

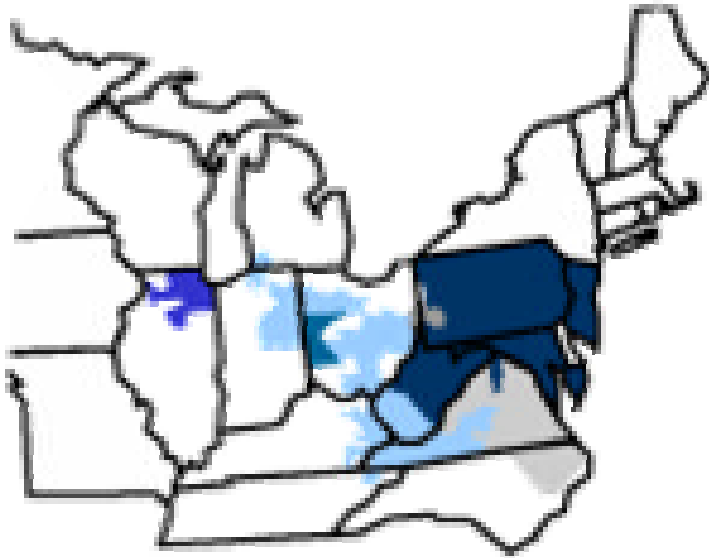


Managing Inter-Regional Coordination with a Joint Operating Agreement

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PJM RTO



PJM - Full Service RTO

- Control Area Operator
- Transmission Provider
- Market Administrator
- Regional Transmission Planner
- NERC Reliability Coordinator

PJM RTO

Generating Units	1,082
Generation Capacity	165,640 MW
Peak Load	135,002 MW
Annual Energy	720,000 GWh
Transmission Miles	56,000
Area (Square Miles)	164,000
Customers	21 Million
Population Served	51 Million
States (+ D.C.)	13 states + D.C.



Joint Operating Agreement (“JOA”) Overview

Objectives

- **Formal, comprehensive approach to management of market, operations and planning coordination among neighboring systems**
- **Proactive management of coordination issues on all levels – long term planning, real-time operations, market operations**
- **Contractual and transparent declaration of all aspects of coordination**

- Publicly filed document
- Transparency of information to be exchanged
- Transparency of coordination procedures
- Best Practices for congestion management
- Best Practices for regional reliability
- Best practices for regional planning
- Defines the on-going process to manage coordination
- Clearly and publicly defines the implementation process and timeline of all aspects of coordination

- **Triggers for coordination activities**
 - Staged integration of activities based on market integration phases
- **Information Exchange**
 - Detailed data exchange based on reliability requirements and coordination
- **ATC/AFC Calculation Coordination**
 - Common approach to reservation management and ATC/AFC calculations for OASIS
- **Flowgate Coordination**
 - Real-time operational coordination

- **Outage Coordination**

- Data exchange and communication protocols for consistent treatment of outages

- **Emergency Procedure Coordination**

- Communications and coordination protocols

- **Regional Transmission Planning Coordination**

- Defines approach for joint planning and coordination of upgrades

Congestion Management Provisions

Market to Non-Market:

- Manage congestion along the borders between a market area and a non-market area

Market to Market:

- Manage congestion along the borders between two market areas



1990's - Effective but inefficient Regional Congestion Management was introduced

- Transmission Line loading Relief (TLR)
 - identify flowgates (frequently constrained segments of the transmission system)
 - monitor flowgates and generate alarms for overload conditions (manually)
 - **curtail regional transactions** that impact loading on flowgates based upon their priority of transmission service

- MISO assessed the impact of 900 of its 1200 TLRs in 2003:
 - ***Too Frequent use*** - 10,800 curtailment hours
 - ***Inefficient*** - resulted in 13% underutilization of transmission system
 - ***Too Slow to take effect*** - flows violated security limits in 556 (60%) of the curtailments



Late 1990's - LMP or Locational Marginal Pricing managed congestion efficiently in a single region

