PJM Regulation Market

**PJM State & Member Training Dept.**

Objectives

Students will be able to:

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

What is Regulation?

Regulation is:

- A variable amount of generation energy under <u>automatic control</u>
- <u>Independent</u> of economic cost signal
- Obtainable within <u>five minutes</u>
- <u>Responds to frequency deviations</u>

- These generating units or demand response resources provide fine tuning that is necessary for effective system control

- Regulating units correct for small load changes that cause the power system to operate out of balance (measured as "ACE")
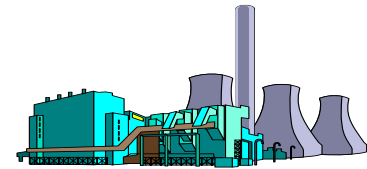
Real-Time Regulation Data/Terms

PJM >> Member

AReg – Assigned Regulation

- Static for hour as a result of market
- Sent by PJM for each resource capable of regulation

RegA – Regulation Control Signal

- Automated Generator Control signal sent by PJM to Resource owner
- Sent every 2 seconds
- Bounded by TReg

RegD – Fast Regulation

- Automated Generator Control signal sent by PJM to Resource owner
- Dynamic signal moves with the frequency deviation component of ACE
- Increases the "utilization" of the energy storage devices

Member >> PJM

TReg – Total Regulation

- Resource owner sends one number for the fleet regulation capability

CReg – Current Regulation

- Calculated value where fleet is operating relative to regulation band
- Fleet-wide value sent from Resource owner to PJM
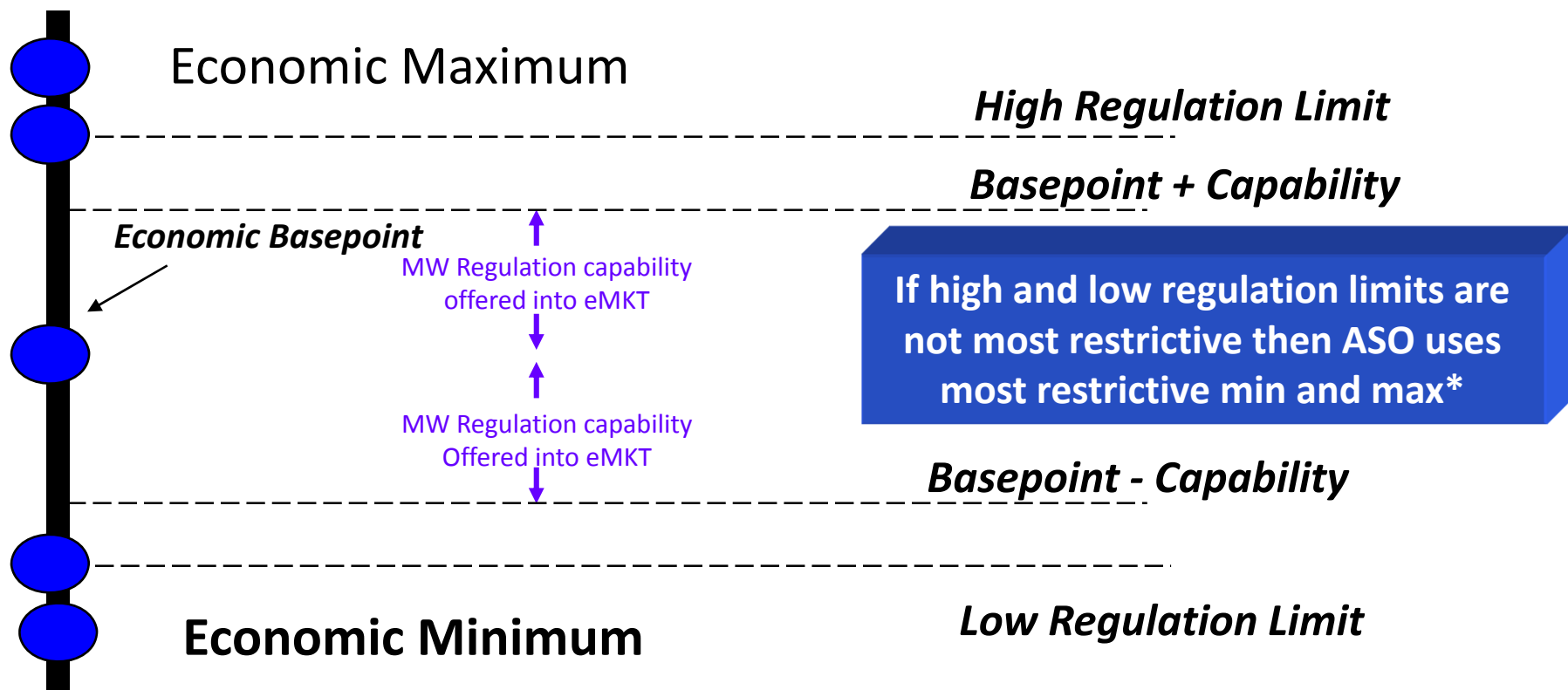- Sent every 4 seconds

