stork analyzes fan vibrations with Bachmann's online CMS. Sensors at locations with a higher damage risk precisely record the behavior of indivi-

dual components such as bearings. "In this way, the system provides asset transparency to our customers, and repairs can be carried out at exactly the right time. With condition-based and predictive maintenance, we reduce maintenance costs for our customers and maximize availability." The operations manager is a fan of the online monitoring approach.

Above all, online monitoring also allows the reliable evaluation of older equipment: "When it comes to older assets, it is difficult to assess 'normal' vibration frequencies with individual measurements. You don't know how the equipment behaved when it was new," says the technician. If continuous data were at hand, the signal trend would clearly reveal which frequencies are generally present, and which could indicate imminent failure.

Efficient Operation

In the past, service technicians made regular site visits, analyzed vibration signals with handheld devices, and then evaluated the results in the office. With this approach, the

STORK

– With around 18,000 employees
  in over 100 countries,
  the company serves more
  than 4,000 clients across
  6 continents

– Stork provides customers with
  fully integrated solutions
  for operation, maintenance,
  modification, and assets
  integrity across a wide range
  of industries

www.stork.com

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service team only collected a snapshot of an asset's condition. Detailed developments and incidents outside this snapshot could not be captured.

Online monitoring has helped the service organization significantly improve the efficiency of its operation. Technicians only need to visit the site if repairs are necessary. "Online monitoring saves our team an enormous amount of time. Our experts spend more time on data analysis – an additional benefit to our customers," says Floor Beugels.

A Compact System

The condition monitoring system was supplied from a single source: In addition to the MX200 processor, Fx220 Fastbus modules, AIC214 vibration sensor modules and BAM100 acceleration sensors, Bachmann also provided the 4G communication router. Based on data from a total of 14 sensors, Bachmann's WebLog Expert® delivers a clear picture of the system's overall health.

New Ideas

Floor Beugels is already thinking ahead: Not only does the CMS provide Stork with a more complete picture of asset condition, in future, sensor data from similar assets distributed worldwide could also be used for in-depth analysis. In addition, Stork wants to incorporate information from the Bachmann system into their Asset Performance Management 4.0 environment to train its algorithms.

Moving Forward Together

Stork encourages customers with critical and difficult-to-access systems to monitor their equipment online. There is no question about the solutions partner: "Bachmann has a wealth of experience in condition monitoring and the collaboration worked really well." Various other applications are already under discussion. For Stork, monitoring these new applications will require only minor adjustments to the setup. The operations manager is pleased: "The best thing is that all applications and assets are displayed by the software in the same, clear way."

A WORLD FIRST

Sembcorp Marine in Singapore is currently building the world's first hybrid LNG-powered tug fleet, which will replace the existing diesel-powered fleet over the coming years. The Hybrid Control System (HCS) is provided by Invertek Drives Far East. The company relies on M1 system components from Bachmann.

Drive control for tug vessels is highly demanding. Tugs require a highly variable power range, high maneuverability, and immense power: new harbor tugs need 65 tons of bollard pull to manage the enormous ships and tankers in Singapore. With the new ship design, Sembcorp aims to contribute to decarbonization, and, above all, to reduce air pollution. The tugs' two 16-cylinder engines, powered by liquefied natural gas (LNG), are supported by electric motors. "Depending on the desired operating mode and required performance profile, the electric engine can be used for propulsion (Power Take-In, PTI) or as a generator (Power Take-Off, PTO)," says Henry Beh, Managing Director of Invertek Drives Far East Pte Ltd.

The two gas engines deliver an overall output of almost 3,000 kW. Sulfur oxide emissions are zero and only very small amounts of nitrogen oxides are produced, removing the need for after-treatment of exhaust gas. In contrast to their diesel-powered counterparts, particle count is negligible.

Efficient Use of Resources

The hybrid system has five drive modes: in 'Harbor' operating mode, propulsion is completely electric and emission-free as the gas engine is switched off. In 'Transit' mode, when not towing vessels, the tug is powered by its gas engine. Any excess power is then stored in the battery. When pulling ships to or from the port, the tug is operated in 'Towing' mode and is powered by the LNG engines only. Then, when high bollard pull is required, 'Boost' mode can be activated, whereby both gas and electric motors are used together to deliver maximum power. Finally, a special feature is available for tug use in firefighting operations: one motor is reserved to operate the firefighting pump, the other is used to maintain the ship's position. "Our controller system ensures that both motor and generator are always operated within the optimal load range, to achieve maximum fuel efficiency and minimum carbon emissions," explains Beh.

Demanding Automation

The combined application in Singapore of a LNG motor with an electric drive is a global first for tug vessels, and control is complex: "Power management of these two motor types, batteries, and converters requires a completely new approach." says Beh. High ship maneuverability must be guaranteed for all performance requirements, and environmental impact must be minimized.

The Hybrid Control System is therefore one of the most critical subsystems of a hybrid vessel. As Beh explains, "It can be seen as the brain that co-ordinates and controls the various on-board propulsion system components, such as engine, electric motor, battery and thruster. The components must work in perfect harmony to achieve the desired operating efficiency and resource-saving objectives."

Together with Bachmann, Invertek engineers developed an appropriate automation solution. Controller and network redundancy is achieved through a ring topology. The two master CPUs operate in hot standby, with automatic synchronization and bumpless transfer. "Thus, the ship operator gains maximum reliability and operational safety," explains the general manager.

Challenges Mastered

The underlying conditions due to the corona pandemic were anything but straightforward. The entire project – including tender, kick-off meeting, system design, and project co-ordination – had to be executed completely online, without a single face-to-face meeting. Beh praises the co-operation with Bachmann's engineers: "They were available to us at any time and were a great help to our customers." When he opted for Bachmann, he was convinced from the start by the company's extensive experience and impressive references in the maritime industry. "It is important for us that all components are approved for such demanding applications in accordance with stringent marine and offshore standards," adds the Invertek manager. To ensure full compliance in meeting the stringent criteria of marine classification, the design and operating procedure, including FMEA, was reviewed by ABS, who also surveyed the final factory acceptance test. Beh is delighted: "Thanks to Bachmann, we've created an excellent basis for fleet expansion with a total of 12 tugs."

INVERTEK DRIVES FAR EAST PTE LTD

– Founded in 2007 as a subsidiary of British Invertek Drives Ltd.

– Based in Singapore

– The company focuses on the design and construction of energy-efficient and resource-saving electric and hybrid drives

invertek.com.sg

IN SEARCH OF LOWER POWER GENERATION COSTS

The construction of competitive wind turbines is becoming increasingly challenging. Development specialists at engineering firm bewind are convinced that accurate blade load measurement can offer significant advantages. bewind uses the Bachmann CLS cantilever sensor to reduce fatigue, extreme loads, and vibrations across wind turbine fleet of an international corporation.

bewind's goal is to develop wind turbines with the highest possible energy yield and lowest levelized cost of energy (LCoE). As experienced developers, they understand the need to consider the entire value chain. Dr. Joachim Tischler, General Manager and project manager for turbine development, explains: "In addition to the cost of components, we also consider numerous other factors during development, such as efficiency and failure probabilities – right through to transport logistics and service concepts."

Improved Plant Efficiency

For turbine cost optimization, bewind requires a standardized solution for reliable blade load measurement. "The highly competitive nature of the wind power industry, particularly in recent years, has led to a significant reduction from turbine manufacturers in material usage per kilowatt of installed power. As a result, structures in both the blade and tower areas are becoming softer, and are operating much closer to technical design limits. Vibrations and load changes must be controlled to ensure stable turbine operation throughout the entire service life, including under extreme conditions," says Dr. Joachim Tischler.

The company conducted extensive research to identify the most suitable sensor for its turbines. For Karsten Warfen, wind turbine developer and safety expert, sensor selection is crucial: "Ultimately, many algorithms and components depend on the measurement technology used. When we start talking about serial turbine production, you can't simply exchange technologies."
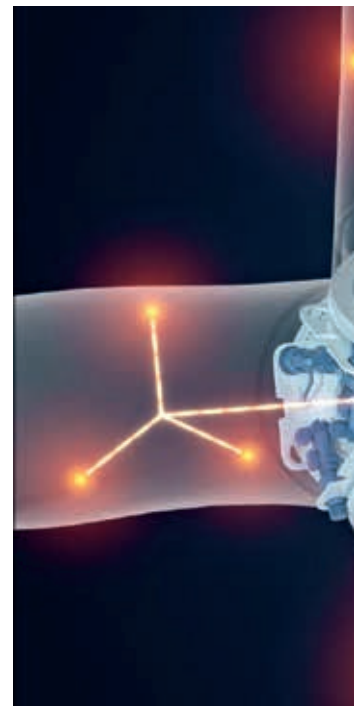
Now as Standard

Future bewind turbines will include strain measurement integrated into the rotor blade as standard. New generation turbines, currently in development for the fleet of an international corporation, will all be fitted with the required sensors. For bewind, Bachmann's CLS and industry-proven measurement principle provide the ideal solution for recording blade elongation and associated loads. The easy-to-install sensor, applied directly at the point of load application, gives development specialists the necessary confidence in strain measurement and enables reliable turbine integration.

"Bachmann's strain measurement principle delivers very precise results and is extremely robust. The high-quality measurements allow the precise control of turbines, as well as operation closer to load limits," says Karsten Warfen.

Reliable Load Statements

For reliable integration, developers rely on four sensors per blade – two edge and two flap sensors. CLS data is processed by the M1 controller with a SAI205 safety module and 4-20 mA interface connection. "We have had good experiences with the Bachmann M1 and safety modules in the past," confirms Karsten Warfen. And with SolutionCenter software, bewind is able to maintain an accurate overview of current blade load processes.

Joachim Tischler praises Bachmann's cooperation "They were very flexible and adapted the sensor design and the controller hardware to our exact requirements." Such flexibility is particularly important to smaller OEMs aiming to reduce LCoE though innovation, enabling them to compete with larger manufacturers. But the sensor also offers plant manufacturers and operators advantages when it comes to maintenance: As the sensors are installed directly at the blade root, repairs can be easily carried out whenever they are needed.
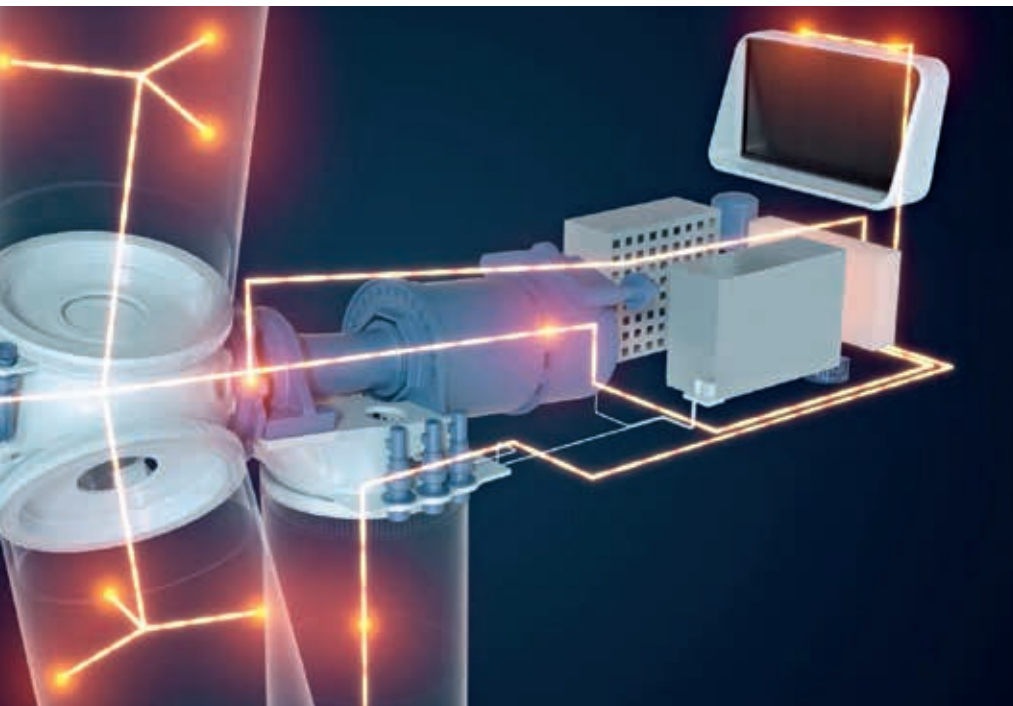
BEWIND GMBH

