POWER

Mar 26, 2019
by Sonal Patel

News

Trump Acts on Critical Infrastructure Resiliency Against EMP Threats

President Trump has signed an executive order (EO) to boost coordination for and national resilience against electromagnetic pulse (EMP) threats—both from nuclear warfare and natural events like solar superstorms. The action suggests new federal mandates to protect critical infrastructure against EMP events and attacks may be on the horizon.

Senior Trump administration officials from the National Security Council (NSC), the Department of Homeland Security (DHS), and the Department of Energy (DOE)—who took the unusual step in asking not be named—on March 26 told reporters on a call that the administration is taking "concrete steps" to address EMP threats.

These steps are designed to protect key systems, networks, and assets that are "most at risk from EMP events in a dynamic threat environment," they said. A DOE official added that the steps are designed to reduce the risk that EMPs pose on U.S. critical infrastructure and its asset network—including power plants and the grid.

The EO essentially directs multiple federal agencies to coordinate to increase national resilience to EMPs. "This includes clear roles and responsibilities for departments and agencies to facilitate action to improve information-sharing between federal and non-federal stakeholders, including assessing and developing, if necessary, EMP standards, and circulating testing results, so that the standards are well-informed by the best science that we have," an NSC official said.

Agencies that will need to coordinate under the EO include the Departments of State, Defense, Interior, Commerce, Energy, Homeland Security, and Director of National Intelligence, which serves as the head of the intelligence community. Coordination and development of executive branch actions will fall under the purview of the national

security advisory and the NSC in consultation with the director of the Office of Science and Technology Policy, they said.

Federal Mandates for Private Sector Defenses Against EMPs Are Coming

Under the EO, the federal government will first move to identify critical functions and infrastructure at greatest risk from EMPs. It will then improve its understanding of EMPs, and evaluate "appropriate ways to mitigate the effects of an EMP or strengthen EMP critical infrastructure to stand against the effects of EMPs," a DOE official said. Finally, it will formulate a response plan, "taking a whole government approach."

"So, the [EO] is going to aid preparedness against EMPs events for increased public-private coordination and planning, including engaging critical infrastructure owners and operators to identify mechanisms to enhance private sector efforts," a DHS official added.

Responding to a reporter's question about why the administration was acting now, the NSC official said that the measure formalizes "an adequate security strategy that reflects the importance that we give to risks that are involved here, because of how they can impact critical infrastructure across the nation." A DHS official noted, though the DHS already has an EMP strategy that aligns well with the EO, it was crucial to officially forge intra-agency coordination and encourage private-sector action.

The Ever-Present EMP Threat

Industry and academia have warned for years—and the DHS has internally recognized that—EMP events, and especially high-altitude EMP (HEMP) events resulting from detonation of a nuclear device, could severely damage critical electrical infrastructure.

EMP components are referred to as E1, E2, and E3. E1 is a "fast pulse" that primarily disrupts or damages electronic-based control systems, sensors, computers, and similar devices, but may also adversely affect long-line electrical systems. The E2 component is similar to lightning and has a similar ability to impair or destroy control features that are not protected from lightning. The E3 "slow pulse" component is a subsequent, slower-rising, longer-duration pulse that creates disruptive currents in transmission lines, which causes grid instability and increases heat in transformers. If the E3 pulse is high enough and long enough, it can result in grid collapse and potentially damage transformers, experts warn.

Solar weather events of sufficient intensity can cause E3-type electromagnetic impacts. In 1989, for example, a geomagnetic disturbance (GMD) caused a regional grid collapse within 92 seconds in the Hydro-Quebec power system that left six million customers without power for up to nine hours. The threat of GMDs has been played up with good reason: Space weather researchers currently estimate a 6% to 12% chance that a Carrington-class storm—a solar storm comparable in size to the largest on record—is likely to hit the earth within the next 10 years. In July 2012, a storm of that magnitude

missed Earth by about nine days, and only because it occurred on the far side of the sun, facing away from the Earth.

