

NYISO/PJM

Market-to-Market Coordination

Joint Stakeholders Meeting

November 3, 2011

Agenda

- Project Timeline & Progress Report
- Key Concepts
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Real-Time Coordination
 - Incorporate Ramapo PAR
- Entitlements
- Settlements
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Next Steps

Project Timeline

Task	Delivery by End of
<p>Market Flow Calculator: Includes specification, development, testing, and implementation of calculation engine, incorporating common treatment for PAR operational requirements and model representation</p>	3rd QTR – 2011
<p>Joint Operating Agreement: Includes defining entitlements and filing for Commission approval</p>	4th QTR – 2011
<p>Software Specifications: Completion of documentation defining changes necessary to administer real-time constraint coordination, settlement administration, audit and validation</p>	3rd QTR – 2011
<p>Software Development: Completion of software tools necessary to administer and settle Market-to-Market outcomes, and validate the results</p>	2nd QTR – 2012
<p>Software Ready: Completion of software validation, including finalized software development, software performance and completeness testing, process validation and operator training</p>	4th QTR – 2012
Implementation	4th QTR – 2012

Progress Report

- Status of Development Efforts
 - Market Flow Calculation
 - Software Requirements / Development
- Status of Joint Operating Agreement

Agenda

- Project Timeline & Progress Report
- Key Concepts
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Real-Time Coordination
 - Incorporate Ramapo PAR
- Entitlements
- Settlements
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Next Steps

Market-to-Market Coordination

- ✓ Achieves the **least cost re-dispatch** solution for coordinated constraints across multiple systems
- ✓ Provides a more **consistent pricing** profile across two markets
- ✓ Enhances **system reliability** by pooling resources from both RTO's to jointly control transmission constraints near the RTO border
- ✓ Potomac Economics estimates the achievable NY benefits of M2M with PJM to be approximately **\$10M annually**

Re-Dispatch Key Concepts

Real Time / Market-to-Market Coordination

- A mechanism for NYISO and PJM to provide more cost effective management of constraints from a larger pool of resources

Monitoring RTO (MRTO)

- The RTO that has the primary responsibility for monitoring and control of a coordinated Flowgate

Non-Monitoring RTO (NMRTO)

- The RTO that does not have the primary responsibility for monitoring and control of a Flowgate, but does have resources that impact the Flowgate

Re-Dispatch Key Concepts

Market Flow

- The flow in MW on a Flowgate that is caused by all real-time control actions to serve load in the RTO footprint

M2M Flowgate

- A Flowgate that may be significantly impacted by the dispatch of generation serving load in an adjacent market or impacted by Ramapo PAR control
- A Flowgate is also known as a transmission constraint

Re-Dispatch Coordination Entitlements (M2M Entitlement)

- Predetermined MW amount that a market entity is entitled to per Flowgate based on its historical impacts to that Flowgate. In the M2M process, real time usage is compared to entitlement to determine settlement

Re-Dispatch Key Concepts

Re-Dispatch Coordination Flowgate

- A Flowgate that is significantly impacted by the dispatch of generation serving load in the adjacent market.

Ramapo PAR Coordination Flowgate

- A Flowgate that may be impacted by Ramapo PAR control. Ramapo PAR Coordination Flowgates will encompass all M2M Flowgates.

Ramapo Key Concepts

Ramapo Target (Ramapo PAR Entitlement)

- The desired flow across the Ramapo PARs. The target will be the sum of
 - 61% of PJM-NY Net Scheduled Interchange over the AC ties, and
 - 72% of the difference of JK and ABC off-schedule flows

Ramapo Overuse

- The difference of actual flow across the Ramapo PARs less the Ramapo Target

Cost of PJM Overuse (NY congestion costs)

- The sum of impact of Ramapo PARs (in the form of a shift factor) on a M2M Flowgate multiplied by that M2M Flowgate's Shadow Price for every binding NY M2M Flowgate

Cost of NY Overuse (PJM congestion costs)

- The sum of impact of Ramapo PARs (in the form of a shift factor) on a M2M Flowgate multiplied by that M2M Flowgate's Shadow Price for every binding PJM M2M Flowgate

