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Broader Regional Markets

Developing Solutions to Lake Erie Loop Flows

Joint IESO, Midwest ISO, NYISO, PJM Stakeholder Technical Conference

December 15, 2009

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Agenda

- Welcome
- Summary of Stakeholder Feedback
- Recommended Solution Review
- Proposal Updates
 - Increased Coordination
 - Buy-Through of Congestion Update
 - Interface Pricing Update
 - Enhanced Interregional Transaction Coordination
- Parallel Flow Visualization Update
- Next Steps
 - Potential Implementation Timeline
 - January FERC Report
 - Ongoing Efforts

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Summary of Stakeholder Feedback

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Summary of Feedback

- Feedback was received by 11 stakeholders on the Broader Regional Markets Solutions to Loop Flow Whitepaper and Presentations
- Feedback generally grouped as follows:
 - Absent/Deficient
 - Buy-Through
 - Cost/Benefit
 - Physical Solutions
 - Flow Visualization
 - Interregional Transactions
 - Implementation
 - Miscellaneous

Absent/Deficient Comments

- Need better coordination of transmission service between ISO/RTO organizations surrounding Lake Erie
- ATC/AFC calculation and coordination efforts need to be improved to avoid over-selling transmission
- A common interface pricing methodology needs to be put in place by all ISO/RTO organizations surrounding Lake Erie

Buy-Through Congestion

- Hedging instruments
- Credit for congestion relief
- Transaction scheduling options to avoid buy-through congestion charges
- Status of firm service customers rejecting buy-through effectively become non-firm
- Potential to double-charge for congestion
- Contract path entities charges based on real, not scheduled, power flow
- Not a market-based solution
- Potential for market manipulation
- Should include an “up-to” congestion charge option
 - May be possible as seams disappear
- Should compensate for counter-flow transactions
- Bill transactions up to point of curtailment similar to NYISO non-firm transactions

- Estimate resource costs of each proposed solution
- Indication that customers will use buy-through congestion needs to be provided in order to justify development and implementation costs
- Concern expressed that solutions options will require a significant amount of staff resources and capital to implement

Physical Solutions

- General support for installation and operation of the PARs on the Michigan-Ontario Interface
- PARs will not solve market pricing issues
- PARs will improve the ability to control actual power flows to scheduled flows
- PARs may increase actual energy flows south of Lake Erie
- All physical devices are part of the solution to address Lake Erie Loop Flows
- Coordination of all PARs surrounding Lake Erie deemed necessary to control Lake Erie Loop Flows
 - Impact to the Public Service – Consolidated Edison Wheeling Agreement
- Michigan consumers bear the bulk of the PAR device costs while others receive benefits

Flow Visualization

- Flow visualization should not be linked with the required compliance filing
- Seen as a long overdue upgrade
- Expand to include all ISO organizations in regional footprint

Interregional Transactions

- More detail needed on interregional transaction coordination

- Improve interface pricing before implementing buy-through of congestion
- Use Midwest ISO/PJM interface pricing methodology
- Hold mandatory progress status update meetings with stakeholders
- Impacts of staggered implementation
- Implement congestion management before buy-through of congestion

- Additional transmission facilities, such as transmission lines, are needed

Thanks

- Thanks to all of you that took the time to provide comments
- All comments were reviewed and discussed as some length
- Comments and feedback have been posted at the following web location:
http://www.midwestiso.org/publish/Folder/4dfde8_124a04ca493_-7c8e0a48324a
- Additional feedback requested and welcome

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Recommended Solution Review

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Concept Development

- Stakeholder meetings to review background issues and solutions to loop flow concepts.
- Joint ISO Meetings
 - Senior level scope reviews and updates
 - Weekly conference calls and additional in-person meetings to develop concepts of buy-through of congestion and congestion management as well as potential timeline.
- Joint Stakeholder Technical Conference
- Broader Regional Markets Whitepaper describing proposed solutions

- Proposed Solutions to Loop Flows
 - Physical Solution
 - Installation and operation of the Michigan/Ontario PARs to better conform actual power flows to scheduled power flows
- Parallel Flow Visualization
- Market Solutions
 - Buy-Through of Congestion
 - Congestion Management (Market-to-Market Coordination)
 - Interregional Transaction Coordination

Solution Objectives

- Reduce need for, frequency of, and magnitude of Transmission Loading Relief (TLR) events to address loop flow.
 - Buy-Through of Congestion provides an alternative to market and operational interruptions caused by TLR events; establishes an economic based alternative to imposed curtailments.
- Align constraint management cost recovery with sources of flow
 - Parallel Flow Visualization and Buy-Through of Congestion facilitate identification of sources of loop flow and provide a mechanism to recover congestion management costs incurred to support loop flows.
- Reduce constraint management costs for consumers across region.
 - Congestion Management achieves a more cost effective utilization of the region's collective assets to address constraints across multiple systems.
- Improve regional price consistency and transmission utilization
 - Congestion Management expands asset pool to address regional constraints.
 - Interregional Transaction Coordination provides for the more frequent adjustment of interchange schedules in response to changing market conditions; expands pool of flexible assets to balance intermittent power resources output.

