Low Frequency Neutral Point Currents (GIC)

Influence of low frequency currents on power transformers and the transmission grid

Currents with frequencies near 0 Hz, i.e. quasi DC, are undesirable in the high-voltage transmission network. These low frequency currents can lead to saturation of power transformers. Saturation increases the volume, reactive power consumption and power loss of the transformers. These effects can have a negative impact on system stability and thus on supply security.

Problem definition and approach

In the project, the behavior of power transformers is investigated in the laboratory, compared with simulations and conclusions are drawn about the behavior of the transformers in the transmission network. To verify the assumptions, star point measurements and phase measurements are carried out at 6 measuring points in the Austrian transmission grid. The own simulation program is used to calculate the low frequency currents in the transmission grid and to identify endangered transformers and to assess the grid status. Figure 1 depicts the different fields of research in the project.

Cause of the low frequency currents

The cause of the low frequency currents has already been identified as geomagnetic disturbances (GMD), which are caused by the interaction of the Sun with the Earth's magnetic field system. These induced currents are called geomagnetically induced currents, GIC. For this reason, magnetic field measurement data are also taken into account and used to calculate the network state in our own simulation program.
Further causes and sources of the low frequency currents are the subject of current research.

**Power transformers**

Within the project laboratory tests with power transformers (Figure 3) are carried out to investigate the influence of the switching group at different low frequency loads. For this purpose, two power transformers were modified (Figure 4) in such a way that the vector group on one side of the transformer is freely adjustable.
Network effects

With the help of the simulation program (Figure 5) and the transformer neutral point measurements, the model for the geomagnetic influence on the transmission network is verified. Taking into account the local currents, the influences of the transformers can be calculated and thus an overall picture of the grid state can be generated. From this, action measures can be derived for the network operator to ensure a long-term stable network operation.

Measuring systems

Currently, the neutral point currents are measured (Figure 6) at 6 transformers in the Austrian transmission grid and the phase currents (Figure 7) in a transformer station. Further measuring locations and measuring methods are in preparation. The measurement data in a 1-second grid allows the validation of the calculations from the software and the laboratory tests. The challenge in measuring the phase currents is the different measuring range. The low frequency currents to be measured have amplitudes of up to 25 A, while at the same time operating frequency currents of up to the single-digit kiloampere range act on the measuring system.

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- Siemens AG