National Rural Electric Cooperative Association
A Touchstone Energy® Cooperative

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Introduction

Chairman Johnson, Ranking Member Carper, and members of the Committee, thank you for inviting me to testify today on "Protecting the Electric Grid from the Potential Threats of Solar Storms and Electromagnetic Pulse."

I serve as the lead legislative representative of the National Rural Electric Cooperative Association (NRECA) on homeland security issues. NRECA isthe service organization for over 900 not-for-profit electric utilities serving over 42 million people in 47 states. NRECA's members include 67 generation and transmission ("G&T") cooperatives that generate and transmit power to 668 of the 838 distribution cooperatives across the nation. Electric cooperative service territory makes up 75 percent of the nation's land mass. Kilowatt-hour sales by rural electric cooperatives account for approximately 11 percent of all electric energy sold in the United States. NRECA members generate approximately 50 percent of the electric energy they sell and purchase the remaining 50 percent.

As member owned not-for-profit utilities, distribution cooperatives and G&Ts reflect the values of their membership and they are uniquely focused on providing reliable electricity at the lowest reasonable cost. Cooperatives have to answer to their member/owners and justify every expense as they are the ones who will have to bear the cost. There is never any debate over whether a proposed project will benefit a cooperative's shareholders or customers because they are one and the same.

Today I am offering testimony on behalf of the electric industry to discuss two distinct issues: Geomagnetic Disturbances, or GMDs, and Electromagnetic Pulses, or EMPs.

Clarifying the Terms

Manmade EMPs

An EMP is a blast of electromagnetic energy that can disrupt or destroy electronic devices. There is a broad range of EMPs with significant variations in terms of impacts and responses. Just as the consequences and likelihood of each of these threats vary, so too does the approach to protecting the electric grid against them.

The only type of EMP that poses a potential widespread threat to the electrical grid are those generated by man through a high-altitude nuclear explosion. In the case of directed energy weapons or "suitcase EMPs" the threat is more localized, likely only impacting an individual facility similar to any other physical assault on grid infrastructure Due to the redundancy and resiliency of the grid, localized events like this have significantly less likelihood of causing a cascading electric system event.

The impact of an EMP from a high-altitude nuclear explosion over the United States would affect more than just electric infrastructure, however. Other critical infrastructures that utilize microprocessors are also vulnerable, including those with which the electric sector has interdependencies. Any activity that relies upon devices containing integrated circuitry- such as industrial process control systems, hospital equipment, as well as transportation and telecommunications systems - could be affected by an EMP attack on our country. As such, the primary responsibility for protecting the United States from such an attack should fall on the country's defense intelligence and military services, not on individual critical infrastructure owners/operators.

Natural GMDs

Geomagnetic disturbances caused by solar storms are initiated by natural events on the surface of the sun in which ejected masses of electrically charged particles are hurled toward the Earth. These create the potential for Earth-based disturbances due to their interaction with the Earth's magnetic field.

When the particles interact with the Earth's magnetic field, especially in certain geographic regions (e.g., northern latitudes), they can cause ground-induced currents (GIC) and other potentially disruptive phenomena. The direct impact of GMDs is primarily limited to reliability of the bulk power system and communication systems. GMDs are common and in fact happen pretty regularly. These are natural events and, as such, industry incorporates them into planning and mitigation efforts. Early alert systems using NOAA satellites allow owners and operators to take action to protect their systems, if necessary. With currently deployed satellites nearing the end of their reliable life cycle, these systems will need to be maintained and enhanced with new satellites in the near future to ensure that early alerts remain available and their timeliness is enhanced.

GMDs are ranked by storm levels, ranging from G1 (minor) to G5 (extreme). GMDs at higher levels have the potential to damage bulk power system assets (e.g., higher-voltage transformers) and to cause a loss of reactive power support, which could lead to voltage instability and power system collapse. The most significant issue for the bulk power system stemming from a strong GMD is the ability for operators to maintain voltage stability[1]. We see lower level GMDs pretty regularly. In fact, a few weeks ago we had a number of days in a row of G3 (strong) storms but no impact was felt on the bulk power system from these occurrences because proper measures were taken and procedures followed.

Based on these risks, in May 2013, under a statutory framework and authority established by Congress in the 2005 Energy Policy Act (Section 215 of the Federal Power Act), Federal Energy Regulatory Commission (FERC) Order No. 779 directed the North American Electric Reliability Corporation (NERC), to develop reliability standards to address the potential impact of GMDs on the reliable operation of the bulk electric system. NERC is an independent, government standards setting body that, under FERC oversight, develops and enforces mandatory reliability and critical infrastructure protection standards for the bulk power system owners, operators and users. NERC, FERC, and the electric power sector have since implemented a mandatory and enforceable GMD standard requiring owners and operators of the North American electric grid to prepare specific tailored operating procedures for use during severe GMD events. NERC has developed a second GMD standard, currently pending FERC approval, which will require tailored assessments and mitigation of the potential impacts of a 100-year GMD event on the

[1] Based upon the NERC 2012 Special Reliability Assessment Interim Report: Effects of Geomagnetic Disturbances on the Bulk Power System. http://www.nerc.com/files/2012GMD.pdf

bulk-power system, including high voltage power transformers. NRECA and its members support the approval and implementation plans developed in both of these standards

