200 MILL.

We help save 200 MILL. tons of CO₂ annually

More than 70,000 WTGs automated

A system availability over 99.96% confirmed by customers
BACHMANN BRINGS FRESH WIND

We automate wind energy: safely, flexibly and in a modular system

Bachmann electronic offers customers in the onshore and offshore wind sector sophisticated automation solutions worldwide. All our activities are focused on the benefit to the customer: We deliver tailored solutions and set ourselves the highest standards. Meeting highly specialized market and customer requirements has long become a standard task for us.

Over 50 million households in the world obtain their electricity from wind power plants controlled with Bachmann solutions. Compared to electricity generation for coal-fired power stations, this saves our atmosphere year on year from 200 million tons of environmentally harmful CO₂. In other words: The wind power plants controlled with Bachmann solutions already replace today the equivalent output of 20 nuclear reactors. State-of-the-art technologies, open systems and highly-efficient development tools impress operators, manufacturers and developers of wind power plants alike.

After all, Bachmann’s M1 automation system is designed for optimum durability and availability, and is thus ideal for the demanding requirements of energy suppliers. International trend setters in wind power technology rely on the Bachmann M1 automation system as a central element for controlling and networking their plants. For good reason, because Bachmann electronic is a company that not only thinks ahead but sets standards and provides facts – something, which in the automation of wind power plants is far more than just a step ahead.
THE SAFE FUTURE OF YOUR WIND FARM

Everything under control with Bachmann system solutions

Our broad and modular product range really meets every customer requirement. We provide you with a homogeneous and holistic system solution that also ensures a high level of availability and is future proof. We offer you everything from a single source and at the highest quality.

CMS
- Over 15 years of experience
- Over 3,000 CMS installed worldwide
- The world’s first GL certification of a PLC-integrated CMS
- Individual retrofit solutions made to measure

... make your plant fit for the future

Wind farm networking
- Open communication interfaces
- Realtime networking via Ethernet bluecom
- Standards acc. to IEC61400-25 and IEC61850
- OPC UA to SCADA and operational control

... for optimum communication in the wind farm
Wind application

**Wind library / Template**
- Complete toolbox for turbine development
- Configurable software modules
- Object structure acc. to IEC61400
- Event system and statistical evaluation

... drastically reduces development and commissioning costs

**Power quality**
- Grid measurement and protection
- Analysis with integrated data recorder
- Static and dynamic grid support
- Grid monitoring in accordance with international grid codes

... to ensure a stable power supply

**Operational control**
- Wind park SCADA
- Scalable from the turbine to the wind farm
- Data models acc. to IEC61400
- Vertical object orientation via OPC UA

... all data "easily" under control
THE BACHMANN SYSTEM

Automation solutions for wind energy

We have the big picture and are always thinking ahead for you. Our innovative solutions ensure efficient engineering for your plants. This is what intelligent automation of state-of-the-art wind turbines looks like.
Automate your wind power plant with Bachmann so you can be sure that every eventuality is covered. Our automation systems stand out on account of their extraordinary robustness, high performance and open interfaces. The latest and most innovative platform for your requirements.

Openness in hardware and software
The M1 system operates as a real-time system. Different open-loop and closed-loop control programs are adapted in modules and run simultaneously in a preemptive multitasking environment. Like the hardware, the software is also modular and can be structured and extended as required following our “no limits” principle. The controller offers additional reserves for expansions or plant-specific adaptations.

Functionality means “ready-to-use”
The modular M1 system offers a wide range of hardware, consisting of over 200 devices and modules. This system contains a large number of configurable function blocks for all necessary machine functions, such as visualization, networking, closed-loop control and diagnostics, to provide you with all the basic functions from the start. Here we place great importance in ensuring that all tools are developed according to international standards, and can also be integrated and parameterized flexibly.

Equipped for challenging climates
The ColdClimate modules from Bachmann - a solution for all applications in demanding climatic conditions, especially where maximum plant availability is critical. The ColdClimate modules are first choice, especially when demanding environmental conditions (e.g. temperature, air humidity, salt spray) are involved. For you this means: Safe operation, even with transient extreme temperatures as low as -40 °C and when condensation is present.
**Hardware concept (example)**

**Scalable and open**
In order to minimize complexity and maximize ease of maintenance, all components of the M1 controller system are consistently developed as part of a modular system. In this way, optimum scalability is ensured for a wide range of requirements. The M1 system perfectly combines the openness of a PC-based controller with the reliability of industrial hardware platforms. A state-of-the-art system architecture designed for effective networking capability enables it to be integrated easily in the area of the controller and plant peripherals.

**Certified systems**
Internationally accredited test institutes verify the conformity of our Bachmann systems with the most important global standards and thus provide approval for the most demanding applications.
INTEGRATED PLC TECHNOLOGY

Bachmann controller modules are specially developed for wind power plants. This enables us to implement an extensive range of functions for you, compactly and economically, in the M1 controller system. Maximum flexibility and a comprehensive range of functions optimize the efficiency of your plant.

**CPUs in the MC series**

Maximum performance for demanding closed-loop control tasks, process control and signal processing, as well as extensive communication protocols - all this provided by the MC210 and MC205 CPUs. The modules are equipped for this with the latest Intel processors and with high-speed GBit networks. A large memory with CFA technology is provided for storing all data safely. In the event of a power failure, critical data is stored in battery-backed non-volatile data memories (NVRAM). The Bachmann M1 controller uses this to also process complex applications with maximum speed and precision.

**CPC – the compact pitch solution**

The compact CPC200 module has been specially developed for pitch applications. Two separate CAN interfaces communicate at one end with the turbine controller via a loop ring and at the other end with intelligent drive amplifiers that adjust the rotor blades. Encoder inputs (SSI/INC) measure the actual rotor position that can also be designed redundantly depending on the pitch design. Furthermore, digital and analog I/Os as well as temperature inputs are also provided on board. The CPC module is designed for single blade control, but can be expanded with the M1 range of modules so that a central controller can also be implemented for a 3-blade control.

A connection with a Bachmann M1 turbine controller also allows the implementation of tele-service tasks as well as the updating of programs via TCP/IP (TCP/IP over CAN).
Germanischer Lloyd has certified the Ω-Guard condition monitoring system (CMS) of Bachmann electronic as the world’s first PLC-integrated solution. Ω-Guard makes it possible for the first time to execute the entire logging, analysis and evaluation whilst the PLC program is running. The AIC212 CMS module of the M1 automation system offers high-resolution vibration measuring inputs for the recording of different measuring points. At present the Bachmann CMS application enables up to four AIC212 modules to be integrated in the analysis. These offer 48 channels for vibration and voltage inputs. Data from the PLC or via fieldbus protocols from other sources can be logged and included in the analysis at the same time as the acceleration signals.

**Additional monitoring functions without doubling the sensors**

The integration in the M1 system means that any signals and variables from the entire control system, such as the actual power or the operating state, can be included in the evaluation. For example, the actual power or the operating state are monitored without the need to double the sensors. In this way, other functions for monitoring the structure and rotor blade can be integrated in the CMS and the PLC, thus offering a clear benefit.

**Maximum flexibility and efficiency**

The GIO212 enables changes to a project to be implemented more simply at short notice. The search for alternative modules becomes unnecessary with the GIO212, and plant conversions, parts list modifications, reprogramming and the necessary tests become a thing of the past. You only need to adjust the settings in the configurator and that’s it. Another benefit: The simpler management of spare parts – with the GIO212 only one module needs to be kept in stock instead of a host of different variants.

**GIO I/O module**

The GIO212 offers an impressively wide range of functions, thus making the use of expensive additional modules in most places unnecessary. All channels of the universal I/O module can either be configured as analog or digital inputs or outputs, as counters or for temperature and resistance measurement. Depending on the function selected, a channel can be assigned up to two functions (mixed mode operation). The digital outputs also come with a special feature: Each channel provides an output current of 100 mA and can also be configured as a push-pull driver, in addition to the ground or positive switching: A simple configuration can thus enable a free digital output to be used, for example, to feed a 20 mA sensor. Cable breaks and the power supply can thus also be monitored without any time consuming integration, without an additional module and without further costs.
Open and standardized communication forms the foundation for the efficient automation of wind power plants. Seamless communication must be ensured, particularly when the devices and systems of different vendors have to be integrated into an effective overall concept, or when operators put additional plant sections into operation over the course of time.

