National Energy Board

Office national de l'énergie

# Reporting of Electric Reliability Information by Canadian Entities

## Re: Recommendation 10 of the U.S. – Canada Power System Outage Task Force Report

**August 2007**

Canada

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## Acronyms and Abbreviations

| | |
|---|---|
| AB | Alberta |
| AESO | Alberta Electric System Operator |
| ANSI | American National Standards Institute |
| BC | British Columbia |
| BCTC | British Columbia Transmission Corporation |
| CAIDI | Customer Average Interruption Duration Index |
| CEA | Canadian Electricity Association |
| DC | Direct Current |
| EIA | Energy Information Administration |
| ERO | Electric Reliability Organization |
| FERC | Federal Energy Regulatory Commission |
| HVDC | High Voltage Direct Current |
| ISO | Independent System Operator |
| IESO | Independent Electricity System Operator (Ontario) |
| kV | Kilovolt |
| MB | Manitoba |
| MRO | Midwest Reliability Organization |
| MW | Megawatt |
| NEB | National Energy Board |
| NBSO | New Brunswick System Operator |
| NERC | North American Electric Reliability Corporation |
| NPCC | Northeast Power Coordinating Council |
| NRCan | Natural Resources Canada |
| ON | Ontario |
| QC | Québec |
| RRO | Regional Reliability Organization |
| RTO | Regional Transmission Organization |
| SAIDI | System Average Interruption Duration Index |
| SAIFI | System Average Interruption Frequency Index |
| SK | Saskatchewan |
| TADS | Transmission Availability Data System |
| U.S. DOE | U.S. Department of Energy |
| WECC | Western Electricity Coordinating Council |

# Foreword

This report is undertaken pursuant to the U.S.-Canada Power System Outage Task Force recommendations, specifically Recommendation 10. In the *Final Report on Implementation of the Task Force Recommendations,* September 2006 (Final Report), it was indicated that "in Canada, the NEB has agreed to prepare a report documenting the reliability information now being collected, the methodologies used, and any gaps or difficulties in the collection of information." This report fulfils the National Energy Board's (NEB's) undertaking in the Final Report.

We wish to acknowledge the cooperation from those entities and individuals supplying information for this report, particularly NERC, NERC's regional reliability organizations and their respective staff members.

# Executive Summary

On 14 August 2003, Ontario and parts of the U.S. Northeast and Midwest experienced an electric power blackout that affected about 50 million people. In its April 2004 report on the causes of this event, the U.S.-Canada Power System Outage Task Force made 46 recommendations toward ensuring the reliability of the North American bulk power system in the years to come. Recommendation 10 identified the need to compile information that would enable the monitoring of reliability performance. In the *Final Report on the Implementation of the Task Force Report Recommendations, September 2006*, (Final Report) it was stated in regard to Recommendation 10 that, in Canada, the NEB would prepare a report documenting the reliability information being collected, the methodologies being used, and the gaps or difficulties in the collection of information. The Final Report indicated that full implementation of Recommendation 10 would require sustained attention from government agencies for several years.[1]

This report fulfils the NEB's undertaking in the Final Report with respect to Recommendation 10. It indicates there is substantial reliability information currently being reported by Canadian entities (e.g., integrated electric utilities, independent transmission and generation companies and system operators) to the provinces, the Canadian Electricity Association and the North American Electric Reliability Corporation (NERC). Reporting to NERC, consistent with NERC's mandate to implement mandatory reliability standards and monitor compliance, has the advantage of comprehensive and standardized reporting for Canadian and U.S. entities, which together influence the reliability of the interconnected Canadian and U.S. bulk power systems.

Perhaps the biggest gap is that currently there is little readily available information that tracks trends in bulk power system reliability performance in Canada or, for that matter, in the U.S. This is not because the information, or data, is not reported, but because it is not readily displayed for public use. Compiling reliability performance information to enable an assessment of reliability trends would be useful to industry, regulators, policy makers and the public.

So far, reliability information compiled by NERC has mainly focused on compliance with reliability standards; however, this is not necessarily the same as indicating trends in reliability performance. Monitoring reliability performance directly -- by the systematic development of standard indicators such as the frequency and duration of transmission system interruptions, trends in reserve margins and incidences of compliance violations -- may provide indications about the effectiveness of NERC and the power industry in improving reliability and the effects of actions taken when problems are identified. Recent initiatives by NERC, including the development of its Information Reliability Dashboard and Transmission Availability Data System would appear to take significant steps in that direction.

This report concludes that since the report on the causes of the August 2003 blackout was issued, substantial steps have been taken to improve the reliability of the North American

1 *U.S.-Canada Power System Outage Task Force, Final Report on the Implementation of the Task Force Report Recommendations, September 2006*, P. 15.

bulk power system, the major initiative being the implementation of mandatory electric reliability standards. Establishing an independent source of reliability performance information has not advanced as quickly. However, efforts undertaken to date by NERC, which is recognized in the U.S. and Canadian jurisdictions as the Electric Reliability Organization, seem directed toward meeting this need. Therefore, from the NEB's perspective, the need for another entity to provide an independent source of reliability information in Canada is not justified at this time.

