MISO-PJM JOA
Metrics and Process Review

WebEx Kickoff
September 11th, 2014
Agenda

- Welcome, Review Agenda 9:30AM
- Background and Process Review 9:40 AM
- JOA Planning Study 10:00 AM
  - Conclusion & Stakeholder Feedback
  - Transition
- Review JCM Work 10:30 AM
- IPSAC Next Steps and Timeline 11:00 AM
- Adjourn 11:30AM
MISO-PJM Planning Study IPSAC Meeting

Background and Process Review
Processes and procedures used to plan the system along the MISO-PJM seam are complex and interrelated.

Work completed pursuant to the JCM discussions including the fact finding analyses and queue coordination activities as well as the recently completed joint study highlight the complexity and dependencies.

- Baseline reliability processes can impact interconnection processes which can impact market efficiency planning at the regional and interregional level.

PJM and MISO staff will be working through the IPSAC to review processes and procedures related to planning along the seam to identify improvement opportunities.

- This review will include a review of the RTO planning processes and JOA market efficiency thresholds and metrics.
Overview of IPSAC Process

- Discuss Current Planning Processes and Metrics
- Solicit Feedback and Suggestions
- Prioritize Issues
- Develop Options to Address Issues
- Quantify Support for Options
- Decide on Changes
  - Make Changes to BPMs or JOA
  - File Applicable Changes
Ground Rules

- **JOA governance**
  - IPSAC provides input to JRPC
  - Not bound by letter of current metrics or process

- **Need to prioritize issues**

- **Goal: Best interregional process synced to regional processes**
  - As feasible, improvements work with current regional processes
  - As necessary, define regional issues that need to be addressed

- **Goal: determine highest priority issues, suggestions for improvement and levels of support**

- **Any polling is informational – determine levels of support**

- **MISO and PJM Provide**
  - Guidance and analysis as needed
  - Input on process issues
MISO-PJM Planning Study IPSAC Meeting

JOA Planning Study - Conclusion & Stakeholder Feedback
• **Goal:** to jointly evaluate cross-border transmission issues and identify opportunities for transmission expansion
  – 2012-2014
  – Multiple Futures
  – Multiple iterations of the study case
  – ≈ 80 project proposals evaluated
  – 2 ultimately passed the metrics but were regional proposals
  – Many perspectives on “lessons learned”
Review - Stakeholders Feedback

• Feedback was received from:
  – Transource, NIPSCO, Hunt Power, ITC

• General comments focused on:
  – Joint future development
  – JOA Cross Border MEP criteria
  – JOA metric
  – Study scope and process
Review - Stakeholders Feedback

• Joint Future Development
  – Support for the upfront definition of futures and their roles in evaluating transmission projects.
  – Futures vastly differed from one another presenting a high hurdle for a project to pass through all futures.
  – It is unclear how the futures would be used to determine cost allocation
  – CBMEP selection should not be further limited by regional criteria
Review - Stakeholders Feedback

• Cross Border MEP Criteria
  – To incorporate lesson learned, a review of the criteria is in order
  – The JOA criteria genesis preceded the recently completely full JOA study. A revisit of the CBMEP is due prior to the commencement of a new study
  – Reconsider the $20M threshold given the regional MEP cost criteria.
Review - Stakeholders Feedback

• JOA Metrics
  – Support for reconsidering the current metrics prior to a new study
  – APC adjustments for purchases and sales should be valued at the market LMP’s and not the production cost
  – Consider adding M2M payments which would, among other things, capture relief of intra-regional congestion
  – Metrics should appropriately reflect projects’ mitigation of congestion
Review - Stakeholders Feedback

• JOA Metrics (Cont.)
  – Re-evaluate the 100% congestion hedging assumptions
  – The number of years used for the NPV calculation should be consistent with the regional processes
  – The 70% APC 30% NLP split discussion should be held only after reconsidering the metrics
Review - Stakeholders Feedback

• **Study Scope and process**
  - Better alignment and coordination between RTOs and their regional processes
  - Consider a different process for identifying interregional transmission needs through regional processes.
  - Please explain how competitive proposals will be solicited and how this will align with regional processes
Goal of these next IPSACs is to look for improvements to the interregional study metrics or process

