

Issue 02|2019



IMPULSE



Die-casting
machines

Significant investment
at VEM in Zwickau

INDUSTRY 4.0

**MOTOR MONITORING
AND DIGITAL TWINS**

SUSTAINABLE PRODUCTION

**MEASURES FOR ENERGY SAVINGS
AND NOISE PROTECTION**

CONDITION MONITORING – FOR RELIABLE OPERATION AND OPTIMISED MAINTENANCE

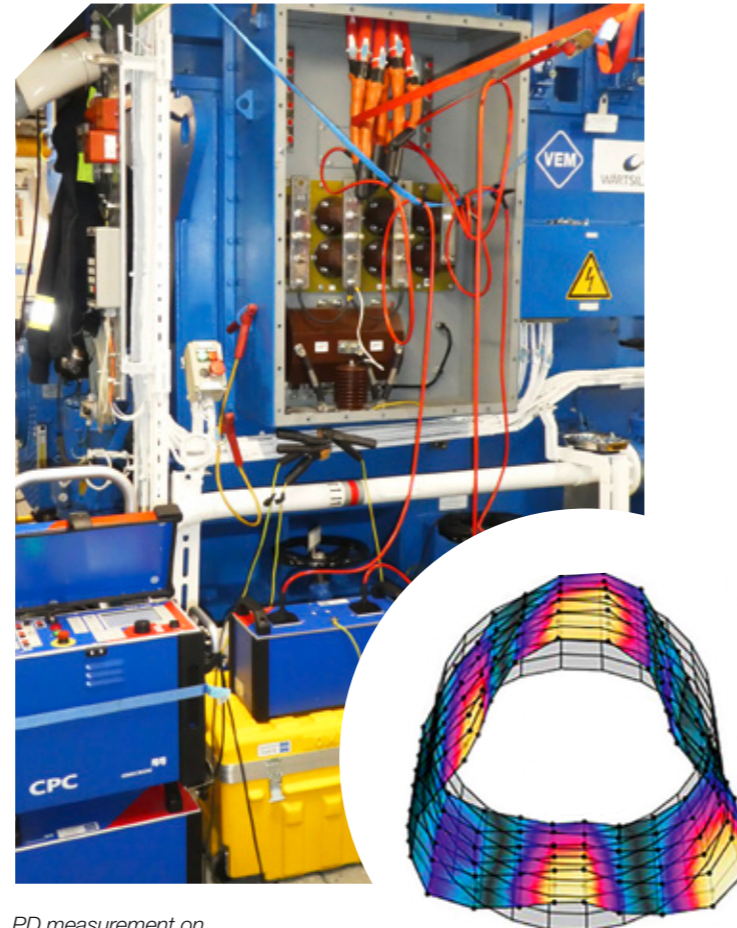
The more measurement data are available to characterise the status of an electrical machine, the easier it becomes to optimise both use and maintenance. “In response to the growing demands expressed by customers, we have expanded our portfolio in this direction and can now offer a comprehensive range of services relating to condition monitoring and life-cycle analyses,” says customer service manager Steffen Liebich. A multitude of electrical and mechanical data are collected and evaluated to determine the machine status.

ELECTRICAL MACHINE EVALUATION THROUGH MEASUREMENTS OF

- Winding resistance
- Insulation resistance
- Partial discharge
- Tan delta
- Shock pulse and inter-turn strength
- Impedance
- Polarisation index (PI)
- High voltage strength
- Thermography
- Supply condition

MECHANICAL EVALUATIONS BASED ON

- Roller bearing diagnosis
- Frequency analyses
- Modal and ODS analyses
- Noise measurements and analysis
- Campbell diagrams
- Field balancing
- Laser-based checking of alignment and erection
- Measurement and analysis of structure-borne noise
- Expansion and displacement measurements on rotating parts
- Stress analyses with DMS systems



PD measurement on a marine generator using the Omicron system

Analysis of stator core vibration

The measurements can be performed during commissioning – as a so-called initial fingerprint – or else at any later time during operation, preferably at regular intervals, as chosen by the customer.

