

**August 14, 2003, Northeast Blackout Impacts and Actions and
the Energy Policy Act of 2005**

David W. Hilt P.E.

North American Electric Reliability Council

116-390 Village Boulevard

Princeton, New Jersey 08540

(609) 452-8060/(609) 452-9550

Background

On August 14, 2003, just after 4 p.m. Eastern Daylight Time, the power grid of the United States and Canada experienced the largest blackout ever. The blackout affected an estimated 50 million people, and more than 61,800 megawatts (MW) of electrical load was lost in parts of Ohio, Michigan, New York, Pennsylvania, New Jersey, Connecticut, Massachusetts, Vermont and the province of Ontario. Although power was successfully restored to most customers within hours, some areas of the United States did not have power for two days and parts of Ontario experienced rolling blackouts for up to two weeks due to a generation capacity shortage. The cost of the blackout has been estimated to be between 7 and 14 billion dollars. This paper addresses some of the actions the electric industry has taken to improve reliability as a result of the findings of the technical investigation into the August 14 blackout.

Impacts of Blackouts

Every major electric disturbance has an immediate impact on the electric system, interconnected utilities and their customers, although their magnitude and scope can vary greatly. The history of large-scale blackouts began shortly after the electric systems in North America became highly interconnected.

In 1962, the Interconnected Systems Group (ISG), composed of utilities located in the Midwest and South, met to prepare for the imminent closure of seven electrically separate interconnections to form the largest synchronized system in the world. This action resulted in the creation of the Eastern Interconnection, which stretches from the Rocky Mountains in the west to the Atlantic Ocean in the east, and from the Gulf of Mexico in the south to the Hudson Bay in the north.

On November 9, 1965, a blackout occurred in the northeastern United States and southeastern Ontario, Canada, that affected 30 million people and interrupted more than 20,000 MW of electrical load for up to 13 hours. As a result, in 1967 the U.S. Federal Power Commission (predecessor to the Federal Energy Regulatory Commission, or FERC) recommended the formation of a council on power coordination made up of representatives from each of the nation's regional electric coordinating organizations to exchange and disseminate information on regional coordinating practices, and to review, discuss, and assist in resolving matters affecting interregional coordination. Federal legislation was also proposed: the Electric Power Reliability Act of 1967, which would have created a federal agency to achieve this goal. That legislation was not enacted once the electric industry acted to create a national electric reliability organization.

In June 1968, twelve regional utility organizations formed the National Electric Reliability Council (NERC). NERC was established to provide a means for coordinating among interconnected utilities in order to ensure that the bulk electric system in the United States was reliable, adequate and secure. In 1981, NERC expanded to include the interconnected electric

systems in Canada and its name was changed to the North American Electric Reliability Council. A portion of Mexico is also included in NERC's reliability footprint.

Since its formation, NERC has operated successfully as a voluntary, self-regulatory organization, relying on reciprocity, peer pressure and the mutual self-interest of all those involved. NERC has developed standards for the reliable operation and planning of the bulk electric system and monitors compliance with those standards on a voluntary basis.

The North American bulk electric system is one of the largest and complicated machines in the world. It is also the most reliable system in the world. Yet, to some degree, blackouts and system events are inevitable. Even with sound standards for reliable operation and planning of the bulk electric system, events can occur that will result in disturbances, particularly when organizations and people do not comply with those standards. Some of these events are summarized below.

- July 13, 1977 - New York City - 9,000,000 people; 6,000 MW interrupted
- July 2, 1996 - Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, Oregon, South Dakota, Texas, Utah, Washington and Wyoming in the United States; Alberta and British Columbia in Canada; and Baja California Norte in Mexico - 2,000,000 people; 11,850 MW
- August 10, 1996 - Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, Oregon, South Dakota, Texas, Utah, Washington and Wyoming in the United States; Alberta and British Columbia in Canada; and Baja California Norte in Mexico - 7,500,000 customers; 28,000 MW
- June 25, 1998 - Minnesota, Montana, North Dakota, South Dakota and Wisconsin in the United States; Ontario, Manitoba and Saskatchewan in Canada - 152,000 customers; 950 MW
- March 18, 2000 – New Mexico – 355,000 customers, 1052 MW

Each of these system events resulted in studies that lead to a series of recommendations to be implemented by the affected entities and in some cases by the industry as a whole. Unfortunately, these recommendations were not always implemented by all systems across North America.

