Geomagnetically Induced Current Measurement in the Austrian Transmission Grid

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Low frequency currents (LFC) can lead to serious problems in power transmission grids. The major share of these currents are geomagnetically induced currents (GIC), which are caused by geomagnetic disturbances. Measurements of LFC in transformer neutral points started in 2013 at a single transformer and have since then expanded to six measurement units all over the Austrian transmission grid.

The save and reliable operation of power transmission systems is one of the main responsibilities of transmission system operators. Therefore, risk analysis of the grid and system equipment is an important topic. First investigations in LFC were triggered by unexpected transformer noise in 2013. Measurements in the transformer neutral point, performed by the Institute of Electrical Power Systems (IEAN) from Graz University of Technology, revealed DC currents with a high correlation to fluctuations in the earth's magnetic field. As an outcome of these investigations, a cooperation for further analysis between ZAMG, IEAN, the Austrian Transmission System operator APG and Siemens Transformers was initialized.

The effects of geomagnetic disturbances on power transmission grids and pipelines are a well known problems in countries close to the magnetic poles. Although Austria is a mid-latitude country, the geological structure, with the Alps in the west and the lowlands in the east, can lead to high amplitudes of GICs as well. With magnetic field measurement data, provided by Conrad Observatory, and data from the Austrian Transmission Grid, GICs can be calculated for all transmission lines, transformers and substations in Austria.

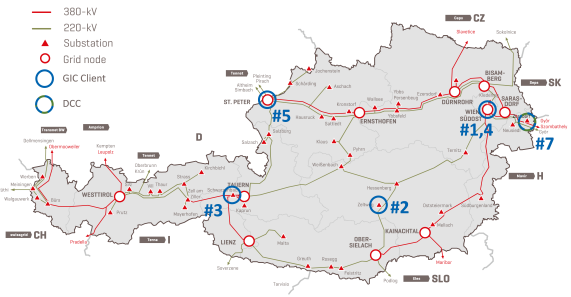

Figure 1: The Austrian transmission grid and equipped transformers with the neutral point current measurement system from IEAN.

The six neutral point measurement systems provide data from transformers in the 380-kV and 220-kV transmission grid, as depicted in Figure 1. The sampled data are sent to the IEAN for further processing and analysis. This measurement data is unique in central Europe and is also used to improve simulation and calculation methods. The combination of measured and calculated currents provides information about impact of GICs in Austria and resulting risks for grid operation. The measured currents are in the range from almost zero to ±13 A during the transition from solar cycle 24 to 25.

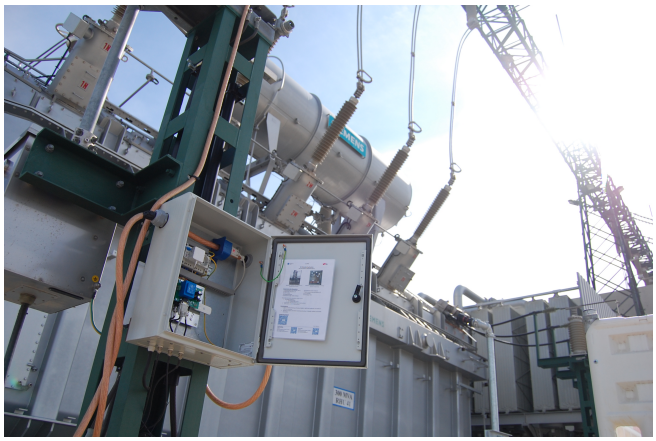

Figure 2: Installed transformer neutral point current measurement system and self-engineered measurement electronic.

Recent research results show that the low frequency transformer neutral point currents are also caused by DC powered public transportation systems, such as the subway system. With this information, mitigation strategies as well as a guideline for operating transmission system during geomagnetic storms can be created. The overall aim to protect the Austrian energy supply is completed with detailed laboratory tests on power transformers.

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