NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Electric Reliability Organization Comments on Draft Outline for the Proposed Joint U.S.-Canadian Electric Grid Strategy

I. Introduction

The North American Electric Reliability Corporation ("NERC"), as the Electric Reliability Organization for North America, hereby submits these comments on behalf of itself and the ERO Enterprise[1] in response to the Department of Energy's ("DOE") July 20, 2016 *Draft Outline for the Proposed Joint U.S.-Canadian Electric Grid Strategy* ("Proposed Joint Grid Strategy").[2] The ERO Enterprise is a collaborative, international network comprised of NERC and the eight Regional Entities that brings together collective leadership, experience, judgment, skills, and technologies for assuring the reliable operation of the North American bulk power system. The ERO Enterprise appreciates the opportunity to submit comments in response to the Proposed Joint Grid Strategy given the importance of strengthening the security and resilience of the electric grid in North America and the vital role the ERO Enterprise plays in that process.

The Proposed Joint Grid Strategy outline includes the following three strategic goals and objectives: (1) protect today's grid and enhance preparedness; (2) manage contingencies and enhance response and recovery efforts; and (3) build a more secure and resilient future grid. As the organization responsible for assuring the reliability of the North American bulk power system, the ERO Enterprise is uniquely qualified to assist with both the development and implementation of the Proposed Joint Grid Strategy. In these comments, the ERO Enterprise addresses numerous topics identified in the goals and objectives of the proposed strategy, including security and grid resiliency, information sharing, and risk analysis through the lens of reliability. Overall, the ERO Enterprise believes that the Proposed Joint Grid Strategy should recognize the important foundation of reliability and incorporate and build upon the significant initiatives in operations, planning and security that the ERO Enterprise, in partnership with the North American electric industry, is currently pursuing. These comments will explain how ERO statutory and regulatory responsibilities as well as current ERO Enterprise initiatives support the Proposed Joint Grid Strategy's three strategic goals and will explain why the ERO Enterprise should be engaged in efforts to develop and implement the Proposed Joint Grid Strategy.

[1] The ERO Enterprise consists of NERC and the eight Regional Entities that have delegated authority to establish and enforce NERC Reliability Standards within the geographic boundaries associated with each Regional Entity. These eight Regional Entities are: Florida Reliability Coordinating Council ("FRCC"), Midwest Reliability Organization ("MRO"), Northeast Power Coordinating Council, Inc. ("NPCC"), ReliabilityFirst ("RFC"), SERC Reliability Corporation ("SERC"), Southwest Power Pool, RE ("SPP RE"), Texas Reliability Entity, Inc. ("TRE"), and Western Electricity Coordinating Council ("WECC").

[2] *Draft Outline for the Proposed Joint U.S.-Canadian Electric Grid Strategy* (published in the Federal Register on July 20, 2016) and available at the following link: https://www.federalregister.gov/articles/2016/07/20/2016-17133/draft-outline-for-the-proposed-joint-us-canadian-electric-grid-strategy.

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II. Background

On March 10, 2016, the White House issued a U.S. Canada Joint Statement on Climate, Energy, and Arctic Leadership, which memorialized specific goals agreed to by U.S. President Barack Obama and Canadian Prime Minister Justin Trudeau.[3] One of the goals articulated in the joint statement was to "Develop a joint U.S.-Canadian strategy for strengthening the security and resilience of the North American electricity grid [and] work together to strengthen the security and resilience of the electric grid, including against the growing threat from cyber-attacks and climate change impacts."[4] As a result of this goal, the DOE and Department of Homeland Security ("DHS") are co-leading an interagency effort, with their Canadian colleagues, to develop this proposed strategy.[5] The Proposed Joint Grid Strategy outline, which is the subject of the DOE's July 20, 2016 *Federal Register* notice requesting public comments, is the first step in developing the Proposed Joint Grid Strategy.

III. Overview of the Electric Reliability Organization

NERC is an international regulatory authority in North America whose mission is to assure the reliable operation of the North American bulk power system. Subject to oversight by the Federal Energy Regulatory Commission ("FERC" or the "Commission") and governmental authorities in Canada, NERC is structured to develop and enforce Reliability Standards in a manner that is respectful of the jurisdictional sovereignty of all North American governmental authorities. NERC is a non-governmental organization, and therefore is not subject to United States Freedom of Information Act laws. NERC also operates the Electricity Information Sharing and Analysis Center ("E-ISAC"), which serves as the main secure information sharing portal for the electricity sector. NERC became certified as the ERO in 2006. The North American bulk power system consists of the electric transmission network in Canada, the United States, and part of Mexico.

NERC is an independent, self-regulatory, not-for-profit corporation that is governed by an independent Board of Trustees.[6] There are currently eleven NERC trustees, three of which are Canadian, including the current chair. The NERC Board of Trustees is responsible for managing the business affairs of NERC.

NERC also has a Member Representatives Committee that is elected by NERC members (rather than the NERC Board) and is authorized to: 1) elect the independent NERC Trustees; 2) vote on amendments to the NERC Bylaws; and 3) provide advice and recommendations to the NERC Board with respect to the development of annual budgets, business plans and funding mechanisms, and other

[3] The U.S.-Canada Joint Statement on Climate, Energy, and Arctic Leadership is available at: https://www.whitehouse.gov/the-press-office/2016/03/10/us-canada-joint-statement-climate-energy-and-arctic-leadership.
[4] *Id.*
[5] *See* Proposed Joint Grid Strategy at p. 3.
[6] All but one of the NERC Trustees shall be independent and nominated by the NERC Members Representatives Committee. The remaining trustee is elected by the Board to serve as the management trustee—currently NERC's Chief Executive Officer.

matters pertinent to the purpose and operations of NERC. Canadian members are also represented on the Member Representatives Committee, pursuant to Article VIII of the NERC Bylaws.[7]

The ERO Enterprise consists of NERC and the eight Regional Entities that perform various delegated related functions on behalf of NERC.[8] In the United States, the Regional Entities have delegated authority from NERC to enforce Reliability Standards within their geographic footprints and to develop and propose Reliability Standards to be in effect within their respective regions. The current delegation agreements have been filed with, and where applicable, approved by governmental authorities.[9]

The ERO Enterprise's key programs are based on four pillars of success:

- Reliability – to address events and identifiable risks, thereby improving the reliability of the bulk power system.
- Assurance – to provide assurance to the public, industry, and government for the reliable performance of the bulk power system.
- Learning – to promote learning and continuous improvement of operations and adapt to lessons learned for improved bulk power system reliability.
- Risk-based Approach – to focus attention, resources, and actions on issues most important to bulk power system reliability, and assuring efficient mitigation of identified risks.

In particular, the ERO Enterprise works together to develop and enforce Reliability Standards; annually assess seasonal and long-term reliability; monitor the bulk power system through system awareness; and educate, train, and certify industry personnel.

IV. Comments

A. The ERO Enterprise is Structured and Uniquely Qualified to Effectively Engage in Joint United States/Canada Grid Strategy

The ERO Enterprise has developed a unique partnership with Canada and Mexico that is dedicated to assuring the reliability of the bulk power system for North America. Through bilateral principles and other agreements,[10] the ERO Enterprise works with policymakers and stakeholders in all three countries on the reliability regulatory framework. Canada has been interconnected with the United States for more than 110 years and has been engaged in cross-border reliability efforts within the Northeast Power Coordinating Council since the 1965 Blackout. NERC has been working with Canada since the late 1960s,

[7] The NERC Bylaws are available at: http://www.nerc.com/gov/Annual%20Reports/NERC_Bylaws-Effective-10142009.pdf.
[8] Each Regional Entities' delegated functions are memorialized in a Regional Entity-specific delegation agreement executed by NERC and the Regional Entity. The eight delegation agreements are available at the following link: http://www.nerc.com/AboutNERC/keyplayers/Pages/default.aspx.
[9] *See,* Letter Order from Office of Energy Market Regulation to North American Electric Reliability Corporation, dated March 23, 2016, approving revised delegation agreements between NERC and each of the eight Regional Entities. (Docket No. RR15-12-001).
[10] *See, Principles for an Electric Reliability Organization That can Function on an International Basis*, August 3, 2005, available at: http://www.nerc.com/FilingsOrders/ca/Canadian%20mous%20DL/BEROG%20Principles%20for%20ERO%2008032005.pdf.

and this engagement became further formalized after the 2003 Northeast Blackout which impacted the United States and Canada.[11] Additionally, representatives of the Canadian entities actively participated in the formation of the ERO in 2006. Since that time, there has been Canadian participation on the NERC Board, NERC committees and other ERO Enterprise meetings on reliability that has formed a unique and important partnership between the United States and Canada. All Canadian jurisdictions that are interconnected to the U.S. Bulk Electric System have developed their own reliability framework, recognizing the ERO Enterprise role in some way, either through reliability legislation, regulation, memorandums of understanding, or some combination of the three.

There are more than 1,900 users, owners, and operators of the Bulk Electric System registered within the ERO Enterprise, including most major Canadian owners/operators and provincial utilities. The Canadian entities that are registered with the ERO Enterprise are members of three of the eight regional entities – the Western Electricity Coordinating Council, the Northeast Power Coordinating Council, Inc., and the Midwest Reliability Organization. These three Regional Entities in particular have executed agreements with most of the provinces in their footprints to memorialize the role of the Regional Entities in compliance monitoring and enforcement and other reliability-related activities. The Canadian entities are active participants in regional and NERC reliability activities, including standards development, compliance enforcement and monitoring, and assessing the reliability and security of the grid.

In addition to individual Canadian utilities and provincial regulators, several Canada-specific groups – CAMPUT, Canada's energy and public utility regulators' association; the Federal-Provincial-Territorial Working Group and its Monitoring and Enforcement Subgroup; and the Canadian Electricity Association – provide important perspectives and serve as regular points of contact for the ERO Enterprise.[12] The ERO Enterprise regularly meets with these groups to address cross-border reliability issues and developments.