Agenda

- Project Timeline & Progress Report
- Key Concepts
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Real-Time Coordination
 - Incorporate Ramapo PAR
- Entitlements
- Settlements
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Next Steps

Purpose

Reduces Congestion

- Expands the pool of assets that are capable of addressing the region's transmission constraints
- Provides better price convergence at the borders as a collective set of assets are used to resolve system limitations

Reduces the Overall Cost Of Congestion

- Provides an RTO with the ability to request generation re-dispatch from neighboring market
- Solves internal constraints at a lower cost

M2M Re-Dispatch Coordination

- Requires manual coordination of NYISO and PJM Operations
 - M2M activation notifications will be done manually when an Re-Dispatch Coordination Flowgate is constrained
- Once re-dispatch has been activated, an automated exchange of data will be coordinated and used for M2M re-dispatch:
 - Flowgate ID, Flowgate Shadow Price, Flowgate Market Flow
 - Note: A Flowgate is also known as a transmission constraint

M2M Ramapo Coordination

- M2M Flowgates and Ramapo Operation
 - Impacts on all M2M Flowgates (known as Ramapo PAR Coordination Flowgates) will be considered for Ramapo Operation
- Market Flow Calculation Adjustment
 - Market Flow Calculation will separate out the impacts of generation dispatch and PAR schedule impacts on each Ramapo PAR Coordination Flowgate
- Does not require manual activation to invoke M2M Coordination
 - Ramapo PAR coordination is already a manual action

Agenda

- Project Timeline & Progress Report
- Key Concepts
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Real-Time Coordination
 - Incorporate Ramapo PAR
- Entitlements
- Settlements
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Next Steps

M2M Entitlements

- Based on determining the historic impacts of the Non-Monitoring RTO's generation on the Monitoring RTO's Flowgates
- Determined using the Market Flow Calculation where:
 - Shift Factors will be determined using a mutually agreed upon representation of the Eastern Interconnection where all normally in-service facilities are modeled as in-service
 - 2009 through 2011 Generation and Load Data
 - Perfect PAR Control exists

M2M Entitlements

- M2M Entitlements will be determined based on four separate periods for each hour of a seven day week
 - Period 1: December, January, and February
 - Period 2: March, April, and May
 - Period 3: June, July, and August
 - Period 4: September, October, and November
- To determine the M2M Entitlement for a particular Re-Dispatch Coordination Flowgate that will be used for every Tuesday at Hour 3 within Period 1:
 - Compute the Hour 3 Market Flow for that M2M Flowgate, for each Tuesday in December, January, and February for 2009 through 2011; and
 - Average those Market Flows

M2M Entitlements

- Determined once and then adjusted as new Transmission facilities are placed in-service
 - The adjustment for new Transmission facilities will be based on how the new Transmission facility changes the distribution of flow between NYISO and PJM
- Determined for Re-Dispatch Coordination Flowgates

M2M Entitlements

- The initial M2M Entitlement calculations will be performed and the results mutually agreed to by both NYISO and PJM
- Later, the Monitoring RTO will calculate changes to the Non-Monitoring RTO's entitlement
- The Non-Monitoring RTO will have the opportunity to dispute any entitlement calculation that it doesn't agree with
- The mutually agreed initial M2M Entitlements determination will be completed in 2012 prior to implementing M2M with PJM

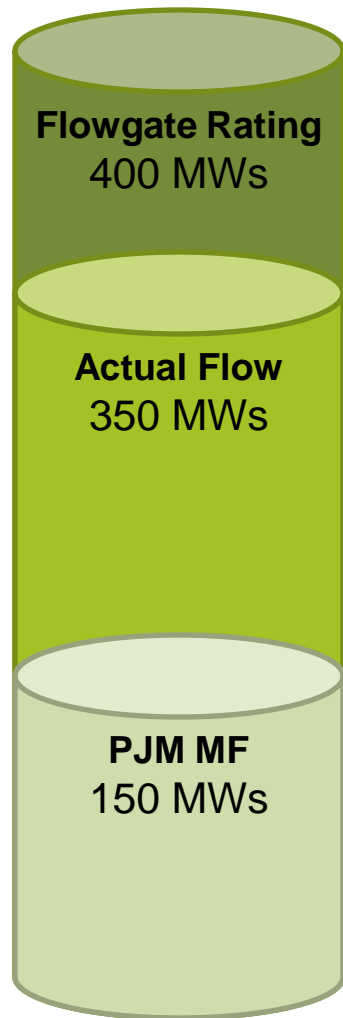
Agenda

- Project Timeline & Progress Report
- Key Concepts
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Real-Time Coordination
 - Incorporate Ramapo PAR
- Entitlements
- Settlements
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Next Steps