Presenting the metrics as informational at this point

Following meetings will allow for discussion, arguments, proposals

When MTEP and RTEP economic analyses results are both available, the JRPC will perform, with the IPSAC, an Annual Issues Review and determine whether a joint study should be performed in 2015

- Plans review will be addressed in separately scheduled IPSAC meetings and run in parallel with metric/process improvement discussions (a timeline is included later in the presentation)
MISO-PJM Planning Study IPSAC Meeting

Review JCM Work
Planning Coordination Issues at JCM

• July 24th JCM meeting highlights on cross border planning
  – Discussion on process and metric issues identified through the recent study
    • Appropriateness of CBMEP criteria including project cost threshold and requirement to meet three sets of metrics
    • Review of JOA metric and possible alternative
  – Discussion of alignment of RTO planning assumptions, timelines and models
  – Discussion of timeline to address these issues through the IPSAC
• Cross Boarder Projects must meet the following Criteria:
  – Evaluated as part of a Coordinated System Plan or joint study process
  – Meet the JOA benefit to cost ratio threshold 1.25
  – Benefit = 70% Adjusted Production Cost Savings + 30% Net Load Payment Savings
  – Minimum project cost of $20 million or greater
  – 10 year Net Present Value of benefits and cost, not to exceed 20 years from study year
  – Qualifies as an economic transmission enhancement or expansion under the terms of the PJM RTEP
  – Qualifies as a market efficiency project under the terms of Attachment FF of the MISO Tariff
  – Addresses one or more constraints for which at least one dispatchable generator in the adjacent market has a Generation to Load Distribution Factor (GLDF) of 5% or greater with respect to serving load in that adjacent market
• **MISO MEP must meet the following Criteria:**
  - Minimum project cost of $5 million or greater
  - Meet the benefit to cost ratio threshold 1.25
  - 20 year Net Present Value of benefits and cost, not to exceed 25 years from study year
  - 345 kV and above and lower voltage facilities of 100kV or above that collectively constitute less than 50% of the combined estimated project cost and without the project could not deliver sufficient benefit to meet the required benefit-to-cost ratio threshold

• **PJM MEP must meet the following Criteria:**
  - No Minimum project cost
  - Meet the benefit to cost ratio threshold 1.25
  - 15 year Net Present Value of benefits and cost
  - 100kV and above
• **Cross Border:**
  – 70% Adjusted Production Cost Savings (APCS) + 30% Net Load Payment Savings

• **MISO**
  – 100% Adjusted Production Cost Savings

• **PJM**
  – **Total Benefit = Energy Benefit + RPM Benefit**
  – **Regional Projects (Double Circuit 345kV and up)**
    • Energy Benefit = 50% Adjusted Production Cost savings + 50% change in Net Load Payment*
    • RPM Benefit = 50% change in Total System Capacity costs + 50% change in Net Capacity Payments**
  – **Lower Voltage Projects**
    • Energy Benefit = 100% change in net load payments*
    • RPM Benefit = 100% change in load capacity payments*

*only zones with decrease in net load payments
**only zones with decrease in net capacity payments
A Cross Border Project must meet three sets of metrics:
- JOA metrics
- Qualify as an economic transmission enhancement or expansion under the terms of the PJM RTEP
- Qualify as a market efficiency project under the terms of MISO’s Attachment FF

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<thead>
<tr>
<th></th>
<th>JOA</th>
<th>PJM</th>
<th>MISO</th>
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</thead>
<tbody>
<tr>
<td>B/C</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
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<tr>
<td>Metric</td>
<td>70% APC + 30% NLP</td>
<td>50% APC + 50% NLP*</td>
<td>100% APC</td>
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<tr>
<td>Cost Threshold</td>
<td>$20M</td>
<td>No Minimum</td>
<td>$5M</td>
</tr>
<tr>
<td>Benefit Years</td>
<td>10+ Year NPV**</td>
<td>15 Year NPV</td>
<td>20 Year NPV***</td>
</tr>
<tr>
<td>Voltage</td>
<td>&gt; 100kV</td>
<td>&gt; 100kV</td>
<td>&gt;= 345kV****</td>
</tr>
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</table>

