# PJM EDC COORINDATION WORKSHOP

July 15, 2021

THE CONTENT OF THIS SLIDE IS INTENDED FOR DISCUSSION PURPOSES ONLY AND REPRESENTS PRELIMINARY VIEWS OF PJM's PROPOSAL TO IMPLEMENT FERC ORDER 2222.

# EDC CORE PRINCIPLES

- EDCs are singularly responsible for distribution-level grid reliability, as well as system, worker and customer safety and security.
- DERs must be integrated into the distribution grid without compromising the reliability, safety, power quality or physical/cyber security of the electric grid.
- PJM tariff rules for DER aggregations must be flexible, allowing for EDC/jurisdictional differences and EDC transitions regarding DERs.

# MARKET REPORT OUT

Chris Wehr

THE CONTENT OF THIS SLIDE IS INTENDED FOR DISCUSSION PURPOSES ONLY AND REPRESENTS PRELIMINARY VIEWS OF PJM's PROPOSAL TO IMPLEMENT FERC ORDER 2222.

# MARKETS AGENDA TOPICS

- Weighting Factors
- Locational Requirements/Nodal vs. Multi-nodal participation
- Market Participation Models
- Single vs. Multiple DER Aggregators
- DER Aggregation Size Requirements
- Metering & Telemetry

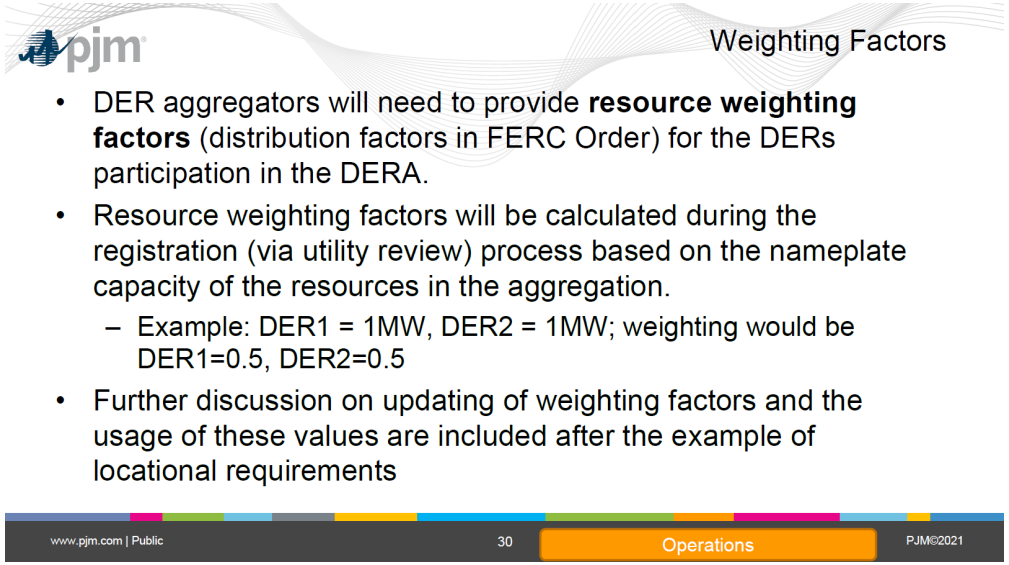
# SUMMARY: EDC MARKET PROPOSALS

- **Weighting Factors (30, 42-44)**
  - DERA weighting factors need to be accurate for energy market representation in order to accurately determine pricing, accurate dispatching of DERs, avoid creating artificial system congestion or other negative impacts that would potentially increase costs compared to individual DER market participation.
- **Locational Requirements (31-41)**
  - EDCs support PJM's initial proposal of a single node approach for DER market participation.
  - DER PJM network mapping shall be coordinated with the EDC's and would only include DER market participants.
  - DER mapping detail to be limited to Enode/Pnode information, not detailed EDC distribution information.
- **Market Participation Model (50-65)**
  - EDCs generally support PJM's initial DERA market participation models but need additional clarification to preferred option for each market and their respective alternative approaches.
- **Single vs Multiple DER Aggregator Per Customer Premise (50-65)**
  - EDCs recommend a single DERA for each customer premise or Point of Interconnection (POI) meter initially.