**IEC61400-25:**
**MMS server and client**
The MMS server (Manufacturing Message Specification Server) collects and provides all the data of the wind power plant. This is presented to the higher-level monitoring system using the teleservice protocol for wind power plants (IEC61850). The MMS server from Bachmann electronic is installed directly as a software module on an M1 controller, and handles the communication of variables available in the user programs on the PLC with the outside, in accordance with IEC requirements. The MMS server can equally represent a device in accordance with IEC61850 or IEC61400-25.

The MMS Client software package enables you to easily integrate peripheral devices such as circuit-breakers, meteorological stations and grid monitoring devices. This type of device thus behaves like a normal fieldbus node that supplies actual values to the runtime program and receives setpoints and parameters from it.

As with all applications on the M1 system, the user programs can be written in IEC61131-3, C or C++.

**IEC60870-5-104**
The IEC60870-5-104 standard defines a general transmission protocol between control systems and substations. This standard enables the teleservice and control technology devices and plants of different manufacturers to communicate with each other without any fundamental adaptations necessary. The Bachmann IEC60870-5-104 server is installed as a purely software component on the PLC and does not require any special hardware.

The SolutionCenter provides a convenient tool for generating externally visible information objects.

The tool features several dialogs and wizards to support the user with data input and to check entries immediately. In this way, any inconsistent or faulty configurations can be prevented.
OPC – tested standards
The Bachmann M1 OPC Enterprise Server provides you with a PC-compatible software interface in accordance with the OPC standard. The OPC Data Access 1.0, 2.04, 2.05 and 3.0 specifications are supported in order ensure comprehensive coverage of a wide range of clients (e.g. SCADA systems, production data acquisition, visualization systems). The OPC server guarantees genuine conformity and thus straightforward application without any problems. This has been confirmed through various certifications and interoperability tests. A large number of our customers can also confirm the capability and stability of the system.

OPC UA
An OPC UA server is also available in addition to the OPC Standard and OPC Enterprise servers. This is run directly on the PLC with the VxWorks real-time operating system, thus making the previously required additional Windows PC unnecessary.

bluecom – the real-time transfer protocol
Bachmann offers a real-time capable communication protocol for synchronous data exchange in energy grids. Based on Ethernet mechanisms, bluecom is designed for high-speed, real-time operation in which for example 250 stations can exchange data packets of 250 bytes in 20 ms. This therefore provides you with a technology that can implement the closed-loop and open-loop control of entire energy grids. In coexistence with standard protocols such as OPC, IEC61400 closed-loop control and data communication can run simultaneously on the same medium. Bluecom makes it possible to create variable topologies, and the integrated control mechanisms enable single stations right through to entire network segments to be added or removed in a controlled manner without any interruptions.
Plants are controlled locally at the device, using mobile devices or from a control station located a distance away. Operators, plant owners, process engineers, service technicians and many other users have completely different perspectives, interests and needs with regard to data access. The principal aim of rights management is to assign each user with the correct read and write access to process variables as well as to the file system of the controller. At the same time, data and parameters must be prevented without fail from being manipulated by unauthorized persons or even accidentally. The security functions in the SolutionCenter were therefore provided with even more convenient configuration options.

**Group formation**
Access rights were previously implemented using levels: The higher the level, the more rights the user had. However this can no longer fully cover the wide range of different applications. Part 8 of the IEC62351 standard (Data and Communication Security) therefore describes a 'role-based access control': Users are assigned to a group such as Viewer, Operator, Engineer or Installer, depending on their role. The configuration of user rights was therefore fully overhauled in the SolutionCenter with this in mind, with groups and their system rights as a prime objective. Users are now no longer created with completely different rights but are assigned to groups to inherit the associated rights. Some roles are predefined, whilst others can be defined by the user as required. The existing settings are naturally still available for existing configurations.

**Detailed rights assignment to files ...**
In a second step, files or file paths are assigned to the individual groups. This enables read and write authorizations to be issued at the drive level (USB stick, CF card, etc.), to directories, right down to individual files. An intelligent inheritance concept mostly only requires a few entries here.

**... and to variables**
SVI variables make process values from the application available to the outside world. Actual values (temperatures, speeds, operating states etc.) should already be marked here as 'read only' in the variable declaration. It makes no sense to set these values from outside, regardless of the user role. However, it is now possible to assign rights as required: Individual read and write authorizations can now
be assigned to each individual process variable depending on the group to which the user belongs. As with file rights, the inheritance concept is also used here. However, the hierarchy is not structured according to file paths but according to software modules and instances of function blocks. It is also possible to define input limits for selected variables.

Testing on the controller
When the user logs into the controller, the Login Checker determines the Group and Level attributes of the user and from then on takes this into account in all activities. Whether the user wishes to make use of the machine visualization, the SolutionCenter engineering tool or a standard communication such as OPC UA therefore does not matter at all. The rights control is always active, regardless of the tool used.

Security log
If required, all activities from outside are permanently recorded in the security log: For example, if a SCADA or ERP system writes accesses a variable via OPC UA, information such as the user name, time or original and new values are stored. All logins and interventions are likewise visible in an online monitor in the SolutionCenter.

One version for everyone
Groups, users and their access rights are defined completely independently of the software development and can be finalized before the delivery of the system or even not until commissioning. This means that any customization of rights does not require the operational control software to be recompiled, tested and archived in different versions: Always the same software version can be delivered. For plant builders this means that the solution implemented in the SolutionCenter can therefore offer yet another key benefit.

Security facts
- SSL encryption
- Dynamic password generation
- Access protection at variable level
- Memory protection
- Access logger in the operating system
Today’s wind power plants are faced with some demanding requirements in terms of grid compatibility. All the relevant data of a three-phase supply grid must be recorded precisely, and critical grid conditions detected reliably. The latest grid codes must be observed in order to ensure the stability and availability of the electrical supply. The GMP232 grid measurement and protection module from Bachmann integrates, for the first time, all the necessary protection and monitoring functions in conventional control tasks.
Extensive grid and generator protection with the GMP232

Decentralized electricity generators, such as wind power plants, must ensure stable operation in accordance with the relevant grid codes. The GMP232 provides grid and generator protection in one. The fast and reliable detection of grid faults and other abnormal events such as voltage surges caused by lightning, short-circuits, ground faults or cable overloads, enables the GMP232 to guarantee protection for the entire power generation plant and the energy supply grid. Every generator fault can also be detected reliably thanks to the integrated high precision measuring functions. The monitoring of harmonics thus enables short circuits or imbalance in the drive train to be reliably detected.

To detect faults with a high level of accuracy, the GMP232 is equipped with an integrated data recorder. This enables the precise synchronized recording of up to 16 measuring channels for four seconds at a maximum resolution of 100 μs. The recording can be triggered remotely or activated in the event that predefined limit values are exceeded. The measuring data is then available in the SolutionCenter or as an exportable file in the Comtrade format.

Static grid support

Static grid support requires the adaption of the supplied active power. With its three-stage frequency monitoring, the GMP232 module registers this reliably and initiate countermeasures. For example the module can initiate a reduction of power generation or the immediate disconnection from the grid. The two-stage voltage reduction protection and voltage rise protection are also integrated in the GMP232, and thus provide the facility to supply the required reactive power to support the grid if the values go above or below the prescribed limits.

Dynamic grid support

Wind power plants must also contribute to dynamic grid support, which is why the plant must remain connected to the grid in the event of a momentary voltage dip (fault ride through). This prevents several generator units from disconnecting from the grid simultaneously in the event that a specific value falls below the lower limit, with the result that a serious power imbalance is caused in the grid, thus leading to a major power outage over a large area. The GMP232 makes it possible to define different limit value curves on the controller and activate them as required. The GSP274 module (grid synchronization) offers further possibilities here.
SCADA AND HMI OF THE FUTURE

M1 webMI pro

The widespread global use of Internet-enabled mobile devices has taken place at breathtaking speed. Their simple and intuitive operation is impressive. Internet and software applications no longer have a fixed location but can be used from anywhere in the world. With ‘M1 webMI pro’, Bachmann electronic is impressively demonstrating its technology leadership: Each M1 controller is turned into the central server for fixed or mobile HMI devices.