* Lower voltage projects are allocated based on 100% NLP
** Not to exceed 20 years from study year
*** Not to exceed 25 years from study year
**** 345 kV and above and lower voltage facilities of 100kV or above that collectively constitute less than 50% of the combined estimated project cost
• **Benefit Metric Definitions – Production Cost**
  – *System Production Cost Savings* – The decrease in overall variable cost of production for the area under study
  – *Adjustments to Production Costs* – Accounts for addition of import value and subtraction of the export value

• **Benefit Metric Definitions – Load Payments**
  – *Load Payment Savings* – Captures the decrease in LMP at load busses by transmission zone
  – *Net Load Payment Savings* – Decreases load payments for the value of FTRs
JCM Capacity Deliverability

• The Capacity Deliverability Fact Finding Effort has Highlighted Difference in RTOs’ Capacity Planning Assumptions
  – When is deliverability study performed in overall reliability planning process?
    • New Capacity Resources (i.e. Resources with Network Resource Interconnection Service)
    • Existing Capacity Resources
  – Upgrade assumptions when including queued generation in out year models?
• Other Potential Reliability Study Process Differences?
IPSAC Next Steps and Timeline
Preliminary Process Review Timeline

- Sept 9 2014, kickoff Metric and Process IPSAC review
- Sept/Oct 2014 – Identify/Prioritize Issues
- Nov/Dec 2014 – Develop Solution Options
- Spring 2015 – Develop JOA and BPM changes as required
- Summer/Fall 2015 – File JOA changes as required
Preliminary Plans Review Timeline

Oct/Nov - Review M2M Congestion and Determine feasibility of “quick hit” Operational Performance Upgrades

Dec - Advance OP upgrades through reviews and approvals

Summer/Fall 2015 – Interregional Evaluations as appropriate

Oct/Nov Along with M2M Congestion Review also Review RTEP and MTEP issues and plans

Spring 2015 – Determine opportunities to consider more efficient or cost effective inter-regional upgrades

Metric and Process Review, September 11th, 2014
Upcoming JOA IPSAC Meetings

• Thursday, September 11th, WebEx, 9:30-11:30 ET
  – Kickoff meeting
  – Discuss objectives and timelines
  – Present feedback from last joint study
• Thursday, October 2nd, Valley Forge, 9-3 ET
  – MISO and PJM to present overviews of their interregional and regional processes and project benefit metrics
• Friday, October 24th, Carmel, 9-3 ET
  – Engage stakeholders in discussion on suggested process improvements and changes to project benefit metrics
• Additional Meetings to be Scheduled as Needed
Additional Questions? Please Contact:

- **MISO Contact**
  Adam Solomon
  asolomon@misoenergy.org
  (317) 249-5838

- **PJM Contact**
  Chuck Liebold
  lieboc@pjm.com
  (610) 666-8281
The JOA, MISO, and PJM Cost metrics are very similar

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<tr>
<th></th>
<th>JOA</th>
<th>PJM</th>
<th>MISO</th>
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<tbody>
<tr>
<td>Discount Rate</td>
<td>7.78% (50% MISO, 50% PJM)</td>
<td>7.7%</td>
<td>8.1%</td>
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<tr>
<td>Annual Charge Rate</td>
<td>16.25% (50% MISO, 50% PJM)</td>
<td>16.7%</td>
<td>15.8%</td>
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</table>
• **Adjusted Production Cost (APC)**
  - **JOA**
    • Each RTO’s production costs adjusted for interchange purchases and sales on an hourly basis.
    - If the RTO is selling interchange, multiply the interchange sales MW by the RTO’s generation-weighted LMP and subtract this value from the RTO’s production cost.
    - If the RTO is purchasing interchange, multiply the interchange purchase MW by the RTO’s load-weighted LMP and add this value to the RTO’s production cost.
  - **PJM**
    • Difference in estimated total annual fuel costs, variable O&M costs, and emissions costs of the dispatched resources in the PJM Region without and with the enhancement or expansion. Costs for purchases from outside of the PJM Region and sales to outside the PJM Region will be captured.
    - Purchases will be valued at the Load Weighted LMP
    - Sales will be valued at the Generation Weighted LMP
  - **MISO**
    • Difference in total production cost of the Resources in each Local Resource Zone adjusted for import costs and export revenues with and without the proposed Market Efficiency Project as part of the Transmission System.
**Metrics – Benefit Calculation**

