

Joint Board Meeting on Security Constrained Economic Dispatch – Northeast Region

Boston, MA

November 29, 2005

Gordon van Welie, President and CEO

Overview

- New England has recognized the benefits of a region-wide economic dispatch for 35 years
- The implementation of centralized economic dispatch has changed and improved over time
 - Technology has aided this progress, resulting in further cost reductions
- The benefits of economic dispatch to New England are significant
 - These benefits have grown since market implementation
- ISO New England has identified a number of areas for future improvements
 - Including improved trade and coordination with NYISO

Definition of SCED

- Security Constrained Economic Dispatch (SCED) is the use of the least expensive generating and demand response resources to meet the minute-to-minute power needs of the region while respecting transmission constraints and covering for potential outages
- For today's discussion, ISO assumes that both selecting day ahead which units to run (unit commitment), as well as directing those units in real time (economic dispatch), is included as part of the SCED discussion
- ISO also commits quick-start units in real time

Historical view of regional economic dispatch

- Beginning in 1970, New England began to operate as an integrated power pool
- Unit commitment and economic dispatch were done centrally
- Savings from the central dispatch were shared throughout the pool
- System operators used experience and off-line studies to manually dispatch units to cover transmission constraints
- Transactions between New England and New York allowed both regions to benefit from available low-cost generation

Historical view of regional economic dispatch (continued)

- In the mid 1980's, transactions with New York were partially automated
- In 1990, New England incorporated the use of a more sophisticated network model for use in real-time dispatch
 - The introduction of a state estimator resulted in more accurate reliability analysis and better operator information through on-line contingency analysis
- In 1999, introduction of electronic communication with generators allowed faster communication of dispatch instructions and better system response

Introduction of Markets: Economic Dispatch Continued and Improved

- ISO New England began operating Interim Markets in March 1999
- ISO continued least-cost unit commitment and efficient five-minute dispatch
 - Following economic dispatch instructions became mandatory
 - Dispatch was based on market-based offers, not costs
 - Offers generally reflect costs (fuel, O&M, emissions, opportunity costs)
 - ISO continued to manually dispatch generators to relieve constraints

Standard Market Design Further Improves Economic Dispatch

- Introduction of New England SMD in 2003 further improved economic dispatch
- Fully automated security constrained economic dispatch implemented
 - Five-minute dispatch performed with security constraints (line limits and contingencies) modeled in the optimization software
 - Improved reliability due to reduced manual processes, reduced response time, and improved information
 - Savings due to more accurate calculation of line limits
- Unit commitment improved by including security constraints
 - Additional savings through improved commitment
- Introduction of day-ahead market improved accuracy of unit commitment
 - Units with day-ahead commitment and financial obligation less likely to experience forced outage
- SCED essential to determination of LMPs

Savings to New England Have Been Substantial

- NEPOOL calculated savings each year due to central commitment and dispatch
 - The calculation determined “NEPOOL Savings Fund”
- This calculation compared actual dispatch costs (using economic dispatch) with estimated costs if each utility dispatched its own generation to meet its own load
 - These calculations are a conservative estimate of the economic dispatch savings because utility “own-load” dispatch estimates assumed perfect foresight, seven days in advance
 - Real-world “own-load” dispatch likely would have been more expensive than estimated due to uncertainty

Savings to New England Have Been Substantial (continued)

- From 1970 through 1997, the estimated total savings due to regional economic dispatch were over \$1.4 billion (in 2004 dollars)
 - Calculated from NEPOOL Savings Fund totals in NEPOOL Annual Reports
 - The estimated benefits are conservative
 - Excludes \$364 million from Quebec Savings Fund, which measured the benefits of the DC tie to Hydro-Quebec
- Similar calculations are not available during the markets period because of generation divestiture
 - Additional improvements to economic dispatch have likely resulted in increased savings

Markets Have Resulted in Additional Savings for Consumers

- These additional savings are enabled by economic dispatch
- ISO estimates cost reductions of nearly \$700 million per year when comparing first full year of markets to fifth year
 - More than \$410 million annual energy cost savings due to investment in efficient generation and competitive market incentives
 - Approximately \$90 million annual savings due to improved unit availability
 - \$170 million annual savings due to reduced out of merit/congestion costs
 - Over \$10 million annual savings due to improved unit response to dispatch instructions

Markets Have Resulted in Additional Benefits for Consumers, Including Reduced Environmental Impact

- Real improvements to the region's electric system
 - Almost \$2 billion in long-needed 345 kV transmission projects in four states have siting approval
 - Massachusetts, Connecticut, Vermont, Maine
 - Approximately \$6 billion in private investment in new generating resources
 - 30% increase in new, cleaner generation
 - Over 9,000 MW of new generation
 - Significant reductions in regional air emissions

