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OVERSIGHT OF FEDERAL EFFORTS TO ADDRESS ELECTROMAGNETIC RISKS

UNITED STATES HOUSE OF REPRESENTATIVES, COMMITTEE ON HOMELAND SECURITY, SUBCOMMITTEE ON OVERSIGHT AND MANAGEMENT EFFICIENCY

ONE HUNDRED FOURTEENTH CONGRESS, SECOND SESSION

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Statement of Subcommittee Chairman Scott Perry (R-PA)
Oversight and Management Efficiency Subcommittee

"Oversight of Federal Efforts to Address Electromagnetic Risks"
May 17, 2016

Remarks as Prepared

America's energy infrastructure is the heart that pumps the American economy. Long term power outages resulting from an attack on our critical infrastructure could cripple our nation's economy and put Americans' health and safety in jeopardy. Because the nation's critical infrastructure is so vital to Americans' way of life, the Federal government has recognized the necessity of securing our infrastructure from an array of risks, including the threat of an electromagnetic pulse (EMP) attack. The most serious EMP risk would come in the form of an EMP resulting from a nuclear detonation at high altitude. Such an attack could cause long-term damage to the power grid. While many believe the likelihood of such an attack is low, the damage and economic aftershocks that would follow demand that we address these risks. We cannot discount that other nation-states, such as North Korea, or sophisticated terror groups might want to utilize an EMP to wreak havoc on our economy.

The Departments of Homeland Security and Energy, and Federal Energy Regulatory Commission have an active role in protecting our critical infrastructure. According to a Government Accountability Office (GAO) report released last month, Federal agencies have taken action to prepare and mitigate EMP risks, but there's still room for improvement. According to GAO, DHS and the Department of Energy have addressed some but not all of the recommendations in a 2008 report from the congressionally authorized EMP Commission.

Unfortunately, DHS has yet to clearly identify a lead office or official within the Department to coordinate efforts internally and with other Federal and industry stakeholders. How can DHS protect us against EMP risks if they don't know who is in charge? I expect to hear from DHS's witness today on how the Department has corrected this failure. GAO also found that Federal partners must do a better job of collaborating their planning activities. Additionally, GAO made recommendations to improve how DHS analyzes EMP risks and how DHS and DOE identify and implement key research and development priorities.

Overall, GAO found that the Federal government's efforts to prepare for and mitigate EMP risks are at best, a mixed bag. The progress made to date is certainly due, in part, to Congress's oversight efforts and the recommendations made in 2008 by the EMP Commission. DHS and DOE must make more headway in their efforts to address EMP. Effectively engaging the private sector to assist with planning and building system resiliency will be an essential component of these efforts.

Congress must also do its part. In November 2015, the House passed H.R. 1073, the Critical Infrastructure Protection Act, authored by Congressman Trent Franks of Arizona, which would require better planning, research, and development for EMP risks. Unfortunately like many other bills passed by this Committee, it remains stuck in the Senate.

I appreciate the hard work of our watchdogs at GAO for their report and the witnesses for appearing before the Subcommittee today. I look forward to hearing how federal agencies will work to improve themselves, in light of GAO's findings, to better protect the American people from EMP risks.

United States Government Accountability Office

Testimony before the Subcommittee on Oversight and Management Efficiency, Committee on Homeland Security, House of Representatives

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CRITICAL INFRASTRUCTURE PROTECTION

Federal Efforts to Address Electromagnetic Risks

Statement of Chris Currie, Director, Homeland Security and Justice

GAO-16-641T

Chairman Perry, Ranking Member Watson Coleman, and Members of the Subcommittee:

I am pleased to be here today to discuss our March 2016 report on federal efforts to address electromagnetic risks to the electric grid.[1] Electromagnetic risks caused by a man-made electromagnetic pulse (EMP) or a naturally occurring solar weather event could have a significant impact on the nation's electric grid as well as other infrastructure sectors that depend on electricity, such as communications. The impact of these events could lead to power outages over broad geographic areas for extended durations. Addressing these events necessitates effective collaboration among multiple government agencies and industry partners, as no single federal program or entity has sole responsibility for addressing electromagnetic risks. In April 2008, the Commission to Assess the Threat to the United States from Electromagnetic Pulse Attack (EMP Commission)[2] issued a report that included over 90 recommendations addressing the preparation for, and protection and recovery from, a possible EMP attack against U.S. critical infrastructure. The majority of these recommendations were made to the Department of Homeland Security (DHS) and to the Department of Energy (DOE).

[1]GAO, *Critical Infrastructure Protection: Federal Agencies Have Taken Actions to Address Electromagnetic Risks, but Opportunities Exist to Further Assess Risks and Strengthen Collaboration*, GAO-16-243 (Washington, D.C.: Mar. 24, 2016).

[2]Established pursuant to the National Defense Authorization Act for Fiscal Year 2001, the EMP Commission was responsible for assessing the following: 1) the nature and magnitude of potential high-altitude EMP threats to the United States; 2) the vulnerability of U.S. military and civilian systems to an EMP attack in terms of emergency preparedness; 3) the capability of the United States to repair and recover from damage inflicted by an EMP attack; and 4) the feasibility and cost of hardening selected military and civilian systems against EMP attack. See Pub. L. No. 106-398, §§ 1401-09, 114 Stat. 1654, 1654A-345-348 (2000). See also Pub. L. No. 109-163, § 1052, 119 Stat. 3136, 3434-35 (2006) (reestablishing the EMP Commission to continue its efforts to monitor, investigate, make recommendations, and report to Congress on the evolving threat to the United States in the event of an EMP attack resulting from the detonation of a nuclear weapon or weapons at high altitude) and Pub. L. No. 110-181, Div. A, § 1075 122 Stat. 3, 333 (2008) (providing, among other things, that the EMP Commission and the Secretary of Homeland Security shall jointly ensure that the work of the EMP Commission with respect to EMP attack on electricity infrastructure, and protection against such attack, is coordinated with DHS efforts on such matters). The National Defense Authorization Act for Fiscal Year 2016 once again reestablishes the EMP Commission but with an expanded purpose that includes the evolving threat from, among other things, nonnuclear EMP weapons and natural EMP generated by geomagnetic storms. See Pub. L. No. 114-92, § 1089, 129 Stat. 726, 1015-16 (2015).

