EMP, IEMI, and NNEMP Overview

Why the Concern?

There is a concern that our society could be severely impacted by an HEMP or IEMI attack or GMD event due to our high reliance on electronic technology (e.g., computers, microprocessors, etc.).

What Are EMP, HEMP, IEMI, NNEMP, and GMD?

Electromagnetic pulse **(EMP)** refers to a very intense pulse of electromagnetic energy, typically caused by the detonation of a nuclear or other high-energy explosive device. High-altitude electromagnetic pulse **(HEMP)** is specifically a nuclear warhead detonated hundreds of kilometers above the earth's surface to produce more widespread effects. It is generally accepted that a HEMP requires a high-altitude missile needing large levels of sophistication and logistical capabilities; therefore, the HEMP threat is often associated with potential attacks from national entities and is being discussed in the U.S. Government as a national defense consideration.

Like HEMP, intentional electromagnetic interference (**IEMI)** is a man-made event, using a portable, non-nuclear device to create a non-nuclear electromagnetic pulse **(NNEMP)** affecting a much smaller area, such as a single building or a substation. Several countries, including the U.S., have already designed IEMI-based weaponry. IEMI is something the industry can act upon.

A geomagnetic Disturbance **(GMD)** is the result of coronal mass ejections (CMEs) that occur during solar magnetic disturbances. The charged particles from CMEs interact with the earth's magnetic field and can result in geomagnetic induced currents (GICs) that flow in electric transmission lines and transformers. The flow of GICs could potentially result in damage to transformers and other negative impacts on the grid, causing the fear of the potential for a system voltage collapse and blackout similar to the one experienced in Quebec in 1989.

Is EMP/IEMI the Same as Geomagnetic Disturbance (GMD)?

No. The E3 pulse generated from an EMP event has very similar characteristics to those found from the CMEs that are generated during a solar GMD event. However, the E1 and E2 pulses are unique to EMP. The E1 pulse has a very high amplitude with a very short time duration, and is a threat to solid state electronic devices, but not to high voltage power equipment. The E2 pulse has a lesser amplitude than E1 and a longer time duration (similar to lightning) but can generally be mitigated with standard industry lightning protection.

How Might an HEMP/IEMI Attack Impact Our Industry?

A HEMP attack could impact any infrastructure (transportation, communication, oil and natural gas, water and sewer, etc.), not just electric utilities, since it could disrupt or destroy many devices that have electronic circuits and microprocessors. Any action plans to protect the power grid from a HEMP attack must be done in concert with actions to protect other key components of the nation's infrastructure. In contrast, an IEMI attack is more targeted in nature, in that it would only impact

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specific substations or other facilities; therefore an IEMI attack would not have the broad impact of a HEMP attack.

How Much Would All This Protection Cost?

Statements about cost have been made by various parties. A research report from Oak Ridge National Laboratory suggests that the cost of retrofitting EMP protection can exceed 25% of the cost of the asset to protect.[1]

What Is Being Done to Address These Threats?

To address the threat of GMD events, the industry has taken a number of actions that include installation of monitoring systems, development of operating strategies, and adoption of two NERC Reliability Standards (EOP-010-1 and TPL-007-1).

While the impact of a HEMP attack could be very high, the likelihood of it occurring is very low. On the other hand, an IEMI attack would be more targeted in nature and has a higher likelihood of occurrence.

Here is a short list of a few of the resiliency activities to address EMP and IEMI being taken by the utility industry:

Modeling and Simulation

Utility engineers are working with governmental agencies and research organizations to better understand and more effectively model the effects of EMP and IEMI on the bulk-power system.

Monitoring Devices and Additional Testing

A few NATF members with areas of higher threat risk are experimenting with the installation of monitoring devices to detect EMP and IEMI. More testing is needed to find additional, practical means to bolster the grid's reliability and resiliency against EMP and IEMI. NATF is collaborating with EPRI on ideas for future needs and potential research projects.

Resistant Control Houses and Fencing

At least one NATF member has been experimenting with a new modular control house design with EMP/IEMI-resistant qualities. We are monitoring progress and will share additional details as they become available. Some fencing exists that appears to have IEMI-resistant properties, and could be a win-win by simultaneously improving physical security.

Hardening via Control Center Design, Wires, and Cables

One NATF member has added tens of millions of dollars to the cost of construction for its new control center for hardening. In addition, several other NATF members are considering similar measures in their projects to build new control centers.

Other measures include more use of fiber optic cable instead of traditional control wires, as well as adding metal jacketing to traditional control cables.

Resiliency and Recovery

Several NATF members are reviewing and revising restoration plans to improve recovery times. These efforts include modification of sparing strategies and cooperation in mutual assistance and sharing arrangements, increased redundancy for certain assets, etc.

[1] Impacts of a Nominal Nuclear Electromagnetic Pulse on Electric Power Systems – Phase III – Final Report, Oak Ridge National Laboratory, AD-A237 104, April 1991.