Outline of Today’s Presentation

- Introduction
- Reliability Rules
- Reserve Requirements
- Market Overview
- Operations
- Ancillary Services Markets
Introduction – New York ISO

- Responsible for administering the wholesale energy markets in New York State and for the reliable operation of the state’s high voltage electric transmission system
- Highly divested and complex marketplace featuring co-optimized market clearing systems
- NYISO market volume is projected to be $10 billion this year and $40 billion since inception
- Unique challenge: New York City is world’s biggest and most complex load pocket. World capitals of finance and communications
- Unique geography makes it the “Hub of the Northeast”
Reliability Rules

- NYISO must comply with all Reliability Rules established by:
  - NERC - North American Electric Reliability Council
  - NPCC - Northeast Power Coordination Council
  - NYSRC - New York State Reliability Council

- Specific rules for the New York Control Area are established by the NYSRC
  - Inclusive of all NPCC and NERC Reliability Rules, and in some cases are more stringent
    - Example – Solving for N-2 contingencies on transmission facilities into NYC when a “Thunderstorm Alert” is declared
Reserve Requirements - NERC

- Standard BAL–002-0
  - Contingency Reserve is required to meet Disturbance Control Standards
  - Contingency Reserve Policies are defined by the Regional Reliability Councils
  - Contingency Reserve may be made up of generation, controllable load resources or coordinated adjustments to Interchange Schedules

- Standard BAL-005-0
  - Regulation Reserve is required to meet Control Performance Standards
Reserve Requirements - NPCC

- Operating Reserve Criteria A-06

  ✓ 10 Minute Reserve
    • Shall be at least equal to first contingency loss and sustainable for one hour

  ✓ 30 Minute Reserve
    • Shall be at least equal to one-half the area’s second contingency loss and be sustainable for one hour

  ✓ Regulation Reserve
    • Shall be sufficient to meet NERC control performance standards CPS1 and CPS2
Reserve Requirements - NYSRC

- Reliability Rules Document – Version 14

✓ 10 Minute Reserve
  - Equal to at least the size of the largest contingency or loss of energy purchases from another area, whichever is greater
    - At least 50% must be synchronized
    - Balance may be non-synchronized

✓ 30 Minute Reserve
  - Equal to at least one-half the size of the next largest contingency
Market Overview

**Day-Ahead Market - Highlights**

- Security Constrained Unit Commitment (SCUC) scheduling software co-optimizes energy and ancillary service (reserve & regulation) bids for least cost solution
- Produces hourly Locational Based Marginal Prices (LBMP)
- Provides binding forward contracts issued to Suppliers and Loads
- Allows for bilateral transaction scheduling concurrently with supply and load bids
- Deviations from the Day-Ahead Market schedules are settled against the Real-Time Market prices
- Installed capacity suppliers are required to bid into the Day-Ahead Market
Market Overview

Real-Time Market - Highlights

- External transaction and generation suppliers may adjust bids hourly for consideration in the Real-Time Market evaluation to address in-day operating conditions.

- Real-Time Dispatch scheduling software re-optimizes energy, reserve and regulation on system-wide basis every 5-minutes.

- Provides for commitment of “quick start” resources.

- Produces 5-minute Locational Based Marginal Prices (LBMP).
Market Overview

Ancillary Services - Highlights

- Co-optimization of energy, reserve & regulation bids for least cost solution

- Suppliers provide separate bids for energy, regulation and reserve services

- Markets allow for substitution of higher quality reserves for lower quality when it is more economic to do so

- Reserve commitment includes locational New York State requirements with locational clearing pricing

- Ancillary services are fully scheduled in the Day-Ahead Market, with re-scheduling made through the Real-Time Market process
NYISO Operations

- Monitor Operating Reserve in a forecast mode and in real time
  - Review of Day-Ahead Market commitment and continuously monitor availability of resources in the Real-Time Market to meet required reserves

- Operations will take additional actions to maintain required reserves based on time frame and extent of reserve deficiencies:
  - Supplemental Resource Evaluations
  - Counting of regional reserve sharing energy
  - Counting/recalling energy exports from suppliers that have an installed capacity obligation to New York
  - Scheduling of emergency energy imports
  - Counting/activating EDRP/SCR
  - Counting quick response voltage reduction relief
Ancillary Services Markets

- In February 2005, a number of enhancements to the Real-Time Market systems were implemented which were designed to improve the efficiency of the markets and use of generating resources.

