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Roundtable on "Perspectives on Protecting the Electric Grid from an Electromagnetic Pulse or Geomagnetic Disturbance"
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Chairman Johnson and Ranking Member Peters:

Thank you for providing me with the opportunity to participate in this roundtable discussion and provide some perspectives on efforts to protect the United States bulk power system from electromagnetic pulse (EMP) and geomagnetic disturbance (GMD). My name is Joe McClelland and I am the Director of the Federal Energy Regulatory Commission's Office of Energy Infrastructure Security. I am here today as a member of the Commission staff and my remarks do not necessarily represent the views of the Commission or any individual Commissioner.

The Federal Energy Regulatory Commission's authorities pertain to certain aspects of the U.S. hydroelectric, oil, natural gas and electrical infrastructures. Relative to the U.S. electric grid, the Commission regulates wholesale sales and transmission of electricity, ensuring that rates, terms and conditions of sale are just, reasonable, and not unduly discriminatory. The enactment of the Energy Policy Act of 2005 gave the Commission a major new responsibility to approve and enforce mandatory reliability standards for the Nation's bulk power system. This authority is in section 215 of the Federal Power Act. It is important to note that FERC's jurisdiction and reliability authority under section 215 is limited to the "bulk power system," as defined in the FPA, which excludes Alaska and Hawaii, as well as local distribution systems. Under the section 215 authority, FERC cannot author or modify reliability standards, but must depend upon an Electric Reliability Organization (or ERO) to perform this task. The Commission certified the North American Electric Reliability Corporation or NERC as the ERO. The ERO develops and proposes new reliability standards or modifications to existing standards with industry for the Commission's review, which it can either approve or remand. If the Commission approves a proposed reliability standard, it becomes mandatory in the United States and is applicable to the users, owners and operators of the bulk power system. If the Commission remands a proposed standard, it is sent back to the ERO for further consideration. The Commission is required to give "due weight" to the technical expertise of the ERO when reviewing any of NERC's proposed standards.

Section 215 of the Federal Power Act provides a statutory foundation for the ERO to develop reliability standards for the reliable operation of the bulk power system. However, the consequences of a severe naturally-occurring event or a national security threat by entities intent on attacking the U.S. by exploiting vulnerabilities in its electric grid using physical or cyber means stands in stark contrast to other major reliability events that have caused regional blackouts and reliability failures in the past. Widespread disruption of electric service can undermine the security of the U.S., its government, military, and the economy, as well as endanger the health and safety of its citizens. Given the national security dimension to this threat, it is imperative that action be taken quickly and effectively protect America's energy infrastructures from all forms of attacks including, cyber and physical as well as EMP and GMD.

For these reasons, the Commission uses a dual-fold approach; employing both mandatory standards to establish foundational practices while also working collaboratively with industry, the states and federal agencies to identify and promote best practices to mitigate advanced threats. Specific to the topic of this roundtable, GMD and EMP events are generated from either naturally occurring or man-made causes. In the case of GMDs, naturally occurring solar magnetic disturbances periodically disrupt the earth's magnetic field which in turn, can induce currents on the electric grid that may simultaneously damage or destroy key transformers over a large geographic area. Regarding man-made events, EMPs can be generated by devices that range from small, portable, easily concealed battery-powered units all the way through missiles equipped with nuclear warheads. In the case of the former, equipment is readily available that can generate localized high-energy bursts designed to disrupt, damage or destroy electronics such as those found in control systems on the electric grid. The EMP generated during the detonation of a nuclear device is far more encompassing and generates three distinct effects, each impacting different types of equipment; a short high energy radio-frequency-type burst called E1 that can destroy electronics; a slightly longer burst that is similar to lightning termed E2; and a final effect termed E3 that is similar in character and effect to GMD, with the potential to damage transformers and other electrical equipment. Any of these effects can cause voltage problems and instability on the electric grid, which can lead to wide-area blackouts.

In 2001, Congress established a commission to assess and report on the threat from EMP. In 2004, 2008 and most recently in 2017, the EMP Commission issued reports on these threats. One of the key findings in the reports was that a single EMP attack could seriously degrade or shut down a large part of the electric power grid. Depending upon the attack, significant parts of the electric infrastructure could be "out of service for periods measured in months to a year or more." It is important to note that effective mitigation against solar geomagnetic disturbances and non- nuclear EMP weaponry can also provide an effective mitigation against the impacts of a high-altitude nuclear detonation.