Physical Solutions to Loop Flows

- Some control of loop flow can be achieved through the use of physical devices such as phase shifting transformers, also known as phase angle regulators or PARs.
- Control of loop flows around Lake Erie will be improved with the completed installation of the Ontario-Michigan PARs.
 - The intent is to operate the Michigan-Ontario PARs so as to better match actual flows with the scheduled flows across the interconnection.
- Status of Michigan-Ontario PARs
 - Initial installation completed in 1999
 - Ongoing operation delayed due to equipment failures & difficulties in getting operating agreements in place
 - Failed equipment replaced and additional further protection upgrades scheduled to be in place by the end of Q1 2010
- Coordinated Operation of All Devices
 - It is important that the operation of such devices by the four markets around Lake Erie be coordinated to avoid detrimental impacts.

Parallel Flow Visualization

- Provides single common source and methodology for isolating sources of flow.
 - Identify sources of flowgate impact, included Balancing Authority to Balancing Authority interchange schedules, and intra-regional generation-to-load impacts.
 - Incorporates state of phase angle regulator controls.
 - Methodology defined at vetted in NERC working groups.
- Market visibility of impacts available through the NERC IDC or OATi tools.
- Loop flow impacts calculated by IDC will reflect the ability (or lack thereof) of the PARs to maintain actual flow consistent with scheduled flow.

Buy-Through of Congestion

- Benefits
 - Buy-Through of Congestion provides for the recovery of congestion management costs incurred in managing loop flow impacts.
 - Provides for an alternative to market and operational interruptions caused by Transmission Loading Relief (TLR) actions by establishing an economic based alternative to imposed curtailments.
 - More efficient utilization of the transmission network.
 - More consistent transaction scheduling decisions with regional prices.
- Concept
 - Parties scheduling transactions with any of the other ISO/RTOs surrounding Lake Erie would be billed for the real-time congestion costs incurred by neighboring systems supporting the loop flow created by the transaction to maintain the schedule.
 - Exposure to congestion costs can be hedged with existing Day-Ahead transmission scheduling processes, or avoided with real-time scheduling processes

Market-to-Market Coordination

- Benefits
 - Lower congestion cost: The redispatch cost for the market would have been higher if one RTO had to control all transmission constraints on its own.
 - More consistent pricing across the RTO border: When the market-to-market coordination is in effect, the prices at the border converge better than before.
 - More Reliable operation: Since economic generation in another RTO/ISO is now available for constraint control, the other should experience fewer emergency transmission operations.
- Concept
 - Achieve the least cost redispatch solution for coordinated constraints across multiple systems.
 - Provide a more consistent pricing profile across the two markets.
 - Enhance system reliability by pooling resources from both RTOs to jointly control transmission constraints near the RTO border.

Interregional Transaction Coordination

- Benefits
 - In-hour transaction scheduling lowers total system operating costs through improved consistency of transaction schedules with market-to-market price patterns.
 - Expand pool of flexible assets to balance intermittent power resources output.
 - Improve price consistency and transmission utilization across markets.
 - Address uncertainty in forward looking scheduling horizons.
- Concept
 - Allow Market Participants to provide flexible energy, reserve and regulation transaction bids, where the real-time dispatch tools will evaluate these flexible transactions on an intra-hour basis.

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Proposal Updates

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Increased Coordination

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Stakeholder Feedback Summary

- Need better coordination of transmission service between ISO/RTO organizations surrounding Lake Erie
- ATC/AFC calculation and coordination efforts need to be improved to avoid over-selling transmission
- A common interface pricing methodology needs to be put in place by all ISO/RTO organizations surrounding Lake Erie

Current NYISO/PJM ATC/AFC Coordination Practices

- NYISO/PJM Joint Operating Agreement specifies the exchange of
 - Scheduled outage information for a minimum of 18 months
 - Interchange schedule information for use in calculation of TTC, ATC/AFV values
 - Transmission configuration changes
 - Generation additions and retirements
- Transmission system impacts are also coordinated as needed with other:
 - Reliability Coordinators
 - Balancing Authorities
 - Generator Operators
- Develop and implement action plans to mitigate potential or actual violations of:
 - Security Operating Limit (SOL)
 - Interconnection Reliability Operating Limit (IROL)
 - Control Performance Standard (CPS)
 - Disturbance Control Standard (DCS)

Current Midwest ISO/PJM ATC/AFC Coordination Practices

- Conducted in a similar manner to NYISO/PJM coordination practices described previously
- Additional calculations are performed to support the Congestion Management Process in place between the Midwest ISO and PJM
 - Calculation of Firm Flow Limits on Coordinated Flowgates
 - Directional market flow impacts on all Coordinated Flowgates
 - Determines the portion of flows in each direction considered Firm and Non-firm for both the current hour and next hour
 - Marginal units and associated participation factors for generation within the market footprint are provided at least quarterly to Reliability Coordinators
 - Determines the impacts of schedule curtailment requests when they result in a shift in the dispatch within the market area
- Congestion Management Process effectively extends the value of the TTC/ATC/AFC calculation process
 - Includes generation impacts on constrained flowgates
 - Maximized the use of constrained transmission facilities
 - Minimizes the need to use TLR to control transmission congestion created by loop flows