# WEIGHTING FACTORS

THE CONTENT OF THIS SLIDE IS INTENDED FOR DISCUSSION PURPOSES ONLY AND REPRESENTS PRELIMINARY VIEWS OF PJM's PROPOSAL TO IMPLEMENT FERC ORDER 2222.

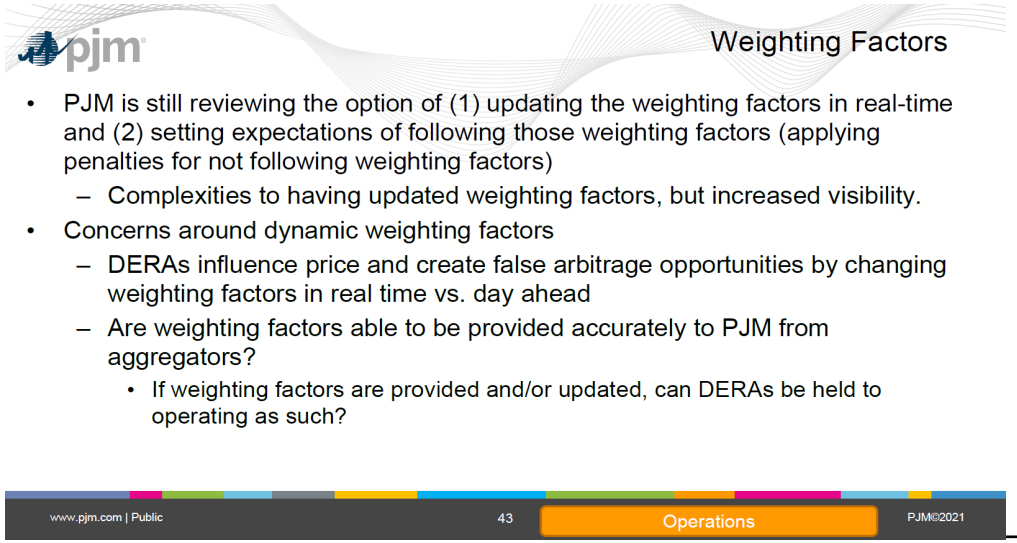
# WEIGHTING FACTORS (SLIDES 30,42-44)



Weighting Factors

- DER aggregators will need to provide **resource weighting factors** (distribution factors in FERC Order) for the DERs participation in the DERA.
- Resource weighting factors will be calculated during the registration (via utility review) process based on the nameplate capacity of the resources in the aggregation.
  - Example: DER1 = 1MW, DER2 = 1MW; weighting would be DER1=0.5, DER2=0.5
- Further discussion on updating of weighting factors and the usage of these values are included after the example of locational requirements

www.pjm.com | Public 30 Operations PJM©2021



Weighting Factors

- PJM is still reviewing the option of (1) updating the weighting factors in real-time and (2) setting expectations of following those weighting factors (applying penalties for not following weighting factors)
  - Complexities to having updated weighting factors, but increased visibility.
- Concerns around dynamic weighting factors
  - DERAs influence price and create false arbitrage opportunities by changing weighting factors in real time vs. day ahead
  - Are weighting factors able to be provided accurately to PJM from aggregators?
    - If weighting factors are provided and/or updated, can DERAs be held to operating as such?