– The private company from Rendsburg, Germany was founded in 2019

– 28 employees with a total of more than 400 years of experience in the onshore and offshore sectors

– Develops competitive wind turbine and subsystem concepts for example for rotor blades and drivetrains. Their customer portfolio includes component and turbine manufacturers as well as wind farm operators and service providers

www.bewind.de

NAVIGATING TOWARDS ZERO EMISSIONS
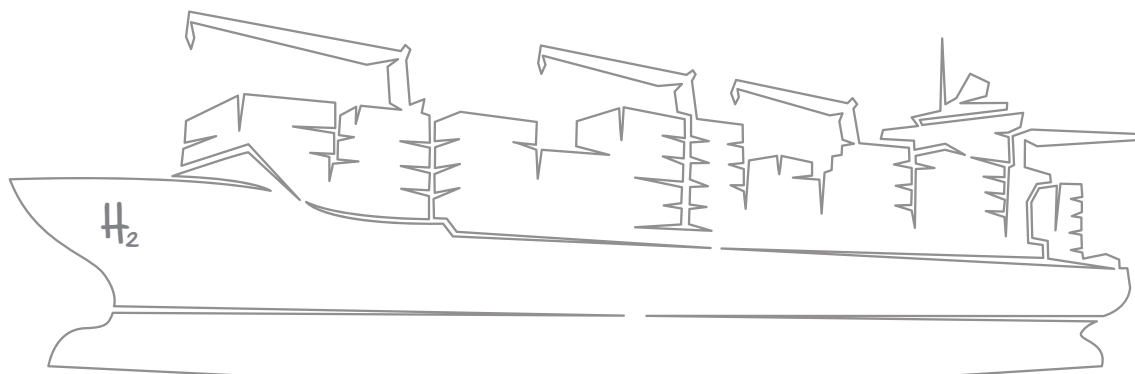
Hydrogen is considered one of the most promising options in the search for alternative shipping fuels. It could be used to generate emission-free electricity for propulsion, as well as for the on-board supply of energy. To discover how far this technology has come, and how green it is today, we talked to Jogchum Bruinsma, Application Manager Maritime Systems at PEM fuel cell manufacturer Nedstack.

Based in Arnhem, in the Netherlands, Nedstack Fuel Cell Technology BV is one of the leading providers in the field of industrial fuel cell technology. Their systems are based on polymer electrolyte fuel cells with proton exchange membranes (PEM). Energy-carrying hydrogen is located on one side of the extremely thin and electrically-isolating synthetic membrane. This reacts with a catalyst, usually platinum, which is applied to the membrane. This splits the hydrogen into protons and electrons. Protons pass through the membrane and migrate to the cathode on the air-filled side. As the protons migrate, electrons generated at the anode (on the hydrogen side) create a current and potential difference between the two electrodes. At the cathode, the hydrogen protons and electrons recombine with oxygen in the air to form pure water (H_2O).

Durability

PEM fuel cells are ideally suited for use in shipping: The technology is well-established, they operate at comparatively low temperatures, have a high power density in terms of both weight and volume, and they are durable, requiring little maintenance. Nedstack builds fuel cell stacks with a service life of over 24,000 hours and systems that last over 15 years. "If you consider an inland vessel with around 4,000 operating hours per year, that's six years before stack maintenance," explains Bruinsma.

Scalable

The open-circuit voltage of a single PEM fuel cell is very small, less than one volt in practice. "However, it can generate a current of up to 250 amperes," explains Bruinsma. By 'stacking' several fuel cells, Nedstack can generate up to 13 kW of power in a single, modular stack. This modularity has key advantages: units can be scaled as required, and are easily replaced when servicing is required.

Bachmann Integrated

"The modularity and scalability of our system can be mapped very easily with the Bachmann M1 automation system," confirms Jogchum Bruinsma. "The modular software structure of the M1 automation system makes it easy and efficient to create one piece of system software, and then to transfer it to our various systems." He also appreciates the engineering environment and in particular the integrated scope function – "it enables us to view highly detailed logs, without additional measuring devices." The flexibility and reliability of the hardware is also important for the Nedstack manager: "This gives us all the freedom we need during system setup and a high level of security."

Big Potential

On the path towards emission-free shipping, Bruinsman currently envisages applications for port tugs, assembly boats and cruise ships: "The megawatt hours of energy required for on-board electricity generation and the continuous operation of auxiliary equipment can easily be generated by fuel cells." At present, the required power levels make it difficult to achieve economic viability for ocean-going propulsion, "but, in inland shipping, a number of ships are being equipped with our technology," explains Bruinsma. For example, Nedstack is supplying fuel cell technology for the Maas, a container vessel and for the Antonie, a dry cargo vessel. The first system was put into use in 2009 by the Dutch consortium 'Fuel Cell Boat BV'. The project launched the first fuel cell boat 'Nemo-H2' for shipping company Lovers. Bachmann was already on board at the time, providing the ship's entire control system.

Going Completely Green

The environmental footprint of the system, cradle-to-cradle, still requires fine-tuning. Hydrogen is still largely produced by steam reforming using a hydrocarbon, usually natural gas. It is considered 'gray hydrogen' and is generated using fossil fuels, so it's still associated with high CO_2 emissions. A key development will be obtaining the electricity required for electrolysis from renewable energies such as wind or solar. "Once we have 'green hydrogen', the entire chain will become CO_2-emission-free. These developments are already in full swing." says Bruinsma.

That is the explicit goal, but, according to the expert, people should not be deterred from starting to use fuel cells: "Even if hydrogen is still a gray area today, at least it doesn't generate environmentally harmful emissions when providing electricity on board." And that is an important first step.

»Even if hydrogen is still a gray area today, at least it doesn't generate environmentally harmful emissions when providing electricity on-board. That is an important first step to zero-emission power generation.«

Jogchum Bruinsma
Application Manager Maritime Systems at Nedstack

NEDSTACK FUEL CELL TECHNOLOGY BV

– Created in 1999 from a division of Dutch company AkzoNobel

– Around 50 employees at its headquarters in Arnhem, Netherlands

nedstack.com
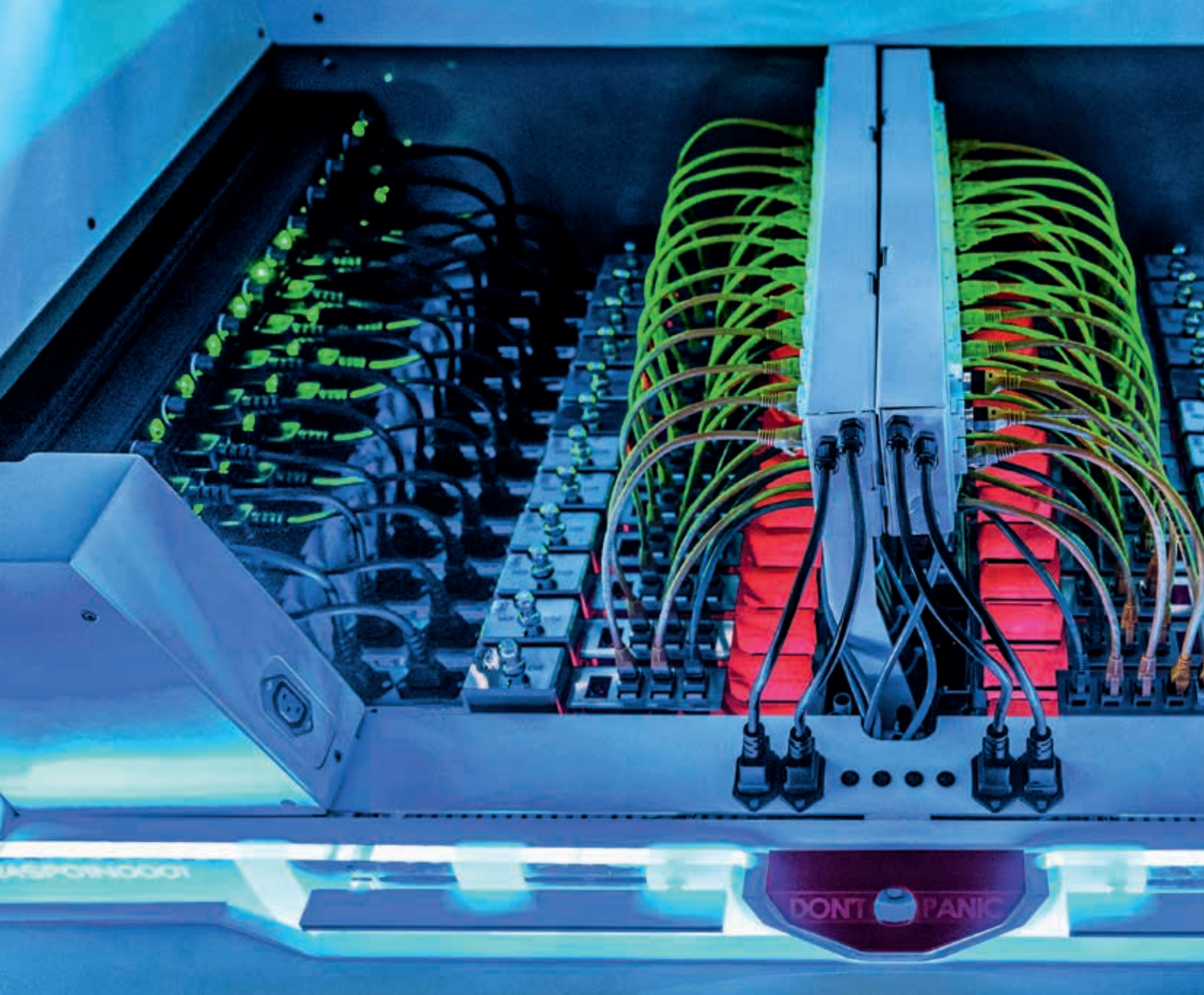
COOL TECHNOLOGY

Take a CPU, immerse it in a liquid, and turn it on. A recipe for disaster at first glance. However, the liquid not only cools the hardware extremely efficiently, the approach also drastically reduces space requirements and costs for data center operators, while also protecting the environment. Asperitas has developed Immersed Computing® and Bachmann has been involved from the very beginning.

Worldwide demand for data processing and storage is increasing at record pace. And so, cloud service providers, emerging technology developers, telecom companies, and research institutions with high-performance computing systems increasingly require data centers to safely accommodate the necessary data infrastructure.

Developments such as artificial intelligence, in-depth data analysis, virtual reality, and the Internet of Things are massively increasing data center energy requirements. This not only drives up costs; the environmental impact is also growing. And in metropolitan areas in particular, the demand for data center space is huge.
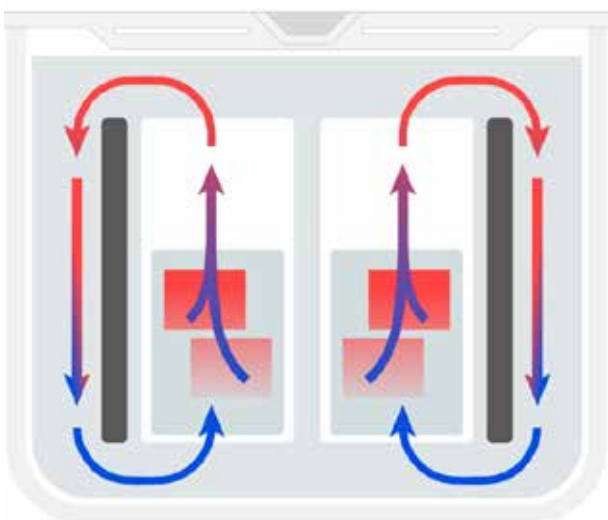
From Air to Liquid

With its solutions, Asperitas wants to develop a global energy-neutral data center industry. To this end, the company offers plug-and-play systems that cool hardware using liquid. The specialists from the Netherlands make use of a physical phenomenon for efficient cooling: The systems use convection (heat transfer) to circulate the dielectric liquid and dissipate heat.