The ERO Enterprise is also actively engaged with United States government representatives on cross-border electric issues. Most recently, in October 2015, the DOE conducted two workshops with stakeholders and members of the academic community to discuss cross-border issues related to electricity. The first workshop focused on U.S.-Canada electricity issues, and the second on U.S.-Mexico electricity issues. The ERO Enterprise participated in both of these workshops and joined participants in discussing policies, regulations and planning associated with the electricity sector in North America to address best practices, regulatory consistency and continuity across the three North American countries and to inform the creation of legal, regulatory, and policy roadmaps for harmonizing regulations and planning. Throughout the workshops, the ERO Enterprise model was viewed favorably as one that supports and facilitates North American electricity integration. The recommendations generated by the two workshops reflect this support and the high priority workshop participants place on reliability and security of the North American bulk power system.[13]

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[11] *See, After the Blackout: Implementation of Mandatory Electric Reliability Standards in Canada*, Energy and Mines Minister' Conference, July 2015. The report is included as **Attachment A** to this filing, and is available at the following link: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/www/pdf/publications/emmc/15-0137%20EMMC-After%20the%20Blackout-e.pdf.

[12] *See,* https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/files/pdf/DataSharingPrinciples_eng.pdf.

[13] The recommendations and action items from the DOE workshops are available here: http://www.rff.org/files/document/file/RFF-DP-16-07.pdf.

Given these existing relationships and the strong, bilateral (and increasingly trilateral with Canada, United States, and Mexico) foundation already in place, the existing reliability regime in North America should be leveraged to help achieve the goals articulated in the DOE's outline that will be used to develop the Proposed Joint Grid Strategy. Included below is a discussion of initiatives that are in place at the ERO Enterprise to address these goals and objectives.

B. The ERO Enterprise is Engaged in Efforts to Protect the Grid from Cyber and Physical Security Risks; Enhance Preparedness, Response, and Recovery Efforts; and Mitigate Risks before they Impact the Grid.

Consistent with the Proposed Joint Grid Strategy's first and second goals – to protect today's grid, enhance preparedness, and manage contingencies and enhance response and recovery efforts—the ERO Enterprise is actively engaged in efforts to address cyber and physical security risks on the North American bulk power system. The electric grid in North America is one of the continent's most critical infrastructures, with many, if not all, of the other critical infrastructures dependent upon it. The grid faces constant and evolving threats—from conventional risks like extreme weather and equipment failures, to new and emerging risks in the security arena, such as coordinated physical and cyber-attacks. The ERO Enterprise continues to lead a multi-faceted approach to enhancing cybersecurity, through mandatory Reliability Standards and enhanced information sharing through the E-ISAC. This expertise can play an important role in the overall DOE Joint Grid Strategy.

The ERO Enterprise has been working with industry and government partners in Canada and Mexico in securing the grid. Some of the ERO Enterprise's ongoing cybersecurity and physical security activities to ensure reliability of the bulk power system, which make the ERO Enterprise uniquely qualified to assist with both the development and implementation of the Joint Grid Strategy, include the following:

- Adopted a physical security Reliability Standard and conducted outreach on physical security measures to industry in conjunction with government partners in the United States and Canada;
- Developed a new comprehensive suite of Critical Infrastructure Protection ("CIP") standards;
- Established ongoing situational awareness, incident management, coordination, and communication capabilities within the electricity sector through timely, reliable, and secure information exchange related to cybersecurity and physical security concerns and continuing information sharing through the E-ISAC;
- Facilitates the bi-annual Grid Security Exercise ("GridEx") for the Electricity Sub-sector in North America; and
- Participates in the Electricity Sub-sector Coordinating Council ("ESCC"), which includes representatives of the asset owners and operators of the North American electricity industry,

including NERC and the Canadian Electricity Association. The ESCC provides a forum for communication between public and private sector partners in the Electricity Sub-sector

These efforts are described in more detail, below.

a. Physical Security Standard

On November 20, 2014, FERC approved the CIP-014-1 – Physical Security Reliability Standard,[14] which NERC developed in response to a March 7, 2014 FERC order directing the development of a standard that addresses physical security threats and vulnerabilities to the most critical facilities and thereby lessening the overall vulnerability of bulk power system facilities against physical attacks. The Physical Security standard also focuses on risk management activities and foundational physical security practices. The Physical Security Standard has been adopted in some of the Canadian provinces that are interconnected with the United States.

Additionally, the ERO Enterprise has been conducting outreach to industry on the Physical Security standard as well as the events surrounding a physical attack on a substation in California in April 2013. With respect to the April 2013 attack, the E-ISAC (described more fully below) issued an Alert to inform industry of the event and provide advice on steps to mitigate and protect against such attacks. In addition, the E-ISAC, DOE, FERC, DHS, and the Federal Bureau of Investigation developed an outreach effort to raise awareness of the event, inform industry of mitigation activities, and provide a forum for industry to meet with state, local, and federal authorities to discuss physical security concerns for the industry's regions. This was an unprecedented public-private partnership effort to address physical security concerns, and involved US and Canadian interests.

b. CIP Version 5 Reliability Standards

Since 2008, NERC has updated its Reliability Standards to reflect the changing cybersecurity landscape. On November 22, 2013, FERC issued an order approving a comprehensive suite of cybersecurity standards, referred to as the CIP Version 5 standards, which requires that all cyber assets must now be categorized as Low, Medium, or High Impact assets.[15] The revised standards include 12 new requirements with new cybersecurity controls to address emerging cyber threats.[16] In addition, the CIP Version 5 standards remove technology-specific requirements by replacing them with a risk-based approach to implementing appropriate and changing technologies. That is, rather than specifying how to implement a requirement, the revised requirements specify the risk-based result that must be achieved, which enables industry to implement new and emerging technologies to address the risk. FERC issued an

[14] The CIP-014-2 Standard is available at the following link: http://www.nerc.com/_layouts/PrintStandard.aspx?standardnumber=CIP-014-2&title=Physical%20Security&jurisdiction=United%20States.
[15] 145 FERC ¶61,160 (November 22, 2013) (Order No. 791).
[16] The CIP standards are available at the following link: http://www.nerc.com/pa/stand/Pages/ReliabilityStandardsUnitedStates.aspx?jurisdiction=United%20States.

order on January 21, 2016 approving additional clarifications to the CIP Version 5 standards made in response to the Commission's directives included in the November 21, 2013 Order.[17]

c. Electricity Sector Information Sharing and Analysis Center ("E-ISAC")

NERC operates the E-ISAC,[18] which serves as the main secure information sharing portal for the electricity sector. The E-ISAC is a non-governmental organization, and therefore is not subject to United States Freedom of Information Act laws. NERC's E-ISAC provides situational awareness, incident management, coordination, and communication capabilities within the electricity sector through timely, reliable, and secure information exchange. The E-ISAC gathers information from electricity industry participants across North America about security-related events, disturbances, and off-normal occurrences within the electricity subsector and shares that information with other electricity industry participants, key governmental entities (including Canada and Mexico), and cross-sector partners. The E-ISAC works routinely with government at all levels, including classified levels, on numerous security topics. The E-ISAC has cleared staff analysts who work with government analysts on classified information sharing. Governmental entities and cross-sector partners also provide the E-ISAC with information regarding risks, threats, and warnings that the E-ISAC disseminates throughout the electricity subsector. Two-way information sharing is critical because it allows the E-ISAC to help industry identify emerging trends and to provide an early warning, particularly in today's ever-changing security environment. The E-ISAC, in collaboration with DOE and the ESCC, serves as the primary security communications channel for the electricity sector and enhances the sector's ability to prepare for and respond to cyber and physical threats, vulnerabilities, and incidents.

The E-ISAC uses a variety of tools, programs, and activities to enhance security, such as a secure web portal, alerts, exercises, training and education. Among its programs, the annual Grid Security Conference brings together cyber and physical security experts from industry and government to share emerging security trends, policy advancements, training, and lessons learned. Additionally, the E-ISAC portal allows the E-ISAC to reach thousands of industry members and hundreds of organizations in the industry and is the mechanism for industry and government to contact E-ISAC staff with questions, concerns, and security-related information in a secure manner. The data received from industry members and partners helps the E-ISAC create timely, relevant, and actionable documents. As a result, NERC continues to grow the E-ISAC's capabilities by enhancing the E-ISAC's private, secure portal to receive voluntary reports from industry members, and, working with various organizations (both industry and government), to obtain the data and mechanisms necessary to conduct these information sharing activities. Some of the products the E-ISAC develops include daily, weekly, and monthly reports; incident bulletins; and issue-specific assessments. E-ISAC staff also advises the NERC Bulk Power System Awareness team on the issuance of NERC Alerts regarding cyber and physical security vulnerabilities.

[17] 154 FERC ¶61,037 (January 21, 2016) (Order No. 822).
[18] NERC's E-ISAC webpage is available at the following link: https://www.esisac.com/.

d. The Cybersecurity Risk Information Sharing Program

The Cybersecurity Risk Information Sharing Program ("CRISP") is a public-private partnership, co-founded by the DOE and NERC, and managed by the E-ISAC, that facilitates the exchange of detailed cybersecurity information among industry, the E-ISAC, DOE, and Pacific Northwest National Laboratory. Participation in the program is voluntary and enables owners and operators to better protect their networks from sophisticated cyber threats. The purpose of CRISP is to collaborate with energy sector partners to facilitate the timely bi-directional sharing of unclassified and classified threat information and develop situational awareness tools to enhance the sector's ability to identify, prioritize, and coordinate the protection of its critical infrastructure and key resources.

e. NERC Alerts

When the ERO Enterprise identifies emerging reliability issues that threaten the reliability of the bulk power system, NERC has a tool that is administered by NERC's Reliability Risk Management Department, which allows for the rapid dissemination of that information through NERC Alerts. NERC Alerts can be issued on any reliability or cyber or physical security issue that could impact the bulk power system, or for which broad and assured awareness is desired. Reliability related Alerts are drafted by technical subject matter experts on NERC staff in close collaboration with industry stakeholders. For security related alerts, NERC staff with appropriate security clearances often work with cleared personnel from Federal agencies to communicate unclassified sensitive information to the industry in the form of NERC Alerts on issues related to cyber or physical security. As defined in Section 810 of NERC's Rules of Procedure, there are three levels of Alerts for formal notice to industry regarding reliability and security issues:

- Industry Advisory. Purely informational, intended to alert registered entities to issues or potential problems. A response to NERC is not necessary.
- Recommendation to Industry. Recommends specific action be taken by registered entities. Requires a response from recipients as defined in the Alert.
- Essential Action. Identifies actions deemed to be "essential" to bulk power system 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 the risk to the bulk power system. Generally, NERC distributes Alerts broadly to users, owners, and operators of the North American bulk power system using its Compliance Registry. Entities registered with NERC are required to provide and maintain updated compliance and cybersecurity contacts. NERC also distributes the Alerts beyond bulk power system 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.).

