PJM Reserve Market

PJM State & Member Training Dept.

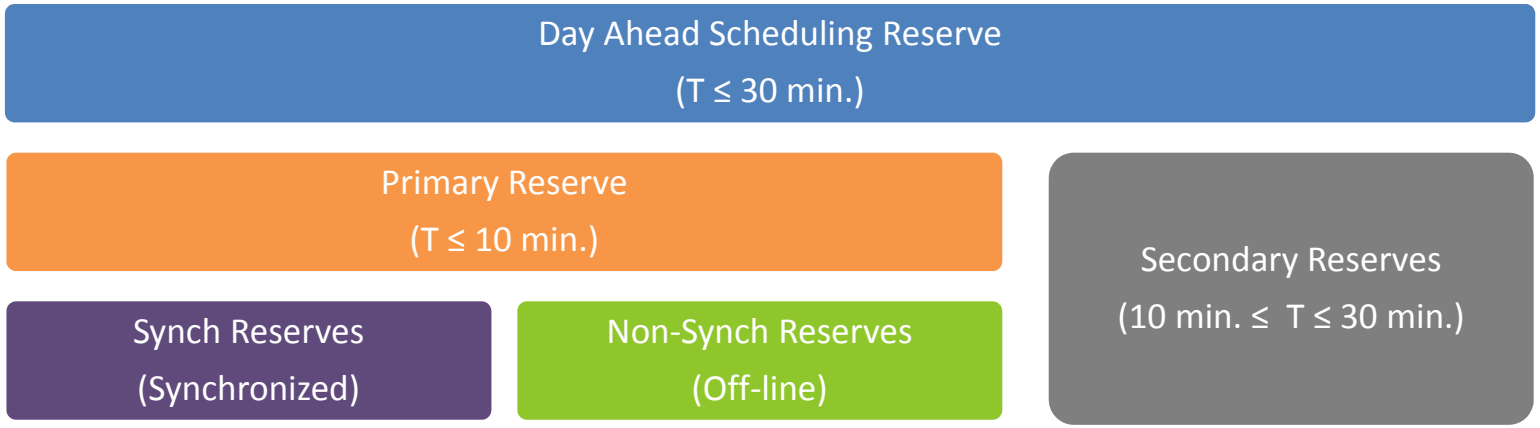
Objectives

Students will be able to:

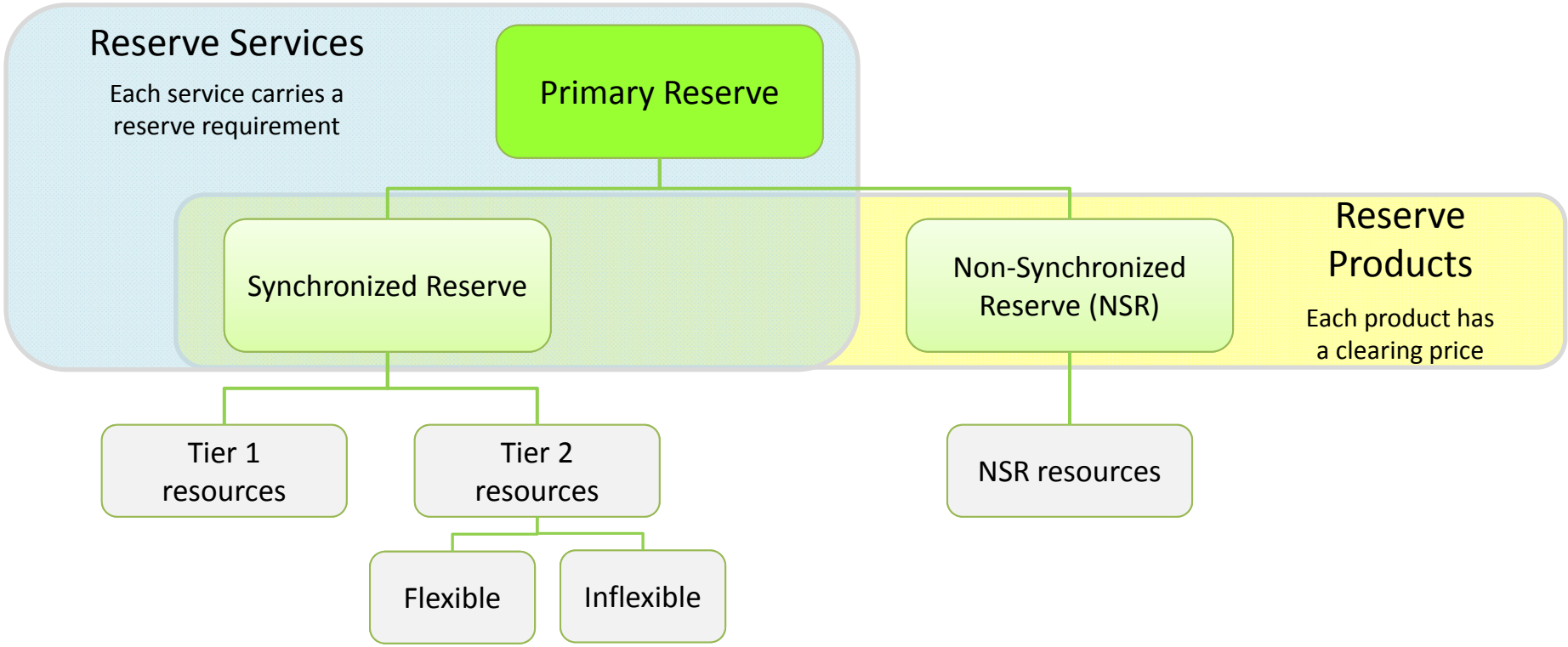
- Identify the process and procedures for participating in the Real-Time Reserve Market

