



Capacity Deliverability

DRAFT CAPACITY DELIVERABILITY FACT-FINDING RESULTS



Background and History

- “Networked” approach to Capacity Deliverability initially proposed several years ago
- MISO issued a whitepaper on the concept in 2012 (available at: <http://www.miso-pjm.com/~media/committees-groups/stakeholder-meetings/pjm-miso-joint-common/20120716/20120716-miso-capacity-deliverability-whitepaper.ashx>)
- At the June 20, 2013 FERC open meeting, OMS and OPSI committed to the submission of a work plan encompassing all of the Joint and Common Market efforts within three months
- On September 26, 2013, PJM and MISO filed the work plan with FERC
- The work plan included a Capacity Deliverability fact-finding effort, at the end of which the RTOs, together and with input from stakeholders, would determine whether additional work on the Capacity Deliverability concept would be beneficial

Background and History

- The fact-finding effort included four technical analysis steps to further investigate the potential impacts of a joint deliverability approach
- PJM and MISO have posted a DRAFT report summarizing the analyses for stakeholder review and comment
- The report also contains a qualitative description of the potential benefits of a joint deliverability approach, as well as further detail on issues that must be resolved before moving to such an approach
- Further work is required to quantify the potential benefits and determine the level of effort required to resolve the identified issues

Capacity Deliverability Concept

- The goal of Capacity Deliverability is essentially to extend the Network transmission service concept across the border between the RTOs
- Rather than requiring resources to individually procure Firm transmission service on each side of the seam in order to qualify as a Capacity Resource, the RTOs would determine prior to the execution of their Capacity auctions the quantity of resources in the other RTO that could be committed in the auction, and the resources that economically clear would be awarded Firm scheduling rights equivalent to the Firm service currently reserved

Potential Capacity Deliverability Benefits

- Certainty for resources that offer into and clear in a Capacity auction that Firm scheduling rights will be awarded without the need to separately procure Firm transmission service as is done today
- Potential increased opportunity for the RTOs to procure the least-cost set of resources to meet resource adequacy requirements subject to the capability of the transmission system to transfer Capacity
- Opportunity for the RTOs to trigger the most cost-effective set of transmission upgrades given the RTO to which resources may be committed for Capacity

Issues to be Resolved

- Transmission upgrade cost allocation: preventing transmission upgrade cost shifts between the RTOs
- Energy market coordination: real-time operational protocols would need to be developed to ensure delivery of energy associated with Capacity commitments during emergency conditions
- Establishment of Capacity import and export limits where they do not already exist and potential modification to the methodology by which those limits are established where they do exist to ensure that the energy associated with Capacity commitments can be reliably delivered
- Treatment of existing Firm transmission rights if Firm scheduling rights are awarded to resources that clear in Capacity auctions
- Establishment of Firm Flow Entitlements in the Market-to-Market congestion management process given committed Capacity resources

OMS/OPSI Issues

- Determine the possibility and significance of cost shifts between MISO and PJM
- Consider the impact of any revised deliverability scheme on reliability
- Consider whether further work on Capacity Deliverability is cost effective
- Conclude whether there is an overall incremental joint deliverability benefit over that which is currently occurring
- Consider whether the revisions can be realistically and cost-effectively implemented
- Determine the long-term rate impact on each RTO's retail customers

Technical Analysis Results

Description	MISO Analysis	PJM analysis
Fact Finding #1 - Step 1	MISO NR Deliverable= 95.4%	PJM NR Deliverable = 99.8%
Fact Finding #1 - Step 2	PJM to MISO Deliverability= 99.5%	MISO to PJM Deliverability = See PJM Presentation
Fact Finding #1 - Step 3	Joint Deliverability = 98%	Joint Deliverability = 96.8%
	MISO NR = 95.6%	MISO NR = 93.8%
	PJM NR = 100%	PJM NR = 99.2%

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APPENDIX A

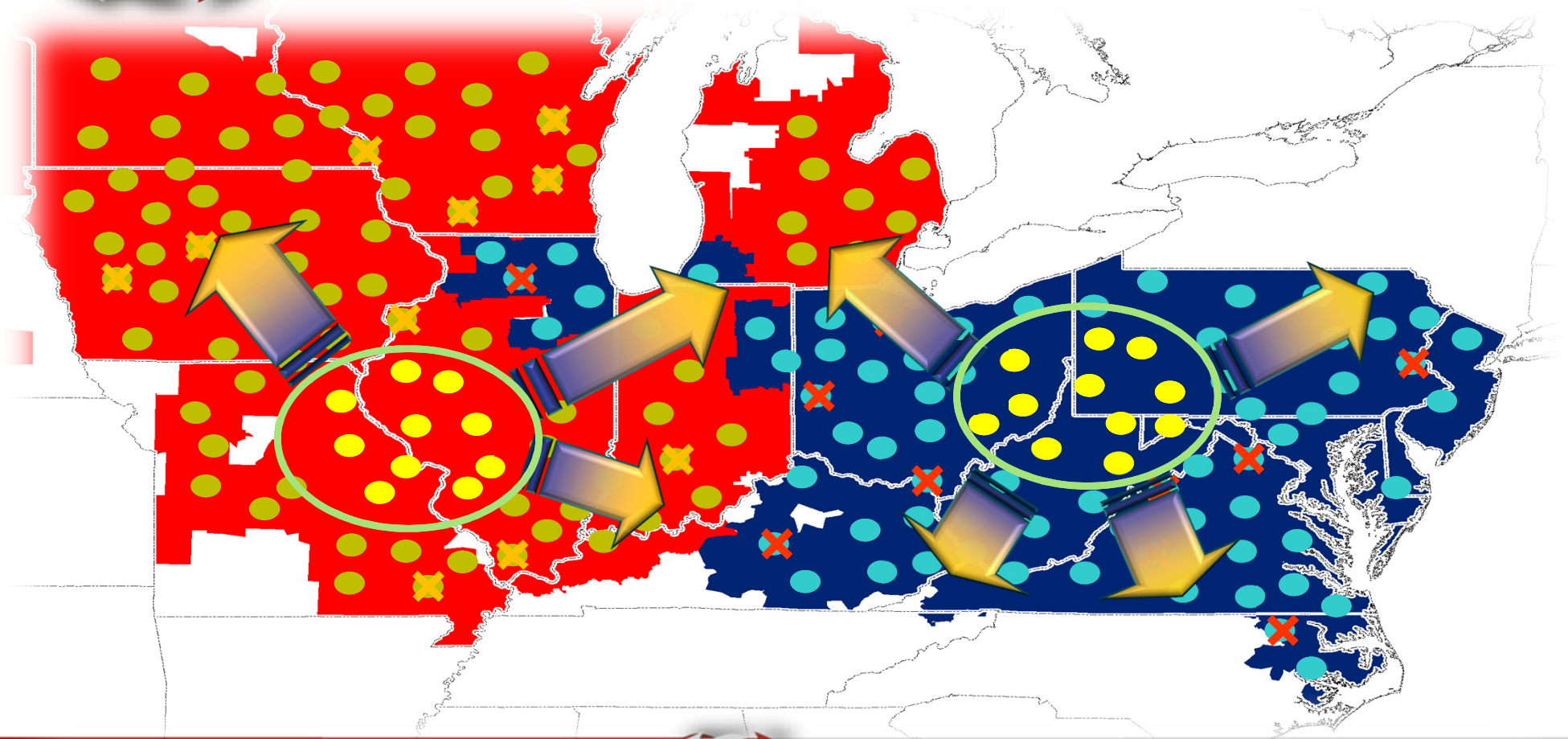
**PJM FF#1 presentation
March 24th, 2014 JCM meeting**