Unit Reg – Resource allocation

- Allocation should be sent as percent allocation for each individual regulating resource of the resource AReg
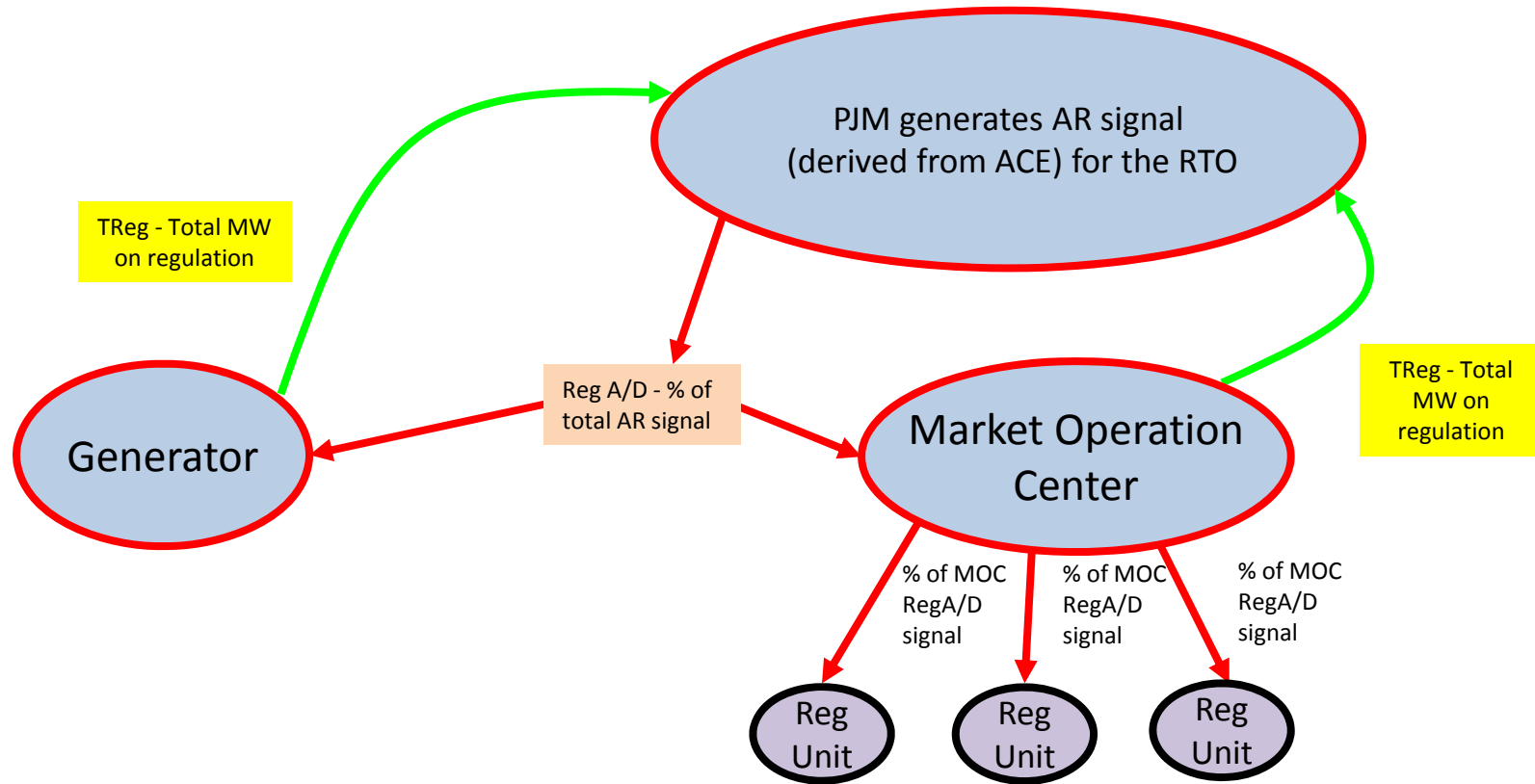
Load BP – Operational Midpoint