The August 14 Blackout Technical Investigation

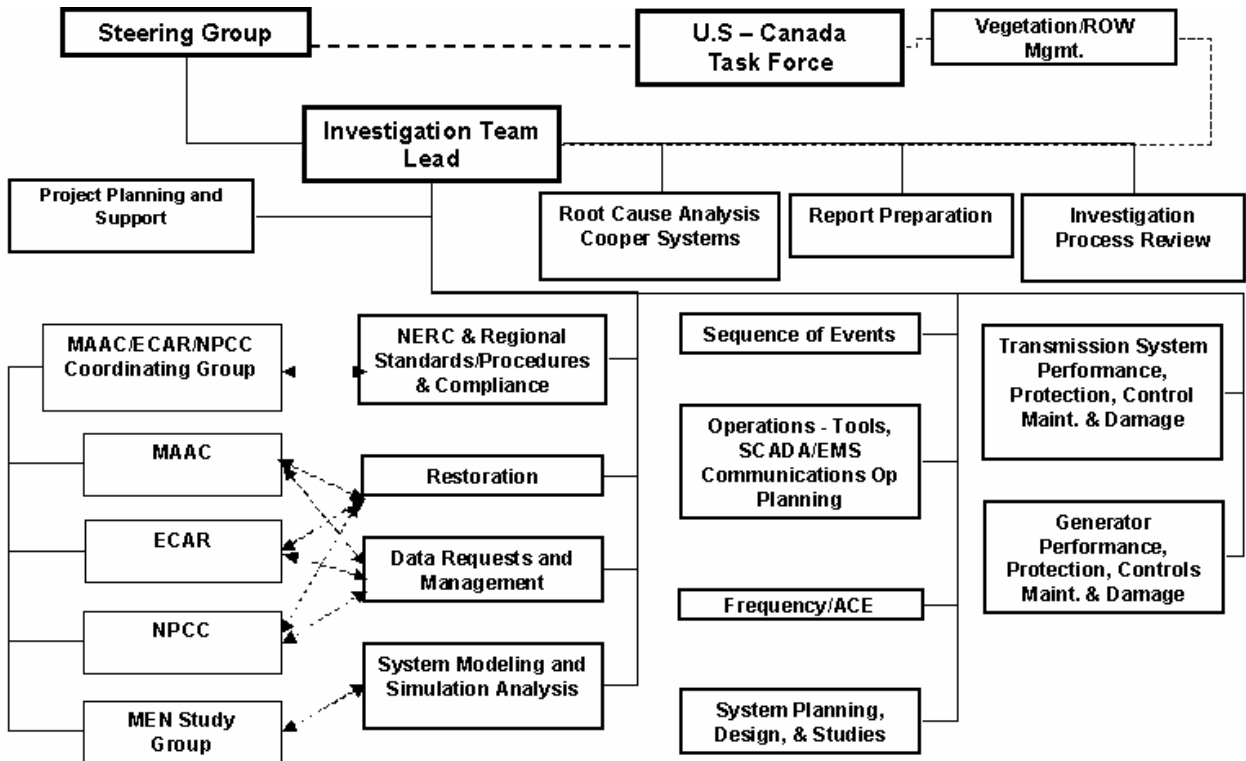
Immediately following the August 14 blackout, NERC launched a broad investigation into the outage and assembled a team of technical experts from across the United States and Canada to investigate exactly what happened, why it happened, and what could be done to minimize the chance of future outages. To lead this effort, NERC established a steering group of leading experts from systems that were not directly involved in the outage.