Engineering and maintenance – an important cost factor

Wind power plants are becoming increasingly more complex with ever increasing requirements. This also naturally increases the effort required for engineering and maintenance as well. It is often not only necessary to allow for local visualization in the field, but also for the connection to a control center, a separate visualization for teleservice and sometimes also solutions for mobile terminal devices. Often each requirement here has to be implemented with separate applications. With many visualization products, the handling of different terminal devices and screen resolutions is also not possible.

Pure web visualization for the Bachmann M1

Bachmann electronic is now launching a powerful product for pure web visualizations on the market called ‘M1 webMI pro’. A slim-line web server that is directly installed on the M1 controller enables the connection of any visualization devices, such as smartphones but also powerful operator terminals. Provided the necessary authorizations are in place, the application can now be accessed from anywhere in the world. Thanks to ‘M1 webMI pro’ all the important information can be shown in a single view and with stunning definition. Perfect graphic results can be achieved on any visualization page without any losses in quality when scaling and zooming. This is thanks to the extraordinary benefits of HTML5 and SVG (scalable vector graphics), the basis for all graphic objects.

State-of-the-art project engineering and simple delivery

The 'atvise builder' engineering tool is used for drawing process pictures, configuring animations and events as well as for other settings. A number of ready-made graphic objects and layouts, as well as the flexible reuse of pages using parameter transfers make it possible to create visualizations efficiently. Integrated editors even allow the drawing of new SVG graphic objects or the creation of additional functions with user-defined Java scripts. Once the visualization is completed, this is transferred to the web server via FTP with just a single click. This makes the delivery of visualizations to large and distributed installations such as wind farms child's play. Time-consuming software installations on all HMI devices involved become completely unnecessary. The latest version of the application is always shown as soon as a client connects with the central web server or reloads

Benefits of M1 webMI pro at a glance:

- Value displays with high refresh rate
- Any browser-based device becomes an HMI
- Operation and visualization when and where you need it
- Loss-free scaling on all screen sizes
- As safe as Internet banking (HTTPS)
- Short refresh in the browser instead of time-consuming software rollouts
- Use of the application by different devices (smartphone, tablet or stationary HMI devices)
- Integration in higher-level SCADA applications
the web page. Special installations or a restart of the HMI devices are no longer necessary. All operator units are thus automatically brought up to date – without any interruption and irrespective of time and place.

Increased efficiency included
The development of web technologies had to allow from the outset for the wide range of different terminal devices, since different screen sizes and resolutions are normally used. Visualization design in ‘M1 webMI pro’ is much easier however, since only a single application has to be created for all devices. If the visualization solution is also implemented directly on the controller, the configuration of the relevant data interfaces is also unnecessary: The variables can be accessed directly, and an OPC server or any proprietary protocols become obsolete. Ultimately, this kind of web solution not only means more efficiency in engineering but also a real increase in cost efficiency.

SCADA with 64-bit power
The increasing complexity and the constantly rising level of automation in a wide range of different installations require future-oriented technologies for monitoring and controlling processes effectively. SCADA systems make a key contribution here and ensure a high level of safety. This is especially the case if they offer, like atvise – the product line of Bachmann’s subsidiary Certic – operation that is not restricted to a particular location or device. The atvise scada control station and visualization system combines the latest web technology with a high performance client-server architecture. While user interfaces can be displayed in web browsers without any installation required, central functions such as process connection, historization, alarm signaling can be run in highly efficient server structures. The full utilization of the internal data structures of the latest processors increases system efficiency. At the same time, the 64-bit data width enables the utilization of considerably more main memory which ultimately allows larger projects with more process variables (nodes). Released operating systems include Windows XP SP3, Windows 7 (32-bit and 64-bit), Windows 8 (32-bit and 64-bit), Windows Server 2008 and Windows Embedded Standard 7. A Wind Power SCADA solution based on this state-of-the-art web-based technology will soon be available. The Bachmann Wind Power SCADA system combines flexibility, openness, the latest in ergonomic engineering, coupled with ready-to-use functions for wind power plants and wind farms.
Our solutions for energy grid management combine control, communication, monitoring and visualization, seamlessly into a comprehensive whole. Bachmann automation solutions thus give you the critical value added. Critical for your success – and critical for the energy supply of the future.

Condition monitoring involves the monitoring of the status of a machine, either continuously or at regular intervals through the measuring or analysis of meaningful physical variables (e.g. vibrations, temperatures, condition of lubricant etc.). The comparison with reference measurements provides information for drawing conclusions about the actual condition of gears, generators, roller bearings, rotors and other elements.

**Maintenance – only if needed**
Condition monitoring enables condition-based maintenance. The generally practiced preventative maintenance involving the exchange of components within fixed time intervals based on empirical values is replaced by a condition-based maintenance strategy. This provides you with a clear financial benefit.

**Benefit:**
**Integrated CMS solution**
Bachmann integrates its condition monitoring solution in the automation and links the measured values to other operating parameters. This increases the diagnostic reliability of the condition monitoring: Fault patterns can be compared to the current operating situation and interpreted with greater accuracy. A systematic control even enables mechanical loads to be reduced. In this way, adjusted operating conditions can extend the lifespan of partly damaged parts up to the next plannable maintenance date.

**Certified safety**
All the system components used for condition monitoring including the online remote Monitoring Center are certified in accordance with the regulations of Germanischer Lloyd.

Bachmann automation components are furthermore provided with several internationally recognized approvals for use in wind power plants and offshore applications.
Online condition monitoring pays for itself

The replacement of a bearing on the gear shaft requires a planned downtime of the wind turbine of around three to four days. In the case of a sudden break caused by wear damage that was not detected in time, this downtime can easily be ten times longer. In this case material and personnel first have to be organized and brought to the plant. Sudden breaks are also often due to higher wind loads in times of strong wind and therefore high yields. If the sudden break causes consequential damage to components, which can only be partially repaired on the plant due to their size and dimensions, additional expenditure is involved. The costs for the use of a crane, particularly with offshore installations are enormous.

Preventing consequential damage

Condition monitoring provides reliable information about the state of important mechanical and electrical components of the wind turbine. This enables any faults to be detected early as well as preventing any possible consequential damage that would mean a lengthy downtime of the installation.

Risk protection

Condition monitoring gives operators, investors and insurers a practical and transparent view of the condition of the plant – and thus also of the expected risk of damage. This is particularly important when commissioning or at the end of the warranty period when service contracts and insurance premiums have to be recalculated.

Expertise in system solutions

Thanks to its many years of experience in the field of CMS, Bachmann can also provide expertise and advice in condition monitoring, as well as supplying the cables required for the measuring technology, the measuring modules and the evaluation software. Today, a team of experts is already monitoring more than 3,000 plants and reporting the relevant plant status.

Benefits of CMS at a glance

- Reduction in maintenance costs through coordinated planning, on time procurement of spare parts and prevention of consequential damage
- Securing of electricity generation and yield optimization through selective and planned maintenance, e.g. in times of weak wind
- Greater utilization of the lifespan of machine elements thanks to accurate condition information
- Practical risk assessment in relation to the failure of important wind turbine components

The Bachmann Online CMS Ω-Guard® provides worldwide access to the status data of the monitored plant from any online workstation.

▶ WebLog workstation

▶ WebLog workstation

▶ WebLog workstation

▶ WebLog workstation

Ω-Guard®-system
Commissioning and configuration

Condition monitoring system
WebLog server

Internet

Sensors

Remote plant management

Wind.application
The new condition monitoring solution for retrofits from Bachmann

After Ω-Guard, the world’s first integrated condition monitoring system (CMS) to be certified by Germanischer LLoyd, the Retrofit CMS from Bachmann Monitoring offers a new system on the market – an alternative solution for retrofitting wind power plants.