“For PD measurements, we use measuring systems from Omicron, which can be seen as the standard solution for online and offline measurements of this kind,” says Liebich. “For the mechanical measurements, we use devices from DBPrüftechnik for standard tasks and the Brüel & Kjaer system Pulse for more complex diagnoses.”

Data acquisition, however, is only one half of the story. The VEM service personnel can also rely on a wealth of know-how from many years of product development and manufacture. When faced with difficult problems, this provides an ideal foundation for competent customer advice and successful implementation of the agreed solutions. In this way, our service department is in a position to elaborate optimised maintenance concepts together with the operator and subsequently to guarantee reliable operation without unplanned downtimes.

DRIVE TECHNOLOGY MADE FIT FOR INDUSTRY 4.0

With electronic documentation and identification, alongside the monitoring system VEMoDiAC, VEM has taken important steps to promote digitisation.

The acquisition and smart combination of data also opens up new possibilities and paths for development in the world of drives. With the electronic catalogue eKAT, VEM has already been providing its customers with relevant data for many years. That has applied above all to its standard and transnorm motors, as well as converters of the VEMoD-RIVE series.

The provision and management of digital data parallel to the actual product, in other words the ordered motor or drive system, is becoming increasingly important. This includes not only static information such as CAD data, documentation, certificates or an electronic rating plate, but also various dynamic data, for example schedule tracking during manufacture, the maintenance history of a motor or data relating to particular events or even downtimes.

Online digital twin

To make these data accessible, VEM will in future be using a combination of the VEM online portal (vem.info) and SAP AIN (AIN = Asset Intelligence Network). Via the URL <https://vem.info/motor number>, users can access the VEM portal where the motor data and documentation are stored. This also satisfies the demand for a link to electronic documentation contained in IEC 600341.

Further data can be made available via a gateway to SAP AIN. The variable classifications used in SAP AIN are essentially those defined in eCI@ss. This serves to standardise the possibilities for digital access. The SAP AIN functionality is to be rolled out step by step from November 2019. SAP AIN will also realise the linking to VEMoDiAC.

Motor identification based on DIN SPEC 91406

From November 2019, the majority of motors supplied by VEM will bear a QR code enabling unambiguous and electronic identification of the motor worldwide. The QR code incorporates a text string made up of a URL assigned specifically to the manufacturer and a unique manufacturer-defined serial number, for example

“<https://vem.info/1234567890>”. One important benefit of this ID is that it can be used directly for access to the VEM portal.

The QR code added to or attached alongside the rating plate is designed with a surrounding margin and a small triangle in accordance with DIN SPEC 91406, so as to distinguish the code from any other QR labels which may be present. To safeguard reliable identification of the motor even after many years of use in tough environments, it is furthermore possible to supplement with QR code with an NFC chip.

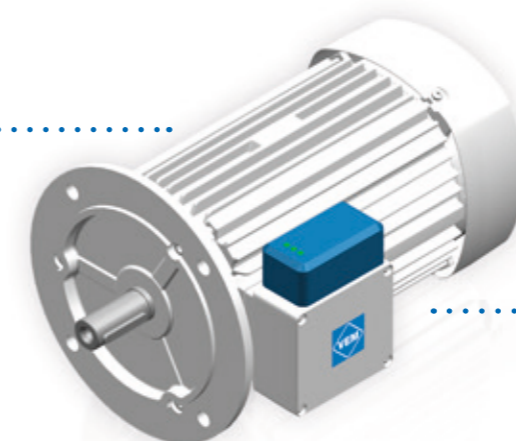


Rating plate for a VEM motor from the Zwickau product range

Transparent motor with VEMoDiAC

Energy management, predictive maintenance or operating data acquisition – the motor monitoring system VEMoDiAC covers numerous applications. VEMoDiAC will be launched for VEM motors up to 30 kW and up to 400 V at the SPS 2019 trade fair.

