The Interconnection Process in New England – Status Update

Transmission Committee

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Agenda

- Brief history of interconnection process developments in New England
- Discussion of the current status throughout New England
- Issues with inverter-based generators
- Discussion of the backlog in Maine
- Future considerations
BRIEF HISTORY OF INTERCONNECTION PROCESS DEVELOPMENTS IN NEW ENGLAND
History of Interconnection Standard Development in New England

- The Minimum Interconnection Standard (MIS) was established in New England in 1998
  - Around that time, other areas also developed separate Energy and Capacity interconnection standards

- Mandatory national Energy and Network (capacity) interconnection options were established in FERC Order 2003

- The integration of the Interconnection Process with the Forward Capacity Market was achieved in 2009 with the adoption of the “FCM-Q” reforms
  - These changes also included reforms to address FERC concerns regarding interconnection queue processing inefficiencies

- The full development of rules for the processing of Elective Transmission Upgrades (ETUs) was approved by FERC in April, 2015
Minimum Interconnection Standard

• Minimum required upgrades, consistent with:
  – No degradation in transfer capability
  – Maximum one-for-one displacement of existing/proposed generation
  – All reliability standards must be met
  – ISO can still operate and maintain the system

• “Compromise” standard
  – More stringent than “plug and play”
  – Does not assure incremental capacity to serve load
  – Assures no degradation to load-serving capability of the system
  – Consistent with market and Tariff constructs for Network Resources
Observation on the Application of the MIS to New Generators

• New generators are competing with conventional generators for transmission access

• New inverter-based generation has very different voltage support and inertial characteristics than conventional generators
  – Many are more distant from the stronger parts of the grid

• Hence, new inverter-based generators are not ready substitutes for many of the conventional generators they are competing with

• Many upgrades may still be required for basic interconnection pursuant to the MIS
2008 FCM-Q Reforms: Summary of Objectives

- Improved coordination between the requirements of the FCM and the Generator Interconnection Process
- Addressed Intra-Zonal Deliverability in New England
- Addressed Interconnection Queue processing issues that had been observed across the industry and discussed at FERC
Observations on the Implementation of FCM-Q

• Capacity Network Resource Interconnection Service (CNRIS) is achieved through successful participation in the FCM
  – Annual CNR Group study in FCA qualification to test for overlapping impacts

• Integrating the Interconnection Queue with the FCM is a very complex undertaking for both the ISO and participants
  – There is more emphasis than ever on processing queue positions as quickly as possible
Elective Transmission Upgrades

- In April 2015, FERC approved the interconnection procedures for Elective Transmission Upgrades (ETUs)
  - New Schedule 25 in the ISO OATT that governs the interconnection of all forms of ETUs to the New England system
    - Closely modeled on, and integrated with, the generator interconnection procedures
  - Established interconnection service rights for certain ETU types
    - New controllable External ETUs
  - Enabled an Internal ETU to become directly associated with a specific Generating Facility seeking CNRIS
    - So that it can be studied together with the Generating Facility and thereby increase the Generating Facility’s ability to qualify for the FCM
  - Did not alter the existing Tariff structure
    - ETUs must function within the existing dispatch, market and tariff structure of the New England system
DISCUSSION OF THE CURRENT STATUS OF THE INTERCONNECTION PROCESS THROUGHOUT NEW ENGLAND
Current Queue Status

• At this time, with very specific exceptions, queue processing is up-to-date

• With the exception of the North and Western Maine portion of the system (which has experienced a backlog of mostly wind interconnection requests), substantially all the generator interconnection requests made through 2014 have completed the system impact study phase or have moved to the Interconnection Agreement and commercialization phases

• Note that the ISO has also identified other parts of the system that would face significant challenges to adding new generation
  – Northern Vermont
  – Northern New Hampshire
Other Recent Queue Observations

• Recent upturn in proposals in Southern New England
  – Appear to have been timed with FCM Show of Interest window
  – Many new proposals in Southeast New England (SEMA/RI)
  – Mostly gas-fired (primary fuel)
  – Studies proceeding well overall

• Recent activity with large solar project applications
  – ~20 MW and larger
Drivers of the Backlog in Maine

1. Issues with Inverter Based Generators

2. Characteristics of the Maine system

3. Requests far beyond the capability of the existing Maine system
ISSUES WITH INVERTER BASED GENERATORS
New Wind Farms are located far from the transmission system.