Condition monitoring systems are increasingly being used as a preventive measure. They enable any impending damage to wind power plants to be detected early on and rectified. Up to now, Bachmann has met the increasing demand for this with a PLC-integrated system solution that enabled the logging, analysis and evaluation of the plant condition in parallel with the PLC program. The Retrofit CMS is an alternative condition monitoring system that is particularly suitable for the retrofitting of wind power plants: The CMS module here runs independently of the controller environment, either as a complete stand-alone solution or as a Top-Box variant in an existing control cabinet.

More and more plant builders are retrofitting
The interest of the wind energy market is considerable, as confirmed by the current orders for the new Bachmann system. Worldwide there are currently over 1,300 wind power plants operating for major utility companies being retrofitted with the Retrofit CMS.
Complete offering – and much experience

Besides the special hardware and software, Bachmann’s system offering includes a worldwide Monitoring Service, provided by Bachmann Monitoring GmbH: The diagnostics specialists based in Rudolstadt in Thuringia, Germany, evaluate the measured data collected with the CMS module in extensive analyses and compare it with the reference data. This enables them to not only notify plant operators of verified fault messages, but also provide appraisals of the current operating state of their plants and their wind farm.

The experts at Bachmann Monitoring can draw on over 15 years of experience for their analysis processes: They currently monitor more than 3,000 wind power plants from over 20 different manufacturers.

**Fully integrated CMS solution**
Integration in the existing Bachmann controller environment as well as in the existing control panel, few hardware and installation requirements

**TopBox-integrated CMS solution**
PLC-independent mounting in the existing control cabinet, few hardware and installation requirements

**Ω-Guard® condition monitoring system**
- Online monitoring
- All-in-one package (sensors, wiring, measuring, evaluation, reporting)
- Integrated or stand-alone solution
- > 3,000 plants worldwide

▲ Detail: The installation location and type of sensor to be installed are specified beforehand for each turbine type. The individual mounting sets ensured efficient and time saving installation.
Both wind turbine manufacturers and plant operators alike aim to achieve maximum availability – mainly for financial reasons. This is already implemented at critical points by the multiple measuring and evaluation of signals, such as rotor speed. Safety-relevant considerations, such as the redundant systems previously mentioned, are thus already implemented in the plant.

Safety engineering under control
The safety components from Bachmann are ideally equipped for use in wind turbines. Operational control, safety engineering and operator terminals are perfectly matched and allow open communication. The fastest possible response times, intuitive operation and comprehensive diagnostic options guarantee

SAFETY WITHOUT COMPROMISE

Up to now, functional safety in wind power plants has been given very varying degrees of importance, and is nearly always reduced to the most necessary personal protection measures. However, modern safety solutions using a programmable safety controller make it possible to implement functions that go far beyond the conventional emergency-stop chain: Secure remote monitoring and teleservice in combination with intelligently used redundant systems can secure and even improve availability.
the highest possible level of safety. The safety modules can be arranged in the wind power plant as required, thus enabling the implementation of individually tailored solutions. Safety channels that are not required can be used as standard digital I/Os without any restrictions. Safety relays can be replaced thanks to the 2A outputs of the remote SDO208 output module. This saves space, wiring effort and additional costs.

**Benefits for manufacturer and operator**
Programmable safety engineering makes the practical implementation and series production easy. It enables the secure monitoring of all the internal states of a wind turbine during operation, including the safety circuits, from anywhere in the world. Our control components are already used successfully in thousands of wind power plants worldwide. Bachmann electronic offers you tailored solutions based on the experience gathered.

- **Remote safety I/Os**
- **Safety controller**
- **Seamless system**: Integration of sensors, operational control and safety systems of a wind power plant.
SAFETY NETWORK IN CASE OF EMERGENCY

Redundancy

Bachmann automation solutions stand out on account of their highly robust design and maximum availability. Nevertheless, no single system can guarantee failsafe operation on its own. Using a redundancy system enables the risk of unplanned machine and plant downtimes to be further reduced considerably.
Malfunctions and failures in important operating components reduce the uptimes of wind power plants. In addition to this, they often lead to consequential damage and lengthy repairs. This involves considerable costs, and the production downtime leads to financial losses. Redundancy systems increase the capabilities of automation systems through the feature of single fault tolerance. This makes it possible to ensure continuous productivity – even while maintenance or modifications are being carried out on the plant – 24 hours a day, 7 days a week. Bachmann’s redundancy solutions enable you to increase the availability of your plant effectively and sustainably: System variants that are tailored to meet any particular requirement enable you to optimize productivity and operational reliability. The seamless embedding in the proven hardware, engineering and programming concept already in place, together with the robustness of tried and tested Bachmann components, guarantee the highest level of operational reliability, thus maximizing yield. This optimum combination not only guarantees single fault tolerance throughout but also multiple fault tolerance in many cases.

Fault detection integrated in the end points
Another benefit of the integration is the voting mechanism used by all Bachmann terminal devices. After being configured once in the application program, redundant process variables here can be used and processed as a single variable without having to manually read or write the values twice. Management and fault detection are completely handled by the system, thus reducing the workload for the user.

Scalable and cost efficient
With Bachmann systems, redundancy can be tailored to meet the requirements at hand. The use of standard components offers a wide choice of powerful CPUs which can communicate with the substations either via copper or fiber optic connections. Combined with the product variants, this results in the most economical solutions – from simple network redundancy to protection from communication failures, right through to the virtually fully available system.

Minimum switchover times
The switchover time is a quality feature of a network redundant system. Typical systems often operate using a ring topology. In the event of a failure the network devices reroute the data packets. However, the detection of a fault and the subsequent switching takes time. The redundancy solutions from Bachmann directly integrate the detection and switchover operation in the communication end points. This approach allows considerably better switchover times, and any topology can be selected thanks to the full Ethernet conformity.
SOLUTION FOR EVERY ENVIRONMENT

ColdClimate

Anyone working in extreme climatic conditions values a reliable partner. Bachmann is renowned worldwide for its quality promise to supply products with only the highest level of reliability.

We are glad that our customers are so demanding. They are looking for unique solutions for challenging environments. Whether it is condensation or operating temperatures between -30 °C and +60 °C (extreme temperatures between -40 °C and +70 °C), Bachmann solutions can withstand them all. The ColdClimate modules are the ultimate answer to extreme climatic conditions.

Our quality promise is also based on a number of testing procedures that go far beyond the required minimum standard – starting with the 100 % test for all modules in an active RUN IN, to extreme temperature change phases in climatic chambers, right through to measuring compliance with standards in the company’s own EMC 3 meter absorber chamber.

Bachmann products are also ideally equipped for other severe environmental conditions: For example for operation in high altitude conditions at low pressure and low heat capacity. And not to be forgotten: severe mechanical stresses caused by shock and vibration that are no match for Bachmann controllers.

Equipped for challenging climates

The ColdClimate modules from Bachmann – a solution for all applications in demanding climatic conditions, especially where maximum plant availability is critical. The ColdClimate modules are first choice, especially when demanding environmental conditions (e.g. temperature, air humidity, salt spray) are involved. For you this means: Safe operation, even with transient extreme temperatures as low as -40 °C and when condensation is present.
Visualization for climate extremes

The visualization devices of the OT100 series and OT200 series provide ‘Essential’ and ‘Intermediate’ class visualization devices for operation in extreme climatic conditions. The display units of the OT100 series are primarily designed for simple text-based displays in conjunction with a powerful M1-CPU. The ColdClimate version of the OT205V on the other hand, is an autonomous, full-featured terminal based on industrial PC technology. With the fully graphical 5.7” VGA display and modern LED backlight technology, it offers in conjunction with Bachmann’s proprietary project design tool (VisDesigner) a solid and fail-safe basis for the rapid implementation of clear visualizations for wind power plants.