www.pjm.com | Public 43 Operations PJM©2021

## Discussion Item

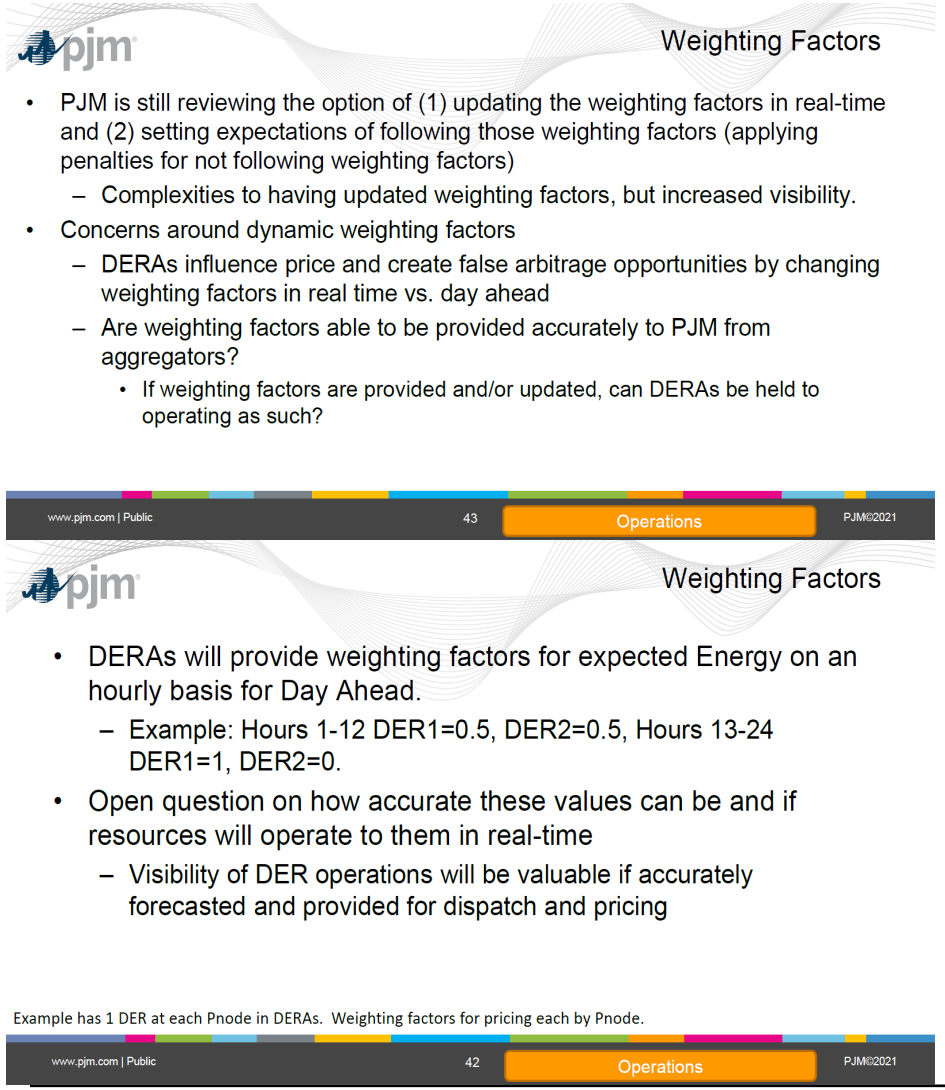
- EDCs are concerned with the limited level of accuracy weighting factors will provide for the DERAs compared to the individual DER performance.

## Concerns

- Weighting factors in general will become less accurate and reliable in large aggregations however this will likely be compounded due to EDC overrides (likely more for Dx connected and BTM DERs than Tx connected).

- Use of nameplate ratings may not be accurate if individual DER output is restricted by the interconnection agreement.