The NERC Alert system is working well. It is understood by industry, handles sensitive information, and communicates this information in an expedited manner. Information sharing through NERC Alerts is

one of the best assets the ERO Enterprise has to combat emerging threats to bulk power system reliability and potential cyber and physical security threats.

f. Grid Security Exercises ("GridEx") in North America

The E-ISAC coordinates GridEx, a biennial grid exercise that is designed to exercise utilities' crisis response and recovery procedures, improve information sharing during a crisis, gather lessons learned, and engage senior leadership from both the United States and Canada.

In 2011, NERC facilitated the first-ever GridEx for the Electricity Sub-sector in North America. NERC now holds a biennial Distributed Play exercise and executive tabletop discussion to:

- Exercise the current readiness of the electricity industry to respond to a security incident, incorporating lessons learned;
- Review existing command, control, and communication plans and tools for NERC and its stakeholders;
- Identify potential improvements in cybersecurity and physical security plans, programs, and responder skills; and
- Explore senior leadership policy decisions and triggers in response to a coordinated cyber and physical event of national significance with long-term grid reliability issues.

NERC held GridEx II on November 13-14, 2013, where over 230 organizations participated in the Distributed Play session. Additionally, a group of senior industry and government executives participated in a tabletop session based on the Distributed Play scenario. The exercise built upon the objectives and findings from the 2011 GridEx recommendations and simulated a coordinated cyber and physical security attack to offer participants a worst-case scenario to review their existing command control and communication plans and to identify potential areas for improvement.

GridEx III, which was held in November 2015, was a very successful exercise that included participation from 364 organizations across North America.[19] In addition, 30 industry and government senior leaders participated in a tabletop exercise. GridEx III provided participants with the opportunity to exercise their incident response procedures during large-scale security events affecting North America's electricity system. The large-scale cyber and physical attack scenario was designed to overwhelm even the most prepared organizations.

g. Electricity Sub-sector Coordinating Council ("ESCC")

NERC participates in the ESCC – a key organization representing all segments of the electricity industry. It is the only sector coordinating council exclusively comprised of chief executive officers, including the chief executive officer of NERC, and is an outstanding example of a strong public-private sector partnership. The ESCC provides key communication with government partners, coordinating

[19] *See,* http://www.nerc.com/pa/CI/CIPOutreach/GridEX/NERC%20GridEx%20III%20Report.pdf.

efforts related to disasters and threats to critical infrastructure. Its government counterparts include senior Administration officials from the White House, relevant Cabinet agencies, federal law enforcement, and national security organizations, as well as relevant Canadian governmental authorities. This past year, the ESCC underwent changes to broaden membership to 30 CEO-level representatives, formally recognizing the significant increased chief executive officer interest and participation on cybersecurity issues. The ESCC's focus to address physical security and cybersecurity issues, working alongside government partners, remains unchanged.

C. The ERO Enterprise is Responsible for Identifying Emerging Reliability Issues in North America in Order to Build a More Secure and Resilient Grid.

The third goal of the Proposed Joint Grid strategy identifies the need to build a more secure and resilient future grid, by: 1) understanding and managing new and evolving risks from grid technologies and grid design; and 2) developing and deploying resiliency tools and technologies and integrating security and resilience into grid planning and regulatory/policy decision making. Resiliency is becoming the yardstick of reliability, and as a consequence, the ERO Enterprise is continually reviewing how best to address resiliency efforts. For example, NERC regularly provides industry information on lessons learned from significant system disturbances and extreme weather events and is developing analytical methods to identify potential interdependencies between extreme weather and resiliency performance.

In addition, the energy landscape in North America is going through a dynamic change. Provinces within Canada have experienced significant changes to their resource mix. Mexico is moving forward on opening its electricity markets to support growth in demand and a variety of resource changes. And the United States is undergoing a metamorphosis from large, remotely-located coal-fired and nuclear power plants, towards gas-fired, renewable, and distribution-centric resources. Demand side management, such as demand response and energy storage, are also contributing to changing characteristics and control strategies in grid operations. As this evolution occurs, the ERO Enterprise is uniquely situated to contribute to those components of the Proposed Joint Grid Strategy focused on resiliency and identification of emerging risks on the North American bulk power system because the ERO Enterprise is at the forefront of these efforts.

One of the biggest challenges to ensuring North American bulk power system reliability will be to understand how the changing resource mix can impact reliability. The ERO Enterprise identifies emerging risks and determines appropriate mitigation strategies to assure reliability in: 1) normal system operating conditions; 2) large industry transitions such as the changing resource mix; and 3) extreme or catastrophic events that can have high impacts but are infrequent. By identifying and quantifying emerging reliability issues, the ERO Enterprise provides risk-informed recommendations that drive its activities and support a learning environment for industry to pursue improved reliability performance. These recommendations, along with the associated technical analysis, provide the basis for actionable enhancements to resource and transmission planning methods, planning and operating guidelines, and NERC Reliability Standards. In addition, NERC's Reliability Issues Steering Committee annually identifies, defines, and prioritizes

reliability risks to the bulk power system.[20] Some of the specific efforts currently underway, which make the ERO Enterprise uniquely qualified to assist with both the development and implementation of the Joint Grid Strategy, are described below:

a. Ongoing Reliability Assessments

NERC prepares seasonal and long-term assessments to examine the current and future reliability, adequacy, and security of the North American bulk power system. The preparation of these assessments involves NERC's collection and consolidation of data from the Regional Entities, and includes reference case data of projected on-peak demand and energy, demand response, resource capacity, and transmission projects. Data and information from each Regional Entity are also used to identify notable trends, emerging issues, and potential concerns. This approach captures virtually all electricity supplied in the United States, Canada, and the portion of Baja California Norte, Mexico that is interconnected with the United States. NERC's reliability assessments are developed to inform industry, policy makers, and regulators and to aid NERC in achieving its mission—to ensure the reliability of the North American bulk power system. These assessments can also provide important perspectives for consideration in the Proposed Joint Grid Strategy.

1. Long-Term Reliability Assessment

The annual Long-Term Reliability Assessment[21] provides a wide-area perspective on generation, demand-side resources, and transmission system adequacy needed to maintain system reliability during the next decade. This assessment includes NERC's independent technical analysis to identify issues that may impact the reliability of the bulk power system to allow industry, regulators, and policy makers to respond or otherwise develop plans to mitigate potential impacts caused by these issues. The Long-Term Reliability Assessment includes key findings that can be used in future system planning by industry and regulators in North America.

2. Special Reliability Assessments

Short-Term Special Assessments are a series of issue-driven reports that examine bulk power system risks over the next 18 months. These concise, ad-hoc reports are developed as reliability issues are identified. Report scopes are targeted, timely, and non-cyclical, with in-depth analysis to inform the relevant audience (i.e., industry, policy makers, and regulators) and provide insights on ongoing ERO Enterprise and industry-wide actions to address each topic.

Longer-term special reliability assessments are also developed on a regional, interregional, and Interconnection basis as conditions warrant, or as requested by the NERC Board or governmental authorities. Teams of reliability and technical experts initiate special assessments of key reliability issues and their impacts on the reliability of a region, subregions, or Interconnection (or a portion thereof). Such

[20] *See*, ERO Reliability Risk Priorities, RISC Recommendations to the NERC Board of Trustees, October 2015; available at the following link: http://www.nerc.com/comm/RISC/Related%20Files%20DL/ERO_Reliability_Risk_Priorities_RISC_Recommendations_to_the_Board.pdf.
[21] NERC's assessments are available at the following link: http://www.nerc.com/pa/RAPA/ra/Pages/default.aspx.

special reliability assessments may include, among other things, operational reliability assessments, evaluations of emergency response preparedness, adequacy of fuel supply, hydro conditions, reliability impacts of new or proposed environmental rules and regulations, and reliability impacts of new or proposed legislation that affects or has the potential to affect the reliability of the interconnected bulk power system in North America.

Special reliability assessments have addressed topics such as gas electric interdependency, integration of variable generation, environment regulations and essential reliability services.

3. State of Reliability Report

The annual State of Reliability report represents NERC's independent view of ongoing bulk power system trends to objectively provide an integrated view of reliability performance. The key findings and recommendations included in the annual State of Reliability report serve as technical inputs to NERC's risk assessment, Reliability Standards project prioritization, compliance process improvements, events analysis, reliability assessment, and critical infrastructure protection. The analysis of bulk power system performance developed as part of the State of Reliability report provides an industry reference of historical reliability, offers analytical insights regarding industry action, and enables the identification and prioritization of specific steps that can be taken to manage risks to reliability.

b. ERO Enterprise Risk Analysis

When specific reliability issues are identified through NERC's assessments or other mechanisms, NERC will often gather all segments of the electricity industry to contribute their knowledge and appoint a special task force to further examine the issue and provide additional technical analysis that can be used in bulk power system planning for industry, governments, and policy makers. Some of these specific task forces are reviewing topics that apply to various aspects of the Proposed Joint Grid Strategy draft outline and that are focused on issues impacting cross-border bulk power system reliability issues. Further descriptions are offered below in order to identify possible alignment with topics outlined in the Proposed Joint Grid Strategy.

1. Essential Reliability Services Task Force

In 2014, the NERC Board of Trustees supported the creation of the Essential Reliability Services Task Force ("ERSTF") to provide insight into trends and potential reliability impacts during a period of rapid resource change. Different resources have different operating characteristics. Generators must be able to continuously balance load and demand throughout the bulk power system to support transmission voltage and frequency response. Conventional generation (i.e., steam, hydro, and combustion turbine technologies) inherently provide essential reliability services needed to reliably operate the system. Whereas wind, solar and other variable energy resources that are an increasingly greater share of the bulk power system provide a significantly lower level of essential reliability services than conventional generation. The challenge for operators is the need for continual balancing of generation and demand while providing sufficient amounts of essential reliability services from wind,

solar, and other distributed resources. Understanding how these different characteristics impact the essential components of a reliable bulk power system is key to ensuring a smooth transition.

