

**Testimony of Joseph McClelland  
Director, Office of Energy Infrastructure Security  
Federal Energy Regulatory Commission  
Before the Committee on Homeland Security  
and Governmental Affairs  
United States Senate  
July 22, 2015**

Chairman Johnson, Ranking Member Carper and Members of the  
Committee:

Thank you for the privilege to appear before you today to discuss threats to the electric grid in the United States. My name is Joe McClelland and I am the Director of the Federal Energy Regulatory Commission's newest office, the Office of Energy Infrastructure Security. I am here today as a Commission staff witness and my remarks do not necessarily represent the views of the Commission or any individual Commissioner.

In the Energy Policy Act of 2005, Congress entrusted the Commission with 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 reliability standards or modifications 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 bulk power system. However, the nature of 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, such as events caused by tree trimming practices. Widespread disruption of electric service can quickly undermine the U.S. government, its military, and the economy, as well as endanger the health and safety of millions of citizens. Given the national security dimension to this threat, there may be a need to act quickly to protect the grid in a manner where action is mandatory rather than voluntary while protecting certain sensitive information from public disclosure.

To provide a significantly more agile and focused approach to these growing cyber and physical security threats, the Commission established the Office of Energy Infrastructure Security – or OEIS – in late 2012. Its mission is to provide leadership, expertise and assistance to the Commission, other federal and state agencies and jurisdictional entities in identifying, communicating and seeking comprehensive solutions to significant potential cyber and physical security risks to the energy infrastructure under the Commission’s jurisdiction. This includes threats from geomagnetic disturbances (GMDs) and electromagnetic pulses (EMPs). OEIS also assists in the identification of key energy infrastructure facilities for the application of best practices. OEIS has been able to recruit and develop deep subject matter expertise to collaboratively perform its task.

Specific to the subject of this hearing, 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 RF-type burst called E1 that destroys 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 targeting the same equipment including key transformers. 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 and again in 2008, the 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 and the Department of Homeland Security 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.

The Commission has used a two-fold approach to help address the EMP and GMD threats:

1. In response to a Commission Order, NERC has proposed two reliability standards on GMD. The Commission approved the first one, a mandatory reliability standard that requires certain entities to implement operational procedures to mitigate the effects of GMD events. The Commission also has issued an order proposing to approve the second one, a reliability standard proposed by NERC that would establish requirements for certain entities to conduct initial and on-going assessments of the vulnerability of their transmission systems against a

benchmark geomagnetic disturbance. The Commission also proposed certain additional actions.

2. Simultaneous with its regulatory approach, the Commission collaborated with federal agencies and industry members to identify key energy facilities, conduct threat briefings to industry members on both GMD and EMP, assist with the identification of best practices for mitigation, and cooperate with international partners to convey threat and mitigation information as well as encourage adoption of best practices for mitigation.

A few US entities have taken some initial steps to address EMP on their systems, 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 conclusion, these types of threats pose a serious risk to the electric grid and its supporting infrastructures that serve our Nation. The Commission is therefore taking both regulatory and collaborative actions to address them.

Thank you again for the opportunity to testify today. I would be happy to answer any questions you may have.