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Before the House Committee on Energy and Commerce
Subcommittee on Energy

"Keeping the Lights On: Addressing Cyber Threats to the Grid"

July 12, 2019

Introduction

Good morning Chair Rush, Ranking Member Upton, members of the Committee and fellow panelists. My name is Jim Robb and I am the President and CEO of the North American Electric Reliability Corporation (NERC). NERC's mission, as the Electric Reliability Organization (ERO) certified by the Federal Energy Regulatory Commission (FERC), is to assure the reliability and security of the bulk power system (BPS) in North America. I have been at NERC for over a year and, prior to NERC, served as the CEO of Western Electricity Coordinating Council, one of six regions in the reliability enterprise. I have more than 30 years of experience working with the electricity industry and am pleased to speak with you today about NERC's responsibilities for grid security.

The threat from cyber attacks by nation states, terrorist groups, and criminals is at an all-time high. Now more than ever, grid security is inextricably linked to reliability. The North American BPS is among the nation's most critical infrastructures. Virtually every critical sector depends on electricity. The BPS is also one of the largest, most complex systems ever created. It is robust and highly reliable. Nevertheless, conventional and non-conventional factors do present risks to the BPS.

Summary

The security landscape is dynamic, requiring constant vigilance and agility. NERC assures grid security through a comprehensive series of complementary strategies involving mandatory standards, reliability guidelines, alerts, information sharing, and partnerships. NERC's mandatory critical infrastructure protection standards (CIP standards) are a foundation for security practices. They provide universal, baseline protections. Due to the ever-evolving nature of cyber threats, security cannot be achieved through standards alone. Vigilance also requires the agility to respond to new and rapidly changing events. Accordingly, NERC's Electricity Information Sharing and Analysis Center (E-ISAC) serves as the information sharing conduit for North America's electricity industry, partnering with cross-sector and international ISACs from electricity and other critical infrastructures, and sharing information between the electricity industry and government for cyber and physical security threats. The E-ISAC facilitates communication of important or actionable information through a secure portal, and strives to determine and maintain "ground truth" during rapidly evolving security events. The E-ISAC also plays a key role in cross-sector coordination, focusing on sectors with which electricity has interdependencies, such as natural gas, water, and other critical infrastructure. Mandatory standards, coupled with effective mechanisms to share information, provide robust and flexible

tools to protect the BPS. NERC works closely with the U.S. Department of Energy (DOE), the U.S. Department of Homeland Security (DHS), FERC, and the Electricity Subsector Coordinating Council (ESCC) to further the public-private partnership that is so important to addressing security. NERC's biennial security exercise, GridEx, is the largest of its kind in the sector and enables industry and government to exercise their emergency response plans, and drive new and innovative approaches to reduce security risk to the grid.

About NERC

NERC is a private nonprofit corporation founded in 1968 to develop voluntary operating and planning criteria and standards for the users, owners and operators of the North American BPS. Pursuant to Section 215 of the Federal Power Act (FPA) (16 U.S.C. §824o) and the criteria included in Order No. 672 for designating an ERO, FERC certified NERC as the ERO for the United States on July 20, 2006. On March 16, 2007, FERC issued Order No. 693, which approved the initial set of reliability standards. These reliability standards became mandatory in the United States on June 18, 2007. The first CIP standards were approved by FERC in January 2008 in Order No. 706.

NERC develops and enforces reliability standards; annually assesses seasonal and long-term reliability; monitors the BPS through system awareness; analyzes system performance; and educates, trains, and certifies industry personnel. NERC performs a critical role in real-time situational awareness and information sharing to protect the electricity industry's critical infrastructure against threats to the BPS. NERC's area of responsibility spans the continental United States, Canada, and Mexico. Our jurisdiction includes users, owners, and operators of the BPS, which serves nearly 400 million people. Although we do not have hands on any controls, the work of FERC, NERC, and the Regional Entities strengthens the fabric of the industry.

Critical Infrastructure Protection Standards

With oversight from FERC, NERC is responsible for developing and enforcing mandatory reliability standards for the BPS. The CIP standards provide a common, universal foundation for security. They are robust and comprehensive, covering a wide range of priorities and threats.

