



# Education for PJM's Current External Capacity Performance (CP) Construct and Challenges

External Capacity Enhancement & Underperformance Risk Management Task Force

6/2/2016



# Types of transactions into PJM

Type of transaction	Tag?	Granularity	Similar to an internal generator?	Subject to tag curtailments?
Interchange (Block Schedules)	Yes	Block	No	Yes
Dynamic Schedules	Yes	Dynamic	No	Yes
Pseudo Ties	No	Dynamic	Yes	No

➤ PJM only allows pseudo ties in its external CP construct because:

➤ They are unit specific

➤ They do not require tags

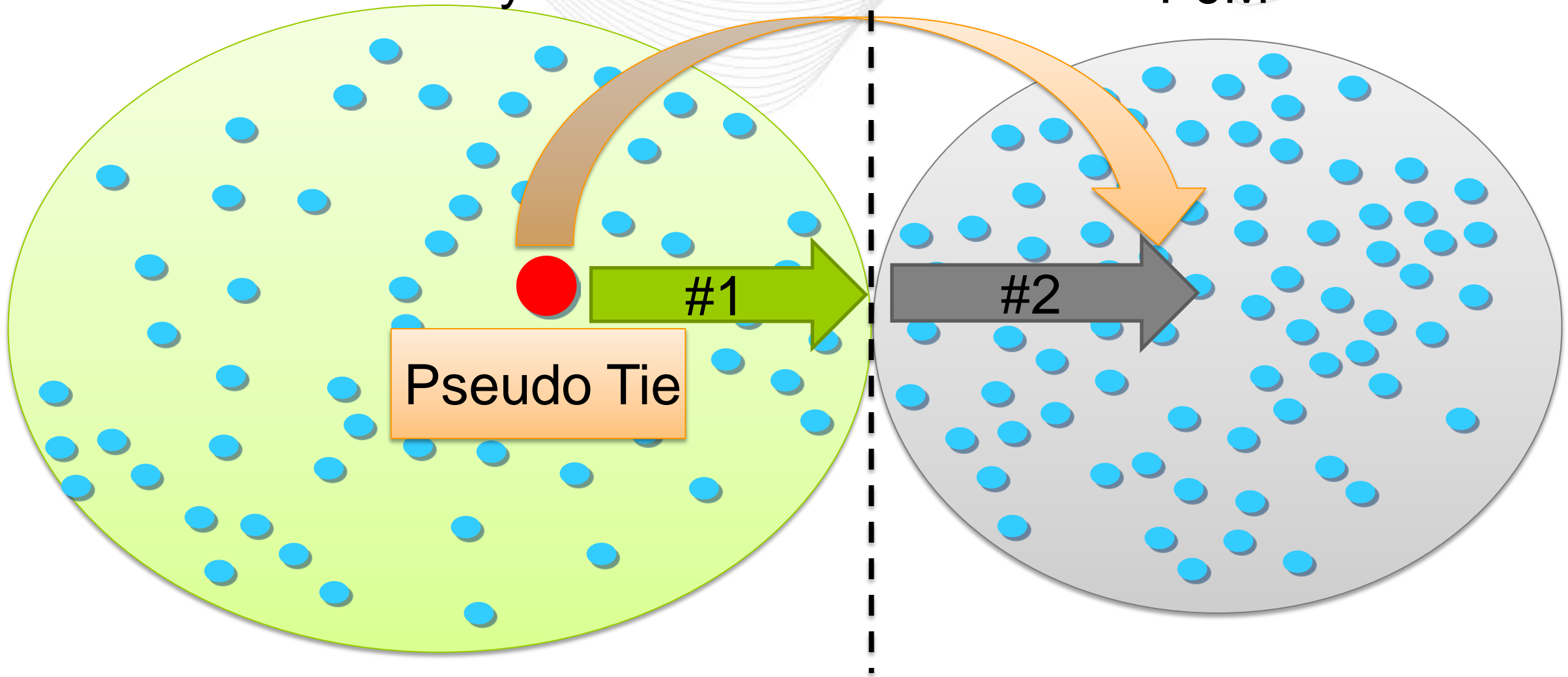
➤ They are dispatched by PJM

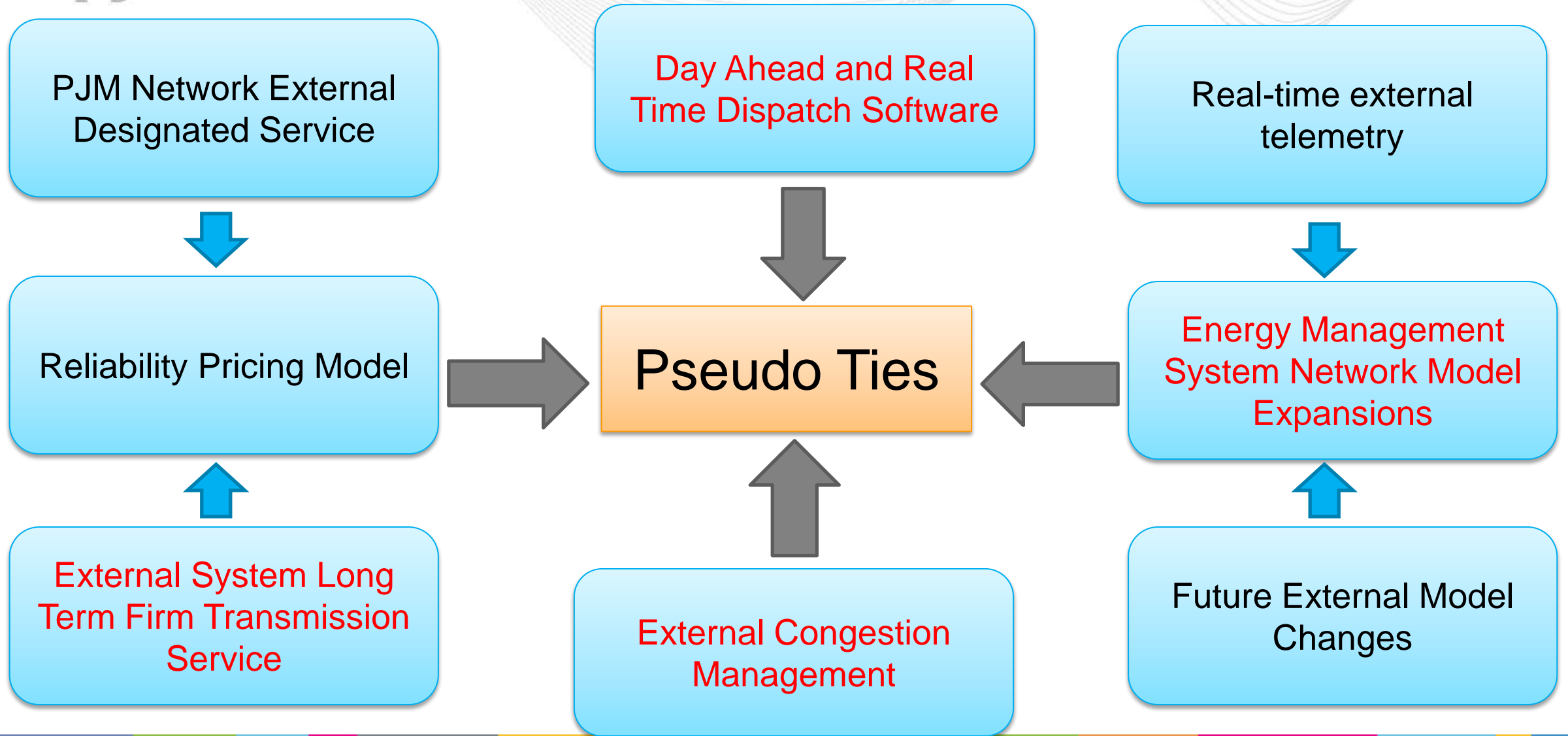


External System

Pseudo Ties

PJM





1. Network Model Expansions - EMS and Markets Modeling Challenges adhering to NERC and FERC compliance standards
2. Congestion Management – Local and Regional external system Congestion Management challenges
3. Planning Analysis – External entity planning analysis lacking unit specific delivery studies
4. Neighboring impacts – External entities concerns surrounding lack of operational control and tagging



# Challenge 1

## Network Model Expansions – Reliability Requirements and Risk Assessment

- 1) FERC Requirements & NERC Standards
- 2) EMS Modeling Obligations
- 3) Market Modeling Obligations



- PJM's pseudo ties cannot be tagged (RAA)
- PJM's pseudo ties must be tagged unless recognized by a congestion management procedure (NERC INT)
- PJM's pseudo ties and any impacted Flowgates must be modeled in EMS (JOA)
- PJM's EMS must perform real-time assessments on a continuous basis (NERC IRO)



- When modeling pseudo ties in PJM's EMS, PJM shall minimize any risks to EMS solution failures to avoid:
  - 1) NERC IRO standard non compliance (Operational Readiness)
  - 2) NERC INT standard non compliance (Transparency)
  - 3) RAA CP standard non compliance (Subject to NERC tagging)