There are three components to the monitoring system: VEMoDiACSens, VEMoDiACGate and VEMoDiACCloud. The sensor module VEMoDiACSens takes care of the required measurements, for example current, voltage, output, temperature and acceleration. Via the on-board WLAN of VEMoDiACGate, the data are then collected and pre-processed before transfer to VEMoDiACCloud. All measurement values are subsequently available for convenient recall, enabling management of the motors and further analysis of their data via a corresponding dashboard. It also remains possible to retrieve documentation, spare parts lists and certificates and to view the past maintenance and event history.



SOFT STARTER FOR ROTARY CONVERTERS

VEM Sachsenwerk GmbH has developed a new technology for the soft-starting and synchronisation of 10 MVA synchronous-synchronous railway converters together the company F&S Prozessautomation GmbH. The background lies in the plans of Norwegian and Swedish railway operators to purchase converters no longer needed by their German counterpart DB Energie and to install them in substations in Scandinavia after a corresponding overhaul. The railway power supply there is identical to the German system in terms of voltages and frequencies. Due to the general network topography with its long distances, however, the 50 Hz supply system is significantly weaker in its design than is the case in Germany. The new soft-starter technology will enable use of the DB converters in a manner which reduces the stresses placed on the machines and the system.

On the basis of experience from overhauls of traction converters over the past 10 years, and with a view to maximising the service life of the converter in future use, VEM recommends adoption of the newly developed solution without starter transformer and thus without the heavy stressing of the machine caused by switching during starting and synchronisation of the synchronous motor. Given the much lower starting current and the significantly reduced mechanical stress during starting, it is furthermore no longer necessary to limit the number of starts per day, which in turn paves the way for entirely new concepts for "timetabled" converter use in railway operations. VEM also sees this as the correct way forward with regard to energy savings and the maintenance costs for the already aging synchronous-synchronous converters. As a special feature, a new control system was developed to enable a rotor-synchronised current block supply to synchronous motors without or with only negligible attenuation and with distinct poles on the pole wheel

in situations of low counter-torque. A method for the subsequent synchronisation of railway converters to the single-phase traction system and the incoming three-phase supply was similarly integrated. Compared to LCI- and IGBT-based solutions or frequency converters, this serves to save both cost and space. The need for matching transformers is also eliminated. These benefits make the process particularly interesting for special applications.

Under the aegis of VEM, the soft-starter was installed at the railway substation in Bützow together with F&S and DB-Energie and fully integrated into the existing control system. It was subsequently tested successfully under operational conditions during June and July of this year. VEM remains in close contact with the operators in Scandinavia with a view to realising the next step of a trial installation in Scandinavia, demonstrating the operational reliability and gaining the acceptance of the responsible decision-makers.



The soft-starter developed especially for VEM to enable the stress-free starting and synchronisation of 10 MVA synchronous-synchronous railway converters. Photo: F&S PROZESSAUTOMATION GmbH



Arrival in April 2019: A mobile crane was necessary to lift the machines from the delivery trucks.

Investment

NEW DIE-CASTING MACHINES TAKEN INTO SERVICE

The new plant brings significant benefits for both production and the employees at the VEM location in Zwickau.

"That was quite something! And I am really happy that we managed it all so well," says Stefan Werner. The supervisor from the magnet body workshop at VEM in Zwickau is visibly relieved and proud. After all, it is not every day that new production machines are installed. And it is seldom the case that this needs to be realised practically from one moment to the next. Dismantling and erection parallel to production poses numerous challenges.

Technologist Marco Kahnes was involved in planning for the million-euro investment from the very beginning and his opinion carried weight in the selection process for the new die-casting machines. The decision fell in favour of the German engineering company Frech, whose machines are actually manufactured in China. It was a wish expressed by the Chinese owners of VEM that due consideration should be given to the Chinese market in connection with machinery purchases.

Benefits are evident

"The preparations included dismantling of the old machines, breaking-up of the old foundations and the casting of suitable channels for all required media in the new foundations," Marco Kahnes explains. At the same time, the hall received a fresh coat of paint and better lighting. The extraction systems at the machines were completely overhauled and now remove the

vapours much better than before. "Everything is brighter and cleaner, and you could say it is now our most attractive hall," says Stefan Werner. "We now have a really pleasant environment for the casting of rotor bodies and other solid components."

