**Testimony of Joseph McClelland**

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**Federal Energy Regulatory Commission**

**Before the Committee on Energy and Natural Resources**

**United States Senate**

**July 17, 2012**

Mr. Chairman, Ranking Member and Members of the Committee:

Thank you for this opportunity to appear before you to discuss the security of the electric grid. My name is Joseph McClelland. I am the Director of the Office of Electric Reliability (OER) of the Federal Energy Regulatory Commission (FERC or Commission). The Commission's role with respect to reliability is to help protect and improve the reliability of the Nation's bulk power system through effective regulatory oversight as established in the Energy Policy Act of 2005. 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.

The Commission is committed to protecting the reliability of the nation's bulk electric system; nevertheless, the Commission's current authority is not adequate to address cyber or other national security threats to the reliability of our transmission and power system. These types of threats pose an increasing risk to our Nation's electric grid, which undergirds our government and economy and helps ensure the health and welfare of our citizens.

I will describe how limitations in Federal authority do not fully protect the grid against physical and cyber threats. My testimony also summarizes the Commission's oversight of the reliability of the electric grid under section 215 of the Federal Power Act (FPA) and the Commission's implementation of that authority with respect to cyber related reliability issues primarily through Order No. 706.

**<u>Background</u>**

In the Energy Policy Act of 2005 (EPAct 2005), Congress entrusted the Commission with a major new responsibility to oversee mandatory, enforceable reliability standards for the Nation's bulk power system (excluding Alaska and Hawaii). This authority is in section 215 of the Federal Power Act. Section 215 requires the Commission to select an Electric Reliability Organization (ERO) that is responsible for proposing, for Commission review and approval, reliability standards or modifications to existing reliability standards to help protect and improve the reliability of the Nation's bulk power system. The Commission has certified the North American Electric Reliability Corporation (NERC) as the ERO. The reliability standards apply to the users, owners and operators of the bulk power system and become mandatory in the United States only after Commission approval. The ERO also is authorized to impose, after notice and opportunity for a hearing, penalties for violations of the reliability standards, subject to Commission review and approval. The ERO may delegate certain responsibilities to "Regional Entities," subject to Commission approval.

The Commission may approve proposed reliability standards or modifications to previously approved standards if it finds them "just, reasonable, not unduly discriminatory or preferential, and in the public interest." The Commission itself does not have authority to modify proposed standards. Rather, if the Commission disapproves a proposed standard or modification, section 215 requires the Commission to remand it to the ERO for further consideration. The Commission, upon its own motion or upon complaint, may direct the ERO to submit a proposed standard or modification on a specific matter but it does not have the authority to modify or author a standard and must depend upon the ERO to do so.

*Limitations of Section 215 and the Term "Bulk Power System"*

Currently, the Commission's jurisdiction and reliability authority is limited to the "bulk power system," as defined in the FPA, and therefore excludes Alaska and Hawaii, including any federal installations located therein. The current interpretation of "bulk power system" also excludes some transmission and all local distribution facilities, including virtually all of the grid facilities in certain large cities such as New York, thus precluding Commission action to mitigate cyber or other national security threats to reliability that involve such facilities and major population areas. The Commission directed NERC to revise its interpretation of the bulk power system to eliminate inconsistencies across regions, eliminate the ambiguity created by the current discretion in NERC's definition of bulk electric system, provide a backstop review to ensure that any variations do not compromise reliability, and ensure that facilities that could significantly affect reliability are subject to mandatory rules. NERC has recently filed a revised definition of the term bulk power system, and the Commission has solicited comments on its proposal to accept NERC's revised definition. However, it is important to note that section 215 of the FPA excludes local distribution facilities from the Commission's reliability jurisdiction, so any revised bulk electric system definition developed by NERC will still not apply to local distribution facilities.

*Critical Infrastructure Protection Reliability Standards*

An important part of the Commission's current responsibility to oversee the development of reliability standards for the bulk power system involves cyber related reliability issues. In August 2006, NERC submitted eight proposed cyber standards, known as the Critical Infrastructure Protection (CIP) standards, to the Commission for approval under section 215. Critical infrastructure, as defined by NERC for purposes of the CIP standards, includes facilities, systems, and equipment which, if destroyed, degraded, or otherwise rendered unavailable, would affect the reliability or operability of the "Bulk Electric System." Under NERC's implementation plan for the CIP standards, full compliance became mandatory on July 1, 2010.