Minimal Maintenance

Thanks to the intelligent cooling concept, the company's systems operate without fans and pumps, significantly reducing maintenance costs. As components do not come into contact with oxygen, they are not at risk of oxidation. "The liquid absorbs and transfers over 1,000 times more energy than air," says Andy Young, CTO at Asperitas. The increased heat capacity enormously reduces thermal stress on hardware. The engineer is well aware that some customers might feel a certain skepticism about immersing hardware in liquid. "Immersion cooling ensures that far more energy is invested in processing data, rather than air chillers and fans, generating the most valuable assets for our customers. Our engineering processes and partnerships within the industry ensure maximum performance with minimum energy overheads; and our certification process ensures the highest reliability. This guarantees the reliable availability of data."

Intelligent cooling: The cooling liquid in Asperitas systems circulates solely through convection.
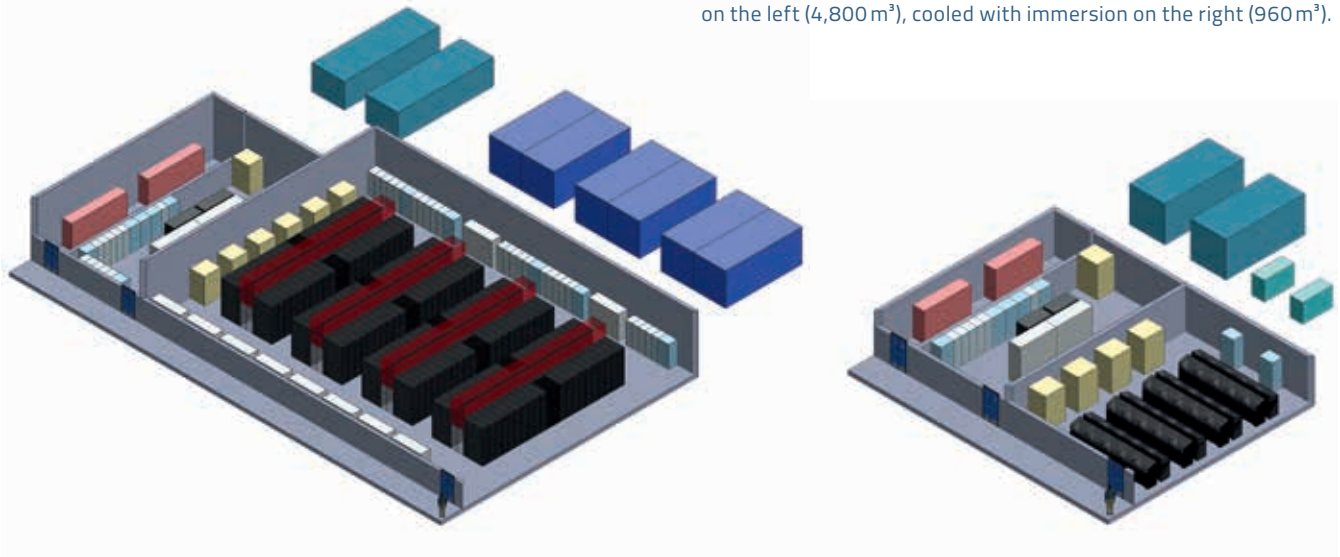
Utilized Energy

High performance hardware also leads to high cooling requirements, which in conventional cooling requires a significant number of cooling devices.

Asperitas has developed a system that ensures virtually zero heat loss: The immersion cooling liquid absorbs 97% of thermal energy from hardware and transfers it to water to be used for other purposes, such as facility heating systems. The effective cooling concept also facilitates higher ambient temperatures, removing the need for air-conditioning systems. Asperitas' solution reduces energy requirements for data center cooling by up to 95 percent.

Higher Performance in a Smaller Space

These savings also enable data center design to be simplified significantly – space requirements are reduced by up to 80 percent. The high-performance cooling capabilities of Immersed Computing® ensures processors can operate continuously at full capacity, increasing performance by up to 40 percent.

»With Bachmann's solutions, we are all set for future generations of our modules.«

Rolf Brink
CEO, Asperitas

ASPERITAS

– Specializes in developing outstanding solutions for energy-efficient and high-density data centers

– Since 2014, Asperitas has worked with cutting-edge partners to develop Immersed Computing® as a unique solution for the global data center industry

– The fully integrated, enclosed and liquid-cooled solutions include application-orientated and optimized server platforms

www.asperitas.com

Condensed hardware: Asperitas' Immersed Computing® solution houses up to 24 server cassettes: capacity for up to 3,072 processor cores, 96 TB RAM, and 768 TB storage with minimum space requirements.

Trust is Good, Control is Better

Systems are complex, and data is valuable. To ensure availability, Asperitas relies on comprehensive real-time monitoring. "This is where Bachmann comes in. Monitoring and control are fully integrated into our products. We use an M1 automation system with an MX207 CPU and GIO212 module as well as various sensors to monitor our hardware modules," says Andy Young. The M1 controls the cooling performance of heat exchangers using valves, ensuring heat dissipation remains constant. "IT equipment must be kept within a narrow temperature range to operate reliably at high performance levels over a long period of time. We're talking about years here," says the CTO. A constant temperature is also extremely important for modules connected in series: "The outflow of one system becomes the inflow of the other. You have to be able to rely on these temperatures at all times."

Making the Right Decisions

For Asperitas, the M1 controller represents a robust platform for stable operation. The monitoring system cannot be too complex, or take protective measures unnecessarily early. The M1 enables Asperitas to monitor a whole range of states within modules and associated IT components. "The flexible M1 system is at the heart of our products and allows us to implement sophisticated and robust decision-making processes based on a range of parameters," explains the experienced technician.

Close Collaboration for Flexible Systems

Asperitas modules have diverse requirements: For 'edge applications' in the telecommunications industry, customers require turnkey data center solutions. For large hyperscale data centers with thousands of computers, however, reducing complexity, providing only the most necessary features, is the key. "Bachmann gives us this flexibility. Their team accompanied us every step of the way. We developed the solution together from the very beginning," says CEO Rolf Brink.

Transparent Visualization

"It wasn't just the hardware that impressed us, the support from the team during software development was also outstanding," adds Andy Young. An atvise®-based portal visualizes all module data streams and states, and enables the configuration of control algorithms. Thanks to a simplified dashboard, Asperitas' customers always have an overview of overall status. "With the atvise® toolkit and support from Bachmann, we were able to develop the dashboard really quickly. Otherwise, we would have had to start from scratch," the CTO concludes.

Whatever demands are placed on Asperitas systems Bachmann helps keep requirements for surrounding infrastructure to a minimum. The CEO is sold: "With Bachmann's hardware and software solutions, we have found a great platform with which we are all set for future generations of our modules."

Forecasting Consumption

AUTOMATED OPTIMIZATION

Dieselstrasse Energy Park from Energieversorgung Halle can store around 2,000 MWh of thermal energy with its 'Energy and Future Storage'. Image: Kappa Agency, 2018

For more than 50 years, Energieversorgung Halle GmbH (EVH) has been generating district heating and electricity from environmentally-friendly cogeneration. Economical power plant optimization requires highly accurate predictions of the amount of heat required and, simultaneously, the amount of electricity that can be generated. Bachmann provides the solution for dynamic heat consumption forecasting.

Around 74,000 apartments, public buildings and commercial enterprises in Halle are supplied with district heating from EVH. The district heating network extends more than 200 km throughout the entire city. Heat is generated in two energy centers, which also produce electricity via environmentally friendly cogeneration, currently based on natural gas. In 2020, more than 440 GWh of electrical energy was fed into the public grid.

Tricky Operational Planning

Economical optimization relies on precise knowledge of future demand for heat. This is the only way to optimize power plant usage, primary energy purchasing, and market sale of electrical energy. Essentially, plant deployment planning is based on heat demand. At the same time, however, it must be matched as closely as possible to the quantities of electricity offered and committed to the market: any shortfalls or surpluses can significantly reduce economic efficiency.

In the past, demand for district heating was determined largely from weather data. Considering the forecasted electricity prices on the spot market and technical data on plant availability, an optimization model was used to determine, largely manually, power plant input for the next day. These settings were only adjusted during the day in the event of a plant failure or a massive change in heat demand.

Challenges in the Energy Market

However, the energy market is now subject to significant changes, presenting suppliers with entirely new challenges and requiring enormous flexibility and agility. The increasing use of renewable energies, and the associated volatility of supply, lead to considerable price fluctuations on the electricity market, especially during the day.

To be able to operate economically and take advantage of any market opportunities, EV Halle has enacted radical organizational and procedural process changes for plant deployment planning, operation, and marketing. A key focus was the dynamic optimization of the operation of the

energy park. Heat demand must always be met, but in future, power plant flexibilities and real-time market prices must also be considered.

AI for Better Forecasting

The most important control variable is still the most accurate possible forecast of heat demand from connected consumers. Bachmann Monitoring and its team, led by Prof. Michael Schulz, redesigned the consumption forecasting process. Data from EVH's own weather measurements; forecasts from weather services; and existing measured values for flow and return temperatures, volume flows, and outside temperatures at the heat transfer stations in the network are now recorded every 15 minutes and imported into the software. At the same time, it has access to the entire data history along with the power plant production data. Using these inputs, a dynamic algorithm forecasts the heat demand using various sub-algorithms and compares the results of the forecasts with the actual values for the same period. The 'best' sub-algorithm in each case is then applied in turn for the subsequent calculation, and all others are modified according to their miscalculations. These AI methods enable the algorithm to learn constantly, dynamically adapting its rules and structure to the current situation.

In a nod to Darwin's theory of evolution, these self-evolving procedures that constantly reshape and select according to temporal accuracy, are referred to as 'genetic algorithms'. These procedures form a class of their own within AI methods and have proven effective in areas such space travel.

Subsequently, trends with various forecast horizons are generated for all operating parameters, according to customer requirements. EVH uses 3 horizons: One, with 1 1/2 days for optimal electricity. Another with a longer forecast period of 14 days for primary energy procurement on the commodities market. And a third horizon of around 12 hours is used to

organize shift operations. There is a strong benefit for network operations: Because transfer stations and power generation plants are now monitored, operations personnel receive feedback on network operating parameters at least four times per hour. Any heat losses are thus identified more quickly, improving operational reliability.

Added Flexibility

Three years ago, as part of the modernization of its plant park, EVH also built a huge, large-scale heat storage facility, the Energy and Future Storage Facility, often affectionately referred to in Halle as 'Germany's largest thermos'. With a volume of 50,000 m³, the facility can store around 2,000 MWh of thermal energy – enough to supply every EVH customer with heat for two days. Crucially, the storage facility decouples heat production from electricity production as far as possible, making it possible to run plants much more flexibly: Necessary 'must-run' situations due to a demand for heat can be reduced and production can be shifted to times of more economical operation. "Today, electricity is traded on the intraday electricity market, and purchase prices vary considerably throughout the day," explains Mathias Hocke, Head of Portfolio Management/Procurement at EVH. This is also supported by an additional power plant unit, which can be started up and shut down at short notice, reacting flexibly to market price signals. "With the thermal storage unit as a buffer, we can now offer electricity at the best possible prices."