Capacity Deliverability Fact Finding 1 PJM Update



Step 1: Intra-RTO Deliverability Testing



Step 1: Intra-RTO Deliverability Analysis

Studied each RTO on jointly developed case while monitoring adjacent area

MISO Results

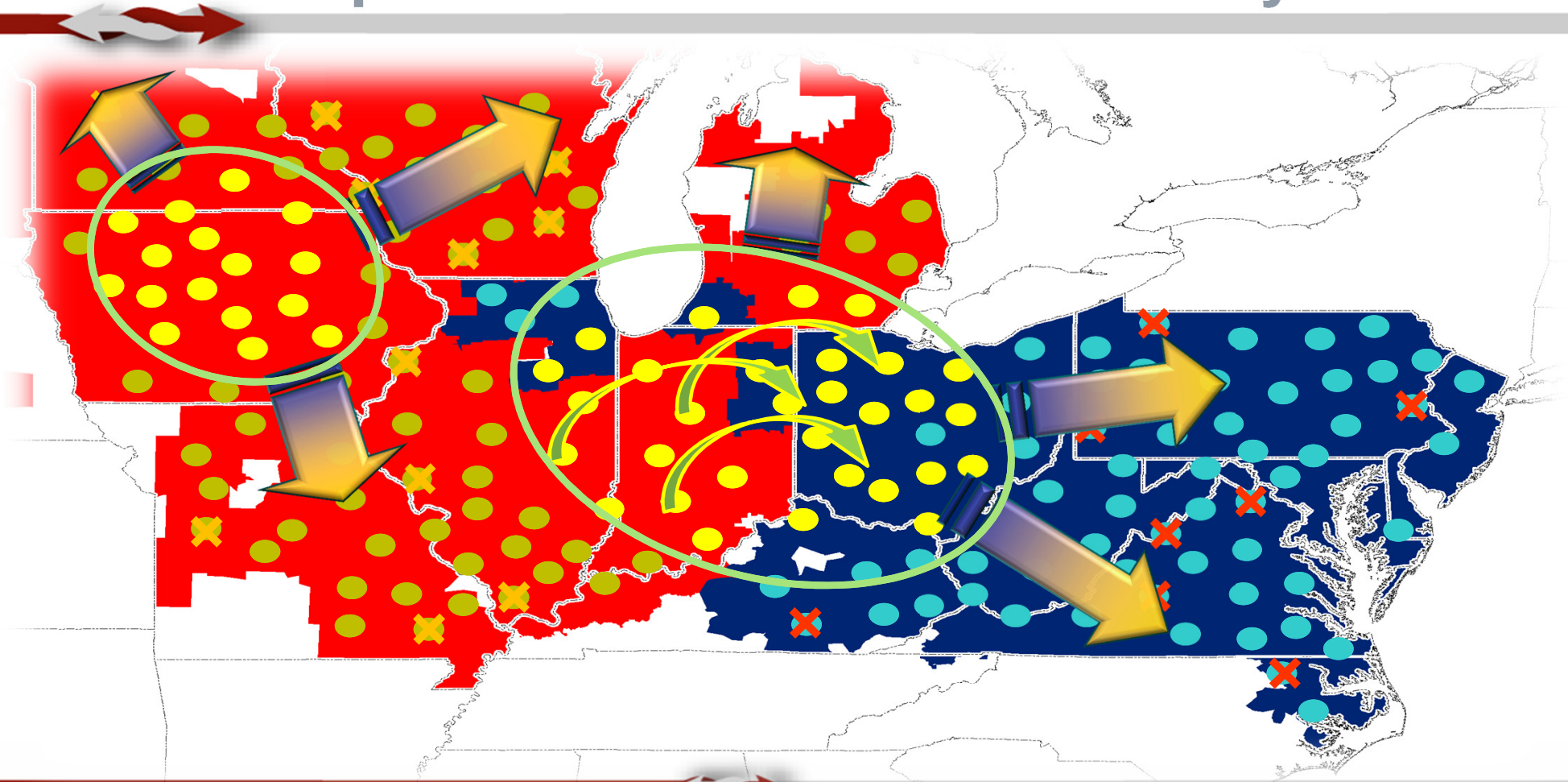
- 95.4% of MISO Capacity Resources Deliverable
- 79 MISO facilities limiting deliverability

PJM Results

- 99.8% of PJM Capacity Resources Deliverable
- 8 PJM facilities limiting deliverability



Step 2: Incremental Deliverability



Step 2: Incremental Deliverability

Expands on Step 1 by including generators in the adjacent RTO in the deliverability test of the RTO under study

Include groups of generators in the adjacent RTO as if they were generation in the RTO under study

Step 2: Incremental Deliverability – PJM Approach



- Use the results from each RTO's Step 1 analysis
- Utilize the transmission capability available beyond ("incremental to") what is required for internal generation deliverability
- Determine generators or groups of generation that could be "moved or delivered" to the adjacent RTO while respecting loading from individual RTO deliverability testing
- Calculate the contribution from specific generation to facility loadings for generation being delivered to adjacent RTO



Step 2: Incremental Deliverability – PJM Approach

Started with the line loadings calculated in step 1

- PJM facilities loaded at 90% or higher for PJM deliverability test
- MISO facilities loaded at 100% or higher for MISO deliverability test (facility loadings for facilities under 100% were not available)

Calculated incremental loading on facilities for a transfer of generation resources from MISO to PJM



Step 2: Incremental Deliverability – PJM Approach

Identified the specific generation contributing to the loading on various facilities