Reserves Overview

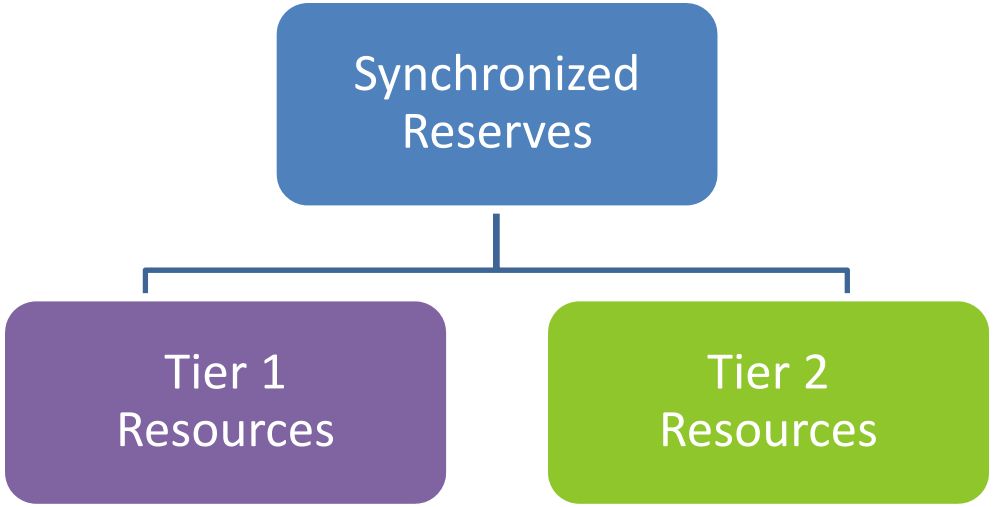
- What are reserves?
  - Reserves are additional generation capacity above the expected load scheduled to protect the power system against the uncertain occurrence of future operating events, including the loss of generation or load forecasting errors



Reserve Markets



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



Tier 1 (Economic)	Online units that follow economic dispatch and only partially loaded and therefore are 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 and 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