Optimal Automation in the Future

With the technical upgrade of production facilities, the heat storage system and the dynamic forecasting of demand, EV Halle has successfully migrated from a demand-driven and manually controlled operation to a revenue-oriented mode of operation with a high degree of automation. "Together with Bachmann Monitoring, we are currently examining further possibilities to further refine the forecast," says Mathias Hocke. In this context, changes in the network, triggered by faults or local maintenance, for example, will be automatically recorded and will help to make the software even more realistic. Hocke is pleased: "This will enable us to further improve the quality of our forecasts and expand our ongoing process of digitization."

»With automated and more accurate forecasting we can more easily track electricity market volatility.«

Mathias Hocke
Head of Portfolio Management/Procurement
at Energieversorgung Halle (EVH)

ENERGIEVERSORGUNG HALLE GMBH (EVH)

– Employs around 320 people

– Supplies electricity, natural gas and district heating to the city of Halle an der Saale, Germany, with a population of around 250,000

evh.de

CLEAN, SCALABLE SOLUTIONS

The number of regulated shipping areas worldwide is increasing. Entry to these areas is not permitted unless vessels comply with strict environmental regulations. In response, thyssenkrupp Marine Systems has developed a system to provide ships with green energy from fuel cells. The associated controller system was developed together with Bachmann.

CO_2-neutral shipping is an ambitious goal. It requires regenerative fuels and extremely efficient energy conversion. Fuel cells with reformers offer a possible solution for the generation of heat and electricity on ships. Syngas can be reformed from the exhaust gas produced during the combustion of a hydrocarbon. Unlike internal combustion engines, when the reformate is converted in the fuel cell, no particulate matter is produced. Furthermore, due to low operating temperatures, only negligible quantities of nitrogen oxide are produced. The result: a greenhouse gas footprint that, based on efficiency alone, offers at least a 25 percent improvement over generators driven by internal combustion engines.

Simplified Design

To comply with emission regulations, diesel generators require various ancillary equipment such as particulate filters, catalytic converters, silencers, and exhaust gas monitoring systems. "With fuel cells, all of this is unnecessary," explains Keno Leites, Project Manager Fuel Cell Application at thyssenkrupp Marine Systems. Furthermore, as fuel cells do not emit sound or vibrations, vibration mounts and sound enclosures are no longer required. The mechanical design of a fuel cell is relatively simple, and it requires only slightly more space than a diesel engine unit.

Initial Milestones

A demonstrator with a rated output of 50 kW, including energy storage, was built to verify the concept. It can be used to validate corresponding safety concepts, process operation and seaworthiness. Currently, automation is decentralized and structured according to existing classification rules. Therefore, subsystem reformers, fuel cells and energy management each have their own controller system, including alarm management and an additional safety controller. A higher-level control system communicates with the ship and controls the energy management system for feed into the electrical system.

However, in the future, thyssenkrupp intends to integrate automation into one system, including carrying safety functions via the operational bus. "In contrast to other industries, integrated automation solutions are not currently permitted in shipping," explains the project manager. Together with Bachmann and the DNV GL classification society, a proposal to this effect has been drawn up and submitted to the International Maritime Organization IMO by the German Federal Ministry of Transport and Digital Infrastructure. "We will implement our solution as soon as we get the green light," Leites confirms.

Future Integrated

The automation solution developed with Bachmann makes it possible to integrate all subsystems into one controller system. For Leites, this is crucial: "This gives us a transparent software architecture with just one alarm system, hardware diagnostics for the entire system, and simple communication between subunits." On the M1 controller, all applications can be processed in parallel and independently of each other. Even the safety controller can be integrated as a separate hardware module. It tunnels the existing network via a certified 'black channel'.

Scaling is also simple: If higher performance is required, hardware can be centrally or decentrally expanded, and the appropriate number of software modules are instantiated and assigned to the hardware. "In this way, a system that has already been validated can easily be scaled and smoothly put into operation," says Leites, describing one of the most important advantages of the envisaged automation structure. The diverse interfaces of the M1 automation system also allow integration into a wide variety of ship automation systems, thus opening up a wide range of applications for the comprehensive solution.

Only Advantages

According to Keno Leites, the integrated solution provides application reliability and scalability, reduced space requirement and significantly lower cabling costs. He is convinced that with series production, the current cost advantage of diesel units will be significantly reduced. The results also showed that the fuel cell generates enough energy for the on-board network and is even sufficient for low-level propulsion. The reduced emissions also enable ships to call at ports with stringent limits.

THYSSENKRUPP MARINE SYSTEMS

– Part of multinational group thyssenkrupp

– Located in Kiel, Hamburg, Bremen and Emden

– 175 years of shipbuilding experience

– Global market leader in conventional submarines and a leader in the development of new surface and underwater technologies for the naval sector

www.thyssenkrupp-marinesystems.com

»We start with the science, not the business model.«

OUTLIER IDENTIFIED!

The failure of a wind turbine is expensive; even more so when it happens unexpectedly, or when the turbine is installed offshore. Such failure events must be prevented with every measure possible. Quantitative and qualitative recording of property-related condition changes, within clusters of turbines, enables the detection of turbine anomalies and the initiation of timely interventions.

Many wind turbines today are installed with in-built condition monitoring systems, while other operators consider retrofitting. In most cases, these systems monitor the drivetrain. However, demand for blade condition and tower structure monitoring is also increasing. Typically, such systems must be separately installed and tailored to individual tasks. Bachmann broadens this horizon: With software for one-off historical and continuous real-time analysis for any group of plants, vibration data from drivetrain monitoring can also be used to draw conclusions about critical changes to the plant structure – without having to install any additional sensors.

Making the Invisible Visible

"We are opening up a whole new dimension of monitoring," says Kirsten Larson, Key Account Manager at Bachmann Monitoring. "We can now separate spectra to such an extent that we can assign vibrations to their origin, as in: what comes from the drive train, and what has a different trigger." Using computational techniques alone, it is therefore possible to identify anomalies from existing vibration data and even assign them to a par-

ticular time. For this task, Prof. Michael Schulz's team uses complex mathematical algorithms and ultimately, in simplified terms, projects coordinates onto a visually detectable, two-dimensional plane to visualize the concrete behavior of a wind turbine. With the appropriate expert knowledge, these graphics can then be analyzed empirically or according to geometric statistics.

Detecting Outliers

In a pool of identical wind turbines at a wind farm, these particular vibration history analyses reveal 'outliers'. Various use cases become immediately apparent: Damage can be detected, and the effectiveness of repairs confirmed. In addition, indicators could be defined over time, for example, which enable conclusions about structural degradation. "And all of this is achieved via condition monitoring, without additional sensor technology, and without having to visit the plant," says Kirsten Larson, emphasizing what is almost certainly the most important advantage. "If a plant is behaving differently to others, targeted servicing can be implemented, avoiding serious damage and equipment failure."
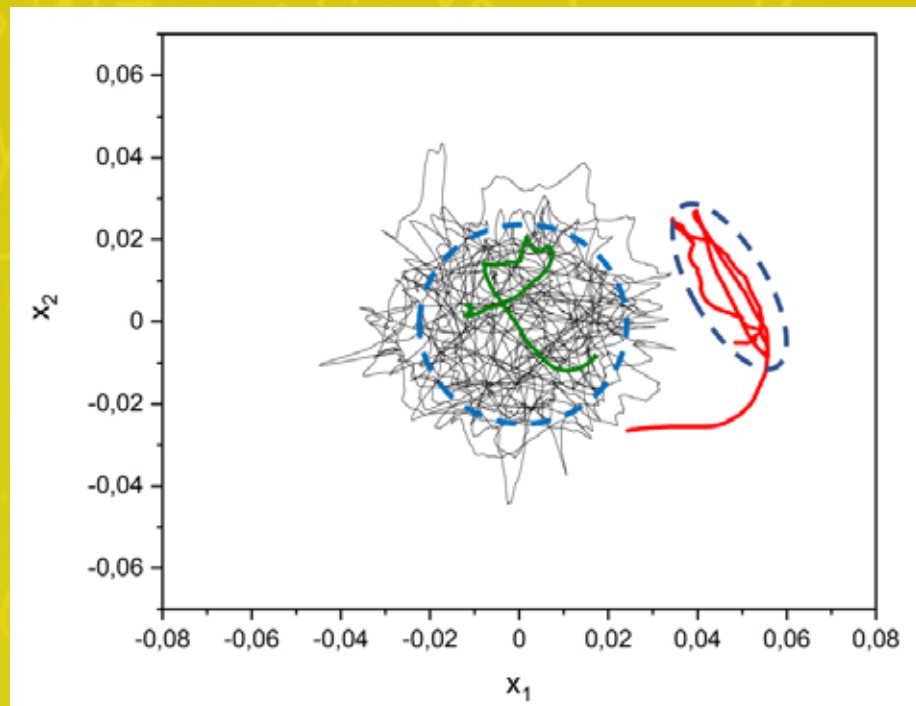
Clear illustration: The analysis shows a different behavior for 1 turbine (red) compared to the other 21 wind turbines in the cluster.
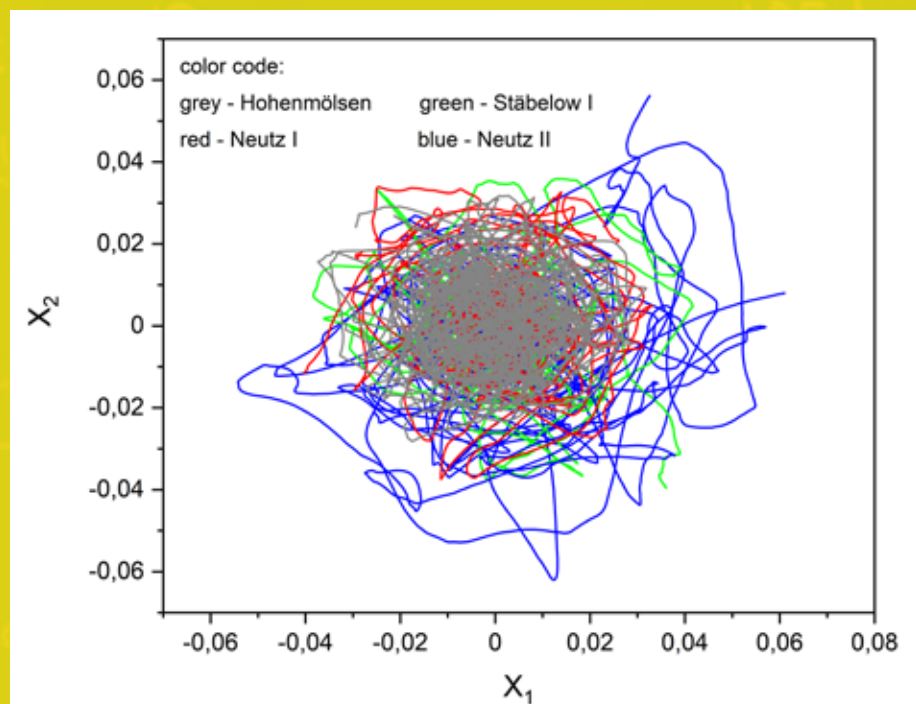
Easy to recognize: The wind turbines of one wind farm (blue, 'B2') show different structural behavior after a longer operation phase compared to identical turbines in three wind farms at other geographical locations.

ON THE HOME STRAIGHT – INNOVATIVE AUTOMATION IN SHIPBUILDING

Set against a backdrop of ever-increasing complexity, the maritime Module Type Package (MTP) standard aims to reduce required time and effort for the set up and commissioning of modern, on-board ship automation. The MTP standard should also provide better error protection.

At Flensburg University, use of the MTP standard for cross-platform interaction between automation components from different manufacturers has now been successfully tested for the first time. Prof. Dr. Eng. Michael Thiemke from the university's Maritime Center provides an insight into current developments and explains why the long journey will be worthwhile.

The Maritime Center at Flensburg University of Applied Sciences (MCFL) operates two research engines with numerous associated subsystems from different manufacturers. For many years, the university has relied on Bachmann's automation and visualization solutions to operate this complex plant. Prof. Thiemke, responsible for the marine engineering research site, explains "We work with MATLAB®/Simulink® at our plant. Bachmann was therefore our first choice for the automation system. This enabled us to cost-effectively and significantly improve our measured value processing."