One welcome side effect complements the technical benefits, namely enhanced safety for the employees. The two die-casting machines are identical and permit 100% protection of the production process. The quality of the die-cast parts, in particular, has improved tremendously. On the old machines, every component differed very slightly in the end, even if this was not immediately detectable from outside. Consequently, costly destructive testing used to be imperative in order to be serve the customers reliably. Stefan Werner is understandably delighted: "That is now a thing of the past, and all castings display the same, constantly high quality." To safeguard this high quality, the employees working with the new machines received a full week of theoretical and practical training.

New aluminium melting furnaces, in which the aluminium bars are melted down directly at the machine, were also purchased in the course of the investment and similarly raise labour safety in Zwickau. All in all, the new plant achieves energy savings of 30 per cent – and that is good for both the factory and the environment.

China

Shanghai

DRIVES FOR POLYETHYLENE PRODUCTION

VEM involved in the largest on-going petrochemical project in China.

A gigantic integrated refinery and petrochemical complex is currently being built in the Chinese city of Zhoushan in Zhejiang Province. VEM is supplying electric hyper and booster drives and further drive systems for the LDPE (low-density polyethylene) plant.

As just one of several new industrial locations, the refinery and petrochemical complex is an element of China's current national economic development plan.

The plant is being built on Zhoushan Island, which many consider to be the most beautiful island in China.

East China Sea

Hangzhou Bay

Zhoushan Island

Zhoushan City

China

ACTIVITIES FOR ENERGY SAVINGS AND NOISE PROTECTION

The first splitter silencers have already been installed on the central ventilation system.

Sustainability and environmental protection are important priorities for the VEM Group. That also applies in respect of the various production processes. At the Wernigerode location, two improvement measures are currently being implemented.



Measure 1: Replacement of the thermal exhaust-air purification

It is a well-known fact that stator impregnation using unsaturated polyester-imide resins results in undesirable organic emissions. The authorities also apply strict rules with regard to purification of the contaminated exhaust air. The thermal air purification system in use at the VEM location in Wernigerode has reached the end of its service life after 25 years in operation and must be replaced.

A new thermal purification system is currently being designed for incorporation into the existing ventilation of the impregnating shop. The organic substances in the exhaust air can in this way be reduced to short-chain components, which are subsequently not damaging for the environment. A second plus for the environment: The process heat can be recovered to heat the drying ovens in the shop, to warm the exhaust air ahead of purification and to support heating of the hall. This enables considerable energy savings. To avoid any loss of production, the system is to be replaced without interrupting normal operation. The replacement is expected to be completed by the late autumn.



Measure 2: Noise improvements in the annealing shop

The annealing process serves to improve the electromagnetic properties of electrical steel, to relieve stresses in the material and to achieve a certain degree of surface protection. Special noise control guidelines apply where annealing plants are located in the vicinity of residential areas.

At VEM in Wernigerode, therefore, a so-called noise register was drawn up to specify the precise noise values which must not be exceeded by the individual plant- and ventilation-related noise sources.

On this basis, silencers have now been installed at 32 different air outlet points in the production hall. These include both inline and splitter silencers, as well as insulating enclosures. The installation has been accompanied by corresponding construction work on the building. It was necessary, for example, to verify the structural strength in view of the additional loads. Furthermore, various substructures were required to distribute the loads which the silencers place on the building structure. The work is scheduled to be completed by the autumn.



FAIR YEAR 2019 CONTINUES

VEM will be attending trade fairs in Gdansk, Bangkok and Nürnberg.

We look forward to presenting our branch-specific solutions for railway engineering, the oil and gas sectors, the maritime industry and electrical automation at further major events up to the end of the year.

