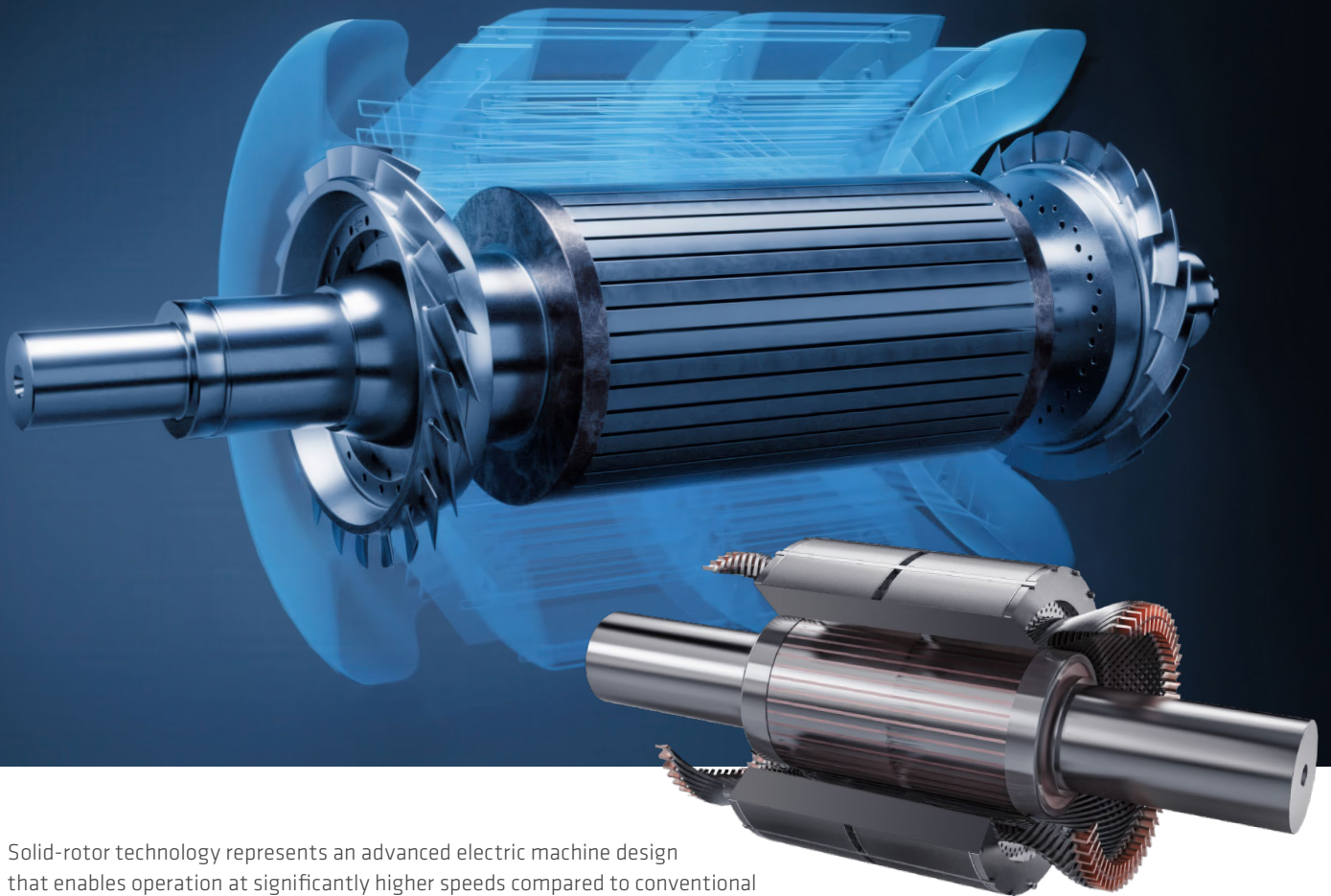


Pushing the limits: Solid-rotor technology for high-speed applications



Solid-rotor technology represents an advanced electric machine design that enables operation at significantly higher speeds compared to conventional laminated rotor construction.

At lower speeds of around 6,000 rpm, several viable technologies are available. As speed increases, maintaining mechanical integrity becomes more difficult.

Solid-rotor technology was developed to address exactly this issue.

The technology allows an electric machine to **run at higher operating speeds** while maintaining reliable rotor balance and mechanical integrity.