- The point around which the regulating resource (unit, plant or registration) operates

Band of Regulation for Generator

Economic Maximum

High Regulation Limit

Basepoint + Capability

Economic Basepoint

MW Regulation capability offered into eMKT

MW Regulation capability Offered into eMKT

If high and low regulation limits are not most restrictive then ASO uses most restrictive min and max*

Basepoint - Capability

Economic Minimum

Low Regulation Limit

* Band of regulation must fall within the economic limits of the generating unit

01/27/2015

Regulation in Real-time Operations

PJM generates AR signal (derived from ACE) for the RTO

TReg - Total MW on regulation

Generator

Reg A/D - % of total AR signal

Market Operation Center

TReg - Total MW on regulation

% of MOC RegA/D signal

% of MOC RegA/D signal

% of MOC RegA/D signal

Reg Unit

Reg Unit

Reg Unit

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Regulation Offer Parameters

- **Reg Type** – The regulation type (Reg A or Reg D). For a unit with both Reg A and Reg D offers, two rows will display

- **Offer MW** – The amount of regulation MW offered for the unit. This field is required if the unit is either Available or Self-Scheduled to provide regulation

- **Price Offer** – Cannot be more than $100/MW total
  - **Capability Offer Price** – resource owner's price to reserve MWs for regulation in $/MW
  - **Performance Offer Price** – $/MW price to provide regulation movement
    - Converted to $/ΔMW by multiplying the value by the ratio of ΔMW/MW for the applicable signal for that offer

Regulation Offers

- **Cost Offer** – Must meet Manual 15 Guidelines
  - **Capability Offer Cost** – cost to reserve MW in $/MW
    - Must be ≤ (fuel cost increase and unit specific heat rate degradation due to operating at lower loads) + $12/MWh
  - **Performance Offer Cost** – $/MW cost Increase due to Heat Rate Increase during non-steady state operation and Cost Increase in VOM
    - Converted to $/ΔMW by multiplying the value by the ratio of ΔMW/MW for the applicable signal for that offer