The scope of the NERC investigation was to determine the causes of the blackout, how to reduce the likelihood of future cascading blackouts, and to minimize the impacts of any that do occur. NERC focused its analysis on facts and technical issues, such as power system operations, planning, design, protection and control, and maintenance. It is the responsibility of power system operating entities to operate the North American bulk electric system reliably at all times, irrespective of regulatory, economic, or market factors. Therefore, NERC did not seek to address these public policy issues in its investigation.

The investigation of the August 14, 2003 blackout involved hundreds of individuals from within the electric utility industry. The investigation effort was divided into teams with the necessary expertise to analyze various aspects of bulk electric system planning and operation.

Each team ultimately produced a report on their portion of the investigation in support of the U.S.-Canada Power System Outage Task Force report and the final NERC report. Each of the team reports include additional detail about the investigation as well as more detailed recommendations.

The investigation organization is shown below.



Within days of the blackout, NERC's investigation became a critical component of the U.S.-Canada Power System Outage Task Force, a bi-national group formed by President George W. Bush and Prime Minister Jean Chrétien to examine all aspects of the August 14 outage. The task force formed three working groups to investigate the electric power system, nuclear power plant performance, and security aspects of the blackout. The electric system working group was led by representatives from the U.S. Department of Energy, FERC, and Natural Resources Canada.

NERC's investigation became a key resource for the electric system working group. NERC teams analyzed an enormous volume of data to determine a precise sequence of events leading to and during the cascade. They met regularly with representatives of the task force and assisted them in determining why the blackout occurred and why it extended as far as it did.

In its November 19, 2003 interim report the government task force concluded, and NERC concurred, that the initiating causes of the blackout were 1) that FirstEnergy (FE) lost

functionality of its critical monitoring tools and as a result lacked situational awareness of degraded conditions on its transmission system, 2) that FE did not adequately manage tree growth in its transmission rights-of-way, 3) that the Midwest Independent Transmission System Operator (MISO) reliability coordinator did not provide adequate diagnostic support, and 4) that coordination between the MISO and PJM reliability coordinators was ineffective. Several specific violations of NERC reliability standards were cited in the report as contributing to the blackout. The interim report can be found at:

ftp://www.nerc.com/pub/sys/all_updl/docs/blackout/814BlackoutReport.pdf

The final U.S. - Canada Power System Outage Task Force report was issued on April 5, 2004. The report confirmed and expanded upon the findings of the interim report and supported and expanded upon the recommendation resulting from NERC's own investigation. The report included 46 recommendations to improve reliability oversight and prevent blackouts. These are noted below

U. S. Canada Power System Outage Task Force Final Report Recommendations

Group I. Institutional Issues Related to Reliability

1. Make reliability standards mandatory and enforceable, with penalties for noncompliance.
2. Develop a regulator-approved funding mechanism for NERC and the regional reliability councils, to ensure their independence from the parties they oversee.
3. Strengthen the institutional framework for reliability management in North America.
4. Clarify that prudent expenditures and investments for bulk system reliability (including investments in new technologies) will be recoverable through transmission rates.
5. Track implementation of recommended actions to improve reliability.
6. FERC should not approve the operation of new RTOs or ISOs until they have met minimum functional requirements.
7. Require any entity operating as part of the bulk power system to be a member of a regional reliability council if it operates within the council's footprint.
8. Shield operators who initiate load shedding pursuant to approved guidelines from liability or retaliation.
9. Integrate a "reliability impact" consideration into the regulatory decision-making process.
10. Establish an independent source of reliability performance information.
11. Establish requirements for collection and reporting of data needed for post-blackout analyses.
12. Commission an independent study of the relationships among industry restructuring, competition, and reliability.
13. DOE should expand its research programs on reliability-related tools and technologies.
14. Establish a standing framework for the conduct of future blackout and disturbance investigations.