- **Net Load Payments (NLP)**
  - **JOA**
    - The NLP benefit for each RTO represents each RTO’s gross load payment minus the estimated value of congestion-hedging transmission rights in each RTO.
      - Multiply the LMP at each modeled load bus in the RTO by the load (in MW) at the bus, for each simulation hour (load LMP * load (in MW)). Subtract from that value the estimated value of congestion-hedging transmission rights for that hour.
      - RTO’s congestion-hedging transmission rights shall be calculated by subtracting the RTO generation-weighted LMP from the RTO load-weighted LMP for each simulation hour. Then multiply this difference by the lower of the RTO’s total generation MW level or the RTO’s total load MW level.
  - **PJM**
    - Difference between the annual sum of the hourly estimated zonal load megawatts for each PJM transmission zone multiplied by the hourly estimated zonal Locational Marginal Price for each PJM transmission zone. Less the value of Transmission Rights for each PJM transmission zone without and with the economic-based enhancement or expansion.
Metrics – Benefit Calculation

• Additional PJM Metrics
  – Total System Capacity Cost
    • Difference between the sum of the megawatts that are estimated to be cleared in the Base Residual Auction under PJM’s Reliability Pricing Model capacity construct times the prices that are estimated to be contained in the offers for each such cleared megawatt* without and with the economic-based enhancement or expansion.

  – Load Capacity Payment
    • Sum of the estimated zonal load megawatts in each PJM transmission zone times the estimated Final Zonal Capacity Prices** for capacity under the Reliability Pricing Model construct* without and with the economic-based enhancement or expansion.

* times the number of days in the study year
** payments paid by load in each transmission zone
<table>
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<tr>
<th>Stakeholder Comment Description</th>
<th>Stakeholder Detailed Comment</th>
<th>Category</th>
<th>MISO/PJM Member (Company)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revise process for identifying inter-regional transmission needs</td>
<td>“...consider a different process for planning interregional transmission projects that will produce more meaningful and constructive results...” The interregional study process for determining and quantifying regional market efficiency needs should be eliminated in favor of each RTO using its respective and established regional study process... each RTO determines what portion of its market efficiency issues is met by each of the interregional proposals...Cost apportionment of the approved CBMEPs across...would be in proportion to the market efficiency benefits”.</td>
<td></td>
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<tr>
<td>and projects</td>
<td></td>
<td>Study Scope &amp; Process</td>
<td>AEP, Transource</td>
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<tr>
<td>Solicitation of competitive interregional transmission proposals</td>
<td>“RTOs need to explain what construct will be used under the interregional planning process to solicit competitive interregional project proposals...and how this...will align with the...regional processes”</td>
<td>Study Scope &amp; Process</td>
<td>AEP, Transource</td>
</tr>
<tr>
<td>Lower voltage criteria</td>
<td>The current criteria for crossborder projects are too stringent. Consider lowering the MISO MCPS voltage threshold through the RECB task force. Discussion was put off until need arises – the joint study results and MCPS shows lower voltage projects being the best solution</td>
<td>Study Scope &amp; Process</td>
<td>Customized Energy Solutions, LS Power, Wisconsin PSC</td>
</tr>
<tr>
<td>Maintain a process for assessing interregional reliability</td>
<td>“When will no harm analysis be performed?” “An important aspect of transmission planning is the evaluation of interconnected reliability. We hope that MISO and PJM have integrated this important aspect into their evaluations of proposed transmission solutions within the IPSAC process”</td>
<td>Study Scope &amp; Process</td>
<td>Exelon, Hunt Power</td>
</tr>
<tr>
<td>Introduce a review of cost assumptions for interregional proposals</td>
<td>When are the cost assumptions used for submitted projects reviewed and discussed through the IPSAC?</td>
<td>Study Scope &amp; Process</td>
<td>Exelon</td>
</tr>
<tr>
<td>Require sufficient information to validate project proposals</td>
<td>Exelon suggests that developers provide adequate detailed information on their proposed solution ideas to allow IPSAC staff to validate line characteristics</td>
<td>Study Scope &amp; Process</td>
<td>Exelon</td>
</tr>
<tr>
<td>Develop project selection rules and define role of futures</td>
<td>Provide clarity and consistency regarding what future scenarios will be used in studies and how those future scenarios will be used so as to avoid uncertainty or confusion. How are projects that meet one Future’s benefit-to-cost ratio but not another treated?</td>
<td>Study Futures</td>
<td>Exelon, ITC, LS Power, NIPSCO, WE Energies</td>
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# JOA Planning Study Comments (2/3)

