

Analysis of Transformer Reactive Power Fluctuations during Adverse Space Weather

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Abstract : A ground-end manifestation of space weather phenomena is known as geomagnetically induced currents (GICs). GICs flow along the electric power transmission cables connecting the transformers and between the grounding points of power transformers during significant geomagnetic storms. Geomagnetically induced currents have been studied in other regions and have been noted to affect the power grid network. In Zimbabwe, grid failures have been experienced, but it is yet to be proven if these failures have been due to GICs. The purpose of this paper is to characterize geomagnetically induced currents with a power grid network. This paper analyses data collected, which is geomagnetic data, which includes the Kp index, DST index, and the G-Scale from geomagnetic storms and also analyses power grid data, which includes reactive power, relay tripping, and alarms from high voltage substations and then correlates the data. This research analysis was first theoretically analyzed by studying geomagnetic parameters and then experimented upon. To correlate, MATLAB was used as the basic software to analyze the data. Latitudes of the substations were also brought into scrutiny to note if they were an impact due to the location as low latitudes areas like most parts of Zimbabwe, there are less severe geomagnetic variations. Based on theoretical and graphical analysis, it has been proven that there is a slight relationship between power system failures and GICs. Further analyses can be done by implementing measuring instruments to measure any currents in the grounding of high-voltage transformers when geomagnetic storms occur. Mitigation measures can then be developed to minimize the susceptibility of the power network to GICs.

Keywords : adverse space weather, DST index, geomagnetically induced currents, KP index, reactive power

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