Settlement

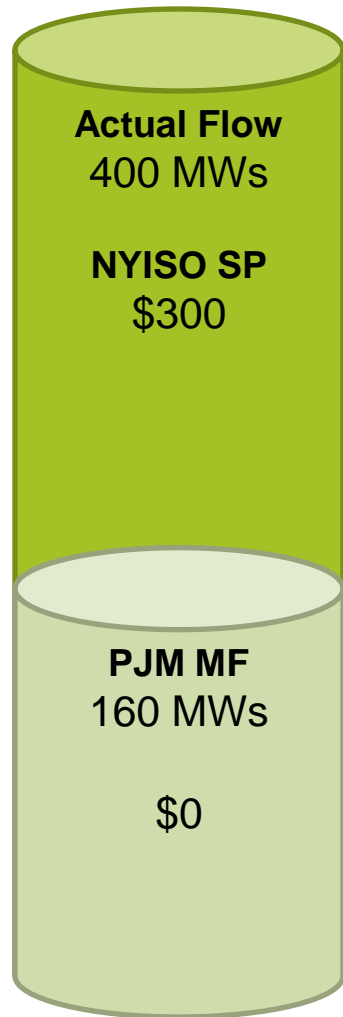
- The NYISO is performing the settlement calculations for both NY and PJM
 - The NYISO will produce invoices for PJM indicating the amount payable to/receivable from PJM
- The settlement calculation will be based on interval level data
- M2M Settlement includes:
 - M2M Re-dispatch Coordination
 - M2M Ramapo PAR Coordination

M2M Re-Dispatch Example – Step 0



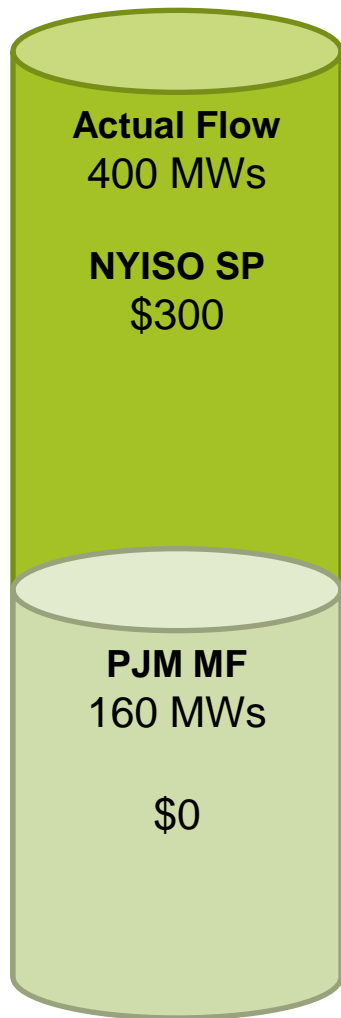
- Initial Conditions
- A NYISO Re-Dispatch Coordination Flowgate is being monitored in real-time
 - NYISO is the MRTTO
 - PJM is the NMRTTO
 - Re-Dispatch Coordination Flowgate Rating = 400 MWs
 - Actual Flow = 350 MWs
 - PJM Market Flow = 150 MWs
 - Re-Dispatch Coordination Flowgate is not constrained

M2M Re-Dispatch Example – Step 1



- NYISO Re-Dispatch Coordination Flowgate becomes constrained
 - Re-Dispatch Coordination Flowgate Rating = 400 MWs
 - Actual Flow = 400 MWs
 - PJM Market Flow = 160 MWs
- NYISO calculates a shadow price of \$300 based on its redispatch for the Re-Dispatch Coordination Flowgate