More than a decade ago, Congress had the foresight to anticipate the emerging risk posed by cyber security threats to the BPS by defining reliability standards to include "cybersecurity protection." NERC's CIP standards are developed in concert with industry subject matter experts through an open, transparent stakeholder process, subject to approval by NERC's Board of Trustees (Board) and FERC. In addition, FERC can order NERC to develop a standard and has done so on topics such as geomagnetic disturbances, physical security, and supply chain cyber security risk management.

The CIP standards group includes the following 12 topics addressing cyber and physical security:[1]

CIP-002 – Cyber System Identification and Categorization requires entities to identify their cyber systems that perform reliability functions and must be protected under the CIP standards. Using bright-line criteria, this standard also requires entities to categorize these systems as high-, medium-, or low-impact based on the risk to the BPS if the system were compromised. This categorization forms the basis for determining the level of controls applied to those systems under the applicable CIP standards.

CIP-003 – Security Management Controls and Requirements for Lower Risk Cyber Systems requires entities to adopt and maintain cyber security policies to establish responsibility and accountability for protecting critical cyber systems. This standard also identifies the security controls for those systems identified as low impact focusing on: cyber security awareness; physical access controls; electronic access controls; cyber security incident response; and protections for transient electronic devices (e.g., thumb drives, laptop computers).

CIP-004 – Personnel and Training establishes rules for authorizing personnel, including contractors and service vendors, for electronic or unescorted physical access to high- and medium-impact cyber systems. It also establishes rules for ensuring these personnel have the appropriate level of training and security awareness.

CIP-005 – Electronic Security Perimeters establishes rules for managing electronic access to high- and medium-impact cyber systems through use of electronic security perimeters that delineate a "trust zone." This standard also establishes rules for remote access to these cyber systems.

CIP-006 – Physical Security of Cyber Systems establishes rules for managing physical access to high- and medium-impact cyber systems.

CIP-007 – Systems Security Management addresses system security by specifying technical, operational, and procedural requirements in support of protecting high- and medium-impact cyber systems.

CIP-008 – Incident Reporting and Response Planning specifies incident reporting and response requirements.

CIP-009 – Recovery Plans specifies recovery plan requirements to help ensure that reliability functions are recovered following a cyber security incident.

[1] To view NERC CIP standards, see http://www.nerc.com/pa/Stand/Pages/AllReliabilityStandards.aspx?jurisdiction=United%20States.

CIP-010 – Change Management and Vulnerability Assessments specifies system configuration management and vulnerability assessment requirements to help prevent and detect unauthorized changes to high- and medium-impact cyber systems.

CIP-011 – Information Protection establishes rules to prevent unauthorized access to cyber system information by specifying information protection requirements.

CIP-013 – Cyber Security Supply Chain Management will require entities to develop and implement a plan to address supply chain cyber security risks during the planning and procurement of industrial control system hardware, software, and services. This standard was approved by FERC on October 18, 2018, and will become effective on July 1, 2020.

CIP-014 – Physical Security of Critical Transmission Substations and Associated Control Centers that pose the greatest risk to reliability if they are damaged or rendered inoperable due to physical attack. The standard requires entities to determine what facilities are critical, assess the physical security threats to and vulnerability of those critical facilities, and implement a plan to mitigate those threats and vulnerabilities.

As experience and technology continue to grow, NERC, with FERC oversight, continues to refine and improve the CIP standards to ensure their effectiveness and timeliness. For example, pending before FERC is a new CIP standard, CIP-012, that would require enhanced protections of sensitive data transmitted between critical control centers.

In June, FERC issued an order approving Reliability Standard CIP-008-6 - Cyber Security – Incident Reporting and Response Planning, noting that the approved standard enhances the security of the Bulk Electric System (BES). The approved standard expands mandatory reporting requirements to include cyber security incidents that either compromise or attempt to compromise electronic security perimeters and electronic access control or monitoring systems (EACMS) associated with medium- and high-impact BES cyber systems. The revised standard also addresses the information to be included in cyber security incident reports and any subsequent updates. Reports and updates from U.S. entities will be sent to the E-ISAC and DHS's National Cybersecurity and Communications Integration Center. The broadened reporting requirements help to enhance awareness of existing and future cyber security threats or vulnerabilities.

