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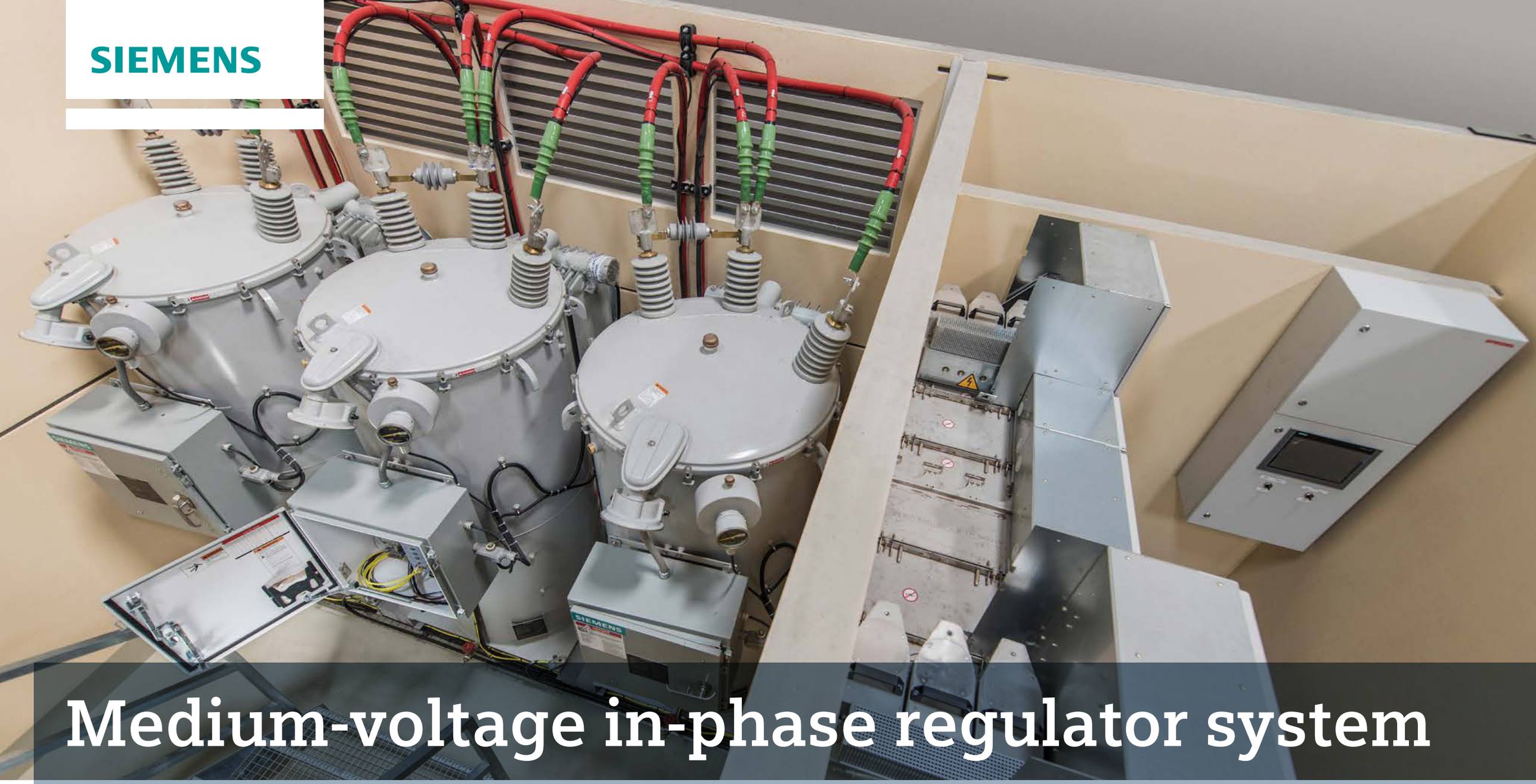


Medium-voltage in-phase regulator system

Energy Management

Challenges

Distributed power generation can have an enormous impact on grid performance. The challenge of equalizing voltage fluctuations is especially problematic wherever a lot of wind and photovoltaic energy meets high power consumption from industrial plants. There are, however, solutions that make it possible to avoid expensive medium-voltage grid expansion. One such approach is to install intelligent equipment such as in-phase regulators. The existing distribution grid can thus operate largely independently and is ready for the future.