# 1. Introduction

On 14 August 2003, Ontario and parts of the U.S. Northeast and Midwest experienced an electric power blackout that affected an area that services about 50 million people. Some areas were without power or experienced rotating blackouts for up to a week or so after the initial failure. In April 2004 report on this event, the U.S.-Canada Power System Outage Task Force (Task Force) made 46 recommendations toward ensuring the reliability of the North American bulk power system in the years to come. Among the recommendations pertaining to institutional matters, the Task Force identified the need to compile information that would enable the monitoring of reliability performance. Recommendation 10 states:

> **"10. Establish an independent source of reliability performance information."**
>
> "The U.S. Department of Energy's Energy Information Administration (EIA), in coordination with other interested agencies and data sources (FERC, appropriate Canadian government agencies, NERC, RTOs, ISOs, the regional councils, transmission operators and generators) should establish common definitions and information collection standards. If the necessary resources can be identified, EIA should expand its current activities to include information on reliability performance."[2]

Recommendation 10 refers to reliability information for the bulk power system, the network of generating stations and transmission systems that compose the interconnected grid. Thus, it does not address information pertaining to local distribution systems, which is where the impact of service interruptions is experienced by most consumers. Nevertheless, performance of the bulk power system is an obvious precursor in determining the final reliability outcome, particularly in preventing cascading power outages, as occurred in August 2003.

In the September 2006 Final Report it was stated in regard to Recommendation 10 that:

> "In the United States, two recent government-sponsored reports have stressed the need for a more systematic collection, analysis and publication of reliability data and information. FERC, DOE, the Energy Information Administration (EIA), and NERC need to agree on what data should be collected by whom, and what analyses of reliability data should be published routinely and by which organization."

2 *U.S.-Canada Power System Outage Task Force, August 14th Blackout: Causes and Recommendations*, April 2004, PP. 1, 141, 147. The Task Force made recommendations in three areas: Group I. Institutional Issues Related to Reliability; Group II. Support and Strengthen NERC's Actions of February 10, 2004; and Group III. Physical and Cyber Security of North American Bulk Power Systems.

> "In Canada, the NEB has agreed to prepare a report documenting the reliability information now being collected, the methodologies being used, and the gaps or difficulties in the collection of information."

The Final Report also indicated that full implementation of Recommendation 10 will require sustained attention from government agencies for several years.[3]

This report fulfils the NEB's undertaking in the Final Report in respect to Recommendation 10. A main objective is to describe the type of reliability information that is currently being reported by Canadian entities (e.g., integrated electric utilities, independent transmission and generation companies and system operators); this perspective is provided in section 2. Section 3 provides an assessment of the information and gaps in the context of Recommendation 10. Section 4 presents conclusions.

This report is not intended to assess current or recent trends in electric reliability. However, the information referred to here, either in its current form or some variation, may eventually be used for that purpose.

# 2. Current Status of Reporting by Canadian Entities on Electric Reliability

This section focuses on the reporting of reliability information by Canadian entities to the federal and provincial governments, the CEA and NERC.

## 2.1 Federal Government

There is no ongoing requirement to report information on electric reliability to the federal government. Electric utilities do report on some of the operational and financial aspects of the electric power industry to Statistics Canada. Statistics Canada could possibly expand its current surveys, or develop a new one, to collect information on reliability.

In order to design a new survey, relevant stakeholders including industry, regulators and policy makers would need to be consulted to decide on such matters as the specific information to be collected, the amount of regional detail and the frequency of reporting and publication. There could also be an issue associated with the need and relevance of national reporting, given that the power systems in Canada are largely under provincial jurisdiction. Assuming the reporting requirements can be identified and standardized across provinces, it could take several years to implement a new survey.[4]

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3 *U.S.-Canada Power System Outage Task Force, Final Report on the Implementation of the Task Force Recommendations, September 2006,* P. 15. The two reports in the U.S. are *Electricity Transmission in a Restructured Industry: Data Needs for Public Policy Analysis,* U.S. DOE, December 2004, and a report on reliability metrics being used by a sample of U.S. transmission companies (by the Lawrence B. Berkeley Laboratory, forthcoming as of June 2007).

4 This follows from communications with Statistics Canada staff.

## 2.2 Provincial Governments

There are some requirements for entities with generation and transmission operations to report reliability information to provincial governments and more directly to the provincial regulators. However, there is little consistency among the provinces on how information is reported, and the amount that is easily accessible to the public also varies.[5] Several integrated utilities report bottom-line indexes of reliability at the consumer level (e.g., in their annual reports), but little information on the performance of the bulk system. In Ontario, where transmission, generation and distribution have been unbundled, the IESO market rules and transmission code require that Hydro One, the main transmission company in that province, report reliability information on a regular basis. This includes such information as voltage variations, flicker (power quality), power outage notification, emergency events and system performance at customer delivery points. BCTC, the main transmission company in British Columbia, reports such information as reserve management, voltage control, outage management (planned and unplanned) and data on power flows.

## 2.3 Canadian Electricity Association (CEA)

CEA members report reliability information that is compiled and released by the CEA in three annual publications.

A report on forced outages for transmission equipment includes information on the number of outages and duration for transmission lines, transformer banks and other major transmission elements. The 2004 version of that report (published in 2006) covers the 5-year period ending 2004.[6] Data are displayed at the national level for CEA member utilities based on the CEA's Equipment Reliability Information System. Utilities providing information receive the detail for each submitter in addition to the national data.

A report on the status of generation equipment contains data on over 850 generating units in Canada, including: the distributions of the generating units by age and maximum continuous rating; a summary of the unit types and operating experience; the top five causes of outages; and the top ten generating unit performers for the year. Detail is provided on operating factors by unit and fuel types, along with outage and cause statistics.[7]

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5 This section is based mainly on a survey of web sites of the provincial regulators, and also draws on observations made in the NEB's *Compendium of Electric Reliability Frameworks in Canada,* June 2004 (e.g., see PP. 4, 48).

