SUCCESS CASE 20.2024

Phase Balancer

IMPROVEMENT OF THE POWER QUALITY PARAMETERS IN HIGHLY PV PENETRATED LOW VOLTAGE NETWORKS

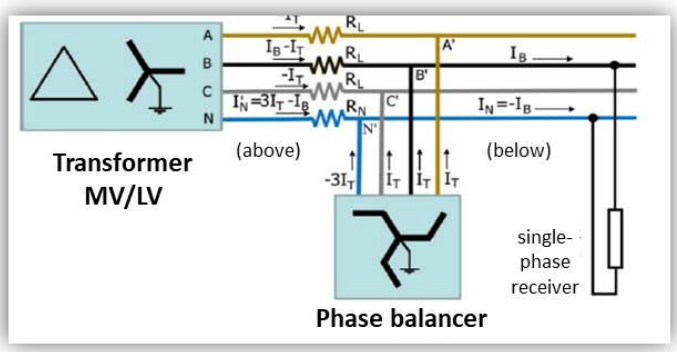
THE CHALLENGE

The **deterioration of voltage conditions** is one of the frequent consequences of connecting an increasing number of photovoltaic (PV) sources to the low voltage grid (LV). Under adverse conditions, i.e., low energy consumption and high insolation, generation can cause voltage problems such as voltage asymmetries. The occurrence of **asymmetry in the LV grid**, mainly caused by single-phase loads and single-phase inverters, over long periods leads to:

- Problems with setting transformer tap changers to maintain the voltage within the permissible values on the grid.
- Limitation in the number of connected renewable sources.
- Reduction in the efficiency of energy delivery due to the flow of additional symmetrical currents through power lines and transformers resulting in additional energy losses.
- Shortening of the life of power lines and transformers due to increased thermal load.
- Increase in measurement accuracy errors.
- Increase in the risk of electrocution where a significant current flows to the ground through working earthing.

THE SOLUTION

The **Phase Balancer** has a built-in three-phase transformer that takes part of the asymmetrical current flowing through the neutral conductor and evenly distributes it to the individual phases. As a result, **asymmetry is reduced and peak voltages are stabilised**. This has a positive effect on power quality factors on the consumer side while reducing losses and the possibility of supplying more energy without investing in network reconstruction.



MAIN ACHIEVEMENTS

PGE Dystrybucja has installed Phase Balancers at 20 grid locations where voltage problems had been identified. The gathered experience confirms that, after switching on the device, phase voltages have become more symmetrical and, in the case of networks with connected single-phase renewable installations, there is also a noticeable beneficial effect on limiting the voltage increase in the phase where generation occurs.

Phase voltages on the customer side after the installation of a Phase Balancer. The voltage fluctuates depending on the time of day, but the difference in deviation between phases is much lower compared to before the installation of the device.

KEY SUCCESS FACTORS

- The device represents a good solution for networks that are heavily saturated with single-phase renewable installations, when the voltage drop is not too large (no more than +/-10%) and does not affect all phases, and the problem is due to asymmetry.
- The decision on the need to install a **Phase Balancer** at a particular site of the network should be preceded by voltage analysis and, possibly, by energy flow studies on a network model.
- When the **Phase Balancer** is switched on, the amplitude of fluctuations and the average value of reactive power decreases to values close to zero (before switching on, large fluctuations in reactive power were observed, the extremes of which range from about 4kVAr of power of an inductive nature to about 7.5kVAr of power of a capacitive nature).

WAY FORWARD

The installed devices are not expensive compared to the benefits they produce. Hence, PGE Dystrybucja has initiated a procurement procedure and installation at other locations where voltage problems have been identified. Based on the analysis of the operations of these devices, it will be decided whether to install the devices at other locations on the network.