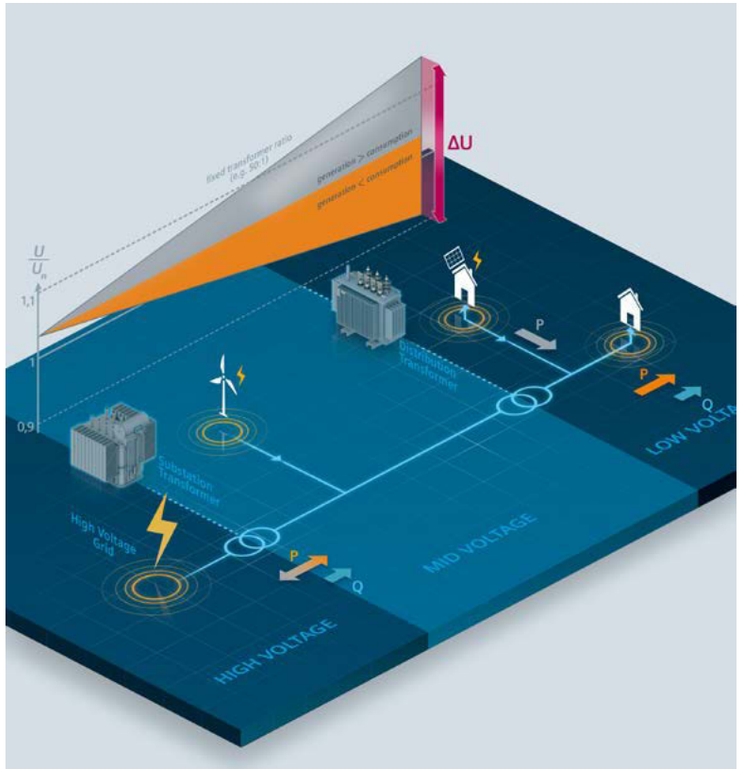
In medium-voltage lines to which many distributed producers are connected, generation can exceed the load peak many times over. As a result, fluctuating load and infeed conditions can induce significant changes in the operating voltage at individual substations.

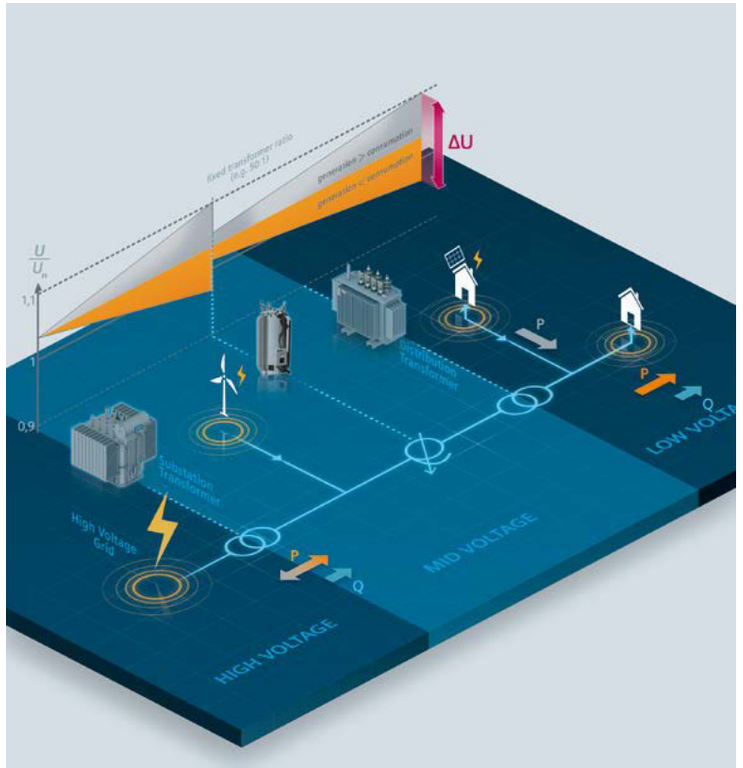
Feeding back power from the active low-voltage grids (LV grids) amplifies the challenges of voltage boosting and thus adhering to the voltage limits of +/-10% [DIN] on the distribution grid levels. In the MV grid today, voltage is often controlled only by the tap changer on the substation transformer. This only regulates the entire MV grid and cannot adjust local voltage changes. This leads to cost-intensive grid expansion.