Wide temperature range and condensation proof

The perfectly matched ColdClimate versions of M1 modules and terminals have two things in common: A very large operating temperature range and moisture condensation resistance. Thanks to a special polymer-based protection of the electronic modules, reliable operation is also ensured when condensation is present. The modules can be used at extreme temperatures from -40 °C to +70 °C, and reliable uninterrupted operation is guaranteed in the temperature range from -30 °C to +60 °C when condensation is present. Thanks to the high quality protection for temperatures between -40 °C and +85 °C, all ColdClimate components can be stored without any restriction.
ALL-IN-ONE ENGINEERING

The Bachmann SolutionCenter represents a genuine milestone in the reduction of engineering costs. A single all-round software solution covers all aspects of the engineering process – from configuration, programming, closed-loop control, motion, communication, safety, visualization, right through to testing and commissioning.

SolutionCenter – the all-in-one engineering tool

Thanks to the highly modular Eclipse plug-in concept, the SolutionCenter can be expanded simply, even for integrated user-specific requirements. The SolutionCenter is perfectly matched to Bachmann devices and systems, and was designed in collaboration with experienced users. It saves time, generates synergies and increases usability. Users can benefit from the cohesive operating concept and avoid the manual entry of redundant or unnecessary data.

An open system

Bachmann offers control system developers the latest in modern and standardized development tools. The M1 system can be programmed in IEC61131 PLC languages, and high-level languages C/C++ or Java. Extensive closed-loop control tasks can be modeled and simulated with Matlab®/Simulink®, and can be tested and run online on the system. The M1 controller supports all commonly available networks such as Ethernet TCP/IP, PROFINET, EtherCAT, CAN bus or Modbus. The configurators required are also included as well as diagnostic and testing tools. A real-time fiber optic bus was developed especially for the wind sector, which ensures a safe connection between the foot of the turbine and the machine room, using the protocols previously mentioned.
Software concept

Integrated and platform-independent

Convenience, intuitive design, openness, robustness, selected functionality and compatibility are the features that make Bachmann software products stand out from the rest.
WIND LIBRARY
(TEMPLATE)

Wind Turbine Template (WTT)

Time-to-market is the most important criterion for the success of a wind power plant on the market. Regardless of whether a new plant or a retrofit is involved, the speed at which a plant is operational depends increasingly on the operational control software. This controller software, which also contains an essential part of the functions of a turbine, represents a major element of the know-how involved in a wind power plant. The Wind Turbine Template (WTT) software framework contains the most important structures and functions for the operational control of a wind power plant. Based on the IEC61400-25 data structures and the functions of Bachmann’s Wind Turbine Essentials software package, the template provides all the components of a wind power plant (nacelle, rotor, converter, generator, etc.). Functions for data logging, trends, wind rose, power curve, login, fault and alarm handling are also ergonomically integrated. The design of the structures is so open that users can implement their own functions or if necessary change the functions provided. This also ensures know-how protection. The modular design enables unit testing, i.e. functions and libraries are inherently tested, thus shortening the final testing required for the entire plant software. The sensor and actuator interfaces are defined with a configurator and can thus be easily adapted to the requirements of the plant. The functions and libraries are programmed in the IEC61131 languages, in C/C++, or with Matlab/Simulink using Bachmann’s M-Target for Simulink interface. The user is provided with a freely configurable turbine visualization as well as the OPC UA/DA and IEC61400-25 interfaces for connecting to SCADA systems.

Simulation included
The Wind Turbine Template covers the requirements of the basic software packages of a wind power plant. The openness of the structures enables the user to make adaptions. Tested, reusable software modules considerably reduce the engineering, increase plant safety and availability and shorten the time to market.

Structure model compliant with IEC61400-25
Wind Turbine Essentials (WTE)

The WTE software package is tailored to the requirements of wind turbine manufacturers. It helps to considerably reduce the developing and commissioning times for the controller software and the visualization. Bachmann’s Wind Turbine Essentials cover many standard tasks required for the automation of wind turbines. This means that recurring functions no longer have to be implemented in the operational control program, but can be prepared in a configuration tool, executed on the controller CPU and monitored and operated in a visualization.

Ready for use – without any programming
The functions are soon ready for direct use by means of a simple configuration and any laborious programming is unnecessary. The WTE Configurator is installed as an additional plug-in for the Bachmann SolutionCenter and uses the devices and communication interfaces entered there. Wind Turbine Essentials considerably reduce the time required for developing and commissioning wind power plants. A host of functions in the form of libraries are also provided, and can likewise be used in the other application programs of the turbine manufacturer. The package supports here IEC61131-3 and C/C++ programming languages.

Standards included
The Bachmann WTE package features an event system that determines the required response of the plant to events resulting from the sensor data. These responses include for example the shutdown, yawing and the alarm generation of the plant. The WTE power curve implements the requirements from IEC61400-12 and shows the energy yield of a wind turbine as a function of the wind velocity. The addresses of the required actual values can be selected in the Configurator, and the calculation of the power curve is automatic. Other functions such as wind rose (statistical distribution of wind speed depending on wind direction), energy meter (measuring of generated and consumed active and reactive power), a universal events counter, such as for the status monitoring of plant sections, as well as different mean value calculations complete the extensive range.

WTT/WTE functions – ready-to-use

**Complete toolbox**
- Configurator in the SolutionCenter
- Ready-to-use software module for the controller
- Library for user implementations
- Visualization for the PC
- Visualization for small-format panels

**Event system**
- Flexible configuration of events
- Flexible selection of plant responses
- Language selection of description texts in the visualization
- Complete and reliable logging

**Statistical evaluations**
- Power curve
- Wind rose
- Event and energy meter
- Automatic scanning of measuring points
- Standards compliant statistical handling
- Graphical display in the visualization "out-of-the-box"
- Retention of values also after software update

**Access control**
- Definition of user roles
- Assignment of user rights to monitor and parameter values in the configuration
- Logging of all write accesses

**Software update**
- Reliable controller update from image
- Rollback mechanism for fault states after the update
The increasing complexity and size of plants also considerably changes the development process. If simple analytical advance calculations can no longer describe or predict the response of a system, practical experimentation is the only solution. Models and prototypes are used to obtain findings and develop a solution. However, what happens if the production of these pilot systems is too expensive, offers only restricted use, or if practical tests are simply too dangerous? Today’s answer is: digital simulation. The actual systems are simulated in a computer program in the form of a simulation model. Irrespective of the type of modeling, mathematical interrelationships are used to describe the response of the system. If these simulation models are recalculated with different environmental conditions and parameters, this corresponds to a virtual prototype test. Safe, affordable, repeatable as required and fully automated. M-Target for Simulink® enables the simple use of computer-aided simulation, taking the actual automation solution into account.
Quality and efficiency
The use of high quality algorithms increases product quality and plant yields. The increasing efficiency of plants can be achieved through the use of new close-loop control and optimization concepts. Solutions which are developed with the help of M-Target for Simulink® can fully demonstrate their strengths in these disciplines. The MATLAB®/Simulink® tool from MathWorks is well-established on the market. It offers support when creating a simulation model of the subcomponent to be automated. For this the standard modeling methods provided by MATLAB® can be used. Alternatively, it is also possible to use the interfaces to several commonly available domain-specific simulation programs in order to utilize partly simulations that have already been created. The algorithms required for automation are then created directly in the simulation environment and their functional suitability checked.

Automatic code generation
As soon as the simulation has produced satisfactory results, i.e. when no weaknesses in the requirements specification and no algorithm errors can be identified, the compilation from the simulation language into executable code for the M1 controller is executed at the push of a button. This is machine compiled by the system, thus eliminating the possibility of any random errors. After code generation, the executable automation program can then be tested immediately on a hardware-in-the-loop test rig equipped with actual controller components or on the actual plant.

Cost efficiency
“Getting to market faster with the better solution” – this is the basic tenet of our global economy. This is where M-Target for Simulink® with the M1 automation system from Bachmann offers considerable help. Calculable investments that are also inexpensive compared to their benefits pay for themselves quickly. The customer-friendly license model of M-Target for Simulink® does not involve any unit-based purchase of licenses and thus has no negative effect on product profitability.
OUR CUSTOMERS

Applications for the wind sector

Many of the world’s leading manufacturers and operators of wind power plants rely on us. Together with them, we are setting new benchmarks and achieving new successes.
ADVANCED CONCEPT – GREATER YIELD
e.n.o. energy

FAIL-SAFE IN WIND
Forward Technology Co., Ltd.