As a result of the ERSTF's analysis, three essential reliability services—frequency response, ramping, and voltage support—were identified in the ERSTF's 2015 "Essential Reliability Services Task Force Measures Framework Report."[22] The report noted that the industry must ensure these essential services are available to support daily operations and when the system needs it the most.

The ERO Enterprise continues to study the complex and interrelated issues surrounding bulk power system performance, specifically as it relates to the changing resource mix. Going forward, the ERO Enterprise will continue to monitor and provide trending analysis through established measurements, such as inertia, frequency response performance, voltage performance, and system strength analysis. As other elements of essential reliability services are identified, the ERO Enterprise will further deepen its assessment of potential impacts and solutions.

2. Distributed Energy Resources Task Force

In 2016, the ERO Enterprise also launched a Distributed Energy Resources Task Force ("DERTF") to identify reliability considerations when accommodating large amounts of distributed energy resources. It is imperative for resource planners, regulators and policy makers to recognize the implications of the characteristics presented by the changing resource mix in interconnection requirements or other reliability requirements to provide sufficient means of adapting the system to both accommodate and benefit from large amounts of variable and distributed energy resources, located either on the bulk power or distribution systems. These needs will become more significant as retirements of base load fossil-fired units continue. The ERO Enterprise is closely monitoring the overarching effects of the changing resource mix, and, as a result, launched the DERTF to track and monitor activities and develop strategies for maintaining reliability during the transition to this new resource mix.

3. Geomagnetic Disturbance ("GMD") Task Force

The ERO Enterprise and industry recognize the potentially serious risks posed by High-Impact, Low Frequency ("HILF") events. Over the past several years, the industry's preparedness for the unique challenges of HILF events has advanced through coordinated actions involving industry experts, public and private researchers, commercial developers, and policy stakeholders, including Canadian partners. This approach is effective in addressing technically complex HILF risks because it engages individuals with specialized expertise, threat knowledge, and power system experience in collaborative efforts.

An example of this collaboration was the formation of the NERC-sponsored GMD Task Force (which included representatives from Hydro Québec and other Canadian entities) in 2011 to develop a technical white paper describing the evaluation of scenarios of potential GMD impacts, identify key bulk

[22] The *Essential Reliability Services Task Force Measures Framework Report*, dated November 2015, is available at the following link: http://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/ERSTF%20Framework%20Report%20-%20Final.pdf.

power system parameters under those scenario conditions, and evaluate potential reliability implications of these incidents. The GMD Task Force issued an interim report evaluating the effects of GMDs on the bulk power system in February 2012.[23] Using an open process involving leading experts from industry, government and private researchers, and equipment and software vendors, the GMD Task Force has continued to support the development of tools and methods for assessing and mitigating GMD impacts, including the GMD standards.[24]

c. Resiliency and Infrastructure Interdependencies

Planning and operating a resilient electricity grid will not only include the integration of substantial amounts of distributed energy resources, distribution-centric resources, and increased dependency on gas infrastructure, but it will include more data on related industries. The ERO Enterprise is working to develop analytical methods to identify interdependencies between events and resiliency performance, and remains committed to ensuring resiliency in all aspects of planning and operations.

The ERO Enterprise has also identified the need for adequate infrastructure, both in terms of electric transmission lines and fuel delivery systems, particularly for natural gas, as essential for ensuring bulk power system reliability. The existing transmission system was planned and designed to support the existing generation fleet, which is comprised mostly of larger, central station electric generation. Therefore, accommodating new resources, particularly those located in areas different from the existing fleet, transmission lines, facilities, and/or other transmission elements will likely be necessary. Additionally, as natural gas-fired generation replaces coal-fired generation, the requisite timeline for natural gas pipeline infrastructure becomes even more relevant.

Coordinated planning of transmission expansion and pipeline expansion is essential to maintain reliability for delivery of renewables from remote locations and natural gas for use in electricity generation. There must be recognition of the concern that changes in the resource mix must not be allowed to outpace enhancements to the delivery infrastructure. A focus on infrastructure needs, with coordination and planning by all levels of government and working with private sector partners, will help ensure a feasible transition to assist new generation and transmission needs.

V. Conclusion

As outlined above, the ERO Enterprise has many tools available to identify and address potential reliability risks posed by emerging reliability issues in North America, which allows the ERO Enterprise to effectively work with industry and government partners, including Canadian governmental authorities, on these efforts. This, along with the ERO Enterprise's engagement on efforts to address cyber and physical security risks to the North American bulk power system, including information sharing through NERC's E-

[23] *See,* 2012 Special Reliability Assessment Interim Report: Effects of Geomagnetic Disturbances on the Bulk Power System, February 2012. The report is available at the following link: http://www.nerc.com/pa/Stand/Geomagnetic%20Disturbance%20Resources%20DL/2012_GMD_Report_112012.pdf.

[24] The two standards addressing geomagnetic disturbances are: EOP-010-1—Geomagnetic Disturbance Operations; and TPL-007-1—Transmission System Planned Performance for Geomagnetic Disturbance Events.

ISAC and all of its capabilities to help address imminent and strategic physical and cyber threats to the power grid, provide a coordinated and comprehensive effort to address cyber and physical security in North America. The ERO Enterprise looks forward to working on the development of the Proposed Joint Grid Strategy, and will continue to work with government, industry, and other stakeholders to share what we know, educate our partners, and learn what we can to secure our systems and stay ahead of the threats.

Respectfully Submitted,

/s/ Janet Sena

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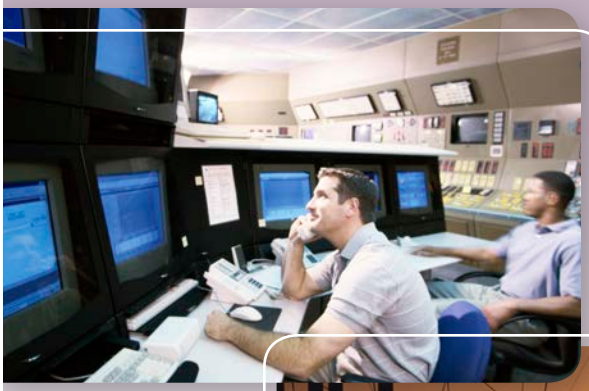
Marcus H. Sachs, Senior Vice President and Chief Security Officer, NERC

August 10, 2016

Attachment A: ***After the Blackout: Implementation of Mandatory Electric Reliability Standards in Canada*** **(July 2015)**



After the Blackout:

Implementation of Mandatory Electric Reliability Standards in Canada

Energy and Mines Ministers' Conference

Halifax, Nova Scotia
July 2015

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Summary

Since the August 14, 2003 northeast blackout, Canadian and American authorities have worked collaboratively and diligently to implement a harmonized continental approach to mandatory reliability standards. Nearly 12 years on, significant progress has been made in standards development, adoption and enforcement in Canada. This achievement is a tangible outcome of active federal/provincial/territorial collaboration under the auspices of the Energy and Mines Ministers' Conference (EMMC). Figure 1 presents a timeline of the major developments toward mandatory standards.

Going forward, emerging and complex issues such as changing resource mixes, resource planning, extreme physical events and cybersecurity will require focused attention by all those involved in electric reliability. Therefore, Canadian and American policy-makers, regulators, enforcement authorities and industry should continue to work closely together as the system evolves and to address emerging challenges both within and outside the standards process.

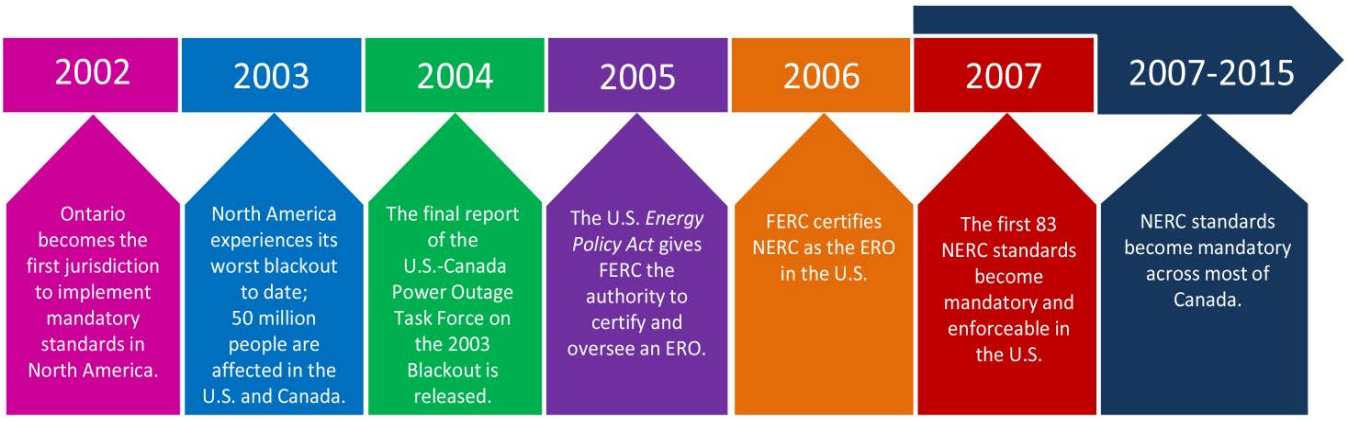


Figure 1. Timeline of major developments toward mandatory standards

Introduction

On August 14, 2003, the largest blackout in North American history occurred when 61,800 megawatts of electric power was lost in Ontario, Ohio, Michigan, Pennsylvania, New York, Vermont, Massachusetts, Connecticut and New Jersey, affecting an estimated 50 million people and causing an estimated $4 billion to $10 billion (U.S.$)[i] in economic losses. The impacts of the event demonstrated how critical electric grid reliability is to our modern society.

Following an extensive bi-national investigation, the joint U.S.-Canada Power System Outage Task Force recommended that appropriate branches of governments in the United States (U.S.) and Canada make reliability standards mandatory and enforceable.

This paper describes the circumstances, process and key milestones toward the implementation of standards in Canada and a look ahead at top priority risks to reliability that could inform future activity.

Overview of the North American bulk electric system

Canada and the U.S. share a highly integrated electrical transmission network. Adding the Baja California region of Mexico, which also has interconnections with the U.S., we have what is referred to as the North American bulk electric system (BES).[1] This immense system of 340,000 kilometres of high-voltage transmission lines[ii] connecting thousands of power generating stations has been referred to as the largest machine ever built. It is the backbone of our modern society, bringing the necessary power to keep our homes, businesses, schools, hospitals and transportation systems running. Without this infrastructure, our standard of living would simply not be possible.