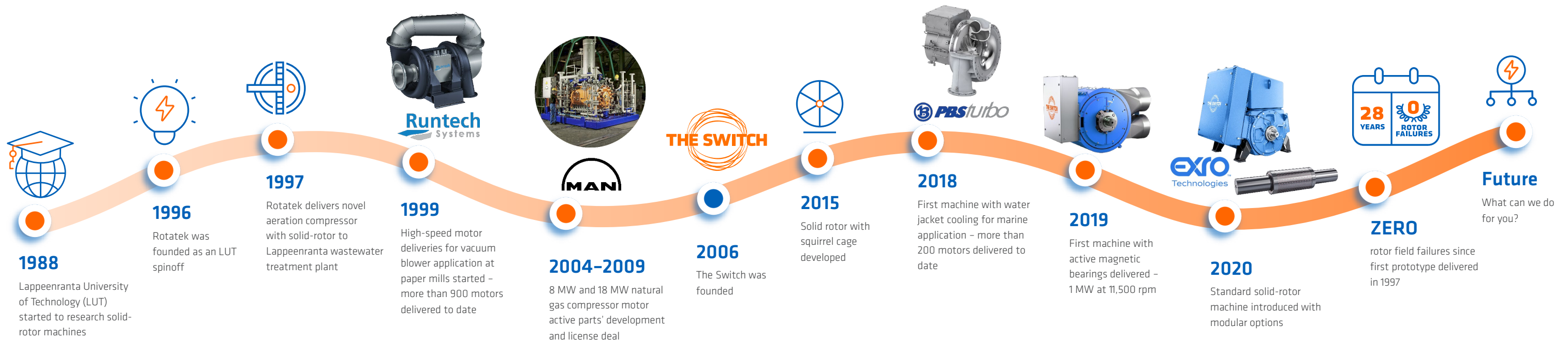
This capability fills the gap between low-power applications – below 200 kW – and multi-megawatt systems technology.

WHAT IS SOLID-ROTOR TECHNOLOGY?

In its simplest form, an electric machine solid rotor is made from a single piece of metal, rather than being built up from laminated steel sheets or multiple assembled components.

Depending on the application, the rotor can be used in its basic form or enhanced with features, such as conductive end rings or a squirrel cage structure, to improve electrical performance.

SOLID ROTOR MILESTONES



Why choose solid-rotor technology?

- **Mechanical robustness and stiffness** – stable and low-vibration operation at high speeds
- **Simple construction** – no laminations and fewer elements for better stability
- **Thermal robustness** – less sensitive to temperature variations
- **Direct-drive operations** – eliminates the need for a mechanical gearbox
- **Reduced system complexity** – lower maintenance needs and smaller footprint

HOW DID THE DEVELOPMENT OF SOLID-ROTOR TECHNOLOGY BEGIN?

The development of solid-rotor technology was driven by the need to operate at higher rotational speeds while maintaining reliable rotor balance. It is based on widely used induction motor technology, which was invented over 100 years ago.

The origins of The Switch solid-rotor technology date back to research at the Lappeenranta-Lahti University of Technology (LUT), Finland, in 1988.

Over the years, a simple solid rotor evolved to improve overall machine performance, including modifying the stator, introducing slotting, and adding features like end rings or a squirrel cage. Some of these solutions are still present in today's products. The real test came when improving the simple rotor construction for real industrial use.

Nearly 3 decades of success

- The Switch has delivered more than 1,000 high-speed solid-rotor machines for various applications
- Zero rotor failures since 1997 when the first prototype was delivered
- Mostly used in compressor applications, especially vacuum compressors, which require high rotational speeds, compact design and high reliability

Collaboration with LUT continues

The Switch and LUT collaboration has been continuous over the past 20 years across many different areas. The Switch contributes practical applicability to university research projects, while LUT supports the research on topics. Located in the same city, The Switch also turns to LUT laboratories to carry out endurance tests that cannot be done at The Switch's own facilities.

This long-term cooperation between industry and academia also brings many benefits to customers. Research has focused on continuously developing The Switch solid-rotor machine technology, its bearing solutions and cooling systems.

SUCCESS CASES



Vacuum compressor for paper mills

- Semi-integrated direct-drive motor for vacuum turbo compressor
- Ongoing deliveries of 9,500 rpm motors
- Deliveries since 1999



High-speed electric motor for marine application

- Drives a turbo blower in an exhaust gas recirculation application
- Enables large two-stroke engines to reach IMO Tier III emission standards
- First machine with water jacket cooling

OTHER APPLICATIONS THAT CAN BENEFIT

Heat pumps are the future

- Megawatt-class heat pumps for the green transition
- Reduce dependency on fossil fuels
- Improve energy efficiency in industrial processes and district heating

Energy storage shows big potential

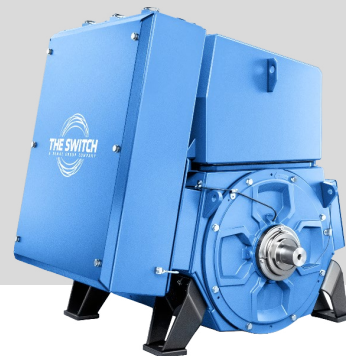
- Flywheel energy storage systems are becoming viable

HIGH-SPEED, HIGH-POWER SCOPE

Speed range: 6,000–20,000 rpm

Power range: 300 kW to over 2 MW with medium-voltage technology

- Compressors
- Blowers
- Pumps
- Vacuum systems
- Test benches



■ The Switch is part of the BEMAC Group.

THE SWITCH LOCATIONS

Finland

Helsinki, office
Lappeenranta, factory
Vaasa, factory

China

Beijing, branch office
Lu'an, workshop

Norway

Stord, factory
Trondheim, office

Japan

Imabari, BEMAC head office