TRAKO
International railway fair
Gdansk/Poland
from 24th to 27th September

OGET/TMOX
Oil, gas and petrochemical exhibition
and marine expo
Bangkok/Thailand
from 9th to 11th October

SPS
International trade exhibition for electric
automation systems and components
Nürnberg/Germany
from 26th to 28th November

PREVIEW 2020

You can also meet VEM at numerous trade fairs in 2020. The following dates can already be noted in your diary:

- **RAIL Live** Madrid, 31.03. – 02.04.2020
- **TOC Asia** Singapore, 21. – 22.04.2020
- **TOC Europe** Rotterdam, 09. – 11.06.2020
- **Electric & Hybrid** Amsterdam, 23. – 25.06.2020
- **SMM** Hamburg, 08. – 11.09.2020
- **Innotrans** Berlin, 22. – 27.09.2020

SYNCHRONOUS RELUCTANCE MACHINES WITH IE5 EFFICIENCY

VEM launches a new generation of energy-saving motors with numerous benefits.

The designers at VEM have developed a new generation of synchronous reluctance machines (SynRM) for sizes 80 to 132. It is thus now possible to supply machines of this type for the entire output range from 750 W to 7.5 kW. The full torque-speed range is covered across all standard pole numbers for each shaft height. The SynRM motors possess identical external dimensions and achieve efficiency level IE5 as defined in IECTS 60034302 at their respective

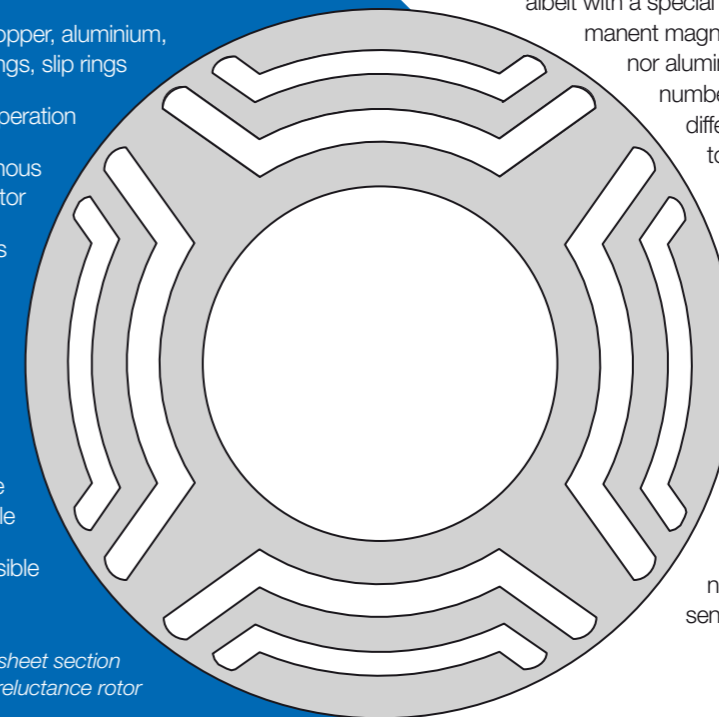
rated operating point, without requiring a position sensor. Another interesting benefit is that it is possible to use a converter of the same size as for an IE3 asynchronous machine with comparable output. This reduces investment costs and shortens the payback period.

Distinguishing feature is the rotor

The rotor is the only distinguishing feature between a synchronous reluctance machine and a standard asynchronous machine with squirrel-cage rotor. Apart from the solid shaft, the SynRM rotor comprises exclusively punched electrical sheet, albeit with a special structure. There are thus no permanent magnets and similarly neither copper nor aluminium on the rotor. This has a number of advantages, but also places different demands on the processes to design and manufacture such machines. A torque can only be produced if the voltage in the stator winding is delivered correctly in accordance with the rotor position. Unlike an asynchronous machine with squirrel-cage rotor, therefore, the synchronous reluctance machine cannot be operated directly on the mains and must always be fed via a suitable converter. One particular challenge is to eliminate the need for a corresponding position sensor.