According to experts, a nuclear EMP is the burst of electromagnetic radiation resulting from the detonation of a nuclear device, which can disrupt or destroy electronic equipment. Nonnuclear EMP weapons can also be designed to intentionally disrupt electronics, but these generally have short range and are not a threat to multiple assets. In addition to manmade EMPs, naturally occurring solar weather events of sufficient intensity can also cause electromagnetic impacts that can adversely affect components of the commercial electric grid, as well as other infrastructure such as satellites and undersea cables. The resulting impact of a solar weather event is commonly referred to as a geomagnetic disturbance (GMD). In 1989, a GMD caused wide-scale impacts on the Hydro-Quebec power system in Canada which caused this regional electric grid to collapse within 92 seconds and left 6 million customers without power for up to 9 hours.

The National Infrastructure Protection Plan (NIPP) outlines the roles and responsibilities of DHS and applicable sector-specific agencies for each of the 16 critical infrastructure sectors.[3] DHS has the lead role in coordinating the overall federal effort to promote the security and resilience of the nation's critical infrastructure and DOE—as the sector-specific agency for the energy sector, which includes critical electrical infrastructure—shares responsibility with DHS. Other federal agencies working to address the threat of EMP and GMD include the Department of Defense (DOD) and the Federal Energy Regulatory Commission (FERC), as well as the National Oceanographic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), and the National Aeronautics and Space Administration (NASA).

As noted in Presidential Policy Directive 21, the energy and communications sectors are uniquely critical due to the enabling functions they provide to other critical infrastructure sectors.[4] The U.S. electric power delivery system is a highly complex network of substations and

[3]DHS, *National Infrastructure Protection Plan, Partnering for Critical Infrastructure Security and Resilience* (Washington, D.C.: December 2013). Sector-specific agencies are the federal departments and agencies responsible for providing institutional knowledge and specialized expertise, as well as leading, facilitating, or supporting the security and resilience programs and associated activities of their designated critical infrastructure sector in the all- hazards environment.

[4]Presidential Policy Directive-21, *Critical Infrastructure Security and Resilience* (Feb. 12, 2013) (identifying, among other things, the 16 critical infrastructure sectors and the sector-specific agencies).

electric lines that transport electricity from generators to residential, commercial, and industrial consumers. Approximately 85 percent of the nation's critical electrical infrastructure is owned and operated by private industry.

My statement today summarizes the findings from our March 2016 report, and like the report, addresses (1) the extent to which key federal agencies have taken actions to address electromagnetic risks to the electric grid, including how these actions align with selected recommendations from the 2008 EMP Commission report and (2) the extent to which additional opportunities, if any, exist to enhance federal efforts in addressing those risks to the electric grid. To conduct this work, we reviewed program documents, research reports, applicable risk assessments, and other supporting documentation related to electromagnetic risks and interviewed agency officials at DHS, DOE, DOD, FERC, and NOAA. We also interviewed officials from industry associations, subject-matter experts from research organizations, product manufacturers, and electric utility operators. More detailed information on our scope and methodology can be found in our March 2016 report.[5] We conducted the work on which this statement is based in accordance with generally accepted government auditing standards.

Federal Agencies Have Taken Various Actions to Address Electromagnetic Risks; Some Actions Align with the 2008 EMP Commission Recommendations

DHS, DOE and FERC have taken various actions to address electromagnetic risks to the electric grid, and these actions generally fall into four categories: (1) standards, guidelines, tools and demonstration projects; (2) research reports; (3) strategy development and planning; and (4) training and outreach. Additionally, some of the actions DHS and DOE have taken generally aligned with recommendations made by the EMP Commission.

Because federal agencies generally do not own electric grid infrastructure, federal actions to address GMD risks are more indirect through such things as developing standards and guidelines, and conducting research that could benefit electric grid owners and operators. Federal agencies have also been involved in strategy development and planning, as well as training and outreach efforts, as a means of preparing federal officials and others to respond to both EMP and GMD events, and enhancing knowledge about electromagnetic risks. For

[5]GAO-16-243.

example, DHS's Science and Technology Directorate (S&T) led the design and development of a prototype transformer that can be more easily transported to another location to help restore electric power in a timelier manner. DHS has also participated in various training and outreach events to enhance understanding of EMP and GMD events. DOE's primary efforts include supporting research to enhance the understanding of the potential impacts to the electric grid from electromagnetic events. More detailed information on key federal agencies' actions taken since 2008 to address electromagnetic risks can be found in Appendix II of our March 2016 report.[6]

Although DHS and DOE did not report that any of their actions were taken in response to the EMP Commission recommendations, some actions taken by both agencies have aligned with some of the recommendations. Specifically, of the seven recommendations made by the EMP Commission related to the electric grid,[7] some of the actions that DHS and DOE took aligned with four of them: conducting research to better understand the interdependencies of critical infrastructures, addressing the vulnerability of control systems to an EMP attack; identifying responsibilities for responding to an EMP attack; and utilizing industry and other governmental institutions to assure the most cost-effective outcomes.[8] For example, with respect to the recommendation on conducting research to better understand interdependencies of critical infrastructures, DHS's Sector Resilience Report: Electric Power Delivery includes some assessment of how various critical infrastructures—including the energy, communications, and transportation sectors, among others—are interdependent in maintaining operations. For more detailed information regarding how identified federal actions align with these

[6]GAO-16-243.