Multiple Platforms – One Standard

Today a wide range of Bachmann controllers already use SCADA servers for communication within a complete system. Sub-areas of the MTP standard, such as the use of eClass objects, are already successfully employed. For the maritime MTP, however, there are not yet any examples of cross-platform controller applications for real plants. The MCFL aims to change that: The goal of the research site is to use MTP to implement an automation network with numerous components from different manufacturers as com-

prehensively as possible. Michael Thiemke is convinced that the standard offers enormous potential for the industry: "The maritime MTP standard will help shipbuilding companies to achieve significantly higher speeds in engineering, commissioning, and integration."

Milestone After Milestone

"September 2021 was the first time we successfully integrated AML files and dynamic data from a third-party controller for an exhaust gas recirculation (EGR) system into a SCADA system with overall system integration," reports Sven Neumann, Application and Support Manager at Bachmann. This supported the fundamental principle of platform-independent interaction between automation components from different providers.

Another important step was the concept of using the MTP standard for combustion engines. Numerous ideas were developed and discussed by experts at the university and in the VDMA working group. "This concept will be implemented as part of the remote control of our new gas engine in the coming months," says Prof. Thiemke. A key aspect of applying MTP to engines, he said, is to examine the management of purchased components, installed on an engine and integrated into the engine manufacturer's controller system. Currently, the integration of a measuring system for bearing and oil monitoring into a higher-level engine MTP is being implemented and tested on the MCFL's gas research engine.

Important services in the MTP standard, with which individual process functionalities are described, have also been considered in the engine MTP and for remote control of the entire plant. The concepts developed for the appropriate consideration of different operating conditions will also be implemented and carefully tested on the new test rig in the coming months.
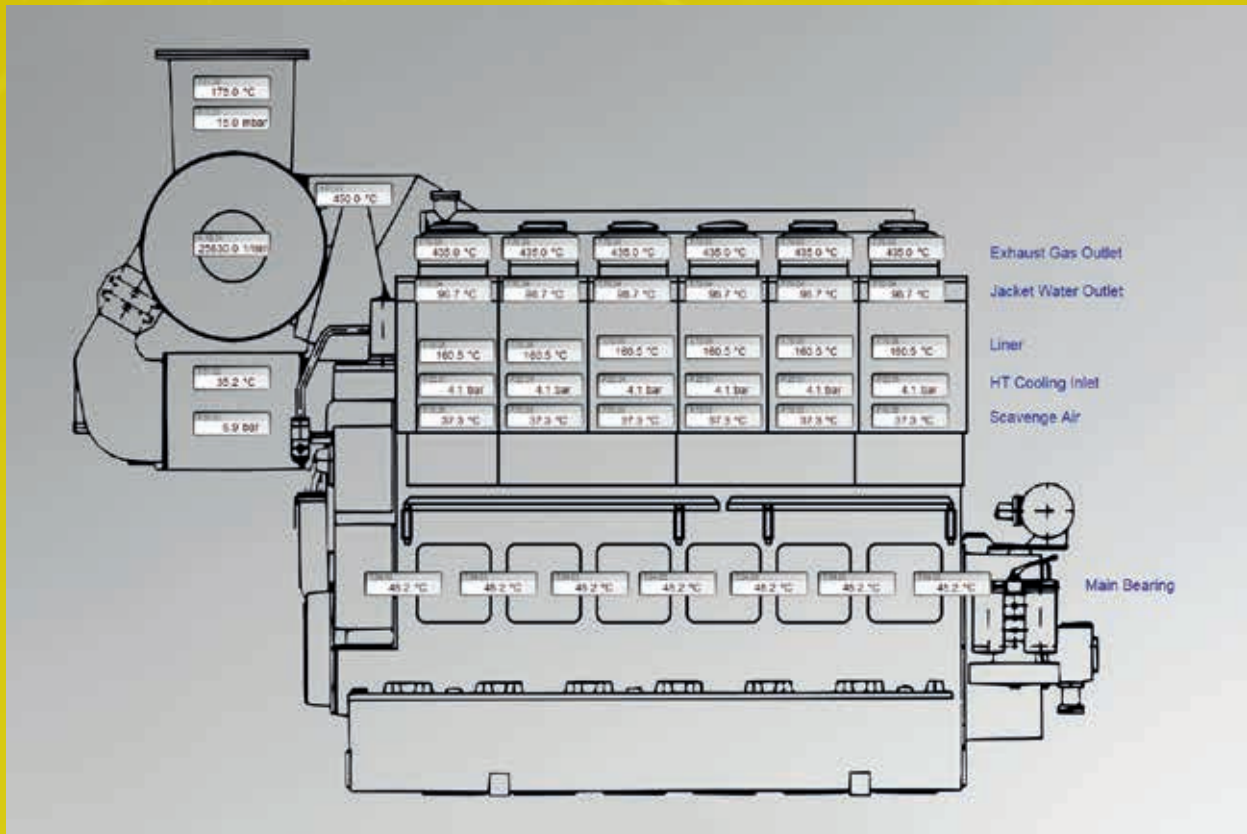
»The MTP standard will help the maritime industry achieve significantly more speed in engineering, commissioning and integration of automation solutions.«

Prof. Dr. Eng. Michael Thiemke
Maritime Center of Flensburg
University of Applied Sciences (MCFL),
responsible for the program of
studies in ship technology

"Module Type Package (MTP) for Marine Engines:
Application of the emerging maritime automation standard", Bachelor thesis
at HS Flensburg, 2020 (Image source: Bengt Ole Scheffler).

According to Prof. Thiemke, another important milestone is the newly-demonstrated possibility of largely automated export of AML files directly from the Bachmann development environment. These files contain static MTP information to be stored on the SCADA server. "Only with this new feature is it possible to generate MTPs with relatively little effort and sufficiently error-free for commercial applications," says the head of the research site. Additional tests with controllers from other manufacturers are planned at the MCFL in the coming months.

Useful Experience

Tests completed on the real machine at the MCFL provide important findings, which have been incorporated into the recently-drafted VDMA standard sheet on the MTP standard. In the development of the EGR control system, for example, solutions were required for an

uninterrupted change of operating modes. The integration of external sensor signals into an MTP module has also been discussed at the MCFL. Prof. Thiemke emphasizes the importance of testing at the university's research site: "Experiences like these enable manufacturers outside the VDMA working group to deal with the new standard in sufficient detail themselves." Due to the intentionally close alignment with the existing process technology standard, companies operating in both industries do not need parallel structures to comply with the maritime-oriented MTP. As Prof. Thiemke explains "This should benefit both the elimination of application errors and the efficiency of the introduction of the maritime MTP standard."

Small but Subtle Differences

Despite many parallels between the two industry MTP standards, the research also revealed different

The MCFL's new gas research engine:
Within the framework of remote engine control, the concept
for use of the MTP standard will soon be implemented.

requirements: "We noticed a major difference from the typical process technology MTP when we tried to transfer an overview of our engine in the usual way using eClass symbols via an AML file," says Prof. Thiemke. Typically, when transmitting according to the standard, image information is omitted. While in the maritime environment, the transmission of display fields and their position is successful without any problems, essential information on their assignment is lost without an image. The transmitted data would not lead to a satisfactory result without tedious reworking by the system integrator.

For the maritime MTP standard, it was therefore recommended that the required image information be supplied in the form of a background image as an attachment to the MTP file, thus making it much easier for the system integrator to carry out the necessary rework.

Working Together for Rapid Implementation

According to the experts, certain detailed questions surrounding the standard will arise only as the number of real applications increases. Nevertheless, the concrete implementations at the research site in Flensburg have already demonstrated that a maritime MTP works. Bachmann is at the forefront in the development of technology for MTP implementation. As Prof. Michael Thiemke explains, "Bachmann's MTP solutions have moved significantly towards market readiness in recent months. We hope that other shipbuilding companies will also quickly recognize the advantages of the standard and that targeted demand from further customers will accelerate the development and market launch by various suppliers on a large scale."

»Greater user benefits call for more intricate technologies.«
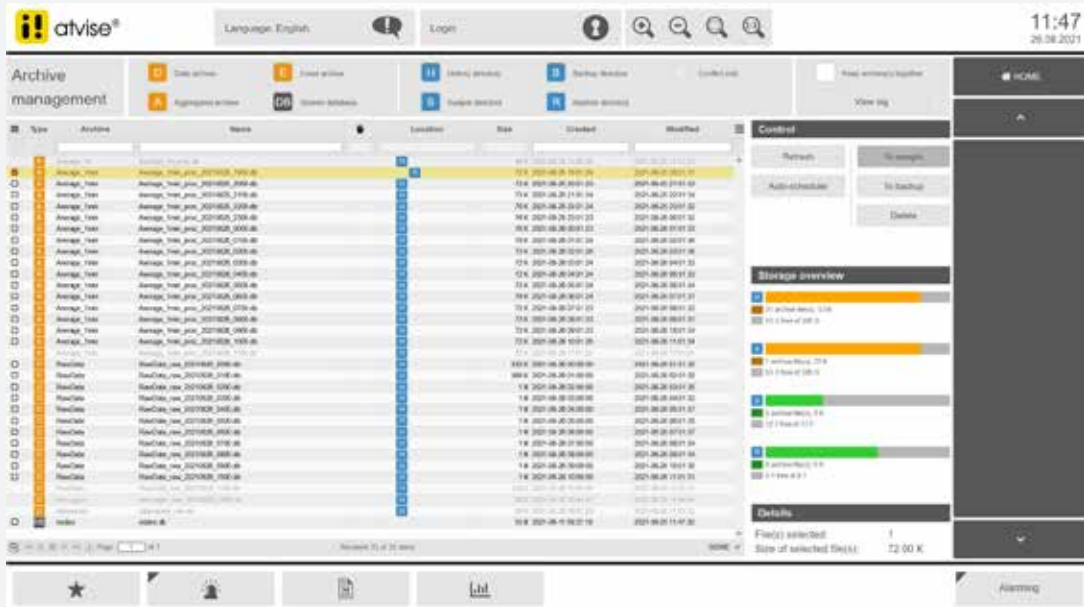
Long-term project archiving made easy with new archive management.

HMI AND SCADA: NEW FROM atvise®

The atvise® platform has been equipped with numerous new features since version 3.5 – ensuring increased control, flexibility and security in engineering.

Complete Regulation with Access Control

The brand new atvise® 3.6 provides increased security for visualization projects with improved access control. Permissions can now be assigned and edited efficiently at a granular data point level. Access rights can be flexibly adapted to the respective application: For simpler applications, the same permissions can be assigned for the entire project. For more extensive applications, permissions can be adapted to meet the specific needs of individual project areas.

User access to visualization and engineering areas can be determined independently, and rights can be nested and inherited. If, for example, an existing project is expanded at a later date, existing access rights can be transferred to any new machine additions and extended as required.

Complete Overview with Extended Version Management

Since the release of atvise® 3.5, the version control import and export interface has ensured complete transparency in any adjustments to atvise® projects. These can be easily assigned a version with tools such as Git or SVN, making every change visible in a traceable history. In addition, this function facilitates variant management for different project versions, enabling components to be efficiently exchanged within a team. Upon release of a project update, it can be imported into the live atvise® project without interrupting ongoing operations.

Complete Reusability thanks to Separation of Graphics and Logic

atvise® 3.5 also enabled the separation of graphical elements and logic blocks, allowing atvise® users to undertake component-based engineering. This enabled generated dynamizations to be used as central logic components for several graphical objects. Changes to a centralized logic component have an immediate effect on all referenced graphical objects, saving valuable time in visualization project implementation and maintenance.

Complete Security with Archive Management

From atvise® 3.5 onwards, archive management enabled simple, long-term archiving via the atvise® interface. Archives can be stored manually or cyclically on an external storage system without any additional programming. They can be recalled again at any time to create evaluations or data analyses. This allows users to select their preferred archiving strategy and to control the amount of actively stored data in the runtime system.