Identify generation or groups of generation that could be delivered into PJM

Identify generation or groups of generation that may not be deliverable to PJM based on transmission limitations

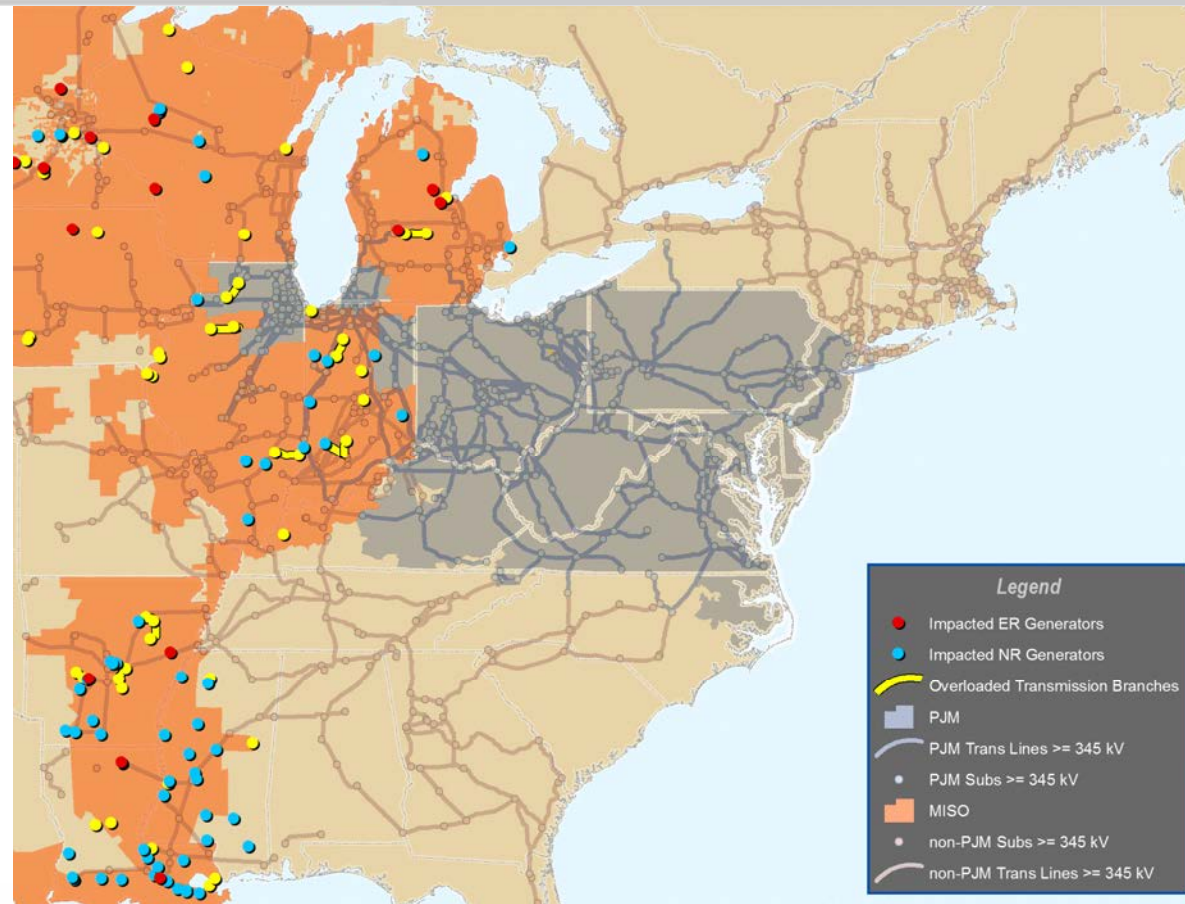
Step 2: Incremental Deliverability – PJM Results

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

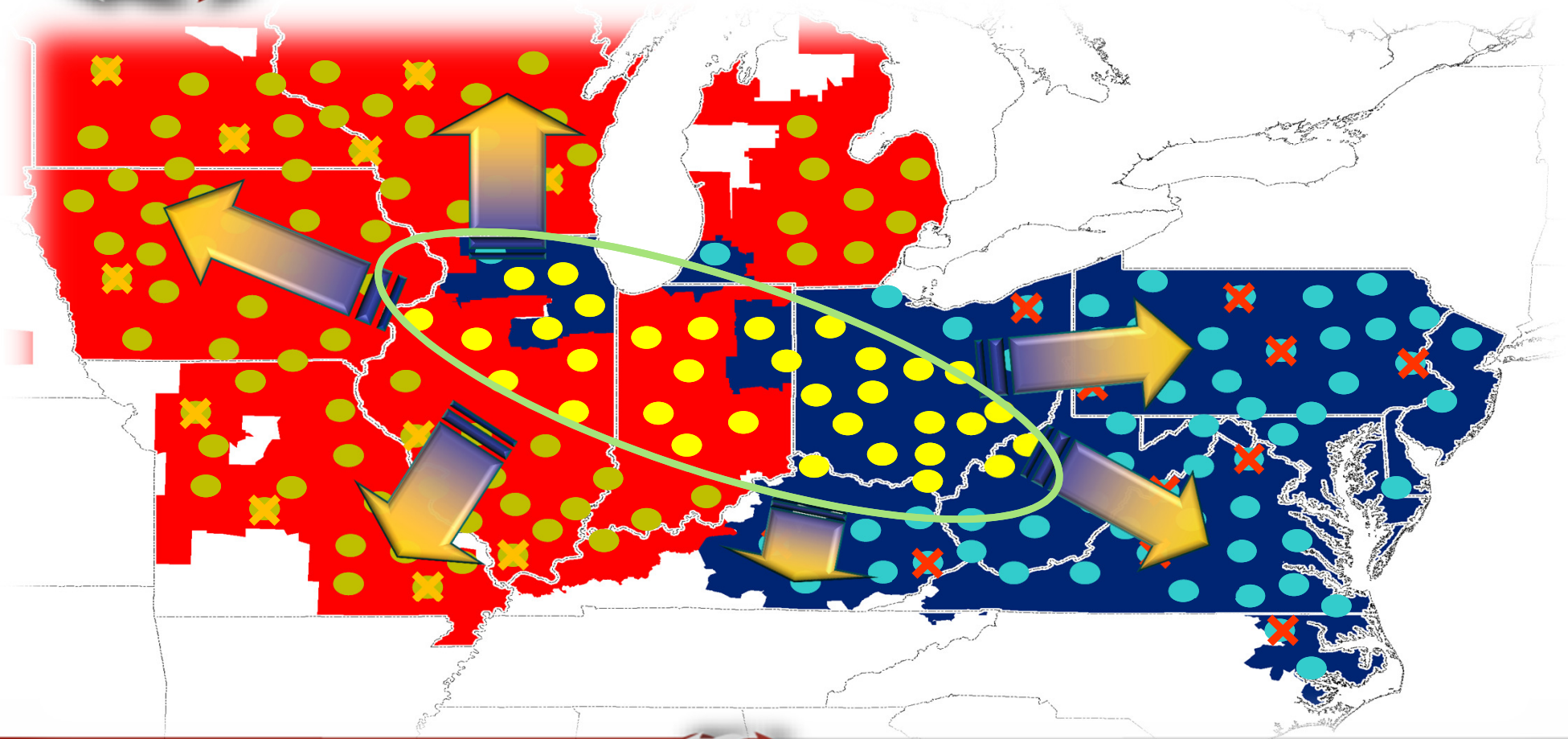
433 generators in MISO contribute to the loading on the overloaded facilities