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<th>Stakeholder Comment Description</th>
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<tbody>
<tr>
<td>Process to communicate and update models</td>
<td>Changes to the model (such as the topology changes) should be communicated as they come to light, rather than at the next IPSAC meeting</td>
<td>Process Improvement</td>
<td>Ameren</td>
</tr>
<tr>
<td>Utilizing previously studied projects to evaluate different metrics</td>
<td>The regional metrics should be calculated for a variety of JOA projects using current models. This may be used to inform the process of evaluating and adjusting the JOA metrics.</td>
<td>JOA CBMEP Criteria</td>
<td>AEP, NIPSCO, ITC</td>
</tr>
<tr>
<td>Consistency of regional and inter-regional benefit metrics</td>
<td>NLP calculation in the JOA is inconsistent with both MISO and PJM regional methodologies. Therefore projects that might pass using the regional approaches appear to be providing limited benefits.</td>
<td>JOA CBMEP Criteria</td>
<td>LS Power</td>
</tr>
<tr>
<td>CBMEP cost criteria</td>
<td>“…the $20M threshold for interregional projects should be re-evaluated especially given that the regional cost thresholds are significantly less restrictive”</td>
<td>JOA CBMEP Criteria</td>
<td>NIPSCO</td>
</tr>
<tr>
<td>Consider increase in transfer capacity as benefit metric</td>
<td>We are concerned MISO and PJM evaluations did not specifically include increasing transfer capacity along the seam between the PJM footprint in Illinois and the MISO footprint in Indiana.”</td>
<td>CBMEP Metrics</td>
<td>Hunt Power</td>
</tr>
<tr>
<td>Narrow scope of benefits considered</td>
<td>The current JOA benefits (metrics) include benefits very distant from the interface that can produce favorable B/C ratios for projects located quite a distance away from the MISO-PJM interface.</td>
<td>CBMEP Metrics</td>
<td>Hunt Power</td>
</tr>
<tr>
<td>Project referral to and evaluation through regional processes</td>
<td>How shall projects which show benefits either to one RTO or under one component of the JOA metric be treated?</td>
<td>CBMEP Metrics</td>
<td>ITC</td>
</tr>
<tr>
<td>Pricing of APC adjustments</td>
<td>“APC adjustments for purchases and sales should be valued at the market LMP’s and not the Production. The LMP’s provide more appropriate price signals than just production costs. The LMP’s also account for the hurdle rates between the various RTOs” of proposed transmission solutions within the IPSAC process”</td>
<td>CBMEP Metrics</td>
<td>ITC</td>
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</table>
| Consistency of regional and inter-regional benefit metrics | “Inter-regional APC is different than the regional APC formulation.”  
 “Consider looking at counting only zones with load cost savings, not all zones (similar to PJM regional metrics).”                                                                                                     | CBMEP Metrics    | NIPSCO                    |
| Definition of NLP metric                             | Net Load Payments savings as defined can be driven by FTR credit increases that effectively offset load cost. FTR credit increases are generally driven by increases in congestion                                                                 | CBMEP Metrics    | NIPSCO                    |
| Capturing congestion through M2M payments             | “... benefits of reducing internal congestion within an RTO and thereby leveling LMP within that RTO are not counted by the current JOA APC…APC adjustments … should continue to be valued at LMP, although the adjustments should take into account intra-RTO transfers … This could be done through inclusion of M2M payment of proposed transmission solutions within the IPSAC process” | CBMEP Metrics    | NIPSCO                    |
| Congestion hedging assumptions                       | “The current hedging assumptions embedded within the APC and NLP metrics should be re-evaluated such that the metrics align more closely with the objective of the study, which is to reduce the cost of delivered power by reducing congestion”                  | CBMEP Metrics    | NIPSCO                    |
| Revisit benefit metrics                              | Prior to discussing the 70%, 30% split for APC and NLP, the metrics should be reconsidered                                                                                                                                   | CBMEP Metrics    | NIPSCO                    |
| Benefit and cost NPV calculation                      | “...the number of years used for NPV should be consistent with what the RTOs consider in their regional studies”                                                                                                            | CBMEP Metrics    | NIPSCO                    |
Intra-RTO Deliverability Analysis – Step 1