STATE-OF-THE-ART IN THE WIND
PROKON

SECURE ADVANCE
REpower Systems AG

WIND POWER IS BOOMING
Sinovel Wind Group Co., Ltd.

COMPLETE TRUST
WestWind energy

PARTNERSHIP WITH TAILWIND
Windtec
ADVANCED CONCEPT – GREATER YIELD

New wind turbine generation of e.n.o. energy

e.n.o. energy has been successful in the erection of wind turbines since 1999, and has been developing, producing and selling its own wind turbines for the German and international market since 2008. The company produces the e.n.o. 82 in series production in Rostock (Germany). The prototype of the e.n.o. 92 was erected in July 2010. The wind turbine generators of e.n.o energy stand out on account of their high quality equipment: The components of prestigious European suppliers are used exclusively. The M1 from Bachmann electronic is being used for the control system.

As a completely new development, the e.n.o. 92 underwent a large number of conceptual changes compared to the 82 type series. As well as improvements made in terms of ease of mounting and maintenance, the increased grid connection quality as required by the market was of key importance. A considerable number of adaptions were also implemented in the overall electrical system: The e.n.o. 92 was provided with a full power inverter concept coupled with an electrically excited synchronous generator. Compared to conventional systems, this concept enables the control to be adjusted flexibly even in difficult grid conditions. However, this increases requirements in terms of open and closed-loop technology at the same time, and so e.n.o. energy systems therefore developed a completely new control system for the e.n.o. 92 series. Besides the electrical hardware such as control cabinets and cabling, a new SCADA solution and grid management concept was developed: “The greatest challenge, however, was the fact that we had to write a completely new control software in addition to developing the control system,” Stefan Bockholt, head of design at e.n.o. energy systems, explains.

Tried and trusted Bachmann M1 controller

The proven Bachmann M1 controller, which offers the performance required for the complex open-loop and closed-loop control tasks involved, was selected as the PLC system. “The robust hardware, the self-contained development environment for the software, the visualization already provided with the Wind Application Box, and the good customer support from Bachmann electronic directly on site were key factors in our decision,” Stefan Bockholt explained. “We were also impressed by the excellent reputation of Bachmann in the wind sector,” Stefan Bockholt adds.

Do-it-yourself yield maximization

The e.n.o. 92 is equipped with a host of algorithms for increasing efficiency and thus maximizing yield. This could be achieved thanks to the controller software developed in-house. Even complex control algorithms for the load optimized operation of the turbine were implemented. These primarily reduce the level of alternating loads on the mechanical system, thus increasing the reliability and service life of all components. The machine control unit is also provided with extensive closed-loop control systems for improving grid connection behavior. Thus all the open and closed-loop control functions stipulated by the System Service Ordinance (SDLWindV) have been implemented. In conjunction with the advanced
e.n.o. energy was founded in 1999 and has since then become an established player in the wind energy sector. The group of companies provides for the planning and erecting of turn-key wind farms, for sale or for proprietary operation, as well as their maintenance and operational management. At present the company has 80 employees in Germany, Sweden and France.

Double use for Bachmann hardware
The e.n.o. gridmaster grid management system is also based on Bachmann’s proven M1 controller hardware and is normally used at the grid connection point. “In my opinion, Bachmann’s excellent development environment with MPLS, the SolutionCenter and the Wind Application Box provided us with considerable support in meeting the challenges we faced,” Stefan Bockholt explains another benefit of the Bachmann system. “The software libraries and the very good hardware documentation were also very helpful,” the design manager added. The grid management is used to control wind farms according to the requirements of the grid connection point. This system can also control the active and reactive power output of the individual turbines in the wind farm and can thus ensure the required participation of generation plants in the static voltage and frequency maintenance as required by the SDLWindV Ordinance. Although e.n.o. gridmaster is optimized for turbines of e.n.o. energy systems it is not restricted to these plants: The concept can also be used in so-called hybrid farms in which generator units of different manufacturers are operated.

High proven availability
Practical experience has shown that the requirements placed on the control system have been completely fulfilled. This was demonstrated by the short commissioning period and the smooth test run of the e.n.o. 92 prototype at the Kirch Mulsow site in Germany. The strategic decision to develop a proprietary controller concept was critical for this success. It enabled tests and adaptions to be carried out swiftly right through to the very reliable operation of the entire system. As a result, the prototype could already show a level of availability of over 93% in the first month. Now after over one year of operation and an achieved power supply of 6.5 million kilowatt hours, the turbine is reaching availability levels of between 98 and 99%.

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One of the first Chinese companies to use Bachmann technology was Forward Technology Co., Ltd. The high reliability of the M1 automation system under, at times, extremely harsh climatic conditions was argument enough for the high-tech company, which now integrates complete controller systems for Chinese wind power plant builders.
Forward Technology Co., Ltd. has its headquarters in Chengdu, the provincial capital of Sichuan. Forward develops, produces, installs and maintains control systems and electrical installations for wind power plants, primarily for large systems with a power output of more than one megawatt. With around 150 employees, every year the company supplies the complete control cabinets for more than 1500 turbine controller systems and 500 pitch control systems - and all of these are based on the Bachmann M1 system.

**Passed the acid test**
When Forward evaluated various manufacturers of automation systems in 2007, the M1 system was simply installed straight into a wind turbine in Mongolia. At -25°C the Dongfang Electric Corporation, one of the biggest power plant builders in China and a customer of Forward, took its wind turbine into operation and tested the controller system under the harshest possible conditions. The reliability and availability of the M1 system convinced Forward Technology and Dongfang in equal measure.

**Far-reaching partnership**
The partnership between Forward Technology and Bachmann electronic is far-reaching: together, the two companies develop basic technology and refine the aspects of efficient system integration for wind turbines. “We offer our customers complete solutions, support them with integration into their plant and thus deliver real added value,” says David Zhang, owner and CEO of Forward Technology. The openness and performance of the M1 system is a key contributing factor in these efforts. “In this way we can cater for the individual needs of our customers and are able to design and build wind turbine controller systems which are tailor-made in terms of functionality and cost-effectiveness,” explains David Zhang further.

**Safe remote access**
If required, the company can also take care of the maintenance and servicing of the installed wind power systems. Consequently Michael Gao, Head Engineer at Forward, really values the comprehensive networking options offered by the M1 system: “It is very easy to set up SSL-protected connections via the Internet to the M1 controllers, which then allows us for example to query parameters which are relevant to the maintenance of the wind power plant.” For this purpose Forward supplies its own, highly functional SCADA system for monitoring, controlling and data acquisition from the plants. This allows operators to evaluate the operating data of individual wind turbines or of a complete wind farm at any time.

**A vital contribution**
According to the mission statement of Forward Technology, the company is “driving forward the development of renewable energies, helping to provide technological advances and supplying first-class products and services”. As David Zhang is happy to confirm, “the cooperation with Bachmann electronic is making a vital contribution to this”. At the same time, he is also already looking to the next steps in the near future: the company is set to widen its range by adding the Bachmann safety controller system, a comprehensive condition monitoring system and – last but not least – the use of the Bachmann coldclimate modules for the most climatically challenging regions in the western and northern parts of China.

» The collaboration with Bachmann makes a decisive contribution. «

David Zhang, Owner and CEO of Forward Technology
Just before completion: The nacelle is placed on the tower at a hub height of 142 meters.
Prokon decided a few years ago to build its own wind turbine. Not to assert itself as a new competitor in the turbine sector, “but simply because we were looking for a reliable, low maintenance technology for our own wind farms, and wanted to be less dependent on suppliers,” Albrecht Schöttle, head of turbine development and production at Prokon describes the motivation behind this step. Schöttle knows what he’s talking about: The company has gained over 17 years of experience as an operator of turbines supplied by different manufacturers. Prokon now owns almost 50 wind farms – with around 300 wind turbines in Germany and Poland.

