PJM/NYISO Wheel Replacement Protocol
Project Overview, Next Steps, and Schedule

Mark Sims
Manager, Transmission Planning
September Planning Committee Meeting
September 15, 2016
Reference to PJM Operating Committee

• See the September OC presentation for additional detail and examples:
<table>
<thead>
<tr>
<th><strong>PJM/NYISO Wheel Replacement Protocol Project Overview</strong></th>
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<tbody>
<tr>
<td><strong>Why was the project started?</strong></td>
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<td>ConEd notified involved parties of intention to terminate non-conforming wheeling service on April 28, 2016. PJM and NYISO are working jointly to develop a replacement protocol to address the operational, planning, and market impacts.</td>
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<td><strong>What is the wheeling service that is currently in place?</strong></td>
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<td>The non-conforming wheeling service has historically been implemented by NYISO and PJM by modeling a fixed 1000 MW flowing from NYISO to PJM over the JK (Ramapo-Waldwick) interface and from PJM to NYISO over the ABC (Hudson-Farragut and Linden-Goethals) interface</td>
</tr>
<tr>
<td><strong>When does the replacement protocol have to be in place?</strong></td>
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</table>
| • Current non-conforming wheeling service will end on April 30, 2017.  
• New protocol must be in place for use on May 1, 2017 |
| **What is the impact to Market Participants?** |
| • Primary impact to PSE&G and ConEd as facility owners  
• No changes to OASIS/Bidding Energy Transaction processes |
PSE&G/ConEd seam:
• 5018: Hopatcong – Ramapo 500 kV line
• J & K: Waldwick – South Mahwah – Ramapo 345 kV lines
• ABC:
  – A: Linden – Goethals 230 kV line
  – B: Hudson – Farragut 345 kV line
  – C: Marion – Farragut 345 kV line
• 61% of AC interchange and 80% of RECO load applied to the 5018 desired flow calculation

• 1,000 MW non-conforming wheel service
  – Imported from NYISO to PJM on the J & K
  – Exported to NYISO from PJM on the A, B, & C
• Example Assumptions:
  – Net AC Interchange schedule: 1,000 MW to NYISO
  – RECO load: 300 MW
• 5018 = 850 MW
  – 61% of AC Interchange (610 MW) + 80% RECO load (240 MW)
• JK = 1,000 MW to PS
• ABC = 1,000 MW to ConEd
Guidelines for New Protocol

• Supports reliable operation of the transmission system
• Effectively manages congestion across the region
• Provides for open access and utilization of the facilities to serve the public interest and provide benefit to consumers
• Does not hinder use of the facilities to respond to emergencies in real-time
• Preserves competitive market behaviors
• Minimize impacts to PJM and NYISO load
• Consider a combination of two concepts:
  – Account for an Operational Base Flow as a starting point
  – Apply an Interchange percentage distribution:
    • 5018: 32%
    • JK: 15%
    • ABC: 21%
Definitions

- **Operational Base Flow**: natural system flows determined using EMS & PSS/e study applications
- **Interchange Percentage**: percentage of net scheduled interchange applied to each interface (5018, JK, and ABC)
- **Interface Target Flow**: target flow PJM and NYISO System Operators will meet during real-time operations
• Operational Base Flow determined by performing studies using the following assumptions:
  – Zero net interchange between PJM and NYISO
  – PARs set to neutral tap setting
• PJM and NYISO will compare analysis results and come to agreement on Operational Base Flow value
• Operational Base Flow value will be applied to the JK and ABC interfaces as a starting point for determination of Interface Target Flow
• Apply Interchange Percentage values on top of Operational Base Flow to determine Interchange Target Flow value.
Interchange/OBF Target Flow Example

• Assumptions:
  – Net AC interchange to NYISO = 1,000 MW
  – RECO load = 300 MW
  – RECO load treatment:
    • 80% applied to 5018
    • 20% flows over western PJM/NYISO ties
  – Operational Base Flow: 400 MW
  – Applied Interface percentages:
    • 5018 – 32%
    • JK – 15%
    • ABC – 21%
  – Western Ties: 32% of net AC Interchange
• 5018 = 560 MW to NYISO
  – 32% of AC Interchange + 80% RECO load
• JK = 250 MW to PJM
• ABC = 610 MW to NYISO
• Western Ties = 380 MW
  • 32% of AC Interchange + 20% RECO load
### Guidelines for New Protocol

