

Hydro One's Transmission Planning and Protection Practices

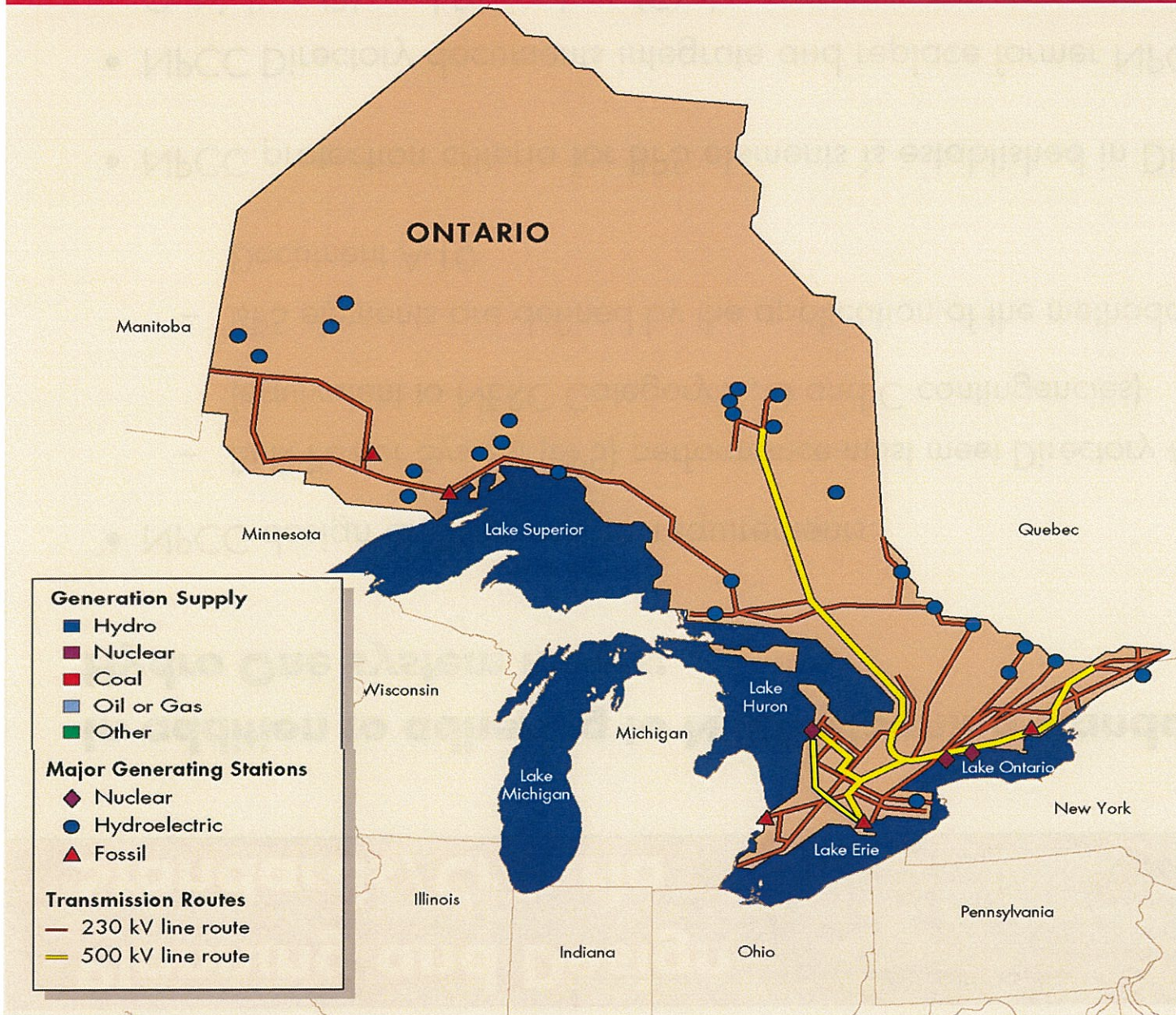
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- Formed when Ontario Hydro unbundled in 1999
- Hydro One became the “wires” company (includes Transmission and Distribution)
- Hydro One owns approximately 97% of the transmission assets in Ontario
- Registered as the following NERC functional entities:
 - Transmission Owner, Transmission Planner & Transmission Operator
 - Distribution Provider, Load Serving Entity
- Full member of Northeast Power Coordinating Council Inc. (NPCC)