Regulation Offers

- **Heat Rate @ Eco Max [BTU/kWh]** - The heat rate at the default economic maximum for a resource. The economic maximum that will correspond to this rate value will be the default economic maximum that is shown on both the Daily Regulation Offers and Unit Details pages. This is an optional parameter that may be submitted in the eMKT System to support the cost-based regulation offer price
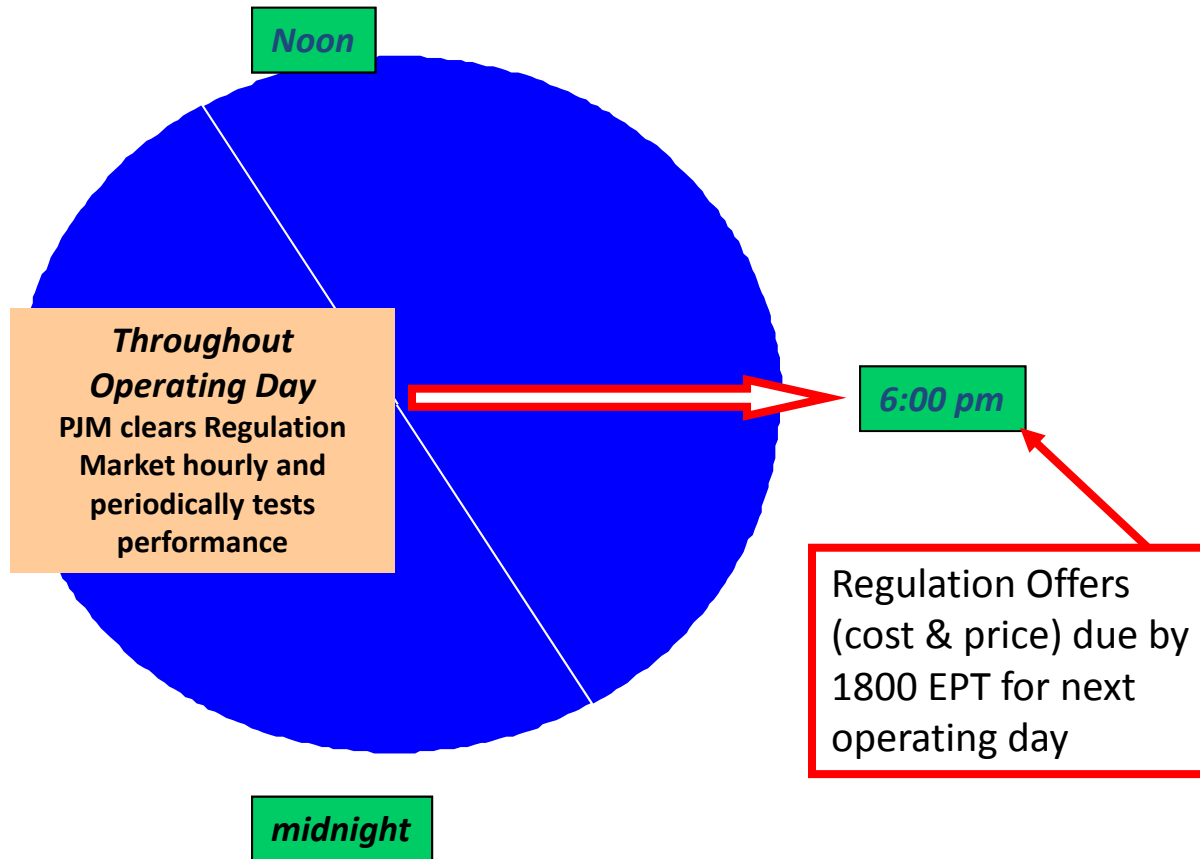
- **Heat Rate @ Reg Min [BTU/kWh]** - The heat rate at the default regulation minimum for a resource. The regulation minimum that will correspond to this rate value will be the default regulation minimum that is shown on both the Daily Regulation Offers and Unit Details pages. This is an optional parameter that may be submitted in the eMKT System to support the cost-based regulation offer price

Regulation Offers

- **VOM Rate [$/MWh of Regulation]** - The increase in VOM resulting from operating the regulating resource at a higher heat rate than is otherwise economic for the purpose of providing regulation

- **Fuel Cost [$/MBTU]** - The fixed fuel costs of the resource. This value will be used to determine the heat rate adjustments during steady-state and non steady-state operation for the purpose of providing regulation. This is an optional parameter that may be submitted in the eMKT System to support the cost-based regulation offer price