NERC is also currently working with industry experts to consider modifications to the CIP standards to better account for technological innovation. As discussed at FERC's June 27 reliability technical conference, these activities include safeguarding information whether on-site or cloud-stored and the need to look at changes to the standards to address these topics for NERC's registered entities.

<u>Supply Chain Risk</u>

In addition to developing the new cyber security supply chain standard, NERC is addressing supply chain risk in several different ways. In 2018-2019, NERC staff prepared a report on cyber security supply chain risks with recommendations for future actions. NERC worked with the

Electric Power Research Institute to provide an independent assessment of industry supply chain risks and presented a final report to the NERC Board in May 2019. Recognizing the complex and evolving nature of supply chain risks, this report contains several recommendations for additional study including Reliability Standards development work to address EACMS and physical access control systems connected to high- and medium-impact BES cyber systems. In addition, NERC will seek approval from its Board at the August meeting to issue a mandatory data request to gather more information on potential supply-chain threats to cyber security.

Also, NERC is currently developing a Level 2 alert regarding Chinese equipment suppliers, including Huawei and ZTE. The alert is a follow-up to the "all-points bulletin" the E-ISAC issued in March. To provide better analysis of the threat and suggested mitigations, the Level 2 alert and the bulletin enable us to provide strategic warning about the potential risk to industry of compromised supply chains, and to get a better sense of the scope of the threat. With this information, the E-ISAC is able to provide better analysis and suggested mitigation.

Finally, NERC's Critical Infrastructure Protection Committee's (CIPC) Supply Chain Working Group has drafted five security guidelines on different aspects of supply chain security including secure equipment delivery, risk considerations for open source software, lifecycle risk management, provenance, and vendor risk management lifecycle. These guidelines are anticipated to be approved by the CIPC and published in September.

Electricity Information Sharing and Analysis Center

NERC's CIP standards provide a universal foundation for security practices. Yet security cannot be achieved through these standards alone. Because of the emerging and dynamic nature of malicious cyber threats, reliability assurance also requires constant situational awareness, prompt information sharing, and real time communication. The E-ISAC provides these services and supports these industry capabilities.

The mission of the E-ISAC is to reduce cyber and physical security risk to the electricity industry across North America by providing unique insights, leadership, and collaboration. It accomplishes this mission by sharing trusted information and analysis in a timely, credible, and actionable manner with asset owners and operators across the continent.

Operated by NERC, and working in collaboration with DOE and the ESCC, the E-ISAC is the central information sharing hub for the electricity industry. The E-ISAC uses a secure portal as the primary means for communicating with its more than 1,000 electricity industry member organizations, and the number continues to grow. The portal was revamped in 2017 and is constantly undergoing upgrades to enhance the user experience. The new portal functions, plus greater outreach with key industry stakeholder groups through our Industry Engagement Program, has improved bi-directional information sharing and allows members greater access to more information.

In addition to coordination with DOE and FERC's Office of Infrastructure Security, the E-ISAC promotes cross-sector coordination through work with the DHS and other agencies and ISACs.

In particular, to further enhance cross-sector collaboration in light of electric and natural gas interdependencies, the E-ISAC continues to expand its partnership with the Downstream Natural Gas ISAC. In the past year, the E-ISAC added partnerships with other interdependent sectors, including the Oil and Natural Gas ISAC, the Water ISAC, and the Multi-State ISAC. Security is a global priority, and because NERC is an international organization, the E-ISAC works with Natural Resources Canada, Public Safety Canada, and the recently established Canadian Centre for Cyber Security to provide cross-border outreach and collaboration. In October 2018, NERC announced a trilateral memorandum of understanding among the E-ISAC, the Japan Electricity ISAC, and the European Energy ISAC with the intention of expanding sources of information and opportunities for analysis with partners who face similar adversarial threats. As the E-ISAC moves to 24/7 watch operations, these international partnerships will provide valuable context and awareness of emerging threats for overnight analysts to share with North American grid operators.