On January 18, 2008, the Commission issued Order No. 706, the Final Rule approving the CIP reliability standards while concurrently directing NERC to develop significant modifications addressing specific concerns. The Commission set a deadline of July 1, 2009 for NERC to resolve certain issues in the CIP reliability standards, including deletion of the "reasonable business judgment" and "acceptance of risk" language in each of the standards. NERC concluded that this deadline would create a very compressed schedule for its stakeholder process. Therefore, it divided all of the changes directed by the Commission into phases, based on their complexity. NERC opted to resolve the simplest changes in the first phase, while putting off more complex changes for later versions.

NERC filed the first phase of the modifications to the CIP Reliability Standards (Version 2) on May 22, 2009. In this phase, NERC removed from the standards the terms "reasonable business judgment" and "acceptance of risk," added a requirement for a "single senior manager" responsible for CIP compliance, and made certain other administrative and clarifying changes. In a September 30, 2009 order, the Commission approved the Version 2 CIP standards and directed NERC to develop additional modifications to certain of them. Pursuant to the Commission's September 30, 2009 order, NERC submitted Version 3 of the CIP standards which revised Version 2 as directed. The Version 3 CIP standards became effective on October 1, 2010. This first phase of the modifications directed by the Commission in Order No. 706, which encompassed both Version 2 and Version 3, did not modify the critical asset identification process, a central concern in Order No. 706.

On February 10, 2011, NERC initiated the second phase of the Order No. 706 directed modification, filing a petition seeking approval of Version 4 of the CIP standards. Version 4 includes new proposed criteria to identify "critical assets" for purposes of the CIP reliability standards. On April 19, 2012, the Commission issued Order No. 761, approving the Version 4 CIP standards, which introduced "bright line" criteria for the identification of Critical Assets. The version 4 CIP standards do not go into effect until April 1, 2014. The currently effective CIP reliability standards allow utilities significant discretion to determine which of their facilities are "critical assets and the associated critical cyber assets," and therefore are subject to the requirements of the standards. It is important to note that although "critical assets" are used to identify subsequent "critical cyber assets," only the subset of "critical cyber assets" – which are self-determined by the affected entities – are subject to the CIP standards. As the Commission stated in Order No. 706, the identification of critical assets is the cornerstone of the CIP standards. If that identification is not done well, the CIP standards will be ineffective at maintaining the reliability of the bulk power system.

In the order approving NERC's Version 4 standards, the Commission recognized that Version 4 is an interim step and stated its concern that Version 4 does not provide enough protection to satisfy Order No. 706. Thus, the Commission established a deadline of end of first quarter of 2013 for NERC to file standards in compliance with the outstanding directives in Order No. 706.

The remaining CIP standards revisions to respond to the Commission's directives issued in Order No. 706 are still under development by NERC. It is important to note that the majority of the Order No. 706 directed modifications to the CIP standards have yet to be addressed by NERC. Until they are addressed, there are significant gaps in protection.

**<u>The NERC Process</u>**

As an initial matter, it is important to recognize how mandatory reliability standards are established. Under section 215, reliability standards must be developed by the ERO through an open, inclusive, and public process. The Commission can direct NERC to develop a reliability standard to address a particular reliability matter. However, the NERC process typically requires years to develop standards for the Commission's review. In fact, the CIP standards approved by the Commission in January 2008 took approximately three years to develop.

NERC's procedures for developing standards allow extensive opportunity for stakeholder comment, are open, and are generally based on the procedures of the American National Standards Institute. The NERC process is intended to develop consensus on both the need for, and the substance of, the proposed standard. Although inclusive, the process is relatively slow, open and unpredictable in its responsiveness to the Commission's directives. This process requires public disclosure regarding the reason for the proposed standard, the manner in which the standard will address the issues, and any subsequent comments and resulting modifications in the standards as the affected stakeholders review the material and provide comments. NERC-approved standards are then submitted to the Commission for its review.

The procedures used by NERC are appropriate for developing and approving routine reliability standards. The process allows extensive opportunities for industry and public comment. The public nature of the reliability standards development process can be a strength of the process. However, it can be an impediment when measures or actions need to be taken to address threats to national security quickly, effectively and in a manner that protects against the disclosure of security-sensitive information. The current procedures used under section 215 for the development and approval of reliability standards do not provide an effective and timely means of addressing urgent cyber or other national security risks to the bulk power system, particularly in emergency situations. Certain circumstances, such as those involving national security, may require immediate action, while the reliability standard procedures take too long to implement efficient and timely corrective steps. On September 3, 2010, FERC approved a new reliability standards process manual filed by NERC. While this manual includes a process for developing a standard related to a confidential issue, the new process is untested and it is unclear how the process would be implemented.