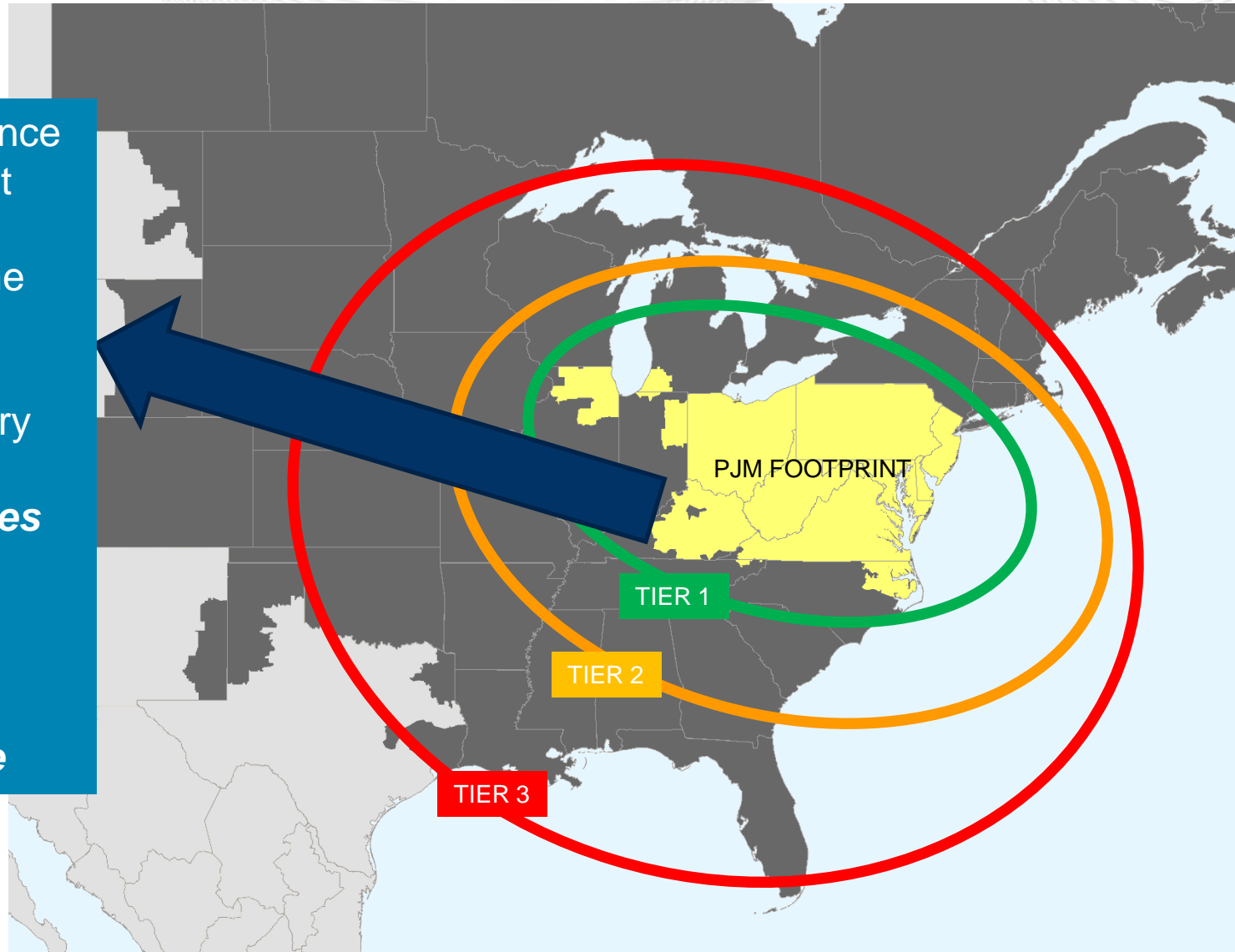


## PJM experiences State Estimator failures when

- PJM’s model of the Bulk Electric System (BES) does not match the actual, current configuration of the BES
- PJM does not receive a significant amount of real-time telemetry (i.e. telemetry link failures)
- PJM receives a significant amount of bad real-time telemetry (i.e. link is available, but a large portion of data becomes corrupted)

As the electrical distance from the PJM footprint **increases**

- Level of detail in the PJM EMS model **decreases**
- Number of telemetry links/amount of telemetry **decreases**
- Requirements and frequency for communication of BES configuration changes **decrease**



- The implementation of external capacity resources increases the risk for State Estimator (SE) failures.
- The risk of failures is much greater for resources located farther away from the PJM footprint.
  - Requires significant model expansion which increases the probability of a mismatch between the BES configuration and the PJM EMS model.
  - Requires increase in the number of telemetry links to support the model which increases the probability of a link outage or failure.
  - Requires significant increase in the amount of real-time telemetry to support model expansion which increases the probability of receiving a significant amount of bad telemetry.

- PJM Markets (Commercial) model must capture all internal and external generator impacts for qualifying external Flowgates:
  - Day Ahead
  - Real-time (Security Constrained Economic Dispatch)
  - Real-time (Market Flow Calculator)

Item	Internal Generators	External Generators
DA Performance (within 3 hours)	Okay - limited congestion	At risk - significant external congestion
RT SCED Performance (Every 5 min)	Okay - limited congestion	At risk - significant external congestion
RT Market Flow Performance (Every 5 min)	Okay - limited congestion	At risk - significant external congestion
NERC and FERC compliance risks	Okay – solution performance	At risk - solution performance

- PJM has NERC and FERC mandated requirements to model external system impacts in its EMS and Markets models
- PJM is concerned that PJM (and members) may be exposed to operational, compliance and performance risks as a result of model expansions to facilitate external capacity participation
- PJM needs to evaluate solutions to ensure robust external capacity participation while minimizing risk to its EMS and Markets models



# Challenge 2: Congestion Management

- When PJM is dispatching pseudo ties the generation transfer is no longer visible to the host Balancing Authority
- Any significant pseudo tie impacts (greater than 5%) causing congestion on host BA facilities will be recognized as regional congestion management (M2M and TLR Flowgates)
- PJM is observing the need to add a significant amount of M2M facilities to effectuate its 2016/17 MISO pseudo ties

External Coordinated Entity	# of Pseudo Ties	# of Flowgates before Pseudo Ties	Additional Flowgates after Pseudo Ties	% Increase from total Flowgates
MISO	7	220	114	41%
All non Markets	3	59	25	9%
Total	10	279	139	50%

Additional Flowgates are concerning since it impacts solution performance, congestion charges and unit deliveries

