Gas-Electric Coordination at MISO
PJM GESTF
August 2013

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MISO
Topics

- Resource Fuel Mix
- Renewable Portfolio Standards
- Fuel Source Energy Contribution
- Expected Change in Generation
- Retirements
- Environmental Retrofits
- Electric & Natural Gas Coordination
- MISO Gas Study
MISO Resource Mix

- Diversified resource mix including coal, gas, oil, nuclear, wind, hydroelectric and biomass resources

- Approximate capacity breakdown by major resource type in the MISO footprint
MISO Renewable Portfolio Standards/Goals

Renewable Portfolio Standard Policies in MISO - June 2013

- MT: 15% x 2015
- ND: 10% x 2015
- SD: 10% x 2015
- MN: 26.5% x 2025, Xcel: 31.5% x 2020
- WI: Varies by utility ~10% x 2015 statewide
- MI: 10% & 1,100 MW x 2015
- IA: 105 MW
- IL: 25% x 2025
- MO: 15% x 2025
- IN: 10% x 2025

MISO - using Ventyx, Velocity Suite © 2013
Annual Energy Contribution by Fuel Source

Energy Contribution by Fuel Source in MISO Midwest Footprint

Year | Coal | Nuclear | Gas | Wind
---|------|--------|-----|-----
2009 | 78%  | 14%    | 3%  | 3%  |
2010 | 76%  | 14%    | 4%  | 4%  |
2011 | 75%  | 13%    | 5%  | 5%  |
2012 | 68%  | 13%    | 9%  | 7%  |
Factors Influencing Midwest Generation

• Significant unit retirements, driven by:
  – Age
  – Environmental regulations
  – Economics

• Fuel costs, particularly natural gas prices

• Current and proposed future environmental regulations
  – MATS
  – Water
  – Carbon

This will drive reserve margin erosion and put higher demands on gas transport infrastructure than were envisioned when it was designed.
MISO Quarterly Survey Results

Coal Resources Impacted
Q2 2013 Survey Capacity (GW)

- Total Coal: 295 Units
- No Action Required: 247 Units
- Total Impacted: 49 Units
- Control Required: 39 Units
- Uneconomic / Replace: 6 Units
- TBD / No Response: 4 Units

Revised 6/19/13
Supply Chain Analysis

Retrofit Project Timeline Relative to MATS Compliance Deadlines

- Wet-FGD
- SCR
- Dry-FGD
- Baghouse
- ACI
- DSI

Minimum Time for Design, Permit, Construction and Installation
Maximum Time for Design, Permit, Construction and Installation

Compliance Deadline w/o Extension
Compliance Deadline w/1-y Extension

PJM GESTF – August 2013
Generation Interconnection Queue

### Natural Gas Fired Generation in MISO Queue

<table>
<thead>
<tr>
<th>Study Status</th>
<th>Requests Numbers</th>
<th>Total MW (Summer Net)</th>
<th>Probability of project going in service</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIA Complete</td>
<td>3</td>
<td>499</td>
<td>High</td>
</tr>
<tr>
<td>Facilities Study</td>
<td>1</td>
<td>725</td>
<td>High</td>
</tr>
<tr>
<td>DPP - System Impact Study</td>
<td>3</td>
<td>1313</td>
<td>High</td>
</tr>
<tr>
<td>Feasibility Study</td>
<td>1</td>
<td>316</td>
<td>Low-Medium</td>
</tr>
<tr>
<td>SPA - Parked</td>
<td>9</td>
<td>5214</td>
<td>Low-Medium</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
<td><strong>8067</strong></td>
<td></td>
</tr>
</tbody>
</table>
Electric & Natural Gas Coordination Task Force (ENGCTF)

- MISO Stakeholder group established in Oct. 2012, providing a forum for electric and natural gas industry collaboration
- Active participation from both industries
- Facilitates cross-industry education
- Tasked with identifying major issues of concern
- Current initiatives / target completion date
  - Loss of Load Expectation Study / Q1 2014 for study results
  - Issue Paper on Misalignment of the Gas/Electric Days / July 2013
    - Survey to be conducted of market participant’s opinion on moving day ahead market
  - Issue Paper on Coordinated Operations / Q4 2013
    - Trial communication with interstate pipelines (day to day, seasonal)
    - Control room display to be developed
    - Aggregate critical notices and operational flow orders
  - Phase III Gas Study / September 2013
Major Interstate Pipelines in the MISO Footprint
MISO’s Gas Infrastructure Analyses

MISO’s Phase I, II and III gas studies are high-level investigations into the ability of the natural gas infrastructure to handle increasing demand.

