Ensuring Grid Reliability and Resiliency in New England

Reliability Technical Conference
Federal Energy Regulatory Commission

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ISO New England’s Strategic Planning Initiative
Focused on developing solutions to the region’s top reliability risks

Reliability requires a flexible, high-performance fleet to address strategic risks:

• Natural gas dependency
• Power plant retirements
• Renewable resource integration
Dramatic Changes in New England’s Energy Mix

Percent of Total Electric Energy Production by Fuel Type
(2000 vs. 2013)
Resource Shift is Creating Reliability Challenges

- **ISO New England** is increasingly reliant on resources with uncertain performance and availability
  - **Natural gas resources** lack firm gas transportation or fuel storage and rely on “just-in-time” fuel supply
  - **Coal, oil-steam fleet** is being displaced by more efficient resources
  - **Intermittent resource growth** with inherently uncertain output
    - 1800 MW of solar PV (cumulative) expected over the next 10 years
    - Approximately 750 MW of existing wind and 2,000 MW of new wind proposed in New England

- **ISO estimates up to 8,300 MW of non-gas-fired generation is “at risk” for retirement by 2020** (28 older oil and coal units)
  - If all retire, ISO estimates 6,300 MW of new or repowered capacity will be needed in the region
Operating Experience this Winter was a Challenge

• January ranked among the coldest months in recent history
  – 9 days were in the coldest 5% of days over the past 20 years

• New England experienced sustained high natural gas prices
  – ISO frequently operated with little or no gas-fired generation
  – High natural gas prices made many oil-fired generators economic

• Gas pipelines were constrained even without significant use by gas-fired generators, and more constrained than we expected

• Generation fleet is operating with limited fuel inventories (other than nuclear and coal resources)

• Oil supply chain is increasingly constrained

• Oil-fired generators were vitally important to reliability this winter
Gas Price Volatility Drove Wholesale Electricity Prices to Record Levels over the Past Two Winters

Winter 2012-13 and 2013-14

Wholesale Electricity at New England Hub (Real-Time LMP) vs. Natural Gas

Electric Energy $/MWh

Fuel $/MMBtu

New Supply is at New England’s Doorstep, but...

Moving additional natural-gas supply into New England from the west will require investment in pipeline infrastructure.

... Pipeline Constraints into New England Cause High Prices and Reliability Issues

Source: The Hartford Courant, December 2013
“At Risk” Generator Retirements have Begun
Not only coal and oil, as expected, but also nuclear plants

Major Retirement Requests:

- **Salem Harbor Station (749 MW)**
  - 4 units (coal & oil)

- **Norwalk Harbor Station (342 MW)**
  - 3 units (oil)

- **Brayton Point Station (1,535 MW)**
  - 4 units (coal & oil)

- **Vermont Yankee Station (604 MW)**
  - 1 unit (nuclear)

### Total MW Retiring in New England*

<table>
<thead>
<tr>
<th>State</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>528 MW</td>
</tr>
<tr>
<td>Maine</td>
<td>159 MW</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>2,682 MW</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>56 MW</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>64 MW</td>
</tr>
<tr>
<td>Vermont</td>
<td>666 MW</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>4,155 MW</strong></td>
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*Megawatts based on relevant Forward Capacity Auction (FCA) summer qualified capacity (NOTE: total includes full and partial generator and demand response Non-Price Retirement (NPR) requests for Capacity Commitment Period (CCP) 2013-2014 through CCP 2017-2018)

Source: Status of Non-Price Retirement Requests; December 20, 2013
Proposed Generation is Primarily Gas and Wind

*More than 90% of the resources in the ISO’s Generator Queue*

**By Type**

- Natural gas, 4,340, 63%
- Wind, 2,067, 30%
- Biomass, 138, 2%
- Solar, 10, 0%
- Oil, 245, 4%
- Pumped-storage hydro, 50, 1%
- Hydro, 12, 0%

**By State**

- MA, 3,367, 49%
- CT, 1,713, 25%
- VT, 191, 3%
- NH, 154, 2%
- ME, 1,437, 21%

Note: Some natural gas include dual-fuel units (oil)

Source: ISO Generator Interconnection Queue (April 2014)
Total: 7,000 MW; FERC Jurisdictional Only
New England Governors Request ISO’s Support to Develop Electric and Natural Gas Infrastructure

• January 2014: Governors, through NESCOE, request ISO technical support and tariff filings at FERC to support their objectives to expand energy infrastructure

• **New Electric Transmission Infrastructure**
  – Enable delivery of 1,200 MW to 3,600 MW of clean energy into New England from no and/or low carbon emissions resources