Synchronous reluctance machines at a glance

- Rotor structure without copper, aluminium, permanent magnets, windings, slip rings
- Only suitable for converter-fed operation
- Design identical to an asynchronous machine apart from the rotor
- Practically no rotor losses
- Higher partial load efficiency
- Lower moment of inertia in the rotor
- No use of rare earth materials
- Wider speed-torque range possible
- Compact converter possible



Efficiency of the electrical machine in converter-fed operation at 1500 rpm, according to IEC TS 60034-30-2; savings calculated for continuous duty at the rated operating point for 8000 h

Output	IE2	IE3	IE4	IE5	Saving IE4 to IE2	Saving IE5 to IE3
750 W	77.2%	80.4%	83.9%	86.6%	620 kWh	534 kWh
1 100 W	79.2%	82.1%	85.6%	88.1%	831 kWh	730 kWh
1 500 W	80.7%	83.5%	86.7%	89.1%	1 029 kWh	903 kWh
2 200 W	82.4%	85.0%	88.1%	90.0%	1 382 kWh	1 150 kWh
3 000 W	83.7%	86.1%	89.1%	91.0%	1 738 kWh	1 501 kWh
4 000 W	84.9%	87.1%	89.9%	91.8%	2 096 kWh	1 881 kWh

CLOSING THE GAP IN OUTPUT SERIES

Jens Proske appointed CTO of the VEM Group with effect from 1st July 2019

The calculation of electrical machines has been Jens Proske's profession and dream job ever since he completed his studies at the Dresden University of Technology. When he took up his job as calculation engineer at the VEM location in his home city of Dresden 20 years ago, he had already worked for several years with a major manufacturer in Bremen and as an assistant at the Chair for Electric Machines and Drives at Dresden University. On 1st July 2019, Jens Proske was appointed to the newly created position of technical director (CTO) of the VEM Group.

The stops along his career road with VEM include management responsibility for the calculation department at VEM Sachsenwerk, which he assumed in 2002 as one of the youngest members of the team. The tasks of his department have since grown constantly in line with the expanded VEM product portfolio. The number of employees has also increased, and Jens Proske has repeatedly demonstrated keen judgement in his recruitment decisions. "The work climate and content are simply ideal," he sums up in his typically succinct and precise manner.

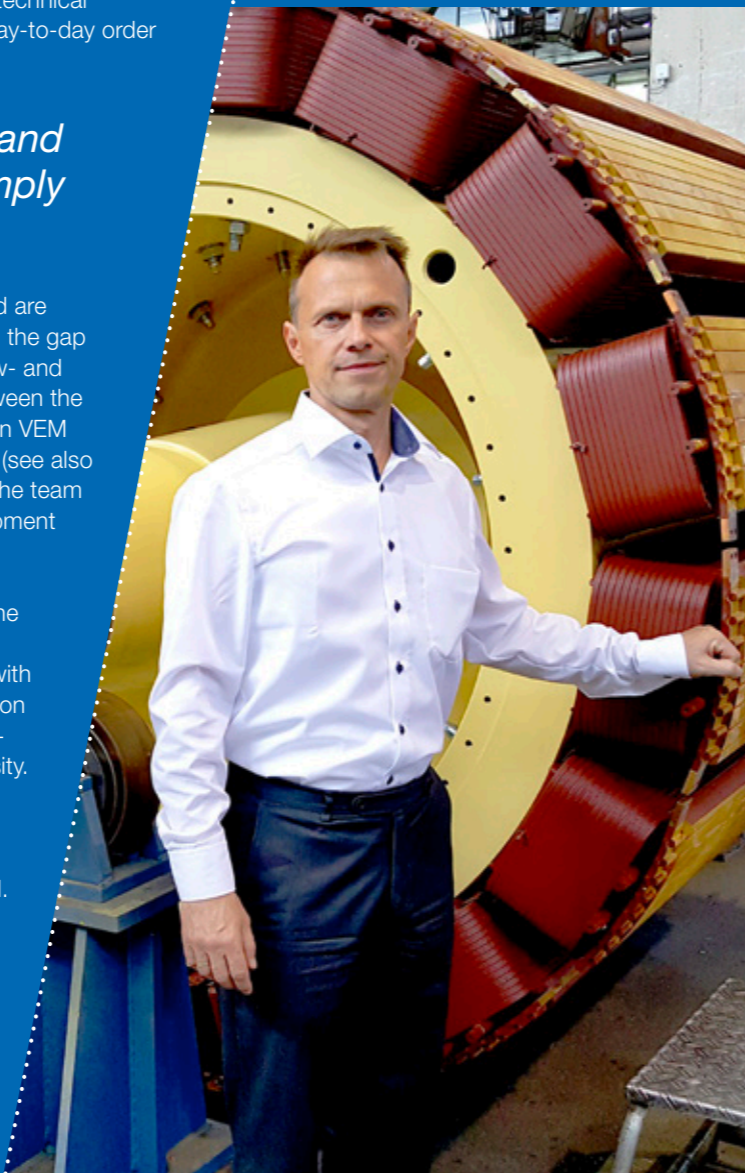
Two years ago, the department began to take on development tasks for the other VEM locations, with a particular focus on new products. "There are technical and financial benefits to be gained by concentrating central tasks for the whole group at one location," Jens Proske explains. This is also a reference to the continuous and longstanding cooperation with universities and institutes in the immediate area. The other locations are nevertheless involved in all developments realised in Dresden.

