

Midwest ISO

Regional Transmission Organization



2006 Summer Operations

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Topics

- ✓ **Midwest ISO - Who We Are**
- ✓ **RTO Services**
- ✓ **Real Time Reliability Applications**
- ✓ **MISO Operator Training**
- ✓ **MISO Market Operations**
- ✓ **MISO Market Benefits to Region**
- ✓ **MISO Market Benefits to Indiana**
- ✓ **Questions**



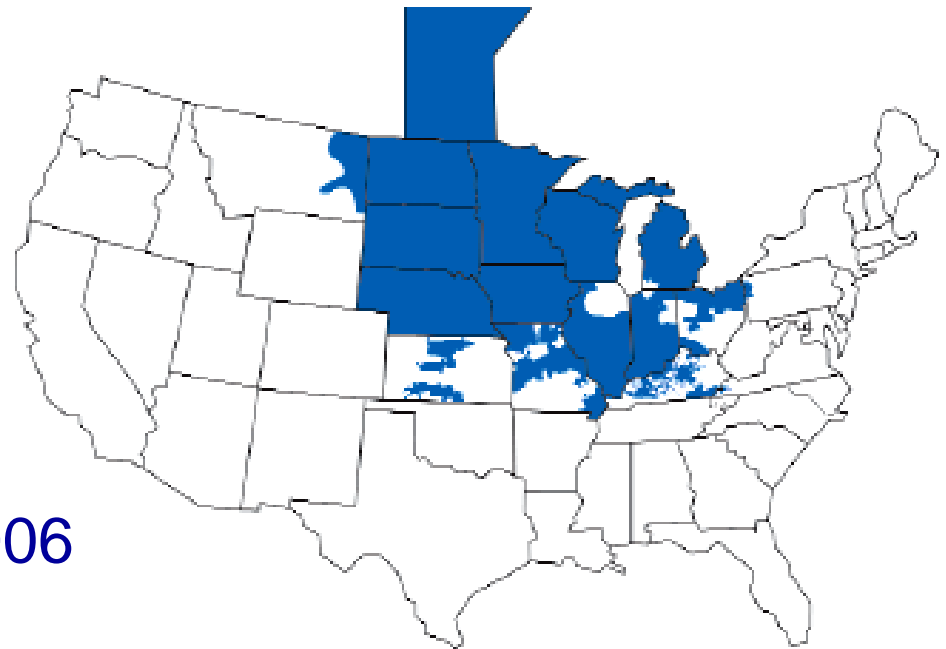
Who We Are

The Midwest ISO is an independent, non-profit entity that monitors the transmission system of high voltage electricity across much of the Midwest.

Operational Since December 15, 2001

SCOPE OF OPERATIONS

- **Peak Load**
(set August 3rd, 2005)
 - 112,197 MW (market)
 - 131,434 MW (reliability)
- **Projected Peak Load for 2006**
 - 114,000 MW (market)
 - 18% reserve margin
 - 134,000 MW (reliability)