- Each ISO has established processes for approving firm transaction requests
- All transmission providers currently honor the physical capabilities of the transmission system surrounding Lake Erie prior to accepting a transmission service request

Increasing ATC/AFC Coordination

- Incremental improvements will not necessarily reduce loop flows around Lake Erie
- The development and implementation of a Congestion Management Process between all parties around Lake Erie will improve ATC/AFC coordination by
 - Including generation impacts on constrained flowgates
 - Maximizing the use of constrained transmission facilities
 - Minimizing the need to use TLR to control transmission congestion created by loop flows
- All parties surrounding Lake Erie will continue to look for additional opportunities to improve ATC/AFC coordination

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Buy-Through of Congestion Update

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Management of Congestion Cost Exposure

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Stakeholder Feedback Summary

- Several parties have commented on the need for an up-to-congestion option to provide a hedging opportunity to the cost exposure from parallel flow congestion charges.
- Concerns expressed with impact on trading volume in the absence of option.

- Existing transaction scheduling already involves evaluating
 - Price forecasts
 - Hedging opportunities
 - Cost exposures.
- Existing scheduling does not include automated price termination thresholds.
- Recognize that the buy-through of congestion provisions do result in a new cost exposure to transaction scheduling.
- However, consideration of this new exposure will parallel existing evaluations of contract path cost risks.

Hedging Options

- NYISO: Up-to congestion product available in DA.
Opportunities to expand virtual trading to the proxy bus locations and virtual trading based upon price differences.
- PJM: Up-to congestion product available in DA.
20-minute notice schedule termination.
Virtual bidding options available.
- MISO: Up-to congestion product available in DA.
20-minute notice schedule termination.
Virtual bidding options available.
- IESO: No products currently available.

- In support of providing sufficient transparency of potential congestion cost charges, additional information will be available:
 - Flowgate Impacts
 - Constraint Shadow Costs
 - Observed Circulation
- Alternative solutions may be available from third party services based upon public data provided by IDC.

- Support provisions to ensure necessary data visibility and transparency of occurring and projected congestion costs to allow full consideration of the potential cost exposure, as well as availability of hedging products to allow traders to purchase congestion management service within the day-ahead markets.
- Capabilities will allow traders to manage cost exposure without the availability of an up-to product, consistent with existing cost risk management.

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Buy-Through of Congestion Scheduling Process

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Scheduling Process Considerations

- Initiated during the hour ahead [*Allows the balancing authority to plan its way into reliable real-time operation*]
- TLR timing and procedures take priority and must not be compromised by buy-through of congestion provisions [*Allows TLRs to be called in a timely manner*]
- There is no distinction between firm and non-firm transmission transactions within the Buy-Through of Congestion process [*Willingness to pay (off-contract path) congestion costs not linked to transmission service selected.*]

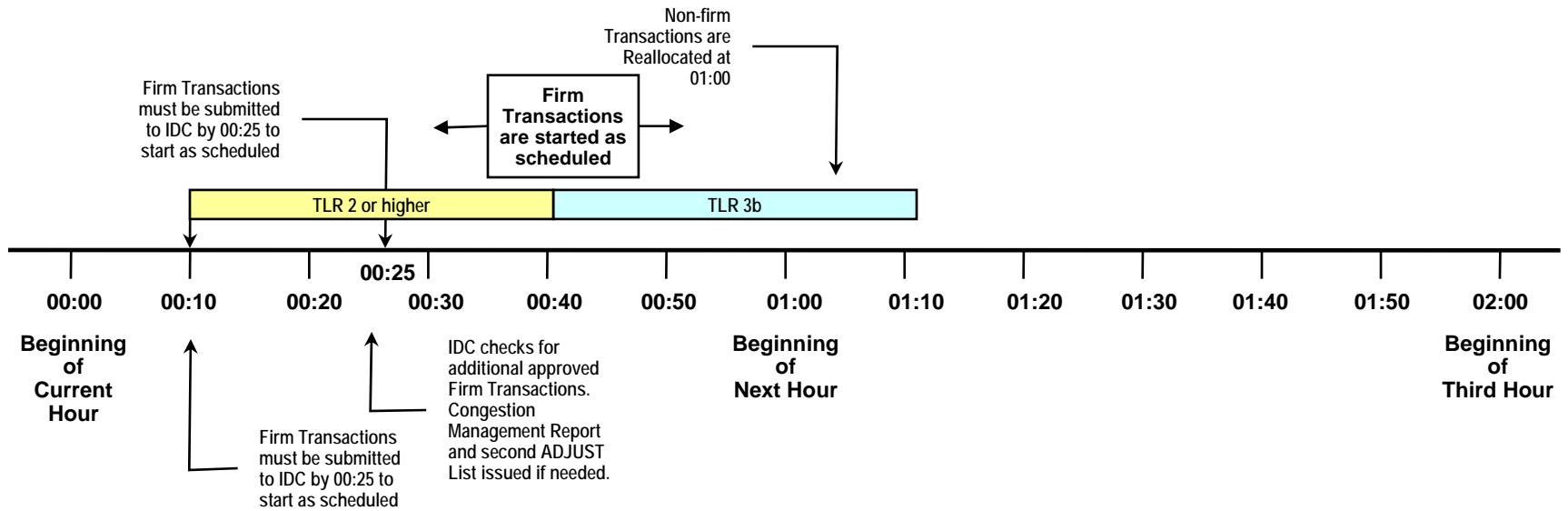
Monitoring ISO Responsibilities

- Monitor and detect congestion [based on look ahead results]
- Ascertain parallel flow impacts on congested flow gate from IDC
- Initiate “request to review” transaction schedules with Responsible Control Area
- Release flow gate transaction scheduling restrictions when congestion no longer expected
- [Subsequently] calculate and communicate congestion charge and allocation to Responsible Control Area

