MISO and PJM Market – to – Market Interregional Coordination Process

PJM / MISO Interregional Market Coordination Proposal

The purpose of this document is to provide a description of the proposed Market-to-Market coordination process that will be implemented concurrently with the implementation of side-by-side LMP-based energy markets in the PJM and MISO regions. As the MISO market is implemented and as the PJM market expands, it will become critical that the LMP-based congestion management procedures are coordinated between the two markets. The market-to-market transaction scheduling processes and the locational marginal prices at the market border points must be coordinated in order to efficiently manage interregional power flows. This coordination process will ensure appropriate LMP values at the market borders and will eliminate potential inefficiencies and gaming opportunities that could be caused by uncoordinated congestion management between the adjacent markets.

Overview of the Market-to-Market Coordination Process

The fundamental philosophy of the PJM/MISO interregional transmission congestion coordination process is to set up procedures to allow any transmission constraints that are significantly impacted by generation dispatch changes is both markets to be jointly managed in the security-constrained economic dispatch models of both RTOs. This joint management of transmission constraints near the market borders will provide the most efficient and least costly transmission congestion management and will also provide coordinated pricing at the market boundaries.

This Market-to-Market coordination process builds upon the PJM/MISO market-to-nonmarket coordination process as described in the whitepaper that is entitled 'Managing Congestion to Address Seams – A Proposal for Congestion Management Coordination" as a starting point. This whitepaper describes the interregional coordination process between a market region that uses an LMP-based congestion management regime and a non-market region that uses a TLR-based congestion management regime (i.e., a market to non-market interface). As described in this whitepaper, the set of transmission flowgates in each market that can be significantly impacted by the economic dispatch of generation serving load in the adjacent market is identified. These flowgates are then monitored to measure the impact of market flows and loop flows from adjacent regions. The paper describes how the market flow impacts will be managed on an interregional basis within the existing NERC IDC to enhance the effectiveness of the NERC interregional congestion management process. The paper also describes a process for calculating flow entitlement for Network and Firm transmission utilization in one region on the transmission facilities in an adjacent region.

The Market-to-Market coordination process builds on the work already completed as described above to adapt the coordination as appropriate to the conditions that will prevail after both the PJM and MISO markets are implemented in the Midwest. In addition, there is a continuing need to define the flow entitlement for Network and Firm transmission utilization in one region on the transmission facilities in an adjacent region.

Identification of Transmission Constraints that Require Coordinated Transmission Congestion Management

As stated previously, only a subset of all transmission constraints that exist in either market will require coordinated congestion management. This subset of transmission constraints will be identified in a manner similar to the method used in the whitepaper described above. The list of transmission constraints will be limited to only those for which at least one generator in the adjacent market has a significant power distribution factor with respect to serving load in the adjacent region (e.g. 5 percent).

Real-time Market Coordination

When any of the transmission constraints that have been identified as requiring coordinated transmission congestion management becomes binding in the monitoring RTO's security constrained economic dispatch, then the RTO will notify the non-monitoring RTO and provide the economic value of the constraint (i.e., the shadow price). Using this information, the security-constrained economic dispatch of the non-monitoring RTO will include the transmission constraint, which will cause it to redispatch generation to manage the constraint if it can do so at a cost lower than the constraint shadow price it received from the monitoring RTO.

This process will continue over the next several dispatch cycles, allowing the transmission congestion to be managed in a coordinated, cost-effective manner by the RTOs. The iterative coordination process will be supported by automated data exchanges in order to ensure the process is manageable in a real-time environment. The iterative protocol is as follows:

- The RTOs will exchange topology information to ensure that their respective market software is consistent.
- The monitoring RTO provides (i) all non-zero shadow prices and (ii) congestion relief (in MW) required to the non-monitoring RTO for any of the coordinated flowgates identified by PJM and MISO
  - the shadow prices are an output of the monitoring RTOs real-time market software.
  - the required relief would serve as a maximum amount of relief that can be provided by the non-monitoring RTO for the interval in question – it prevents the non-monitoring from redispatching excessive quantities of generation.
- This information is an input to the non-monitoring RTO's market software, which will optimize to minimize production costs while respecting the binding constraints in monitoring RTO's area.
- The initial redispatch actions determined by the non-monitoring RTOs market software are executed.