Group II. Support and Strengthen NERC's Actions of February 10, 2004

15. Correct the direct causes of the August 14, 2003 blackout.
16. Establish enforceable standards for maintenance of electrical clearances in right-of-way areas.
17. Strengthen the NERC Compliance Enforcement Program.
18. Support and strengthen NERC's Reliability Readiness Audit Program.
19. Improve near-term and long-term training and certification requirements for operators, reliability coordinators, and operator support staff.
20. Establish clear definitions for *normal*, *alert* and *emergency* operational system conditions.

Clarify roles, responsibilities, and authorities of reliability coordinators and control areas under each condition.

21. Make more effective and wider use of system protection measures.
22. Evaluate and adopt better real-time tools for operators and reliability coordinators.
23. Strengthen reactive power and voltage control practices in all NERC regions.
24. Improve quality of system modeling data and data exchange practices.
25. NERC should reevaluate its existing reliability standards development process and accelerate the adoption of enforceable standards.
26. Tighten communications protocols, especially for communications during alerts and emergencies. Upgrade communication system hardware where appropriate.
27. Develop enforceable standards for transmission line ratings.
28. Require use of time-synchronized data recorders.
29. Evaluate and disseminate lessons learned during system restoration.
30. Clarify criteria for identification of operationally critical facilities, and improve dissemination of updated information on unplanned outages.
31. Clarify that the transmission loading relief (TLR) process should not be used in situations involving an actual violation of an Operating Security Limit. Streamline the TLR process.

Group III. Physical and Cyber Security of North American Bulk Power Systems

32. Implement NERC IT standards.
33. Develop and deploy IT management procedures.
34. Develop corporate-level IT security governance and strategies.
35. Implement controls to manage system health, network monitoring, and incident management.
36. Initiate U.S.-Canada risk management study.
37. Improve IT forensic and diagnostic capabilities.
38. Assess IT risk and vulnerability at scheduled intervals.
39. Develop capability to detect wireless and remote wireline intrusion and surveillance.
40. Control access to operationally sensitive equipment.
41. NERC should provide guidance on employee background checks.
42. Confirm NERC ES-ISAC as the central point for sharing security information and analysis.
43. Establish clear authority for physical and cyber security.
44. Develop procedures to prevent or mitigate inappropriate disclosure of information.

Group IV. Canadian Nuclear Power Sector

45. The Task Force recommends that the Canadian Nuclear Safety Commission request Ontario Power Generation and Bruce Power to review operating procedures and operator training associated with the use of adjuster rods.
46. The Task Force recommends that the Canadian Nuclear Safety Commission purchase and install backup generation equipment.

The final task force blackout report can be found at:

<http://www.nerc.com/~filez/blackout.html>

The report must be downloaded by chapters as it is a very large report.

Blackout Investigation

After the government task force issued its final report, NERC continued to support the electric system working group with technical analysis. NERC also began to develop its own technical report and a set of recommendations to address issues identified during the investigation.

NERC reviewed all of the significant system events and blackouts that have occurred since 1965. One theme was clear. Most of the investigations into those blackouts resulted in recommendations involving the so-called “three Ts”: tools, trees, and training. The August 14 blackout illustrated the old adage “Those who do not learn from history are doomed to repeat it.” It became clear when reviewing previous blackouts and system events that the industry had not fully implemented all of the recommendations from previous investigations or had since forgotten them.

The electric utility industry is continually changing and companies must continually adapt to the changing environment in which they operate. This includes changes to system configuration, regulation, ownership, operating centers, organizational structures, and regional markets structures. Some of these changes have resulted in a loss of focus and responsibility for reliability among industry participants. Some argue that these changes in and of themselves are detrimental to reliability, while others argue that reliability will improve as a result of these changes.