M2M Re-Dispatch Example – Step 2



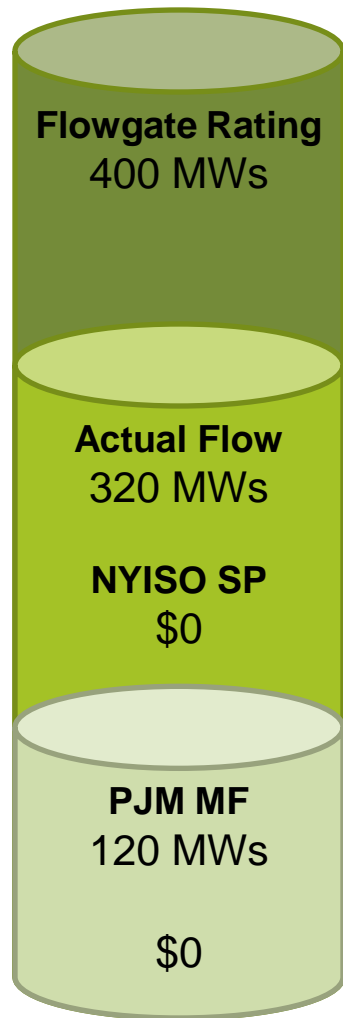
- NYISO Re-Dispatch Coordination Flowgate is constrained
 - Actual Flow = 400 MWs
 - PJM Market Flow = 160 MWs
 - NYISO shadow price = \$300
- NYISO requests PJM to redispatch for the Re-Dispatch Coordination Flowgate
 - NYISO electronically sends the \$300 shadow cost
 - NYISO verbally confirms that PJM is able to enter into M2M with NYISO for this Re-Dispatch Coordination Flowgate
- PJM begins redispatching for this Re-Dispatch Coordination Flowgate
- M2M Settlements Begin

M2M Re-Dispatch Example – Step 3



- This step iterates until M2M ends
- PJM redispatches for this Re-Dispatch Coordination Flowgate
 - PJM shadow price = \$250
 - PJM Market Flow = 150 MWs
- NYISO Re-Dispatch Coordination Flowgate is still constrained
 - NYISO continues to redispatch
 - Actual Flow = 400 MWs
 - NYISO shadow price = \$270
- Automatically, the M2M software continues to update PJM with the latest Re-Dispatch Coordination Flowgate data
 - NYISO electronically sends the \$270 shadow cost

M2M Re-Dispatch Example – Step 4



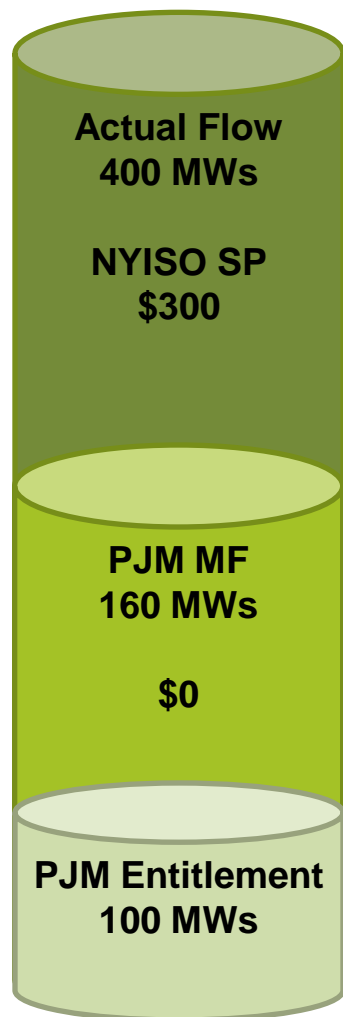
- M2M Coordination Process continues until the Re-Dispatch Coordination Flowgate is no longer constrained
- M2M Settlements End

Re-Dispatch Settlement

- Settlements are based on:
 - Re-Dispatch Coordination Flowgate Market Flow
 - Re-Dispatch Coordination Flowgate Shadow Price
 - M2M Entitlements for the Re-Dispatch Coordination Flowgate

