PJM Reserve Market
Objectives

Students will be able to:

- Identify the process and procedures for participating in the Real-Time Reserve Market
What are Reserves?

- Reserves are additional generation capacity above the expected load
  - Protects the power system against the uncertain occurrence of future operating events:
    - Loss of generation or load forecasting errors
Reserve Markets

Reserve Services
Each service carries a reserve requirement

Primary Reserve

Synchronized Reserve

Tier 1 resources
Flexible
Inflexible

Tier 2 resources

Non-Synchronized Reserve (NSR)

NSR resources

Reserve Products
Each product has a clearing price

PJM Operates in real-time to ensure Contingency/Primary (10 minute) and Synchronized Reserve Requirements are always maintained
Synchronized Reserves

Tier 1 Resources

Tier 2 Resources

Tier 1 (Economic)
- Online units that follow economic dispatch and only partially loaded
  - Able to increase output within 10 minutes following PJM dispatcher request to an event

Tier 2 (Non-economic)
- Resources that offered into the Synchronized Reserve Market
  - Cleared Condensers (CTs & hydro) transition to online Tier 2 condense mode
- Steam reduced to provide Tier 2 CTs online at min – operating at a point that deviates from economic dispatch Demand Response that can drop load
Tier 2 Requirements

• Eligibility
  – “Generation Resources and Demand Resources must be able to provide 0.1 MW of Tier 2 Synchronized Reserve Capability in order to participate in the Tier 2 Synchronized Reserve Market.” (Manual 11 – Section 4.2.1)

• Commitment
  – “Any resource that is committed for Tier 2 when a synchronizes event occurs is obligated to respond for their commitment at the start of the event within 10 minutes” (Manual 11 – Section 4.2.7)
Call for Synchronized Reserve

Loading of Synchronized Reserve is a Reliability Service!

• The resource owners implement the requested percentage of Synchronized Reserve:
  – Without regard to price and as quickly as possible
• Continue to implement Synchronized Reserve until directed by PJM dispatcher to discontinue

At most, one level of operator intervention between PJM and customer reducing load

100% Synchronized Reserve Request – All Call

PJM Generation Dispatcher

Market Operation Center (MOC)

Curtailment Service Provider

Gen Unit

Gen Unit

DSR Customer
Synchronized Reserve Offers

• **Offer MW** - The amount of Synchronized Reserve MW offered for the unit.
  – The Synchronized Reserve quantity is defined as the increase in output achievable by the unit in ten (10) minutes

• **Offer Price** - Must be a positive number; required if the unit is available for Synchronized Reserve.
  – A Synchronized Reserve offer price may not exceed the unit’s O & M cost (as determined by the Cost Development Subcommittee) plus $7.50/MWh margin

• **Condense Energy Use** - This is the amount of energy a condensing unit consumes in an hour while operating in the condensing mode

• **Condense Startup Cost** - This is the actual cost associated with getting a unit from a completely off-line state into the condensing mode including fuel, O&M, etc.
Managing Synchronized Reserve Data

- **Condense to Gen Cost** - The cost, in dollars, of transitioning a condenser to the generating mode. The value submitted for this cost must be less than or equal to the condense Startup cost.

- **Full Load Heat Rate** - The heat rate of the unit, specified in BTU/kWh, when the unit is at full load.

- **Reduced Load Heat Rate** - The heat rate of the unit, specified in BTU/kWh, when the unit is at reduced load.

- **VOM Rate** - The variable rate, in dollars, of operating and maintenance costs.
**Managing Synchronized Reserve Data**

- **Spin as Condenser** - Used to identify if a combustion turbine can be committed for synchronized reserve as a condenser

- **Condenser Available Status** - Status of the resource availability for condensing
  - **Available** - Indicates if the unit is available to condense for voltage support
  - **Not Available** - Indicates if the unit is unavailable to condense for voltage support
Sync Reserve Market Time Line

Throughout the Operating Day
PJM Clears
Sync Reserve Market Hourly

Synchronous Reserve Offers for Tier 2 (cost and price) due by 14:15 EPT for next operating day
Non-Synchronized Reserve Timing

60 minutes before:
- ASO calculates hourly NSR estimates

30 minutes before:
- NSR estimates posted

Operating Hour
- RT SCED calculates 5 min assignments;
- LPC calculates NSRMCPs
Synchronized Reserve Timing

- A forward commitment for some reserve resources and all regulation resources will be posted 30 minutes prior to the operating hour
  - Synchronous Condensers and Demand Response resources will be considered “inflexible” units and committed on a forward basis

Operating Hour

60 minutes before
- ASO calculates inflexible resource Tier 2 commitments and preliminary Tier 1 estimate

30 minutes before
- Inflexible Tier 2 commitments and preliminary Tier 1 estimate posted

RT SCED calculates 5 min available Tier 1 and Tier 2 assignments; LPC calculates SRMCPs

Incremental commitments may be made for inflexible units
## Non-Synchronized Reserve Results Posting

<table>
<thead>
<tr>
<th>What</th>
<th>Frequency</th>
<th>Location</th>
<th>When</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary Estimate</td>
<td>Hourly</td>
<td>Markets Gateway</td>
<td>30 min prior to top of hour</td>
</tr>
<tr>
<td>Assignment</td>
<td>Every 5 minutes</td>
<td>ICCP link</td>
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<td>Clearing Price</td>
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Must Offer Requirement

• A must offer requirement is applied to the Synch Reserve and Non-Synchronized Reserve Markets

• Implicit must offer requirements are already built into the design of Tier 1 Synch Reserve and NSR
  – All online generation resources following PJM’s dispatch and operating below eco max are automatically considered in the commitment of Tier 1 resources
  – All available offline generation capable of providing energy within 10 minutes are automatically considered in the commitment of NSR
Must Offer Requirement

• Must offer requirement for Tier 2 Synch Reserve resources
  – All non-emergency capacity resources available to provide energy and capable of providing synchronized reserves must submit offers for Tier 2 Synchronized Reserves
    • Applies only during periods for which PJM has issued a Primary Reserve Warning, Voltage Reduction Warning or Manual Load Dump Warning
  – Penalty for violating the must offer requirement is referral to the Market Monitor, similar to the day-ahead must offer requirement for capacity generation resources
Non-Synchronized Reserve Offers

• The Non-Synchronized Reserve Market is a cost-based market

• Being off-line and available within 10-minutes as a part of economic dispatch does not entail a cost, therefore:
  
  – No explicit offer is entered in Markets Gateway
    • All eligible resources will be considered to have an offer of $0/MWh
    • The NSR MW available from each resource will be calculated based on:
      ▪ Startup and Notification Time from lesser of cost schedule and price schedule
      ▪ Economic Minimum
      ▪ Synch Reserve Ramp Rate, or energy ramp rate in absence of a synch reserve ramp rate

• No Three Pivotal Supplier test - already a cost-based market
Managing Synchronized Reserve Data

The following Markets Gateway pages are used to manage the Synchronized Reserve Offers:

- **Unit Detail** - use this web page to enter Synchronized Reserve maximum limit for Tier 1 resources

- **Synchronized Reserve Offers** - use this web page to create Synchronized Reserve offers for Tier 2 resources and modify the status of the Synchronized Reserve offer

- **Synchronized Reserve Updates** - use this web page to modify synchronized reserve resource availability and parameters on an hourly basis (up to 60 minutes before the top of the hour)

- **Synchronized Reserve Bilaterals** - use this web page to facilitate a Synchronized Reserve bilateral transaction
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.