6 *2004 Forced Outage Performance of Transmission Equipment, For the Period January 1, 2000 to December 31, 2004,* CEA, 2006

7 *2005 Generation Equipment Status Annual Report,* CEA, July 2007

A report on the performance of distribution systems provides historical data, for the most recent 5-6 years, including the relatively well known SAIDI, SAIFI and CAIDI indexes; these measure the duration and frequency of system and customer outages.[8] The report also produces the annual Index of Reliability, which indicates the overall availability of the distribution system on an annual basis. The data are based on CEA member utilities, which account for almost all power distribution in Canada. Data are available to the public on a national basis. Details of submitters are made available to submitting utilities. Some international comparisons are included.[9]

## 2.4 NERC Reporting Requirements

### *Background*

NERC is currently composed of eight regional reliability organizations (RROs) in Canada, the U.S. and Baja California Norte, Mexico (Appendix 1).

Effective 1 January 2007, NERC commenced operations as the Electric Reliability Organization (ERO) and assumed the responsibilities for electric reliability from its predecessor, the North American Electric Reliability Council.[10] NERC is responsible for implementing mandatory reliability standards. It is subject to regulatory oversight by the FERC in the U.S. and is recognized by the NEB and provincial authorities in Canada. The key difference between NERC today and the previous organization is that compliance with reliability standards was largely voluntary, although subject to "peer pressure."

"NERC's mission is to improve the reliability and security of the bulk power system in North America. To achieve that, NERC develops and enforces reliability standards; monitors the bulk power system; assesses future adequacy; audits owners, operators, and users for preparedness; and educates and trains industry personnel. NERC is a self-regulatory organization that relies on the diverse and collective expertise of industry participants."[11]

Consistent with NERC's mission, Canadian entities, along with their U.S. and Mexican counterparts, have for many years reported reliability information to NERC. In essence, reporting entities provide information to their respective RROs which then report to NERC's headquarters in Princeton, New Jersey. To provide some perspective on the extent and significance of that reporting, a brief overview of NERC's activities in developing reliability standards and monitoring compliance follows.

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8 SAIDI refers to the system average interruption duration index (the number of hours of service interruptions per customer in a given year). SAIFI refers to the system average interruption frequency index (the number of service interruptions per customer in a given year). CAIDI refers to the customer average interruption duration index (hours per service interruption in a given year).

9 *2005 Annual Service Continuity Report on Distribution System Performance in Electrical Utilities, Composite Version*, September 2006, CEA

10 "NERC" refers to both the North American Electric Reliability Corporation (effective 1 January 2007) and its predecessor, the North American Electric Reliability Council.

11 www.NERC.com.

***Reliability Standards***

NERC currently has 12 categories of reliability standards. Generally speaking, the standards measure the real time operation of the grid, "operating reliability," and assess longer-term anticipated growth in electric generation and transmission relative to anticipated load (demand) growth, or "resource adequacy." [12]

The 12 categories of standards are:

- Resource and Demand Balancing (BAL)
- Critical Infrastructure Protection (CIP)
- Communications (COM)
- Emergency Preparedness and Operations (EOP)
- Facilities Design, Connections and Maintenance (FAC)
- Interchange, Scheduling and Coordination (INT)
- Interconnection Reliability Operations and Coordination (IRO)
- Modeling, Data and Analysis (MOD)
- Organization Certification (ORG)
- Personal Performance, Training and Qualifications (PER)
- Protection and Control (PRC)
- Transmission Operations (TOP)
- Transmission Planning (TPL)
- Voltage and Reactive (VAR)

As of mid-2006, NERC had 107 standards in these categories.

An integral part of implementing standards is monitoring to gauge compliance; thus, regular reporting by participants in Canada and the U.S. is required. The main tools that NERC has to monitor reliability are:

- Quarterly and Annual compliance reports
- Summer/Winter Reliability Assessments and Long-term Assessments (10 years)
- System Disturbance Reports
- Reliability audits (including readiness audits).

<u>Quarterly and Annual Compliance Reports</u>

These reports are comprised of data and other information initially compiled at the regional level by the RROs, and then assembled for quarterly and annual publication at the NERC web site. Highlights have also been discussed at Stakeholder Meetings (now

12 In developing its standards NERC has adopted and follows the American National Standards Institute (ANSI) process. Two essential criteria for mandatory reliability standards, which will be subject to financial penalties, are that they be clear and measurable.

the Members Representatives Committee) and the public meetings of the Board of Trustees.

Examples of data portrayed in the 2005 annual report include:

- compliance with reliability standards, by region (96 percent compliant in 2005)
- confirmed violations and severity of violations (on a scale of 1 through 4, with 4 being most severe)
- report on specific aspects of reliability standards; in the 2005 report, special attention was given to vegetation-related transmission outages
- other information included developments with respect to cyber security and audits of regional compliance programs
- progress on recommendations from the previous year's report.

NERC reported on the extent of compliance with 40 standards in 2004 and 44 standards in 2005.[13]

The regional compliance results are audited by NERC staff through periodic audits of the processes used by the RROs, which in turn audit the reporting entities in their respective areas.[14] Ultimately, the goal of the compliance program is to improve reliability through monitoring compliance, and identifying areas for improvement with follow-up actions.

Reliability Assessment Reports

Each year, NERC publishes a summer outlook and winter outlook reporting on the adequacy of generation and transmission, by region. It also publishes a long-term outlook for the next 10 years. The reports are prepared by the RROs and then rolled up by NERC to provide a North American overview. A main purpose is to identify areas where new transmission and generation may be required in order to prevent reserve margins from falling below the levels required to maintain reliability.