- PJM is concerned that PJM pseudo ties will be subject to curtailments based on external system bottlenecks that were not addressed when the pseudo ties were evaluated by external systems
- PJM is concerned that although the pseudo ties are granted Firm Transmission Service that the current congestion management constructs will recognize the delivery as non firm and as a result PJM will be exposed to M2M payments and TLR market flow curtailments when external bottlenecks are constrained

- During Joint and Common Markets updates, MISO discussed its local reliability concerns associated with PJM pseudo ties
- Certain pseudo ties can impact local reliability limitations that are not recognized in the regional congestion management process
- Such local limitations may require pseudo tie dispatch commitments outside of PJM dispatch commitments



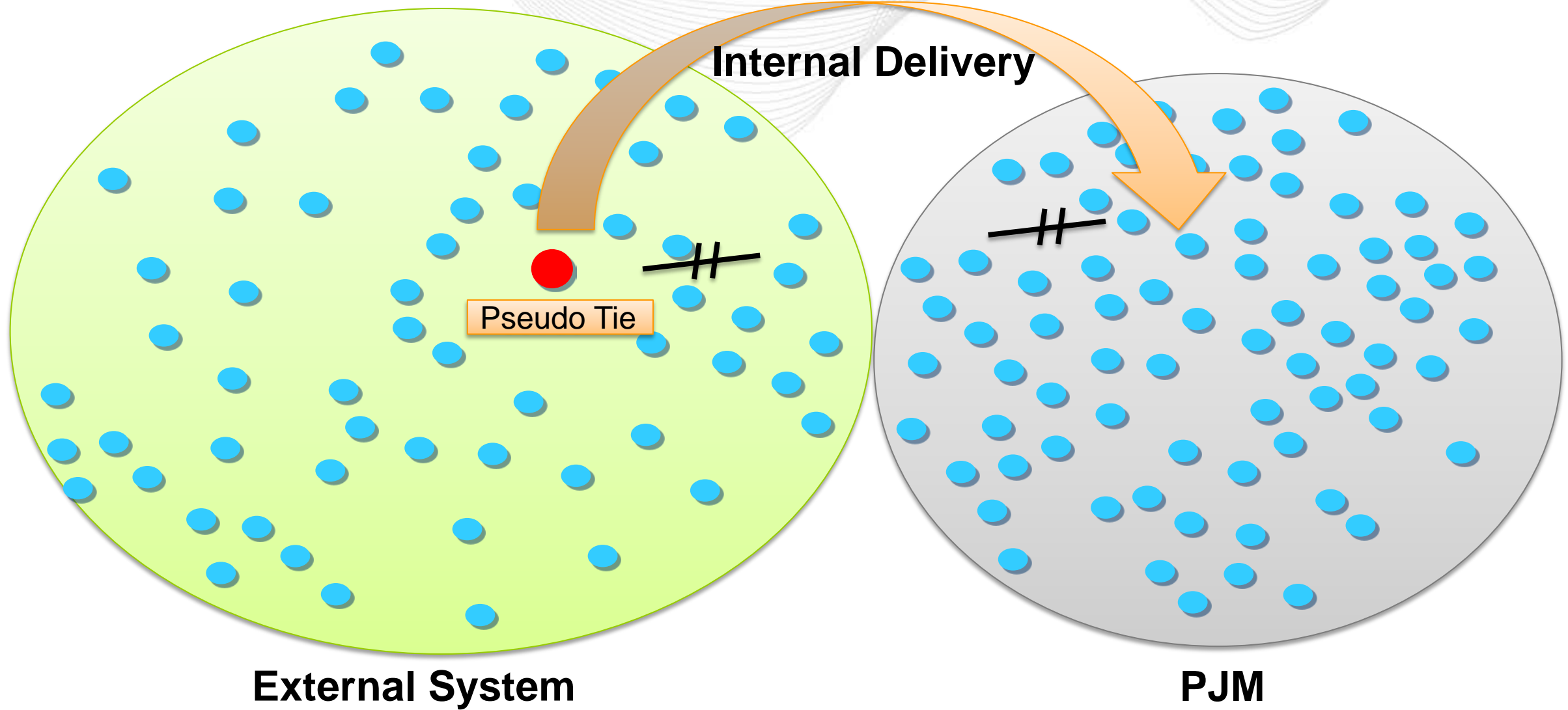
- PJM is concerned that PJM pseudo ties will be subject to curtailments and out of merit dispatch commitments to satisfy local reliability conditions based on such conditions that were not evaluated by external systems
- PJM is concerned that PJM may incur uplift payments to accommodate such commitments and those payments might not be recuperated by external parties

- PJM has addressed reliability concerns associated with regional and local congestion management requirements for pseudo ties through operating guides, but these are temporary solutions
- PJM and its members need to develop a long term solution to address both regional and local congestion management challenges that were not observed during external entity pseudo tie evaluation process
- PJM will work with its CMP members to address pseudo tie firm priority recognition gap

