

DYNAMICS OF POWER AND TELECOMMUNICATIONS RECOVERY FOLLOWING A HEMP INSULT

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Today's electric power grid relies on public data networks for a small fraction of its real-time data requirements. This dependence is expected to grow substantially in the near future. While public data networks may be more efficient and cost-effective for power companies under normal operating conditions, it is not clear that this level of reliance on real-time data provided by public data networks reduces the combined susceptibility of power and telecommunications infrastructures. A mathematical model describing the coupled dynamics between the power and telecommunication infrastructures following an attack on the U.S. from a high-altitude nuclear detonation is developed which incorporates experience-based analytical models of telephone network recovery. We address the question of whether or not these dynamically coupled infrastructures will recover from a HEMP attack. Solution of the developed non-linear equations identifies a scenario we call negative reinforcement. This is the case where the power grid and supporting telecommunication networks both collapse due to their mutual interdependence, whereas they would not collapse if they were not dynamically coupled. The same theory that predicts negative reinforcement also predicts conditions for the opposite case, mutual recovery. This is the case where both infrastructures recover when they are dynamically coupled. The interdependency equations show there are four dimensionless parameters that determine whether the combined systems will recover or collapse: the fraction of telecommunication equipment required to provide a positive growth of power, the fraction of telecommunication equipment at the beginning of the joint power-telecomm recovery process, the fraction of power available at the beginning of the joint power-telecomm recovery process, and another dimensionless parameter defined in the equations. Illustrative examples are rendered that depict negative reinforcement and mutual recovery.

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3. (a)
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