Cybersecurity Risk Information Sharing Program (CRISP)

Managed by the E-ISAC and in partnership with DOE, CRISP uses innovative technology and leverages DOE and its National Laboratories' analytical capabilities. CRISP provides timely two-way sharing of unclassified and classified threat information and develops situational awareness tools to enhance the electricity industry's ability to identify, prioritize, and coordinate the protection of their critical infrastructure and key resources. CRISP companies cover more than 75% of U.S. customers and participation continues to grow. To address the challenge of reaching smaller utilities, the E-ISAC has worked with DOE on including these entities in the CRISP program. CRISP information is shared in a secure fashion through the E-ISAC portal, and allows non-CRISP member companies to benefit from the shared indicators and threat actor activity captured by the program. CRISP information also supports the development of situational awareness to enhance the industry's ability to identify, prioritize, and coordinate the protection of its critical infrastructure and key resources. In addition to CRISP, the E-ISAC is pursuing cyber automated information sharing systems as well as a malware analysis repository and threat information exchange to provide for more advanced information sharing capabilities.

NERC Alerts, Critical Broadcasts, and Briefings

In addition to the secure portal, the E-ISAC shares information through a number of forums to increase awareness of threats, and to recommend mitigation. When there is a significant security concern, NERC and the E-ISAC communicate with the electricity industry via two distinct platforms.

NERC alerts provide concise, actionable security information to the electricity industry. Security alerts communicate unclassified sensitive information and mitigation measures. Alerts are divided into three levels:

- **Level One – Industry Advisory**: Purely informational, intended to alert registered entities to issues or potential problems. A response to NERC is not necessary.
- **Level Two – Recommendation to Industry**: Recommends specific action be taken by registered entities. Requires a response from recipients as defined in the alert.

- **Level Three – Essential Action:** Identifies actions deemed to be "essential" to BPS reliability and requires NERC Board of Trustees approval prior to issuance. Like recommendations, essential actions require recipients to respond as defined in the alert.

NERC determines the appropriate alert notification based on risk to the BPS. Generally, NERC distributes alerts broadly to users, owners, and operators of the North American BPS using its compliance registry. Entities registered with NERC are required to provide and maintain updated compliance and cyber security contacts. NERC also distributes the alerts beyond BPS users, owners, and operators to include other electricity industry participants who need the information. Alerts may also be targeted to groups of entities based on their NERC-registered functions (e.g., balancing authorities, transmission operators, generation owners, etc.). Alerts are developed with the strong partnership of federal technical organizations, including FERC, DOE and their National Laboratories, DHS, and BPS subject matter experts. Since 2009, NERC has issued 46 security-related alerts, 41 of which were cyber-related (41 Industry Advisories and five Recommendations to Industry). Those alerts covered items such as sabotage events, pandemic, Aurora, Night Dragon, malware targeting electric assets in Ukraine, and heightened awareness and reporting guidance of suspicious activity. Responses to alerts and mitigation efforts are identified and tracked, with follow-up provided to individual owners and operators and key stakeholders.

In addition to NERC alerts, the E-ISAC uses the Critical Broadcast Program (CBP). This program was launched in 2018 to rapidly share information with members, either through conference calls or "all-points-bulletins". The CBP leverages E-ISAC staff and stakeholder expertise to obtain and share the best available information and potential mitigation strategies to address developing security threats and events in a timely manner. The information is shared through conference calls, the E-ISAC portal and other means, as necessary.

The E-ISAC also hosts regular monthly threat briefings, unclassified threat workshops, classified forums for its clearance-holding members, and allows asset owners and operators to interact with our analysts and each other to share trend analysis and context on common threats to the electricity sector. These activities allow members to discuss emerging threats, learn from security experts, and provide feedback directly to the E-ISAC—which serves to improve E-ISAC's products and services.