389 of these generators are MISO NR

Total capacity of these Network Resources is 58,275 MW (i.e. 34.8% of the NR capacity in MISO)



Step 3 - Inter-RTO Deliverability Testing



Inter-RTO Deliverability – PJM Results

9 transmission facilities in PJM restrict deliverability

- 2 345 kV facilities and 7 138 kV facilities

168 transmission facilities in MISO restrict deliverability

- 19 230 kV and above with remaining on 69 kV to 161 kV

96.81% Combined Capacity/NR deliverable

- 99.2% of PJM capacity resources deliverable
- 93.8% of MISO network resources deliverable



Inter-RTO Deliverability – MISO Results



One 138 kV transmission facility in PJM restricts deliverability

84 transmission facilities in MISO restrict deliverability

98% of the combined generation is deliverable

- 100% of PJM generation deliverable
- 95.61% of MISO generation deliverable



Next Steps

Update MISO generation deliverability test to identify facilities loaded between 90% and 100%

Repeat the step 2 analysis





APPENDIX B

**MISO FF#1 presentation
March 24th, 2014 JCM meeting**





Fact Finding #1 Update

JCM

March 21st, 2014



Summary of Activities

- Intra-RTO Deliverability (FF#1 – Step 1)
 - Study complete
- Inter-RTO Deliverability (FF#1 – Step 3)
 - Study complete
- Incremental Deliverability (FF#1 – Step 2)
 - Preliminary results available

FACT FINDING #1 – STEP 2 (Informational Filing)

- Include generators from the other RTO's footprint in the deliverability analysis
- Study them as if these units were the generation in the RTO performing the Deliverability Analysis
- Change the static dispatch level for these “other RTO” generators to match the dispatch methodology of the RTO performing the Deliverability Analysis
- Start analysis with “other RTO” generators that are already Capacity Resources for the RTO performing the analysis
- Expand the analysis to include “other RTO” generation pockets through out the other RTO footprint

FACT FINDING #1 – STEP 2 METHODOLOGY

MISO Methodology

1. Performed the Incremental Deliverability in accordance with the Informational filing
2. Included all PJM units in MISO's deliverability analysis
3. Preliminary results indicate about 99.46% of PJM NR units are deliverable to MISO
4. MISO will update these results, after PJM review, and post them on the JCM website by March 30th.

RESULT SUMMARY

Description	MISO Analysis	PJM analysis
Fact Finding #1 - Step 1	MISO NR Deliverable= 95.4%	PJM NR Deliverable = 99.8%
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Next Steps

Post the updated FF#1-Step 2 results by March 30th, 2014

Include these results in the final report

Discuss the final Fact Finding #1 and #2 results at the April, 2014 Capacity Deliverability Conference call



APPENDIX C

**MISO FF#2 presentation
March 24th, 2014 JCM meeting**





**Capacity Deliverability
Fact Finding 2 Update
MISO-PJM JCM**
March 21st, 2014





Executive Summary

- MISO is on schedule to complete Fact Finding 2 as filed with FERC
- Results show: 6.1 to 7.7 GW export capability from MISO to PJM and 10.2 to 14.3 imports into MISO from PJM.
 - **PJM Import limits from MISO calculated by PJM currently higher than MISO calculated Export Limits**
 - **Higher limits primarily driven by updated PJM load modeling**
 - **MISO in process of coordinating with PJM on modeling updates and will be conducting sensitivity transfer analysis with updated models**
 - MISO expects export capability **to increase with PJM modeling update from non-diversified to diversified peak load.**
- Results are encouraging for Resource Adequacy – informs additional transmission availability between two RTOs
- Results targeted for completion by end of March