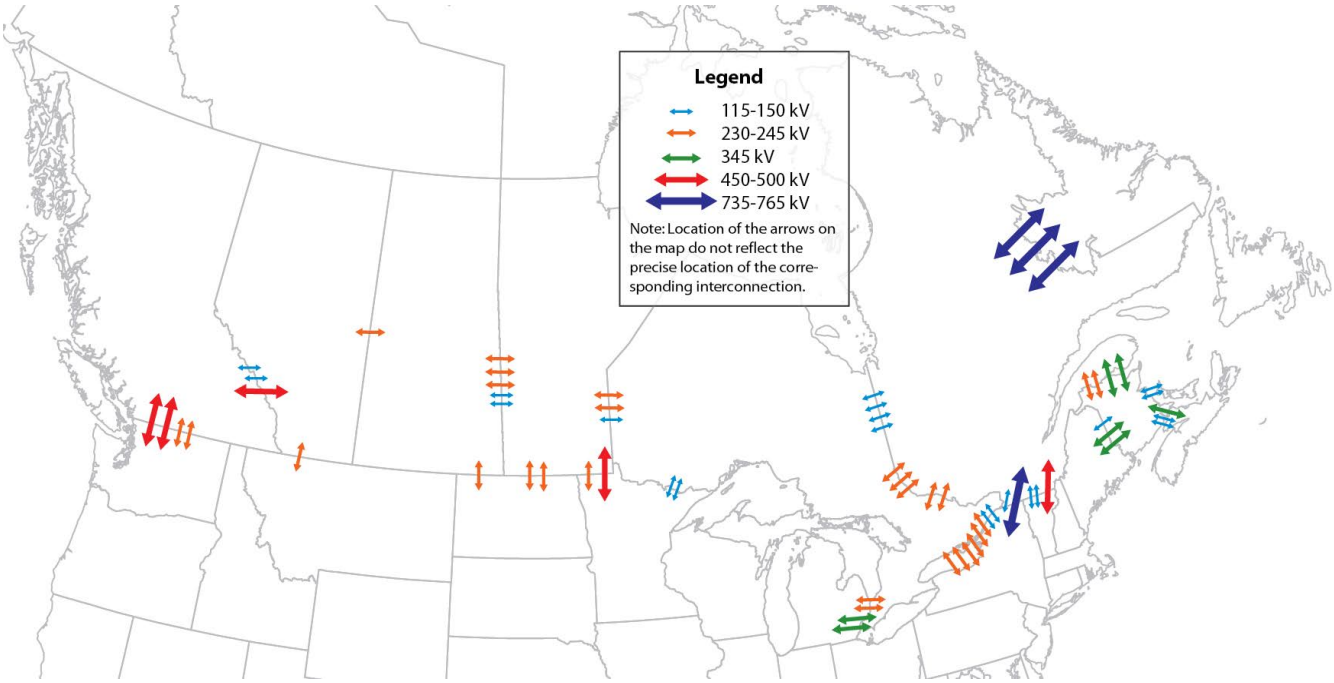


Figure 2. Transmission interconnections in Canada (2015)

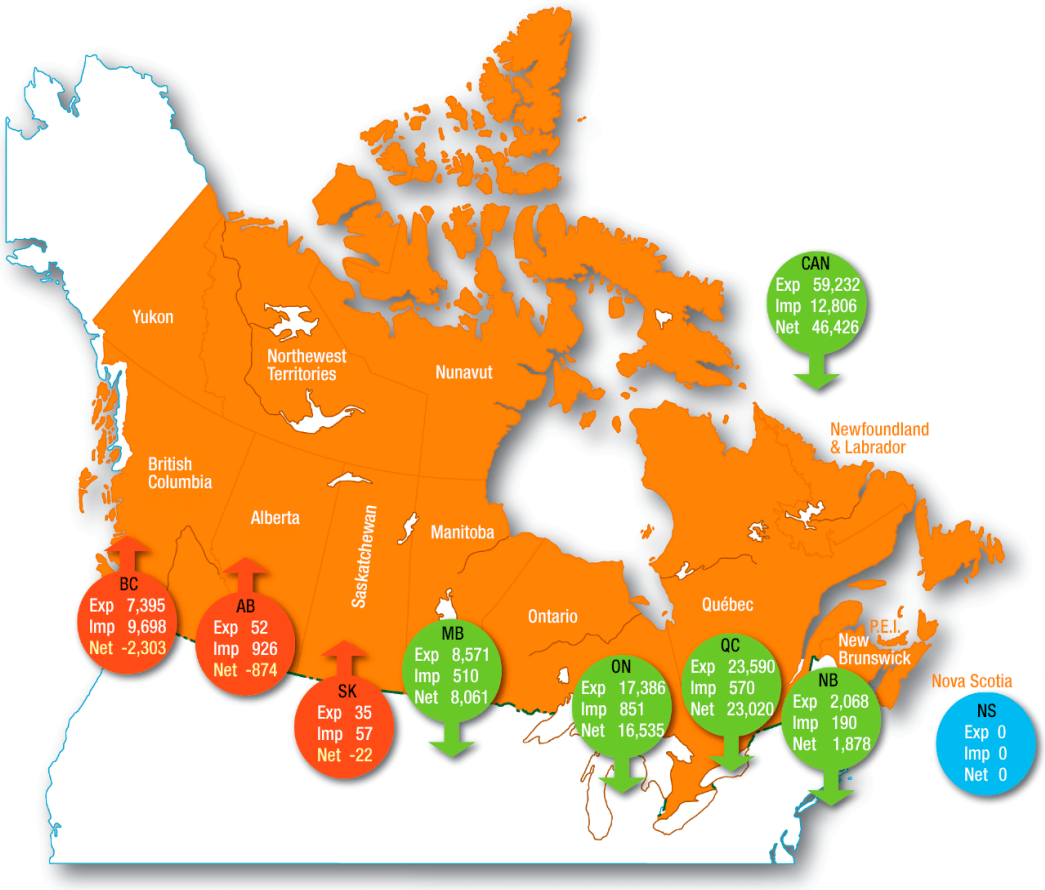
Despite the highly interconnected nature of the BES, regulatory systems are distinct for each jurisdiction. In Canada, regulatory oversight of electric reliability rests primarily within the jurisdiction of the provinces. Federal jurisdiction is limited to the permitting of international exports and the construction and operation of international power lines and designated interprovincial power lines.[2] In

[1] It is important to note that this paper focuses on the bulk electric system (i.e., 100 to 765 kV transmission), not local distribution systems.

[2] Currently, no such designation exists on any interprovincial power lines.

the U.S., the Federal Energy Regulatory Commission (FERC) has authority over electric reliability of the U.S. portion of the BES.

Utility system operators constantly balance electricity supply and demand in real time for the needs of their system. Interconnected transmission networks provide economic benefits by allowing electric utility companies to buy and sell power from each other. It also provides them with alternative power paths in emergencies (such as during extreme temperatures and/or when generating capacity is reduced for planned or unplanned maintenance), enabling reliability of the grid to be maintained despite localized outages.



Data displayed are in gigawatt-hours.
Numbers may not sum due to rounding.
Source: Canadian Electricity Association (CEA) using data from NEB

Figure 3. Electricity exports and imports between Canada and the U.S. (2014)

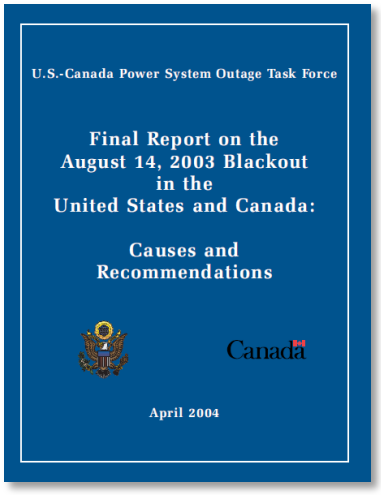
Canada exports and imports electricity to and from the U.S. across 34 active international transmission lines. In addition, there are 32 interprovincial lines facilitating trade between provinces.

However, interconnections can, in limited circumstances, facilitate increased vulnerability to cascading blackouts if entities[3] do not operate according to a common set of operating protocols. Such protocols are essential when unplanned events occur on the interconnected system and jurisdictions rapidly draw power from neighbouring jurisdictions that, in turn, draw power from the next jurisdiction in attempts to maintain the supply-demand balance. This was the case in August 2003.

> Electric reliability
>
> A reliable bulk electric system is a system able to meet the electricity needs of end-use customers even when unexpected equipment failures or other factors reduce the amount of available electricity.
>
> North American Electric Reliability Corporation

Overview of the 2003 blackout report

In response to the blackout, the U.S. and Canada established a joint U.S.-Canada Power System Outage Task Force to investigate the causes of the blackout and to recommend ways to reduce the possibility of a recurrence.



The final report*, Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*,[iii] published in April 2004, concluded that the outage originated in Ohio and quickly cascaded over a large area. The primary identified causes of the outage are referred to as the "3 Ts": trees, tools and training. That is, overgrown trees contacted multiple high-voltage transmission lines, tripping them out of service and increasing the load on remaining lines. This load resulted in increased line sagging and contact with additional overgrown trees. The area control centre did not have the tools that might have shown the location of significant line and facility outages within the control area. Finally, training of system operators was inadequate to respond to the emergency situation.

In addition, the report suggested that the system of voluntary reliability standards that had been in place since 1968 was no longer adequate to meet current needs. Changes in the electricity industry, such as restructuring to more competitive markets, had altered many of the traditional mechanisms, incentives and responsibilities of the entities involved in ensuring reliability.

The report also found that many of the problems arose not because the North American Electric Reliability Council[4] (NERC) – in place at the time of the blackout – was an inadequate or ineffective

[3] Entity is a common term used in the electric sector to describe industry participants.

[4] This council is now named the North American Electric Corporation.

organization, but rather because it had no structural independence from the industry it represented and had no authority to develop strong reliability standards and enforce compliance. The report included 46 recommendations – the most important being that appropriate branches of government in the U.S. and Canada make reliability standards mandatory and enforceable and provide appropriate penalties for noncompliance.