It is NERC’s position that, regardless of the industry or corporate structure that is in place today or will exist tomorrow, reliability can be maintained if the reliability rules are followed by all market participants. This blackout, which resulted from a failure to follow existing reliability standards, has resulted in renewed focus on reliability and related standards. It is expected that if the industry fully implements the recommendations resulting from this investigation, reliability will be improved and the probability of major system disturbances will be greatly lessened. As a result of industry, public and government attention resulting from the August 14 blackout and its subsequent investigation, the implementation of the blackout recommendations will help to ensure that the industry does not repeat this mistake again.

All of the public reports related to the August 14, 2003 blackout can be found at:
<http://www.nerc.com/~filez/blackout.html>

These reports include reports on system operations, vegetation management, and reports detailing the progress on completion of recommendations.

NERC Blackout Recommendations

In February 2004, the NERC Steering Group directing the technical investigation presented 14 recommendations to the NERC Board of Trustees. The recommendations fell into three categories: correcting the direct causes of the blackout, strategic initiative to strengthen compliance with existing standards and track recommendations, and technical initiatives to prevent or mitigate the impacts of future outages.

Actions to Remedy Specific Deficiencies were directed at First Energy (FE), the Midwest Independent System Operator (MISO), and the PJM Interconnection, LLC (PJM), to correct the deficiencies that led to the blackout.

1. Correct the Direct Causes of the August 14, 2003 Blackout.

Strategic Initiatives by NERC and the regional reliability councils to strengthen compliance with existing standards and to formally track completion of recommended actions from August 14, and other significant power system events.

2. Strengthen the NERC Compliance Enforcement Program.
3. Initiate Control Area and Reliability Coordinator Reliability Readiness Audits.
4. Evaluate Vegetation Management Procedures and Results.
5. Establish a Program to Track Implementation of Recommendations.

Technical Initiatives to prevent or mitigate the impacts of future cascading blackouts.

6. Improve Operator and Reliability Coordinator Training
7. Evaluate Reactive Power and Voltage Control Practices.
8. Improve System Protection to Slow or Limit the Spread of Future Cascading Outages.
9. Clarify Reliability Coordinator and Control Area Functions, Responsibilities, Capabilities and Authorities.
10. Establish Guidelines for Real-Time Operating Tools.
11. Evaluate Lessons Learned During System Restoration.
12. Install Additional Time-Synchronized Recording Devices as Needed.
13. Reevaluate System Design, Planning and Operating Criteria.
14. Improve System Modeling Data and Data Exchange Practices.

NERC approved these recommendations in its *Actions to Prevent and Mitigate the Impacts of Future Cascading Blackouts* on February 10, 2004, <http://www.nerc.com/~filez/blackout.html>. In June, NERC approved four additional recommendations as a result of its investigation:

1. Develop a standard on vegetation clearances.
2. Develop a standing capability for NERC to investigate future blackouts and disturbances.
3. Accelerate the standards transition.
4. Evaluate NERC actions in the areas of cyber and physical security.

Actions to Improve Reliability

The August 14 blackout galvanized the industry along with regulators and governments in the United States and Canada to take steps to ensure that everything that can be done will be done to prevent such a blackout in the future. As the following section demonstrates, much has been done since the blackout to improve reliability in North America.

Near-Term Actions Letter

On October 15, 2003, NERC requested every control area and reliability coordinator in North America review six “Near-Term Actions to Assure Reliable Operations” and provide a response indicating that such a review had been completed and the status of any necessary corrective actions by December 15, 2003. These actions were based on what was known about the blackout at that time and included the following key areas:

1. Voltage and Reactive Management
2. Reliability Communications
3. Failures of System Monitoring and Control Functions
4. Emergency Action Plans
5. Training for Emergencies
6. Vegetation Management

This provided an opportunity for all control areas and reliability coordinators to perform a self assessment of their reliability practices to ensure their organizations are within NERC and regional reliability council standards and established good utility practices. These operational entities took this effort very seriously given the heightened awareness from the blackout. Most operating entities have not only reviewed the six near term actions and assured they were prepared for reliable operations, but sought ways to improve their preparedness.

