Technical and Commercial Factors in Developing Tomorrow's Grid

Jan Carr

Distributed Generation and The Future of Ontario's Electricity Grid

October 26-27, 2008
Waterloo

Outline

- why we have what we have
  - the starting point
- characteristics of distributed generation
  - differences that need to be accommodated
- future grid
  - what we need and what we need to get there

History

- electricity systems have evolved in response to economic and reliability constraints
- optimized economies of scale
- optimized lifecycle costs for plant
  - plant/fuel combination depends on duty cycle required
- optimized reliability
  - centralized system control
    - cost of storage exceeds cost of generation

What We Have – The Starting Point

- lowest cost supply possible by use of:
  - a small number of large-scale generators
  - highest energy density sources of energy available
  - reliability from just-in-time production
- hierarchical system architecture
  - breakpoint between transmission and distribution
    - transmission
      - purpose-designed with sophisticated monitoring and control
      - planned to interconnect major sources of supply with major load centres
    - distribution
      - "handbook" design with limited and simple monitoring and control
      - planned to connect customers to transmission system
- Starting Point
  - change in approach will generally increase costs
    - existing approach results from aiming at lowest cost
  - capability of existing system is lowest at the level where distributed generation needs to connect
    - investment in grid required to enhance its capability

Characteristics of Distributed Generation

- small-scale
  - must connect to distribution
    - low connection costs necessary
  - uncoordinated development
    - multiple owners with a variety of business cases
- non-dispatchable
  - intermittent renewables
    - wind, solar
  - operation dictated by owner
    - cogeneration operations depend on heat host
    - biomass operation has fuel storage constraints

The Challenge

- How do we evolve the least sophisticated and lowest value part of the grid to accommodate uncoordinated development of a large number of small scale supplies with narrow financial margins and random operation while continuing to ensure electricity customers receive supply that is as reliable and affordable as has been provided through coordinated planning and centralized operational control?

Future Grid – Technical Requirements

- heirarchical distributed control
  - individual generators "negotiate" with a local automated hub for "right" to operate
  - system operator deals only with hubs
    - each hub looks like a large scale generator
- distribution systems converted to hybrid distribution/ gathering systems
  - voltage profiles and fault protection enhanced to accommodate two-way power flow
  - extensions and reinforcements dictated by supply locations in addition to customer locations
- increased reliance on experience-based probabilistic methods for planning and operation
  - planning and operating reserve margins will be less deterministic
  - implies that distributed generators will not have unrestricted options for development or for operation

Future Grid – Commercial Requirements

- standing feed-in tariff and connection rules
  - allows generation developers to chose their own timing
  - reduces transaction costs for small scale projects
  - consistent with “handbook” design of distribution system
- part of revenue from tariff must go to distribution system owner
  - fee for system use essential to pay for logical expansion and enhancements necessary
- administration by distribution system owners
  - one-stop for generation developers
  - recognizes that most complex aspect is local system connection

Important Details

- equitable queuing rules to ensure maximum use of available system capacity
  - non-transferrable connection permits – prevent scalping
  - tight "use it or loose it" timelines
- regional or provincial tariff
  - some benefits are local
    - distributor's revenue requirements from customers offset by revenue from generators
  - some are provincial
    - energy production and costs are presently pooled provincially
  - transmission constraints make generation in some regions uneconomic
    - locational pricing for all generation (large scale and small scale) is necessary

Important Details

- simple vs comprehensive
  - simple arrangements can be put in place quickly but cannot capture all opportunities
    - e.g. existing Standard Offer Program used existing surplus system capacity and does not provide for expanding the system
  - comprehensive arrangements take time to establish
- fixed vs indexed pricing
  - traditional tariff will be less flexible than market based pricing
  - potential for an innovative indexed tariff

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