Designing a collaborative approach

Shortly after the blackout, at the 2003 Council of Energy Ministers meeting,[5] ministers established a senior-level (Assistant Deputy Minister) Federal-Provincial-Territorial Electricity Working Group (FPT EWG) "to exchange information and views on the circumstances and implications of the failure of the power system on August 14, 2003, and on possible new United States' initiatives to implement mandatory electric reliability standards."[6]

Figure 4. NERC functions

The group, in turn, formed the Bilateral Electric Reliability Oversight Group (BEROG) with the U.S. to harmonize the implementation of mandatory reliability standards developed by an electric reliability organization (ERO). The BEROG was composed of members of the FPT EWG (which by then also included Canadian regulators), as well as officials from the U.S. Department of Energy (DOE) and FERC.[7]

In 2005, the BEROG developed principles for a reliability organization that can function on an international basis. The concept of an ERO was to have a single entity to develop and enforce reliability standards. Principal tenets of the ERO are that it be independent from industry, backstopped by legislation and a single entity responsible for the entire interconnected North American electric grid. Recognition was given that the ERO would have to be a "NERC-like" organization, given its expertise and large network of industry volunteers.

[5] This meeting is now called the Energy and Mines Ministers' Conference.

[6] Other assigned objectives of the group included examining ways to accelerate the permitting of electricity generation and transmission projects; monitoring emerging interprovincial/international electricity issues; and promoting renewable and cleaner energy sources.

[7] With the addition of Mexican authorities, the group is now referred to the Trilateral Electric Reliability Oversight Group.

In the U.S., the *Energy Policy Act* of 2005 gave FERC new authority to approve and oversee an ERO responsible for reliability of the BES in the U.S. In 2006, FERC certified NERC as the ERO for the U.S. In 2007, compliance with the first 83 NERC reliability standards became mandatory for BES owners, operators and users in the U.S.

NERC governance model

NERC was created in 1968[8] by representatives of the electric utility industry in response to a large 1965 blackout as a voluntary council to develop and promote voluntary compliance with rules and protocols for the reliable operation of the BES in North America.

Today, NERC is an independent, self-regulatory, not-for-profit corporation that is governed by a Board of Trustees (3 members of the 11-member board are Canadian, including the current chair, Frederick W. Gorbet). The "ERO Enterprise" is composed of NERC and eight associated member-driven regional entities that perform various delegated reliability functions on behalf of NERC. The ERO Enterprise develops and enforces reliability standards; educates, trains, and certifies industry personnel; monitors the BES in real time; assesses reliability annually via 10-year and seasonal forecasts; and evaluates users, owners, and operators for preparedness.[iv]

There are more than 1,900 users, owners and operators of the BES registered within the ERO Enterprise. Most major Canadian owners/operators, including the provincial utilities, are members of three of the eight regional entities: the Western Electricity Coordinating Council (WECC); the Northeast Power Coordinating Council (NPCC); and the Midwest Reliability Organization (MRO) (Figure 5).

NERC standards are designed to provide for the reliable operation of the BES. Standards are grouped into 14 categories, such as Transmission Operations; Resource and Demand Balancing; Communications; Emergency Preparedness and Operations; and Critical Infrastructure Protection. In the U.S., there are currently approximatively 105 standards in force, subsets of which are also in force in Canadian jurisdictions.[v]

[8] NERC was then called the North American Electric Reliability Council.

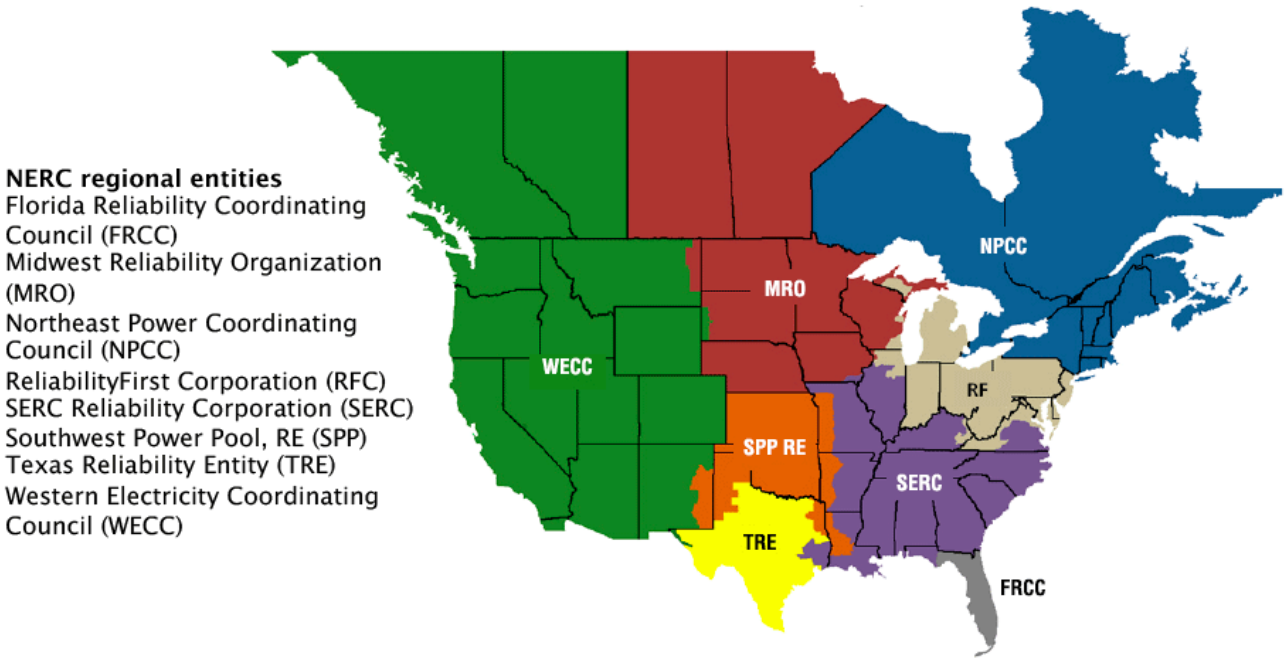


Figure 5. The eight NERC regional entities

NERC reliability standards are developed using an open and inclusive process managed by the NERC Standards Committee. Standards drafting teams are comprised of industry and other representatives from both the U.S. and Canada and are facilitated by NERC staff. Following a balloting process, standards are presented to the Board of Trustees for final approval before filing with the U.S. FERC and Canadian regulators (provincial regulators and the National Energy Board [NEB]).

The development of a standard (or modifications to an existing standard) can originate from within NERC, or NERC can be directed to develop a standard by FERC if vulnerabilities are identified.[9] In the U.S., FERC's authority to act on a proposed NERC standard is limited to 1) approval or 2) remand for modification. In Canada, provincial jurisdictions have differing authorities regarding the acceptance, rejection, remand or tailoring of NERC standards.

[9] Under NERC's rules, anyone in North America can potentially submit a standards authorization request to recommend initiation of a standard project.

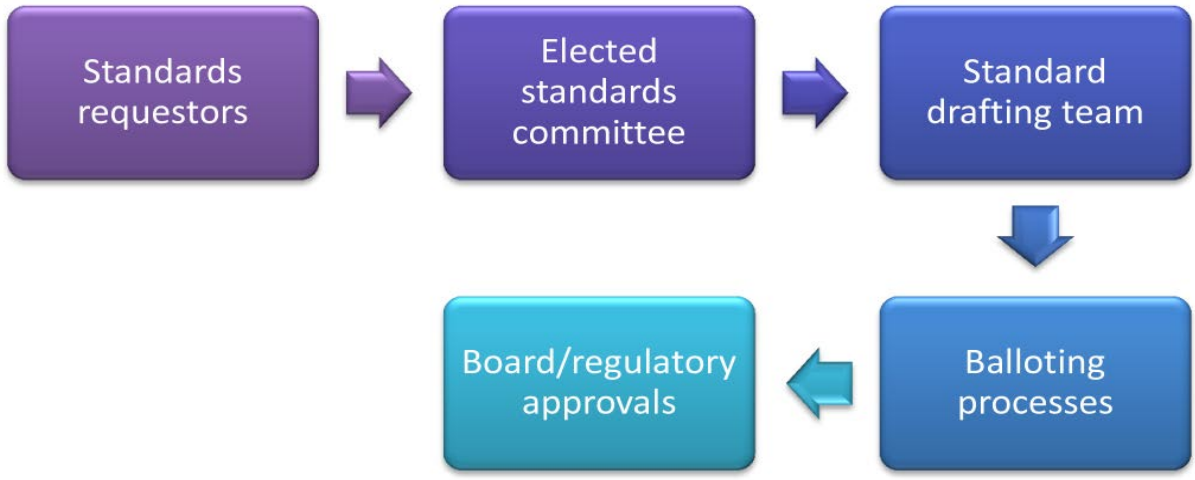


Figure 6. The overall standards-making process

NERC reliability standards in Canada

All provinces have legislation granting authority to one or more provincial authorities to be responsible for electric system reliability. At the federal level, reliability is included in NEB authorities. While not all jurisdictions have the necessary legal structures to name an ERO, the NEB and all provinces within the BES, except Newfoundland and Labrador and Prince Edward Island (P.E.I.), have recognized NERC as an electric reliability standards-setting organization and support NERC in its standards-setting and oversight role as the North American ERO.

Recognition of NERC

Recognition of NERC as the ERO by a province is done through legislation, regulation, orders in council, memoranda of understanding (MOU) or other agreements. The provinces of Ontario, Quebec, Nova Scotia, New Brunswick, Alberta, Saskatchewan as well as the NEB have such MOUs or agreements with NERC. While there are currently no MOUs in effect with British Columbia and Manitoba, both provinces have adopted NERC reliability standards as mandatory and enforceable and work closely with the ERO (see Annex B for links to jurisdictional mechanisms to recognize NERC).

Adoption of NERC standards

Each Canadian jurisdiction with mandatory reliability standards has put in place processes to consider the adoption or modifications of NERC standards. In some jurisdictions, the regulator reviews the NERC standards and modifies them as necessary for their respective jurisdiction while others post the NERC standards for a set comment period and conduct a formal review if issues are raised.

NERC standards or modified NERC standards are mandatory and enforceable or are in the process of becoming mandatory and enforceable[10] in all provinces connected to the BES except P.E.I. and Newfoundland and Labrador. Likewise, NERC standards are mandatory on NEB-regulated international lines.