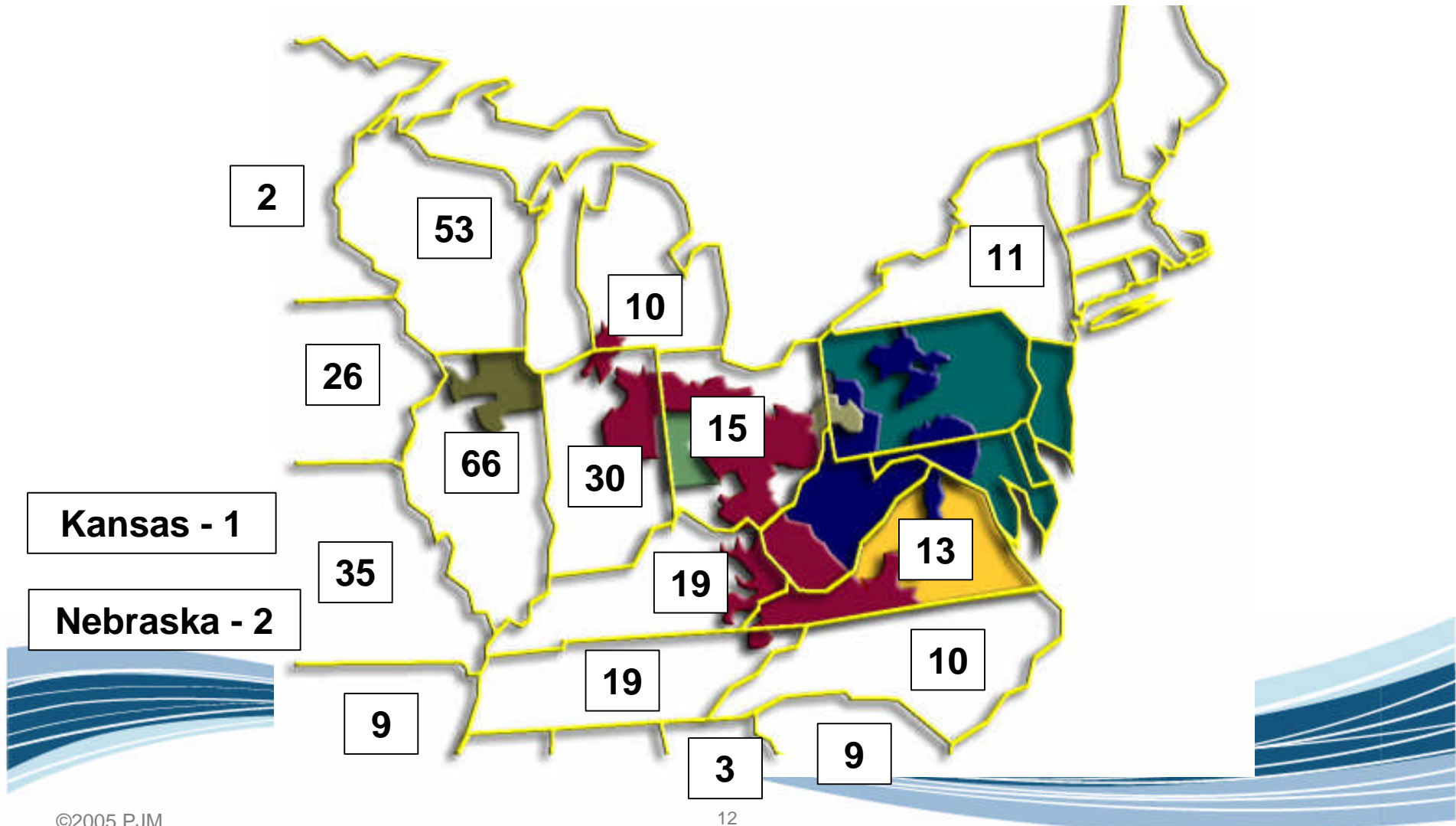
- **security-constrained, economic dispatch**
- **determined the economic value of generation in real time at every node on the system based upon:**
 - **transmission system parameters**
 - **generation loading**
 - **transactions**



Regional Solution Market-to-Market Congestion Management

- **Use LMP for a regional solution**
- **Identify flowgates and level of acceptable parallel flows by each region on each flowgate**
- **If the reliability limit of the flowgate is exceeded, all regions impacting the flowgate will redispatch generation to respect the flowgate limit**

PJM respects 333 flowgates external to its footprint.