[7]The seven EMP Commission recommendations related to the electric grid include the following: (1) conducting research to better understand infrastructure systems and interdependencies; (2) expanding activities to address the vulnerability of control systems; (3) identifying clear authority and responsibility to respond to an EMP attack; (4) engaging federal and industry entities to determine liabilities and funding; (5) establishing monitoring efforts and defining testing standards and metrics; (6) providing capabilities to help protect the electric grid from an EMP attack and recover as rapidly and effectively as possible; and (7) utilizing industry and governmental institutions to assure cost effective outcomes.

[8]With regard to the last multipart recommendation identified above, DHS and DOE took some actions that aligned with 5 of the 15 subparts of this recommendation. Some of the sub-parts include such efforts as developing national and regional restoration plans and assuring the availability of critical communication channels, among other efforts.

seven EMP Commission recommendations, see Appendix III of our March 2016 report.[9]

Additional Opportunities Exist To Enhance Federal Efforts to Address Electromagnetic Risks to the Electric Grid

DHS Has Not Clearly Identified Roles and Responsibilities for Addressing Electromagnetic Risks

In our March 2016 report, we found that DHS had not clearly identified internal roles and responsibilities for addressing electromagnetic risks to the electric grid or communicated these to external federal and industry partners. While multiple DHS components and offices, including the National Protection and Programs Directorate (NPPD), the Federal Emergency Management Agency (FEMA), and S&T, had each conducted independent activities addressing electromagnetic risks to the electric grid, none had been tasked with lead responsibility for coordinating related activities within the department or with federal and industry stakeholders. As a result, during the course of our review for our March 2016 report, we experienced ongoing challenges in identifying applicable DHS personnel and related departmental actions. For example, NPPD officials had difficulty identifying their specific roles and activities addressing electromagnetic risks to the electric grid, including efforts to collect or synthesize available risk information to provide input into department-wide risk assessments.

Furthermore, industry representatives and other federal officials told us it is not clear who within DHS is responsible for addressing electromagnetic risks. The 2008 EMP Commission report recommended that DHS make clear its authority and responsibilities, as well as delineate the functioning interfaces with other governmental institutions, regarding EMP response

[9]GAO-16-243.

efforts. We concluded that designating internal roles and responsibilities within DHS regarding electromagnetic risks and communicating these to federal and industry partners could provide additional awareness of related activities and help ensure more effective and coordinated engagement with other federal agencies and industry stakeholders, and could help reduce the risk of potential duplication, overlap, or fragmentation within the department or across federal agencies.

In our March 2016 report, we recommended DHS designate roles and responsibilities within the department for addressing electromagnetic risks and communicate these to federal and industry partners. DHS concurred with our recommendation and reported that their Office of Policy is coordinating across the department to identify and document applicable roles and responsibilities regarding electromagnetic issues to ensure full mission coverage while minimizing potential overlap or redundancy and expects to complete this effort by December 2016. These actions, if implemented effectively, should address the intent of our recommendation.

DHS and DOE Have Not Fully Addressed NIPP Requirement to Identify Key Electrical Infrastructure Assets

In our March 2016 report, we found that DHS and DOE had not taken actions to identify key electrical infrastructure assets as required given their respective critical infrastructure responsibilities under the NIPP. The NIPP explicitly states that to manage critical infrastructure risk effectively, partners must identify the assets, systems, and networks that are essential to their continued operation, considering associated dependencies and interdependencies of other infrastructure sectors. The 2008 EMP Commission report also recommended that DHS and DOE prioritize nodes that are critical for the rapid recovery of other key sectors that rely upon electricity to function, including those assets that must remain in service or be restored within hours of an EMP attack. Neither DHS nor DOE reported any specific actions taken to identify critical electrical infrastructure as part of risk management efforts for the energy sector, including any systematic review of a 2013 FERC analysis of critical substations, or any further collaboration to determine the key elements of criticality that they believe should be considered when evaluating the vast array of infrastructure assets constituting the U.S. electric grid. The extensive size and scope of the electric power system necessitates collaboration among partners to ensure all individual expertise is effectively leveraged.

As a result, we recommended in our March 2016 report that DHS and DOE direct responsible officials to review FERC's electrical infrastructure analysis and collaborate to determine whether further assessment is needed to adequately identify critical electric infrastructure assets. DHS

and DOE each concurred with our recommendation. DHS reported that NPPD is to collaborate with FERC to identify critical electrical infrastructure assets beginning with the evaluation of critical substations identified by FERC, and will explore elements of criticality that might not have been considered by FERC, in coordination with DOE. DOE stated that its Office of Electricity Delivery and Energy Reliability will review FERC's electrical infrastructure analysis and will work with FERC and DHS to identify any additional elements of criticality and determine if further assessment is needed. Both DHS and DOE expect to complete these efforts by March 2017. These actions should address the intent of our recommendation.