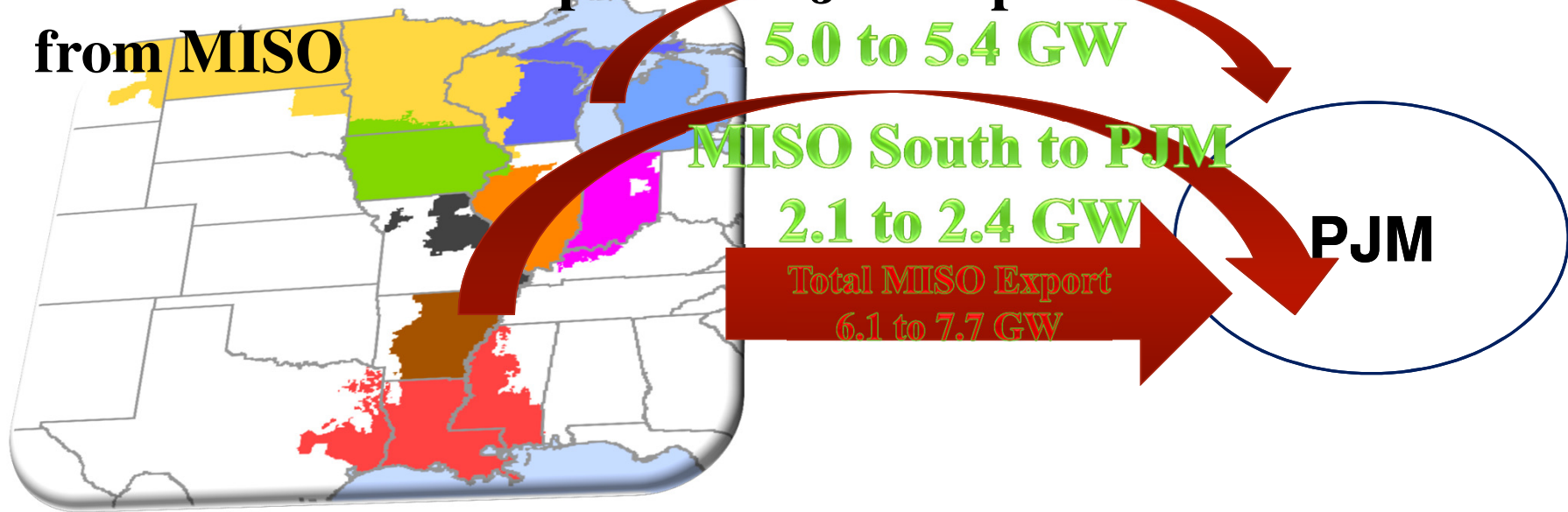
Background

- Scope of Fact Findings:
 - Fact Finding 1 - Determine MISO-PJM Joint Deliverability
 - Fact Finding 2 – Determine Transmission Import and Export Limits
- Generation and transmission limits, as determined in Fact Findings 1 and 2 are intended to be used in conjunction to:
 - Inform potential import and export capability between the two systems
 - Qualify as Planning Resources in Resource Adequacy Auction
- **Overall mission to identify pros and cons of improving current construct – additional process step evaluating transmission availability through point to point TSR analysis conducted in both RTOs**
- The final report **being delivered** will include findings as well as whether additional work is needed



MISO Exports

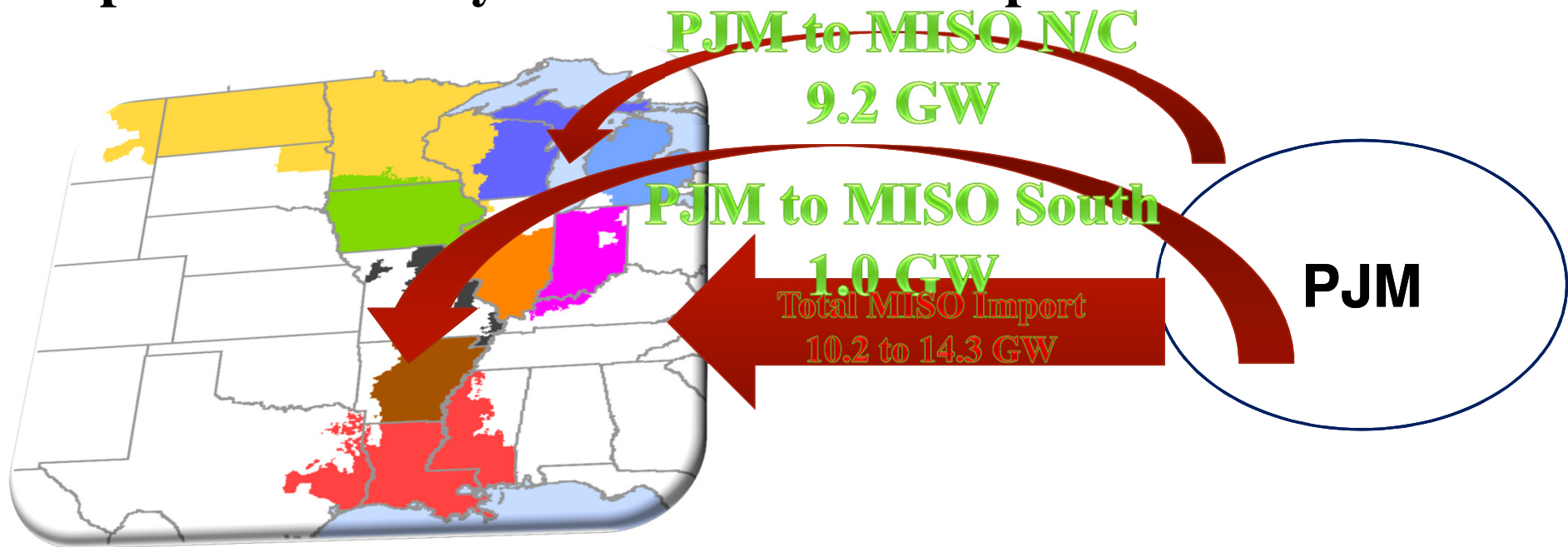
- The range of limits under multiple scenarios, all indicate export availability above current firm sales
- These results correspond to PJM Import Limits from MISO



Note: These export limit calculations based on FF1 models contains PJM “non-diversified” load representation. (PJM’s internal analysis of CILs contains “diversified” loads – net PJM load reduction of over 11 GWs). It is expected that MISO-calculated Export Limits would increase with the same modeling changes applied to this study.

MISO Imports

The range of limits under multiple scenarios, all indicate import availability above current firm purchases





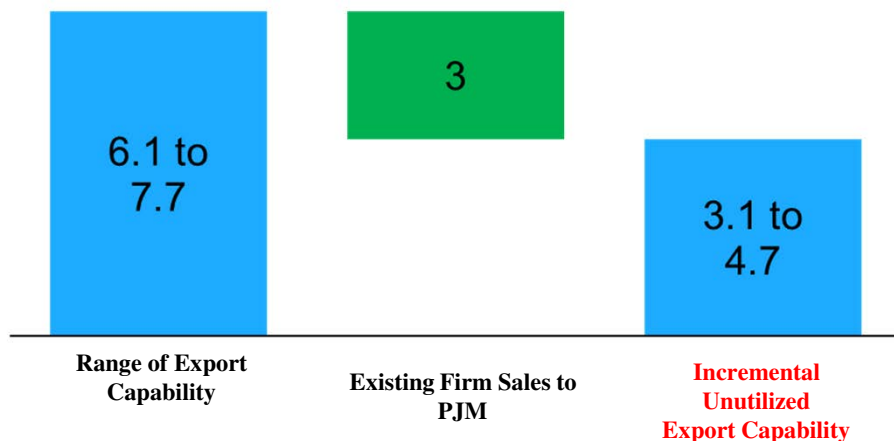
Method used to Establish Limits

- Import and Export transfer calculations establish “total” limits - all transactions between MISO and PJM removed from Fact Finding 1 base case
- Range is a consequence of transfer modeling between either aggregate MISO or individual MISO Local Resource Zones to either aggregate PJM or to PJM Western Deliverability Area
 - **MISO export limits:**
 - **Highest limit is derived from exporting to PJM Western Region Local Deliverability Area (LDA) from individual MISO Local Resource Zones with tie lines with PJM**
 - Lowest MISO export limit is derived from exporting to aggregate PJM system from aggregate MISO system
 - **MISO import limits:**
 - **Highest MISO import limit is derived from importing from aggregate PJM region into individual MISO Local Resource Zones with tie lines with PJM**
 - **Lowest MISO import limit is derived from importing from aggregate PJM system into aggregate MISO system**