- Settlements occur when Real-Time M2M Coordination was invoked for a Re-Dispatch Coordination Flowgate

M2M Re-Dispatch Settlement – Ex. 1

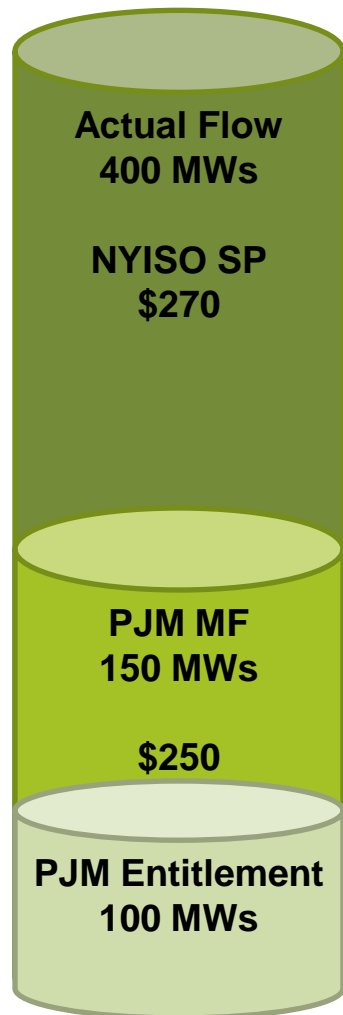


Example 1

- NYISO Re-Dispatch Coordination Flowgate is constrained
 - Actual Flow = 400 MWs
 - PJM Market Flow = 160 MWs
 - NYISO shadow price = \$300
- PJM begins re-dispatching for this Re-Dispatch Coordination Flowgate
- M2M Settlements Begin
 - PJM Entitlement = 100 MWs
 - PJM is over its entitlement
 - PJM pays $(160 \text{ MWs} - 100 \text{ MWs}) * \300 or \$18,000.00

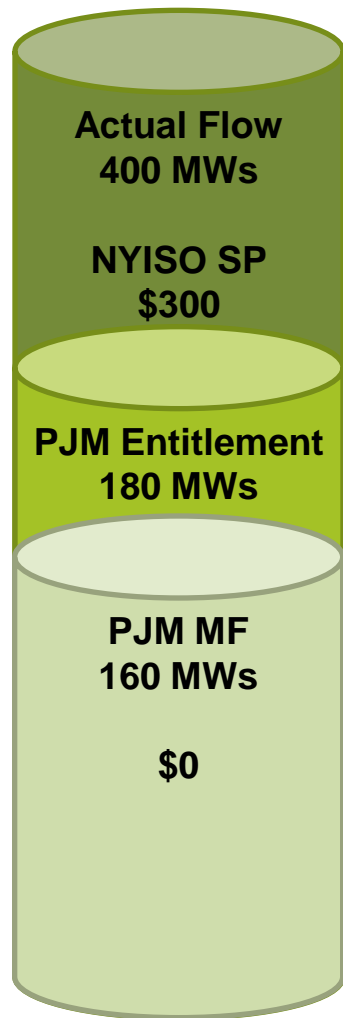
M2M Re-Dispatch Settlement – Ex. 1

Example 1 (cont.)



- PJM redispatches for this Re-Dispatch Coordination Flowgate
 - PJM shadow price = \$250
 - PJM Market Flow = 150 MWs
- NYISO Re-Dispatch Coordination Flowgate is still constrained
 - NYISO continues to redispatch
 - Actual Flow = 400 MWs
 - NYISO shadow price = \$270
- M2M Settlement
 - PJM Entitlement = 100 MWs
 - PJM is over its entitlement
 - PJM pays $(150 \text{ MWs} - 100 \text{ MWs}) * \270 or \$13,500

M2M Re-Dispatch Settlement – Ex. 2



Example 2

- NYISO Re-Dispatch Coordination Flowgate is constrained
 - Actual Flow = 400 MWs
 - PJM Market Flow = 160 MWs
 - NYISO shadow price = \$300
- PJM begins redispatching for this Re-Dispatch Coordination Flowgate
- M2M Settlements Begin
 - PJM Entitlement = 180 MWs
 - PJM is under its entitlement
 - NY pays $(180 \text{ MWs} - 160 \text{ MWs}) * \0 or \$0.00

