

EGU21-14663

<https://doi.org/10.5194/egusphere-egu21-14663>

EGU General Assembly 2021

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Shield wires effect on GICs in Portuguese power network and design of an instrument to monitor GICs in the transformer neutrals

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Geomagnetically Induced Currents (GICs) are the result of rapid variations in the Earth's geomagnetic field and of the finite conductivity of the Earth. Along grounded conducting structures such as the power grids, the induced electric field drives electric currents in closed circuits. Extreme values of GICs can be a threat to the normal operation of the power system. So, there is an increasing interest in the study of the GICs' risk and the first step to take is the numerical modelling. In order to model GICs, different factors/parameters must be considered, as the distribution of conductivity, laterally and in depth and characteristics of the different components of the network. These include the values of the different resistances in the power network, the types of transformers and also the transmission path for the GICs. Shield wires represent possible paths for GIC currents. In this study the influence of shield wires on GICs in power systems is modelled. Tests were done using realistic values for the circuit parameters provided by the Portuguese high voltage power network company (REN).

The MAG-GIC (Geomagnetically induced currents in Portugal mainland) project has already produced GIC simulations for the South of Portugal. However, there are still no direct records of GICs in the electrical transmission network to validate that model. This study also encompasses the task of producing a measuring instrument to monitor GICs in the neutral of a given transformer. Such an instrument can provide for the measurement and recording of quasi-DC currents with Hall current sensors, with high resolution. It is targeted to operate remotely over a time interval of several months while being minimally invasive to the power transformer (PT). The system relies on LEM high sensitivity closed loop Hall effect current sensors and it is built over a Raspberry Pi 4 Model B platform with a high resolution digitizer (24 bits) expansion board (Waveshare AD/DA). The system also includes temperature monitoring for offset correction. Recorded data are locally stored on a database (InfluxDB) and a wifi interface allows rapid long term trend visualization through a customized dashboard (Grafana).