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Nuclear Electromagnetic Pulse Review

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Electromagnetic Pulse (EMP) from nuclear detonations have been observed for well over half a century. Beginning in the mid-to-late 1950s, the physics and modeling of EMP has been researched and will continue into the foreseeable future. The EMP environment propagates hundreds of miles from its origins and causes interference for all types of electronic instrumentation. This includes military, municipal and industry based electronic infrastructures such as power generation and distribution, command and control systems, systems used in financial and emergency services, electronic monitoring and communications networks, to mention some key infrastructure elements. Research into EMP has included originating physics, propagation and electromagnetic field coupling analyses and measurement-sensor development. Several methods for calculating EMP induced transient interference (voltage and current induction) will be briefly discussed and protection techniques reviewed. These methods can be mathematically simple or involve challenging boundary value solution techniques. A few illustrative calculations will demonstrate the concern for electronic system operability. Analyses such as the Wunsch-Bell model for electronic upset or damage, and the Singularity Expansion Method (SEM) put forth by Dr. Carl Baum, will facilitate the concern for EMP effects. The SEM determines the voltages and currents induced from transient electromagnetic fields in terms of natural modes of various types of electronic platforms (aerospace vehicles or land-based assets – fixed or mobile). Full-scale facility and laboratory simulation and response measurement approaches will be discussed. The talk will conclude with a discussion of some present research activities.