In order to better understand and quantify the effect of EMP and GMD on the power grid, FERC staff, the Department of Energy (DOE) and the Department of Homeland Security (DHS) sponsored a study conducted by the Oak Ridge National Laboratory in 2010. The results of the study support the general conclusion of prior studies that EMP and GMD events pose substantial risk to equipment and operation of the Nation's electric grid and under extreme conditions could result in major long-term electrical outages. Unlike EMP attacks that are dependent upon the capability and intent of an attacker, GMD disturbances are inevitable with only the timing and magnitude subject to variability. The Oak Ridge study assessed a solar storm that occurred in May 1921, which has been termed a 1-in-100 year event, and applied it to today's electric grid. The study concluded that such a storm could damage or destroy over 300 bulk power system transformers interrupting service to 130 million people with some outages lasting for a period of years. From the time of that study however, others have concluded that the power grid may collapse before significant damage was done to transformers; resulting in a potentially wide-spread, but relatively short, power outage.

To date, a few U.S. entities have taken some steps to address EMP on their systems. Efforts such as EMP hardening of power control centers and substation control buildings have been implemented but much work remains. Internationally, the United Kingdom, Norway, Sweden, Finland, Germany, South Korea, Japan, Australia, New Zealand, South Africa, Israel and Saudi Arabia have GMD and/or EMP programs in place or are in the early stages of addressing or examining the impacts of GMD or EMP. The costs of these initiatives can vary widely depending on factors such as the threshold of protection, the service requirements of the load, the type of equipment that is to be protected, and whether the installation is new or a retrofit.

In response to the GMD threat, the Commission convened a technical conference in April of 2012 inviting subject matter experts from industry and government with diverse views on the effects of a GMD event. A general consensus from this conference was that a wide-spread outage resulting from a GMD event should be prevented. Based on the record, the Commission has initiated action under both the establishment of baseline standards and the identification and promotion of best practices to help address GMD events.

Regarding the establishment of mandatory standards, beginning in May 2013, the Commission directed NERC to develop and submit for approval proposed reliability standards that address the impact of geomagnetic disturbances on the reliable operation of the Bulk-Power System in two stages.

Stage 1, which was approved in June 2014, requires entities to develop plans and implement operator action in response to a GMD event. Stage 2, which was approved by the Commission in September of 2016 requires entities to perform GMD vulnerability assessments and develop corrective actions as necessary to address the threats. From this time, the standards have continued to evolve requiring the GMD assessments to be completed by 2023, completion of the corrective action plans by 2024, and implementation in two stages; non-hardware mitigation by 2026 and hardware mitigation by 2028.

Simultaneous with its standards activities, the Commission continues to collaborate with other federal agencies and industry members to identify key energy facilities, conduct threat briefings to industry members on GMD and EMP threats and assists with the identification and adoption of best practices for mitigation of these threats.

FERC's regulatory authority with respect to rates also may be relevant to addressing these issues. For example, FERC issued a policy statement entitled "Security Cost Recovery Policy Statement", on September 14, 2001, three days after the September 11, 2001 attacks. That two-paragraph policy statement stated that FERC would "approve applications to recover prudently incurred costs necessary to further safeguard the reliability and security of our energy supply infrastructure in response to the heightened state of alert." Further examples include subsequent orders by FERC providing clarity on how it will address services provided by the Edison Electric Institute and Grid Assurance for emergency spare transmission equipment. Work in this area is ongoing, with FERC and DOE recently announcing a Security Investments for Energy Infrastructure Technical Conference on March 28, 2019. The purpose of the conference will be to discuss current cyber and physical security practices used to protect energy infrastructure and will explore how federal and state authorities can provide incentives and cost recovery for security investments in energy infrastructure, particularly the electric and natural gas sectors.

FERC continues to prepare for a more EMP and GMD resilient grid through collaboration on federal, state and international levels. Including participation in DOE's Electric Sector Coordinating Council, the Energy Infrastructure Security Council's national and international efforts to foster collaboration on both foundational and best practices for EMP and GMD preparedness, briefings to the

EMP Commission and collaboration with DHS, DOE, the Department of Defense, the national laboratories, and industry including the Electric Power Research Institute (EPRI) the electric industry's research organization. The Commission also participates as a member of the Space Weather Operations, Research, and Mitigation (SWORM) Subcommittee studying the threats, vulnerabilities and best practices to address them. Among the accomplishments of this subcommittee has been the issuance of the National Space Weather Strategy and the Space Weather Action Plan which developed high-level strategic goals for enhancing national preparedness for a severe space weather event. In addition, FERC continues to assist both DOE and DOD to identify defense-related critical electric infrastructure as directed under the FAST Act, thereby assisting with their decisions regarding EMP and GMD protection at these facilities. As a final example, FERC also provides outreach to the states through meetings, closed briefings and participation on panel sessions with public utilities and regulatory commissions.

In conclusion, EMP and GMD threats pose a serious threat to the electric grid and its supporting infrastructures that serve our Nation. The Commission is taking both a standards and a collaborative approach to protect and provide a more resilient electric grid to these threats.