Recently, the E-ISAC coordinated closely with the DHS Cybersecurity and Infrastructure Security Agency (CISA) on reported threats to critical infrastructure from Iranian actors in response to geopolitical developments. We produced an all-points bulletin within three hours of the first public reporting of the threat, and followed the next day with a technical indicators bulletin provided by CISA to asset owners and operators.

GridEx

Consistent with our mission to promote a strong learning environment, NERC hosts a grid security exercise every two years – grid security exercise (GridEx) – which simulates

widespread, coordinated cyber and physical attacks on critical electric infrastructure designed to overwhelm even the most prepared organizations. GridEx is the largest geographically distributed grid security exercise for the electricity industry. It consists of a two-day distributed play exercise and a separate executive tabletop session. GridEx allows participants to:

- Exercise crisis response and recovery;
- Improve communication;
- Identify lessons learned; and
- Engage senior leadership.

In 2017, 6,500 individuals and 450 organizations participated in GridEx IV, including industry, law enforcement, and federal and state government agencies. The executive tabletop included 42 participants from a cross-section of industry executives and senior officials from federal and state governments. Participating organizations are encouraged to identify their own lessons learned and share them with NERC. NERC uses this input to develop observations and propose recommendations to help the electricity industry enhance the security and reliability of North America's BPS. We are deep into planning for GridEx V, which will take place November 13-14, 2019.

GridSecCon

Consistent with promoting a learning environment and information exchange, NERC hosts the annual Grid Security Conference (GridSecCon). This widely attended conference brings together cyber and physical security experts from industry and government to share emerging security trends, policy advancements, and lessons learned related to the electricity industry. While the specific agenda varies, general objectives include:

- Promoting reliability of the BPS through training and industry education;
- Delivering cutting-edge discussions on security threats, vulnerabilities, and lessons learned from senior industry and government leaders; and
- Informing industry with discussions on security best practices, reliability concerns, risk mitigation, and cyber and physical security threat awareness.

Cybersecurity Trends

These engagements and analytical capabilities have increased the E-ISAC's insight into threats to the grid. This greater insight has translated into more security products for industry, as well as more member-originated information submitted to the E-ISAC and more sharing.

As the E-ISAC looks to the future, we anticipate certain trends:

Credential harvesting: Tactics to acquire legitimate user credentials to gain initial access to targeted networks and establish persistence mechanisms will continue to be popular because it

helps evade detection. Sophisticated spear phishing activity to harvest credentials is the most common technique observed by members.

Exploitation of the trust relationship between targeted organizations and their business partners: Recent incidents have demonstrated that nation-state adversaries are targeting the electricity industry and other industries by compromising the networks of third parties with which the intended targets have established business relationships. This tactic is a type of supply chain attack, and increases the success rate of tactics used to initially compromise the intended target.

Network device targeting: From the high profile reports on VPNFilter to the state-sponsored actors targeting network devices, switches and routers located on the edge of networks are a prime target for threat actors capable of intercepting and processing a large amount of information. Because these devices are placed at the boundary between internal networks and the internet, and exist to allow controlled access to the internal network, they will most likely continue to be a target of reconnaissance.

Use of native tools: Adversaries will likely continue to use tools and capabilities already present on a compromised network – such as PowerShell or Windows Management Infrastructure (WMI) – to conduct reconnaissance, lateral movement, and privilege escalation. The presence or use of these tools on a targeted network is unlikely to raise alarm, so their inappropriate use helps evade detection.

Conclusion

Reliability is NERC's mission, and grid security is inextricably linked to reliability. To date, there has not been any loss of load in North America that can be attributed to a cyber attack. At the same time, the security landscape is dynamic, requiring constant vigilance and agility. NERC addresses cyber threats through a comprehensive range of complementary strategies. Our partnership with DOE is critical to the electricity industry's priority for security. Mandatory CIP standards provide a universal foundation for security and is a shared priority with FERC and industry. Through the E-ISAC, NERC provides situational awareness, and sharing of timely, actionable intelligence with industry and government. Strong public private partnerships are key to successful information sharing within the electricity sector and across sectors. NERC remains keenly focused on our mission to assure reliability of the BPS.