# Challenge 3: Planning Analysis

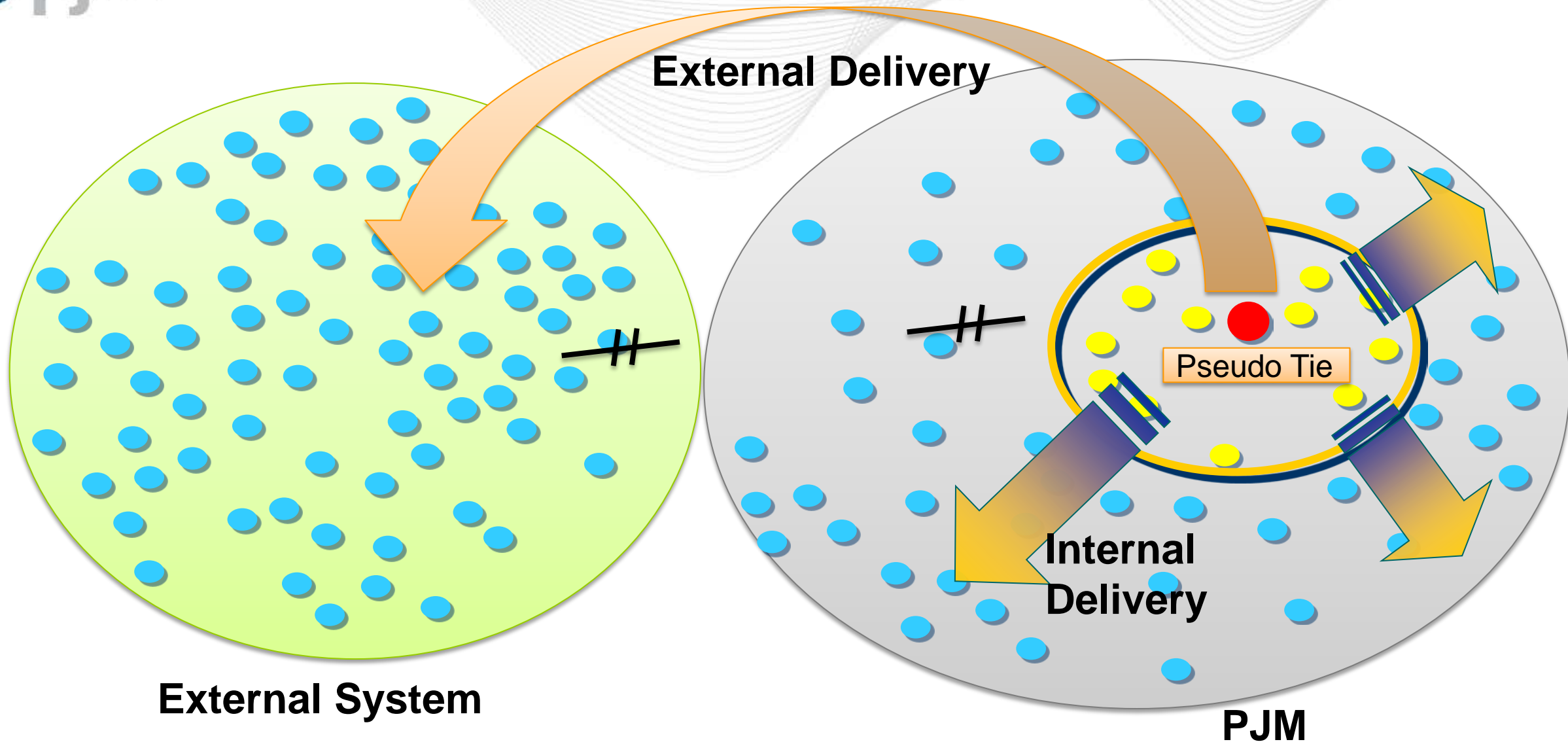


- Unit Specific into PJM - Network External Designation Study
  - PJM studies external capacity resources from its physical location delivering energy to the PJM footprint
  - PJM monitors all PJM BES facilities in the deliverability study
  - PJM studies base (PTDF), N-1 (OTDF), N-1-1, and common mode
  - PJM monitors external facilities significantly impacted by the transfer



## Unit specific out of PJM

- PJM studies internal capacity resources from its physical location delivering energy to external system footprint
- PJM simultaneously studies surrounding generator bottlenecks that may introduce while the internal capacity resource is transferred
- PJM monitors all PJM BES facilities in the deliverability study
- PJM studies base (PTDF), N-1 (OTDF), N-1-1, and common mode
- PJM monitors external facilities significantly impacted by the transfer
- This analysis is consistent with PJM's internal capacity generator deliverability study process



- PJM is concerned that the external systems are not evaluating PJM's pseudo ties in a manner consistent with how PJM evaluates pseudo ties out of PJM (unit specific out)
  - Granularity
  - Deliverability Criteria Differences
- If external systems are not evaluating PJM's pseudo ties in a manner consistent with PJM's planning process then, although external systems grant Firm Point to Point service, PJM pseudo ties are exposed to external unplanned congestion

- These slides provide a description and comparison of the assumptions and criteria used by MISO and PJM during the study of customer proposed projects
- Some items under review and may be revised

	MISO	PJM	So what's the Impact?
Study Horizon	Uses 3 and 10 year cases	Uses 5 year case	1. Two different sets of results? 2. Different transmission assumptions? 3. Different generation assumptions?  <b>TRUE BUT</b>  Projects near the RTO seams are studied under both RTOs criteria which will bridge the study gap and fix identified issues above.
ERIS Analysis	Summer Peak and Summer off-Peak	Summer Peak, Light Load, and Winter <sup>1</sup>	
NRIS Analysis	Summer Peak only	Summer Peak, Light Load, and Winter <sup>1</sup>	