DHS Has Not Fully Leveraged Existing Opportunities to Collect and Analyze Information on Electromagnetic Risks

We found in March 2016 that although DHS components had independently conducted some efforts to assess electromagnetic risks, the department had not fully leveraged available risk information or conducted a comprehensive analysis of these risks. Within the Office of Policy, there is recognition that "space weather" and "power grid failure" are significant risk events, which DHS officials have determined pose great risk to the security of the nation. However, DHS officials were unable to provide detailed information about the specific risk inputs—namely threat, vulnerability, and consequence information—that were used to assess how electromagnetic events compared to other risk events, or how these inputs were used to inform DHS's applicable risk-management priorities. Further, officials within NPPD were unable to identify any specific actions taken or plans to systematically collect or analyze risk information regarding electromagnetic impacts to the electric grid as part of department-wide risk assessment efforts.

According to the NIPP, to assess risk effectively, critical infrastructure partners—including owners and operators, sector councils, and government agencies—need timely, reliable, and actionable information regarding threats, vulnerabilities, and consequences. Additionally, the electric grid remains vulnerable to other potential threats, such as physical and cyberattacks. We concluded that better collection of threat, vulnerability, and consequence information through existing DHS programs and strengthened collaboration with federal partners could help DHS better assess the relative risk ranking of electromagnetic events versus other risks and help inform asset protection priorities. Moreover, according to subject-matter experts, the impact to the electric grid from electromagnetic threats may vary substantially by location, network and operating characteristics, and other factors. For example, key reports on GMD indicate that high-voltage transformers located at higher latitudes in the United States are likely subject to increased potential for adverse impacts from GMD events than those at lower latitudes. Further collection

of information on sector interdependencies could also help DHS to assess the potential economic consequences associated with long-term power outages and provide information to help assess the cost-effectiveness of various mitigation strategies.

In our March 2016 report, we recommended that DHS's NPPD and Office of Infrastructure Protection (IP) work with other federal and industry partners to collect and analyze key inputs on threat, vulnerability, and consequences related to electromagnetic risks. DHS concurred with our recommendation and reported that the department has initiated efforts to assess electromagnetic risk and help determine priorities. For example, DHS stated the Department has a joint study with DOE underway that will analyze the hazard environments, impacts, and consequences of different sources of EMP and GMD on the electric grid to determine events of concern and potential means of mitigation. DHS expects to implement these efforts by December 2016 and if implemented effectively, should address the intent of our recommendation.

Federal Agencies Have Not Fully Coordinated Efforts to Implement EMP Risk Management Activities

We also found in March 2016 that key federal agencies, including DHS and DOE, as well as industry partners had not established a fully coordinated approach to identifying and implementing risk management activities to address EMP risks. According to the NIPP Risk Management Framework, such activities include identifying and prioritizing research and development efforts, and evaluating potential mitigation options, including the cost-effectiveness of specific protective equipment. The publication of the National Space Weather Action Plan in October 2015 identified many key federal activities in these areas regarding the GMD risk; however, no similar efforts had been proposed regarding EMP risks to the electric grid.[10]

DHS officials stated an EMP attack generally remains a lower risk priority compared to other risk events with higher probability such as natural disasters or cyberattacks. DOE officials also noted resource limitations and competing priorities as the key driver for not pursuing additional risk management activities specifically related to EMP events. However, we

[10]White House, *National Space Weather Action Plan* (Washington, D.C.: October 2015). Among other actions, the National Space Weather Action Plan lays out responsibilities for federal entities to establish benchmarks for space weather events, which are intended to serve as inputs into such activities as developing vulnerability assessments, creating engineering standards, and developing more effective mitigation practices and procedures.

found that even if an EMP attack is not determined to be among the highest resource priorities for DHS and DOE relative to other risk events, there are opportunities for enhanced collaboration among federal agencies and industry stakeholders to address identified gaps and help ensure that limited resources are more effectively coordinated and prioritized. For example, recent reports issued by DOE and a leading research organization for the electric industry identified gaps in the information available regarding likely EMP impacts to modern grid technologies and electronic control systems. They noted that such information remains important for developing applicable protective guidelines and equipment design specifications.

In our March 2016 report, we recommended that DHS and DOE engage with federal partners and industry stakeholders to identify and implement key EMP research and development priorities, including opportunities for further testing and evaluation of potential EMP protection and mitigation options. DHS and DOE concurred with our recommendation and each identified actions to convene applicable stakeholders to jointly determine mitigation options and conduct further testing and evaluation. DHS stated S&T will work with DOE and the Electricity Subsector Coordinating Council to develop a joint government and industry approach to identify options for mitigating the consequences of an EMP event. DHS expects to implement this effort by September 2016. In addition, DOE stated it is working with the Electric Power Research Institute to develop an EMP Strategy that is scheduled for completion by August 31, 2016, and the strategy is to be followed by a more detailed action plan identifying research and development priorities and specific opportunities to test and evaluate EMP mitigation and protection measures. If implemented effectively, DHS and DOE's actions should address the intent of our recommendation.

We will continue to monitor DHS and DOE actions taken to address our March 2016 recommendations and have also recently initiated two additional reviews. One is evaluating the electromagnetic event preparedness of U.S. electricity providers and the other is a technical assessment of protective equipment designed to mitigate the potential impacts of a GMD on electrical infrastructure. We expect these projects to be completed by mid-2017.

Chairman Perry, Ranking Member Watson Coleman, and Members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

GAO Contact and Staff Acknowledgements

If you or your staff members have any questions concerning this testimony, please contact Chris Currie, Director, Homeland Security and Justice at (404) 679-1875 or CurrieC@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. GAO staff who made key contributions include Dawn Hoff, Assistant Director; Chuck Bausell, Kendall Childers, Josh Diosomito, Ryan Lambert, Tom Lombardi, Steven Putansu, John Rastler, and Cody Raysinger.