Complete Synchronization via OpenID Connect

The upcoming atvise® 3.7 will enable atvise® to connect with identity providers via the new OpenID Connect interface. OpenID Connect allows user roles and rights to be managed centrally and superordinately. atvise® automatically assumes control of runtime authorizations via the interface. Server-side scripts make numerous additional authentication solutions available.

More on this topic is provided on our website

GRID PROTECTION: HIGH VOLTAGE

The GMP232 series measures and monitors three-phase electrical networks. It has been consistently designed to meet the needs of decentralized generation plants for application at the point of common coupling. Integrated into the M1 automation system, the new GMP232/52 offers direct connection for nominal voltages of up to 1000 V.

Higher generator voltages make it possible to generate more power from wind turbines and other units, independent of the technical and personnel requirements of the medium- and high-voltage range. The grid measurement and protection module maximizes safety and is fully supported by the European EN 50549 grid protection standard.

Proven Solution

The success of the GMP232 modules speaks for itself: its combination of robustness and measurement accuracy is second to none. Power quality parameters such as harmonic spectrum, distortion factor or asymmetry are automatically determined by the module, along with statistical power system parameters. The sophisticated real-time data recorder stores time sequences with resolutions of up to 10kHz when monitoring functions are triggered, enabling the retrospective reproduction and analysis of faults.

Higher Power and Enhanced Network Fault Diagnosis

The new GMP232/52 supports nominal voltages up to a medium-voltage limit of 1000 V. When the generator voltage is connected directly to the protection module, potential power increases by around 45% compared to the 690 V version. And with the current unaffected, cabling costs remain unchanged. Power can also be increased in existing systems without cabling modifications. The new version's wider measuring range of up to 1,500 Vrms and 5 Arms increases robustness and aids comprehensive network fault detection – clearly assigning causes, as well as the cost of any damage.

Improved Overvoltage and Overcurrent Parameters

The GMP232/52 is designed for rated surge currents of 250 A for 250 ms and rated short-time currents of 100 A for 1 second. The module is overvoltage category III compliant across the entire nominal voltage range, and overvoltage category IV compliant up to 600 V. In addition to the wide selection of parameterizable decoupling and intrinsic protection functions, the module also offers new voltage protection functions in accordance with EN 50549-2:2020 for floating 10-minute average voltage, along with negative sequence, zero sequence and positive sequence voltage. The GMP252/52 facilitates operating license procedures and unit certifications according to the latest European generator connection standards.

More on this topic is provided on our website

WebLog Expert®: SIMPLE, HOLISTIC MONITORING

With Bachmann's new CMSSHM plugin for controller-integrated monitoring software, WebLog Expert® now supports Structural Health Monitoring (SHM) for wind turbines. Intelligent algorithms enable the use of drivetrain monitoring data to monitor structural condition without any additional sensors.

WebLog Expert® paves the way for holistic wind turbine monitoring through the visualization of SHM characteristics. Structural damage can be detected earlier, optimizing inspection cycles, and significantly extending the service life of wind turbines.

WebLog Expert® receives characteristic values from the new CMSSHM plug-in for Bachmann's CMSSTD controller software, and a finite element model is used to create a digital twin of the plant. This continuously calculates motion, natural frequencies, and structural loads, allowing WebLog Expert® to display the estimated remaining service life of the plant. Ongoing fatigue cycle recording can then be linked to damage events such as strong gusts of wind, which enables the optimization of turbine operating mode.

Current structural health can be assessed using a single acceleration sensor from the existing drivetrain monitoring system. A set of sensors, distributed across the turbine, provide an even more precise insight into plant condition. Bachmann's monitoring solution supports signals from a wide range of sensor types and systems: inclination, cantilever, humidity and temperature sensors, as well as strain gauges, counters, and information from the SCADA system.

Characteristic values are displayed with comprehensible graphic and trend functions. WebLog Expert® also supports the automated generation of SHM characteristic reports based on individual templates, reducing the time required for daily analysis.

The first three individual modes (top) and the fatigue cycle Rainflow count (bottom) indicate remaining system life.

INTELLIGENT SENSORS:
ICE FREE?

The robust CLS300 Cantilever Sensor continuously and precisely records structural loads on wind turbine rotor blades. With this measurement data, individual blades can be independently adjusted to maintain an optimal position and reduce loads as they occur. Using intelligent algorithms and Bachmann monitoring software, the sensor enables a wide range of new application possibilities. Already in development: reliable ice detection for automatic restarts.

Extreme Load know-How

Critical ice mass detection, based on the structural dynamic behavior of rotor blades, requires not only precise sensors, but also sophisticated algorithms to reliably evaluate measurement data. To validate these algorithms, Bachmann is currently performing extensive testing under harsh, frozen conditions around the world, including in Canada and the Czech Republic.

Robust Algorithms Through Simulation

Certain extreme operating conditions are difficult to recreate through field testing. To optimize detection algorithms, Bachmann's experienced wind experts also carry out structural simulations with various blade loads in different operating situations. In contrast to field testing, this enables ice formation to be simulated with kilogram precision. Algorithm sensitivity can then be precisely analyzed and optimized. Simulations can also be used to precisely calculate the effects of particularly strong mass imbalances or high turbulence in the wake of neighboring turbines. This minimizes interference and ensures replicability as required.

Increased Production

When ice is reliably detected, systems can be stopped automatically, and existing de-icing equipment used in a targeted manner to remove hazards. If the absence of ice can be clearly confirmed below the start-up speed of the plant, then plants can be automatically restarted earlier to increase production and automatically deliver back into the grid –

provided that the ice detection system and its connection with the plant control system are certified for restarts. This also eliminates the need for time-consuming, on-site visual inspections following ice-related stoppages.

Sustainable Cost-Reduction

The intelligent algorithms behind Bachmann's monitoring solution use CLS data to precisely detect ice on individual blades, even without external SCADA data such as rotation speed, power or wind speed. This eliminates the need for error-prone SCADA signals from the plant controller.

The Bachmann CLS uses industry-standard distance measurement without optical-electrical transformation of the measurement signal, which reduces system operating costs. Thanks to its robust, non-contact design, the sensor is not affected by blade deformation. This makes it hard-wearing and stable in the long term, minimizing repair and failure costs.

Furthermore, simple and replicable installation in the blade root area is possible without adjustment. This reduces installation time and the cost of commissioning, as well as increasing the reliability of installations.

One Sensor for All

Finally, synergies arising from the intelligent combination of CLS applications remove the need for separate load detection, ice detection and structural monitoring subsystems.

More on this topic is provided on our website

PROFISAFE: A WORLD OF SAFETY

Bachmann's PROFIsafe (F-Host) completes the M1 automation system's fully integrated safety package. The secure communication solution can be incorporated into existing safety solutions as a software extension.

Gate Box   Rotary Encoder   Safety light curtain   Drive
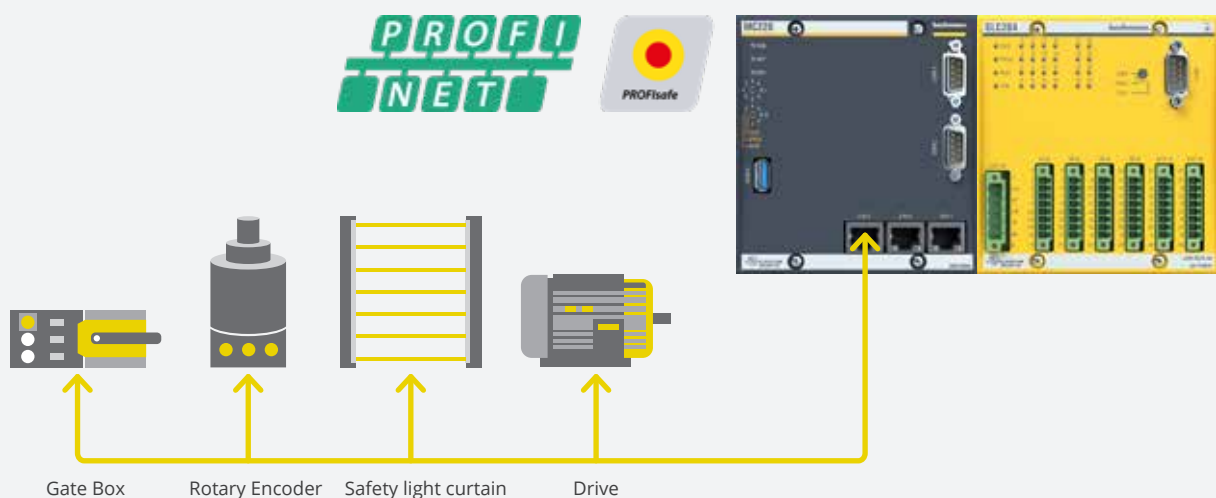
No additional hardware required: The PROFIsafe gateway is a software-only solution for Bachmann's standard CPUs.

Bachmann's SLC284 safety module, secure digital and analog I/O modules, and new PROFIsafe F-host combine to provide a holistic automation solution – and one that is fully compliant with Machinery Directive 2006/42/EC. The M1 automation system's complete component integration enables the construction of individually-expandable safety solutions in accordance with the latest safety standards. A comprehensive selection of task-specific, PROFIsafe-compatible sensors and actuators offers additional functional safety solutions. The wide range of components includes safe absolute encoders, drives, laser scanners, safety switches, vibration sensors, inclination sensors, PROFIsafe gateways, and much more.

Coded Processing
The PROFIsafe gateway is a software-only solution and is fully compatible with almost all Bachmann CPUs. This ensures that existing safety applications can be easily and safely expanded, without additional hardware components.

Straightforward Integration
As with all other Bachmann safety modules, PROFIsafe devices can be fully integrated into safety controllers. PROFIsafe connections can be configured without programming using Bachmann's intuitive PROFINET configurator. A Tool Calling Interface (TCI) up to class 3 can be enabled for external device configuration tools.

Functional Safety
State-of-the-art software technology makes it possible to integrate a functionally secure F-Host gateway alongside existing safety modules on Bachmann's proven standard CPUs. Compliance with Safety Integrity Level SIL3 / PL e / CAT 4 standards ensure all mechanical engineering safety levels are met.

More on this topic is provided on our website

POWER PLANT CONTROLLER:
BALANCING ENERGY MARKET CERTIFIED

Our Smart Power Plant Controller (SPPC) has been equipped with a range of new functions – all fully certified to VDE-AR-N 4110/4120. This facilitates participation in the balancing energy market whilst also reducing the cost of certification.

In Germany, the VDE-AR-N 4110 standard requires certified controllers at the point of common coupling at all energy parks with a capacity of 135 kW or higher. The standard ensures grid stability by regulating interactions between the park and the grid. Our VDE-AR-N 4110/4120 certified power plant controller supports heterogeneous parks with up to 100 individual Power Generation Units (PGUs). Modular hardware and clear visualizations help make the SPPC a robust, expandable energy park controller.

New Functionality
The SPPC's certified functions go far beyond the minimum requirements of VDE guidelines. Supporting primary control for the provision of frequency-dependent active power, the controller enables power plant prequalification along with the potential for subsequent balancing energy market participation. The SPPC's component certificate also includes active power adjustment during overfrequency or underfrequency (P(f) characteristic). Certification costs are reduced as the function does not have to be installed in each individual PGU. In addition, the controller enables connection to older generation units, increasing functionality across the entire plant.

Certification requirements are also reduced through the SPPC's central control over automatic grid reconnection following PGU decoupling protection.

Together these functions increase grid connection flexibility and create opportunities for additional revenue generation.

In addition to the certified functions, the SPPC also offers integration of non-controllable loads and external components such as reactive-power compensation systems and the event system, along with freely configurable data historization. The updated user interface for configuration and operation visualizations provides an improved overview of project planning and operations.

Ready-to-use plant certification simulation software (MATLAB®/Simulink®), rights management according IEC 62443, and multilayer security architecture for protection against cyber-attacks complete the package.