FERC rules governing review and establishment of reliability standards allow the agency to direct the ERO to develop and propose reliability standards under an expedited schedule. For example, FERC could order the ERO to submit a reliability standard to address a reliability vulnerability within 60 days. Also, NERC's rules of procedure include a provision for approval of "urgent action" standards that can be completed within 60 days and which may be further expedited by a written finding by the NERC board of trustees that an extraordinary and immediate threat exists to bulk power system reliability or national security. However, it is not clear NERC could meet this schedule in practice. Moreover, faced with a national security threat to reliability, there may be a need to act decisively in hours or days, rather than weeks, months or years. That would not be feasible even under the urgent action process. In the meantime, the bulk power system would be left vulnerable to a known national security threat. Moreover, existing procedures, including the urgent action procedure, could widely publicize both the vulnerability and the proposed solutions, thus increasing the risk of hostile actions before the appropriate solutions are implemented.

In addition, a reliability standard submitted to the Commission by NERC may not be sufficient to address the identified vulnerability or threat. Since FERC may not directly modify a proposed reliability standard under section 215 and must either approve or remand it, FERC would have the choice of approving an inadequate standard and directing changes, which reinitiates a process that can take years, or rejecting the standard altogether. Under either approach, the bulk power system would remain vulnerable for a prolonged period.

This concern was highlighted in the Department of Energy Inspector General's January 2011 audit report on FERC's "Monitoring of Power Grid Cyber Security." The audit report identified concerns regarding the adequacy of the CIP standards and the implementation and schedule for the CIP standards, and concluded that these problems exist, in part, because the Commission's authority to ensure adequate reliability of the bulk electric system is limited. This report emphasizes the need for additional authority to ensure adequate cyber security over the bulk electric system.

Finally, the open and inclusive process required for standards development is not consistent with the need to protect security-sensitive information. For instance, a formal request for a new standard would normally detail the need for the standard as well as the proposed mitigation to address the issue, and the NERC-approved version of the standard would be filed with the Commission for review. This public information could help potential adversaries in planning attacks.

**Physical Security and Other Threats to Reliability**

The existing reliability standards do not extend to physical threats to the grid, but physical threats can cause equal or greater destruction than cyber attacks and the Federal government should have no less ability to act to protect against such potential damage. One example of a physical threat is an electromagnetic pulse (EMP) event. EMP events can be generated from either naturally occurring or man-made causes. In the case of the former, solar magnetic disturbances periodically disrupt the earth's magnetic field which in turn, can generate large induced ground currents. This effect, also termed the "E3" component of an EMP, can simultaneously damage or destroy bulk power system transformers over a large geographic area. Regarding man-made events, EMP can also be generated by weapons. Equipment and plans are readily available that have the capability to generate high-energy bursts, termed "E1", that can damage or destroy electronics such as those found in control and communication systems on the power grid. These devices can be portable and effective, facilitating simultaneous coordinated attacks, and can be reused, allowing use against multiple targets. The most comprehensive man-made EMP threat is from a high-altitude nuclear explosion. It would affect an area defined by the "line-of-sight" from the point of detonation. The higher the detonation the larger the area affected, and the more powerful the explosion the stronger the EMP emitted. The first component of the resulting pulse E1 occurs within a fraction of a second and can destroy control and communication electronics. The second component is termed "E2" and is similar to lightning, which is well-known and mitigated by industry. Toward the end of an EMP event, a third element, E3, occurs. This causes the same effect as solar magnetic disturbances. It can damage or destroy power transformers connected to long transmission lines. It is important to note that effective mitigation against solar magnetic disturbances and non-nuclear EMP weaponry provides effective mitigation against a high-altitude nuclear explosion.

In 2001, Congress established a commission to assess the threat from EMP, with particular attention to be paid to the nature and magnitude of high-altitude EMP threats to the

United States; vulnerabilities of U.S. military and civilian infrastructure to such attack; capabilities to recover from an attack; and the feasibility and cost of protecting military and civilian infrastructure, including energy infrastructure. In 2004, the EMP commission issued a report describing the nature of EMP attacks, vulnerabilities to EMP attacks, and strategies to respond to an attack.[1] A second report was produced in 2008 that further investigated vulnerabilities of the Nation's infrastructure to EMP.[2] Both electrical equipment and control systems can be damaged by EMP.

An EMP may also be a naturally-occurring event caused by solar flares and storms disrupting the Earth's magnetic field. In 1859, a major solar storm occurred, causing auroral displays and significant shifts of the Earth's magnetic fields. As a result, telegraphs were rendered useless and several telegraph stations burned down. The impacts of that storm were muted because semiconductor technology did not exist at the time. Were the storm to happen today, according to an article in *Scientific American*, it could "severely damage satellites, disable radio communications, and cause continent-wide electrical black-outs that would require weeks or longer to recover from."[3] Although storms of this magnitude occur rarely, storms and flares of lesser intensity occur more frequently. Storms of about half the intensity of the 1859 storm occur every 50 years or so according to the authors of the *Scientific American* article, and the last such storm occurred in November 1960, leading to world-wide geomagnetic disturbances and radio outages. The power grid is particularly vulnerable to solar storms, as transformers are electrically grounded to the Earth and susceptible to damage from geomagnetically induced currents. The damage or destruction of numerous transformers across the country would result in reduced grid functionality and even prolonged power outages.