Solution

Many operators are familiar with voltage fluctuations in their grids which are caused by expansion, increasing load, and economic decisions. The use of electronic components is of limited economic benefit and allows energy costs to increase unnecessarily.

The use of in-phase regulators is an extremely sensible measure for adhering to the voltage limits during grid operation, one that is more cost efficient than expanding the MV grid. Voltage regulators compensate for different voltage loads and maintain a constant output voltage.



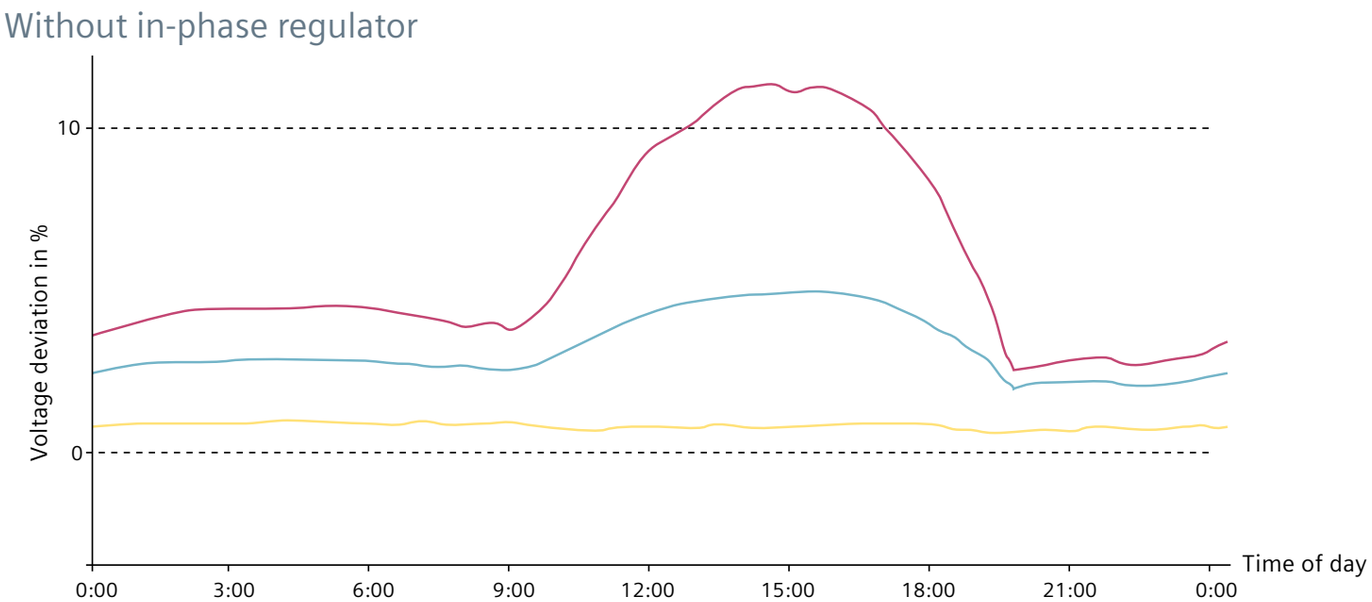


Function of the medium-voltage in-phase regulator system

The voltage regulators for area voltage regulation are positioned along the line, so that voltage range infringements cannot occur – regardless of the load situations at the secondary substations between the transformer substation and the in-phase regulator. Power quality measurement on the primary and secondary sides of the in-phase regulator make it possible to monitor voltage quality and to transmit the measured data.