Implementing the Blackout Recommendations

In February 2004, NERC approved 14 recommendations designed to prevent and mitigate the impacts of future cascading blackouts. The first of these recommendations addressed specific actions necessary to correct the direct causes of the blackout and were directed to those entities where certain deficiencies had been identified that led to the events of August 14. The actions to correct the direct causes were to be completed by June 30, 2004, in preparation for summer operations. All of the entities involved worked to meet these requirements and certified to NERC on June 30, 2004, that the remedial actions had been accomplished. There were limited exceptions noted where system conditions would not allow an entity to perform the necessary testing or equipment vendors could not meet the schedule for software updates.

The next group of strategic initiatives were designed ensure that these direct causes were not likely to occur again in the affected systems or elsewhere. The first initiative both strengthened the NERC Compliance Enforcement Program and provided for public disclosure of all violations of NERC standards. To accomplish this, NERC strengthened measures used to measure compliance and strengthened and clarified certain standards. NERC adopted these strengthened standards and measures in April 2004 and applied them to operating entities throughout North America. Improvements will be necessary at most reliability coordination centers to fully meet the standard.

NERC has historically relied on peer pressure to obtain compliance but has not disclosed specific standards violations (NERC presently has no authority to levy fines and penalties for non-compliance with its standards). NERC adopted Disclosure Guidelines in June 2004 that ensure all violations of NERC reliability rules are made public following a due process investigation. All confirmed violations of NERC and regional standards are publicly released and NERC can be found at: <http://www.nerc.com/~comply/quarterly.html>.

The Compliance Enforcement Program historically measured how each entity met the requirements of the NERC standards during a year. A key strategic initiative was the establishment of a program to perform “readiness audits” of all control areas and reliability coordinators in North America on a three-year cycle. Reliability coordinators and control areas must perform well, particularly under emergency conditions, and at all times strive for excellence in their assigned reliability functions and responsibilities. The purpose of the Readiness Audit Program is to evaluate the control area’s or reliability coordinator’s preparedness and readiness to perform their assigned reliability functions and responsibilities on a forward looking basis as opposed to monitoring historical compliance with a standard.

The Readiness Audit Program is the single most significant and important initiative NERC has implemented. These readiness audits provide an independent review of control area and reliability coordinator operations and identify areas where the operating entity can improve their overall operation. Further, the readiness audits are intended to provide a means to identify and share best reliability practices among companies. The readiness audits are designed to be constructive and

help control areas and reliability coordinators achieve excellence in meeting their assigned reliability functions and responsibilities.

Readiness audits began in February of 2004 and by the end of 2006, all entities with primary reliability responsibilities to the bulk power system will have been audited.. The readiness audit reports are published at <http://www.nerc.com/~rap/audits.html>.

The audits have provided a great deal of insight into areas where the industry is performing well and, in some cases, identified best practice approaches. The audits have also revealed some areas where additional attention is needed. In some cases, what is identified as a best reliability practice by one entity may require considerable attention by another. Identifying these allows the industry participants to learn from each other regarding reliability practices and provides the ability to advance the industry through implementation of such best practices.

The third strategic initiative addresses vegetation management. Those operating transmission lines over 200 kV have been directed to make their vegetation management plans and documentation of work available for inspection by NERC and the regions, and to report all vegetation-related outages. Following the 1996 outage in the Western United States, the WECC region began a program of collecting and publicizing vegetation related outages. This resulted in a reduction in outages due to tree contact. NERC recognized the need for attention to vegetation management and saw the WECC program as a good starting point. NERC has since developed a compliance template to implement this recommendation.