Redispatch-Ready
In Germany, from October 2021, every PGU of 100 kW and above will be required to use Redispatch 2.0. The process requires transmission and distribution system operators to provide plant schedules based on extensive forecasts and is intended to reduce grid bottlenecks, minimize overall energy distribution costs, and guarantee grid security.

The SPPC can function as an interface for Redispatch 2.0 via multiple supported communication protocols. For targeted prioritization, PGUs can be grouped by energy type, grid operator and logical cluster in the plant controller.

The latest version of the Smart Power Plant Controller supports the P(f) characteristic.
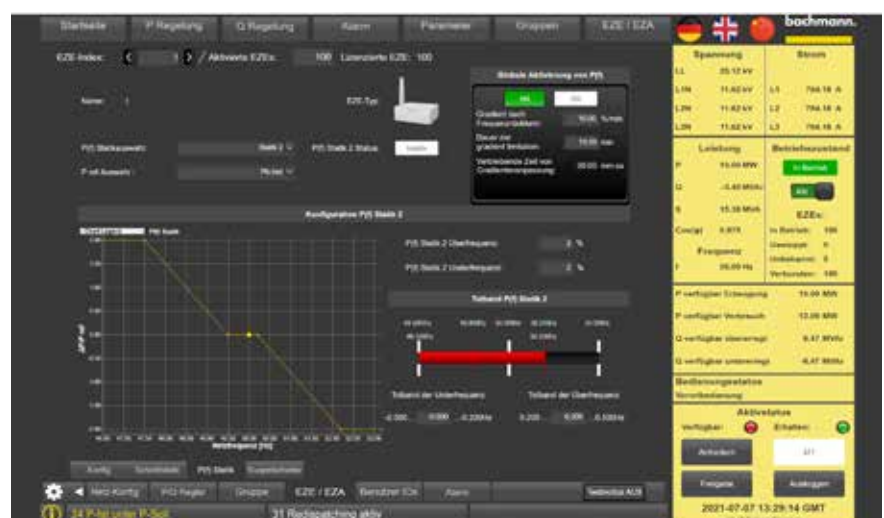
More on this topic is provided on our website

STABLE POWER SUPPLY: ACCURACY IN THE UK

The UK wants to move away from fossil fuels and towards renewable energy. However, the volatile nature of renewable energy causes faster frequency changes in the grid, with a knock-on effect on grid stability. The GMP232/x detects even the smallest frequency deviation at the feed-in point, therefore maintaining a constant frequency and meeting the stringent requirements of the UK's National Grid ESO.

National Grid ESO has strict specifications for grid measurement equipment: to enable the fastest possible frequency balancing in the grid, Dynamic Containment requires a measurement accuracy of ≤ 1 mHz.

For many project developers, our comprehensively certified GMP232/x, is the perfect solution. The grid measurement and protection module measures both frequency with dynamic event suppression and averaged frequency over a specified duration - all with an accuracy of ≤ ±0.001 Hz. The module also accurately measures current, voltage, power, power factor and phase angle.

Grid events are recorded as CSV files for National Grid ESO at 50 ms intervals with globally synchronized time stamps. Any deviations can be reliably assessed in relation to other measuring points.

Configurable digital protection functions ensure compliance with grid connection conditions and enable comprehensive plant self-protection. Complete controller integration facilitates simple installation and commissioning.

The new GMP232/52 will soon be released in response to the steadily increasing power requirements of wind turbines and will support directly connectable nominal voltages of up to 1000 V. It therefore keeps cabling material costs low despite additional power. Find out more on page 53.

SIMPLY PRECISE
GMP232/x

More on this topic is provided on our website

MTP AND OPENBRIDGE: READY FOR THE FUTURE OF SHIPBUILDING

Maritime vessels comprise numerous systems from a wide variety of manufacturers. The result: thousands of discrete communication signals, a multitude of different interfaces, and significant programming work during commissioning. This increases susceptibility to errors and the risk of information loss during documentation. In addition, inconsistent visualization solution structures make it difficult for the bridge to maintain a complete overview.

Bachmann has eliminated these problems by co-developing and supporting the Module Type Package (MTP) and OpenBridge software standards.

Simplification at Every Stage of the Value Chain
The MTP description format standardizes communication between systems and management on ships. "With MTP we are pursuing higher speeds of engineering, commissioning and integration. This will ultimately lead to more accurate project schedules and will significantly reduce the Total Cost of Ownership," says Burkhard Staudacker, describing Bachmann's goals. The Key Account Manager believes that the standard is a major step forward for the maritime industry towards Industry 4.0.
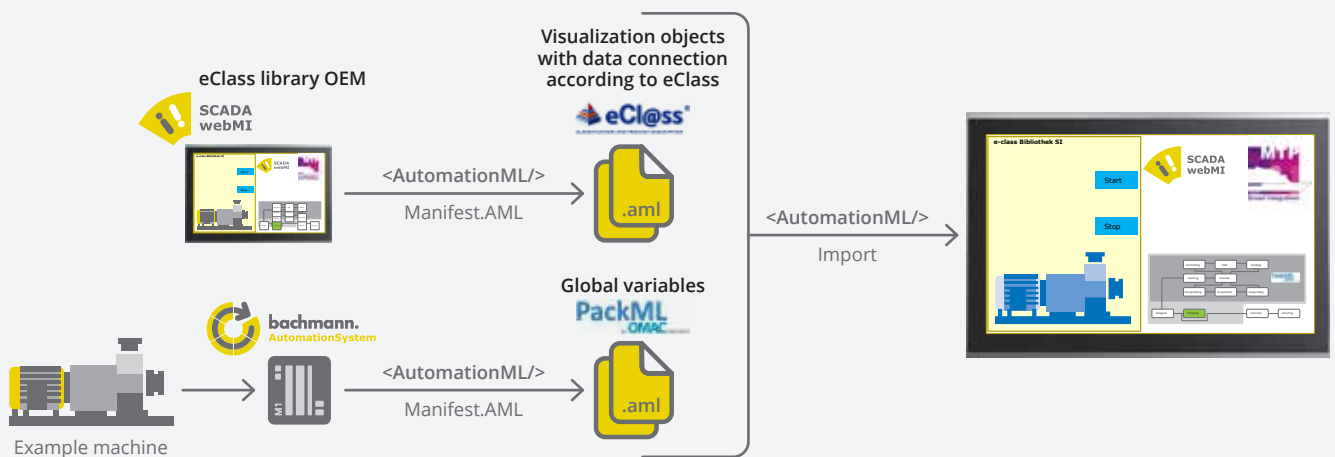
Simple and safe retrofitting: Standardized, exportable automation and visualization data enable the rapid import of new third-party systems into existing visualization applications.

Through a VDMA working group, leading manufacturers are jointly developing the maritime standardization project based on the MTP process technology standard. The group includes experts in ship automation technology, mechanical engineers, system integrators, shipyards, owners, universities and institutes. Developing an acceptable standard for the entire shipbuilding industry is a challenge, says Staudacker: "With this approach, we are aiming for maximum acceptance; concrete benefit at every stage of the value chain has been part of the project from the very beginning."

Thanks to MTP, manufacturers of subsystems such as thrusters, gearboxes, or separators can easily provide their SCADA systems with application visualizations and interfaces. The know-how always remains with the manufacturer: "Import into the control system only involves the interface, and not the entire program," reassures the Key Account Manager. In addition, it is now possible to achieve complete system approval during the Factory Acceptance Test (FAT), including electrical interfaces – eliminating the need for a second commissioning onboard the ship.

System integration reduces the cost of automation system engineering and visualization, as well as commissioning. It also saves time at the shipyard: "Module testing by manufacturers means that the majority of signal tests are no longer required during cruiser commissioning – a labor intensive process that typically takes around four months," explains Burkhard Staudacker. Owners can expect a significant increase in investment security. Unified communication with MTP simplifies the retrofitting and implementation of new systems from other suppliers: "It's as easy

as installing a printer in the office – the machine can be operated immediately," says Staudacker. Lower susceptibility to errors during engineering and commissioning also significantly reduces service costs.

Next Generation Maritime Workstations
To relieve the bridge crew during daily operations, atvise® scada supports visualizations based on the OpenBridge framework. This delivers a simple, clear and consistent design, intuitive interactions and reusable components. The free, open-source design guide pursues the development of safe and efficient maritime workplaces and accounts for international shipbuilding regulations.

The numerous OpenBridge elements in atvise® scada enable screen interfaces to be easily adapted with widgets during system operation. Building blocks such as main engine data, rudder position, azimuth, thruster, and various other display and control elements facilitate completely customizable interfaces with easy-to-place elements. Safety is also at the forefront: clearly assignable alarms allow the initiation of targeted measures. For crew, the uniform interface reduces familiarization time when changing ships, as the look and feel is very similar.

Stronger Together
The combination of the MTP and OpenBridge standards ensures flexible, fast and safe engineering in the maritime industry and provides highly reliable systems. Burkhard Staudacker is certain: "These open standards enable us and our partners to combine our strengths and work together on better solutions for the future. In turn, this will maximize results for the entire industry."

More on this topic is provided on our website

»Communication with people is what leads us to fascinating new ideas.«

SOMEWHERE TO LEARN AND DO BUSINESS

Gert Jan Huisink and Pelle de Jong have been active in the shipping and maritime industry for decades. Convinced that problems are solved better together than alone, the two Dutchmen set up a platform that enables maritime professionals to share knowledge and experience in an entertaining and engaging way. We spoke to Gert Jan Huisink about the creation, ideas, and goals for their initiative: the LISA community.

Gert Jan, what motivated you to set up the LISA Community?

The initial idea goes back a few years, to when we had just finished a trade fair. Pelle and I found that we could only meet a fraction of the companies that interested us, without enough time for a real exchange of ideas. We asked other exhibitors and customers if they felt the same way. Unsurprisingly, their response was overwhelming agreement. So, in 2018 we began a pilot project: a small, high quality business event called 'Maritime 24', where shipowners and suppliers could build relationships and share information during a 24-hour program. Completely informal, no business suits – just open discussions and personal connections. The resulting momentum was sensational, and since then we have arranged these events twice a year. But we kept asking ourselves, how can we take things further and not wait six months for the next ses-

sion? So, knowing full well that we wanted to reach people in their everyday lives, few of whom knew what a 'community' was, and who were not particularly online-savvy, we started developing an online community.

How did you get started? And where is LISA today?

We started talking to shipowners and asking how we could help improve their employee performance in a fun and effective way. In April 2020, we launched the LISA platform, a place of learning for professionals to grow. Pelle and I are in complete agreement here: if you want to learn, you don't need to go to school. Knowledge can come directly from your environment – from colleagues, suppliers, or customers. After all, we all have the same goal – for ships to sail reliably and safely. So, together with three shipping companies, we wanted to see if an online environment could be used to help train and develop employees.

That is actually one of our industry's greatest challenges: very limited options for highly-specific job profiles. And that's why we launched LISA.

If I wanted to describe the heart of the community, I would say that it brings people together to share experiences and insights, knowledge and ideas, and also helps them to be successful. If you look at LISA today, there are now dozens of smaller groups in which people meet online on a regular basis to do just that.

What does LISA actually stand for?

(Smiles) That was actually just our internal project name. An abbreviation that stood for "Learning and Improving in Shipping App". While we were building the platform and contacting the various stakeholders, we used the name LISA. Everyone became quite familiar with the acronym, so we kept it on as our name.

How did you initially attract people to LISA? Is it a closed community today?

Through Maritime 24 we already had addresses, and of course we used our network of contacts. We started with around 300 members; today over 2,500 are registered with LISA. Essentially, the platform is open to everyone and is free to use. At the beginning, however, we ask a few questions to make sure that only those with an interest in the maritime industry register on the platform, as that is our focus.

Last year the platform hosted over 250 online events, some of which were exclusive events for closed groups. These can be associations with membership requirements or so-called mastermind groups, whose members have to hold a certain position within our industry. This helps them to open up and share their current challenges.