• **Increased Natural Gas Capacity**
  – Increase firm pipeline capacity into New England by 1000 mmcf/day above 2013 levels, or 600 mmcf/day beyond announced projects
  – Targeted to be in-service by winter 2017/18

• Potential cost recovery through ISO tariff
  – States to decide on cost allocation

*Note: NESCOE – New England States Committee on Electricity*
Issues to be Addressed

• Assuming the New England States proceed with this direction, three major issues need to be addressed:
  – The appropriate design to address FERC jurisdiction under the Federal Power Act
  – Who owns the incremental pipeline capacity, and who releases it to the market?
  – Will pipeline developers build the pipe on the strength of a FERC order that guarantees net cost recovery through the ISO tariff, and who will provide the financial assurance to underwrite the arrangement in the ISO tariff?
ISO’s Forecasting Tools are Evolving with the Changing Resource Mix

• New England states are investing billions of ratepayer dollars in energy efficiency (EE) and distributed generation (solar PV)
• ISO worked with stakeholders to create EE and DG forecasts
• Wind provides a small, but growing portion of region’s energy
• So, in addition to forecasting energy and peak demand, the ISO now forecasts growing behind-the-meter resources and other renewable generation:
  – Energy efficiency
  – Distributed generation (solar PV)
  – Wind power
Energy Efficiency is a Priority for New England

Nearly $13 billion to be spent over 14 years

2013 State Energy-Efficiency Scorecard

Ranking of state EE efforts by the American Council for an Energy-Efficient Economy:

- Massachusetts 1
- Connecticut 5
- Rhode Island 6
- Vermont 7
- Maine 16
- New Hampshire 21

• States invested billions over the past few years, and more is on the horizon
  - Approximately $2.3 billion invested from 2009 to 2012
  - Approximately $4.5 billion to be invested from 2013 to 2017
  - ISO estimates $5.7 billion to be invested in EE from 2018 to 2023

Source: American Council for an Energy-Efficient Economy
EE Affects New England’s Electricity Consumption

*Peak demand growth is lower; energy use is flat*

New England: Summer 90/10 Peak (MW)

New England: Annual Energy Use (GWh)

Source: [Final ISO New England EE Forecast for 2018-2023](#) (April 2014)
State Policies are Driving Significant Growth of Distributed Generation (DG)

• Solar photovoltaics (PV) make up most of this DG
• Historical DG levels were too small to impact the bulk power system, but forecast levels create new challenges
• Most of these resources are not visible to ISO system operators
• Region needs more robust interconnection standards as solar PV grows
ISO Forecasts Solar PV Growth over Next Decade

Cumulative Growth in Solar PV through 2023

Source: Final Interim PV Forecast (April 2014)

2% of New England’s net energy load in 2023
Renewable & EE Resources are all Trending Up

Wind (MW)

- Existing: 700
- Proposed: 2,000

Solar (MW)

- PV thru 2013: 499
- PV in 2023: 1,807

Energy Efficiency (MW)

- 2012: 223
- 2018-23: 1,233

Nameplate capacity of existing wind resources and proposals in the ISO-NE Generator Interconnection Queue; megawatts (MW).

2014 Final Interim ISO-NE Solar PV Forecast, based on state policies.

Final ISO-NE Energy-Efficiency Forecast for 2018-23, peak MW savings based on state-sponsored EE program budgets: $5.7 billion.
Highlights of *Reliability* Challenges

- New England has a growing reliability problem due to natural gas pipeline constraints and declining resource performance.
- The region is in a precarious operating position for the next several winters (and any periods of high gas demand or gas pipeline interruptions) as major non-gas resources retire and proposed market enhancements and energy infrastructure improvements are years away.
- Expected retirements will exacerbate reliability concerns.
- System operators need new tools to balancing a rapidly growing fleet of variable generation resources.
Highlights of *Market* Challenges

- Wholesale electric energy market pricing will be volatile and correlated with stressed system conditions on both the gas pipeline and electrical systems.
- Capacity market incentives are necessary to improve generator performance and ensure reliability, but may not be sufficient on their own to drive pipeline investments.
- Variable generation resources (wind and solar) will reduce demand and energy-market revenues for traditional sources of generation (gas-fired), which are needed to balance the variability of these resources.
- Resources will increasingly rely on capacity markets to offset loss of energy market revenues.
What Does the 21st Century Grid Look Like?

• Retirement of older fossil-fired resources
• Expanded access to lower-priced energy (natural gas)
• Increase in non-carbon resources (wind and hydro)
• Increase in behind-the-meter generation (EE and solar)
• A highly skilled workforce to operate this system reliably
Questions