Note 1: Winter testing will commence with New Service Queue requests which use the 2021 RTEP case for study



# Challenge 3: Types of Resources studied by MISO and PJM

	MISO	PJM
Generation Interconnection	Yes	Yes
Merchant Transmission Interconnection	No	Yes
Transmission Service Requests	Yes	Yes
Upgrade Requests (IARR)	No	Yes



	MISO	PJM
Case year	Typically a 3 year and a 10 year case	Typically a 5 year case
Base line reliability Upgrades	<ol style="list-style-type: none"> <li>1. Only MISO Board approved, MTEP A projects, are added to our study base cases</li> <li>2. If an IC wants to advance an MTEP project, that option is available to the IC but they must bear the advancement costs.</li> </ol>	Model upgrades which have been approved as needed in all years leading up to and including the year on which the study is to be performed
Using upgrades not contained in the base case (potential future base line upgrades)	<p>Test MTEP B projects, in addition to other TO recommended projects, for constraint mitigation.</p> <p>If MTEP B projects fix the constraint, then they are included in the GIA with the caveat that they must:</p> <ol style="list-style-type: none"> <li>i. move to MTEP A by the next MTEP cycle or</li> <li>ii. move to MTEP A within 1 year of execution of the GIA</li> </ol> <p>Otherwise, the IC either funds 100% of that MTEP B project or funds an alternative (if identified during the SIS phase)</p>	Test upgrades for future base case years. If upgrades can fix a violation and the upgrade is chosen as the appropriate reinforcement the customer must pay for advancement costs associated with the upgrade

	MISO	PJM
Deactivations	If the unit retirement is public information, then that information is incorporated in all MISO Planning study cases	<ol style="list-style-type: none"> <li>1. Generators turned off to prevent backing off loading based on the date the deactivation request is received</li> <li>2. Generators removed as required based on deactivation date &amp; transfer of rights and then any upgrades are modeled</li> </ol>
Previously queued requests	<ol style="list-style-type: none"> <li>1. All previously queued, active DPP projects, are modeled online in the base case at their expected seasonal output.</li> <li>2. All projects with executed Interconnection agreements are modeled online in the base case at their expected seasonal output.</li> <li>3. Projects under suspension are modeled online in the base case at their expected seasonal output.</li> </ol>	<ol style="list-style-type: none"> <li>1. All previously queued requests still active (under study) are modeled off line. This results in the projects aggravating a constraint, but not having the ability to back off a constraint.</li> <li>2. Capacity (firm) portion of all projects with signed ISAs is modeled on-line. This allows projects to both aggravate and back off constraints</li> <li>3. Projects under suspension (in the construction phase) are turned off so they do not back off constraints</li> </ol>



# Challenge 3: Summer Peak Reinforcement – Capacity (Firm) / Network Resource Requests

	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)
PJM Capacity Resource / Firm merchant transmission	Summer peak	1. <500kV: 5% DF or 5% impact on facility rating 2. >500kV: 10% DF or 5% impact on facility rating	1. <500kV: 5% DF or 5% impact on facility rating 2. >500kV: 10% DF or 5% impact on facility rating	1. <500kV: 10% DF or 5% impact on facility rating 2. >500kV: 10% DF or 5% impact on facility rating	As Required
100% of requested Capacity Interconnection Rights					
Long Term Firm Transmission Service (Into PJM)	Summer Peak	3% DF or 3% impact on facility rating			As Required
Long Term Firm Transmission Service (Out of PJM)	Summer Peak	1. PJM facilities: 5% DF or 5% impact on facility rating 2. Other facilities: 3% DF or 3% impact on facility rating			As Required
MISO NRIS	Summer Peak	Study Gen has $\geq$ 5% DF or MW Impact $\geq$ 20% of Applicable Line Rating	Study Gen has $\geq$ 5% DF or MW Impact $\geq$ 20% of Applicable Line Rating	Only when requested by a Transmission Owner	As Required
All Units at 100% of capacity rights					

Note: (For PJM) Project which is first to cause the need for a reinforcement will always have cost allocation regardless of the MW contribution



# Challenge 3: Summer Peak Reinforcement – Energy (Non-Firm) / Energy Resource Requests

	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)
<b>PJM</b> Energy Resource / Non-Firm merchant transmission All fuel types at 100% of Summer Energy Output	Summer peak	N/A	N/A	1. <500kV: 10% DF or 5% impact on facility rating 2. >500kV: 10% DF or 5% impact on facility rating	As Required
<b>MISO ERIS</b> Wind at 20% nameplate Gas at 100% of Nameplate Coal & Nuclear at 100% of Nameplate	Summer Peak	1. Study Gen has $\geq 5\%$ DF 2. MW Impact $\geq 20\%$ of Applicable Line Rating 3. Overloaded element is at generator's outlet	1. Study Gen has $\geq 20\%$ DF 2. MW Impact $\geq 20\%$ of Applicable Line Rating 3. Overloaded element is at generator's outlet	Based on Local TO Criteria	Based on Local TO Criteria

Note: (For PJM) Project which is first to cause the need for a reinforcement will always have cost allocation regardless of the MW contribution