- **Energy Storage Loss [$/MWh of Regulation]** - The value is used to account for the energy losses experienced by an energy storage device while providing regulation service. This field is valid only for energy storage resources

Regulation Offers

- **Eco Max MW** - Maximum generation limit when unit is providing regulation. This value is entered on the **Unit Detail page** and can only be edited there

- **Reg Min MW** - Minimum generation limit when unit is providing regulation. This value is entered on the **Unit Detail page** and can only be edited there

- **Min Offer MW** - Minimum MW for assignment. The value should not be greater than the Offer MW

- **Available Status** - availability of unit
  - Available
  - Not Available

- **Self Scheduled** - indication the resource is self scheduled

- **Rolling Avg Performance Score** - The average performance score for the last 100 operating hours. It is used to adjust the capability and performance offer

Regulation Market Time Line

Noon

Throughout Operating Day
PJM clears Regulation Market hourly and periodically tests performance

6:00 pm

Regulation Offers (cost & price) due by 1800 EPT for next operating day

midnight

01/27/2015

Regulation Market Timing

60 minutes before | **30** minutes before | Operating Hour

ASO calculates regulation commitments → Regulation commitments posted → LPC calculates 5 min RMCPs

Regulation Market Results

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

Public → Market Results A/S → Regulation Results (Mileage and RTO average Performance Score)

From the Public reports under the Regulation Results tab

Generator →Market Results → Regulation and Reserve Award

Managing Regulation Data

The following eMKT pages are used to manage the Regulation Offers:

- **Unit Detail** - use this web page to enter regulating high and low limits
- **Regulation Offer** - use this web page to create regulation offers and modify the status of the regulation offer
- **Regulation Updates** - use this web page to modify regulation resource availability and parameters on an hourly basis
- **Regulation Bilateral Transactions** - use this web page to facilitate a regulation bilateral transaction

eMKT Materials

eMKT

eMKT allows PJM members to submit information and obtain data needed to conduct business in the Day-Ahead, Regulation and Synchronized Reserve markets.

Login | Register

eMKT Documents	Date
eMKT Incident Report - April 2008 (PDF)	
Sample file for Six Digit Precision of Aggregates in Day Ahead CSV File (CSV)	
eMKT Frequently Asked Questions (PDF)	08.17.2011
2012 Spring Daylight Savings Transition Information (PDF)	03.06.2012
eMKT User Guide (PDF)	06.01.2012
Market Database Dictionary (PDF)	11.23.2011
External Interface Specification Guide for eMKT - Rev 25 (effective 06.22.2012) (PDF)	07.11.2012
eMKT XML Schema (XSD)	06.26.2012
eMKT XML Schema - Including Shortage Pricing and Performance-Based Regulation - Effective 09.24.2012 (XSD)	08.21.2012

eMKT Documentation

http://www.pjm.com/markets-and-operations/etools/emkt.aspx

Unit Detail Search

Portfolio: [▼]   Unit: [▼]   Date: 12/27/2013 (mm/dd/yyyy) [Change Date]   [Get Report]   [Get CSV Report]

Unit Detail Result for _____ **on 12/27/2013**

Name	Value	Name	Value
Type Of Unit	Single Boiler	Plant Name	
Unit Number	1	Unit Shortname	
Node		Operating Company	
Capacity Resource	Yes	Regulation Resource	Yes
Default Status	MustRun	Default Ramp Rate	1.0
Fixed Gen.	No	Self Supply	No
Emergency Min(MW)	20.0	Emergency Max(MW)	52.0
Economic Min(MW)	20.0	Economic Max(MW)	52.0
CIR	(null)		
Regulation Min(MW)	20.0	Regulation Max(MW)	52.0
Reduced Ramp Rate (%)	0	Spinning Max(MW)	52.0
		Use Extended Cold	No