- Studied each RTO on jointly developed case while monitoring adjacent area
- MISO Results
  - 95.4% of MISO Capacity Resources Deliverable
  - 79 MISO facilities limiting deliverability
- PJM Results
  - 99.8% of PJM Capacity Resources Deliverable
  - 8 PJM facilities limiting deliverability
Incremental Deliverability – Step 2

Among all of the overloaded transmission facilities identified by MISO in their step 1 analysis, 78 transmission facilities were also impacted by a transfer from MISO to PJM.

389 of these (58,275 MW) are NR or 34.8% of MISO NR

These results raise questions of differences between reliability criteria and study results in PJM and MISO.

This must be addressed prior to any market efficiency review to prevent cost shift.

Many MISO transmission issues are lower voltage.
<table>
<thead>
<tr>
<th>Study Horizon</th>
<th>MISO</th>
<th>PJM</th>
<th>So what’s the Impact?</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Uses 3 and 10 year cases</td>
<td>Uses 5 year case</td>
<td>1. Two different sets of results?</td>
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<td></td>
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<td>2. Different transmission assumptions?</td>
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<td>3. Different generation assumptions?</td>
</tr>
<tr>
<td>ERIS Analysis</td>
<td>Summer Peak and Summer off-Peak</td>
<td>Light load only &lt; 500kV</td>
<td>TRUE BUT</td>
</tr>
<tr>
<td>NRIS Analysis</td>
<td>Summer Peak only</td>
<td>Summer Peak Only</td>
<td>Projects near the RTO seams are studied under both RTOs criteria which will bridge the study gap and fix identified issues above.</td>
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</table>
### JCM - Summer Peak Reinforcement – Capacity (Firm) / Network Resource Requests

<table>
<thead>
<tr>
<th>Load</th>
<th>Category A (System intact)</th>
<th>Category B NERC Category B (loss of 1 element):</th>
<th>Category C NERC category C1, 2, 4, 5: (loss of 2+ elements)</th>
<th>TO Criteria Transmission Owner Criteria (FERC 715)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PJM</td>
<td>Summer peak</td>
<td>1. &lt;500kV: 5% DF or 5% impact on facility rating</td>
<td>1. &lt;500kV: 5% DF or 5% impact on facility rating</td>
<td>1. &lt;500kV: 10% DF or 5% impact on facility rating</td>
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<td></td>
<td>2. &gt;500kV: 10% DF or 5% impact on facility rating</td>
<td>2. &gt;500kV: 10% DF or 5% impact on facility rating</td>
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<td></td>
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<td></td>
<td>Study Gen has &gt;= 5% DF or MW Impact &gt;= 20% of Applicable Line Rating</td>
<td>Study Gen has &gt;= 5% DF or MW Impact &gt;= 20% of Applicable Line Rating</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Study Gen has &gt;= 5% DF or MW Impact &gt;= 20% of Applicable Line Rating</td>
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<tr>
<td>MISO NRIS</td>
<td>Summer Peak</td>
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**PJM**
- Capacity Resource / Firm merchant transmission / Long Term Firm Transmission Service
- 100% of requested Capacity Interconnection Rights