# Challenge 3: Light Load (PJM) / Shoulder Peak (MISO) Reinforcement

	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)
<b>PJM</b> Load at 50% of summer peak	Wind 40% ramp to 80% energy	50% of summer peak	1. <500kV: 5% DF or 5% impact on facility rating 2. >500kV: 10% DF or 5% impact on facility rating	1. <500kV: 5% DF or 5% impact on facility rating 2. >500kV: 10% DF or 5% impact on facility rating	1. <500kV: 10% DF or 5% impact on facility rating 2. >500kV: 10% DF or 5% impact on facility rating	As Required
	Oil & Gas off					
	Coal (<500MW) at 45% initial					
	Coal (≥ 500MW) at 60% initial					
	Nuclear at 100%					
	Pumped Storage – Full Pump					
	Other fuel resources at 0%					
<b>MISO ERIS</b> Load at 70% of summer peak	Wind at 100% nameplate	70% of summer peak	1. Study Gen with ≥ 5% DF 2. Study gen MW Impact ≥ 20% of Applicable Line Rating 3. Overloaded element is at generator's outlet	1. Study Gen with ≥ 20% DF 2. Study gen MW Impact ≥ 20% of Applicable Line Rating, or 3. Overloaded element is at generator's outlet	Based on Local TO Criteria	Based on Local TO Criteria
	All other units are modeled at their expected seasonal output. Coal, Nuclear are at 100% Oil and Gas off					

Note: (For PJM) Project which is first to cause the need for a reinforcement will always have cost allocation regardless of the MW contribution

- PJM pseudo ties need be treated comparably to an internal CP resource when it receives CP status
- PJM is concerned that the external system studies are not granular enough to recognize external system impacts
- PJM and its members need to develop a solution to address the external CP planning analysis inconsistencies

# Challenge 4: Neighboring Impacts



- MISO's concerns related to operational control :
  - Concerned with the volume of pseudo ties and with the distant pseudo ties because the physical limitations will remain as is
  - Because the attaining RTO will be dispatching/controlling the resource, attaining RTO's model needs to be detailed
  - Any local reliability issues have to be managed utilizing operating guides
  - M2M Congestion management may not be rapid as internal native BA's congestion management process



- INT 004 requires **Pseudo-Tie units to be tagged unless it is included in a congestion management procedure**
- When PJM pseudo ties impact external entities where PJM does not have a formal congestion management procedure, pseudo tie will be required to be tagged by default
- However, PJM external CP cannot be tagged because then those transactions could be curtailed via NERC TLR process and PJM therefore is no longer in control of such resources

- When PJM discovers that its pseudo ties are impacting its neighbors without formal congestion management procedures, PJM has to work with its neighbors to execute procedures
- So far PJM has been successful establishing agreements with such neighbors on a case by case basis
- PJM is concerned that certain pseudo ties may not be approved by its neighbors through congestion management procedures, and therefore required to be tagged

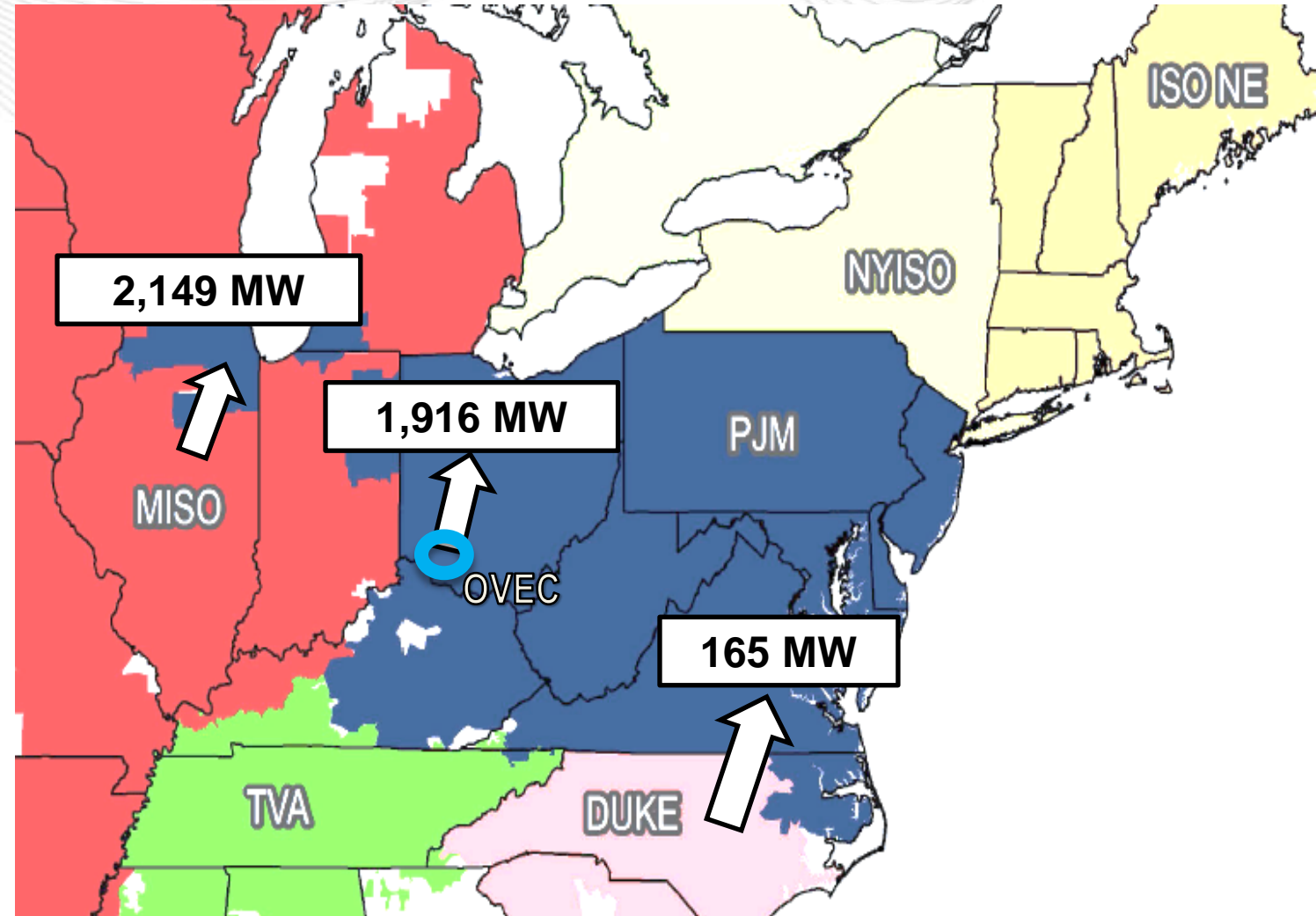
- PJM has to work with its external neighbors to address their concerns in the pseudo tie process
- If an external impacted entity is not amenable to waive the tagging requirement and generate a congestion management agreement, then the pseudo tie may not be implemented
- Despite the current processes, some entities have expressed reliability concerns related to loss of dispatchability and operational flexibility, etc.