Economic Dispatch Improvements Are Included in Wholesale Markets Plan

- ISO New England and stakeholders have identified many improvements to New England's power markets
- These are described in the ISO's Wholesale Markets Plan
- The Plan seeks to maximize the benefits of the markets to New England while recognizing resource constraints
- Improvements to the established economic dispatch are prioritized with other market enhancements

Some Major Market Enhancements Identified in the Plan

- LICAP
- Ancillary Services Market Phase II
- Combined-cycle modeling
- Cold Snap related changes
- Interregional Transaction Scheduling improvements
- Special Case Nodal Pricing
- Demand-Response Reserves pilot program
- Integrated day-ahead load response
- Pricing of external nodes

Future Improvements to Current Economic Dispatch Identified in the Plan

- Co-optimization of energy and reserves
 - Part of ASM Phase II project
- Reduce seams and improve interface coordination and transfers with adjoining control areas
 - Already made many improvements (e.g. facilitated transactions checkout, elimination of through-or-out charges)
 - Interface with NYISO is not fully utilized
 - Potential to improve the efficiency of regional dispatch between NY and NE
 - Imports from NY limited to approximately 1000 MW under typical conditions
 - Total efficiency gains limited by modest physical import capability from NY
 - ISO's are exploring different mechanisms to improve interface use:
 - ISO redispatch of interface
 - More frequent transaction scheduling
 - Elimination of through-or-out charges and improved coordination over interfaces will achieve large majority of the benefits of combined dispatch over larger region

Future Improvements to Current Economic Dispatch Identified in the Plan (continued)

- Better integrate demand response to improve load factors
 - Demand response should be a seamless part of wholesale markets
 - Integrated into day-ahead unit commitment and real-time dispatch
 - Demand response encouraged by special case nodal pricing
- Each MW of demand response reduces needed generation and transmission infrastructure
 - 100 MW reduction in peak load can save approximately \$1.2 million/month in generation infrastructure investment
 - Also saves on additional fuel delivery infrastructure and emissions

Future Improvements to Current Economic Dispatch Identified in the Plan (continued)

- Research and development projects to improve economic dispatch and reduce costs:
 - More optimal unit commitment based on new optimization models (Mixed Integer Programming), which allow more accurate resource modeling (e.g. multiple CC unit configurations) and reduce costs of meeting demand
 - Improved modeling to accurately reflect reactive power and model voltage constraints
 - Incorporate on-line stability analysis
 - Multi-interval optimization, which can result in additional savings

Specific Discussion Items: SCED is Integral to Operating New England's Grid

- Economic dispatch in New England has resulted in substantial cost savings
 - Has also improved system reliability due to improved operator tools and information
- SCED is an integral part of the regional market
 - SCED, including unit commitment, is an integral part of the market design and pricing rules
 - Day-ahead financial commitments can decrease costs by improving unit reliability
 - Real-time, security constrained economic dispatch is a prerequisite for wholesale markets with locational pricing

Specific Discussion Items: Regional Economic Dispatch Improves Reliability

- Regional economic dispatch has improved reliability
 - Central dispatch with a complete view of the transmission system, and the authority and ability to respond to system risks and emergencies, is more reliable than isolated control areas
 - Lesson of the 2003 blackout
 - Fundamental driver behind power pooling in the Northeast following the 1965 blackout
- SCED has evolved to include more accurate, on-line tools which are integrated into the dispatch
 - This results in better information about the state of the system and more rapid response to potential security violations
 - This occurs while simultaneously reducing costs

Specific Discussion Items: Regional Economic Dispatch Produces Savings

- Operation as a regional power pool has resulted in demonstrable savings of more than \$1.4 billion from 1970 through 1997 (in 2004 dollars)
 - It is expected that these savings have carried forward into the market regime
- During the market period, there have been approximately \$700 million in additional annual cost reductions achieved during the first five years of operations
 - This number includes estimated cost reductions due to improvements in unit efficiency, improved unit availability, reduced out of merit costs, and other efficiency gains
- ISO has identified a number of areas for future improvements to SCED to build on these savings

Conclusions

- New England has clearly benefited from economic dispatch
- Economic dispatch has reduced costs and improved reliability
- Economic dispatch is integral to the market design
 - Market design improvements, including improvements to economic dispatch, will result in further efficiencies
- Economic dispatch has improved over time, with additional enhancements under development
 - Improving interchange with NYISO is an important part of planned enhancements