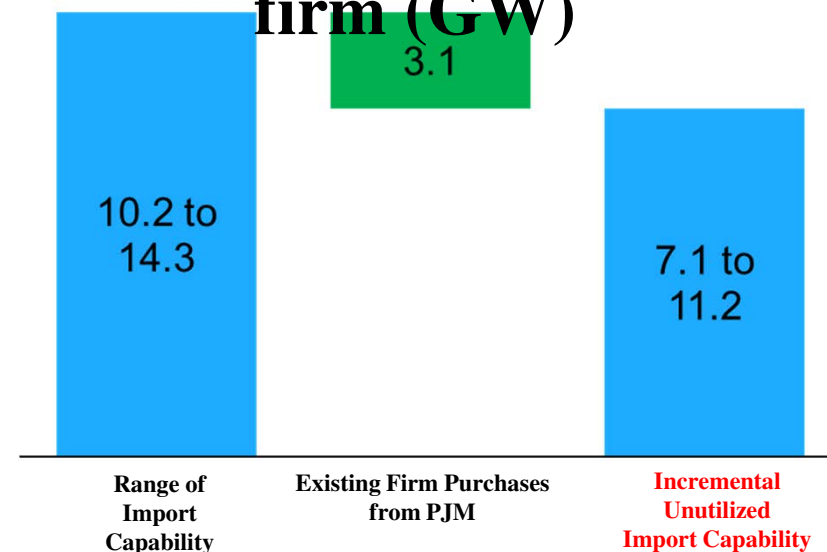


Transmission availability above firm levels is materially significant

Exports above existing firm (GW)



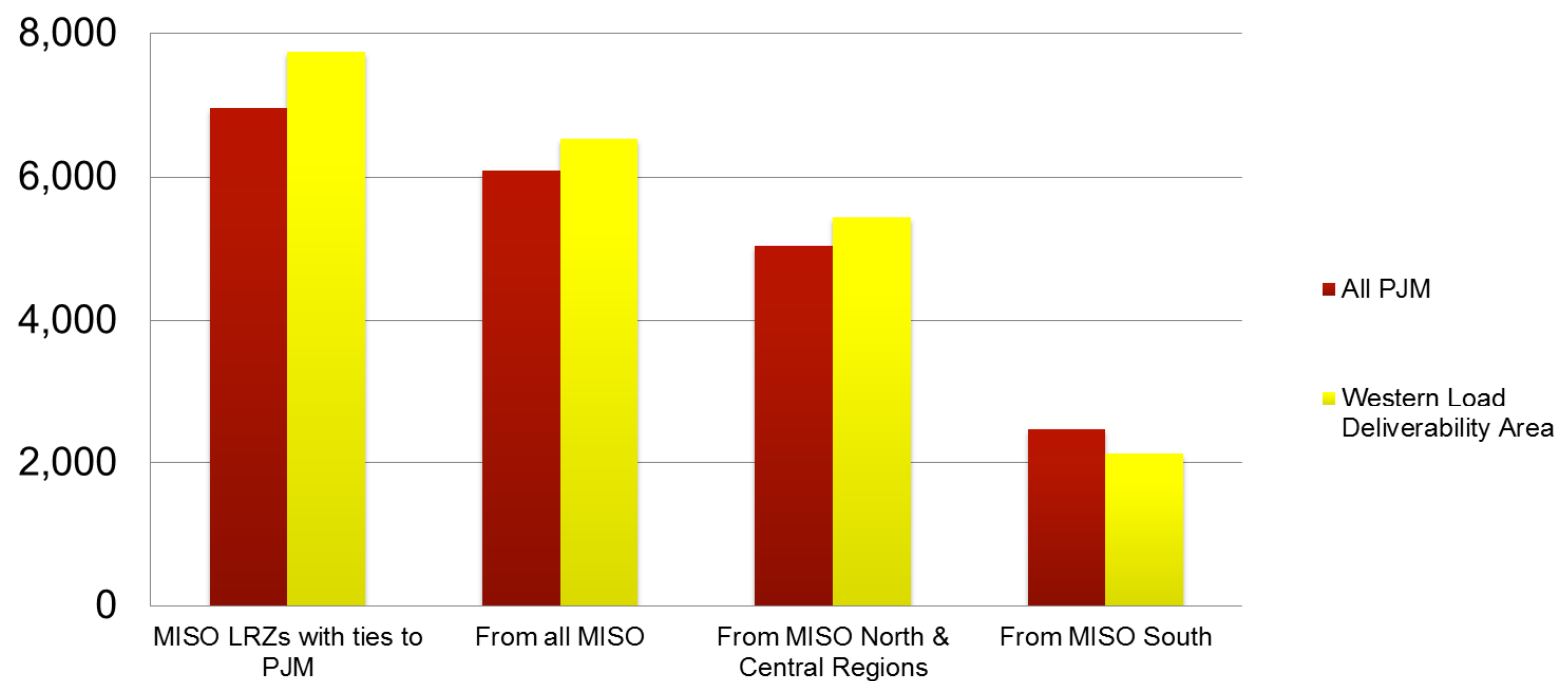
Imports above existing firm (GW)