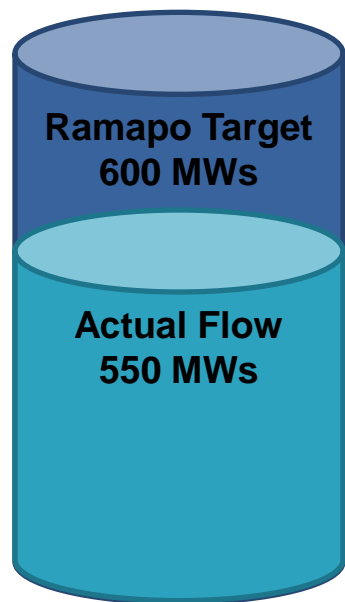
M2M Re-Dispatch Settlement – Ex. 2

Example 2 (cont.)



- PJM redispatches for this Re-Dispatch Coordination Flowgate
 - PJM shadow price = \$250
 - PJM Market Flow = 150 MWs
- NYISO Re-Dispatch Coordination Flowgate is still constrained
 - NYISO continues to redispatch
 - Actual Flow = 400 MWs
 - NYISO shadow price = \$270
- M2M Settlement
 - PJM Entitlement = 180 MWs
 - PJM is under its entitlement
 - NY pays $(180 \text{ MWs} - 150 \text{ MWs}) * \250 or \$7,500

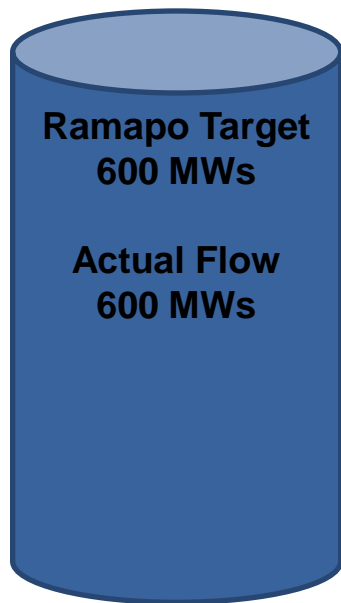
M2M Ramapo Example 1



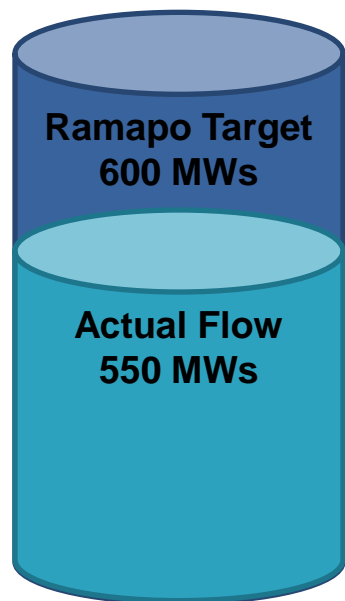
- Initial Conditions
- There are several Ramapo PAR Coordination Flowgates within PJM and NY that are constrained
 - Cost of NY Overuse = \$120/MWH
 - Cost of PJM Overuse = \$230/MWH
 - Ramapo Actual Flow = 550MWs
 - Ramapo Target Flow = 600MWs
- Since the Cost of PJM Overuse is greater than the Cost of NY Overuse, Ramapo would be operated to cause more flow into NY over Ramapo in this example

M2M Ramapo Example 1

- Ramapo Operation
- Since the Cost of PJM Overuse is greater than the Cost of NY Overuse, Ramapo would be operated to cause more flow into NY over Ramapo
- After Ramapo has been moved
 - Cost of NY Overuse = \$170/MWH
 - Cost of PJM Overuse = \$175/MWH
 - Ramapo Actual Flow = 600MWs
 - Ramapo Target Flow = 600MWs