Jens Proske: "Furthermore, we are able to develop complete series of electrical machines without tying up capacities which are needed in the technical departments to handle day-to-day order processing."

"Work climate and content are simply ideal"

The tasks which lie ahead are clearly defined. Currently, the gap in the output series of low- and high-voltage motors between the Wernigerode and Dresden VEM locations is being closed (see also page 11). Prominent on the team agenda is further development of the new unified series UR 2.0.

The UR 2.0 will replace the present motor series for industrial applications – with new cooling, new insulation system and thus a significantly higher power density. This new series will then also be manufactured in China, the home country of the new owner of VEM.



Jens Proske (52) is married and has three children. A 50-hour week leaves little scope for hobbies. His spare time is devoted above all to the family and to his house and garden.

MODULAR DESIGN CHARACTERISES NEW SURFACE-COOLED MOTOR SERIES FOR LOW AND HIGH VOLTAGES

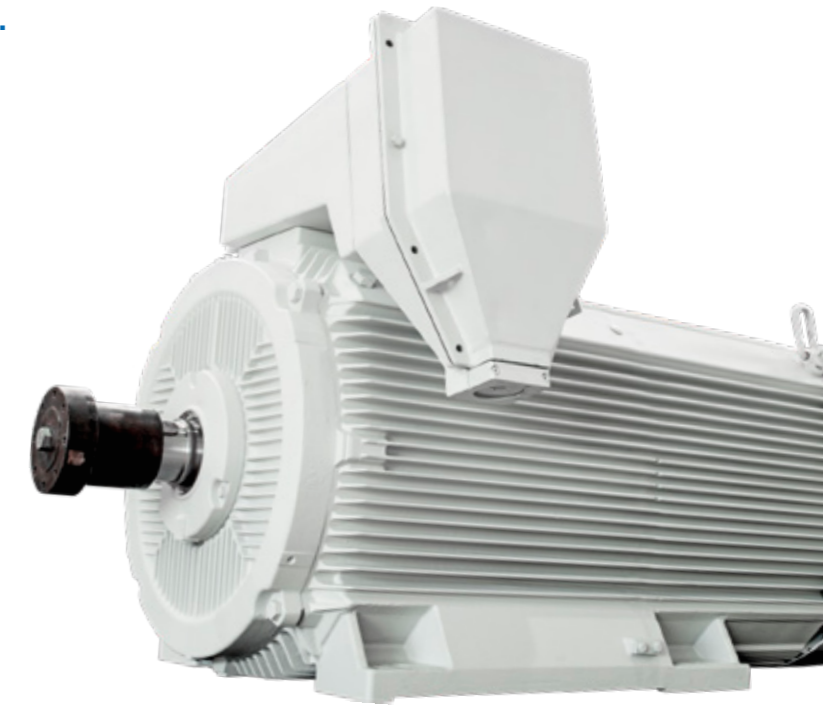
VEM now offers a series of exclusively surface-cooled motors. The development is a product of close cooperation between the VEM locations in Wernigerode and Dresden.