Midwest ISO Reliability Area



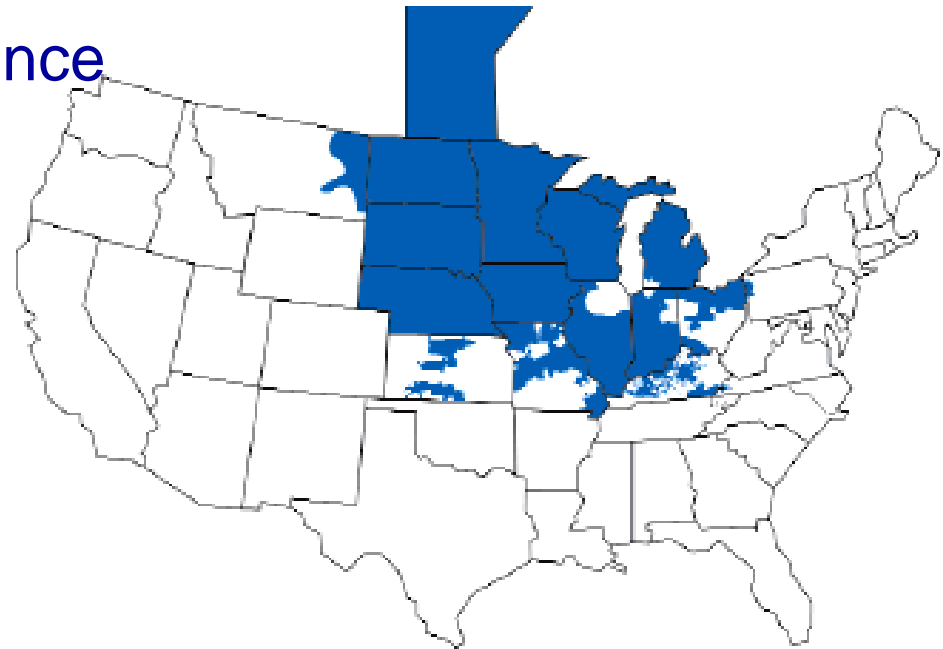
Who We Are

The Midwest ISO is an independent, non-profit entity that monitors the transmission system of high voltage electricity across much of the Midwest.

Operational Since December 15, 2001

SCOPE OF OPERATIONS

- 15 states & 1 Canadian province
- 97,000 miles of transmission
 - 500kV, 345kV, 230kV, 161kV, 138kV, 120kV, 115kV, 69kV
- 947,000 square miles
- 2 control centers
 - Carmel, IN
 - St. Paul, MN