Meanwhile, a high-altitude burst nuclear test 900 miles from Hawaii in 1962 (a project known as Starfish Prime), offered "just a small taste of things to come," as Dr. George Baker, professor emeritus at James Madison University and director for the foundation for resilient societies, testified on Feb. 27 before a Senate committee. "Consequences involve risk measurement units of millions of casualties (EMP Commission), trillions of dollars (Lloyds of London), and, dents in the history of civilization (Center for Policy on Emerging Technology). The good news is that well-known, effective, and practical engineering solutions are available to counter these threats. We have the engineering know-how and tools to protect ourselves. What is lacking is resolve," he said.

While about 85% of critical electrical infrastructure is owned by private industry, the DHS, DOE, and the Federal Energy Regulatory Commission (FERC) have addressed EMP and GMD risks through standards and guidelines, research, strategy development, planning, and training. In 2001, Congress also established the EMP Commission, tasking it to assess the nature and magnitude of potential EMP threats to the U.S.

In July 2017, the EMP Commission released a much-awaited assessment of EMP threats, and its foremost, most-critical recommendation was that the president establish an "executive agent" with the authority, accountability, and resources to manage U.S. national infrastructure protection and defense against existential EMP threats. "Current institutional authorities and responsibilities—government, industry, regulatory agencies—are fragmented, incomplete, under-resourced, and unable to protect and defend against foreign hostile EMP threats or solar superstorms," it warned.

The commission also encouraged the president to work with Congressional leaders, and that government agencies and industries adopt new standards to protect critical national infrastructure from damaging E3 EMP heave fields.

However, while government entities in the U.S. and Canada along with industry organizations, such as the Electric Power Research Institute (EPRI), have widely studied general threats posed to the grid from a severe GMD resulting from a solar storm, and to a lesser extent, threats posed by a HEMP, consensus is that more research is needed to inform assessments for specific mitigation measures by generators and transmission providers.

According to Baker, that's one reason the private sector "is not doing very much of anything to address the EMP threat." Another reason is an absence of federal EMP directives and standards for the electric power grid, which has resulted in "inconsistent industry interest, approaches and questionable protection effectiveness." Baker added: "The [North American Electric Reliability Corp.(NERC)]/electric industry EMP approach appears to be to let the national grid fail and concentrate attention, investments and preparedness on elaborate recovery plans to rebuild the grid in the aftermath of an EMP-caused grid collapse. This approach is fraught with risk."

Power Sector Reluctant to Harden Without Regulatory Certainty

The issue is compounded by a widespread industry reluctance to harden because there are no current EMP/GMD regulations or requirements for civilian infrastructure. "Power industry officials have expressed reservations that any near-term protection initiatives could well be rendered obsolete if they don't conform to unknown future regulations and standards," Baker said. Cost is another factor. "Generation stations have not been addressed because of cost-recovery limitations (unlike transmission systems where federal regulations allow cost recovery)," he said.

Still, Baker noted, a few uncoordinated efforts exist: CenterPoint Energy, PJM, and Dominion Energy have each hardened a major control center, and American Electric Power has protected 400-plus substation control shelters.

"Notwithstanding, other than a beta-test of a GMD protection device for one transformer in Wisconsin, no hardening of the bulk power system's high-voltage, heavy-duty, long-lead-time replacement items has occurred. The grid, in its current unhardened state, would likely be out of service for long periods following a major solar storm or EMP attack," he said.

"Without protection, there is real evidence from atmospheric testing and laboratory testing that the grid will collapse, causing long-term, large-scale cascading debilitation of dependent infrastructures and services," he warned. EMP system debilitation is mainly due to the upset and thermal burnout of grid-essential command, control, and communication electronics, and physical damage to the heavy-duty grid components that supply our power, including transformers and possibly generators, he said.