**MISO NRIS**
- All Units at 100% of capacity rights
<table>
<thead>
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<th>Category B NERC Category B (loss of 1 element):</th>
<th>Category C NERC category C1, 2, 4, 5: (loss of 2+ elements)</th>
<th>TO Criteria Transmission Owner Criteria (FERC 715)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PJM</td>
<td>Summer peak N/A</td>
<td>N/A</td>
<td>1. &lt;500kV: 10% DF or 5% impact on facility rating</td>
<td>As Required</td>
</tr>
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<td>2. &gt;500kV: 10% DF or 5% impact on facility rating</td>
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<td>All fuel types at 100% of Summer Energy Output</td>
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<tr>
<td>Load</td>
<td>Category A (System intact)</td>
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<td>Category C NERC category C1, 2, 4, 5: (loss of 2+ elements)</td>
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<tr>
<td>MISO ERIS</td>
<td>Summer Peak</td>
<td>1. Study Gen has &gt;=5% DF</td>
<td>1. Study Gen has &gt;=20% DF</td>
<td>Based on Local TO Criteria</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. MW Impact &gt;= 20% of Applicable Line Rating</td>
<td>2. MW Impact &gt;= 20% of Applicable Line Rating</td>
<td>Based on Local TO Criteria</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Overloaded element is at generator’s outlet</td>
<td>3. Overloaded element is at generator’s outlet</td>
<td>Based on Local TO Criteria</td>
</tr>
<tr>
<td>Wind at 20% nameplate</td>
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</tr>
<tr>
<td>Gas at 100% of Nameplate</td>
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</tr>
<tr>
<td>Coal &amp; Nuclear at 100% of Nameplate</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Resource modeling</td>
<td>Load</td>
<td>Category A (System intact)</td>
<td>Category B NERC Category B (loss of 1 element):</td>
<td>Category C NERC category C1, 2, 4, 5: (loss of 2+ elements)</td>
</tr>
<tr>
<td>-------------------</td>
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<tr>
<td>PJM</td>
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<td></td>
</tr>
<tr>
<td>Load at 50% of summer peak</td>
<td>Wind 40% ramp to 80% energy</td>
<td>1. &lt;500kV: 5% DF or 5% impact on facility rating</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oil &amp; Gas off</td>
<td>2. &gt;500kV: 10% DF or 5% impact on facility rating</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Coal (&lt;500MW) at 45% initial</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Coal (&gt; 500MW) at 60% initial</td>
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<tr>
<td></td>
<td>Nuclear at 100%</td>
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<td></td>
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<tr>
<td></td>
<td>Pumped Storage – Full Pump</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Other resources at 0%</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
## JCM - Light Load (PJM) / Shoulder Peak (MISO) Reinforcement

<table>
<thead>
<tr>
<th>Resource modeling</th>
<th>Load</th>
<th>Category A (System intact)</th>
<th>Category B NERC Category B (loss of 1 element):</th>
<th>Category C NERC category C1, 2, 4, 5: (loss of 2+ elements)</th>
<th>TO CriteriaTransmission Owner Criteria (FERC 715)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MISO ERIS</td>
<td>Wind at 100% nameplate</td>
<td>70% of summer peak</td>
<td>Study Gen with &gt;= 5% DF</td>
<td>Study Gen with &gt;= 20% DF</td>
<td>Based on Local TO Criteria</td>
</tr>
<tr>
<td></td>
<td>All other units are modeled at their expected seasonal output. Coal, Nuclear are at 100% Oil and Gas off</td>
<td>2. Study gen MW Impact &gt;= 20% of Applicable Line Rating</td>
<td>Study gen MW Impact &gt;=20% of Applicable Line Rating, or Overloaded element is at generator’s outlet</td>
<td>Overloaded element is at generator’s outlet</td>
<td>Based on Local TO Criteria</td>
</tr>
<tr>
<td></td>
<td>Load at 70% of summer peak</td>
<td>3. Overloaded element is at generator’s outlet</td>
<td>Based on Local TO Criteria</td>
<td>Based on Local TO Criteria</td>
<td>Based on Local TO Criteria</td>
</tr>
</tbody>
</table>

**MISO ERIS**

- Load at 70% of summer peak
- Wind at 100% nameplate
- All other units are modeled at their expected seasonal output. Coal, Nuclear are at 100% Oil and Gas off

**MISO**

Load at 70% of summer peak

- Wind at 100% nameplate
- All other units are modeled at their expected seasonal output. Coal, Nuclear are at 100% Oil and Gas off

**PJM**

Resource modeling

- Load
- Category A (System intact)
- Category B NERC Category B (loss of 1 element):
- Category C NERC category C1, 2, 4, 5: (loss of 2+ elements)
- TO Criteria Transmission Owner Criteria (FERC 715)