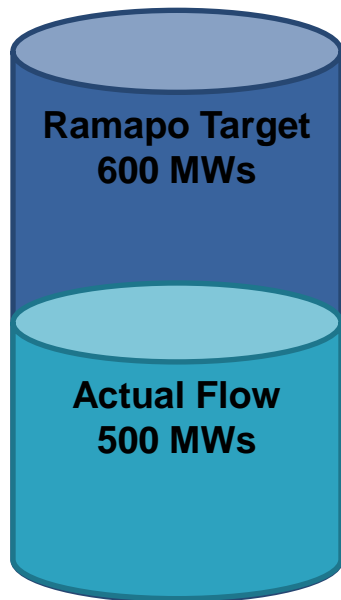
M2M Ramapo Example 2



- Initial Conditions
- There are several Ramapo PAR Coordination Flowgates within PJM and NY that are constrained
 - PJM Congestion Cost = \$120/MWH
 - NY Congestion Cost = \$80/MWH
 - Ramapo Actual Flow = 550MWs
 - Ramapo Target Flow = 600MWs
- Since the PJM Congestion Cost is greater than the NY Congestion Cost, Ramapo would be operated to cause more flow into PJM over Ramapo in this example

M2M Ramapo Example 2

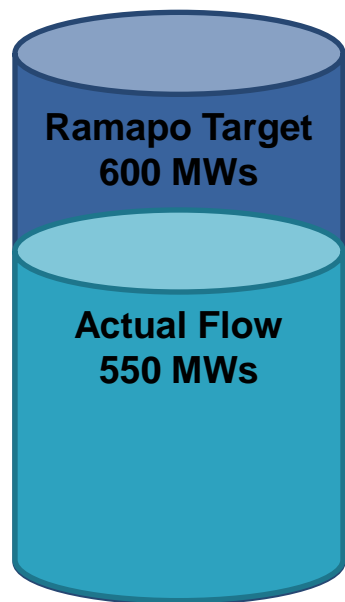
- Ramapo Operation
- Since the PJM Congestion Cost is greater than the NY Congestion Cost, Ramapo would be operated to cause more flow into PJM over Ramapo
- After Ramapo has been moved
 - PJM Congestion Cost = \$95/MWH
 - NY Congestion Cost = \$90/MWH
 - Ramapo Actual Flow = 500MWs
 - Ramapo Target Flow = 600MWs



M2M Ramapo Settlement

- Settlements are based on:
 - Ramapo Overuse - the difference of actual flow across the Ramapo PARs less the Ramapo Target
 - Cost of Overuse/Congestion Cost - the incremental cost of congestion for all binding Ramapo PAR Coordination Flowgates at Ramapo

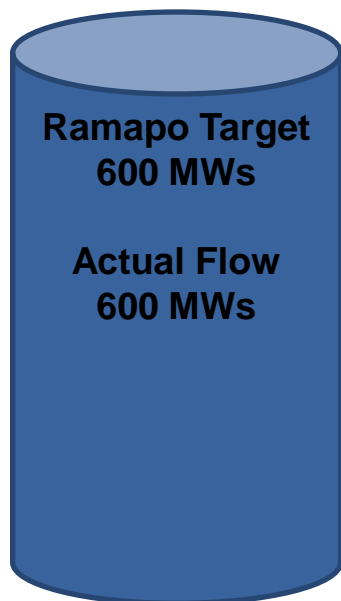
M2M Ramapo Settlement – Example 1



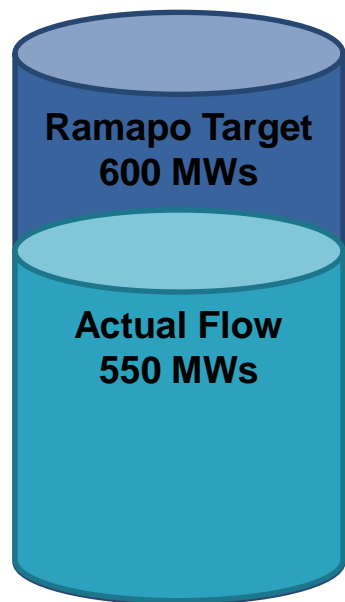
- There are several Ramapo PAR Coordination Flowgates within PJM and NY that are constrained
 - Cost of NY Overuse = \$120/MWH
 - Cost of PJM Overuse = \$230/MWH
 - Ramapo Actual Flow = 550MWs
 - Ramapo Target Flow = 600MWs
- Ramapo Actual Flow < Ramapo Target Flow
 - PJM is Overusing NY's Transmission System
- Ramapo Settlement is:
 - Cost of PJM Overuse X Ramapo Overuse
 - \$230/MWH X 50MWs = \$11,500/H