Data required for these reports include:

- forecasted peak demands
- forecasted capacity resources
- generating facility additions, retirements and re-ratings
- transmission facility additions, retirements, and re-ratings
- fuel requirements
- write-ups addressing specific issues.

Additional detail is provided in **Appendix 2** of this report.

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13 *NERC Compliance Enforcement Program 2005 Summary Report, July 31, 2006*. These standards are monitored directly by NERC; the RROs report to NERC on these and monitor other standards as well.

14 For example, refer to the WECC *Compliance Enforcement Program Audit,* November 30, 2006.

Disturbance Reporting[15]

Reporting on system disturbances is contained in a data base maintained by NERC's Disturbance Analysis Working Group. The database records major electric utility system disturbances reported to the U.S. Department of Energy (U.S. DOE) and NERC. The U.S. DOE requires electric utilities to report system emergencies that include electric service interruptions, voltage reductions, acts of sabotage, unusual occurrences that can affect the reliability of the bulk electric systems, and fuel problems. When a utility experiences an electric system emergency, the utility sends a copy of the report to its RRO, which then sends a copy to NERC. Canadian utilities have often voluntarily filed emergency reports with the U.S. DOE and the RROs.

NERC has published its findings on bulk electric system disturbances, demand reductions, and unusual occurrences since 1979 in reports entitled *System Disturbances*. The objectives of these reports include sharing the experiences and lessons of North American utilities and determining whether the reliability standards adequately address the normal and emergency conditions that can occur on the bulk electric systems.[16]

Readiness Audits

The readiness audits are separate from NERC compliance audits, which measure compliance with NERC reliability standards. The intent of the readiness audits is to ensure that operators of the bulk electric system have the tools, processes, and procedures in place to operate reliably. The audits help balancing authorities, transmission operators, and reliability coordinators recognize and assess their reliability responsibilities and evaluate how their operations support those responsibilities. NERC uses the results of these audits to identify best practices and to promote changes required to improve reliability performance.

***Recent NERC Initiatives***

As part of compliance reporting, NERC collects substantial information on grid operations, including real time data on power flows, power system voltages and frequencies, and the ability of systems at any point in time to handle contingencies based on the availability of generation reserves and transmission capacity. This information is being used in developing NERC's Reliability Metrics and Benchmarking program and developing indicators for display on its Reliability Information Dashboard (Appendix 3).[17]

Related to performance metrics, NERC has recently developed the Transmission Availability Data System (TADS), which will collect such data as outage frequency and

15 This section is summarized from the description of disturbance reporting at the NERC web site http://www.nerc.com/~dawg/

16 Events are reported as they occur, and are compiled in annual reports at the NERC web site: ftp://www.nerc.com/pub/sys/all_updl/oc/dawg/disturb06.pdf

17 www.nerc.com. Go to site map/NERC Fast Links/ Reliability Information Dashboard.

duration, mean time between failures and percent availability.[18] Subject to approval by the NERC Board of Trustees, the system is planned to be implemented in 2008. NERC will publish a public annual report that will show the results for each RRO and a confidential report will be produced for each transmission owner.

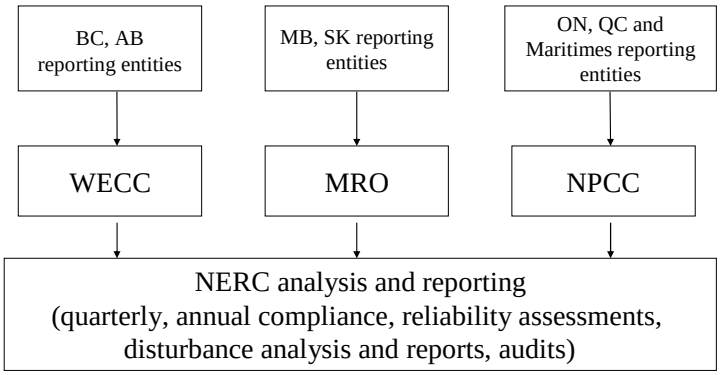
To some extent, these initiatives toward developing performance metrics are motivated by FERC's final rule on the ERO, which includes a requirement for NERC to periodically provide the Commission with reports on the "Reliable Operation of the Bulk-Power System" and "assessments of the adequacy of the Bulk-Power System."[19] Along with its reliability assessment reports, NERC is undertaking to meet these requirements.

***Reporting by Canadian Entities to the RROs***

Reporting by Canadian entities occurs on a regional basis to three NERC regional organizations: the NPCC for the Maritimes, Québec and Ontario; the MRO for Manitoba and Saskatchewan; and the WECC for Alberta and British Columbia. Depending on the province, the reporting entities may be transmission companies, integrated utilities or system operators. The reporting requirements for the Canadian and U.S. entities to a given RRO are the same.

Entities reporting to NPCC account for about 70 percent of the Canadian net energy for load, compared with 22 percent for WECC and 8 percent for the MRO.[20] The reporting relationships are indicated in the following schematic.

Reporting by Canadian Entities to
Regional Reliability Organizations and NERC




18 *Transmission Availability Data System Final Report*, by the Transmission Availability System Task Force, June 2007. The 13-member Task Force was chaired by Hydro-Québec TransÉnergie and had representation from the Canadian Electricity Association.

19 FERC Order 672, February 3, 2006, P. 307.

20 On a regional basis, net energy for load (NEL) = (regional generation) - (electricity transfers from the region) + (electricity transfers into the region). NEL includes power losses.

To more clearly understand the type of data that NERC and RROs gather from industry, informal requests were sent from NEB staff to the three regional organizations pertaining to:

- the name of the Canadian entities supplying the information
- the data/information required
- the frequency (e.g., real time, monthly, quarterly, annual, etc.).