Prototypes on the grid
The first two prototypes of the P3000 turbines will be connected to the grid in 2013: One plant is being erected in Schleswig-Holstein, Germany, and the second in the German state of Mecklenburg-Western Pomerania. The turbine has a rotor diameter of 116 meters, and with a direct drive permanent magnet generator, has an electrical output of 3 megawatts. The hybrid tower of the wind power plant in Cracow (Mecklenburg-Western Pomerania) is not just manufactured from steel alone, but also has 1,500 tons of concrete in its lower section and 110 tons of steel tubing on the upper section. In this way it was possible to achieve in a safe and cost-effective way a nacelle height of 142 m instead of the conventional 94 m of towers made only from steel.

Plant controls of the latest generation – with CMS
The plant controls are based on the Bachmann M1 automation system featuring the latest MC210 processor generation. The Ω-Guard
condition monitoring system from Bachmann is integrated in the controller. This makes it possible to link the measured variables from the sensors directly with other operating parameters, such as azimuth position, wind direction and wind speed. This increases the diagnostic reliability of the condition monitoring: Fault patterns can be compared to the current operating situation and interpreted with greater accuracy. Another benefit: The μ-Bridge sensors from Bachmann are specially designed for safe signal acquisition, even with very slow rotating roller bearings – ideal for the drive train of the direct drive generators of the P3000.

**Supported software development**

The turbine software was developed using the WTE (Wind Turbine Essentials) library as a basis: “Many tasks for the automation of the wind turbine were covered straight away so that we could complete the development and commissioning of the PLC software and visualization in the shortest possible time,” Albrecht Schättle explains with delight.

**Certified safety**

The certified Bachmann Safety Control safety system that is distributed over the tower and nacelle protects the entire plant. It consists of the SLC284 programmable safety controller in the nacelle as well as the remote I/Os in the tower. Furthermore, this does not require any separate cabling: The fiber optic cable between the nacelle and the tower handles the reliable data exchange in the safety chain. Standards compliant grid connection The GMP232 grid measurement module is also integrated in the controller. This measures and monitors the current, voltage, frequency, output and power quality of the two inverter systems on the P3000. It ensures the proper compliance with the so-called grid codes in order to ensure the stability and availability of the electrical supply:
Protection and monitoring functions are thus integrated in the ‘conventional’ tasks of the controller.

**Impressive solution**

Up to 100 turbines are to be built at Prokon each year and the production capacity at the plant in Itzehoe is twice as much. Schöttle explains: “Even if we don’t intend to compete with other vendors with our turbines, this capacity offers far more than merely competitive production and is absolutely state-of-the-art. The P3000 and the subsystems of Bachmann electronic provide us with a reliable and highly cost-effective and technologically impressive turbine.”

Another plus point: The M1 automation system allows a high degree of flexibility whilst still ensuring a high degree of functional integration at the same time.

»*With WTE we were able to complete the development and commissioning of the PLC software and visualization in the shortest possible time.*«

Albrecht Schöttle,
Head of turbine development and production at Prokon
The company concentrates on the development, production and installation of multi-megawatt equipment. The product portfolio encompasses wind energy system types with power ratings between 2 and 6.15 megawatts. For seven years now, Bachmann electronic has been a controller and systems supplier to REpower.

The most successful in its class
Today, Germany’s third-largest wind power system manufacturer can make use of its experience gained in the production, project planning and erection of almost 2,000 wind energy systems worldwide with a total power rating of over 3,000 MW. With these systems, REpower sets standards and repeatedly provides systems that are among the most successful in their class. The highyield and reliable systems are designed in Germany in the REpower development center in Rendsburg and built in the plants in Husum (North Friesland), Bremerhaven and Trampe (Brandenburg).

Partnership-based cooperation
“There has been a close cooperation with the development center in Rendsburg for many years. That includes help with system design and integration of innovative communication tools,” says Klaus Pawlowski, sales representative for Bachmann electronic, and explains further: “We also support REpower in the adaptation of external systems, such as pitch control, or with control integration into higher-level networks based on standards, such as the wind power standard IEC 61400-25.” Further, Bachmann electronic ensures the software compatibility of the various machines with each other and secures the long-term compatibility of the employed M1 automation system. “From one of the first system generations in 2002, the 2-megawatt series ‘mm82’, to the newest systems, such as the ‘6M’ with a power rating of over 6 mega-
watts, REpower has been able to build on the identical software system platform,” says Klaus Pawlowski, describing one of the efforts that Bachmann electronic is happy to make for the successful wind power system builder.

One of the most powerful wind power systems in the world
With the ‘6M’ series, REpower now has one of the world’s most powerful wind energy systems in its portfolio. The automated offshore turbine, also with the Bachmann M1 system, has a guaranteed electrical power rating of 6,150 kW. The system has a rotor diameter of 126 meters with a hub height of 80–95 meters in offshore use and 100–117 meters in onshore use and, when erected on the open sea, can supply electricity to up to 5,400 households. Particularly in the case of offshore use, in which the sea-built systems can be reached for servicing on just a few days due to weather conditions, high reliability of the components used is essential. “The high availability of the Bachmann M1 automation system really convinced us,” confirms Guntram Kunft, Head of SCADA Development at REpower.

Visionary goals
REpower endeavors to establish itself further among the manufacturers of wind energy systems as a supplier of premium products in order to ensure outstanding quality of its products and services in the future as well and remain competitive over the long term. The basis for REpower’s strategic goal of technological leadership is its vision of achieving the price level of fossil-fueled power plants in 2012 through continuous reduction in the price for wind energy. In the research and development area, besides the development of new, high-performance product series, the continuous optimization of existing products and services as well as the further development of essential key components is at the forefront. As expected from a strong partnership, Bachmann electronic as a supplier permanently provides resources to the company.
WIND POWER IS BOOMING

Sinovel is one of the leading suppliers in China

Sinovel Wind (Group) Co., Ltd. is China’s first specialized high-tech enterprise to have independently developed, designed, manufactured and marketed large-scale onshore, offshore and intertidal series of wind turbines that are adaptable to a global variety of wind resources and environmental conditions. Sinovel has been growing by leaps and bounds. They will continue to meet challenges, pursue excellence in a pioneering and creative spirit, strive to build itself into the most competitive wind power equipment manufacturer in the world, and realize the strategic objective of becoming the world’s No.1 supplier.
Sinovel Wind Co., Ltd. is the largest Chinese manufacturer and market leader for wind turbines in China.

wind.application: Mr. Gang, how do you see the general development of wind power in China?

Tao Gang: Wind power plays a key role in climate protection and renewable energy, both in China and of course worldwide. As the Ernst&Young report on the development of renewable energies shows, China is leading the way: More electricity is produced here from renewable energy than anywhere else in the world. Almost every second wind turbine erected worldwide is located in China. The promotion of renewable energy is also part of the national energy strategy: Around 12% of our electricity demand is required to be provided by renewable energy sources by 2020.

wind.application: What are the developments taking place in the offshore sector?

Tao Gang: China’s largest offshore wind farm with a total output of 100 MW was put into operation some years ago: Sinovel erected 34 wind turbines in the 3 MW class very close to the world’s fourth longest bridge, the Donghai bridge near Shanghai, with a length of over 32 kilometers. The farm supplied clean energy to the World Expo in Shanghai and supplies power to around 50,000 homes. The experiences in Europe show that offshore installations belong to the future. I also see this trend taking place in China, particularly on our country’s east coast: There is a huge energy requirement in the rapidly growing industrial cities. The province of Jiangsu and Shanghai have a long coastline with shallow water that is ideally suited for the extensive development of offshore energy. Wind conditions are more stable than onshore, there is no need to build on expensive land, and the distances to the loads are shorter and less expensive to cover.

wind.application: The total potential for energy from offshore turbines in China is estimated at around 750 gigawatts and around 30 GW of this is expected to be installed by 2020. What projects do you have in the pipeline?