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Statement for the Record

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Before the

United States House of Representatives
Committee on Homeland Security
Subcommittee on Oversight and Management Efficiency

Regarding

"Oversight of Federal Efforts to Address Electromagnetic Risks"

May 17, 2016

Thank you, Chairman Perry, Ranking Member Coleman, and distinguished Members of the Committee. It is my pleasure to be here to discuss the threat posed by electromagnetic pulse events (EMP) to our Nation and its critical infrastructure, including its cyber, communications, and electric-grid assets.

Over the past several decades, the risk to digital and physical infrastructures has grown. For example, today's power grid and information networks may be more vulnerable to EMP than those of a few decades ago, as the grid transitions from an analog system to a digital system to improve efficiency. My testimony today will focus on the Department of Homeland Security's (DHS) preparations to respond to and assist recovery from a potential EMP attack, as well as touch on the joint DHS/Department of Energy (DOE) effort to review the EMP science and provide a peer-reviewed estimate of the potential risks.

The Federal Government plays an important role supporting the critical infrastructure community to manage risks from low-probability, high-consequence events, such as EMPs and severe geomagnetic disturbances (GMDs). DHS and its interagency partners will be using our unique resources built over the past decade to address the scale and degree of uncertainty associated with risks such as the ones I am here to discuss today.

The Department takes seriously the recent review and recommendations of the Government Accountability Office (GAO) on federal efforts to address EMP risk, as well as the recommendations issued by the 2008 EMP Commission, and welcomes further cooperation with other government agencies to ensure we are appropriately responsive on this critical topic.

Background on EMP

An EMP is the burst of electromagnetic radiation created, for instance, when a nuclear weapon is detonated or when a non-nuclear EMP weapon is used. EMPs can be high frequency, similar to a flash of lightning, or low frequency, similar to an aurora-induced phenomenon. The consequences of an EMP can range from permanent physical damage to temporary system disruptions, and can result in fires, electric shocks to people and equipment, and critical service outages.

There are two general classes of EMP of concern: (1) Nuclear sources of EMP, such as High altitude EMP (HEMP), and (2) Non-Nuclear sources of EMP (NNEP). HEMP results from a nuclear detonation typically occurring 15 or more miles above the Earth's surface. The extent of HEMP effects depends on several factors including the altitude of the detonation, the weapon yield, and whether it was designed for EMP effects. On the ground, effects may be diminished by the electromagnetic shielding, or "hardening," of assets. A high-altitude burst could blanket the entire continental United States and could cause widespread impacts to multiple sectors, including to lifeline sectors such as the energy and communications. HEMP threat vectors can originate from a missile, such as a sea-launched ballistic missile; a satellite asset; or a relatively low-cost balloon-borne vehicle.

Non-Nuclear EMP (NNEP) can be created by sources such as Radio Frequency Weapons or Intentional Electromagnetic Interference devices, which are designed to produce sufficient electromagnetic energy to burn out or disrupt electronic components, systems, and networks. NNEP devices can be either electrically-driven, where they create narrowband or wideband microwaves, or explosively-driven, where an explosive is used to compress a magnetic field to generate the pulse. The range of an NNEP is fairly short (typically less than 1 kilometer) and faraday casings with line filters and surge arresters can mitigate much of the EMP effects.

Potential Impacts on Critical Infrastructure

In some of its forms, EMP can cause widespread disruption and serious damage to electronic devices and networks, including those upon which many critical infrastructures rely. There is uncertainty over the magnitude and duration of an electric power outage that may result from an EMP event due to ambiguity regarding the actual damage to electric power assets from an event. Any electric power outage resulting from an EMP event would ultimately depend upon a number of unknown factors and effects to assets that are challenging to accurately model, making it difficult to provide high-specificity information to electric system planners and system operators. These variables include characteristics such as the EMP device type, the location of the blast, the height of the blast, the yield of the blast, and design and operating parameters of the electric power system subject to the blast. Secondary effects of EMP may harm people through induced fires, electric shocks, and disruptions of transportation and critical support systems, such as those at hospitals or sites like nuclear power plants and chemical facilities.

All critical infrastructure sectors are at risk from EMP, particularly those sectors that rely heavily on communications and sensor (e.g., radar) technology, information technology, the electric grid, or that use a Supervisory Control and Data Acquisition system. The complex interconnectivity among critical infrastructure sectors means that EMP incidents that affect a single sector are likely affect other sectors – potentially resulting in additional failures..

DHS Efforts to Address GAO Recommendations

DHS is working collaboratively, both internally and with external stakeholders, in various arenas to address the recommendations issued by GAO on this topic. DHS has been working on the topic of EMP for a number of years, and we will continue working on it in the future. An example of our previous work on the topic of EMP includes a 2010 study on "Electromagnetic Pulse (EMP) Impacts on Extra High Voltage Power Transformers" conducted by the National Infrastructure Simulation and Analysis Center for DHS.

As part of DHS's continuing commitment to this issue, there are resources across the Homeland Security enterprise engaged on this topic, including within the Federal Emergency Management Agency (FEMA), the National Protection and Programs Directorate (NPPD), and the Science and Technology Directorate (S&T). The scope of activity, as reviewed by GAO, falls into three areas of activity: (1) risk assessment and analysis, (2) communication and coordination of threat information, and (3) research and development to mitigate EMP risks.