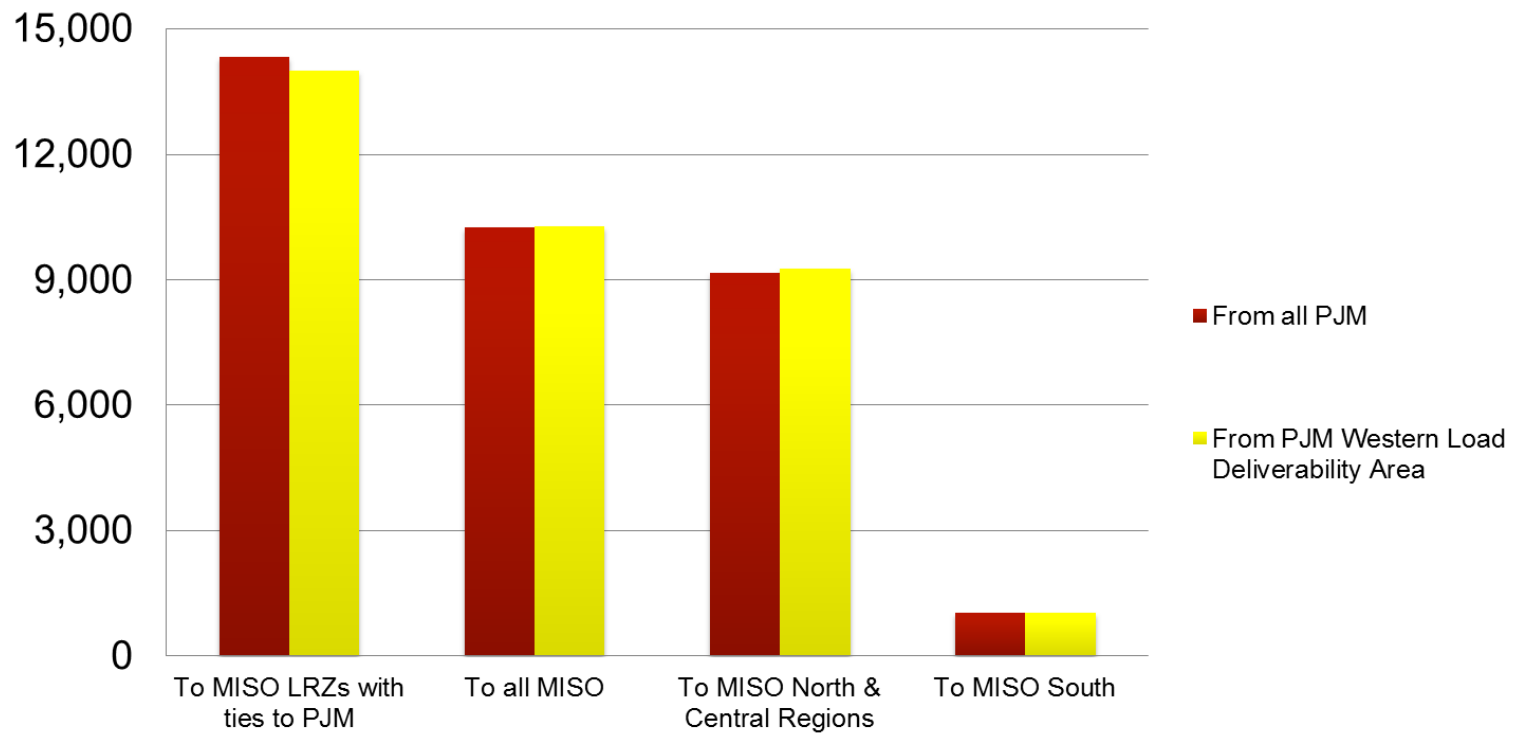
Potential MISO's Resource Adequacy Construct Improvements

- MISO will engage stakeholders to consider potential improvements to its resource adequacy construct to consider the results of this analysis
- Potential Improvements include:
 - Creating an External Local Resource Zone
 - Establishing a Capacity Export Limit out of the zone
 - **Considering** existing Firm reservations amongst External Zone Resource qualification
 - Using calculated Capacity Export transmission limit as an input into Loss of Load Expectation studies to derive Capacity Benefit Margin (CBM) in establishing Planning Reserve Requirement
- MISO is targeting improvements for 2015/16 Planning Year

MISO Export Capability Range - Details



MISO Import Capability Range - Details





APPENDIX D

**PJM FF#2 presentation
November 8, 2013 JCM meeting
Updated with most recent CIL values**



Problem Statement & Issue Charge

Linked to RTO Capacity Import Limit Methodology Problem Statement & Issue Charge

- <http://www.pjm.com/~media/committees-groups/committees/pc/20130912/20130912-item-03-rto-capacity-import-limit-problem-statement-issue-charge.ashx>

Charge: The PC will evaluate and adopt a method to determine an RTO Capacity Import limit for use in PJM Planning and applied in the RAA and future RPM auctions

Problem Statement & Issue Charge

Key Work Activities

Evaluate PJM staff analysis of the transmission system's ability to reliably import the quantity of Capacity Resources currently committed via the RPM auctions, plus the assumed CBM.

Consider alternative methodologies and inputs for ensuring that the maximum level of Capacity imports is not exceeded through the RPM auction process, to potentially include path specific values vs. an overall RTO import limit.

Evaluate alternative methodologies for calculating an RTO Capacity import limit for potential application in the PJM planning process and the RAA for use in future RPM auctions.

Establish an RTO Capacity import limit calculation methodology or alternative mechanism based on the above review and evaluation.



Methodology Development Timeline

August PC

- Problem statement introduced

September PC (9/12/2013)

- Problem statement approved
- Technical overview

September MRC (9/26/2013)

- Problem statement & discussion

September PC Special Call (9/27/2013)

- Technical discussion
- Stakeholder feedback

October PC (10/10/2013)

October PC Special Call (10/18/2013)

- Technical discussion
- Stakeholder feedback

October MRC (10/24/2013)

- Status update
- Review RAA and Tariff – Attachment DD language

November PC (11/7/2013)

- Propose and request approval of Methodology

November MRC (11/21/2013)

- Request approval of Methodology

February 2014

- Import limit method anticipated to be included in the 2017/18 RPM BRA Planning Parameters

May 2014

- 2017/18 RPM BRA

Stakeholder Review

Stakeholder Feedback

- Committee meetings
 - PC, MRC
- Teleconference
- Email

Incorporation of Feedback

- Alternative methodology development

Alternative Methods Considered

Previous 9/27/2013 Alternative

- Reviewed at 9/27/2013 Special PC Call

Previous 10/18/2013 Alternative

- Reviewed at 10/18/2013 Special PC Call

Current Alternative (Recommended)



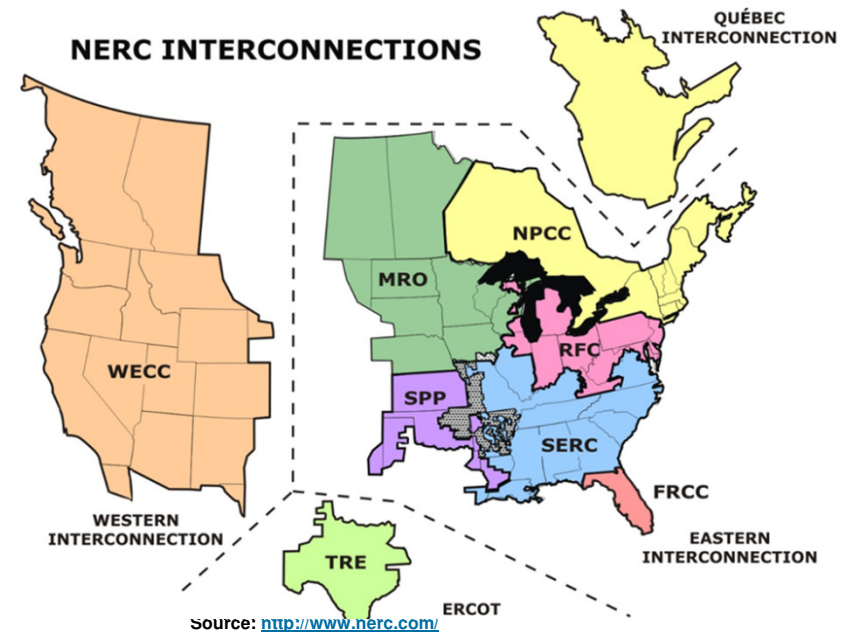
Evaluation of an RTO Capacity Import Limit Methodology – Methodology & Key Analytical Assumptions