Hydro One Network



System Details

Stations

Transmission - 280
Distribution - 1023

Lines/UG Cables

500kV - 3,784km
230kV - 13,824/50km
115kV - 10,953/220km
4 to 44kV - 119,800km

Customers

Transmission:
Large Direct - 110
Local Distribution - 83
Generation - 33
Distribution:
Customers - 1.3 M

Generators

218 (includes 77 OPG)

Peak Demand

27,005 MW (Aug 1/ 06)

In addition to adhering to NERC planning standards, the Hydro One system meets:

- NPCC design and operations requirements:
 - Bulk Power System (BPS) performance must meet Directory #1 requirements (equivalent to NERC Category A, B and C contingencies)
 - BPS elements are defined by the application of the methodologies in Document A-10
- NPCC protection criteria for BPS elements is established in Directory #4
- NPCC Directory documents integrate and replace former NPCC Criteria (A), Guideline (B) and Procedure (C) documents

NPCC Document A-10 (Classification of Bulk Power System Elements) establishes the methodology:

- Assess power system elements assuming local protection does not operate under fault conditions
- Essentially studies the impact to the power system under 3-phase bus fault conditions for remote back up protection operations (without communication) or uncleared faults
- Both transient stability and steady state tests are conducted to review the impact on system performance
- Those tests which demonstrate a significant adverse impact outside the Local Area define the power system elements which are classified as BPS
- Determination of BPS is not based on voltage class

Protection Criteria for BPS elements are specified in NPCC Directory #4 and include:

- 2 independent protection groups which do not share a common element
- Breaker fail protection for local and remote breakers
- Protections operate within the times determined by studies (with due regard for security , dependability and selectivity)
- Separate CT's for each protection group and separate PT secondaries
- Redundant station batteries or dc supplies with physical separation
- Breakers with 2 trip coils
- 2 physically separated and independent communication channels
 - the two teleprotection groups shall not share the same component
- Physical separation of protection and teleprotection groups (i.e. A/B separation)

Hydro One Design and Protection Practices



- Meet NPCC Directory #1 and Directory #4 for all BPS facilities (currently most 500kV and many 230kV facilities)
 - H1 protection separation practices has always met the intent of NPCC criteria at the time and has evolved to match
- Protections for all 500kV and the vast majority of 230kV facilities which are **non-BPS** are designed and have been maintained as BPS facilities
- Virtually all 115kV facilities have historically been non-BPS.
 - most 115kV facilities are radial in nature
 - in many larger load areas, duplication of protection elements are provided (e.g. relays, communication etc) but not at BPS levels (e.g. dual trip coils and batteries, full separation etc)

Significance of Single Point of Failure of Protection Systems for Hydro One



- Implicitly addressed based on design requirements for BPS facilities
 - Fully independent redundant protection groups removes risk of single protection element resulting in protection system failure
- Non-BPS facilities based on A-10 criteria have no significant adverse impact outside the Local Area should local protection fail
- Large number of non-BPS facilities (230kV and above) have fully redundant local protection systems
- Local 115kV systems with significant or critical loads are also provided with some level of protection redundancy
- Ongoing protection sustainment program for end-of-life protections. Single local protection groups are assessed when replacements are considered.

In Summary...

- Hydro One's practices and criteria in transmission planning and protection would implicitly cover single protection system failure while meeting the relevant BES performance requirements in NERC Standards and NPCC Directories.
- Hydro One believes the three example cases in the NERC Advisory suggests that assessments of a single point of failure of non-redundant protection systems need to be sufficiently comprehensive; otherwise, it could be a reliability concern to the BES.
- Hydro One believes the best forum to address this issue is through NERC activities in reviewing, modifying or developing appropriate reliability standards.