<u>Distinctions between EMPs and GMDs</u>

Unfortunately, sometimes EMPs and GMDs are mistakenly conflated in the policy dialogue. It is important to keep these two separate threats distinct and to not conflate them from a policy, planning, protection or mitigation perspective. As stated earlier, EMPs are manmade and GMDs are caused by naturally occurring events. Furthermore, the magnetic fluctuations that result from GMDs are fundamentally different from EMPs generated by a high-altitude nuclear explosion and, as a result, pose different risks. Nuclear EMPs actually have three components—E1, E2, and E3—each of which arises from a different physical effect following a nuclear detonation. E3 is a slow pulse and resembles GMDs generated by a very severe solar flare. However, GMDs do not have an E1 or E2 component. The similarity between an EMP E3 component and a GMD caused by a sever solar flare may have led some to mistakenly confuse EMP and GMD, but such confusion overlooks critical distinctions and can have unintended consequences, including potentially undermining or conflicting with mitigation measures and protective standards already in place.

When considered as part of the broader spectrum of potential threats to the electric grid, nuclear-induced EMP is considered an extremely low-likelihood, high-consequence event. That doesn't mean the electric industry disregards or ignores its significance; merely that it is considered appropriately as part of a broader risk management strategy. The electric sector's approach to protecting critical assets against all types of threats is known as defense-in-depth, which includes balancing preparation, prevention, response, and recovery for a wide variety of hazards to electric grid operations. The industry recognizes that it cannot protect all assets from all threats. Instead, its priorities are to protect the most critical grid components against the most likely threats; to build in system resiliency; and to develop contingency plans for response and recovery when either man-made or natural phenomena impact grid operations.

Fundamentally, a nuclear-induced EMP would take the form of either a terrorist attack or an act of war occurring on or above U.S. soil. As such, the principal responsibility for preventing or guarding against a nuclear attack lies with the federal government. However, whatever the threat, industry works to ensure that the grid remains safe, and that reliable and affordable electricity is delivered to customers when and where they need it. We can't prevent every attack, remove every vulnerability, or respond in advance to every threat, but our defense-in-depth approach has proven successful in maintaining a highly reliable grid.

Industry works closely with government on matters of critical infrastructure protection through the Electric Sector Coordinating Council (ESCC). The ESCC brings together industry executives and senior-level government officials for high level policy discussions on important security issues affecting the electric industry. Both the public and private sector have unique roles, responsibilities, and capabilities. Leveraging each of these in a coordinated way is imperative. An EMP is the type of emerging issue that the ESCC can address at the policy level with DOE, DHS, the Department of Defense, and other federal agencies that have unique national resources beyond the capabilities of the private sector.

Moving Forward

How do we minimize the potential consequences of an EMP or GMD? Some propose that industry install their particular "protective device" or fully "gold plate" the entire grid so that it could, theoretically, at least partially survive a high altitude nuclear blast. However, there is no consensus on precisely what measures should be taken, the unintended effects they might have on the system, how much such an effort would cost, or how successful such efforts would be in limiting impacts to the bulk power system. For example, due to non-uniform designs and complexity, substation solutions (e.g., Faraday-cages) would have to be individually customized, which would not come at a standardized rate. Additionally, there are concerns that installing "protective devices" in some areas of the bulk power system could unintentionally cause problems in other areas. Further research and testing of these devices is needed, and is underway.

Even assuming that every conceivable blocking device were installed to protect every inch of the electric grid and caused no problems, power supplies still would likely be disrupted for a significant length of time in an impacted area. That is because other critical infrastructures that utilities rely upon to function—such as transportation systems for our fuel, water systems for cooling, and telecommunications for operations—would also not be available.

The North American power grid is a huge, complex machine that spans the entirety of the United States, Canada and even parts of Mexico. Its function can be impacted by many different types of events or threats, from natural events like GMDs and severe storms to man-made malicious threats like EMP, cyber or physical attacks. Due to the expanse of not only these threats as well as the system itself, the electric sector addresses risk management through our defense-in-depth approach. This includes preparing for and preventing what we can, while at the same time planning for response and recovery in case of worst case scenarios.

Unfortunately, planning for recovery at a national level for widespread destructive events is necessary in today's world. Efforts aimed at bolstering reserves of strategic transformers, for example, are a step in the right direction, as could be tasking DHS with further examination of EMP threats as a national security issue.

Conclusion

Owners and operators of critical electric infrastructure have every incentive to prevent their systems from going down for even a moment if they can avoid it. Electric utility professionals know their systems best, including the operational and reliability impacts of potential external threats, so they should be included in any efforts commissioned to look into these matters. Utilizing existing public-private critical infrastructure partnership frameworks, like the Electricity Subsector Coordinating Council (ESCC), to ensure input and engagement on national security issues like recovery from a nuclear blast is, for a large part, why they exist.

Thank you for holding this hearing and inviting the electric industry to provide perspective on these very important issues and how they impact the complex machine that is the electric grid. I would be happy to address any questions you may have.