# APPENDIX

## Tier 1

- 31 Pseudo-Ties
- 4,230 Total MW
- 3,172.7 CP MW

There are currently no Pseudo-Ties implemented for external resources that reside in Tier 2 or Tier 3.



# Appendix - Existing Capacity Resource Requirements

Item	Internal Generators	External Generators
NERC Tagging	No	No
Pseudo Tie	N/A	Yes
Capacity Import Limit Exception	N/A	Yes (Till 2020/21)
Transmission Service	N/A	Firm Point to Point/Network External Designated
Must Offer Requirements	Yes	Yes
Unit Specific	Yes	Yes
Performance Assessment	Yes	Yes

- *JOA Congestion Management Process (CMP):*
  - *CMP Section 1.4 - The Market-Based Operating Entity's **Energy Management System (EMS)** has the capability to monitor and respond to real-time and projected flows created by its real time dispatch.*
  - *CMP Section 5.4 - Operating Entities' real-time **EMS's** have very detailed state estimator and security analysis packages that are able to monitor both thermal and voltage contingencies every few minutes. State estimation models will be at least as detailed as the IDC model for all the Coordinated and Reciprocal Coordinated Flowgates. Additionally, Reciprocal Entities will be continually working to ensure the models used in their calculation of Market Flow are kept up to date.*

- *JOA Interregional Coordination Process*
  - *ICP Section 8 - Under normal operating conditions, the Midwest ISO and PJM operators will model all Reciprocal Coordinated Flowgates (RCFs) in their respective **EMSs**. A subset of these Flowgates, impacted by Market Flows from the two RTOs' energy markets, will be subject to the market-to market process and called M2M Flowgates.*
  - *ICP Section 8.2.1 - The Midwest ISO and PJM operators will model all M2M Flowgates facilities with actual limits in their respective **EMSs**.*



- Reliability Assurance Agreement (RAA)
  - *Section 1.7A - Capacity Market Seller may offer an external Generation Capacity Resource to the extent that such resource: (i) is reasonably expected, by the relevant Delivery Year, **to meet all applicable requirements to be treated as equivalent to PJM Region internal generation that is not subject to NERC tagging as an interchange transaction**; (ii) has long-term firm transmission service confirmed on the complete transmission path from such resource into PJM; and (iii) is, by written commitment of the Capacity Market Seller, subject to the same obligations imposed on Generation Capacity Resources located in the PJM Region by section 6.6 of Attachment DD of the PJM Tariff to offer their capacity into RPM Auctions.*

- NERC Standards require **Pseudo-Tie units to be tagged unless it is included in a congestion management procedure:**
  - *INT-004, R1: Each Purchasing-Selling Entity that secures energy to serve Load via a Dynamic Schedule or Pseudo-Tie shall ensure that a Request for Interchange is submitted as an on-time<sup>1</sup> Arranged Interchange to the Sink Balancing Authority for that Dynamic Schedule or Pseudo-Tie, unless the information about the Pseudo-Tie is included in congestion management procedure(s) via an alternate method. <http://www.nerc.com/pa/Stand/Reliability%20Standards/INT-004-3.pdf>*
- NERC Standards require reliable State Estimator and Contingency analysis solutions:
  - *IRO-008-2, R4: Each Reliability Coordinator (RC) shall ensure that a **Real-time Assessment is performed at least once every 30 minutes***  
<http://www.nerc.com/pa/Stand/Reliability%20Standards/IRO-008-2.pdf>
  - *TOP-001-3, R13: Each Transmission Operator (TOP) shall ensure that a **Real-time Assessment is performed at least once every 30 minutes.***  
<http://www.nerc.com/pa/Stand/Reliability%20Standards/TOP-001-3.pdf>