Reliability of the Gas/Electric Interface in MISO

NASUCA
June 2018
The generation fleet in the MISO region has been evolving; MISO efforts continue to anticipate and plan for the future.

### MISO Generation Portfolio Evolution

#### 2005
- Coal: 76%
- Gas: 13%
- Hydro: 2%
- Nuclear: 2%

#### 2017
- Coal: 48%
- Gas: 16%
- Hydro: 24%
- Nuclear: 8%

### 2032 Future Scenarios

- **Limited Fleet Change**: Stalled generation fleet changes. Limited renewables additions driven solely by existing RPS under limited demand growth.
- **Continued Fleet Change**: Continuation of the renewable addition and coal retirement trends of the past decade.
- **Accelerated Fleet Change**: Renewables and demand side technologies added at a rate above historical trends. Fleet changes result in a 20% CO₂ emission reduction.
- **Distributed & Emerging Tech**: New renewable additions largely distributed and storage resources co-located with largest sites.

1. Emission reductions from current levels by year 2031.
Though MISO is favorably situated in the gas grid, there are challenges with increased reliance on gas.

**MISO Favorable Location on Gas Grid**

- Fast Start
- Various fuel risks and mitigation across the region
- Potential common mode of failure
- Gas infrastructure project challenges
- Major industry differences between gas and electricity

**Fuel Assurance Issues**
- Interruptible Transportation (IT)
- MISO Gas Generator Fuel Survey Results
- Firm Transportation (FT)
- Shared FT and IT
- Dual-Fuel, Shared FT and IT
- Dual-Fuel, IT

**Increasing Reliance on Gas**

- MISO North / Central
- MISO Total (including MISO South)

<table>
<thead>
<tr>
<th>Year</th>
<th>MISO Total</th>
<th>MISO North / Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>6%</td>
<td>21%</td>
</tr>
<tr>
<td>2012</td>
<td>11%</td>
<td>21%</td>
</tr>
<tr>
<td>2013</td>
<td>8%</td>
<td>21%</td>
</tr>
<tr>
<td>2014</td>
<td>7%</td>
<td>21%</td>
</tr>
<tr>
<td>2015</td>
<td>12%</td>
<td>21%</td>
</tr>
<tr>
<td>2016</td>
<td>16%</td>
<td>21%</td>
</tr>
<tr>
<td>2017</td>
<td>27%</td>
<td>21%</td>
</tr>
<tr>
<td>2018</td>
<td>24%</td>
<td>21%</td>
</tr>
<tr>
<td>2019</td>
<td>21%</td>
<td>21%</td>
</tr>
<tr>
<td>2020</td>
<td>21%</td>
<td>21%</td>
</tr>
<tr>
<td>2021</td>
<td>21%</td>
<td>21%</td>
</tr>
<tr>
<td>2022</td>
<td>21%</td>
<td>21%</td>
</tr>
</tbody>
</table>

**Gas-Electric Challenges**

- Just-in-time delivery
- Various fuel risks and mitigation across the region
- Potential common mode of failure
- Gas infrastructure project challenges
- Major industry differences between gas and electricity
MISO continues to make steady progress on gas contingencies to assess potential reliability risk

- Incorporated in planning studies since 2015, involvement in industry studies and dialogue
- Using the gas generator survey, MISO can help scope vulnerability
- Exposure to gas contingencies is greatly dependent on gas topology and mitigation levers
- Access to accurate data in a useful format helps support system reliability and resilience

### Top-5 Gas Pipelines

<table>
<thead>
<tr>
<th>Pipeline</th>
<th>Connected MWs</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANR</td>
<td>Dual Fuel, Indirectly Connected to Pipeline via LDC (MW), Dual Fuel, Directly Connected to Pipeline (MW), Connected to Multiple Pipelines (MW)</td>
</tr>
<tr>
<td>Texas Eastern</td>
<td>Directly Connected to Pipeline and also Connected to a LDC (MW), Indirectly Connected to Pipeline via LDC (MW)</td>
</tr>
<tr>
<td>NNG</td>
<td>Only Connected to this Pipeline (MW)</td>
</tr>
<tr>
<td>Gulf South</td>
<td></td>
</tr>
<tr>
<td>Columbia Gulf</td>
<td></td>
</tr>
</tbody>
</table>
MISO has incorporated natural gas disruptions in various planning studies since 2015

- Assess system impact of extreme events for TPL-001-4 standard compliance
- Evaluate potential LOLE impact under largest gas pipeline contingencies
- Assess the system reliability performance for anticipated operating horizon

NERC TPL-001-4 Extreme Event Analysis

Resource Adequacy Impact Analysis

Coordinated Seasonal Assessment
Current planning studies have found no major reliability risk driven by gas pipeline contingencies evaluated

Study

- MISO currently uses 31 gas contingencies, as extreme events, to evaluate transmission needs and risk
- Contingencies list is reviewed and updated annually based on geographic clustering, external studies, historic events, and transmission owner/planner feedback

Results

- No cascading resulted from gas pipeline events in MTEP15,16,17 TPL analyses
- No impact found in 2017/18 Winter CSA assessment
- No meaningful reliability limitations found in LOLE analysis of one extreme event (full pipeline outage in current resource portfolio), as annotated in FERC resilience responses*

---

*“Only in one scenario, under the extreme and long-term event of the loss of the largest natural gas pipeline for the entire summer peak season, was a slightly elevated regional loss of load risk observed.” MISO response in AD18-07 Page 27, Filed 03/09/2018
MISO’s ongoing activities include study initiatives to assess additional gas disruptions

Collaboration with Industry and Stakeholders

- Create detailed catalogue of historical events and refine gas system contingency list
- Estimate probability and impact and identify possible mitigations
- Update information on gas topology and system parameters

To help address:

- How to ensure data accuracy and transparency in a useful format?
- At what point does increased dependence on gas create a severe contingency risk?
- How could such risks be integrated into operations and planning to improve reliability?
Questions?

Jordan Bakke
Manager, Policy Studies

JBakke@misoenergy.org

Want to know more about MISO Gas-Electric Planning?