Responsible Control Area Responsibilities

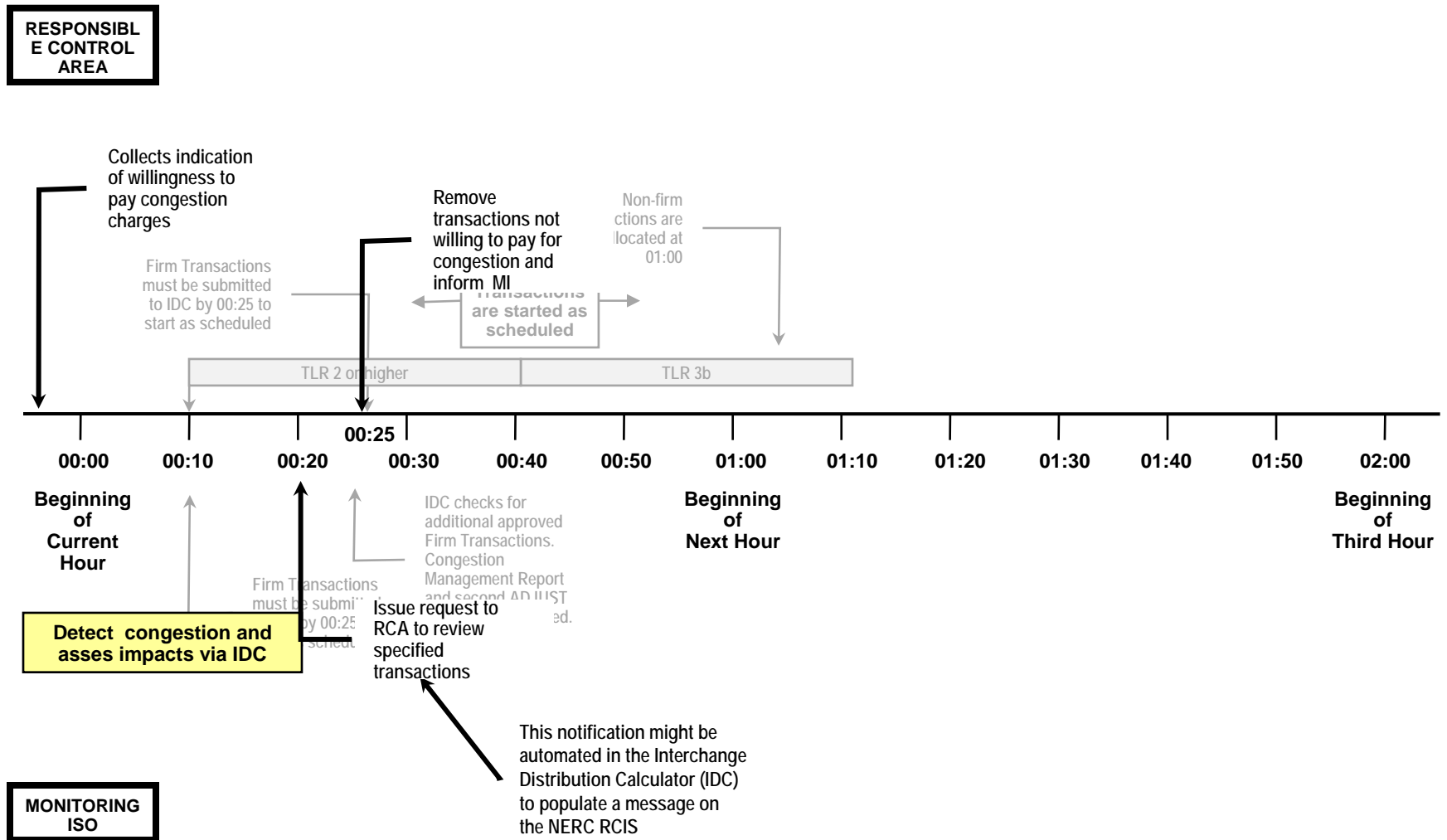
- Collects bidding indicators of “willingness to pay” (off-contract path) congestion from transactions sinking in its market
- schedule or remove relevant transactions following “request to review” from Monitoring ISO
- Process, collect and distribute settlement charges associated with buy-through of congestion