The Compliance Enforcement Program annually confirms that each entity operating transmission facilities above 200 kV and any facilities identified as critical below 200 kV has a documented vegetation management plan, including an annual work plan for vegetation management. NERC also confirms that each entity followed their annual work plan and collects any vegetation related outages. An annual report will be provided to NERC and posted on the NERC web site, starting in early 2005 for calendar year 2004. A new vegetation management standard was approved in February of 2006 that will make certain vegetation outages violations of the standard beginning in April of 2006.

The fourth strategic initiative recognized that because not all entities were directly affected by the blackout, they might not have the same incentives to make changes to prevent future blackouts and disturbances. After each major blackout in North America since 1965, an expert team of investigators has probed the causes of the blackout, written detailed technical reports, and issued lists of recommendations to prevent or minimize the scope of future blackouts. Yet the causes of the August 14 blackout were strikingly similar to those of the earlier blackouts. Therefore, NERC is establishing a recommendations tracking process to track and confirm the implementation of all blackout recommendations throughout the industry. Through this recommendation NERC and the U.S. - Canada Power System Outage Task Force tracked the implementation of both the recommendations of their respective investigations. At a conference hosted by the U.S. – Canada Power System Outage Task Force in June of 2006, the task force determined the recommendations had been fully implemented.

The last group of NERC recommendations are technical initiatives designed to help prevent future cascading outages; these apply to all entities. Some required further development work by the technical community before any final standard or other implementation can be established.

Of these technical initiatives, several stand out as having the most impact on the industry. First is a recommendation that requires all reliability coordinators, control areas, and transmission

operators to provide at least five days of training and drills in system emergencies per year, using realistic simulations, for each staff person with responsibility for the real-time operation or reliability monitoring of the bulk electric system. This training requirement was established in addition to any existing training requirements. Documentation of the program and training records are to be available for review by NERC and the regions.

Initially, NERC required these operating entities to provide the required training by June 30, 2004, allowing credit for training completed since July 1, 2003. This requirement is now part of a NERC reliability standard.

Recommendation 8 is designed to improve transmission system protection to slow or limit the spread of future cascading outages and may result in utilities making changes to their system protection philosophies and schemes. The system began a high-speed cascade starting with the tripping of the Sammis – Star 345 kV line in Ohio on August 14. That line tripped when the loading on the line encroached into the zone 3 relay setting. A number of other lines then tripped in rapid succession, mostly due to overreaching relay protection schemes as opposed to actual short circuits on the line.

This recommendation required that all transmission owners evaluate the zone 3 relay settings on all transmission lines operating at 230 kV and above by September 30, 2004 for the purpose of verifying that each zone 3 relay is not set to trip on load under extreme emergency conditions. In each case that a zone 3 relay is set so as to trip on load under extreme conditions, the transmission operator is reset, upgrade, replace, or otherwise mitigate the overreach of those relays as soon as possible and on a priority basis, but no later than December 31, 2005. This effort has been completed and non-conforming system protection systems modified or replaced.

System studies indicate that had minimal amounts of load been shed on August 14 in the Cleveland area, it is unlikely that the blackout would have occurred. Some load centers in North America currently apply automatic under-voltage load shedding in addition to operator initiated actions to address rapidly deteriorating system conditions. Such a system might have prevented or limited the spread of the August 14 blackout. Recognizing this potential, NERC Recommendation 8 required each regional council to complete an evaluation of the feasibility and benefits of installing under-voltage load shedding capability in load centers within the region that could become unstable as a result of being deficient in reactive power following credible multiple-contingency events. The studies and reports have been completed and some undervoltage load shedding schemes installed.

Last but certainly not least, as a result of the blackout investigation NERC accelerated the development of new reliability standards translating the existing NERC operating policies and planning standards, along with the new compliance templates and several new standards, into an integrated and comprehensive set of measurable reliability standards.