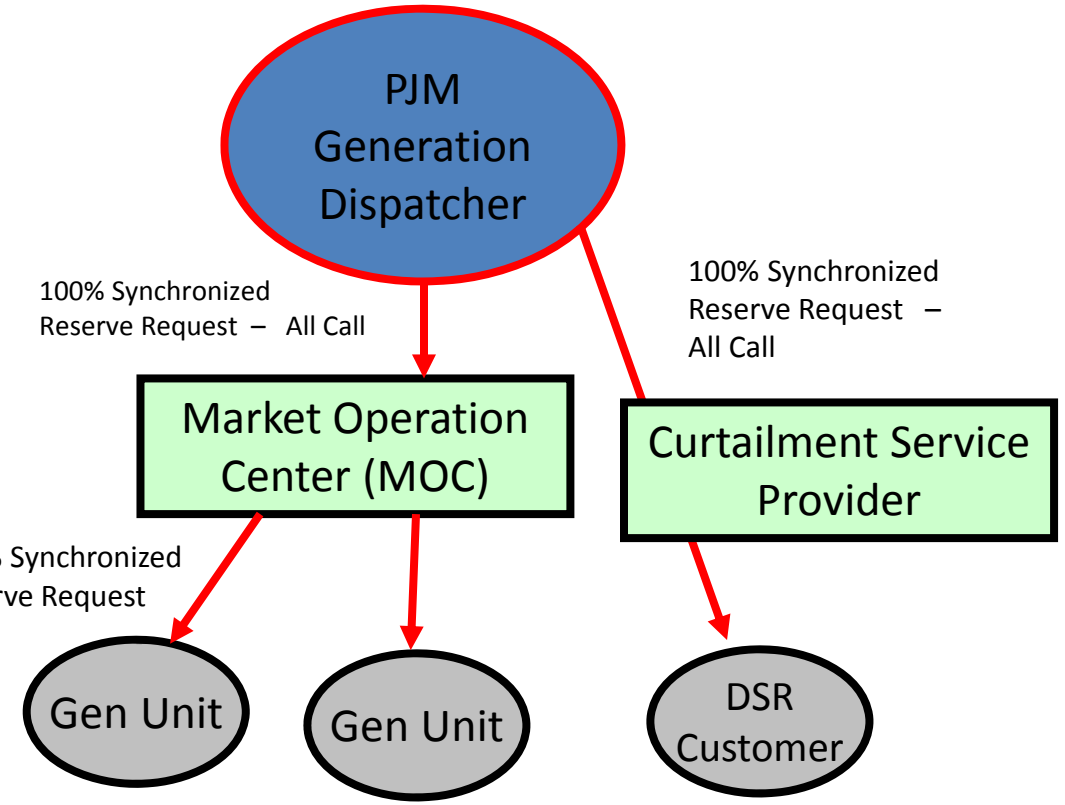
- Eligibility
  - "Generation Resources and Demand Resources must be able to provide 0.1 MW of Tier 2 Synchronized Reserve Capability in order to participate in the Tier 2 Synchronized Reserve Market." (Manual 11 – Section 4.2.1)
- Commitment
  - "Any resource that is committed for Tier 2 when a synchronizes 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, without regard to price and as quickly as possible, implement the requested percentage of Synchronized Reserve. 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



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 eMKT
    - 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

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.