Process Overview – TLR Timeline



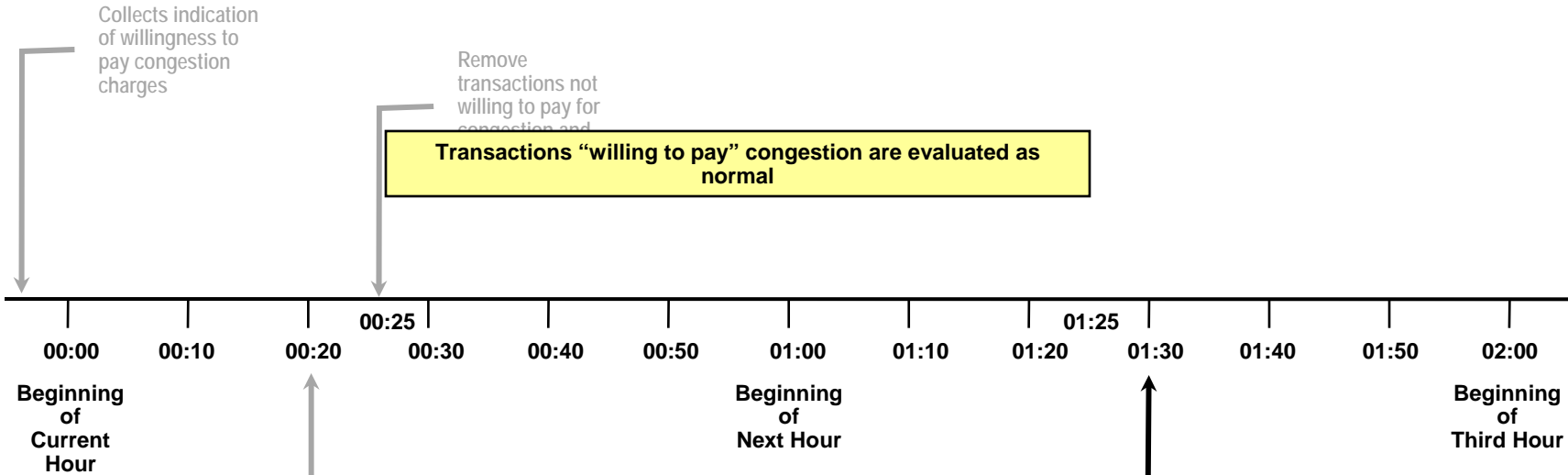
Source: Standard IRO-006-4.1 — Reliability Coordination — Transmission Loading Relief

Process Overview – Transaction Removal



Process Overview – Transaction Re-Instatement

RESPONSIBLE CONTROL AREA



Detect congestion and asses impacts via IDC

Remove transactions not willing to pay for congestion and
Transactions "willing to pay" congestion are evaluated as normal

Issue request to RCA to review specified transactions
Continue to evaluate congestion/constraints on flow gate

Release limitations on flow gate for following hour (where appropriate)

MONITORING ISO

automated in the Interchange Distribution Calculator (IDC) to populate a message on the NERC RCIS

This notification might be automated in the Interchange Distribution Calculator (IDC) to populate a message on the NERC RCIS

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Payment for Congestion Relief

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- Indicated by stakeholders as a desirable feature that should be added
- ISO Design Team has considered how this might be accomplished
- Concept identified but not yet fully defined – further consideration of process details needed to confirm practicality and implementability

Process Considerations

- Option should not impose a (residual) cost risk onto region's internal load;
- Alternatively, a trader can explicitly schedule a transaction through the relevant market that is expected to benefit from congestion relief; compensation in this instance is effected via the associated LBMP.

How it might work

- [Off-contract path] forward flows are charged for congestion based on their impact on the congested flow gate
- Counter-flows allow greater volumes of forward flows and hence collection of congestion costs to occur
- Identified counter-flow transactions would be compensated at same MWh rate that forward flows are charged.
- Total compensation paid limited by congestion charges collected at the same time
- Revenue sufficiency (collections versus payments) would be monitored and evaluated to determine whether payment limitation could be adjusted/eliminated

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Buy-Through Congestion Charges Example