Because the data are mainly collected in compliance with the reliability standards, they are reported by standard (Appendix 4). The data and other information are then compiled and analyzed to produce the compliance and other reports referred to earlier. Differences in reporting between the regions arise from additional requirements in the regions (e.g., special studies) or differences in the regional compliance programs. The reporting Canadian entities for each NERC region are:

- **NPCC** - NBSO, Hydro-Québec TransÉnergie, IESO
- **MRO** - Manitoba Hydro, SaskPower
- **WECC** - AESO, BCTC.

In summary, the requirement of entities in Canada to report reliability information to NERC constitutes comprehensive and consistent reporting across Canada.

## 3. Assessment of Current Reporting and Gaps in the Provision of Reliability Performance Information

The main purpose of Recommendation 10 is to establish an independent source of reliability performance information and, accordingly, common definitions and information collection standards should be established. Apart from that, Recommendation 10 does not provide specific direction on the performance information to be monitored, such as specific measures or performance indicators, or what the criteria to establish them should be. Based on the information reported by Canadian entities, a number of considerations or questions arise that may help to assess these matters from the Canadian standpoint.

***How might this information be used? Why is it important?***

There are a number of uses for compiling reliability performance information including the fundamental monitoring of trends, which may point to the effectiveness of reliability standards or the industry's and NERC's implementation of standards. This information is also likely to be useful to regulators and policy makers.

***What are the criteria for selecting reliability information?***

It is necessary that data and other information be accessible, transparent, verifiable and consistent over time, enabling analysis of trends and possibly inter-regional comparisons.

Consistency requires that data be reported on a regular basis and that reporting be mandatory, or at least that the data will be made available with a high degree of assurance. It goes without saying that the data would need to be comprehensive in the sense of being complete and representative of industry (reliability) trends.

***What information is currently being reported?***

As indicated in section 2, there is currently substantial information being reported by Canadian entities to the CEA, the provinces and NERC with respect to the reliability of bulk power systems. Reporting by entities to NERC largely meets the above criteria and has the advantage of comprehensive and standardized reporting for Canadian and U.S. entities, which together influence the reliability of the interconnected Canadian and U.S. bulk power systems.

Currently, reporting on reliability standards and related reliability compliance information is not mandatory for all Canadian entities unless and until their respective provincial regulators adopt NERC standards. Reliability information requirements imposed by the FERC on NERC in the U.S. are also not mandatory in Canada, unless adopted by Canadian regulators. For the most part, going forward, it does not seem likely that reporting by Canadian entities would be greatly affected, i.e., whether reporting requirements are mandatory or not, given the historical cooperation under voluntary standards, and the interest in maintaining good relationships in their respective RROs with their U.S. counterparts.

***What are the gaps between what is currently reported and what is needed?***

Perhaps the biggest gap is that currently there is little readily available information that tracks trends in bulk power system reliability performance in Canada or, for that matter, in the U.S. As indicated above, this is not because the information, or data, is not reported, but because it is not readily displayed for public use.

So far, reliability information compiled by NERC has mainly focused on compliance with reliability standards; however, this is not necessarily the same as indicating trends in reliability performance. Monitoring reliability performance directly -- by the systematic development of standard indicators such as the frequency and duration of transmission system interruptions, trends in reserve margins and incidences of compliance violations, etc. -- may provide indications about the effectiveness of NERC and the power industry in improving reliability and the effects of actions taken when problems are identified. NERC's Information Reliability Dashboard and TADS initiatives would appear to take significant steps in that direction. In this context, monitoring compliance with reliability standards could well be a leading indicator of reliability in that current failures to comply may lead to future reliability issues.

***Independent Source of Reliability Information***

Recommendation 10 implies that the independent source of reliability information would be a government agency, suggesting that the EIA could possibly carry out this responsibility in the U.S. As indicated in section 2, with some investment of time and

resources, it would be possible for Statistics Canada to perform this function in Canada. However, it seems that much, if not all, of the data required for developing reliability indicators is already being reported to NERC for standards compliance and reporting. Therefore, there does not appear to be a need to establish another information source in Canada. Whether additional information would be required depends eventually on what might be regarded as appropriate performance measures.[21]