Midwest ISO Reliability Area

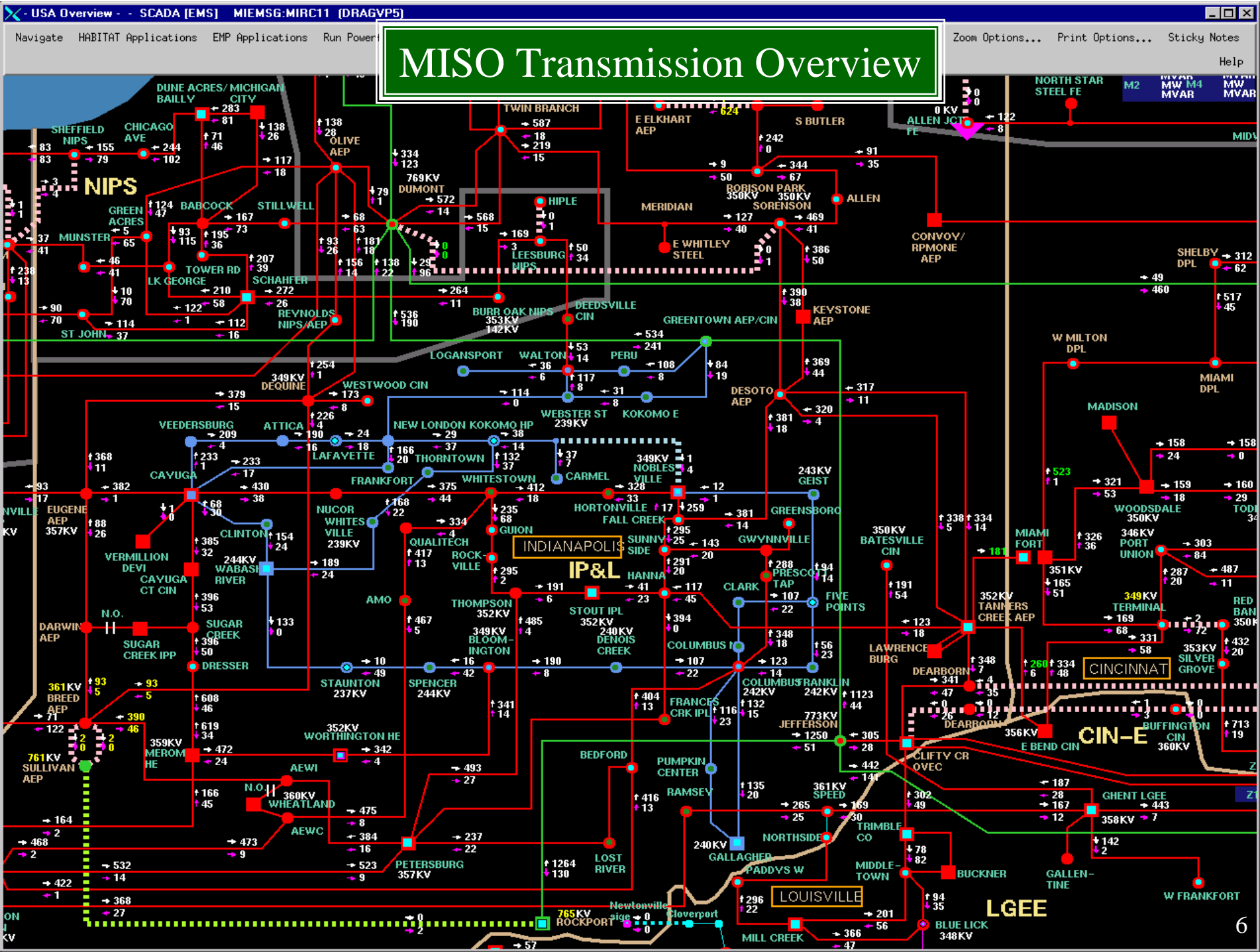
Carmel, Indiana



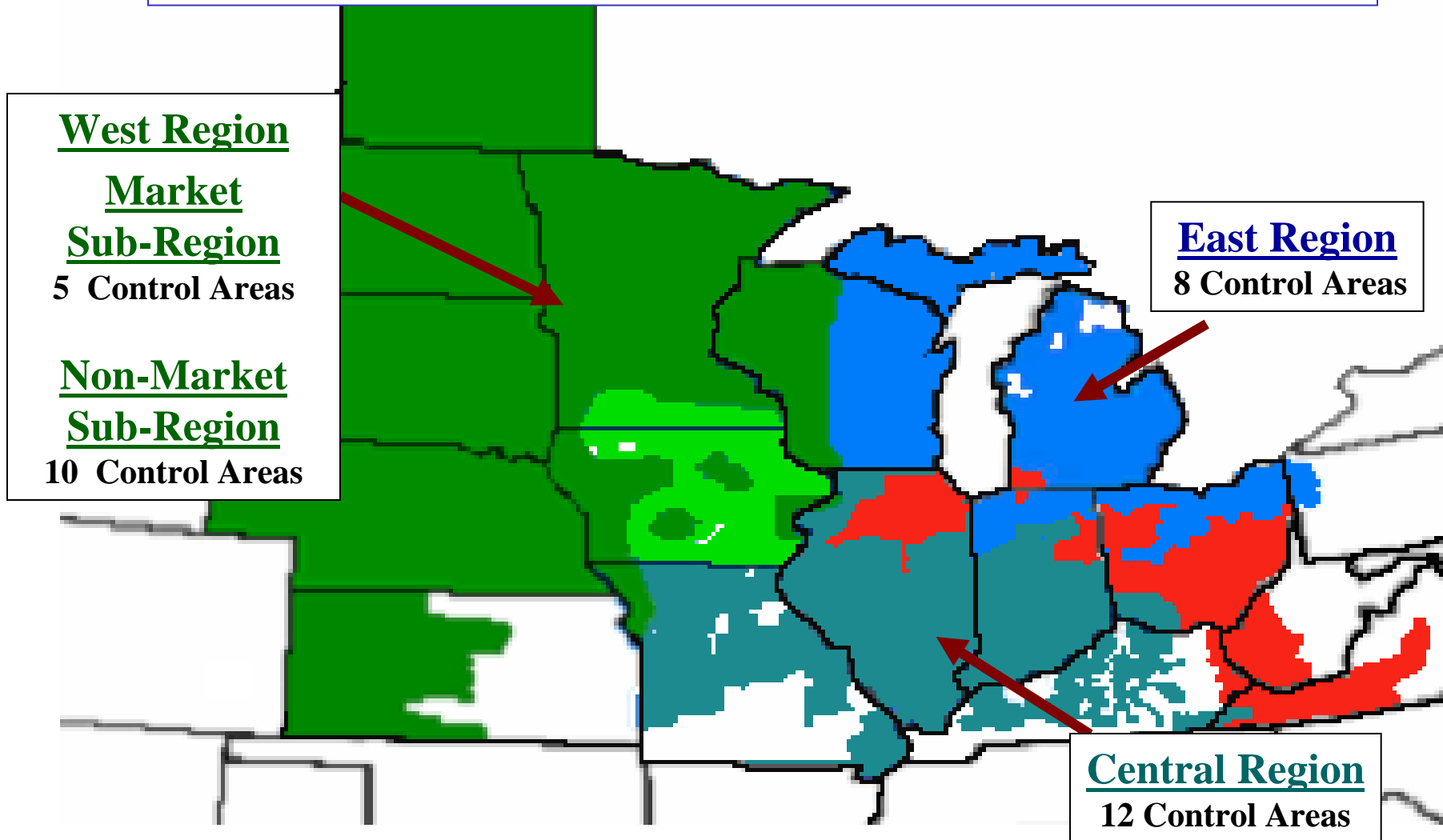
Control Centers



St. Paul, Minnesota



Midwest ISO Regional Operating Desks





- ✓ Monitor flow of power over the high voltage transmission system
- ✓ Schedule transmission service
- ✓ Security analysis
- ✓ Manage power congestion through locational marginal pricing (LMP) energy market
- ✓ Long term regional transmission planning
- ✓ Real time and day ahead energy markets
- ✓ 5-minute security-constrained dispatch of entire market (maintaining reliability in most economic manner)

Network Model

- 33,000 network buses
- 230,586 SCADA points
- 5,091 generating units
- 27,406 loads



State Estimator

- 230,586 real-time measurements
- Solves every 90 seconds
- Runs continuously

Real Time Contingency Analysis

- 9,000+ contingencies - “*what if’s*”
- Solving time < 2 minutes
- Runs every 5-minutes automatically – or immediately on demand





MISO Operator Training





MISO Operator Training



Comprehensive Operator Training Program

- Includes:
 - ✓ Classroom learning
 - ✓ Simulator training
 - ✓ Emergency training
 - ✓ System dynamics training
 - ✓ Cross-training with Control Area Operators and Transmission Operators
 - Have visited all member control rooms
 - Discussed procedures, local area issues, applications



MISO Operator Training



Training is provided to RT Operations Staff on:

- ✓ Voltage Stability/System Dynamics
- ✓ State Estimation
- ✓ Alarming
- ✓ Interpretation of Overview/One-line Displays
- ✓ Loss of Key Applications
- ✓ Member Systems via Site Visits
- ✓ Emergencies



MISO Operator Training



Emergency Training

Consists of combination of activities, including:

- ✓ **Emergency Response & Restoration Drills – *MISO holds annual Emergency Response and System Restoration drills. Largest and most comprehensive of their kind anywhere in country (2005 Drills included 4 NERC Regions, 5 Reliability Coordination centers, 35+ Control Areas)***

- ✓ **Tabletop Emergency Drills – *MISO has developed several one-day tabletop drills involving varying combinations of MISO staff and Control Area Operators within MISO***

- ✓ **Emergency Operations Training on Simulator – *MISO has developed several training scenarios for use with our training simulator***