PJM RTO Capacity Import Limit Method Key Assumptions

Key Analytical Assumptions

- Monitored facilities
 - Thermal
 - All Eastern Interconnection BES (100 kV and above)
 - Voltage
 - Any part of the Eastern Interconnection for voltage collapse
 - All PJM BES for voltage magnitude and voltage drop limits
- Simulated contingencies
 - PJM single contingencies
 - All PJM internal BES contingencies + ties
 - Eastern Interconnection single contingencies
 - All non-PJM 230 kV+ bus-to-bus
 - Selected non-PJM BES breaker-to-breaker



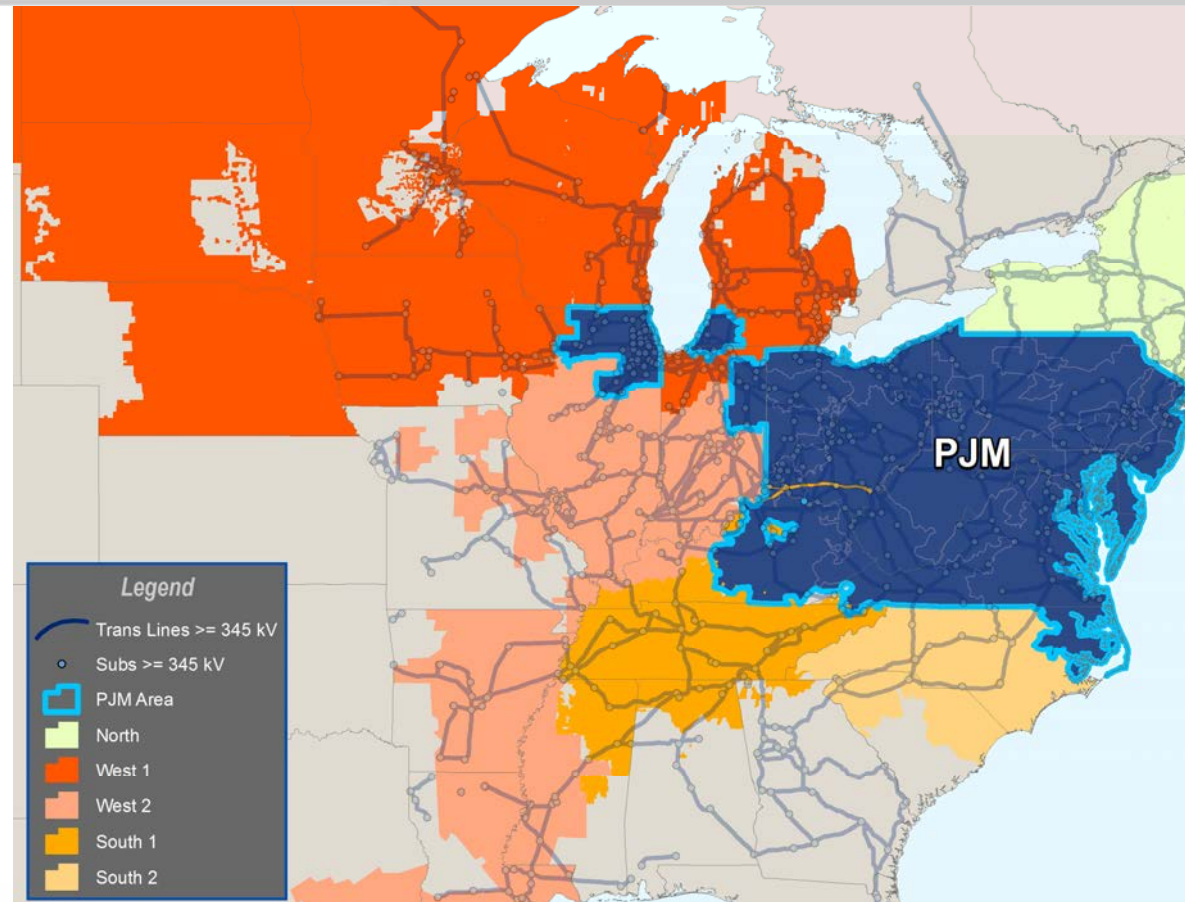
Import Source Zones

Five external source zones

- North = NYISO & ISO NE
- West 1 = MISO East, MISO West & OVEC
- West 2 = MISO Central + MISO South
- South 1 = TVA & LGEE
- South 2 = VACAR (non-PJM)

Source zone optimization

- Scale zones independently
- Internal to each zone, scale uniformly



PJM RTO Capacity Import Limit Method Key Assumptions

Monitored facilities

- All Eastern Interconnection as described on a previous slide

Distribution Factor

- Minimum 3% DFAX cutoff applied to impacted facilities

Source Regions & Regional Optimization of Import

- Five conceptual source regions

Individual Generating Unit Redispatch

- No redispatch

Preliminary Methodology Results

<u>PJM CAPACITY IMPORT LIMITS (MW)</u>						
	Simultaneous	North	West 1	West 2	South 1	South 2
Capacity Import Limit	6,499	144	3,739	2,865	1,861	1,877
Currently Reserved Network External Designated Service*	8,521	105	2,403	3,956	1,287	770

These values posted as part of the Planning Parameters for the upcoming 2017/2018 RPM Planning Parameters

*Network External Designated Service awarded as of 1/29/14

RAA Language – Exemption Clause

See RAA language for specific rules

Overview of exemption for external resources:

- i. Dedicated to identified load in PJM
- ii. Pseudo-tied
- iii. Confirmed firm transmission service
- iv. Commits to must offer requirement, same as internal generation

Next Steps

PJM Filed the Capacity Import Limit methodology on November 29, 2013

PJM is awaiting FERC approval of its filing, and expects a FERC order by April 22, 2014

Assuming FERC approval, PJM will implement in the May, 2014 RPM Base Residual Auction