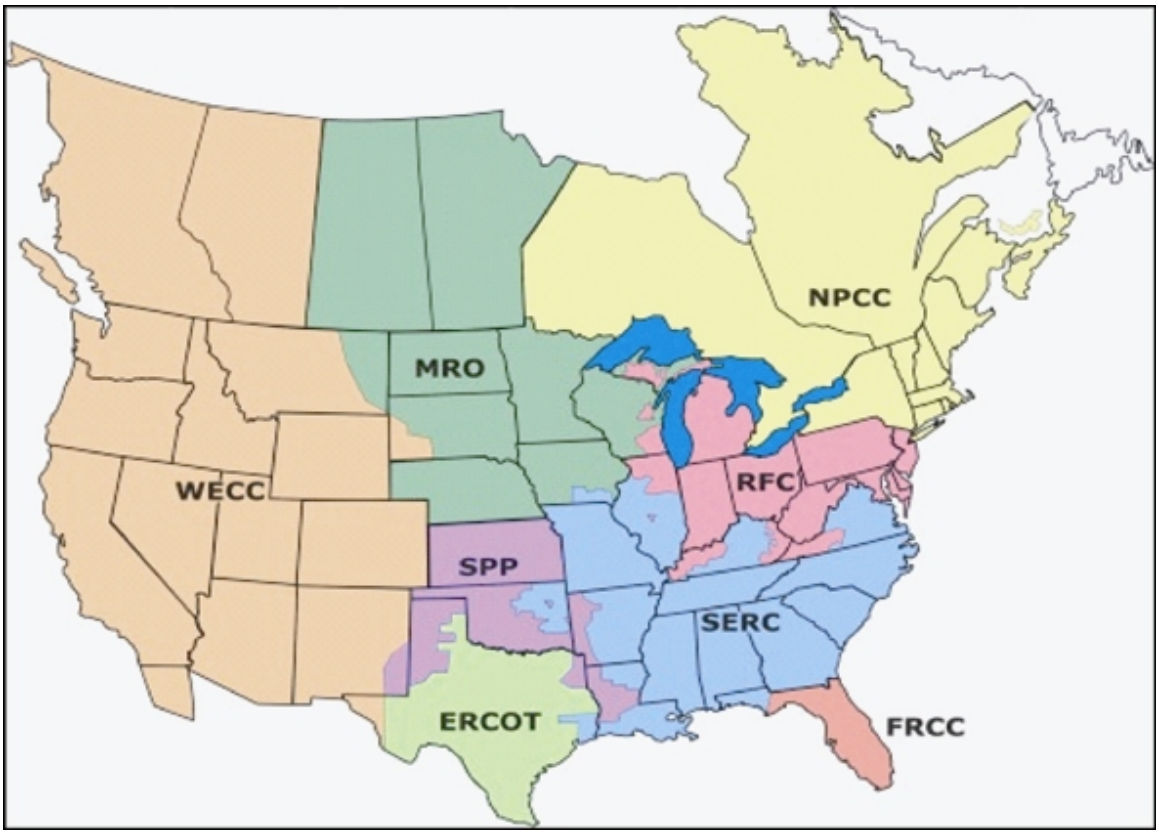
Having NERC as the source of reliability performance information also has the advantage of benefiting from broad stakeholder input including the industry, RROs, regulators, policy makers and the public. Any concern about whether NERC would be an independent source would appear to be addressed given the transparent nature in which NERC conducts its monitoring and compliance reporting. Finally, NERC has a process in place to ensure commonality in definitions and collection standards. This is an important consideration given the inter-regional (cross-border and inter-provincial) nature of electric reliability.

## 4. Conclusions

Since the report on causes of the August 2003 blackout was issued in April 2004 substantial steps have been taken to improve the reliability of the North American bulk power system, the major initiative being the formation and implementation of mandatory electric reliability standards in 2007. Establishing an independent source of reliability performance information has not advanced as quickly. However, efforts undertaken to date by NERC, which is recognized in the U.S. and Canadian jurisdictions as the ERO, seem directed toward that end. From the NEB's perspective, the need for another entity to provide an independent source of reliability information is not justified at this time.

21 A matter not addressed in this report is the relationship between grid reliability and investment. It is often indicated that trends in transmission investment in North America generally have not kept pace with the growth in electricity demand, which has led to stressing the transmission system and, in some cases, compromising electric reliability. If "investment performance" in transmission were identified as a need, it may be appropriate to approach Statistics Canada (which currently undertakes a survey of the capital expenditures of Canadian electric utilities and publishes annual data) to clarify what data are currently collected and whether any changes to its survey would be required.

## Appendix 1: NERC Regions




| | |
|---|---|
| WECC | Western Electricity Coordinating Council |
| MRO | Midwest Reliability Organization |
| NPCC | Northeast Power Coordinating Council |
| SPP | Southwest Power Pool Inc. |
| RFC | Reliability First Corporation |
| SERC | Southeastern Electric Reliability Council |
| ERCOT | Electric Reliability Council of Texas |
| FRCC | Florida Reliability Coordinating Council |

# Appendix 2: Information Requirements for NERC's Reliability Assessments

## I. Summer/Winter Assessment

Additional data may be found at: http://www.nerc.com/~filez/ras.html

### A. Required Data

- Previous year's actual data
  - Updates to previous year's generation and transmission (summer and winter)
  - Actual Peak Demands previous summer/winter
  - Actual in service capacity for previous summer/winter (by month)

- Forecasted data for upcoming summer/winter (more subcategories may be found on actual forms – main categories only included)
  - Forecasted Peak Demands
    - Internal demand
    - Standby demand
    - Load management
    - Interruptible demand
  - Forecasted Capacity Resources
    - Uncommitted capacity
    - Operable committed capacity
    - Net generation capacity
    - Total capacity purchases
    - Total capacity sales
    - Available capacity margin

- Generating Facility Additions, Retirements and Re-ratings
  - Region, sub-region
  - Unit
  - MW change
  - Unit type
  - Fuel type
  - Change to unit
  - Projected operating date

- Transmission Facility Additions, Retirements, and Re-ratings
  - Region, sub-region
  - Facility
  - Length
  - Capacity
  - Voltage
  - Type of change
  - Projected operating date

- First Contingency Incremental Transfer Capabilities (FCITCs)
  - FCITCs to and from each region and sub-region each jurisdiction is connected with
  - Base transfer values on which incremental transfer capabilities are determined
  - HVDC tie ratings

Note: FCITCs may be tied with reliability standards

**B. Written Assessment**

- Demand and Energy

  Includes: changes in peak demand and key factors, weather assumptions, firm sales, load management and interruptible demand

- Resource Assessment

  Includes: change in projected capacity/reserve margins, firm purchases/contracts, fuel supply adequacy, anticipated hydro conditions

- Transmission Assessment

  Includes: transmission constraints and changes, interregional transmission capability studies