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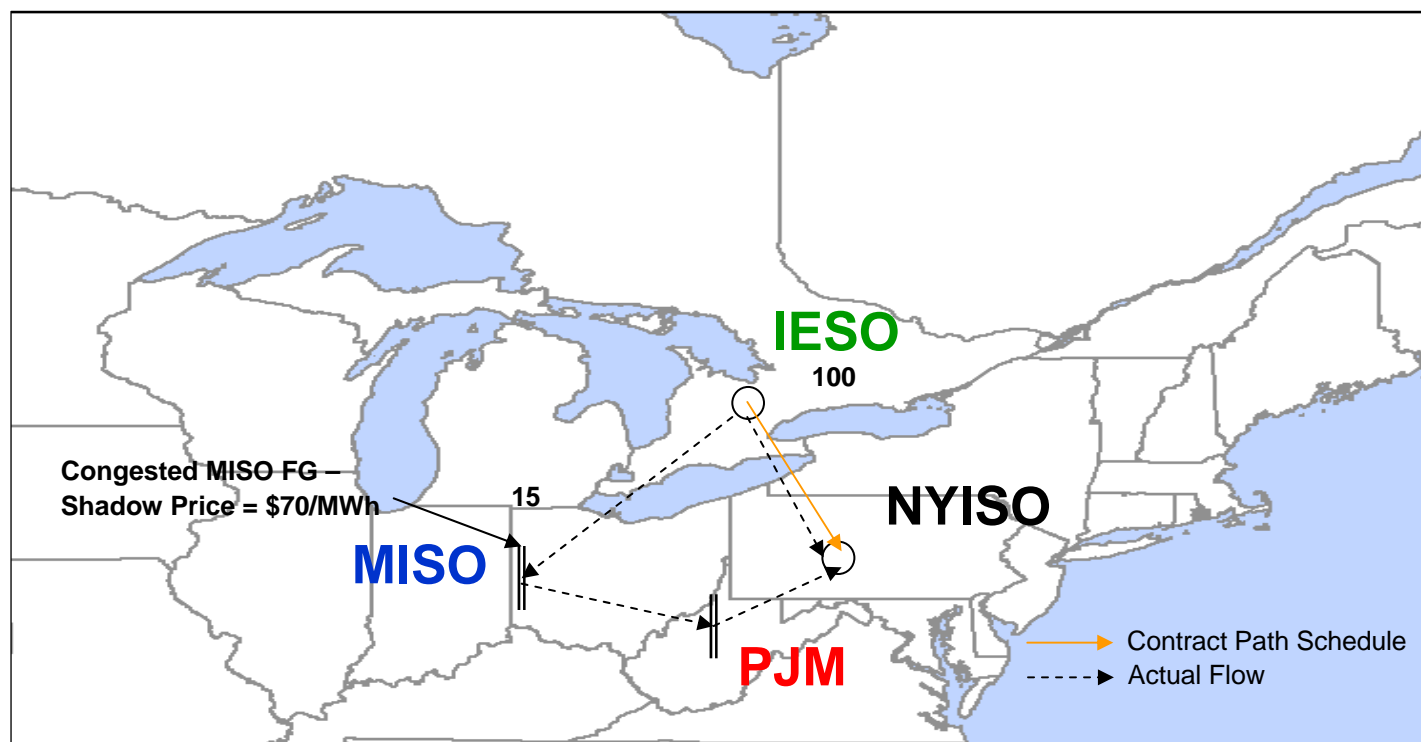


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Buy-Through of Congestion Charges



Market participant enters into a contract to buy 100 MW of energy from a source within IESO and sell the 100 MW to a sink within NYISO; for one five-minute interval during the hour the contract has a 15% transfer distribution factor on a constrained flow gate within Midwest ISO

Under the Buy -Through of Congestion process, the actual flows from this contract would result in an \$87.50* congestion charge from Midwest ISO being billed to the contract holder via their NYISO invoice

Does this result in the contract holder being “over-charged” for congestion?

Congestion charge calculation is: $\$70/\text{MWh} * 15\% * 100\text{MW} * 5/60 \text{ h} = \87.50

Impact of Parallel Flows on Congestion Charges

- Today, the security constrained dispatch is included in the actual binding necessary to manage the flow gate and thus accounts for the impact of parallel flows.
- For a transaction that is not delivered completely on the contract path, the effect of the actual flows is carried through to the calculation of the shadow price of the constraint
- In the proceeding scenario, if we were to assume a congested flow gate also existed on the NYISO system contract path the flow on the parallel path would result in the contract holder receiving a reduced congestion charge from NYISO for the portion of the flows actually occurring on the NYISO system
- If the parallel path did not exist, all contract path flow would have occurred on the NY flow gate and NY generation would have to be adjusted both upstream and downstream from the constraint to prevent an overload
 - This would generally result in a lower LMP at the source of the contract, and allow the contract holder to pay only a portion of the total congestion caused by the transaction

Impact of Parallel Flows on Congestion Charges

- The parallel flows reduce congestion on the NYISO system but cause increased congestion on a neighboring system – Midwest ISO in this scenario
- The cost of the increased congestion on the Midwest ISO system is not captured in the congestion charged by NYISO
- The implementation of the Buy-Through of Congestion product would create a mechanism for the Balancing Authorities to recover congestion costs associated with those parallel flows
- This process would allow the full cost of congestion to be collected from the cost causer and would not result in a contract holder be “over-charged” for congestion

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Interface Pricing Update

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- In 2007, NYISO Experienced a large growth in Lake Erie loop flow, caused in part by a difference in pricing methodologies between NYISO and PJM.
- As part of the July 16, 2009 FERC Order on Lake Erie loop flow, FERC directed the NYISO to develop solutions “including addressing interface pricing”.
- Stakeholder submitted comments questioned the methodologies and the need for consistency.

- Interface pricing and tag based pricing produce similar results when transactions flow on their scheduled paths.
- Circuitous path scheduling may not be appropriate in the absence of the ability to conform actual flows to scheduled flows.
 - Tag-based pricing and path prohibitions may produce similar market responses
- Efficient prices produce desired market behavior and facilitate regional energy interchange.