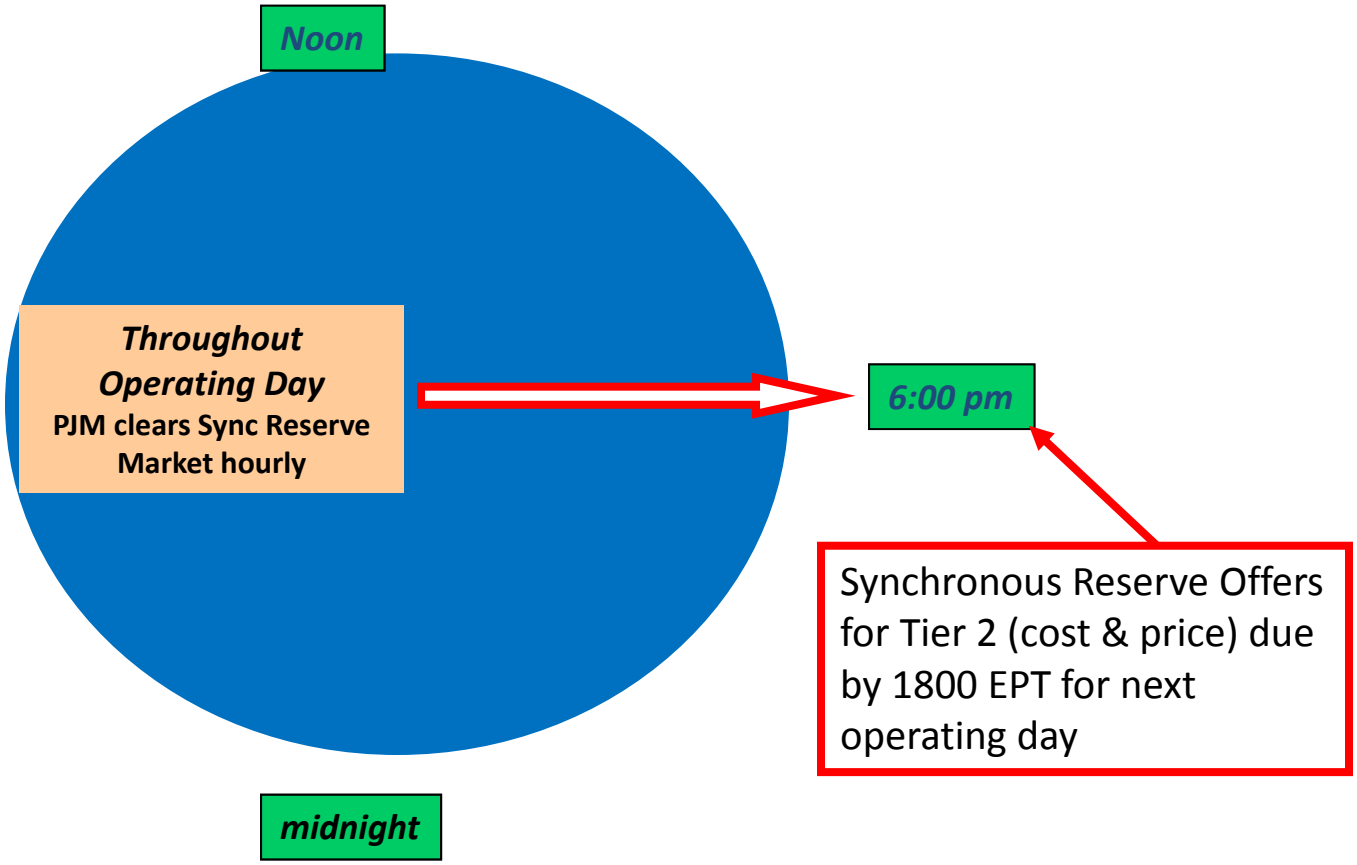
Managing Synchronized Reserve Data

- **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

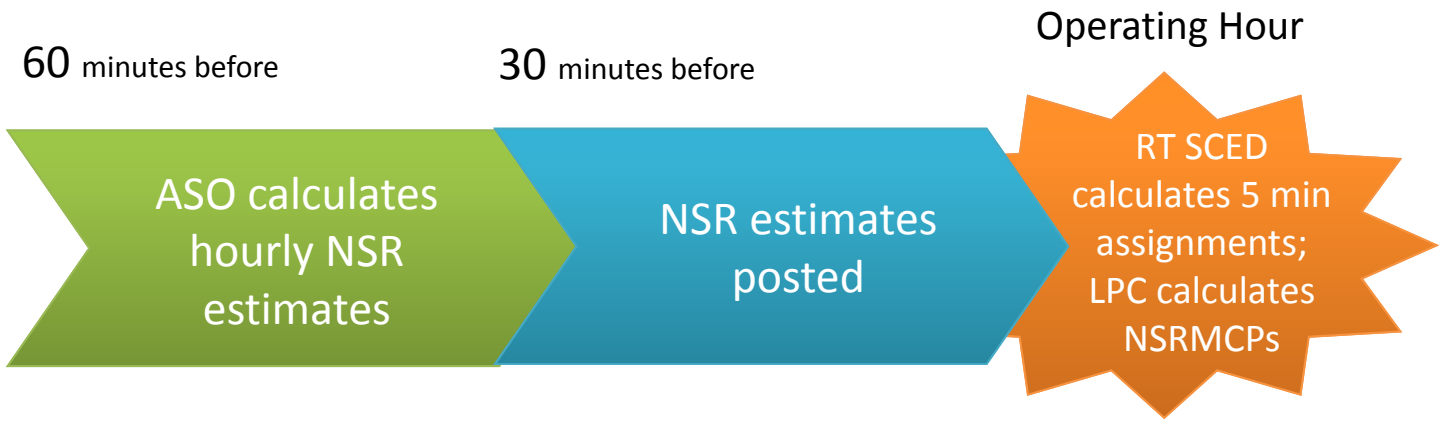
Managing Synchronized Reserve Data

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

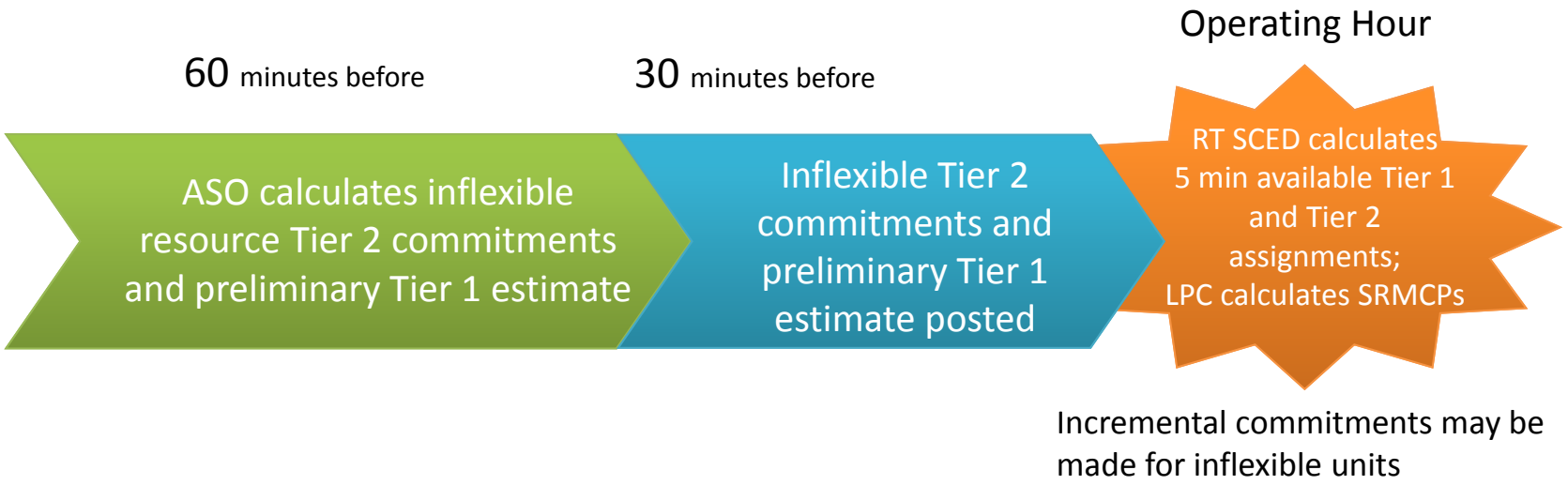
Sync Reserve Market Time Line



Non-Synchronized Reserve Timing



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

Non-Synchronized Reserve Results Posting

What	Frequency	Location	When
Preliminary Estimate	Hourly	eMKT	30 min prior to top of hour
Assignment	Every 5 minutes	ICCP link	Every 5 min
Clearing Price	Every 5 minutes	eData	Every 5 min

Synchronized Reserve Results Posting

What	Frequency	Location	When
Preliminary Tier 1 Estimate	Hourly	eMKT	30 min prior to top of hour
Inflexible Tier 2 Assignment	Hourly	eMKT	30 min prior to top of hour
Flexible Tier 2 Assignment	Every 5 minutes	ICCP link	Every 5 min
Clearing Price	Every 5 minutes	eData	Every 5 min

