Long term Geomagnetically Induced Current Observations from New Zealand

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Transpower New Zealand Limited have measured DC currents at transformers in the New Zealand electrical network at multiple South Island locations for many years. Near continuous archived DC current data exist since 2001, starting with 12 different substations, and expanding from 2009 to include 17 substations. From 2001-2015 a total of 61 distinct transformers were monitored. Primarily the measurements were intended to monitor the impact of the High Voltage DC system linking the North and South Islands when it is operating in "Earth return" mode. However, after correcting for Earth return operation, the New Zealand measurements provide an unusually long and spatially detailed set of Geomagnetically Induced Current (GIC) measurements.

It is recognised that GIC caused the loss of a South Island transformer in November 2001, during a storm that caused multiple alarms across the South Island. The 2009 onwards expansion in measurement locations was undertaken to better monitor the Space Weather risk caused by GIC.

Here we describe the New Zealand DC observations, and the corrections required to identify GIC in this dataset. We examine the peak GIC magnitudes observed from these observations during large geomagnetic storms on 6 November 2001 and 2 October 2013. Peak storm time currents of ~30-50 A are observed, depending on the measurement location. We then examine those GIC in transformers throughout the South Island and compare them to the various magnitude and rate of change components of the magnetic field. Our results show there is a strong correlation between the magnitude of the GIC and the rate of change of the horizontal magnetic field (*H'*). This correlation is particularly clear for transformers that show large GIC current during magnetic storms.

Our research is part of a New Zealand funded project to identify the risk posed by GIC to the New Zealand electrical network. Transpower (the transmission system operator) is a key stakeholder in this project, and has supported us with the GIC observations and detailed information on the DC characteristics of the primary transformers and transmission lines which make up the New Zealand network. Our team is now working on modelling GIC in New Zealand , with the goal of validating the model against the high-resolution transformer-level observations.

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