Different options exist for setting up the regulating system for in-phase regulators:

- Local regulation
  - Regulation by measuring the voltage directly at the load-side output of the in-phase regulator system
  - Regulation by measuring the voltage and current at the load-side output of the regulator with current compounding
- Area voltage regulation
  - Distributed measurement on the medium- and/or low-voltage grid
  - Voltage optimization of the grid area by the regional controller and active regulation of the in-phase regulator system



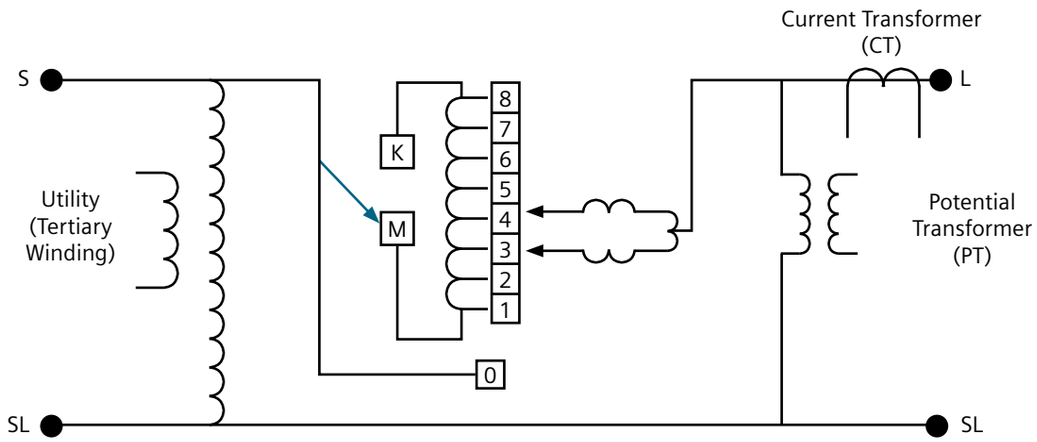
Comparison of voltages for a 24-hour load cycle in summer, with and without in-phase regulator

Technical data of the medium-in-phase voltage regulator system

Power	3 x 300/420 A
Frequency	50 Hz
Voltage	20 kV
Basic insulation level (BIL)	125 kV
No. of switching steps	32
Regulating range	+/-10%
Installation	Outdoor setup
Design	Concrete station
Dimensions (LxWxH)	6 x 3.6 x 3.32 m
Weight	approx. 48 t

