Case Study
PCS100 Active Voltage Regulator (AVR)
Voltage regulation for utility grids with distributed generation

Utility grid operators face new challenges posed by distributed generation. Voltage drop is no longer the primary consideration. Voltage rise, caused by increasing photovoltaic and wind turbine generation, requires new voltage regulation options.

ABB has successfully trialed its PCS100 AVR; the ideal solution for many voltage regulation issues.

PCS100 AVR MV solution - designed for outdoor installation

Background

Distribution grids now need to accommodate an increasing number of, and range of, distributed generation technologies including: photovoltaics, combined heat and power plants and onshore wind turbines. Voltage drop during the peak load is no longer the major consideration. Voltage rise from new generation technologies challenges the security of supply and the ability of utilities to achieve grid code compliance.

Voltage problems caused by worst case generation and load scenarios already exist in many grids. European Standard DIN 50160 sets voltage quality requirements at ±10 percent of nominal voltage. There are grids that already fail to comply with this standard, and this standard is expected to tighten in the future. Furthermore, many of the installed photovoltaic inverters shut down at only five to seven percent above nominal voltage. This puts even more pressure on the utilities to improve voltage regulation. Up until now, the voltage in the distribution grid has been regulated in the main substations by an on-load tap changer (OLTC) on the primary side of the high voltage /medium voltage transformers.

Further equipment to actively regulate the voltage in the grid was not required because the worst-case (peak load and maximum voltage drop) has been predictable and compensated by the OLTC.

Unpredictability

Many utilities are by government policy to allow the connection of renewable generation technology, particularly small, distributed photovoltaics. This makes prediction of the generation location difficult and compounds the problem when combined with the variable output of wind and solar generators.

In the small villages and rural locations in Germany, countless photovoltaic generators have been set up with simple single or three phase inverters. The weak grids in these areas often have overvoltage problems during times of light load and high generation. The high voltage causes the distributed generation to trip and interrupts the supply of renewable generation to the grid.

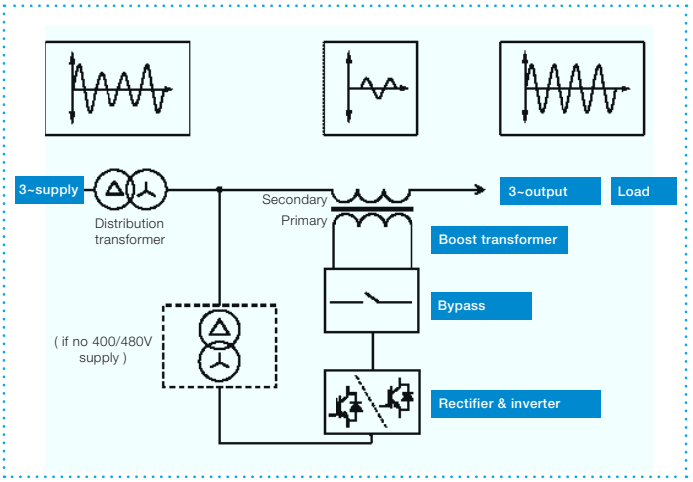
Counteracting the voltage problem in Germany

To date, the main method to counteract voltage problems has been to build new cables and substations. This expensive method, costing up to 150 euros per meter to lay cables in residential areas, also requires considerable time and effort for the construction consent process. The requirement for a secondary substation makes this option even less cost effective.

It's not surprising that many utilities are searching for new, cost effective, easy to implement and permanent solutions for regulating voltage in their grids.

Highlights
Correction of voltage by ±10% (medium voltage (< 33 kV), LV low voltage (<1 kV) distribution grid
Fast, seamless and accurate - no moving parts
Universal deployment and quick, outdoor installation
Proven track record of reliability
Cost effective

The PCS100 AVR low voltage solution



SLD of the PCS100 AVC and PCS100 AVR

Solution

ABB has a proud history of designing and building industrial strength active voltage conditioners. Voltage is corrected with a series injection transformer and a power electronics converter. With an installed base of 492 MW worth of units in the industrial market, reliably in fixing voltage problems is an ABB specialty.

As the market leader in this technology, ABB has expanded their product range to solve the voltage regulation problems in the utility market. The new PCS100 AVR (Active Voltage Regulator) addresses voltage regulation problems associated with distributed generation. It is rated to dynamically and continuously correct the grid voltage by up to ±10 percent.

The PCS100 AVR incorporates a bypass system. Should the inverter trip, the bypass system shunts the injection transformer, relieving the load from the inverter and providing a direct connection between the grid and the load without interruption.

The PCS100 AVR is currently undergoing trials by major German utilities in both low voltage and medium voltage installations.

Low voltage (LV)

The PCS100 AVR LV can be installed next to an existing secondary substation, or it can be supplied as an integrated part of a new substation. It is connected in series between the low voltage side of the distribution transformer and the load feeders. Six pilot units have been installed in Europe to correct utility voltage regulation problems for several major utilities.

Benefits

The key benefits of the above configuration are its easy implementation and its capability to connect to existing electrical infrastructure. The PCS100 AVR LV can be sized to suit different distribution transformer sizes such as 400 kVA and 630 kVA. Voltage regulation is provided for all of the feeders supplied by the distribution transformer.

Medium voltage (MV)

For medium voltage applications the PCS100 AVR MV is installed in series with the supply and provides continuous and dynamic voltage correction of up to ±10% percent for loads to 10 MVA and beyond. One pilot unit in Germany has been strategically placed to regulate the voltage to a medium voltage switching station that supplies feeders to more than 60 secondary substations.

Benefits

A PCS100 AVR MV solution has an advantage over its competitors, in that it solves voltage regulation problems from a central location. When the grid layout favors a medium voltage installation, this can replace the installation of many smaller units on the low voltage network.

Pilot data	PCS100 AVR LV	PCS100 AVR MV
Load capacity		
Capacity	400 kVA	8 MVA
Displacement power factor	0 lagging to 0.9 leading	0 lagging to 0.9 leading
Input		
Nominal supply voltage	400 V, 3 phase, 50 Hz	20 kV, 3 phase, 50 Hz
Continuous operating range	± 20% of nominal supply voltage	± 20% of nominal supply voltage
Fault Capacity	15 kA @ 400 V	4 kA @ 20 kV
Output		
Nominal output voltage	400 V (customer adjustable)	20 kV (customer adjustable)
Correction range	± 10%	± 10%
Reg accuracy (in correction range)	± 1% typical ± 2% maximum	± 2% typical ± 3% maximum
Efficiency of system	> 99%	> 99%

For more information and contact details see:
www.abb.com/powerquality