"The military has the benefit of decades of system testing and a classified database documenting EMP effects on hundreds of systems that has caused them to recognize that the electric power grid, in its present unprotected state, cannot be relied on following an EMP attack," he noted. "The military includes hardened backup power as part of mission-essential system design. [The Department of Defense] is installing hardened 'microgrids' on key bases to make them independent of the surrounding grid."

Several commercial enterprises, too, have developed turnkey EMP services and product lines, he noted. Manufacturers of emerging power technologies are also integrating EMP resilience. NuScale, the small modular nuclear reactor that is farthest along in the development chain, for example, exhibits many features that reduce EMP vulnerability in comparison with traditional nuclear plant designs, according to a published November 2018 analysis (that Baker co-authored). Design features include passive shut-down capability; island-mode operation and steam bypass mode; electrical isolation of safety equipment; inherent shielding; underground cables and redundant fibre optics; and built-in redundancy.

But when asked how much it could cost to harden the nation's power grid with available technical options, Baker estimated that "prioritized protection" for the existing electric power system is on the order of $50 billion.

That estimate considers protection of "top-down thin-line" priority grid systems, including selected high-voltage generation plants—such as nuclear plants and black-start plants—and selected transmission substations. Power plants, which are not subject to FERC protection standards, likely represent the largest share of EMP/GMD protection costs, and few solutions exist. In fall 2018, the Defense Threat Reduction Agency began for the first time testing EMP resiliency at a generating station, he noted.

His estimate also includes control centers and communication networks necessary for monitoring grid status and controlling post-event restoration efforts, along with necessary fuel assets. "From a cost-benefit standpoint, this amount is reasonable when compared with the dollar losses from a national-scale blackout," which he estimated could result in losses of tens of trillions of dollars, he said.

Industry Wants EPRI's EMP Findings to Inform Action

The Edison Electric Institute (EEI) on Tuesday said its member companies—which include all U.S. investor-owed power companies—applauded the president's "ongoing focus" on EMP threats to critical infrastructure. EEI Vice President for Security and Preparedness Scott Aaronson noted industry security strategies "constantly evolve and are closely coordinated with the federal government through the Electricity Subsector Coordinating Council (ESCC) partnership. "From electric company CEOs to energy grid operators, we work closely to share threat information and partner with all levels of government to mitigate, and respond to, national-level incidents or threats to electric-sector critical infrastructure," he said.

But he cautioned: "How an EMP may impact critical infrastructure is an extremely complex issue that cannot be solved with a one-size-fits-all solution. Sound policy should be informed by sound science."

For now, industry is awaiting findings from a research project EPRI launched in 2016 to evaluate how EMPs could impact the energy grid. EPRI is expected to share its EMP findings next month with industry, policymakers, and the public, "providing the necessary information for companies to better understand the potential impact of EMP incidents to the transmission system. The findings also will include recommendations for mitigation approaches and investments," Aaronson said.

"Developing this scientific basis enables companies to make science-informed decisions for developing, testing, and deploying EMP-resistant grid components," he said.

—Sonal Patel is a POWER associate editor (@sonalcpatel, @POWERmagazine)

Updated (March 26): Adds EEI's comments

#Ferc #Congress #NERC #EPRI #EEI #Resiliency #National Security #Executive Order #Grid Threats #EMPs #Solar Storms #GMDs #Trump Administration #George Baker #EMP Commission

MORE NEWS

Disaster Preparedness: The Quest for Transformer Resilience

Though critical to the nation's power grid, large power transformers are some of the most vulnerable components in...

China Leads Investment in Coal Projects—and Also Renewables

China continues to finance new coal plants in more than two dozen countries, even as the country has...

Electrification: Too Much of a Good Thing?

Electrification has been a much-touted driver for the global energy transition toward decarbonization. But though an all-electric future...

EPRI: Electrification to Reshape Power Landscape

Even in the absence of climate policy, customer adoption of electric end-use technologies over the next 30 years...