Low short circuit ratios of remote locations mean that wind farm models often do not perform as expected.

This results in the need to perform electromagnetic transient analysis (PSCAD) in addition to steady state and dynamic stability analysis.

Large reactive losses incurred with flow over long distances.

This results in the addition of significant reactive upgrades for voltage and stability.

FERC exemption on Wind reactive requirement means that every wind farm study must individually identify the reactive requirement (there is no reactive margin left on the Maine system).
Wind Farms provide little inertia or voltage support

Changes to wind generator parameters are frequently proposed because of a change in manufacturer or a change in technology/control design

Upgrades needed for earlier wind farms, such as series capacitor and/or dynamic reactive devices, further complicate the analysis of later wind farms

- Sub-synchronous analysis
- PSCAD analysis
Initiatives for Addressing Inverter-Based Generation Are Already Under Way

- July 2015 Reliability/Transmission Committee presentation

- Areas of potential improvements
  - Reactive performance of inverter based generators
  - Defining the requirements of a complete new Interconnection Request for inverter-based generators
  - Standardized models
  - Material modification
  - Consideration of network upgrades
  - Standard Scope of a Feasibility Study

- The July 2015 Reliability/Transmission Committee presentation also introduced the concept of adding Phasor Measurement Units at new large generators
DISCUSSION OF THE BACKLOG IN MAINE
Multiple Communications Regarding the Severe Challenges in Maine

- “New England Wind Integration Study” (the “NEWIS”) – to assess the effects of large-scale wind penetration in New England (2009)
- Northern Maine System Performance, Planning Advisory Committee (PAC) presentation (September 21, 2010)
- Wind Development in Constrained Areas, PAC presentation (March 21, 2013)
- Strategic Transmission Analysis: Wind Integration Study, PAC Presentation (December 18, 2013)
- Strategic Transmission Analysis: Wind Integration Study – Stage 1-Maine, Regional Constraints, PAC Presentation (May 21, 2014)
- Strategic Transmission Analysis: Wind Integration Study – Stage 2-Maine, Interface Constraints, PAC Presentation (December 18, 2014)
The Existing Maine System

The Maine system has long transmission lines with relatively little load.

Multiple Major Interfaces to manage North-South flows.

Multiple Local Interfaces to manage local constraints (Not Shown).

Three existing Special Protection Systems (SPS) associated with actions to reduce North-South flows under contingency conditions.


Maine Voltages.
# Requests Far Beyond the ExistingCapability of the Maine Transmission System

<table>
<thead>
<tr>
<th>Maine System</th>
<th>Approximate (MW)</th>
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<tbody>
<tr>
<td>Forecast 2015 Summer Peak Load(^1) (net)</td>
<td>2,300</td>
</tr>
<tr>
<td>Maine Export Capability</td>
<td>1,900</td>
</tr>
<tr>
<td>Load + Export Capability</td>
<td>4,200</td>
</tr>
<tr>
<td>Existing Generation Capacity (Summer 2015)</td>
<td>3,100</td>
</tr>
<tr>
<td>New Brunswick Import Capability</td>
<td>1,000</td>
</tr>
<tr>
<td><strong>New Wind Requests (August 2015)(^1)</strong></td>
<td><strong>3,300</strong></td>
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<tr>
<td>Resource Totals</td>
<td>7,400</td>
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1. Note that most of the proposals are located north of Orrington – where there is only approximately 300 MW of load.
FURTHER CONSIDERATION
Considerations

• Interconnection issues in the identified remote areas of the system are not caused by, nor can they be addressed by, queue process changes
  – The existing transmission system was built to serve minimal system load and is at its limit
    • As noted above, studies since 2009 have shown the need for significant transmission system expansion
    • Even if small incremental amounts of wind can be added, it is clear that the existing system cannot support hundreds or thousands of proposed MWs
  – If individual projects are not able or willing to make the scale of system upgrade investments now required; key issue becomes infrastructure

• How to address the infrastructure issues?
  – Additional wind integration analysis to identify the overall upgrades required to interconnect the levels of MW that are proposed?
    • Such an approach is essentially a clustering study and only appears to be a way forward if coupled with cost allocation to queue projects to share costs
    • Interconnection cost allocation alternatives?
Next Steps

• Introduce proposed Tariff changes at the September Transmission Committee

• Transmission Committee action in October
Questions