



# A Question of Distribution





Unregulated distribution networks are still the norm around the world. However, the disadvantages are evident every day in emerging markets as well as in industrial centers. The future belongs to regulated distribution transformers.



It's touch and go every day: Will the voltage remain stable? Or is today the day when it happens? Network operators, industrial consumers, energy suppliers and transformer manufacturers worldwide are familiar with these concerns: They are all faced with the challenge of maintaining a stable voltage in the precariously balanced medium- and low-voltage networks and of securing an optimal voltage band – today, and in the future. It all revolves around the question: What is the role of distribution network transformers in this situation?



Jorge Leiva,  
TTE,  
Buenos Aires

**“With VRDTs, we can manage volatile supply, load fluctuations, and feed-ins from decentralized generators.”**

One thing is clear: everyone wants a stable voltage band. But the causes of voltage problems often differ fundamentally from one country to the next: On the one hand, suppliers in the highly developed industrial countries are struggling with the integration of renewable energies. On the other hand, many economically weaker countries are faced with networks with a tight short-circuit capacity, long transmission distances, and volatile consumers and generators.

#### CONTROLLING THE VOLTAGE

Jorge Leiva, who is responsible for research and development at the Argentinean transformer manufacturer TTE in Córdoba, is currently investigating how the integration of the new ECOTAP VPD on-load tap-changer from Maschinenfabrik Reinhausen (MR) influences the design of distribution transformers. Together with his colleague Pablo Arrascaeta and a team of engineers, he is currently developing a prototype.

Although energy consumption is continually increasing in this South American nation, operators are lagging behind considerably with the expansion of their networks. This results in high voltage fluctuations, which regularly lead to equipment damage and faults in production processes. TTE developer Leiva explains: “Since we are also affected by the volatile voltage, we will use the prototype to supply stable voltage to our test facilities for the transformers that are produced on site. This means that, in addition to regulated transformers, we can also demonstrate reliable tests to our customers.” Franco Pizzutto, Business

Development Manager at MR, sees the protection of industrial processes as an application area with great potential: “Voltage regulated distribution transformers (VRDTs) with ECOTAP VPD can benefit all those who operate their own distribution network and need to control sensitive processes with volatile medium voltage such as, for example, industrial companies or hospitals.”

Although renewable energies such as solar power or wind farms still play a minor role in Argentina, the Ministry of Energy and Mining is already generating significant momentum for growth. This primarily concerns farms above the ten-megawatt class. TTE developer Leiva, however, is expecting new network connection guidelines, which will also allow decentralized generators with smaller power outputs to connect to the network. “In such an environment, regulated distribution transformers can perform to their full potential and manage the problems of volatile supply, load fluctuations, and feed-ins from decentralized generators.”

#### THE END OF THE ONE-WAY STREET

The situation is different in highly developed industrial countries, which are already a step ahead in terms of renewable energies. The challenge for distribution networks here has less to do with the large wind and solar farms that are found, for example, in Spain, as these transfer the recovered energy directly to the high-voltage networks. Instead, it is the small and extra-small decentralized feeders at the medium- and low-voltage levels which cause particular problems for suppliers because the distribution networks have been designed as one-way streets.

In Germany, however, the networks are now characterized by rapid two-way traffic, as the German legislature wants at least 80 percent of the power supply to be covered by renewable energies by 2050 at the latest. In the last few years, generous subsidies have created a boom in wind power, biogas and photovoltaic plants (PV) – with impressive figures: Over 1.5 million solar plants now supply more than six percent of the German electricity requirement. And the trend is rising. According to the Fraunhofer Institute for Solar Energy Systems, more than 98 percent of the solar power plants in Germany are connected to the regional decentralized low-voltage network. In many regions, more electricity is generated than consumed on sunny days. The load flow then turns around and the generation-driven energy recovery significantly exceeds the original reference power for a while. The networks reach their intake limits, and voltage fluctuations occur.

However, large-scale suppliers, such as Avacon AG and Bayernwerk AG, which belong to the E.ON Group, must guarantee a voltage band of plus/minus ten percent, while at the same time continually connecting additional



renewable energy providers. Franco Pizzutto brings the VRDT into play: "Since 2008, we have been working with transformer manufacturers and network operators to research how to support voltage band compliance with VRDT. We also focused on the optimization of network topologies, and how to reduce or avoid the costs of complex network extension measures."

## SUNSHINE OVER BAVARIA

The largest regional network operator in Bavaria, Bayernwerk AG, is particularly affected by the PV boom. On sunny days, the Bavarian company has to accept up to 5,600 megawatts of solar power from more than 255,000 generators and transport it from the countryside to the cities and other load centers via the low-, medium-, and high-voltage networks. Electrical engineer Sebastian Schmidt is responsible for research and development activities at Bavaria's largest large-scale supplier and explains: "We have to anticipate such developments. A classic network expansion with new cables and additional transformer stations takes decades, and is correspondingly cost and labor intensive. Therefore, we are always looking for alternative ways to optimize our networks." It is this search that led Bayernwerk AG straight to MR. Schmidt adds: "MR had already established itself as a reliable partner in the field of high- and medium-voltage tap-changers, which have made it possible to dynamically adjust the voltage level, especially in medium-voltage networks that are characterized by feed-ins. Together, we have worked intensively on the development, standardization, and use of regulated transformers for distribution networks within the framework of group-wide research projects."

## ADDITIONAL BANDWIDTHS

Bayernwerk affiliate Avacon AG played a leading role in the development. In addition to the feed-in of solar power, the German large-scale supplier, which is located in the north of Germany and is one of the country's largest regional energy service providers, focuses on wind energy and biomass plants. Stefan Henssen, who works in the field of distribution network technology, reports additional problems: "Many wind farms feed directly into the medium-voltage networks; at the same time, the distribution networks are becoming increasingly volatile. Therefore, we have to manage a fluctuating supply voltage. The VRDT is ideal for this task, as it decouples the medium voltage from the low voltage and creates additional bandwidths."

In addition to the technical parameters, the network planners focus primarily on investment and operating costs for all network optimization measures. Avacon technician Henssen explains: "In order to be able to replace →



Distribution networks were designed as one-way streets, but they are now characterized by rapid two-way traffic. VRDTs ensure a stable voltage band.

"We're always looking for alternatives to improve our networks."



Sebastian Schmidt,  
Bayernwerk AG,  
Bamberg

## REINHAUSEN INSIDE

**Regulated distribution network transformers** keep the voltage in distribution networks stable, compensate for fluctuations in the medium voltage and respond to changes in feed-in and load at the low-voltage level.

The **ECOTAP VPD** turns rigid distribution transformers into intelligent regulating transformers. The most important features of the new tap-changer:

- Maintenance free for up to 500,000 tap changes due to vacuum technology
- Most compact tap-changer worldwide
- Suitable for synthetic and natural esters as insulating liquid
- Large regulating range yet fine grading

[www.reinhausen.com/ecotap](http://www.reinhausen.com/ecotap)