Capacity Performance

Education and Dialogue Session
August 12, 2014
January 2014 Polar Vortex and Winter Storm

Figure 2: January 2014 Minimum Temperatures: Columbus, Philadelphia, Chicago and Richmond

Winter Storm
January 7 – Peak Load vs. Typical Load

Megawatt

Hour Ending

80,000
90,000
100,000
110,000
120,000
130,000
140,000
150,000
160,000

January 7: Hourly MW Load (Preliminary)

138,733
Morning Peak

141,846
Evening Peak

100,801
Morning Peak

106,182
Evening Peak

Typical January Demand Curve
Jan. 7 Evening Peak, 7:00 p.m.
Forced Outages

- Coal: 13,700 MW (34%)
- Gas Plant Outages: 9,700 MW (24%)
- Natural Gas Interruption: 9,300 MW (23%)
- Nuclear: 1,400 MW (3%)
- Other: 6,100 MW (15%)

Total Forced Outages: 40,200 MW (22% Total PJM Capacity)
Increased Generation Outage Rates

Figure 4: Generator Outages – January 2014
Increased Generation Outage Rates

Figure 5: Forcéd Outages

January 7, 7 p.m.
40,200 MW

- Coal: 15,700 MW (34%)
- Nuclear: 1,400 MW (4%)
- Gas Intermittent: 9,300 MW (23%)
- Gas Plant Outages: 9,700 MW (24%)
- Other: 6,100 MW (15%)

January 24, 8 a.m.
29,100 MW

- Coal: 9,000 MW (31%)
- Nuclear: 2,700 MW (9%)
- Gas Plant Outages: 8,800 MW (37%)
- Gas Intermittent: 6,900 MW (24%)
- Other: 4,200 MW (14%)

January 28, 7 p.m.
23,800 MW

- Coal: 6,000 MW (25%)
- Nuclear: 1,000 MW (4%)
- Gas Intermittent: 4,700 MW (20%)
- Gas Plant Outages: 6,300 MW (22%)
- Other: 3,300 MW (14%)

Coldest low/high temp of the three days

<table>
<thead>
<tr>
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<th>January 7</th>
<th>January 24</th>
<th>January 28</th>
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<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
<td>Low</td>
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<td>4</td>
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<td>3</td>
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Wind Chill vs. Forced Outage – Western PJM

Outage (MW)

-30 -20 -10 0 10 20 30 40

Wind Chill °F

9,000 8,000 7,000 6,000 5,000 4,000 3,000 2,000 1,000 0

Winter 2008-2014
Cold Weather Induced Equipment Issues

- Frozen equipment
- Fuel Issues
  - Frozen fuel
  - Delivery issues
- Emissions equipment
- Consumables impacts
- Secondary processes
- Units not frequently operated
Fuel Security and Reliability

Loss of Load Probability on Peak Winter Day

Assumptions:
- PJM is at a 90/10 winter load level
- No DR is implemented
- Emergency assistance is only from RPM committed external units
Fuel Security and Reliability

RPM Committed Resources

Limited DR, Extended Summer DR and non-high availability capacity

Study determines the total amount of allowable Limited DR, Extended Summer DR and non-high availability capacity such that the PJM LOLE is maintained at an acceptable level.
PJM Queued Generation (Nameplate Energy) – Active and Under Construction

- Natural Gas, 45,432 MW, 62%
- Wind, 19,351 MW, 26%
- Oil, 45 MW, 0%
- Other, 232 MW, 0%
- Solar, 2,192 MW, 3%
- Storage, 162 MW, 0%
- Wood, 63 MW, 0%
- Biomass, 381 MW, 0%
- Methane, 118 MW, 0%
- Hydro, 283 MW, 0%
- Coal, 2,972 MW, 4%

As of 03/2013
• Fuel availability is within the generation owner’s control
• Penalties for capacity resource unavailability during peaks are insufficient
• Incentives created by insufficient peak period penalties
• Current PJM capacity market rules do not allow full reflection of costs for low probability, high reliability events
• Current PJM energy market rules either do not allow full reflection of costs for low probability, high reliability impact events, or bias decisions away from more reliable solutions
• Overarching direct and indirect incentives for enhancing availability and market implications
Natural Gas and Electricity Markets Issues

• Transportation Issues:
  – Timing of Gas Day and Electricity Day
  – Operational Flow Orders
  – Connections behind LDC city gate

• Commodity Market Issues:
  – Timing of commodity purchases with respect to electricity commitments
  – Weekday vs. weekend
Reduced and Restricted Availability
Generation and Demand Resources

- Fuel procurement restrictions; primarily natural gas.
- Environmental limitations that limit the total run hours for a generation resource.
- A lack of compensation for resource flexibility
- A shift in the supply curve has rendered resources designed to be base load into the role of peaking resources.
- Reductions in staff at some generation sites to minimize costs
- Increase of Demand Response (DR) as a capacity resource
Increasing Amount of Inflexible Resource Offer Parameters

• Some generation resource owners have chosen to decrease staffing at sites
• Business rule changes in 2012 that allowed unit owners to manage startup and notification times in excess of 24 hours
  – During recent summer days has exceeded 5,000 MW
• Limited run hours due to environmental restrictions
Performance Incentives / Penalties
Operational Availability and Flexibility
Fuel Security
Other Cold Weather Initiatives

- Energy Storage Participation in RPM (PC)
- QTU Credit (MIC)
- Cold Weather Resource Performance Improvement – long term aspects (OC)
- Gas Unit Commitment Coordination – long term aspects (OC)
- Unit Market Offers (MIC)
- Gas / Electric Coordination
• 13,700 MW coal out on January 7 with 13,000 out because they had no natural gas to start. Why weren’t these units already on?
• Figure 5 is confusing. Pie charts have different days than table and are not in chronological order, or is the middle chart supposed to be January 24?
• “PJM data show that generator outage rates can be expected to increase during cold weather conditions.” Would be good to discuss the basis for this conclusion. More than just three days of data? Need an explanation of Figure 6.
• “The end result is that with a greater shift toward gas-fired resources there is no incentive for generators to sign up for Firm Transportation and expand available pipeline capacity, and then greater uncertainty of which resources will be available based on the ability to secure bundled commodity and transportation on a short-term basis.” Is it a good assumption that signing up for firm transport will incent construction of new gas pipeline capability? Thought you needed a longer commitment.
What is Short-term spot firm transportation?

LOLP (Should we consider an LSE’s peak load obligations as well)

Need more explanation of unnumbered figure (7?) on page 16 and discussion on how a 15% outage rate in winter translates to a 10% LOLP

Are figures 7, 8 and 9 all based on the PJM LOLP study? How do these figures tie together?

“Performance data from January, 2014, clearly indicate that, under extreme winter conditions, the amount of unavailable generation can exceed 20 percent of the total generation fleet.” But is it usual to expect that high a level of outages? Thought this was unusual. During “normal” weather, outages much less. So do we plan for LOLP based on extreme or normal?

Perhaps I read too quickly, but the only thing I saw that made me think about redefining capacity was the “lack of compensation for resource flexibility.”