The two remaining provinces and the territories are unique from the other provinces with respect to their reliability regimes. P.E.I. does not have a formal agreement with NERC. Most of the electricity used in P.E.I.is generated in New Brunswick, and the New Brunswick Power Corporation (NB Power) provides load balancing and serves as the reliability coordinator for the island. Through agreements between NB Power and Maritime Electric, there is an obligation for Maritime Electric to meet certain reliability standards requirements related to the load balancing and reliability coordinator functions provided by NB Power.

While Newfoundland and Labrador has not adopted NERC standards in a formal manner to date, Newfoundland and Labrador Hydro's reliability guidelines and procedures are similar to NERC reliability standards requirements. The province is currently assessing implications of NERC and NPCC membership and standards when the Island of Newfoundland interconnects with Nova Scotia and Labrador in 2017/2018 via the two subsea high voltage direct current transmission link components of the Muskrat Falls hydroelectric project. The Labrador portion of the province is already connected to the BES via three 735-kV transmission lines into Quebec.

Finally, the three territorial systems each serve small loads via regional grids or stand-alone community generators, which are isolated from the BES.

Compliance and enforcement

Each Canadian jurisdiction with NERC standards has measures to enforce compliance. Authorities can order corrective actions, impose reporting requirement, and in some jurisdictions, impose financial penalties. Examples of three provinces in which NERC standards are mandatory and where financial penalties can be levied for non-compliance are described here. Figure 8 displays an overview for all Canadian provinces.

In Ontario, which was the first jurisdiction to implement mandatory standards in North America in 2002, the Independent Electricity System Operator's (IESO) Market Assessment and Compliance Division makes violation and sanction determinations for all Ontario entities and the IESO. Sanctions include, among other things, orders to 1) do "such things as may be necessary" to comply with the market rules; 2) cease the act, activity or practice constituting the violation; 3) impose record-keeping or reporting requirements on a market participant; 4) issue a non-compliance letter; and 5) impose financial penalties. The maximum financial penalty amount is $1 million per occurrence for each breach at issue.

[10] At the time of this writing, the Quebec regulator has adopted 43 standards and has set the effective date for 12 standards for April 1, 2015.

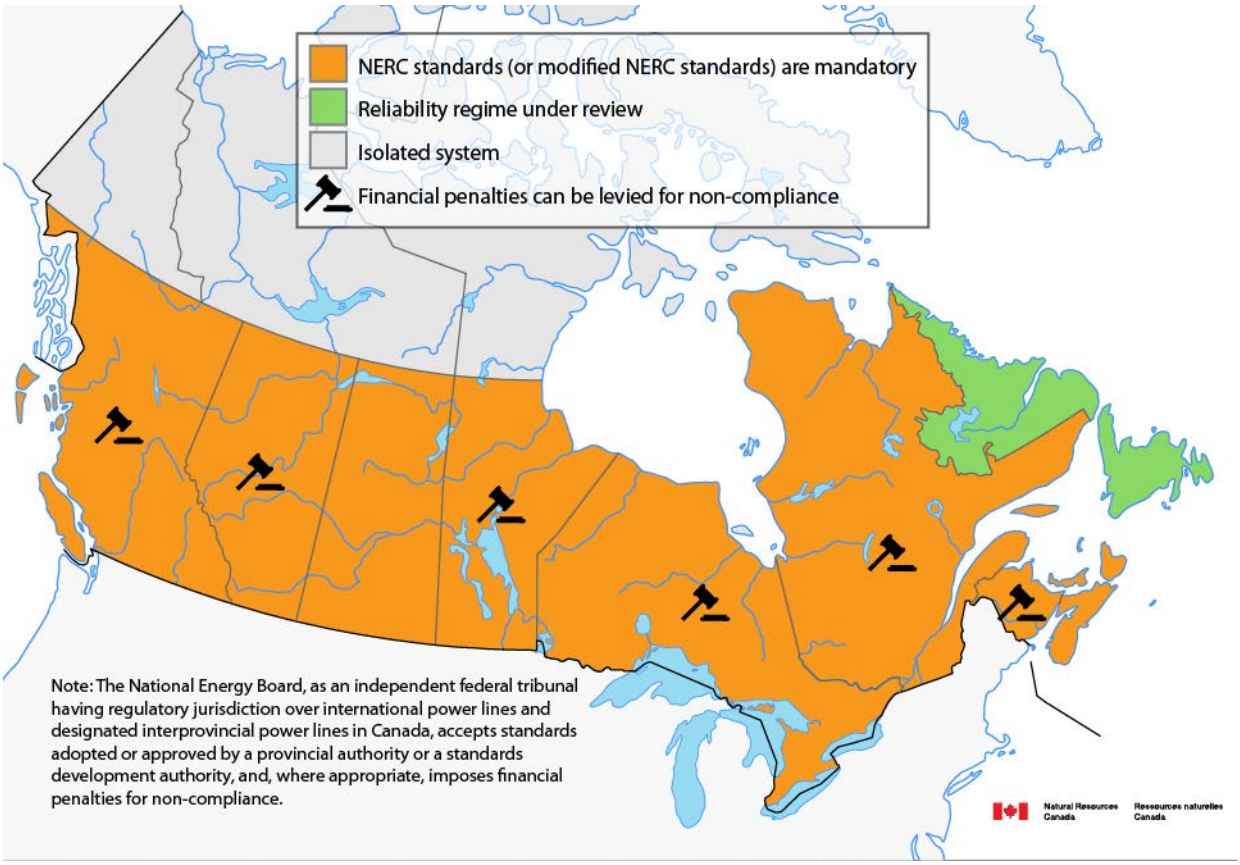


Figure 7. Electric reliability regimes in Canada (2015)

In Alberta, in accordance with Alberta Utilities Commission (AUC) rules, the Market Surveillance Administrator (MSA) may issue a notice of specified penalty for contravention of an Alberta reliability standard. Alternatively, the MSA may seek an administrative penalty before the AUC or other relief. The maximum administrative penalty amount is $1 million per day on which the contravention occurs or continues.

In British Columbia, the provincial government has passed amendments to the *Utilities Commission Act* that enables the British Columbia Utilities Commission (BCUC) to levy the same administrative penalties as WECC for non-compliance with standards. These can be up to $1 million per day in extreme cases. In Quebec, under its enabling legislation, the Regie de l'Energie ensures that electrical power is transmitted in accordance with its reliability standards. To that end, it can impose corrective measures, remedial plans and administrative penalties of up to $500,000 per day on parties violating reliability standards.

More details on Canadian jurisdictional reliability regimes, including reliability standard-making and enforcement functions and U.S. comparators, can be accessed through the NERC website.[vi]

While Ontario was a pioneer in the implementation of mandatory standards in North America, the implementation of mandatory and enforceable electric reliability standards across Canada has generally taken time primarily because of the constitutional divisions of responsibility and the unique regulatory design of each jurisdiction. It could be concluded that the specific and systemic causes of the August 2003 blackout are now largely addressed through mandatory electric reliability standards. The significant progress made in standards development, adoption and enforcement in Canada is a tangible outcome of active federal/provincial/territorial collaboration.

Maintaining oversight and coordination

The close working relationship of Canadian and American policy-makers, regulators and enforcement authorities has proven valuable in maintaining overall jurisdictional cooperation. The FPT EWG has remained active throughout the establishment of the ERO Enterprise and the implementation of reliability regimes across Canada. The group continues to confer regularly and report annually to energy ministers through the annual EMMC. It also confers regularly with the Canadian Electricity Association (CEA), NERC and FERC on reliability issues, including in two face-to-face meetings with NERC and FERC each year (Mexican authorities are also invited to participate).

NRCan-DOE MOU on enhanced energy collaboration

On September 18, 2014, Greg Rickford, Canada's Minister of Natural Resources and Dr. Ernest Moniz, United States Secretary of Energy, signed an MOU launching an agreement on enhanced energy collaboration between Natural Resources Canada (NRCan) and the U.S. DOE. The signing continues a long and productive history of Canada-U.S. collaboration on a wide range of energy issues and shared interests in greater energy security, environmental responsibility and sustainability.

Under the MOU, Canada and the U.S. plan to cooperate on initiatives, including sharing of knowledge, technical information and research plans to improve environmental practices in conventional and unconventional oil and gas development; enhancing the reliability and security of North American energy infrastructure; supporting the advancement of an efficient and clean electric grid; enhancing coordination on energy efficiency standards; facilitating increased use of natural gas in the transportation sector; collaborating to reduce the cost of carbon capture and storage (CCS); and engaging in regional and multilateral dialogues on energy and environmental issues to advance shared priorities.

In 2012, the FPT EWG established the Monitoring and Enforcement Subgroup (MESG), composed of officials from regulators and other entities responsible for compliance in Canada, to share information on monitoring and enforcement regimes and developments across Canada.

The CEA has been a very active participant in NERC since its formation. It has worked with the FTP EWG on reliability and the development of the ERO and is represented on several NERC committees. Also, Canada's Energy and Utility Regulators (CAMPUT)[11] is involved with NERC. Over the past two years,

[11] In 2011, the CAMPUT constitution was amended to drop the name Canadian Association of Members of Public Utility Tribunals, but to continue using the acronym, since this is well recognized.

NERC has given a higher profile to the CEA and CAMPUT at their Board of Trustees and Member Representatives Committee meetings, inviting their remarks on reliability activities in Canada.

Outside of its role with the FPT EWG, NRCan also works closely with government, industry and academia partners to advance physical and cyber security research and skills transfer at its National Energy Infrastructure Test Centre.

Finally, NRCan and the U.S. DOE maintain a close relationship under the auspices of the Canada-U.S. Clean Energy Dialogue and the 2014 Memorandum of Understanding on Enhanced Energy Cooperation, which includes enhancing the reliability and security of North American energy infrastructure as a key area of focus.

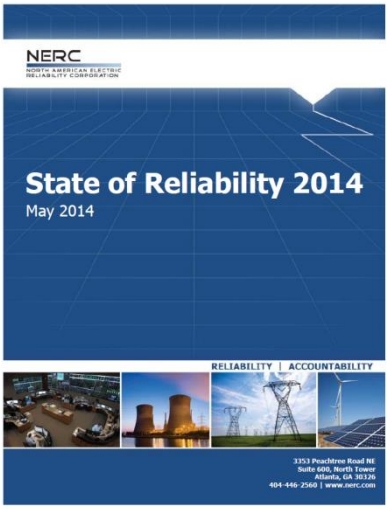
Going forward, these close working relationships will continue to be of value as the system evolves and new issues arise.