Energy Policy Act of 2005

The Energy Policy Act of 2005 authorized the creation of a self-regulatory electric reliability organization (ERO) that spans North America, with Federal Energy Regulatory Commission (FERC) oversight in the United States. The [legislation](#) makes compliance with reliability standards approved by the FERC mandatory and enforceable. The North American Electric Reliability Council (NERC) has applied to FERC, and government authorities in Canada to become the ERO in North America and is the only applicant to file with the FERC. The legislation respects the international character of the bulk electric system by ensuring that the

ERO applies for and receives comparable recognition and approvals from government authorities in Canada.

NERC is building on work already completed, and will take the necessary actions to achieve certification as the ERO in the United States and Canada in accordance with all legislative and regulatory requirements. NERC's goal is to become certified and begin operating as the ERO by January 1, 2007.

FERC issued [*Final Rules Concerning Certification of the Electric Reliability Organization and Procedures for the Establishment, Approval, and Enforcement of Reliability Standards*](#) on February 3, 2006. In accordance with the FERC rule, NERC submitted its application to FERC on April 4, 2006. At the same time, NERC submitted applications with the National Energy Board and the provinces of Alberta, British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, Nova Scotia, and New Brunswick to implement comparable agreements in Canada. Approval of NERC's applications will result in the formation of an independent, international electric reliability organization with the authority to develop and enforce reliability standards for the entire North American bulk electric system.

In anticipation of becoming the ERO, NERC has already taken several steps to meet the requirements of the reliability legislation:

- NERC modified its governance to meet the independence requirements of the reliability legislation by appointing an independent Board of Trustees.
- NERC developed a funding model to ensure that adequate resources will be available to develop and implement reliability rules.
- NERC implemented an American National Standards Institute-accredited standards development process that is fair, open, balanced, and inclusive.
- NERC substantially revised and strengthened its existing reliability standards and is developing and implementing new standards.
- NERC established a program to monitor and enforce compliance with NERC and regional reliability standards, and publicly discloses violations of those standards.
- NERC reorganized and is expanding its staff to enhance its organizational effectiveness and efficiency as the ERO.

Despite these key changes, the transformation of NERC will require further effort and dedication on the part of everyone with an interest in the reliability of the North American bulk electric system.

Conclusion

When a major system disturbance or blackout occurs, most operating entities take the time to review their operations to assure themselves that such an event cannot occur on their system. Such technical investigations require months of analysis to determine the causes and identify all of the lessons to be learned from the system events. However, as the investigation found, recommendations resulting from a blackout investigation are not always implemented.

The initial impacts of the August 14 blackout have been developed based on economic impacts of not having or providing electricity. Estimates of total costs in the United States have ranged between \$4 billion and \$10 billion (U.S. dollars).¹ In Canada, gross domestic product was down 0.7% in August, there was a net loss of 18.9 million work hours, and manufacturing shipments in

Ontario were down \$2.3 billion (Canadian dollars).² Clearly, the impact of the outage was significant on both sides of the border.

Implementing the NERC and U.S.-Canada Power System Outage Task Force blackout recommendations were key to bringing about the changes necessary to reduce the likelihood of future system events. The electric industry, industry organizations, regulators, and governments worked together to implement these recommendations.

Most importantly, NERC and a broad array of industry stakeholders have supported the passage of reliability legislation in the United States that would make NERC reliability standards mandatory and enforceable, and would establish penalties for non-compliance. The U.S.-Canada Power System Outage Task Force concluded that making NERC reliability standards mandatory and enforceable is the single most important thing that can be done to improve the reliability of the North American electric system. Congress passed the *Energy Policy Act of 2005* which contained the provisions necessary to make reliability standards mandatory and enforceable in the U.S.

The implementation of mandatory standards is expected to be fully implemented sometime in 2007.

¹ “The Economic Impacts of the August 2003 Blackout,” Electric Consumer Research Council (ELCON), February 2, 2004.

² Statistics Canada, Gross Domestic Product by Industry, August 2003, Catalogue No. 15-001; September 2003 Labour Force Survey; Monthly Survey of Manufacturing, August 2003, Catalogue No. 31-001.