- In the next interval, the monitoring RTO will solve and produce new shadow prices. If the non-monitoring RTO took redispatch actions to reduce its flow on the constrained flowgate, the shadow price should be reduced.
- This process will continue throughout subsequent dispatch cycles, iterating towards an optimal solution where the marginal costs of redispatch to manage the binding constraint for each RTO are approximately the same.

We should note here that under this proposed approach, the coordinated dispatch protocols are performed any time that a transmission constraint that has been identified as requiring coordinated transmission congestion management becomes binding. This approach produces the level of coordination that is required to ensure efficient congestion management across the market seams. This approach provides a much higher level of interregional congestion management coordination than that which currently exists between any existing adjacent markets.

One could contemplate a lower level of coordination that would require the dispatch protocols to be implemented only when the non-monitoring RTO economic dispatch produces a level of flow that is above their flow entitlement on the constrained transmission flowgate. This approach would not achieve a sufficient level of market coordination at the market seams.

Real-time Market Settlements of the Coordinated Congestion Management

The Market Settlements under the coordinated transmission congestion management would be performed based on the real-time power flow contribution on the transmission flowgate from the non-monitoring RTO as compared to its flow entitlement. If the real-time powerflow is greater than the flow entitlement, then the non-monitoring RTO would pay the monitoring RTO for congestion relief provided to sustain the higher level of real-time powerflow. This payment would be calculated based on the following equation:

> Payment = (Real-time Powerflow MW – Flow entitlement MW) * Transmission constraint shadow price in the monitoring RTO dispatch solution

If the real-time powerflow is less than the flow entitlement, then the monitoring RTO would pay the non-monitoring RTO for congestion relief provided at level below the flow entitlement. This payment would be calculated based on the following equation:

> Payment = (Flow entitlement MW – Real-time Powerflow MW) * Transmission constraint shadow price in the non-monitoring RTO dispatch solution

These payments will be calculated on an hourly integrated basis.

Essentially, these payments for congestion management will be added into the congestion charges collected in the RTO that receives the payment in order to fund the FTR credits in that RTO for the hour. The RTO that makes the payment will get the revenue from excess congestion charges collected. These excess revenues will occur because the RTO making the payment will be utilizing more of the flowgate than specified in its entitlement.

If the transmission congestion has occurred on the flowgate because of a facility deration or because of a line outage, then any resulting transmission congestion revenue inadequacy will be shared on a pro-rata basis (based on flow entitlement percentage) between the RTOs.

Settlement of Interregional Transactions (via Proxy Buses)

In order for the market-to-market coordination to function properly, the proxy bus models for PJM and MISO must be coordinated to the same level of granularity. The proxy bus modeling approaches must be the same at the market borders.

The proxy bus models will be based on using a flow-weighted average pricing model at common tie points at the market borders. In the Day-ahead Market and in the FTR models, the flow-weighted proxy bus definitions will be used at all times. In the real-time market, if the scheduled flow and actual flow are consistent at the proxy bus location, then the flow weighted average price will be utilized. If significant loop flows exist at any of the proxy bus border point locations then the proxy bus price will be changed to reflect actual real-time flow patterns.

Day-ahead Market Coordination

The redispatch protocol for interregional congestion management will normally be performed as needed in the Real-time market, however if the need for congestion relief assistance is predictable on a Day-ahead basis, the protocol will be implemented in the Day-ahead market.