NPPD's involvement on EMP issues resides in a number of functional components including the Office of Cyber and Infrastructure Analysis (OCIA), the Office of Infrastructure Protection (IP), and the Office of Cybersecurity and Communications (CS&C). OCIA has partnered directly with the DOE's Office of Electricity Delivery and Energy Reliability to assess the impacts of EMP and Geomagnetic disturbance events on electric power assets. This study, facilitated through DHS's National Infrastructure Simulation and Analysis Center and DOE's National Laboratories, is intended to develop scientifically rigorous, peer-reviewed methods for assessing electric power asset impacts to EMP events. This study will include participation of the Intelligence Community, the broader interagency, the academic community, and the private sector, when possible.

The EMP study by OCIA will leverage newly-started private sector activities that are occurring through the Electric Power Research Institute, as well as previous government investments in research which have been sponsored by DHS and DOE. The estimated completion date of this risk analysis-based study of the electric power sector is approximately mid-2017.

IP and OCIA continue to work collaboratively with the Department of Energy and the Federal Energy Regulatory Commission (FERC). As the GAO report indicates, collaboration can and should be increased with an emphasis on identification of critical infrastructure assets of the electric power sector. Once identified, this list of assets can be used to guide protection and preparedness activities at DHS and to help prioritize response and recovery actions by DOE and DHS after a large-scale event. DHS is also increasing our collaboration with DOE and FERC in the near-term, including additional collaboration between staff-level subject matter experts.

CS&C, which oversees the National Cybersecurity and Communications Integration Center (NCCIC), has been assessing the potential risks to the communications and control elements of the electric grid from EMP, as well as radio frequency weapons, solar weather, and cyber threats for several years. As part of these efforts, the NCCIC developed the "EMP Protection Guidelines for Equipment, Facilities and Data Centers" report and provided related briefings to the Continuity of Government community and to the Communications Sector, as well as other programs and sectors, to inform the community and help mitigate EMP and radio frequency weapons threats. The previously mentioned joint study by OCIA and DOE's Office of Electricity Delivery and Energy will seek to learn and build upon the knowledge and expertise gained from the NCCIC's previous studies on this topic.

FEMA continues to leverage the National Preparedness System to build, sustain, and deliver the capabilities needed to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk, including risks to the energy sector. The tools and processes within the National Preparedness System include, but are not limited to, plans, training, and exercises for managing a variety of risks to the nation's infrastructure, including EMP and cyber vulnerabilities.

FEMA is also actively developing their Power Outage Incident Annex to enhance the Response and Recovery Federal Interagency Operational Plans. The Annex, developed in partnership with the federal interagency community and the private sector, will describe the process and

organizational constructs through which the Federal Government will respond to and recover from the impacts of a widespread disruption in the power grid from any cause.
Lastly, S&T develops near-term solutions to bridge capability gaps, and S&T has invested in multiple research programs for increasing the electric grid's resilience against solar weather hazards. Previous research investments, such as the Recovery Transformer (RecX) project, are available for private sector risk reduction on EMP and are available to be deployed by private sector owners and operators today.

Conclusion

DHS, for many years, has pursued a deeper understanding of the EMP threat, as well as its potential impacts, effective mitigation strategies, and a greater level of public awareness and readiness. These efforts have been undertaken in cooperation with other federal agencies and private sector owners and operators; and we are committed to continuing to expand our focus on this issue, as warranted by the risk environment.

I want to thank the Committee for the invitation to speak here today and for your ongoing support for our work in this area. I welcome your questions.

Testimony of Joseph McClelland
Director, Office of Energy Infrastructure Security
Federal Energy Regulatory Commission
Before the Committee on Homeland Security
Subcommittee on Oversight and Management Efficiency
United States House of Representatives

Hearing on Oversight of Federal Efforts to Address Electromagnetic Risks

May 17, 2016

Chairman Perry, Ranking Member Watson Coleman and Members of the Subcommittee:

Thank you for the privilege to appear before you today to discuss electromagnetic 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 Office of Energy Infrastructure Security (OEIS). 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 (ERO) to perform this task. The Commission certified the North American Electric Reliability Corporation (NERC) as the ERO. The ERO develops and proposes for the Commission's review reliability standards or modifications, which the Commission 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.

I note that Congress took steps to address such a situation late last year, including in the Fixing America's Surface Transportation Act (FAST Act) a section entitled, "Critical Electric Infrastructure Security." That section assigned notable new authority to the Department of Energy (DOE) and the Commission, among other Federal agencies. Under this new authority, DOE can declare a grid security emergency and order actions to address it. As I will discuss further below, DOE is also to consult with the Commission regarding development of a Strategic Transformer Reserve Plan to reduce the threats from physical, cyber, EMP, GMD, severe weather, and seismic events. The Commission, in consultation with DOE, is to develop regulations governing the designation, protection, and appropriate sharing of Critical Electric Infrastructure Information. In addition, under the Cybersecurity Act of 2015 also enacted late last year, Congress directed the Federal Government to share and receive cybersecurity threat and mitigation information, while restricting its regulatory use, with non-federal entities including state governments and industry.

Consistent with these requirements, the Commission established OEIS in late 2012 to provide a more agile and focused approach to growing cyber and physical security threats. The mission of OEIS is to provide 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).

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, that 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, the Commission, 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.

To date, a few U.S. 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.

With these issues and challenges in mind, the Commission has used a two-fold approach to help address the GMD and EMP threats, applying both regulatory and collaborative actions.