- **Regulation Max MW** - Maximum generation limit when unit is providing regulation
- **Regulation Min MW** - Minimum generation limit when unit is providing regulation
- **Reduced Ramp Rate (%) = Minimum Reduced Ramp Rate Floor Percent** - Minimum percentage of the bid-in ramp rate used for the reduced energy ramp rate logic when a unit is providing both energy and regulation
  - If you enter zero (the default values) then 100% of the assigned Regulation MW (divided by 5) will reduce the bid-in energy ramp rate for SCED
  - Note: Hourly updates are made on the Regulation Update screen, not the Unit Hourly Screen

Regulation Offers

Daily offers for Regulation Offers are entered in Regulation Offers page

Unit	Schedules	Dispatch Lambda	Market Results	Regulation Market	Synchronized Reserve Market	Nonsynchronized Reserve Market	DA Scheduling Reserve Market	Con Ed	Parameter Limits	Interface Pricing	Opportunity Cost Calculator

Regulation Offers	Regulation Updates	Regulation Bilaterals

Regulation Offers Search

Portfolio: [▼]   Unit: [▼]   Date: 12/27/2013 (mm/dd/yyyy) [Change Date]

[Get Report]
[Get CSV Report]

Pages: 1 2 3 4 Next

Records: 1 - 10 of 35 matches.

Regulation Offers Results for ALL LOCATIONS on 12/27/2013

[Submit]

Location	Area	Reg Type	Offer MW	Capability Offer Price	Performance Offer Price	Capability Offer Cost	Performance Offer Cost	Heat Rate @ Eco Max	Heat Rate @ Reg Min	VOM Rate	Fuel Cost	Energy Storage Loss	Eco Max MW	Reg Min MW	Min Offer MW	Available Status	Self Scheduled	Rolling Avg. Performance Score
Steamer 1	PJM_RTO	A	0	0.00	(null)	(null)	(null)	(null)	(null)	(null)	(null)	(null)	52	20	0.0	Not Available	-	(null)
Steamer 2	PJM_RTO	A	15	6.30	0.30	12.31	0.30	9662	9714	0	2.35	(null)	585	425	5.0	Available	-	(null)
Steamer 3	PJM_RTO	A	16	12.33	0.29	12.33	0.29	9837	9890	0	2.38	(null)	585	425	10.0	Available	-	(null)
Steamer 4	PJM_RTO	A	10	8.28	0.67	12.28	0.67	10714	10761	0	2.94	(null)	630	425	3.0	Available	-	(null)
Steamer 5	PJM_RTO	A	11	9.17	0.39	15.17	0.39	10352	11457	0	4.03	(null)	339	141	2.0	Available	-	(null)
Steamer 6	PJM_RTO	A	8	7.49	0.57	13.49	0.57	10671	11377	0	3.26	(null)	400	160	2.0	Available	-	(null)
Big CC 1	PJM_RTO	A	10	12.57	0.48	13.57	0.48	11173	11915	0	3.27	(null)	400	160	3.0	Available	-	(null)
Big CC 2	PJM_RTO	A	25	6.37	0.48	12.37	0.48	9908	9942	0	2.72	(null)	1320	1125	6.0	Not Available	-	(null)
Big CT 1	PJM_RTO	A	25	12.12	0.45	12.12	0.45	9613	9629	0	2.96	(null)	1320	950	6.0	Available	-	(null)
Big CT 2	PJM_RTO	A	9	8.40	0.26	13.63	0.26	10305	10716	0	3.6	(null)	210	110	2.0	Available	-	(null)

Entries in the Regulation Updates page will override entries on the Regulation Offers page for the hour ending. **The deadline for entering the Regulating Updates is 60 minutes prior to the beginning of the desired operating hour ending. For example, a Regulation Update for hour ending 15 must be made by 13:00 (beginning of hour ending 14)**

Regulation Bilaterals

Questions ?