Indiana Utility Regulatory Commission

Rules and Procedures for Wholesale Electricity Exchanges

George Stevens
Utility Analyst

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RTO = Regional Transmission Organization

- An organization of electric utility transmission users, and other entities approved by FERC to efficiently coordinate transmission planning and expansion, operation, and use on a regional basis
- Provides wholesale electric transmission service under one tariff for a large geographic area
- Offer wholesale energy markets
- 100 kV transmission and above
- Independent Organization
- Membership is voluntary

Market Overview

- Day-Ahead Energy Market
  - Reflects expectations of next day Real-Time Market outcomes
- Reliability Assessment Commitment
  - Reflects Day-Ahead Market cleared demand versus MISO forecast of Real-Time Market demand
- Real-Time Energy Market
  - Reflects continuous balancing of supply and demand within limits of reliable transmission system operations
- FTR Market
  - Financial Transmission Rights
  - Reflects expectations of future Day-Ahead Market outcomes

Day Ahead Energy Market Supply and Demand

- Energy Demand Bids
  - Fixed Demand Bids
  - Price-sensitive Demand Bids
  - Virtual Demand Bids
- Supply Requirements
  - Fixed Supply Offers
  - Price-Sensitive Supply Offers
  - Virtual Supply Offers

Day Ahead Energy Market Results

- Hourly clearing prices are calculated for each hour of the next Operating Day
  - Prices based on the concept of Locational Marginal Prices (LMP)
- Hourly Supply and Demand Quantities
  - Cleared using Security Constrained Unit Commitment (SCUC) and Security Constrained Economic Dispatch (SCED)
  - Computer programs to match supply and demand
- Hourly Balancing Authority Net Scheduled Interchange

Real Time Energy Market

- A balancing market in which LMPs are calculated every five minutes
  - Based on MISO dispatch instructions and actual system operations
- SCED program used to identify dispatch signals to be sent to generating units
  - Same as program used in Day-Ahead market
- Generators that are available but not selected in the Day-Ahead Energy Market may alter their Offers for use in the Real-Time Energy Market

Financial Transmission Right (FTR) Market

- Provides an opportunity for Market Participants to manage the risk of congestion cost in the Day-Ahead Market
- Entitles the holder to a stream of revenues or charges based on the congestion over the FTR path
- Financial instruments – do not represent a physical right for delivery of energy
- Provides a mechanism to hedge the congestion costs between the Point of Receipt and Point of Delivery of the FTR in the Day-Ahead Market
- Only market participants can hold FTRs

Market Configuration

- Participants
- New Day 2 Rules
  - Day 1 Transmission Grid coordination was February 2002
  - Day 2 Market was April 2005
- Components
- Schedules
- Locational Marginal Prices
- Settlements

Market Configuration Participants

- Market Participant candidates:
  - Own and/or operate generating resources
  - Serve load
  - Engage in power marketing
  - Own or operate demand response facilities
  - Purchase or sell FTRs
  - Purchase transmission service
  - Schedule or settle resources for another Market participant or another non-participant entity

Market Configuration Participants

- Market Participants can:
  - Submit bilateral transactions
  - Submit offers to supply energy
  - Submit bids to purchase energy
  - Hold FTRs
  - Settle on all payments and charges with the Midwest ISO

Market Configuration Participants

- Market Participants can be:
  - Billed for transmission service
  - Receive charges and credits for participation in the:
    - Day-Ahead Market
    - Real-Time Market
    - FTR Market

Market Configuration Participants

- Agents for Market Participants
  - Meter Data Management Agent
    - Manage and conduct metering services
  - Scheduling Agent
    - Submits schedules, bids and offers
  - Billing Agent
    - Conducts settlement and billing services

Day 2 Market
New MISO Rules April 2005

- All resources within the footprint are evaluated as a single pool of resources
- Offers and bids may be submitted or updated in the Real-Time market up to 30 minutes before the hour
- Generation assets that are operating to meet their own load must be communicated to the Midwest ISO
- Resource commitment and dispatch activities move from Balancing Authorities to the Midwest ISO
- Commitment and dispatch activity information is now forwarded to the Midwest ISO
- The Midwest ISO provides selection and dispatch information to Balancing Authorities and generators

MISO Markets - -Key Components Part 1

- Market Timelines
- Market Activities
- Locational Marginal Prices
- Demand Bids
- Generation Offers
- Self Schedules
- Financial and Physical Bilateral Transactions

MISO Markets - Key Components Part 2

- Load Aggregation
- Hubs
- Day-Ahead Market
- Reliability Assessment Commitment
- Real-Time Market
- Financial Transmission Rights
- Market Settlements
- Ex Post LMP Calculation

MISO Markets - -Key Components - Focus

- Market Timelines
  - Month (s) Ahead Activities
  - Specific Participant Market Information
  - Public Market Information
- Locational Marginal Prices
  - Transmission and Commercial Models
  - LMP Equation
  - LMP Example
- Settlements
- Information Transfer

MISO Market Activities Month (s) Ahead of Day Ahead and Real Time Markets

- Months in Advance – Submit Generation Maintenance Schedules and Resource Adequacy Plans; Annual FTR Allocation; Reserve Transmission Service
- Month Prior – Submit Generation and Transmission Outages; FTR Annual Auction, Monthly Allocation and Monthly Auction; Day-Ahead Market
- Operating Month – Provide Operating Reserves and Regulation; Reliability Assessment Commitment; Day-Ahead Market; Real – Time Market
- Operating Month and Months After – Settlement Meter Data and Settlement Statements, Invoices, and Disputes

