Mitigating the EMP Threat

By **DR. MICHAEL HOWARD**

A reliable and resilient energy grid is essential to economic prosperity and national security. It should come as no surprise that protecting the grid from natural and man-made hazards is a top priority for the electric power industry.

One hazard that has become a concern for government and industry alike is the threat of an electromagnetic pulse, or EMP, created from the detonation of a nuclear weapon at high altitude or in space. Such a detonation could release three consecutive and distinct high-energy pulses that can interfere with normal energy grid operations.

Working closely with the Electricity Subsector Coordinating Council (ESCC), the Electric Power Research Institute (EPRI) led a three-year research program to better understand EMP risks and mitigation options. The program included more than 60 electric companies and several government entities with extensive expertise and knowledge of EMP, such as the U.S. Department of Energy, the three DOE nuclear weapons labs, and the Defense Threat Reduction Agency.

EPRI's three-year program sought to answer two key questions:

- What are the potential impacts of EMP on the electric transmission system and on sensitive substation components critical to delivering electricity?
- Can EMP impacts be technically and cost-effectively mitigated?

EPRI performed extensive modeling to simulate the coupling of an EMP pulse into overhead transmission lines and cables, and observed how the resulting voltage surges impacted common transmission substation equipment such as digital protection relays. We also conducted tests on other electrical equipment, including instrument transformers, distribution-class transformers, and insulators. These tests took place in our EMP testing facilities in Knoxville, TN, and Charlotte, NC.

EPRI's program also tested and evaluated several mitigation devices and strategies aimed at reducing potential EMP impacts. We found that the initial EMP pulse potentially could disrupt or damage substation electronics, but we identified cost-effective options to mitigate potential impacts. These mitigation techniques are detailed in a report recently published by EPRI. They include changes to substation designs, such as shielding, grounding, surge protection, and use of fiber optic-based systems.

Field evaluations to test initial-pulse mitigation options are currently underway. Since initial-pulse impacts are not confined solely to transmission substations, EPRI is looking to evaluate the impacts to generating facilities.

Assessment results of the third and final pulse indicated that, while a regional disruption is possible, the pulse would not cause widespread transformer damage. Because damage to large power transformers would be minimal, recovery times are not expected to be the months-long outages hypothesized by some if the mitigation measures for an initial-EMP pulse are deployed. Our research also identified additional options for mitigating the final-pulse impacts, similar to those that can be employed to protect against the effects of geomagnetic disturbances like solar flares.

Because we acknowledge the national security concerns associated with EMP, EPRI will continue to work closely with the ESCC and various external stakeholders, including state and federal government agencies, to ensure that credible science informs critical policy decisions and economic investments to maintain a reliable and resilient energy grid. EP

For additional information on EPRI's recent EMP report, visit www.EPRI.com

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The Electricity Subsector Coordinating Council (ESCC) serves as the principal liaison between the federal government and the electric power sector, with the mission of coordinating efforts to prepare for, and respond to, national-level disasters or threats to critical infrastructure. The ESCC includes electric company CEOs and trade association leaders representing all segments of the industry.

ESCC
Electricity Subsector Coordinating Council