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

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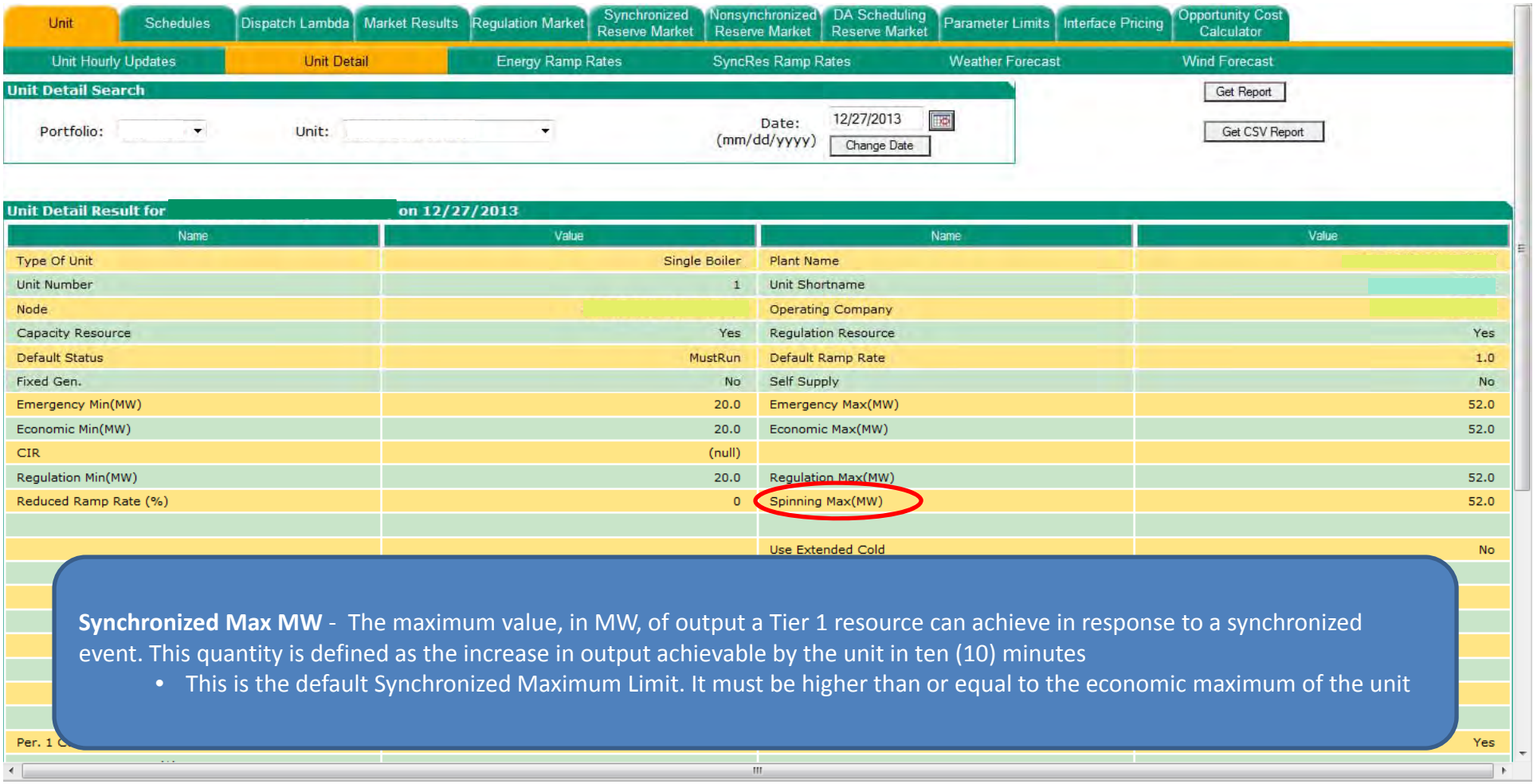
- No Three Pivotal Supplier test - already a cost based market

Managing Synchronized Reserve Data

The following eMKT 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 Offers** - use this web page to create Synchronized Reserve offers for Tier 2 resources and modify the status of the Synchronized Reserve offer
- **Synchronized Updates** - use this web page to modify synchronized reserve resource availability and parameters on an hourly basis
- **Synchronized Bilaterals** - use this web page to facilitate a Synchronized Reserve bilateral transaction