In 2020, in the midst of the corona pandemic, you launched LISA. Did this benefit the launch?

Corona helped us in that everyone can now use conferencing software such as Microsoft Teams or Zoom. What was completely alien a few years ago is now common practice. Such profound changes to our everyday work highlight the value of community. For example, a shipping company's crewing department consists of only a few people who had to react quickly to the global impact of the pandemic:

traveling, crew changes, outbreaks, tests and so on. For them, LISA was a blessing. Every week we held a mastermind group meeting to exchange valuable insights and information. This sort of information isn't normally available; you can't just Google it. The online meetings proved to be very valuable, reducing stress and frustration. It helps to be part of a group where you know and trust each other. We create a pleasant atmosphere in which people are open and can share mutually beneficial experience.

LISA also needs to finance itself. How do you do this?

We operate a similar business model to top trade fairs. To have your own 'space' on LISA, similar to a stand at a trade fair, you must become a Premium Member. This allows you to take full advantage of the platform's features: you can set up events, organize courses and host a dedicated space to connect and exchange ideas with other members.

Equipment suppliers need customers to exist, and ship owners cannot sail without supplies, technical equipment, knowledge and services. There is a common benefit – LISA facilitates connection. We see these connections growing, increasing value for everyone involved. We might even see new financing models. The beauty is that we develop LISA together. We share and discuss ideas with our Premium Members. They are LISA's VIPs and have a say in everything we do.

What are your further plans for LISA?

Well, we've only just started. We hosted a lot of online events last year, which was great; sometimes 5, sometimes 50 people joined the conversation. It's not just about listening and consuming – members really take part and exchange information. Events were initiated by us and by our Premium Members, so ultimately by the network itself. You invite people based on a topic and then hold a discussion. It's quite simple, but it can be so valuable when you bring the right people together.

This is also how we find out which topics are important, where knowledge is lacking, and where there is an interest in development. The result could then be follow-up activities, for example a dedicated course. We want to develop this further in the future: to bring people together to learn from each other, but in a structured way. This is how you get them from A to B in several steps. But again, the most intensive learning happens spontaneously and from one another.

I have another example: if a shipowner has all their personnel on LISA, and if every crew member (officer rank and above) participates in a dedicated group course, then together they learn everything they need to progress to the next rank. Not alone, but with colleagues in similar positions. Participants learn with and from each other until they achieve the next rank. Submitting homework that your colleagues can see may be a challenge, but you learn from each other. And the best part is that this leads to continuing discussions on board about elements covered in the training. And that's great.

How are these special training courses funded?

We are looking at different business models. Some courses will only be available for a fee. If something emerges that is tailored to a particular shipping company, then that company would finance the course. If manufacturers want to deliver training, then it is up to them whether to charge or not. This is also a fun part of LISA: we experiment with different formats and see what works and what doesn't. People who want to grow within this profession should have the opportunity to do so. We don't want them to depend on their boss or their HR department.

To some extent, LISA was also a 'replacement' for trade fairs and conferences that could not take place due to the pandemic. How will this develop from your point of view?

We are optimistic. We're now considering how to combine traditional trade fairs with LISA. In the run up to a trade fair, we could host pre-events on LISA, and then afterwards attendees can use it to keep in touch with new contacts. A group can stay connected on the platform and continue the conversation beyond the event. That's the next step for us: the combination of face-to-face meetings and personal connection with a follow-up in an online environment. This is far more valuable than just a single call. The added value is not just that you can question your counterpart; the value is in bringing together like-minded people who face the same, specific challenge. It's then that being part of a group shows its highest value.

Gert Jan, thank you very much for the interview. Best regards to Pelle. And to LISA!

The LISA Community can be downloaded in the Appstore or Playstore, or accessed online: https://www.lisa.community

Gert Jan Huisink (left) and Pelle de Jong, founders of the LISA Community.

»The more we learn, the fewer mistakes we make, the less time we waste, the less frustration we have in our work, the more effective our cooperation and business becomes.«

Gert Jan Huisink
Founder of the LISA Community

$$\begin{pmatrix} 0 \\ -F_i \end{pmatrix} \qquad d\eta_j = \begin{pmatrix} \sigma_1\, d\eta \\ \sigma_2\, d\eta \end{pmatrix}$$

...ssipationstheorem $\qquad \sigma_1^2 = \sigma_2^2 / F_i$

$(\sigma_{ij}^2\, P)$

σ_{ij}^2 : Diffusionskoeff.

δ_{ij}

$$\langle dx_i\, dx_j \rangle = \langle A_i\, dt\; A_j\, dt \rangle$$

Integration über zeit

$$\int \frac{\langle dx_i\, dx_j \rangle}{dt}\, dt \to \langle x_i x_j \rangle(t) \cdot \langle x_i x_j \rangle$$
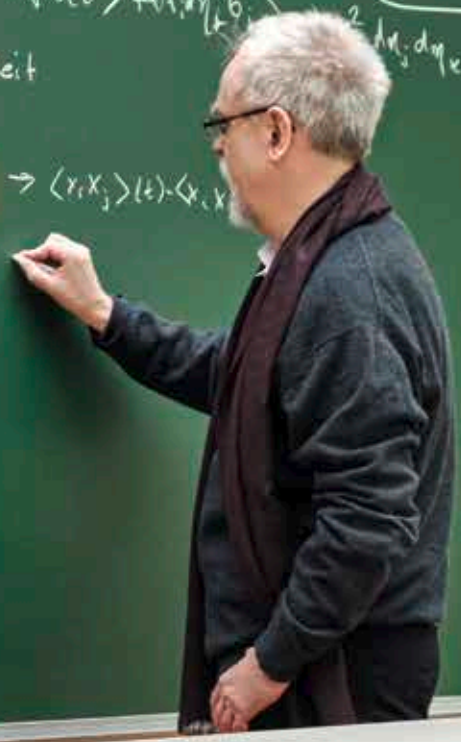
Artificial Intelligence

ALWAYS ONE STEP AHEAD

Intelligent algorithms give us an overview of our increasingly complex everyday lives. They organize, direct our attention, and make our lives noticeably easier. Prof. Michael Schulz uses them to generate a complete overview of complex machines in critical infrastructures, enabling optimal operation and lower costs for the longest possible period. The theoretical physicist talked to us about the practical applications of his decades of research, as well as his vision for the machines of the future.
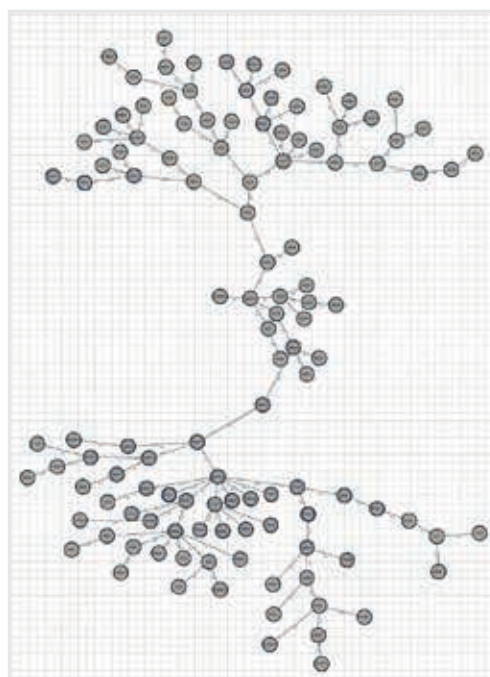
Just one of many algorithms for precise condition assessment: graphical clustering. Globally distributed plants with similar behavior are automatically grouped together. This allows conclusions about impending damage to be drawn quickly.

»In principle, algorithms are transferable to all machines with only slight adjustments. That's what makes them so exciting.«

Prof. Dr. Michael Schulz
Bachmann Monitoring

Prof. Schulz, what exactly is your focus at Bachmann?

To use a buzzword: artificial intelligence (AI). But that's stated in very general terms. In my case, it's about specific, dynamic filtering methods, which use a wide variety of data to detect deviations from the normal state of a machine and therefore better predict unwanted errors.

How can this be used in practice?

A concrete example is the graphical clustering of units that behave in a similar way, based on the measured data. This is a simple and proven way to assess whether, if one machine is about to fail, other similar machines might also fail. They don't need to be geographically close – production units in the United States might show a similar damage pattern to those in Asia, Australia or South Africa. For operators with thousands of units spread around the world, this is enormously beneficial – they can prioritize maintenance in a sensible way.

This algorithm is a self-learning system that does not need to be trained based on patterns – it just requires data with the same structure. In principle, you can also marry data of different classes, but then you need a learning system. In wind turbines, for example, this could be vibration signals from the CMS system and data from a SCADA system.

But the possibilities are virtually endless – there are hundreds of useful algorithms for condition assessment.

What motivated you to transfer your research findings to this area? What makes the topic so interesting for you personally?

The high degree of complexity fascinates me. A machine is a system that is much more complicated than our solar system. In addition, I want to contribute to current developments, such as renewables. I wanted to make the latest mathematical methods accessible to industry – to answer questions about how the condition of a machine changes due to different operating procedures, aging processes, damage by foreign bodies, or atmospheric stresses such as rain or cold weather.

How did you first become interested in theoretical physics? Did you always know you that it was what you wanted to do?

I took a liking to science and mathematics at an early age. However, until shortly before I graduated from high school, chemistry was still my focus. Only then did my interest turn to physics, and during my studies increasingly to theoretical physics. There are many very exciting areas, and some of them deal with fundamental questions. I find these particularly interesting. For example, non-equilibrium

states that are externally or internally influenced in some way. That's a fundamental problem. I simply wanted to know if there are any solutions, and still do. And especially whether there are universal rules or laws to describe these phenomena. And that's where artificial intelligence comes in. Such rules do indeed exist. They are not as universal as Newton's axioms, for example, but they are sufficiently general to be applied to different machines. Essentially, it is not the scattering of data that is decisive, but its internal dynamics, structures, and time behavior. To recognize and verify this requires a new kind of mathematics.

I've been researching this topic for about 20 years now for various types of machines. After around 15 years of research, I founded my own company to translate the findings into practical solutions for high-load machines such as offshore wind turbines. So, it was only logical that I should continue this work with my team at Bachmann. Every day we deal with machines that are difficult to access, where unforeseen failures and maintenance are a real problem.

You spoke about the universal use of algorithms. What other solutions could they contribute to in the future?

It won't just be wind turbines. In principle, an algorithm can be transferred to any machine with only slight adjustments. That is what makes them so exciting. If they are correctly parameterized, then their mathematical generality can be applied to a wide range of systems.

Our research has also been used in the mining industry for the production of construction aggregate. The screen vibrates, and the rocks shatter. Such loads can destroy machines relatively quickly. Refineries have also already benefited from our algorithms. In large pipeline systems with oil temperatures of several hundred degrees Celsius, just before pyrolysis, tar can form close to the ball valves. This must be detected early enough for the safe closure of the valves.

There almost endless applications for predictive maintenance with AI to offer added value. Take the car, for example

– things are the same today as they were in the previous century. Back then, value was placed on the maximum. Wear and tear were of no concern. You changed the part instead of servicing it. Today, on the other hand, we are looking for long-lasting machines without enormous costs. Machines that produce as optimally and cost-effectively as possible. To do this, damage must be avoided, and maintenance optimized. To put AI in the context of a car: If a component was going to fail, the car would notify you in good time, and select an appropriate driving mode to reach the nearest garage before breaking down. Maintenance could then be carried out without immediately having to replace the part.

That is precisely my vision: to help develop the machines of the future and improve them. Our contribution is a small but important one. Of course, machines must be designed by engineers. But they also need to be kept alive and operated optimally from a physical point of view. This was the mission of our team from the very beginning, and we continue to carry it forward at Bachmann.

Many thanks for the interview.

Concentrated expertise: With its intelligent algorithms, the Bachmann team around Prof. Michael Schulz is paving the way for predictive maintenance of complex plants.

»Our Competence.
Our Responsibility.«

bachmann.