- Operational Issues

  Includes: generating unit or transmission facility outages anticipated (outage schedule), unusual operating conditions, environmental/regulatory restrictions

- Reliance on outside assistance/external resources

  Includes: changes in reliance on external sources, analysis of availability of external sources, regional emergency actions in past year

- Potential fuel-supply interruptions

  Includes: analysis on fuel supply to be included if completed

- Process used to determine generation deliverability to load

  Includes: process done to ensure that resources are sufficient to meet load requirements and mitigating procedures

- Other region-specific issues

## II. Long-Term Reliability Assessment – 10 year

Additional data may be found at: http://www.nerc.com/~filez/ras.html

### A. Required Data

- Historical and Projected Peak Demand and Energy – Monthly, Annual
- Capacity for Existing Generators in Reporting Year
- Historical and Projected Demand and Capacity - summer and winter, with fuel-type breakdown (more subcategories may be found on actual forms – main categories only included)
  - Internal Demand
  - Standby Demand
  - Direct Control Load Management
  - Interruptible Demand
  - Net Generator Capacity
  - Distributed Generator Capacity
  - Capacity Purchases - Total
  - Capacity Sales - Total
- Historical and Projected Capacity Purchases/Incoming Transfers (Megawatts) – summer, winter
- Historical and Projected Capacity Sales/Outgoing Transfers (Megawatts) – summer, winter
- Projected Transmission Lines (230kV and above)
- NERC Fuel-Type Breakdown (capacity) summer, winter
- NERC Transmission Line Circuit Miles
  - Existing
  - Planned – first 5 years
  - Planned – second 5 years
  - Total planned

### B. Written Assessment

- Introduction and Conclusion

  Includes: summary of the region's expected performance, list of members, description of peak demand season, size of region, population served
- Demand and Energy

  Includes: changes in peak demand from previous year and key factors, weather assumptions, firm sales

- Resource Assessment

  Includes: change in projected capacity margins and comparison to requirement, discussion of regional resource adequacy assessment, dependence on outside purchases, firm purchases/contracts, use of “unspecified purchases/capacity additions” for projections, aggregate new merchant or uncommitted capacity, fuel supply adequacy and possible issues with fuel supply, changes in generation/resource planning since the August 2003 blackout

- Transmission Assessment

  Includes: transmission constraints, changes, and mitigation, new transmission facilities, interregional transmission capability studies, changes in transmission planning since the August 2003 blackout

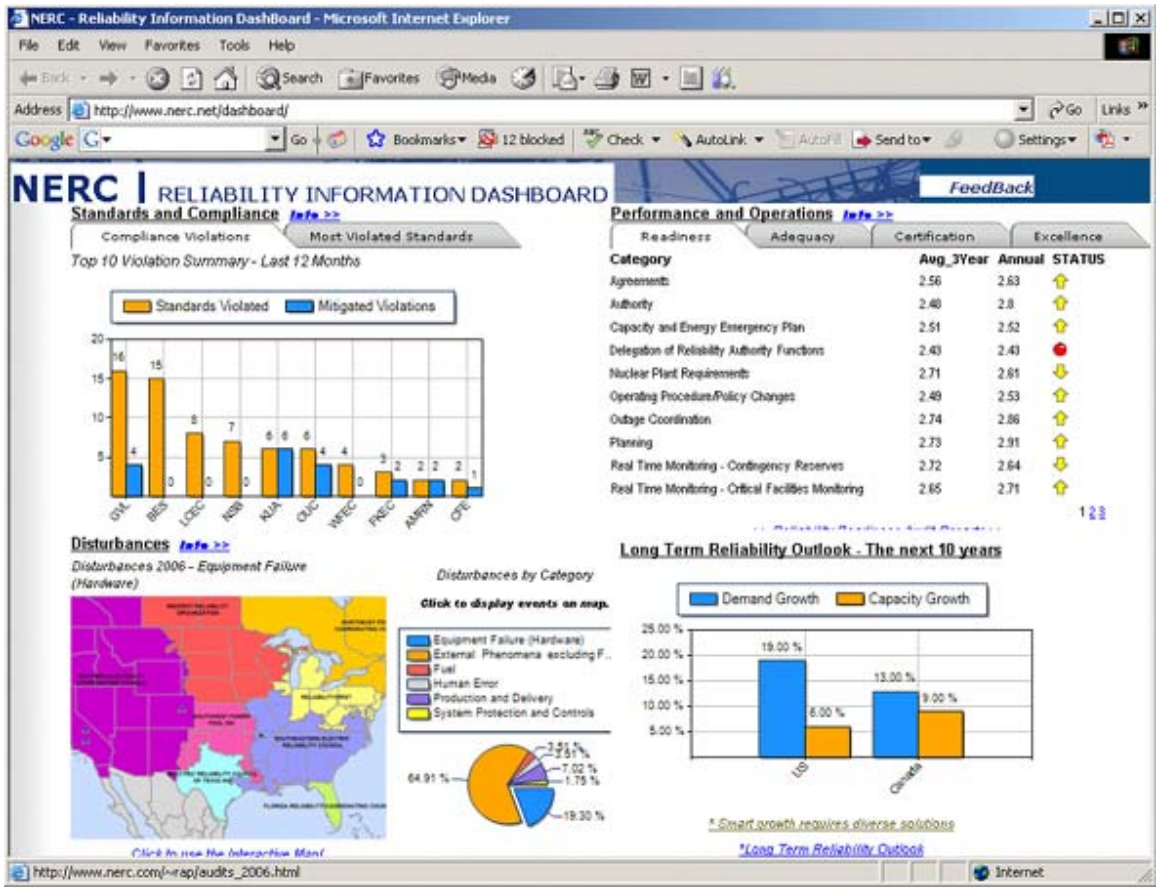
- Operational Issues

  Includes: generating unit or transmission facility outages, mitigating measures that may impact reliability, changes in transmission/generation operations since the August 2003 blackout, environmental/regulatory restrictions