- ✓ **Transferring to/Operating from Backup Control Center Drills – *MISO has trained and will continue training our operators on a wide range of emergency conditions including need to rapidly transfer all operations to back-up facility***



MISO Market Operations

- MISO began operating its Real-Time and Day-Ahead energy market on April 1, 2005
 - Locational Marginal Prices (LMPs) with Financial Transmission Rights (FTRs) optimizes dispatch to manage congestion
- Similar to systems used PJM, ISO-New England, the New York ISO





MISO Market Operations

- Locational Marginal Pricing (LMP) based upon Security Constrained Economic Dispatch (SCED)
- SCED minimizes cost to serve load while maintaining reliability of electrical system
- 1,435 Commercial Pricing Nodes
- Net Scheduled Interchange (NSI) sent every 4-seconds.
- Generator instructions calculated and sent every 5-minutes
- Dispatch consistent with offer parameters submitted by Market Participant





MISO Market Benefits - Specific Examples

- **More Power Import Capability**
 - During record heat and peak loading in Summer 2005, MISO Market enabled members to import more power
 - Rather than curtailing large imports to manage congestion via NERC TLR as in the past, MISO market provided correct signals to run key generators in a manner to allow more economic energy imports at peak times
 - MISO members reported that the MISO Market allowed them to avoid emergency energy procedures several times during summer 2005



MISO Market Benefits - Specific Examples

- **More Simultaneous Generation Maintenance**
 - During Spring 2006 maintenance period, several large generation plants were off-line simultaneously in a state neighboring Indiana
 - MISO detected a potential problem and recognized the need to commit additional generation within the Market to maintain adequate voltages and maintain flows within limits. MISO developed procedures to deal with potential reliability scenarios
 - MISO coordinated with local transmission operators on daily basis to efficiently and reliably manage the situation
 - Prior to MISO Market operations, taking this many units out of service in one area for maintenance simultaneously was unheard of