M2M Ramapo Settlement – Example 1

- After Ramapo has been moved
 - PJM Congestion Cost = \$170/MWH
 - NY Congestion Cost = \$175/MWH
 - Ramapo Actual Flow = 600MWs
 - Ramapo Target Flow = 600MWs
- Ramapo Actual Flow = Ramapo Target Flow
 - No overuse is occurring
- Ramapo Settlement is:
 - \$0

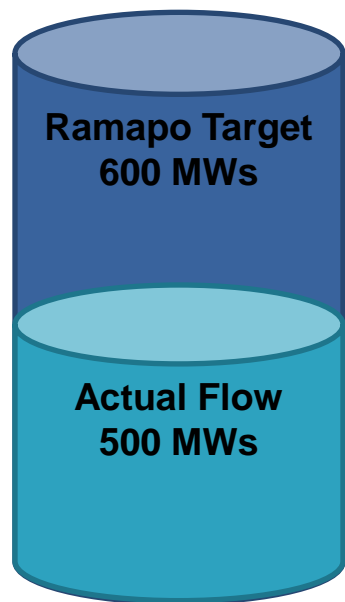


M2M Ramapo Settlement – Example 2



- There are several Ramapo PAR Coordination Flowgates within PJM and NY that are constrained
 - PJM Congestion Cost = \$120/MWH
 - NY Congestion Cost = \$80/MWH
 - Ramapo Actual Flow = 550MWs
 - Ramapo Target Flow = 600MWs
- Ramapo Actual Flow < Ramapo Target Flow
 - PJM is Overusing NY's Transmission System
- Ramapo Settlement is:
 - NY Congestion Cost X Ramapo Overuse
 - \$80/MWH X 50MWs = \$4,000/H

M2M Ramapo Settlement – Example 2



- After Ramapo has been moved
 - PJM Congestion Cost = \$95/MWH
 - NY Congestion Cost = \$90/MWH
 - Ramapo Actual Flow = 500MWs
 - Ramapo Target Flow = 600MWs
- Ramapo Actual Flow = Ramapo Target Flow
 - PJM is still Overusing NY's Transmission System
- Ramapo Settlement is:
 - NY Congestion Cost X Ramapo Overuse
 - \$90/MWH X 100MWs = \$9,000/H

Agenda

- Project Timeline & Progress Report
- Key Concepts
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Real-Time Coordination
 - Incorporate Ramapo PAR
- Entitlements
- Settlements
 - Re-Dispatch Coordination
 - Ramapo PAR Coordination
- Next Steps

Next Steps

- Joint Operating Agreement Revisions and new Market-to-Market Appendix
 - FERC filing Q4 2011
 - Effective Q4 2012

- Continuing Stakeholder Education/Updates

Appendix



Acronyms

- CF - Coordinated Flow Gate
- FFE – Firm Flow Entitlement
- JOA – Joint Operating Agreement
- MRTTO – Monitoring RTO
- M2M – Market-to-Market
- MF – Market Flow
- NMRTTO – Non-Monitoring RTO
- NNL – Network Native Load
- SP – Shadow Price

M2M Flowgate Tests

- M2M Flowgates are determined through a set of tests
 - Non-Monitoring RTO Generation Impact \geq Defined Threshold on the Monitoring RTO Flowgate
 - Ramapo PAR OTDF \geq Defined Threshold on the Monitoring RTO Flowgate
- Flowgates that pass either test are eligible for Ramapo PAR coordination and are identified as Ramapo PAR Coordination Flowgates
 - Additionally, M2M Flowgates that pass the Non-Monitoring RTO Generation Impact test above are eligible for re-dispatch coordination and are identified as Re-Dispatch Coordination Flowgates
- A list of M2M Flowgates will be posted on the NYISO and PJM websites