The compact series in sizes 355, 400 and 450 is designed on a modular basis. These three shaft heights cover outputs from 180 kW/11kV to 1500 kW/690 V. Drives with a shaft height of 450 are offered and sold with pole numbers from 2 to 8.

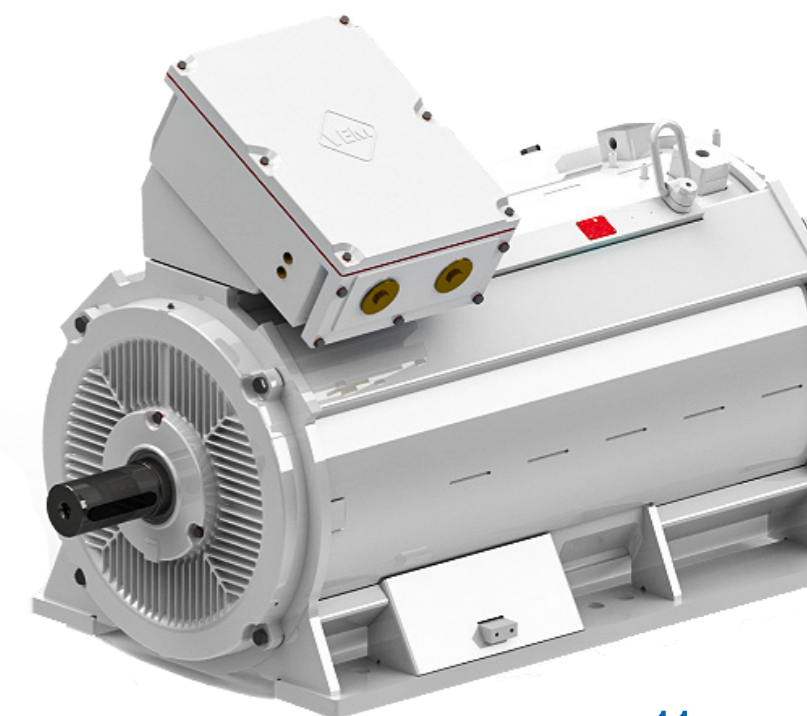
One objective of the development was to use as many identical components as possible within the modules. By combining different modules, e.g. different housings or rotors, a broad diversity of motor variants can be created. After replacing a ribbed cast-iron housing with a welded water jacket, for example, the motors can be cooled with water instead of air. In a similar manner, a stator core with low-voltage winding can be replaced with a core with high-voltage winding. With regard to the rotor, the customer can choose to use either a squirrel-cage rotor in die-cast aluminium or a rotor with permanent magnets.

Medium-size machine under development

The VEM location in Dresden is presently working on further expansion of the motor series to include shaft height 500. At the same time, development of the air-cooled Ex "d" series continues. This development will enable cost-efficient products for outputs up to 2240 kW to be offered as high-voltage machines. For the Dresden location, it will thus become possible to produce a favourably priced medium-size machine with short delivery times. The Wernigerode factory, in turn, has recently been able to extend its product and output range in the low-voltage segment from 700 kW to 1070 kW.



Air-cooled high-voltage machine with shaft height 400



Water-cooled low-voltage machine with shaft height 400

SUCCESSFUL PRODUCTION START

The new VHC23000 XTS machining centre at VEM in Wernigerode (photo) has been taken into service as planned (see also Impulse 1/2019). After a short running-in phase, the special machining centre for shaft ends is now delivering the desired results for all required shaft heights.



DRIVES FOR STEEL MILL IN THE USA

VEM has received a major order in connection with the expansion of a steel mill in the USA. The order comprises main drives, auxiliary drives and roller table motors in sizes from 132 to 710. They are to be manufactured at the VEM locations in Dresden and Wernigerode. Delivery is scheduled for 2020.



New foot drilling machine in Zwickau

VEM is investing heavily at the Zwickau location. In addition to the new die-casting machine (see page 5), a new foot drilling machine has also been commissioned. Thomas Klemm (photo) was one of the first employees to enjoy the benefits. In addition to the enhanced variability, the new machine provides for greater flexibility in the individual work processes, can be retooled faster and guarantees even higher quality.

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