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Was Guideline Met?</th>
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<td>Supports reliable operation of the transmission system</td>
<td>✓</td>
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<td>Minimize impacts to PJM and NYISO load</td>
<td>✓</td>
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<td>Can be facilitated with the Phase Angle Regulator (PAR) technology at the ABC, JK, and 5018 interfaces (current equipment for May 1, 2017 implementation)</td>
<td>✓</td>
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<tr>
<td>Can be implemented in both PJM and NYISO market models</td>
<td>✓</td>
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Timeline

January 2016

February 2016

March 2016

April 2016

May 2016

June 2016

July 2016

August 2016

September 2016

October 2016

November 2016

December 2016

January 2017

February 2017

March 2017

April 2017

May 2017

NYISO Stakeholder Approval

Finalize and Submit JOA Revisions to FERC

Implementation and Testing

New Protocol "Go-Live"
Future Initiatives

• Operations:
  – Develop JOA changes
  – Develop Operating Protocol
  – Collaborate with Planning groups
  – Develop System Operator Training

• Planning:
  – Finalize assumptions for future Planning cases
  – Study light load cases to determine impacts
  – More details to be provided in Planning presentation
• NYISO created and posted a Whitepaper for the Wheel Replacement effort on their website. The concepts in this paper were based discussions between PJM and NYISO over the past four months:


• PJM reviewed the whitepaper and offered edits

• Second version of the whitepaper will be posted jointly in September with NYISO and will include PJM specific concepts and additional proposal details
• September 13\textsuperscript{th} OC meeting – Operational topics
• September 14\textsuperscript{th} MIC meeting – Market based topics
• September 15\textsuperscript{th} PC meeting – Planning topics
• Joint PJM/NYISO Stakeholder meeting – September 16, 2016 at NYISO
Questions?
Appendix
The current technology limitations were discussed and included in the requirements.

- **PAR Limitations:**
  - Each PAR has tap ranges for adjustments
  - PSE&G and ConEd owned PARs have tap adjustment limitations:
    - 20 tap adjustments per day, per PAR
    - 400 tap adjustments per month, per PAR
  - Taps are left in reserve to allow adjustment options for actual overloads:
    - As an example, a PAR with a +/- 16 Tap range will not be adjusted beyond +/- 14.
### Operational Base Flow MWs applied into PJM (JK interface) and to NYISO (ABC Interface)

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<th>-500/500</th>
<th>-1000/1000</th>
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<td><strong>Con</strong></td>
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<td>ABC target flow is undeliverable during periods of high AC Interchange due to the calculated target flow exceeding the combined thermal capability of the ABC lines.</td>
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<td>Summer 2016 OATF cases do not solve for AC Interchange values above 1,100 MW</td>
<td>EMS cases solve at all interchange levels with minimal congestion impacts</td>
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<td>EMS cases solve at maximum AC Interchange exports to NYISO but insufficient phase angle capability on the Waldwick PARs makes target flows on JK unachievable.</td>
<td>Target flows are achievable</td>
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<td>Congestion observed in EMS cases with PAR taps exhausted.</td>
<td>Allows acceptable usage of neighboring system with M2M coordination available when congestion is observed</td>
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<td>congest flows on JK unachievable.</td>
<td>Provides maximum Operational flexibility</td>
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<td><strong>Pro</strong></td>
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### Planning

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<td>Significant probable RTEP Reliability Violations (pending verification) anticipated in the PSE&amp;G Transmission Zone beyond the -500/500 protocol</td>
<td>Minimal RTEP Reliability Violations (pending verification) anticipated in the PSE&amp;G Transmission Zone</td>
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<td>Potential for price separation (potential reduced CETL margin) in the RPM forward looking capacity market</td>
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<td>Experience difficulty holding this flow in planning cases due to physical limitations on the PAR devices</td>
<td>Minimal RTEP Reliability Violations (pending verification) anticipated in the PSE&amp;G Transmission Zone</td>
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<tr>
<td></td>
<td>Minimal RTEP Reliability Violations (pending verification) anticipated in the PSE&amp;G Transmission Zone</td>
<td>No change from the current protocol, therefore no new RTEP reliability violations.</td>
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<td>PARs have good margin.</td>
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<td>May not reflect near term future operations</td>
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### Operations

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### RECO Load treatment:
80% on 5018 and 20% on Western PJM/NYISO AC Ties

### Interchange Assumption:
32% on 5018, 15% on JK, 21% on ABC, 32% on Western Ties