Recommendation Without PAR Control in Place

- In recognition of the overall objective of harmonizing the market rules across the region, as well as the current lack of a clear schedule for the implementation and operation of the Ontario – Michigan Phase Angle Regulators to control Lake Erie loop flow, the NYISO will pursue modifications to its interface pricing methodology.
- As such the NYISO will engage its stakeholder community to adjust the interface price methodologies to:
 - Recognize the incremental distribution of power flows around Lake Erie when evaluating and pricing the marginal impacts of transaction and generation schedules;
 - Evaluate the need for and scheduling rules surrounding establishing an additional proxy bus location for the MISO to acknowledge power deliveries from or to the Midwest region;
 - Evaluate the continued applicability of the existing circuitous path prohibitions.

Recommendation With PAR Control in Place

- To maintain compatible and efficient proxy bus prices when the Ontario-Michigan PARs are installed and operational, the proxy bus pricing methodologies will be considered to:
 - The state of control of the Phase Angle Regulators to manage Lake Erie loop flows.
 - Under Lake Erie loop flow controlled operation, the actual delivery of power and pricing methodologies will reflect contract path, or bid path (consistent with current NYISO and IESO implementations.)
 - Under uncontrolled Lake Erie loop flow operation, the proxy price methodologies will need to reflect the revised power deliveries.
 - Evaluate the revisions necessary to extend tag-based pricing to incorporate contract path deliveries;
 - Evaluate the location(s) established for proxy price determination;
 - Evaluate the ability to predict the controllability of the Phase Angle Regulators to manage Lake Erie loop flows to incorporate the necessary assumptions into the respective Day-Ahead and Hour-Ahead markets.

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Interregional Transaction Coordination Between PJM and NYISO

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PJM-NY
Interregional Transaction Coordination

- Market-Based Scheduling Mechanism allowing for real-time scheduling of transactions between the New York Control Area and the PJM Control Area on a more frequent basis
- The additional scheduling flexibility is intended to allow market participants to minimize buy-through of congestion exposure

PJM-NY Interregional Transaction Coordination

- Concept
 - Market Participants will provide energy transaction offers in the NYISO and PJM Real-Time Markets, where each markets' real-time scheduling systems would evaluate these transactions on a fifteen minute basis
 - Transmission Reservations continue to be allocated on an hourly basis by PJM
 - The NYISO intends to offer a mechanism for market participants to reduce/reinstate the schedule of their transaction during the dispatch hour
 - The feature will be available for import and export transactions
 - Wheel-through transactions will not be qualified to offer on a 15 minute basis

PJM-NY
Interregional Transaction Coordination

- Phased Approach
 - Phase 1 - Begin with fifteen minute energy transaction scheduling at the controllable line proxy buses between the PJM and NY control areas
 - Phase 2 – Continue to expand the fifteen minute energy scheduling process to the 'AC' interface between the PJM and NY control areas

PJM-NY
Interregional Transaction Coordination

- PJM and NY to continue discussions on opportunities to achieve more efficient scheduling outcomes through increased coordination of, and greater frequency of, scheduling decisions
- 2010 – Work with NY and PJM stakeholders on furthering the concept

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Additional NYISO-PJM Interface Pricing Points

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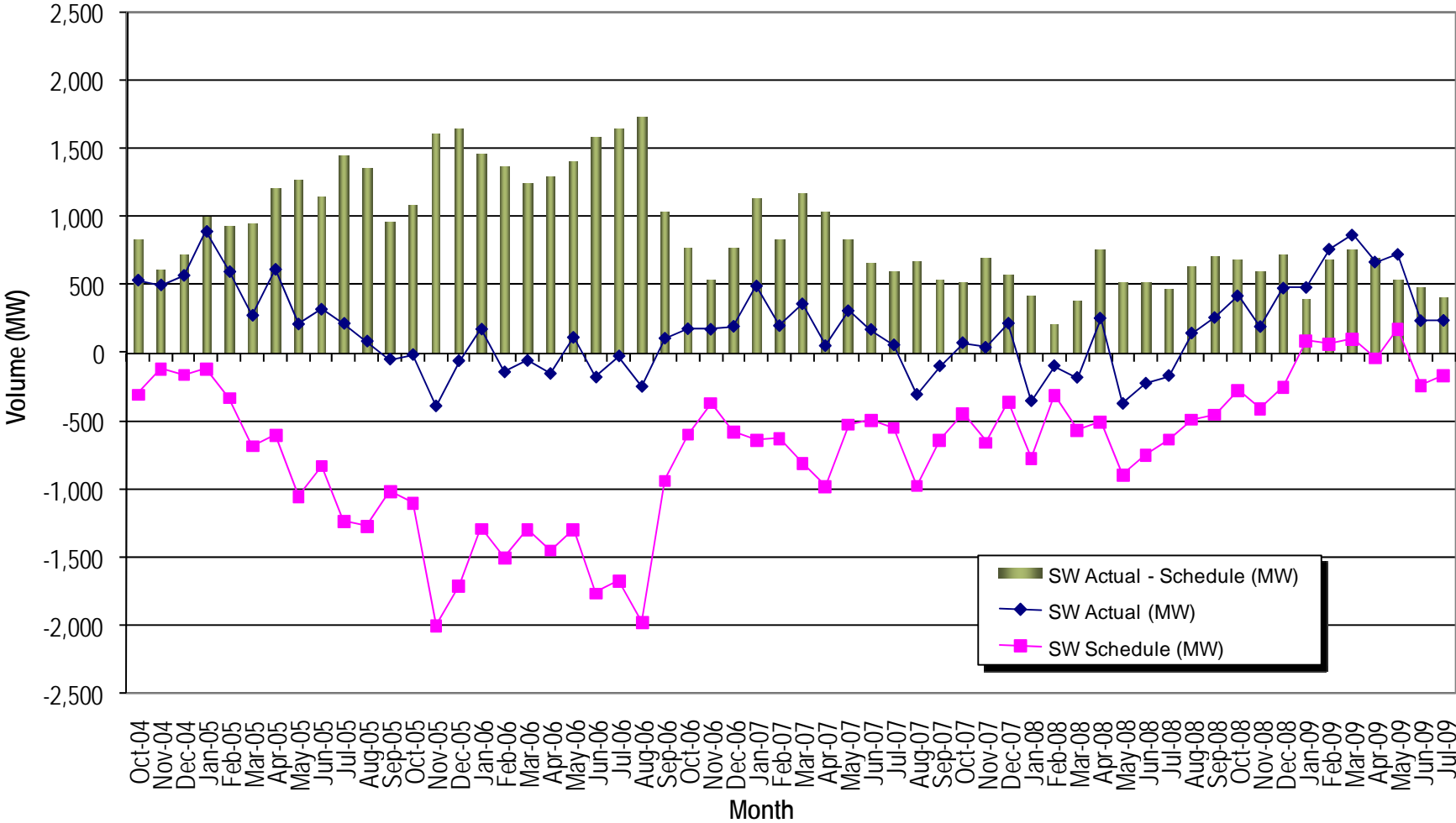
- Market participants have expressed a desire for NYISO and PJM to establish additional pricing points on the interface between NYISO and PJM
- At the present time there are three interface pricing points between the NYISO and PJM
 - AC interconnected facilities between NYISO and PJM
 - Neptune DC interconnection between NJ and Long Island, NY
 - Linden Variable Frequency Transformer (VFT) interconnection between NJ and NYC