Tao Gang: We won the tender for the installation of 600 MW of turbines for the offshore farms near Binhai and Sheyang in Jiangsu province, and thus 60% of the tendered output. We also received the order for a further 800 MW off the coast of Hami (Xinjiang province) and 550 MW off Zhangjiakou (Heibei province). This is impressive testimony to our robust technology and makes us market leaders for offshore turbines in China.

wind.application: You are pioneers in the field of multi-megawatt plants in China, as well as building the first 5 MW turbine in China and equipping China’s first offshore wind farm. Sinovel is a company that is highly driven by innovation. What role does your technology partner Bachmann play now and in the future?

Tao Gang: Bachmann’s know-how and experience enables us jointly to implement advanced and future-proof control solutions. We highly appreciate their application support as well as the training made available for our technical personnel. In future we will be testing the use of the coldclimate modules and the condition monitoring solutions specifically for offshore applications. The integration of safety modules in the M1 automation system for our wind turbines is another project on which we are working. This kind of solution definitely has an important role in the future.
WestWind is one Germany’s leading full-service providers for the development of projects in the wind energy sector. The company’s portfolio ranges from the design of wind farms to the operational management of its own plants or those of third parties. realtimes spoke to Jens Rösler, head of technical operational management at WestWind, about Bachmann’s involvement and about friendships.

**wind.application:** Why do you use a condition monitoring system (CMS)?

**Jens Rösler:** CMS allows us to ensure the early detection of damage in order to prevent the avoidable occurrence of major damage and to optimize the planning of repairs. We try, for example, to move any repairs when possible to the times of weak winds between May and August. The early detection of so-called wear damage, particularly to the bearings of major components on the drive train, and the resulting plannable replacement of components without any major downtimes, ensure the high energy availability of the wind power plants even when damage occurs. Reduced insurance premiums are another attractive spin-off of the use of CMS.

**wind.application:** Why did you choose the CMS solution from Bachmann?

**Jens Rösler:** The innovative and future-proof concept greatly impressed us. Already at our first contact, we noticed that the Bachmann employees are absolutely professional in their work, and are not satisfied with their success to date, but always stay on the ball in order to keep up with the current state of the art. The price and the full-service monitoring offered also impressed us. The entire concept matches the philosophy at WestWind superbly. Since 2009, all plants with gears are equipped with the Bachmann CMS and we are fully satisfied with it.

**wind.application:** Where do you use the Bachmann system?

**Jens Rösler:** All wind power plants with gears belonging to the operational management at WestWind are always monitored by Bachmann Monitoring. This includes an NM 60/1000 (NEG Micon), two AN 1300s (AN Bonus) and seven GE 1.5 sl turbines. These are specifically the Marklohe/Wohlenhausen, Wagenfeld, Frestorf, Frestorf-West and Haustedt wind farms (all in Germany).

**wind.application:** What have been the specific benefits of the Bachmann system so far?

**Jens Rösler:** In the past we had a lot of main bearing damage on the GE installations, faulty generator bearings and two occurrences of damage to gears. One of these occurrences could be repaired on the installation thanks to early detection. At present we have generator bearing damage on a GE 1.5 sl. In the planned repair, it was possible to also replace the partly
damaged slip ring. During the repair it was also discovered that a bearing shield was damaged. The costs for this are around 15,000 euros. In the worst case, the generator could have become a total write-off if there had not been the permanent online monitoring provided by Bachmann Monitoring in Rudolstadt (Germany). Furthermore, this could have occurred in autumn and winter when the best wind conditions are present. The resulting damage, including the loss of yield, would then easily be 10 times as expensive as the repair carried out now.

**wind.application:** What is the daily handling with the system like?

**Jens Rösler:** As we have a contract for full-service monitoring with all installations and have had very good experience with it, we just have to log into WebLog for control purposes. We receive a great deal of support from Bachmann and have a great deal of trust in the experienced Bachmann technicians that daily monitor the measured values. We are always notified of any abnormalities. We also find the regular customer training courses very valuable. The collaboration is simply excellent. It is open and based on trust, in fact one can honestly say that some real friendships have developed from it. We urgently recommend all our existing and naturally also future customers of wind power plants with gears to have their installations monitored with the Bachmann system. We are looking forward to more innovative ideas from Bachmann that will help to further increase the availability of our wind power plants.

**wind.application:** Many thanks for this interview.

» We are completely satisfied with the Bachmann CMS. «

Jens Rösler,
Head of technical operational management at WestWind
AMSC Windtec was founded in Carinthia, Austria, in 1995 and develops comprehensive technology solutions worldwide for wind power generation units with high degrees of availability and efficiency. The system components for the complete automation of the unit come from Bachmann electronic. In a discussion of AMSC Windtec with ‘wind.application’, we describe the company’s business model and report on the successful cooperation between the two Austrian system providers. Since 2007, Windtec has belonged to the American Superconductor Corporation (AMSC). AMSC Windtec employs a total of 130 people at its Klagenfurt (Austria) location, where a team of more than 110 technical experts in the Design and Engineering Center work on developing solutions and on technology transfer for customers.
**wind.application:** AMSC Windtec does not build wind power generation units of its own, but instead markets the technology and components in a concept that you call "Build your own wind turbine". This makes it possible for companies (OEMs) to build their own wind power systems under license. Meanwhile, all successful new entrants in wind energy are your customers. What advantages do you get from your model?

**AMSC Windtec:** We absolutely offers added value as a systems developer. We deliver the technology, whereby the development focus is on the optimal combination of mechanical engineering, electrical engineering and software. Currently, there is no other company in the wind market that can offer a comparable service of »everything from a single source«. In addition, we offer support in building up a local supply chain, in which our customers either produce large components, such as rotor blades, gears, generators and towers, themselves, or suppliers build production facilities directly at our customers’ locations. And so "wind energy clusters" are created. We also sometimes plan the logistics, from the processes to the production buildings. And we offer our customers the know-how for assembly, test, set-up, start up and maintenance of our wind power systems.

**wind.application:** You are developing the technologies for 10 MW wind power systems. How do you see the further performance development of the turbines?

**AMSC Windtec:** If you look at the performance of wind power systems from the mechanical engineering perspective, the systems are disproportionately heavy and expensive compared to their performance. The reason is, the maximum blade top speed is almost constant, and then the torque (which in this context means the same as the costs) grows by the square of the performance. This situation can be countered by sophisticated control and regulation technology, perfect mechanical design and the use of new materials. In addition, the project developer must consider that the costs for transport and building the infrastructure are lower for a few large systems than for many small turbines. And so with advancing technology, larger systems will also become more attractive. There’s no reason at this time to say there won’t be commercial 20 MW systems someday.

**wind.application:** How do you see the development of wind energy in Europe and globally?

**AMSC Windtec:** Regardless of all scenarios and forecasts, we have to face the fact that our fossil fuel resources are going to end. Currently, they meet 79% of the world’s energy needs. That is also the market share that alternative energies have available. And we can still serve this market, since besides hydroelectric power, wind energy is the only economically relevant alternative at the moment. The Global Wind Energy Council assumes scenarios for wind energy that, even in the moderate model forecast an annual growth rate of 12.5% and in the reference scenario of 7.5%. The best market for the wind industry in the coming years is certainly China. There we’re already very well established with a market share of 25%.

**wind.application:** Your wind power systems are characterized by innovation and constant further development. What tasks are given to Bachmann electronic as a technology partner?

**AMSC Windtec:** Bachmann electronic is also a system supplier, just like us. We can both see the "big picture". This means that in our communication with Bachmann, there is never any question who has to do what or why – the central issue is always the end customer’s success. We profit from one another during development because there are excellent ideas on both sides. And we’re also operating in an unbelievably good market, and business is really fun with a partner like Bachmann electronic.
THE TWO BISHOPS

Why it helps to stay human in technology

We at Bachmann would never force people to follow convention but give them the space they need to develop their own abilities. This allows the unfolding of new and unconventional solutions – during a chess break as much as during an impromptu meeting.

We don’t work next to each other but with each other. This provides the basis of trust that also connects our customers. One strategy tip from chess says: Keep the space open for your two bishops to effectively use their enormous scope.

This is what we want to live. Together with you. Every day.