- Other issues

# Appendix 3: NERC Reliability Information Dashboard

Sample page from NERC's Reliability Information Dashboard, March 2007



# Appendix 4: Regional Data Reporting by Canadian Entities for NERC Standards

| Data Reported from Canadian Regions | Related NERC Standards | Frequency of Reporting |
|---|---|---|
| Modeled equipment characteristics (generation, transmission); transformer minimum, nominal, maximum rating; bus data; reactive compensation & ratings; DC ties | MOD-010/MOD-011/FAC-005 | Annual |
| Simulation of steady state and dynamic power flow data | MOD-010/MOD-012/MOD-014/MOD-015 | Annual |
| Regional procedures and reporting of the monitoring, review, analysis and correction of all transmission protection system misoperations | PRC-003/PRC-004 | Annual |
| Transmission and generation system protection maintenance, testing program | PRC-005 | Annual |
| Underfrequency load shedding (UFLS) program requirements | PRC-007/PRC-008 | Annual |
| Underfrequency data and analysis and documentation of UFLS performance following a UF event | PRC-009 | By incident |
| Undervoltage load shedding program maintenance and testing | PRC-011 | Annual |
| Procedure review, analysis and reporting of special protection system misoperation | PRC-012/PRC-016 | Annual, actual misoperation by event |
| System performance study under n, n-1, n-2 conditions ( transmission planning ) | TPL-001/002/003/004 | Annual |
| Reliability Assessments (Adequacy and Security) for Near Term (1-5 years) and Longer term (6-10 years) planning of generation and transmission facilities | TPL-005/006 | Annual |
| Emergency preparedness & planning, blackstart capabilities of generation & transmission system restoration plans | EOP-001/002/005/008/009 | Planning data annual, event by incident |
| Vegetation Management and Facility Design Data | FAC-002/003/005 | 3-year review |
| Personal Performance & Training data | PER-001 to 004 | Annual |
| Outage Coordination, Reporting Violations | TOP-003/005/007 | Monthly to annual depending upon the standard |
| Reliability Coordination, Transmission Loading Relief data | IRO-001/004/006 | Monthly to annual depending on the standard |
| Contingency Reserve for disturbance power balance | BAL-002 | Annual |
| Interchange transaction tagging | INT-001 | Annual |
| Islanding, loss of generation, voltage excursion etc., transient disturbance | Equivalent NERC standard: EOP-004 | As events happen |

## Appendix 5: Glossary

| | |
|---|---|
| Adequacy | One of the two basic functional aspects in defining the reliability of bulk power electric systems, which is the ability to supply the aggregate electrical demand and energy requirements of customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements. The other basic aspect is operating reliability. |
| American National Standards Institute (ANSI) Process | A development process for standards, accredited by ANSI, which is based on principles of openness, balance, due process and consensus. |
| Balancing Authority | The responsible entity that integrates resource plans ahead of time, maintains load-interchange-generation balance within a balancing authority area, and supports interconnection frequency in real time. |
| Bulk Power System | A term commonly applied to the portion of an electric utility system that encompasses the electrical generation resources and transmission system. |
| Cascading Power Outage | The uncontrolled, successive loss of system elements triggered by an incident at any location. Cascading results in widespread service interruption, which cannot be restrained from sequentially spreading beyond an area predetermined by appropriate studies. |
| Distribution | The transfer of electricity from the transmission network to the consumer. |
| Generation | The process of producing electric energy by transforming other forms of energy; also, the amount of electric energy produced. |
| Independent System Operator (ISO) | An ISO is functionally separated from other electricity market participants, i.e., generators, transmission companies and marketers, and makes non-discriminatory access available to users of the transmission system. The ISO is responsible for monitoring and controlling the transmission system in real time. |

| | |
|---|---|
| Operating Reliability | One of the two basic functional aspects in defining the reliability of bulk power electric systems, which is the ability to withstand sudden disturbances such as electric short circuits or unanticipated failure of system elements. The other basic aspect is adequacy. |
| Peak Load | The maximum load consumed or produced by a unit or group of units in a stated period of time. |
| Regional Transmission Organization (RTO) | A voluntary organization of transmission owners, transmission users, and other entities approved by the U.S. Federal Energy Regulatory Commission to efficiently coordinate transmission planning (and expansion), operation, and use on a regional (and interregional) basis. |
| Reliability | The degree of performance of the elements of the bulk electricity system that results in electricity being delivered to customers within accepted standards and in the amounts desired. Reliability can be addressed by two basic and functional aspects of the electric system, adequacy and operating reliability. |
| Reserve Margin | The amount of unused available capability of an electric power system at peak load as a percentage of total capability. |
| Transmission | The movement or transfer of electric energy over an interconnected group of lines and associated equipment between points of supply and points at which it is transformed for delivery to consumers, or is delivered to other electric systems. Transmission is considered to end when the energy is transformed for distribution. |
| Unbundling | Separation of the vertically-integrated functions of utility companies into generation, transmission, distribution and energy services. |
| Utility | An entity owning and operating an electric system and having the obligation to provide electrical service to all end-users upon their request. |
| Vertically-Integrated Utility | A utility that combines the functions of generation, transmission and distribution. |