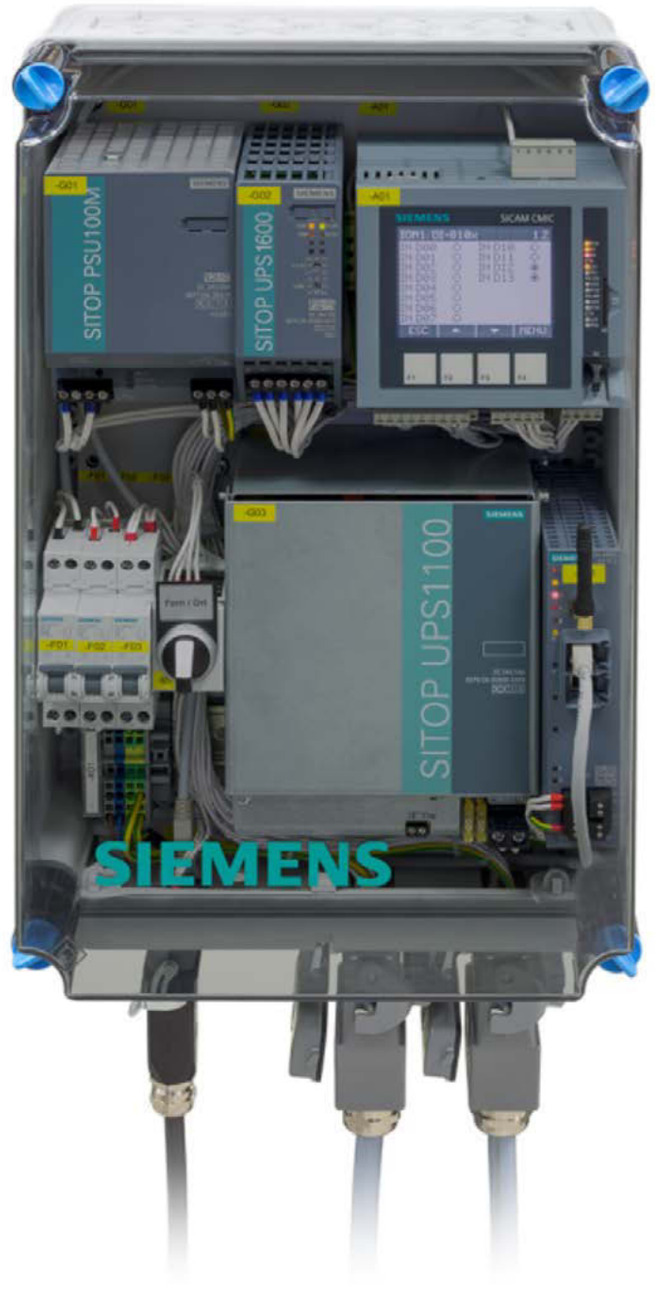
In-phase voltage regulator

- Long, flexible regulating range
- Fine control with 32-step switch
- More rugged and more economical than capacitors or low-voltage regulators
- Regulates up to 25 MVA due to three single-phase units
- Long lifecycle
- Regulating unit with spring mechanism
- Vacuum regulating unit available for certain designs
- Bypass enables maintenance to be carried out without interrupting the load



SICAM/CMIC automation system control unit

- Standard system design of the ENEAS Ultra Compact Box for medium-voltage distribution grid automation tasks
- Remote monitoring of relevant operating data of the in-phase voltage regulator and transmission of the power quality measurement data and data from the SICAM FCM short-circuit indicators
- Control of the medium-voltage switchgear, also taking into account locking conditions for the in-phase voltage regulator
- Automation programs for commissioning and decommissioning the in-phase voltage regulator.