- **Reciprocal Coordinated Flowgates (RCFs)** that are owned by MISO or PJM are used in Market-to-Market Coordination
- Coordination of RCF constraints results in consistent pricing near RTO borders

Redispatch Coordination

- Each RTO has the ability to request additional Firm Flow Entitlement (FFE) of RCFs from the other RTO in their Day-Ahead (DA) market.
- DA Coordination happens only by exception under abnormal conditions
- DA Coordination consists of only a single evaluation. It is NOT an iterative approach.
- Real-Time compensation then flows between RTOs based on usage over any adjusted FFE.



Real-Time Coordination Overview (cont'd)

- The result of this coordination is the most economic redispatch solution for the combined footprint.
- The RTOs compensate each other for the redispatch provided based on real-time market flows compared to flow entitlements.
- The compensation enables each RTO to remain revenue adequate (fully funding its Financial Transmission Rights) while providing flowgate relief to the other.

Day-Ahead Coordination Steps



Either RTO requests additional usage of an RCF from the other RTO in the DA market.



RTO being requested analyzes projected usage of flowgate and informs requesting RTO whether additional usage can be granted.



If granted both RTOs adjust DA limit for the subject RCF in their DA analyses.



Real-Time Coordination Steps



Monitoring RTO informs non-monitoring RTO when RCF binds in dispatch solution.