The redispatch protocol may be implemented in the Day-ahead market upon the request of either RTO if the adjacent RTO verifies that such Day-ahead redispatch is feasible. An example of the Day-ahead protocol is as follows:

> The monitoring RTO specifies the amount of scheduled flow reduction that it is requesting on a specific transmission flowgate and communicates the request to the non-monitoring RTO.
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> The non-monitoring RTO would then lowers MW limit that it utilizes in its Day-ahead market on the specified transmission flowgate by the specified amount. This means that instead of modeling the transmission flowgate constraint at flow entitlement amount, the non-monitoring RTO would model the constraint as the flow entitlement less the requested MW reduction. Therefore, the non-monitoring

> RTO will schedule less flow on the specified transmission flowgate in order to provide Day-ahead congestion relief for the monitoring RTO. The monitoring RTO may then use the additional MW capability in its own Day-ahead energy market.

Alternatively, similar Day-ahead procedures are available to allow the non-monitoring RTO to request an increase its scheduled utilization of a flowgate above its flow entitlement. In this case, the monitoring RTO would reduce its scheduled utilization in order to provide congestion relief for the non-monitoring RTO.

The market settlements for such Day-ahead congestion relief would be performed in a similar manner to the real-time market settlements of the coordinated congestion management protocol. The Day-ahead payment for the RTO that is requesting congestion relief would be calculated as follows:

> Payment = (Day-ahead Powerflow MW – Flow entitlement MW) * Transmission constraint shadow price in the Day-ahead market of the RTO that was requested to reduce its scheduled flow.

This payment would be calculated based on the hourly Day-ahead Market results. Obviously, if such congestion relief is requested and performed on a Day-ahead basis, then the real-time flow entitlement for the affected hours in the corresponding Real-time market would be adjusted accordingly.

Financial Transmission Rights Allocation/Auction Coordination

The allocation of FTR products in each marketplace must recognize the flowgate entitlement that exists in adjacent markets. The FTR allocation (or Auction) model will essentially contain exactly the same level of detail for adjacent regions as the Day-ahead market model and the real-time market model. Each RTO will allocate (or Auction) FTRs to Network and Firm Transmission customers subject to a simultaneous feasibility test that determines the amount of transmission capability that exists to support the FTRs. The simultaneous feasibility analysis for each RTO will model that RTO's flow entitlement on the transmission flowgates in the adjacent region as the powerflow limit that must be respected in the FTR allocation / auction process. The transmission flowgates in each RTO will be modeled in the simultaneous feasibility test at a capability value equal to the flowgate rating minus the flow entitlement that exists for flows from the adjacent market. In this way, the FTR allocation across both RTOs will recognize the reciprocal transmission utilization that exists for Network and Firm transmission customers in both markets.

Evolution of the Market-to-Market Coordination Process

In addition to the redispatch of units within each market to control the transmission congestion problems at the market borders, the market-to-market Transmission congestion coordination process could include adjustment of the interchange between the markets based on the participant bids and offers submitted into each market. This coordination process would allow the constraints between the two control areas to be efficiently managed. It would also more efficiently manage the dispatch of control area to control area schedules when transmission constraints between the areas are not binding by making full use of the generation offers and load bids in each market. An evaluation of the feasibility of adding these interchange adjustments to the procedures will be performed as part of the implementation process.

After the implementation real-time market-to-market congestion coordination process described above, the potential exists to implement an even more tightly integrated PJM / MISO energy marketplace. The evolution of the interregional markets could transition into the implementation of a single energy product and a single FTR product across both market regions.

The most likely next step would be to create an iterative clearing mechanism which will result in full coordination of the day-ahead energy markets and real-time energy markets by performing joint security-constrained economic dispatch through an iterative approach. This stage would essentially create a single energy marketplace across both RTOs. The iterative dispatch process would require a high level of integration and data transfer between the RTOs on both a day-ahead and real-time basis.

Further evolution could involve implementing a single Day-ahead energy market and a single real-time energy market across the entire footprints of both markets. This would require a single day-ahead market clearing engine and a single real-time market clearing engine.

Both of these steps will require substantial software development. It is expected that an evaluation of the benefits and the feasibility of these steps will be performed to determine how to proceed after the initial common market implemented.