In March 2010, Oak Ridge National Laboratory (Oak Ridge) and their subcontractor Metatech released a study that explored the vulnerability of the electric grid to EMP-related events. This study was a joint effort contracted by FERC staff, the Department of Energy and the Department of Homeland Security and expanded on the information developed in other initiatives, including the EMP commission reports. The series of reports provided detailed technical background and outlined which sections of the power grid are most vulnerable, what equipment would be affected, and what damage could result. Protection concepts for each threat and additional methods for remediation were also included along with suggestions for mitigation. The results of the study support the general conclusion that EMP events pose substantial risk to equipment and operation of the Nation's power grid and under extreme conditions could result in major long term electrical outages. In fact, solar magnetic disturbances are inevitable with only the timing and magnitude subject to variability. The study assessed the 1921 solar storm, which has been termed a 1-in-100 year event, and applied it to today's power grid. The study concluded that such a storm could damage or destroy up to 300 bulk power system transformers interrupting service to 130 million people for a period of years.

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[1] Graham, Dr. William R. et al., *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack* (2004).
[2] Dr. John S. Foster, Jr. et al., *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack* (2008).
[3] Odenwald, Sten F. and Green, James L., *Bracing the Satellite Infrastructure for a Solar Superstorm*, Scientific American Magazine (Jul. 28, 2008).

On April 30, 2012, the Commission held a technical conference to discuss issues related to reliability of the bulk power system as affected by geomagnetic disturbances. The conference explored the risks and impacts from geomagnetically induced currents to transformers and other equipment on the bulk power system, as well as options for addressing or mitigating the risks and impacts. The Commission is considering the comments filed after that conference.

The existing reliability standards do not address EMP vulnerabilities. Protecting the electric generation, transmission and distribution systems from severe damage due to an EMP-related event would involve vulnerability assessments at every level of electric infrastructure.

**<u>The Need for Legislation</u>**

In my view, section 215 of the Federal Power Act provides an adequate statutory foundation for the ERO to develop most reliability standards for the bulk power system. However, the nature of a national security threat by entities intent on attacking the U.S. through vulnerabilities in its electric grid stands in stark contrast to other major reliability vulnerabilities that have caused regional blackouts and reliability failures in the past, such as vegetation management and protective relay maintenance 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, to act in a manner where action is mandatory rather than voluntary, and to protect certain information from public disclosure.

The Commission's current legal authority is inadequate for such action. This is true of both cyber and physical threats to the bulk power system that pose national security concerns. Section 215 of the FPA excludes all facilities in Alaska and Hawaii and all local distribution facilities from the Commission's reliability jurisdiction, which may leave significant facilities vulnerable to the threat of a cyber or physical attack. In addition, although the NERC standards development process as envisioned in section 215 can be fine for routine reliability matters, it is too slow, too open and too unpredictable to ensure its responsiveness in the cases where national security is endangered. This process is inadequate when measures or actions need to be taken to address threats to national security quickly, effectively and in a manner that protects against the disclosure of security-sensitive information.

These shortcomings can be solved through a comprehensive, government-wide approach to cyber security issues or through a sector-specific approach. If a government-wide course is pursued, care should be taken to ensure that the two approaches complement each other, preserving FERC's ability to regulate electric reliability effectively. Any new legislation should address several key concerns. First, to prevent a significant risk of disruption to the grid, legislation should allow the federal government to take action before a cyber or physical national security incident has occurred. In particular, the federal government should be able to require mitigation even before or while NERC and its stakeholders develop a standard, when circumstances require urgent action. Second, any legislation should ensure appropriate confidentiality of sensitive information submitted, developed or issued under this authority. Without such confidentiality, the grid may be more vulnerable to attack. Third, if additional reliability authority is limited to the bulk power system, as that term is currently defined in the FPA, it would not authorize Federal action to mitigate cyber or other national security threats to reliability that involve certain critical facilities and major population areas. Fourth, it is important that entities be able to recover costs they incur to mitigate vulnerabilities and threats.

**Conclusion**

The Commission's current authority is not adequate to address cyber or other national security threats to the reliability of our transmission and power system. These types of threats pose an increasing risk to our Nation's electric grid, which undergirds our government and economy and helps ensure the health and welfare of our citizens. Thank you again for the opportunity to testify today. I would be happy to answer any questions you may have.