First, with respect to regulatory actions, the Commission has directed NERC to propose two reliability standards on GMD. The Commission approved the first of NERC's proposals, 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 of NERC's proposals, a reliability standard that would establish requirements for certain entities to conduct initial and ongoing assessments of the vulnerability of their transmission systems against a benchmark geomagnetic disturbance. The Commission has received comments on its proposed order and held a related technical conference in March. The Commission is currently reviewing this record to determine how to move forward.

The Commission's regulatory authority with respect to rates also may be relevant to addressing these issues. For example, the Commission has issued two orders to provide clarity on how it will address services provided by Grid Assurance, a company recently created by several electric utilities and energy companies. Grid Assurance is intended to enhance grid resilience and protect customers from prolonged outages by providing electric utilities that subscribe to Grid Assurance with timely access to an inventory of emergency spare transmission equipment, including transformers, that otherwise can take months or longer to acquire.

Second, with respect to collaborative actions, the Commission works closely with Federal agencies, state agencies, and industry members in many ways. In general, such collaboration has included efforts to identify key energy facilities; conduct physical and cyber threat briefings, including on GMD and EMP, to industry members; 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.

Some of the Commission's collaborative actions are relevant to GMD and EMP threats. For example, in November 2014, the National Science and Technology Council (NSTC) created the Space Weather Operations, Research, and Mitigation (SWORM) Task Force to develop high-level strategic goals for enhancing National Preparedness for a severe space weather event. This Task Force is co-chaired by members from the Office of Science and Technology Policy, DHS, and the National Oceanic and Atmospheric Administration. The Commission has participated in the SWORM Task Force's efforts from its inception.

In addition, as required by the FAST Act, DOE, in consultation with the Commission and others, is developing a plan to establish a Strategic Transformer Reserve. The Strategic Transformer Reserve Plan is to identify the sufficient number, type, cost, and location of equipment needed to temporarily replace critically damaged large power transformers and substations that are part of the critical electric infrastructure or that serve defense and military installations. Specific to the subject of today's hearing, the Strategic Transformer Reserve Plan will decrease vulnerabilities related to physical and cyber threats, including both EMP and GMD. The Strategic Transformer Reserve Plan is not limited to transformers, but is also to include other critical electric grid equipment as necessary to provide or restore sufficient resiliency.

The Commission's efforts to date are consistent with the recommendations of the Government Accountability Office's recently released report on electromagnetic risks to the electric grid. I believe that building on previous collaboration among the Commission and other Federal agencies can enhance our collective response in addressing electromagnetic threats to the electric grid in the United States.

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

Statement of

Judson M. Freed
Director, Emergency Management and Homeland Security
Ramsey County, Minnesota
on behalf of the National Association of Counties

before the

Committee on Homeland Security
Subcommittee on Oversight and Management Efficiency
U.S. House of Representatives

for the hearing

"Oversight of Federal Efforts to Address Electromagnetic Risks"

May 17, 2016

Washington, D.C.

Thank you Chairman Perry, Ranking Member Watson Coleman and Members of the Subcommittee on Oversight and Management Efficiency for this opportunity to testify.

My name is Judson Freed and I have served as Director of Emergency Management and Homeland Security in Ramsey County, Minnesota since 2003. I am also vice chair of the Emergency Management Subcommittee of the National Association of Counties' Justice and Public Safety Policy Steering Committee.

About NACo

NACo is the only national organization that represents county governments in the United States, including Alaska's boroughs and Louisiana's parishes. Founded in 1935, NACo assists America's 3,069 counties in pursuing excellence in public service to produce healthy, vibrant, safe and resilient communities.

About America's Counties

Counties are highly diverse, not only in my state of Minnesota, but across the nation, and vary immensely in natural resources, social and political systems, cultural, economic and structural circumstances, and public health and environmental responsibilities. If you've seen one county, you've seen one county, and there are 3,068 more to go.

Counties also often serve as our nation's first line of defense before and after disasters strike. While state statutes and organizational structures vary, local emergency management responsibilities are most commonly vested in county governments. Many counties, including Ramsey County, are required to maintain an emergency management agency to coordinate all activities related to emergency and disaster situations. These responsibilities go well beyond the functions of public safety and emergency services and involve a community wide effort before, during and after a disaster or emergency incident occurs. Emergency managers are charged with preparing their communities for disasters so that when these events inevitably take place, their toll on our residents, homes and public and private structures is minimized. Following a disaster, local emergency managers, on behalf of their elected officials, work to mitigate damage and save lives. In the aftermath of disasters, we coordinate and help fund clean-up, recovery and rebuilding so that our residents can return to their lives as quickly as possible.

About Ramsey County, Minnesota

Ramsey County is a large, fully urban county located near Minnesota's border with Wisconsin, and with a population of more than 550,000, is the second-most populous county in Minnesota. It is also the smallest county in Minnesota, and with its large population, among the most densely populated counties in the nation. St. Paul, the capital of Minnesota, is our county seat.

As a large, urban county located in the northern Midwest, Ramsey County faces perennial threats ranging from tornadoes and ice storms to train derailments and multi-location terrorist attacks. In my role as the County's Director of Emergency Management and Homeland Security, I work to protect our local communities and their residents and structures from the ongoing threats posed by these disasters.

Federal Efforts to Address Electromagnetic Risks: the Local Perspective

Counties are not merely stakeholders in this conversation, but a pivotal part of the federal-state-local partnership of governments that together share the responsibility of protecting our nation and its residents from disasters. Any potential failing of our nation's power grid – and the cascading impacts that would follow – would require an immediate on-the-ground response by county emergency

managers, law enforcement, firefighters, EMS, 911 call centers, public health officials and public records and code inspectors. As such, counties appreciate the potential threat posed by electromagnetic risks and commend the Subcommittee for convening this hearing to assess federal efforts to address these risks.