<table>
<thead>
<tr>
<th>Study</th>
<th>Assumptions</th>
<th>Methodology</th>
<th>Completion</th>
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<tbody>
<tr>
<td>Phase I</td>
<td>$4.50/MMBtu gas price* 12 GW coal retirements</td>
<td>Modified Backcast Analysis</td>
<td>2/2012</td>
</tr>
<tr>
<td>Phase II</td>
<td>$2.50/MMBtu gas price* 12 GW coal retirements</td>
<td>Modified Backcast Analysis</td>
<td>7/2012</td>
</tr>
<tr>
<td>Phase III</td>
<td>$2.50/MMBtu gas price* $3.84/MMBtu gas price* 12 GW coal retirements</td>
<td><strong>Midwest:</strong> Modified Backcast Analysis</td>
<td>(est.) 9/1/2013</td>
</tr>
<tr>
<td></td>
<td>Static vs. dynamic market conditions (pipeline expansion)</td>
<td><strong>South:</strong> Corridor Flow Analysis</td>
<td></td>
</tr>
</tbody>
</table>

* Base year gas price
Phase III Natural Gas Infrastructure Analysis

• Study Objectives
  – Assess the ability of natural gas infrastructure throughout the MISO footprint to serve growing demand
  – Identify current and potential areas of pipeline congestion
  – Identify and characterize changing flow patterns and development trends

• Outcomes
  – Expand MISO’s knowledge of natural gas infrastructure throughout the footprint
  – Inform ENGCTF discussions and MISO planning processes

• Study Milestones
  – May 1st kickoff
  – Aug. 15th preliminary results
  – Sept. 15th finalize results
Phase III Methodology Overview

• Modified Backcast Analysis (MBA)
  – Provides continuity with Phase I and II studies
  – Indicates current and potential future pipeline congestion given static infrastructure (i.e. not enough firm commitments to expand infrastructure)
  – Pipeline-by-pipeline approach is geared toward mainline pipelines vs. networked pipelines; both exist within the MISO footprint

• Forward Balancing Analysis (FBA)
  – Complements Phase I and II study methodology
  – Accounts for known and projected trends; provides dynamic look at pipeline infrastructure
  – Balancing analysis on a sub-regional approach geared toward understanding behavior of networked pipeline systems

• Corridor Flow Analysis
  – Provides overview of in-flows and out-flows in heavily networked region, on a corridor basis
  – Builds knowledge base on infrastructure in new portion of footprint
Phase III Preliminary Results: Midwest MBA

- Newly discovered/recoverable supply basins, system expansion, and increasing interconnectivity of natural gas infrastructure in the region are contributing to changing flow patterns and improved flexibility for pipeline customers, physically and contractually.

- Study results indicate a clear trend of decreasing sub-regional constraints, with a few isolated exceptions.

- Results agree with conclusions of Forward Balancing Analysis
Phase III Preliminary Results: Midwest FBA

- Shifting supply and demand fundamentals outside and inside the Midcontinent Market will increasingly position the region as a destination rather than a waypoint in route to other markets.

- The increased retention of supply passing through the region, the greater diversity of supply options and the growth in Bakken production will provide end users with opportunities to reassess their portfolio of assets in accordance with organizational policies.

- Demand for natural gas in the Midcontinent region is dominated by residential and commercial customers, though average daily demand from power burn is projected to increase from 9% to 14% over the next few decades.
Phase III Preliminary Results: South

- **Inflows will likely continue to decline** in the short-to-medium term; this will be offset by steadily declining need for outflows, due to production growth in the Northeast.

- **LNG and industrial demand growth will upset traditional summer weighted demand** in the latter-half of the decade.

- Flows from Texas and Northeast Louisiana into MISO-South will continue to decline, but **outflows from the region will remain strong**, attracting supply from Texas and the Midcontinent.

- This in combination with the even more precipitous decline of flows to the Northeast has **decreased pipeline utilization** in the MISO-South area.
Questions?

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