Observations and Concerns

- Additional pricing points along a free-flowing AC interface have historically provided market participants with the ability to game that interface through transaction scheduling activities
- This behavior is difficult for transmission providers to easily identify and mitigate during real-time operations
- NYISO and PJM staffs believe the creation of additional pricing points along the free-flowing AC interface would create opportunities for gaming the interface between NYISO and PJM
 - Potential for increasing loop flows around Lake Erie is a major concern

PJM Southwest Interface

Southwest
 October 2004 - July 2009
 (TVA and East Kentucky Power Cooperative)



Potential New Interfaces

- The deployment of new technologies which provide the ability to completely control scheduled flows may allow for the establishment for additional pricing interfaces
 - Variable Frequency Transformers for example
 - Control capability must exist to prevent the introduction of additional loop flows
- The potential for establishing new pricing points will be evaluated by the staffs of NYISO and PJM going forward

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NERC Parallel Flow Visualization Project

- The NERC Parallel Flow Visualization (PFV) Project detail was presented at the October 29 joint stake holder conference.
- The project will enable a RC to distinguish the source of flow between (A) each separate region's impacts associated with generation-to-load dispatch and (B) individual transaction impacts
- The NERC ORS at their November 2009 meeting approved moving forward with the project. This included selection of the vendor and the detailed timeline.
- Beginning November 1, 2010 and after a 12 to 18 month trial period following NERC ORS approval the project would be placed in production.
- We have agreed to assess the progress of the project in June of 2010. If the solution is determined to be abandoned, unsupportable, or unachievable, the ISOs will pursue alternative solutions to the visibility initiative in an effort to maintain the currently proposed solutions implementation timelines.

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Potential Implementation Timeline*

- Parallel Flow Visualization
 - Software Ready 4Q – 2010
 - Parallel Operations 4Q – 2011
- Regional PAR Coordination Operating Guide
 - Initiate Regional Study 2Q – 2010
- Interface Pricing Revisions
 - NYISO Revisions - Design 2Q – 2010
- Buy-Through of Congestion
 - Design Development 4Q – 2010
 - Implementation 3Q – 2011
- Congestion Management
 - PJM-NYISO Implementation 3Q – 2011
 - Extend to Additional Regions 2012
- Interregional Transaction Coordination
 - Energy Scheduling with NY/HQ 1Q – 2011
 - Energy Scheduling with NY/PJ 4Q – 2011
 - Extend to Additional Regions 2012

*Prospective timeline pending design development and approval from Market Participants, neighboring Control Areas and the Commission.

- File report with FERC detailing proposed solutions on January 12, 2010.
- Submission will include:
 - Broader Regional Markets Solutions to Loop Flows – White Paper
 - Potential Implementation Timeline
 - Ongoing Efforts

- Continued design and detail development of recommendations
 - Additional feedback and discussion
 - Detailed design, Joint Operating Agreements and tariff development beginning in 2010.
- Implementation of Parallel Flow Data Reporting
- Periodic Joint Stakeholder Briefings
 - Anticipating quarterly meetings.
- Complete Benefits Assessment

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