- Two settlement system for Reserve & Regulation Markets
  - Similar to the energy market, this design provides financial incentives for suppliers to be available in real-time operation and to perform when called upon.

- Ancillary Service prices that incorporate marginal Lost Opportunity Cost (LOCs)
  - Replaces separate LOC payments paid through uplift under the previous design.
Ancillary Services Markets

- Ancillary Service Market Enhancements (continued):

  ✓ *Reserve and Regulation Markets are scheduled and settled on a 5-minute basis in real time like the energy market*
  
  ✓ *All dispatchable capacity is considered for scheduling as energy or reserves*
  
  ✓ *Demand curves established for Reserve and Regulation*
    - During shortages, the demand curves reflect shortage costs into both the energy and ancillary service clearing prices
Ancillary Services Markets

- Under the Demand Curve approach:
  - In shortage situations, the price of reserves is set by the demand curve
  - Markets clear with a price that reflects the level of the shortage even when the desired reserves are not available at any price

- Objectives in establishing the Demand Curve prices were:
  - To schedule resources to meet the required reserve constraints when they are available
  - To send the desired price signals to the market when true shortages occur
Reserve & Regulation Values

NYCA Wide Reserve Values
- Total Spinning Reserve – 600 MW
- Total 10 Min Reserve – 1200 MW
- 30 Minute Reserve – 1800 MW

NYCA Wide Regulation Values
- Regulation - 175 - 275 MW

Eastern Reserve Values
- Total Spinning Reserve – 300 MW
- Total 10 Min Reserve – 1000 MW
- * 30 Minute Reserve – 1000 MW

Long Island Reserve Values
- * Total Spinning Reserve – 60 MW
- * Total 10 Min Reserve – 120 MW
- 30 Minute Reserve – 270-540 MW

* Denotes locational reserve categories that reflect a desire for dispersed reserves but are not operational requirements under the NYSRC reliability rules.
## Reserve & Regulation Demand Curves

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<th>NYCA</th>
<th>East</th>
<th>Long Island</th>
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<tbody>
<tr>
<td><strong>Spinning 10 Minute Reserve</strong></td>
<td>$500/MWh</td>
<td>$25/MWh</td>
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<tr>
<td><strong>Total 10 Minute Reserve</strong></td>
<td>$150/MWh</td>
<td>$500/MWh</td>
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<td><strong>30 Minute Reserve</strong></td>
<td>200 MW @ $50/MWh</td>
<td>$25/MWh</td>
<td>$300/MWh</td>
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<tr>
<td></td>
<td>200 MW @ $100/MWh</td>
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<tr>
<td></td>
<td>Remainder @ $200/MWh</td>
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<tr>
<td><strong>Regulation</strong></td>
<td>25 MW @ $250/MWh</td>
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<tr>
<td></td>
<td>Remainder @ $300/MWh</td>
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Reserve Demand Curve

- Reserve Demand Curve pricing example assuming shortage of all reserve categories
- This example demonstrates the additive nature of the demand curves

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<tbody>
<tr>
<td>Total Spinning Reserve</td>
<td>$850</td>
<td>$1,400</td>
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<tr>
<td>Total 10 Minute Reserve</td>
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<tr>
<td>30 Minute Reserve</td>
<td>$200</td>
<td>$225</td>
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Ancillary Services Markets

Reserve Demand Curve – 30 Minute Reserves

- In this example, sufficient reserve bids are available to the market scheduling systems to meet the reserve values.

- The clearing price of reserves will reflect the cost of the last MW scheduled to meet the requirement.
Ancillary Services Markets

Reserve Demand Curve – 30 Minute Reserves

- In this example a shortage exists and the requirement cannot be met with the resources available to the market scheduling system.

- Without a demand curve, the market price would reflect the cost of the last MW of available supply scheduled.

- With a demand curve, the price is set by the demand curve. The market clears at a price higher than it otherwise would have and sends the desired price signal to the market consistent with the level of reserve shortage.
Demand Curve Conclusions

- The NYISO’s experience under the demand curve approach has demonstrated reliable operation during the record peak load conditions in Summer 2005

- The demand curves allow for the efficient integration of normal market scheduling processes and, if necessary, additional operational actions to meet reliability objectives

- The NYISO believes demand curves enhance reliability under LBMP operation by sending the desired market signals to suppliers under shortage conditions