Mr. Chairman, I will focus my remarks today on three principles that we believe the Subcommittee should observe as you assess federal efforts to mitigate against electromagnetic risks:

- **First, the potential impact of federal policy changes on local governments should be closely considered, particularly when it comes to emergency management.** Counties are charged with protecting local communities from threats both natural and man-made, and federal actions that change national priorities can unintentionally compromise counties' ability to carry out this responsibility and ultimately make our nation less safe.

- **Second, electromagnetic risks should be viewed in the context of the wide variety of threats faced by our nation and its local communities.** We must prepare for an arguably unprecedented variety of risks – from hurricanes and tornadoes to terrorism and cybersecurity threats – and should not lose sight of this fact as we assess electromagnetic threats.

- **Third, emergency management resources – both fiscal and administrative – are finite at all levels of government and should be allocated based on holistic and pragmatic risk-assessment.** Diverting limited resources from highly-probable threats will make our nation less prepared for the risks and disasters that have proven to be perennial visitors to our communities.

By observing these principles – which are elaborated upon below – as you assess federal efforts to mitigate against electromagnetic risks, the Subcommittee can lessen the likelihood that policy changes made leave our country more prepared for one particular threat while decreasing our overall preparedness for the many different risks that face our local communities at any given time.

The potential impact of federal policy changes on local governments should be closely considered, particularly when it comes to emergency management. As outlined in the opening section, counties play a critical role in protecting our local communities from natural and man-made threats. It has been said that "disasters are local," and I can attest that a well-organized local emergency management structure is crucial to disaster preparation, mitigation and recovery efforts.

But many factors affect a local emergency manager's ability to perform his or her functions in a streamlined and efficient manner. De-prioritization of emergency management efforts at the county level or insufficient support for emergency management from the state government are just two examples. Another example – most relevant to the conversation at hand – involves rapidly changing priorities and policies at the federal level. Counties respond to the federal government's actions, not just in our role as intergovernmental partners working with our federal counterparts towards the shared goal of serving American residents, but also because our constituents demand that their local leaders keep pace with the federal government's priorities and initiatives.

Policy changes related to electromagnetic risks would be no different in this regard. Consider the Critical Infrastructure Protection Act (H.R. 1073), which was passed by the House late last year. The bill would require, in part, that the Secretary of the U.S. Department of Homeland Security "conduct outreach to educate… emergency response providers at all levels of government of the threat of [electromagnetic

pulse] events." Imposing federal requirements like this has the potential to disrupt the ongoing process of local emergency management planning and coordination and could undermine our ability to preserve the safety of our communities. We urge Members to consider the cumulative impact of such requirements as Congress works to enact this legislation.

Electromagnetic risks should be viewed in the context of the wide variety of threats faced by our nation and its local communities. Due to changes in weather patterns and population growth – especially in densely populated areas like Ramsey County – our nation is facing an arguably unprecedented number of threats and disasters. We must not lose sight of these various threats as we take on the work of assessing the risks posed by electromagnetic pulses and space weather events.

According to NACo's analysis of data made available by the Federal Emergency Management Agency (FEMA), 92 percent of counties across the nation have had at least one presidential disaster declaration in the past ten years. Overall, these disaster declarations are happening at unprecedented rates, and each disaster seems costlier than the last. Due to globalization and advances in technology that have made us more interconnected than ever before, communities across the country also face novel cybersecurity threats from within and outside the U.S.

While we appreciate the importance of protecting our nation against a potentially devastating failure of our power grids resulting from an electromagnetic event, we urge you to consider this threat in the context of all of the risks and threats that we have been entrusted to protect our communities against, especially at a time when the full range of threats seems to be increasing year after year.

Emergency management resources – both fiscal and administrative – are finite at all levels of government and should be allocated based on holistic and pragmatic risk-assessment. As disasters increase in both frequency and cost, we must be pragmatic in resource allocation, so that our limited emergency management resources go as far as possible in preserving lives, homes and public and private structures in our local communities. Rather than creating new priorities or costly mandates, we urge you to view electromagnetic risks as one element in the portfolio of major risks we face.

In Ramsey County, we have worked hard to ensure that our emergency management decisions and policies are based on pragmatic risk assessment that takes into consideration both the likelihood and potential consequences of various threats. This method of emergency management is one that was promoted in the U.S. Department of Homeland Security's 2014 *Quadrennial Homeland Security Review*, and is widely accepted as a local best practice in counties throughout the country. Through this sort of risk assessment, we aim to make resource allocation decisions that will best protect our communities from threats and disasters. While low priority events like electromagnetic pulses may be deprioritized in this way – and while we appreciate that these events are not unprecedented – we nonetheless believe that given our finite resources, we can best protect our residents, homes and public and private structures through this manner of risk assessment.

That said, we are by no means inattentive to the threats posed to our power grids. We monitor space weather reports and provide weekly reports to our public safety partners and leadership; we monitor the status of our region's power grid and include our utility providers in our oversight and planning workgroups. We assess transmission line protection in light of severe weather and flooding – as well as geomagnetic incidents. Whether through space weather, terrorist threat, or an ice storm or hurricane, large-scale power failures would present significant and cascading challenges to our emergency response systems, and we consider these risks in our disaster response and coordination efforts, and

based on our broader risk-assessment strategies, work to mitigate these risks at every opportunity.

Closing

Thank you again Chairman Perry, Ranking Member Watson Coleman and Members of the Subcommittee for this opportunity to provide the local perspective in this important conversation on federal efforts to address electromagnetic risks.