Principles for Data Sharing

In 2012, the FPT EWG and FERC finalized the "*Principles for Data Sharing"* to aid in the event of future cross-border outages or investigations. Based on the principles, the FPT EWG, FERC and NERC further developed a Draft Protocol for Sharing Confidential Data and Other Information Related to a Cross-Border Disturbance that could be used and tailored as appropriate by each jurisdiction in the event of a cross-border incident.

Measuring results

Reliability, and by extension, the impact that the ERO Enterprise has had on the reliability of the BES is not easily measured. Balancing the supply and demand of electricity will always be a challenge given the complex, variable and instantaneous interaction of numerous generators and loads in different locations. Additionally, the unpredictable nature of external factors such as extreme weather events makes it difficult to draw conclusive trends from year-over-year comparisons.



Qualitatively, it can be said that the specific and systemic issues that contributed to the 2003 blackout have been addressed by NERC standards and are being monitored and enforced. Indeed, one measure of success is the fact that there has not been an event of similar scale on the BES since 2003.

For example, NERC included in its *State of Reliability Report 2014*, that in 2013, the BES was able to withstand the most "stressful" events of the year without significant loss of transmission, generation or load. These measures indicate the system's ability to perform reliably over a variety of operating conditions. 2013 also saw significantly fewer high priority energy emergency alerts resulting from an imminent or initiated loss of load than previous years. This further demonstrates the ability of the BES to respond to a variety stresses (severe weather, system constraints, etc.).

Looking ahead: priority risks

Looking ahead, in its *5-year Performance Assessment* report,[vii] NERC identifies its top-priority reliability risks for 2014–2017, which it will use to guide future project work including standards development, system analysis and information sharing. While again technical in nature, some risks may be served by focused regulatory and/or policy attention in both Canada and the U.S., such as changing resource mix, resource planning, extreme physical events and cybersecurity.

Changing resource mix: As the generation and load on the power system changes (e.g., integrated variable resources, increased dependence on natural gas, increased demand-side management, new technologies deployed), the system is being brought into states that are significantly different than those considered when the system was designed and planned, exposing new vulnerabilities not previously considered. Fundamental operating characteristics and behaviours are no longer a certainty.

Resource planning: Plant retirements (largely due to aging infrastructure; implemented environmental regulations; increased uncertainty in future resources due to other potential environmental regulations; and lower natural gas prices, which significantly affect power plant economics) are leading to cases where resources may be inadequate to ensure firm demand is served at all times.

Extreme physical events: While the probability of extreme physical events (such as physical attacks, geomagnetic disturbances or severe weather) that lead to extensive damage is low, the potential consequences are significant enough that risk avoidance (reducing the probability) is insufficient as a sole risk management strategy.

Cybersecurity: Cyberattacks against the BES could potentially cause major grid disturbances or outages. Such threats are complex and rapidly evolving, commanding the attention of NERC, owners/operators, governments and others involved in critical infrastructure protection.

Going forward, policy-makers should continue to address reliability issues as well as complement regulatory efforts where appropriate and give consideration to these priority risks for reliability. These efforts should be made in collaboration with NERC, FERC and industry participants.

Conclusions and recommendations

As described in this report, much has been done to improve North American BES reliability since the August 2003 northeast blackout. The main conclusions are summarized as follows.

1. **All Canadian jurisdictions connected to the North American BES have implemented mandatory and enforceable electric reliability standards (P.E.I. and Newfoundland and Labrador exceptions explained in the footnotes).**[12, 13]

2. **The ERO Enterprise (NERC and the eight regional entities) provides a harmonized approach for electric reliability standards across the North American BES.**

3. **The specific and systemic causes of the August 2003 blackout are now largely addressed through mandatory electric reliability standards.**

4. **Significant progress has been made in the development of reliability oversight and enforcement mechanisms in Canada since the August 2003 blackout.**

5. **The close working relationship of Canadian and U.S. policy-makers, regulators and enforcement authorities has proven valuable in maintaining overall jurisdictional cooperation throughout the implementation of mandatory electric reliability standards.**

6. **Changing resource mix, resource planning, extreme physical events and cybersecurity will be priority risks facing the electric sector going forward.**

Going forward, the following recommendations are presented for consideration of all involved parties:

1. **Canadian policy-makers, regulators, enforcement authorities and industry should continue to work closely with FERC and NERC on electric reliability matters.**

2. **Canadian policy-makers should complement regulatory efforts where appropriate and give consideration to the reliability impacts of changing resource mixes, resource planning, extreme physical events and cybersecurity.**

[12] As the BES interconnection facilities between New Brunswick and P.E.I. are covered by agreements between MECL and NB Power, and there are no BES facilities on P.E.I., there are no further requirements for P.E.I. to implement mandatory standards.

[13] Newfoundland and Labrador is currently assessing implications of NERC and NPCC membership and standards as the Island of Newfoundland interconnects with Nova Scotia and Labrador in 2017/18.

Annex A – List of acronyms

AUC: Alberta Utilities Commission

BCUC: British Columbia Utilities Commission

BES: Bulk Electric System

BEROG: Bilateral Electric Reliability Oversight Group

CAMPUT: Canada's Energy and Utility Regulators (formerly Canadian Association of Municipal Public Utility Tribunals)

CEA: Canadian Electricity Association

ERO: Electric Reliability Organization

EMMC: Energy and Mines Ministers' Conference

FERC: Federal Energy Regulatory Commission

FPT EWG: Federal-Provincial-Territorial Electricity Working Group

IESO: Independent Electricity System Operator

MRO: Midwest Reliability Organization

NB Power: New Brunswick Power Corporation

NEB: National Energy Board

NERC: North American Electric Reliability Corporation

NPCC: Northeast Power Coordinating Council

NRCan: Natural Resources Canada

P.E.I.: Prince Edward Island

WECC: Western Electricity Coordinating Council

Annex B – Recognition of NERC in Canada

Jurisdiction	Recognition of NERC (legislation, regulation, MOU, other)	Regulatory authority
British Columbia	NERC and WECC are recognized as standards-making bodies under the *Utilities Commission Act* (1996).	British Columbia Utilities Commission
Alberta	The reliability standards made by NERC and WECC apply in Alberta to the extent that those standards are adopted by the Alberta Electric System Operator under Section 19 of the *Alberta Transmission Regulation* (2007); authority to designate NERC as the ERO under Section 20; and NERC is formally recognized as the ERO in Ministerial Order 79/2007 (2007).	Alberta Utilities Commission
Saskatchewan	NERC and MRO are recognized as Saskatchewan's electric reliability standards setting bodies under the SaskPower-MRO-NERC MOU (2009).	SaskPower
Manitoba	Manitoba Hydro's membership in the MRO and its obligations to adopt reliability standards were sanctioned by the province through Order in Council No. 206 (2004). Reliability standards and enforcement are legal requirements under the *Reliability Standards Regulation* (2012) and the *Monetary Penalty Payment Regulation* (2012).	Government of Manitoba and the Manitoba Public Utilities Board
Ontario	NERC is recognized as a "standards authority" under the *Ontario Electricity Act* (1998). NERC is recognized as the ERO for Ontario under the OEB-NERC MOU (2006).	Ontario Energy Board
Quebec	NERC and NPCC are recognized experts in setting reliability standards and monitoring their application under the Agreement on the development of electric power transmission reliability standards and of procedures and a program for the monitoring of the application of these standards for Quebec (2009).	la Régie de l'énergie
New Brunswick	NERC is recognized as a standards-making body under the *New Brunswick Reliability Standards Regulation* (2013) under the *New Brunswick Electricity Act* (2003). NERC is recognized the New Brunswich ERO under the NB-NBSO-NERC MOU (2008).	New Brunswick Energy and Utilities Board
Prince Edward Island	Most of the electricity used in P.E.I. is generated in New Brunswick. Normally there is no conventional generation running in P.E.I. The New Brunswick Power Corporation provides load balancing and serves as the reliability coordinator for P.E.I.	Island Regulatory and Appeals Commission

Nova Scotia	NERC is recognized as a standards-making body under the NSUARB-NERC MOU (2006).	Nova Scotia Utility and Review Board
Newfoundland and Labrador	While Newfoundland and Labrador has not adopted NERC standards in a formal manner to date, Newfoundland and Labrador Hydro's reliability guidelines and procedures are very similar to many NERC reliability standard requirements. The province is currently assessing implications of NERC and NPCC membership and standards given the Muskrat Falls hydroelectric development and associated Maritime and Labrador Island subsea transmission links that will connect the Island of Newfoundland to Nova Scotia and to Labrador, respectively.	Newfoundland and Labrador Board of Commissioners of Public Utilities
Northwest Territories	Isolated system not connected to the BES	NWT Public Utilities Board
Yukon	Isolated system not connected to the BES	Yukon Utilities Board
Nunavut	Isolated system not connected to the BES	Utility Rates Review Council of Nunavut
Federal	NERC is recognized as a corporation that is to carry out its mandate as an ERO as applicable to international power lines under the NEB-NERC MOU (2006). NERC and regional entities are recognized as "standards development authorities" under General Order MO-036-2012 and Amending Orders for certain permitted lines (2012).	National Energy Board

References

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[ii] North America Electric Reliability Corporation website - ERO Enterprise Operating Model nerc.com/AboutNERC/Pages/Strategic-Documents.aspx

[iii] Natural Resources Canada website nrcan.gc.ca/energy/renewable-electricity/7361

[iv] North America Electric Reliability Corporation website – ERO Model nerc.com/AboutNERC/keyplayers/Documents/ERO_Enterprise_Operating_Model_Feb2014.pdf

[v] North America Electric Reliability Corporation website - Reliability standards nerc.com/AboutNERC/keyplayers/Pages/default.aspx

[vi] North America Electric Reliability Corporation website – Provincial summaries nerc.com/AboutNERC/keyplayers/Pages/default.aspx

[vii] North America Electric Reliability Corporation website – Reliability Report nerc.com/gov/Pages/Three-Year-Performance.aspx