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Case Studies of Extreme Space Weather Effects on the New York State (NYS) Electric Power System

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New York State (NYS) is home to one of the largest urban cities in the world, New York City (NYC). Understanding and mitigating the effects of extreme space weather events are important to reduce the vulnerabilities of the NYS present bulk power system, which includes NYC. Extreme space weather events perturb Earth's magnetic field and generate geo-electric fields that result in the flow of Geomagnetically Induced Currents (GICs) through transmission lines, followed by transformers and ground. GICs find paths to ground through transformer grounding wires causing half-cycle saturation to their magnetic cores. This causes transformers to overheat, inject harmonics to the grid and draw more reactive power than normal. Overheating, if sustained for a long duration, may lead to transformer failure or lifetime reduction. Presented work uses results from simulations performed by the Global SWMF-generated ground geomagnetic field perturbations. Results from computed values of simulated induced geo-electric fields at specific ground-based active INTERMAGNET magnetometer sites, combined with NYS electricity transmission network real data are used to examine the vulnerabilities of the NYS power grid. As an urban city with a large population, NYC is especially vulnerable and the results from this research can be used to model power systems for other urban cities.