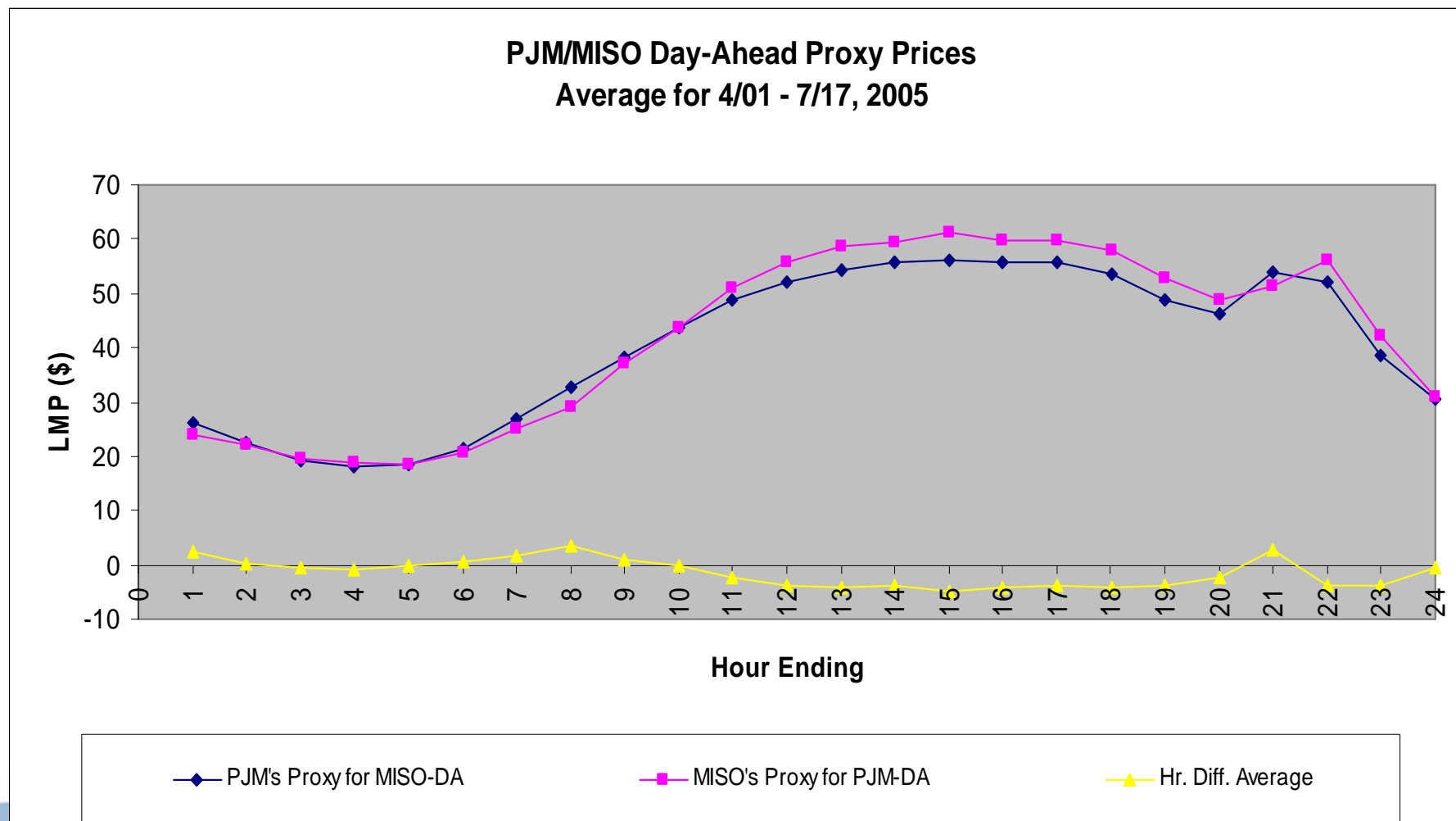


Monitoring and non-monitoring RTOs continue to exchange shadow price information throughout operation for constraint to ensure least-cost overall solution.

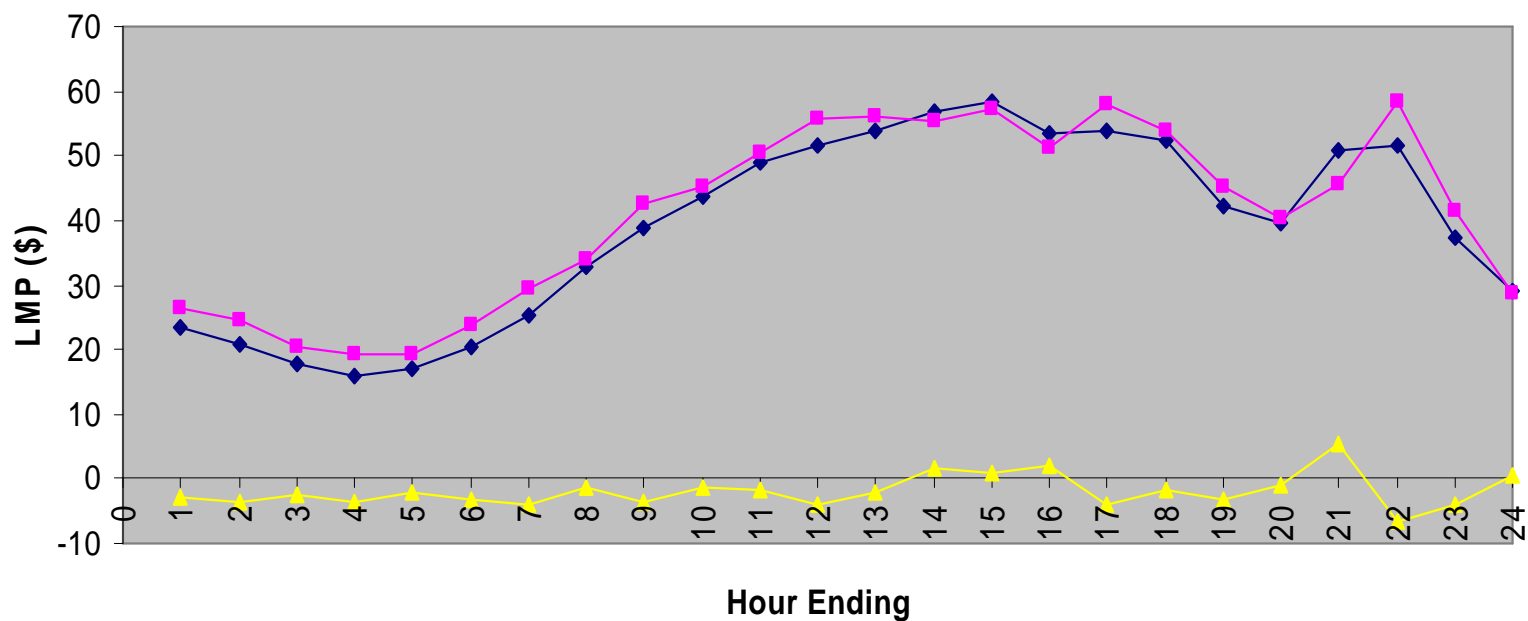


Monitoring RTO informs non-monitoring RTO when RCF is no longer binding and constraint is ended.





PJM/MISO Real-Time Proxy Prices **Average from April 1st through July 17th, 2005**



◆ PJM's Proxy for MISO-RT

■ MISO's Proxy for PJM-RT

▲ Hr. Diff. Average-RT