MISO Market Benefits - Specific Examples

- **More Transmission Maintenance**
 - Transmission Operators have planned to take maintenance outages to replace structures on a key 345kV transmission line in the Midwest during June and July 2006. This results in reduced maintenance costs
 - Prior to MISO Market, this type of maintenance would only have been scheduled during the spring and fall
 - Transmission owners have gained such confidence in the MISO Market's security constrained dispatch that they are now comfortable performing maintenance of this type during the summer months
 - The maintenance will result in better reliability on the system



MISO Market Benefits - Specific Examples

- **Managing Costs with Independent Market Monitor**
 - In one specific instance, a market participant attempted to inappropriately inflate prices of their generation in order to profit from conditions on the system
 - If left unchecked, these actions could have increased costs to our members by as much as \$2M per day
 - MISO was able to identify the issue and contacted the Independent Market Monitor who took action to mitigate these prices to reference values
 - MISO's actions protected our member companies and their customers from substantial and inappropriate costs



MISO Market Benefits - Specific Examples

- **Quicker Reaction = Greater Reliability**
 - Control room operators are able to proactively take actions to prevent transmission emergencies, resulting in increased transmission system reliability and cost savings to customers
 - In April of 2005, a critical transmission line connecting Minnesota to Wisconsin was forced out of service due to a large fire. MISO had less than 15 minutes advance notice of this outage
 - MISO operators quickly diverted energy flows off the transmission line and directed quick-start units on line to further reduce flows and enable parallel lines to reliably absorb the remaining flow on the line when it was forced out



MISO Market Benefits - Specific Examples

- **Watching our neighbors**
 - In late 2005, MISO and its members began observing excessive North to South energy flows over and above system operating limits
 - MISO discovered the cause to be a product being sold by PJM called “Pay-Thru-Congestion” which allowed PJM to sell transmission service above the capacity of the transmission system – while providing no way to relieve its impact on facilities outside of PJM’s boundaries
 - MISO contacted PJM to implement restrictions that allow PJM to continue offering this service while respecting MISO facility limits



MISO Market Benefits - Specific Examples

- **Monitoring and responding to extreme conditions**
 - In March 2006, several dangerous storms moved across the MISO footprint, resulting in more than 25 transmission facilities being forced from service and widespread power outages (70,000+ customers) across the Midwest. Majority of the damage was focused on the Springfield, Illinois area
 - Midwest ISO's broad system visibility, study capabilities, personnel and advanced applications allowed MISO to reliably manage the high voltage transmission system throughout these events
 - MISO's ability to see the big picture, monitor the region in and around the impacted areas, and direct appropriate actions allowed member utilities to focus their efforts on restoring their system(s) in a reliable and timely manner



MISO Market Benefits to Indiana

- In late 2004, facilities in northern Indiana were being overrun by power transfers
- MISO determined the flows were caused by power moving within the PJM Market from west to east
- MISO and PJM collaborated and adopted a new operating procedure to limit and/or curtail these flows to protect the impacted facilities



MISO Market Benefits to Indiana

- In addition to specific operating guides, MISO has worked with PJM to adopt new procedure - “Safe Operating Mode”
- The procedure consists of PJM and/or MISO working together to relieve unforeseen* issues on the transmission system outside of their own market footprint until formal operating guides can be established
- This procedure has been successfully implemented several times to protect Indiana transmission assets

***Unforeseen due to forced outages, storms, etc.**



MISO Market Benefits to Indiana

- In April of 2006, strong thunderstorms disabled several transmission facilities in Central Indiana
- The MISO market applications were able to:
 - Identify these outages as they occurred
 - Adjusted generation resources to respect all areas of the transmission system prior to company even requesting these actions



MISO Market Benefits to Indiana

- In May of 2006, a utility to the south of MISO lost a substantial amount of generation, which threatened to overload valuable transmission assets in southern Indiana
- The MISO market applications and operators:
 - Immediately identified the threat posed on the assets
 - Informed all impacted utilities of situation
 - Produced feasible mitigation procedure to protect the assets
 - Identified facilities in central Indiana that were out for maintenance and ordered these facilities returned to service immediately to further strengthen the transmission system



MISO Market Benefits to Indiana

- LMP and SCED tools have significantly enhanced the effectiveness while lowering the cost of regional reliability coordination.
- These examples demonstrate how MISO is prepared to assist the Indiana utilities this summer.

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