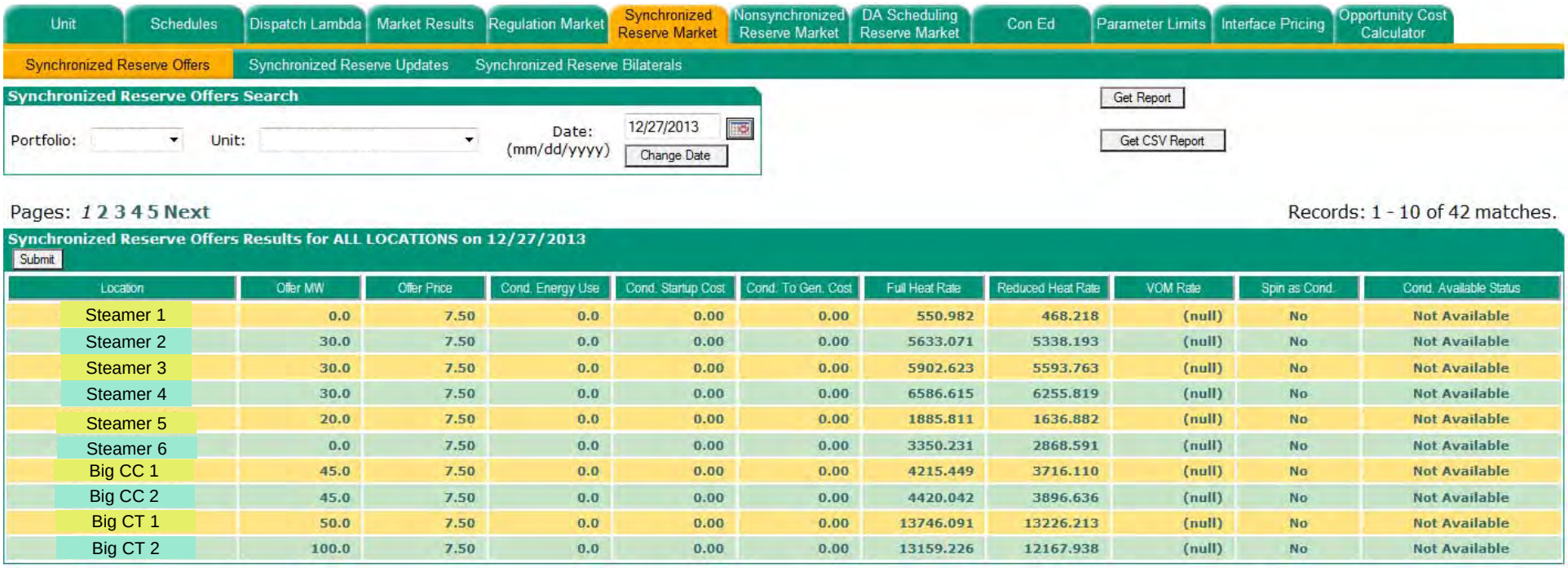


Synchronized Max MW - The maximum value, in MW, of output a Tier 1 resource can achieve in response to a synchronized event. This quantity is defined as the increase in output achievable by the unit in ten (10) minutes

