Introduction to the PJM Markets
Objectives

Students will be able to:

• Describe some of the basic functions of PJM
PJM Markets Today

- Day-Ahead Energy Market
- Real-Time Energy Market
- Reliability Pricing Model (RPM)
- Regulation Market
- Reserve Market
- Financial Transmission Rights/Auction Revenue Rights (FTR/ARR)
Energy Market

• PJM coordinates the continuous buying, selling and delivery of wholesale electricity through the Energy Market.

• PJM balances the needs of suppliers, wholesale customers and other market participants and monitors market activities to ensure open, fair and equitable access.
• PJM’s Reliability Pricing Model (RPM) provides a long-term price signal, consistent with the PJM Regional Transmission Expansion Planning process, for capacity resources and load serving entities’ (LSEs) unforced capacity obligations
FTR

• PJM auctions Financial Transmission Rights (FTRs) to assist market participants in hedging price risk when delivering energy on the grid

• FTRs are financial instruments that entitle the holder to a stream of revenues (or charges) based on the hourly energy-price differences across the transmission path in the Day-Ahead Market
Questions?
Operational Reliability
Dispatch Functions

• Ensure sufficient generation is available or running to satisfy the demand at any hour of the day including maintaining adequate reserves
  – This is called *Generation Control*

• Monitor, operate and control the high voltage transmission system in a reliable manner
  – This is called *Transmission Control*
Achieving Energy Balance

Daily Load Curve

<table>
<thead>
<tr>
<th>Hour</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>24</td>
<td>26</td>
</tr>
</tbody>
</table>

Frequency in Hz

62  61  60  59  58

Demand & Exports & Losses

Power & Imports

PJM©2018

10/8/2018
Events That Take Place

• Units trip
• Units are delayed
• System Constraints
• Contract Curtailments
• Weather
• Emergency Procedures
PJM EMS says “What If”?  

If this line trips...  

This line will overload...
Corrective Actions

Total Supply = Demand = 820 MW

Bus 2 generator - Increase output

Bus 1 generator - Decrease output
PJM Reserves - Introduction
Reserve Monitoring

- Reserves are additional capacity above the expected load
- Used to protect the system against uncertain occurrences
  - Loss of capacity
  - Load forecasting errors
- Compliance with NERC, SERC and RFC BAL standards
Operating Reserve

• Generating capability and/or equivalent generating capability scheduled to operate in excess of the forecast hourly integrated PJM RTO load that can be converted fully into energy within 30 minutes from the request of the PJM dispatcher

• Load that can be removed from the system in 30 minutes from the request of the PJM dispatcher
Primary Reserve

• NERC term is Contingency Reserves
  – On or off-line reserves available within 15 minutes

• PJM Primary Reserves
  – Reserves which can be converted fully into energy or;
  – Load that can be removed from the system within 10 minutes of the request
  from the PJM Dispatcher

• NERC and PJM terms are interchangeable

• Primary (Contingency) Reserves are subdivided two categories:
  – Synchronized Reserves
  – Non- Synchronized (Quick Start) Reserves
Synchronized Reserves

- Reserve capability that can be converted fully into energy or load that can be removed from the system within 10 minutes of the request from the PJM dispatcher and must be provided by equipment electrically synchronized to the system

- Includes:
  - increase in the output of a synchronized generator
  - reduction in load from a synchronized resource such as the load of a pumped hydro resource currently synchronized in the pumping mode and capable of being shut down
  - the maximum output energy level that could be attained on a resource operating as a synchronous condenser
Quick Start (non-synchronized) Reserves

• Reserve capability that can be fully converted into energy or load that can be removed from the system within 10 minutes of the request from the PJM dispatcher and is provided by equipment not electrically synchronized to the system

• Includes:
  – the reduction in load from a non-synchronized resource which can be attained in 10 minutes
  – Examples:
    • run-of-river hydro
    • pumped hydro
    • industrial combustion turbines, jet engine/expander turbines
    • Diesels
    • interruptible demand resources
Supplemental Reserve

- Reserve capability that can be fully converted into energy or load that can be removed from the system within a 10-to-30 minute interval following the request of the PJM dispatcher.

- These resources do not have to be electrically synchronized to the system.
Questions?

PJM Client Management & Services
Telephone: (610) 666-8980
Toll Free Telephone: (866) 400-8980
Website: www.pjm.com

The Member Community is PJM’s self-service portal for members to search for answers to their questions or to track and/or open cases with Client Management & Services