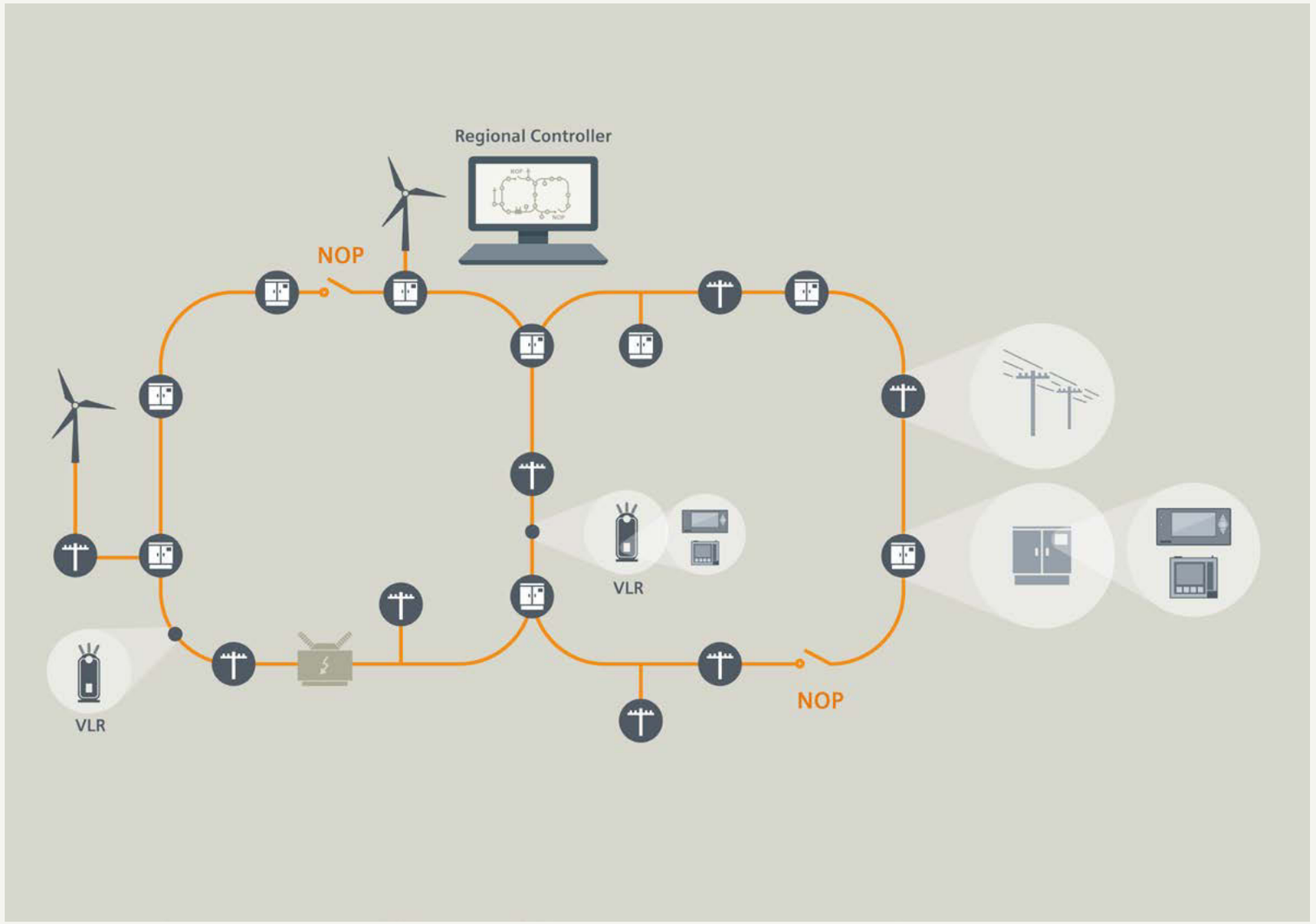


8DJH switchgear

- Up to 17.5 kV, 25 kA or 24 kV, 20 kA
- Busbar 630 A, feeders up to 630 A
- Factory-assembled, type-tested switchgear according to IEC 62271-200
- Individual panels and block versions available
- Compact design for low floor space requirement
- Fully flexible switchgear concept; panels or blocks can be added on both sides
- Optimized switching devices and protection concepts for any switching duty
- Interlock control prevents maloperation (e.g., switching of medium-voltage in-phase regulator only possible in de-energized condition)
- Bypass option, and thus minimization of losses by isolating the medium-voltage in-phase regulator
- Smart-Grid-ready by means of motor operating mechanisms, low-power instrument transformers for current and voltage measuring, and intelligent short-circuit indicators
- Supervision / monitoring of the voltage quality according to the power quality standard IEC 61000-4-30 via the SICAM P850 power meter and conventional current and voltage transformers

Benefits of voltage regulation

- Cost-saving alternative to grid expansion
- Easily integrated into existing grid structure
- Little installation effort
- Extensive regulating range
- Flexible regulation models for optimum operation
- Siemens has many years of experience with proven products



Reference:
Netze BW Niederstetten

- Instead of regular expansion of its distribution grid, a grid intelligence solution with voltage regulators was implemented in Niederstetten
- Automated fault management for three circuits
- Line length: approx. 90 km
- 84 secondary substations
- Automated area voltage regulation for active voltage stability
- Distributed power quality measurement in the grid area (primary and secondary sides)
- SCADA remote monitoring – transmission of short-circuit and ground-fault messages to the controller

For more information
visit our website

Dr. Martin Konermann

Technical Director at Netze BW GmbH

» We're supporting the development of a clever, predictive power grid infrastructure in Germany. We're not only trying to actively help shape the new energy policy, but enable local implementation of this policy at the communal and municipal level in the first place. «

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