Market Information Schedule for Each Specific Participant

- 1100 Day Ahead - Market Closes, perform Security Constrained Economic Dispatch
- 1700 Day Ahead – Post day ahead results and hourly Day Ahead LMPs; Next-day Reliability Assessment Commitment (RAC) rebid process begins
- 1800 Day Ahead – Next-day RAC re-bid process closes; perform RAC based on resource Start-up and No-load
- 2000 Day Ahead – Notify units
- Real Time – 5 minute intervals – Perform Security Constrained Economic Dispatch; Send net scheduled interchange and resource base points for all resources; Send Dynamic Schedule values and Ex Ante Dispatch LMP Prices
- Real Time – 4 second intervals – Send ramped Balancing Authority Net Scheduled Interchange and ramped Dynamic Schedule values

Public Market Information Schedule for All Participants

- 1700 Day Ahead – Post Hourly LMP and Components for each hour at each node, Binding Constraints, and Forecasted Load
- Real Time – 5 minute intervals – Post 5-minute Ex-Post LMP and Components at key locations, Binding Constraints, and Current Load
- Operating Day plus 1 (no later than 5 business days from the Operating Day – Post Hourly Ex-Post LMP and Components at all Locations
- Months After – Post offers with Masked Identity

LMP Calculation – Transmission Network Model and Commercial Model

- Transmission Network Model
  - Detailed electrical topology
  - ENode = physical point of injection or withdrawal
  - EPNode = an ENode with an established price
- Commercial Model
  - EPNode is link to Transmission Network Model
  - EPNodes are either Load EPNodes or Generation EPNodes
  - CPNode is an aggregation of EPNodes
    - Settlements are at the CPNode level
    - Metering data is at the CPNode level

Basic MISO Energy Charge LMP - Locational Marginal Price

- LMP = MEC + MCC + MLC
- MEC = Marginal Energy Charge
  - One node is the reference point for LMP, all other LMPs are relative to that reference node; the cost of bringing the next unit of supply – to balance supply and demand – to the market
- MCC = Marginal Congestion Charge
  - If congestion prevents serving the load with the lowest cost generator, the system is re-dispatched using a higher cost generator
- MLC = Marginal Loss Charge
  - Losses are paid by the load (demand)
- LMP varies at different times and locations due to:
  - Varying demand bids and generation offers
  - Changing transmission system conditions

Basic MISO Energy Charge LMP - Locational Marginal Price

	NO CONGESTION		WITH CONGESTION	
	Node A (Gen.)	Node B (Load)	Node C (Gen.)	Node B (Load)
Losses A to B or C to B	---	5%	---	5%
Load at B	---	1 MW	---	1 MW
Production at A or C	1.053 MW	---	1.053 MW	---
Bid Price at A or C	$ 20.00		$ 23.00	
Prod. Cost at A or C	$ 21.06		$ 24.22	
Marginal Energy Charge (MEC)	$ 21.06	$ 20.00	$ 24.22	$ 20.00
Marginal Congestion Charge (MCC)	$ -	$ -	$ -	$ 3.16
Marginal Losses Charge (MLC)	$ -	$ 1.06	$ -	$ 1.06
Total = LMP	$ 21.06	$ 21.06	$ 24.22	$ 24.22

Basic MISO Energy Charge LMP - Locational Marginal Price Varies by Hour

Hour Ending	Factor	12:00	14:00	16:00	18:00	20:00	22:00
Ref. Cost	1.0000	$ 20.00	$ 24.00	$ 36.00	$ 40.00	$ 38.00	$ 37.00
Ref. Node A	1.0000	$ 20.00	$ 24.00	$ 36.00	$ 40.00	$ 38.00	$ 37.00
Node B	1.0150	$ 20.30	$ 24.36	$ 36.54	$ 40.60	$ 38.57	$ 37.56
Node C	1.0230	$ 20.46	$ 24.55	$ 36.83	$ 40.92	$ 38.87	$ 37.85
Node D	1.1500	$ 23.00	$ 27.60	$ 41.40	$ 46.00	$ 43.70	$ 42.55
Node E	1.5500	$ 31.00	$ 37.20	$ 55.80	$ 62.00	$ 58.90	$ 57.35
Node F	2.1300	$ 42.60	$ 51.12	$ 76.68	$ 85.20	$ 80.94	$ 78.81
Node G	2.5600	$ 51.20	$ 61.44	$ 92.16	$ 102.40	$ 97.28	$ 94.72

Settlements Part 1

- Market Responsibilities
  - Process market settlement data for each Operating Day
  - Produce financially binding settlement statements and invoices
  - Receive and distribute Market Participant payments
  - Manage the dispute process
- Participant Responsibilities
  - Submit meter data in a timely manner
  - Review settlement data and statements
  - Verify and reconcile invoices
  - Process payments to and from the Midwest ISO
  - Submit disputes

Settlements Part 2

- Two Settlement System
  - Day-Ahead settlement and Real-Time settlement
  - Only the difference between the Real-Time quantity and the Day-Ahead quantity is exposed to the uncertainty of the Real-Time price

Settlements Part 3

- Settlement Statements and Invoices
  - Three statements (Day-Ahead, Real-time, and Financial Transmission Rights) and one summary for each operating day
  - Statements and summary issued at days 7, 14, 55 and 105 after the Operating Day
  - Market Participants receive 84 settlement statements and 7 summary statements each week
- Settlement Disputes
  - Submit within 10 calendar days from the date of issue
  - Attempt to resolve within 30 calendar days after submission

Information Transfer

- Market Data Systems
  - Day Ahead / Real Time
  - Financial Transmission Rights
  - Financial Scheduling System
  - Physical Scheduling System
  - Market Settlements System
  - Customer Relationship management System
  - Asset Registration System
- Data Exchange
  - Web site available to Market Participants only that allows access to all market systems

Rules and Procedures for Wholesale Electricity Exchanges

- Discussion

- Questions