Effects of Geomagnetically Induced Currents on the New York State Electric Power Systems

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Geomagnetic storms can perturb Earth's magnetic field and generate geo-electric fields that result in the flow of Geomagnetically Induced Currents (GICs) through the transmission lines, followed by transformers and the ground. GICs are also known to have adverse effects on mid-latitude regions. Thus, this study focuses on the effects of GICs on the New York State (NYS) Electric Power Systems, located in a mid-latitude region. Although GICs affect high voltage levels, e.g. above 300 kV, the presence of a coastline in NYS makes the low voltage transmission lines also susceptible to GICs. As the ground conductivity and the power network topology significantly vary within the region, it becomes imperative to estimate the magnitude of GICs for different places. In this study, the geo-electric fields are calculated with the Geoelectric Field Calculator Tool, which allows for the calculation of the fields using both a 1-D ground conductivity and a 3-D surface impedance ground response model. The calculated geo-electric fields, and an extensive modeling of the whole NYS electricity transmission network using real data, are used to calculate the magnitude of the GICs. NYS is also home to one of the largest urban cities in the world, New York City (NYC). Therefore, understanding and mitigating the effects of GICs are important to reduce the vulnerabilities of the NYS present bulk power system, which includes NYC. Results of our study can shed some light on effects of GICs on other power systems located in mid-latitude regions like NYS, and urban cities like NYC.

Keywords: GICs, Geomagnetic Storms, Geoelectric fields, Electric Power Systems, Mid-latitude regions