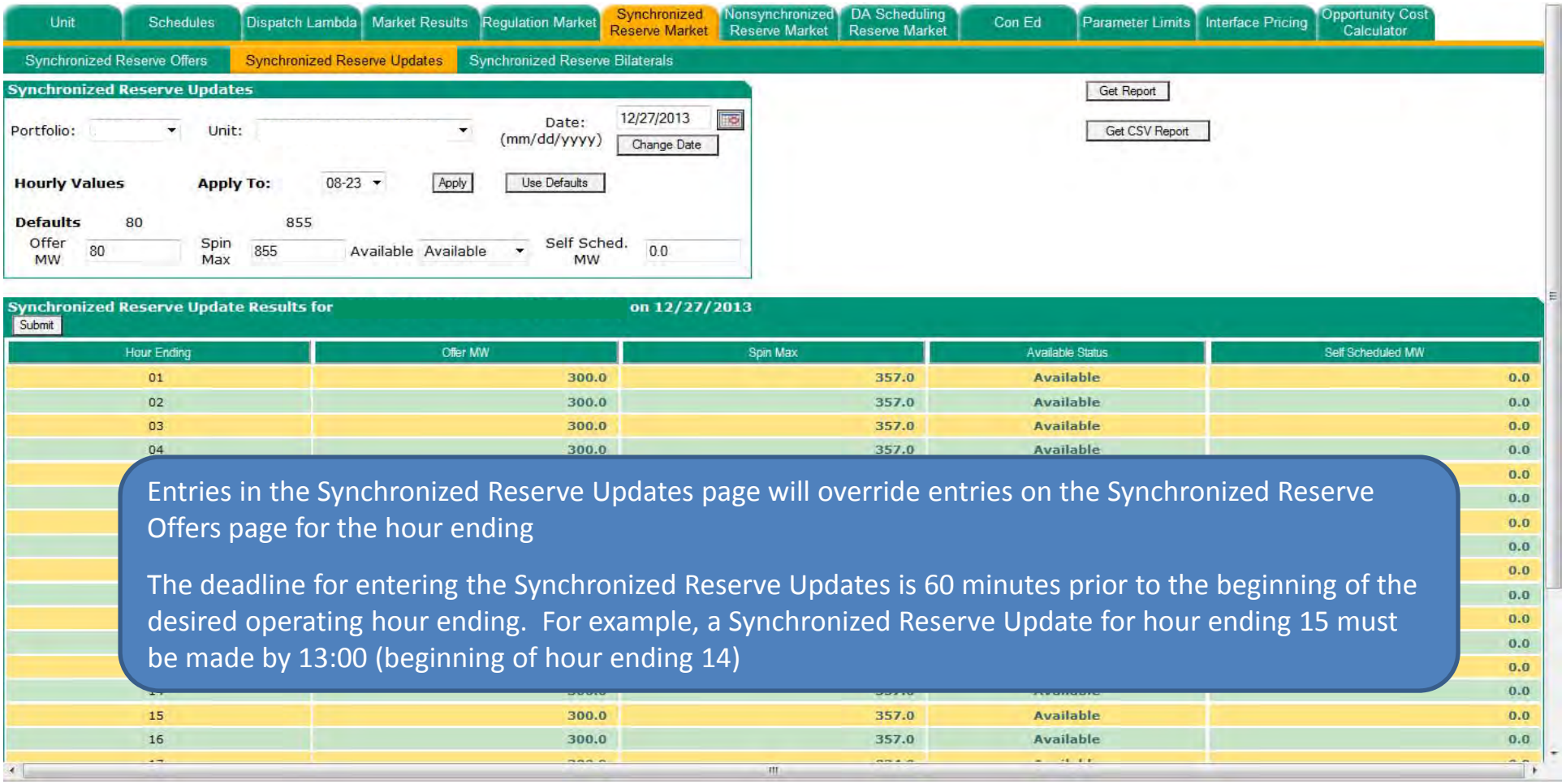
- This is the default Synchronized Maximum Limit. It must be higher than or equal to the economic maximum of the unit

Synchronized Reserve Offers

Daily offers for Synchronized Reserves are entered in Synchronized Reserve Offers page



Location	Offer MW	Offer Price	Cond. Energy Use	Cond. Startup Cost	Cond. To Gen. Cost	Full Heat Rate	Reduced Heat Rate	VOM Rate	Spin as Cond.	Cond. Available Status
Steamer 1	0.0	7.50	0.0	0.00	0.00	550.982	468.218	(null)	No	Not Available
Steamer 2	30.0	7.50	0.0	0.00	0.00	5633.071	5338.193	(null)	No	Not Available
Steamer 3	30.0	7.50	0.0	0.00	0.00	5902.623	5593.763	(null)	No	Not Available
Steamer 4	30.0	7.50	0.0	0.00	0.00	6586.615	6255.819	(null)	No	Not Available
Steamer 5	20.0	7.50	0.0	0.00	0.00	1885.811	1636.882	(null)	No	Not Available
Steamer 6	0.0	7.50	0.0	0.00	0.00	3350.231	2868.591	(null)	No	Not Available
Big CC 1	45.0	7.50	0.0	0.00	0.00	4215.449	3716.110	(null)	No	Not Available
Big CC 2	45.0	7.50	0.0	0.00	0.00	4420.042	3896.636	(null)	No	Not Available
Big CT 1	50.0	7.50	0.0	0.00	0.00	13746.091	13226.213	(null)	No	Not Available
Big CT 2	100.0	7.50	0.0	0.00	0.00	13159.226	12167.938	(null)	No	Not Available



Entries in the Synchronized Reserve Updates page will override entries on the Synchronized Reserve Offers page for the hour ending

The deadline for entering the Synchronized Reserve Updates is 60 minutes prior to the beginning of the desired operating hour ending. For example, a Synchronized Reserve Update for hour ending 15 must be made by 13:00 (beginning of hour ending 14)

Questions?