# WEIGHTING FACTORS- (SLIDES 30,42-44)



Weighting Factors

- PJM is still reviewing the option of (1) updating the weighting factors in real-time and (2) setting expectations of following those weighting factors (applying penalties for not following weighting factors)
  - Complexities to having updated weighting factors, but increased visibility.
- Concerns around dynamic weighting factors
  - DERAs influence price and create false arbitrage opportunities by changing weighting factors in real time vs. day ahead
  - Are weighting factors able to be provided accurately to PJM from aggregators?
    - If weighting factors are provided and/or updated, can DERAs be held to operating as such?

www.pjm.com | Public 43 Operations PJM©2021

Weighting Factors

- DERAs will provide weighting factors for expected Energy on an hourly basis for Day Ahead.
  - Example: Hours 1-12 DER1=0.5, DER2=0.5, Hours 13-24 DER1=1, DER2=0.
- Open question on how accurate these values can be and if resources will operate to them in real-time
  - Visibility of DER operations will be valuable if accurately forecasted and provided for dispatch and pricing

Example has 1 DER at each Pnode in DERAs. Weighting factors for pricing each by Pnode.

www.pjm.com | Public 42 Operations PJM©2021

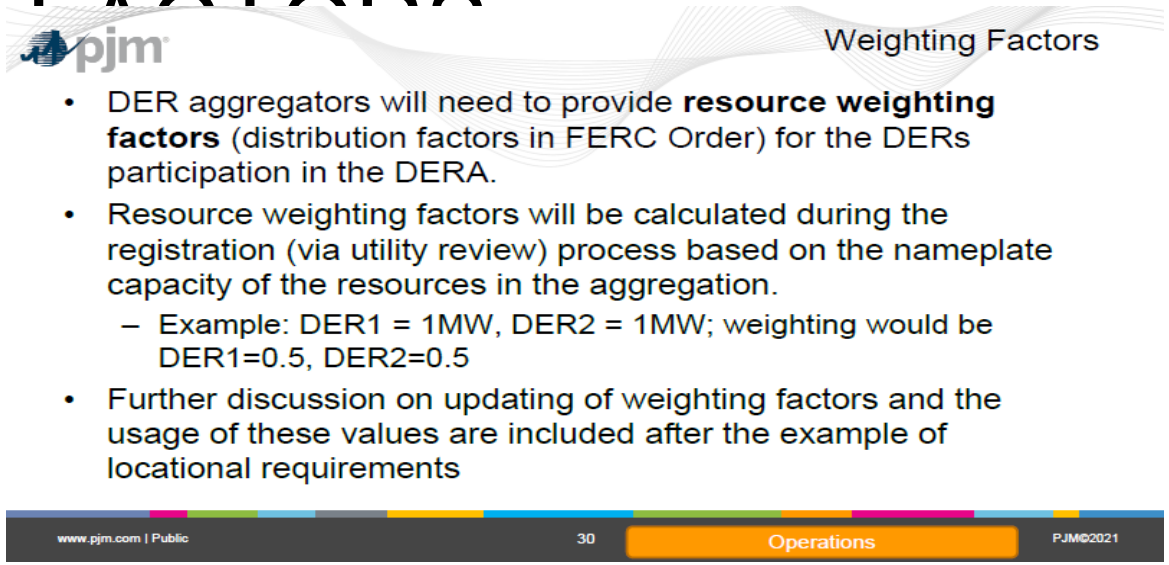
## Questions

- Will weighting factors be different by market or hourly for all markets?
- How often can weighting factors be updated for each market ?
- Can weighting factors be seasonal (summer/winter)?
- Will PJM require testing to validate weighting factors?
- Will DERAs be penalized if individual DER performance deviates significantly from the hourly weighting factors provided?
- NERC Requirements
  - ✓ What are the potential changes because of Aggregations
  - ✓ What are the potential changes are needed for reclassifications of some distribution connected DERs that would not otherwise be subject to NERC requirements?
  - ✓ Are additional contractual requirements pursuant to NERC requirements?

## Thoughts

- PJM to perform additional analysis for determination of hourly weighting factors and potential price influence that could materialize. Weighting factors need to accurately represent individual DER performance
- EDCs and their customers need to be financially held harmless if weighting factors are not achieved due to a DER being disconnected due to unplanned outages.

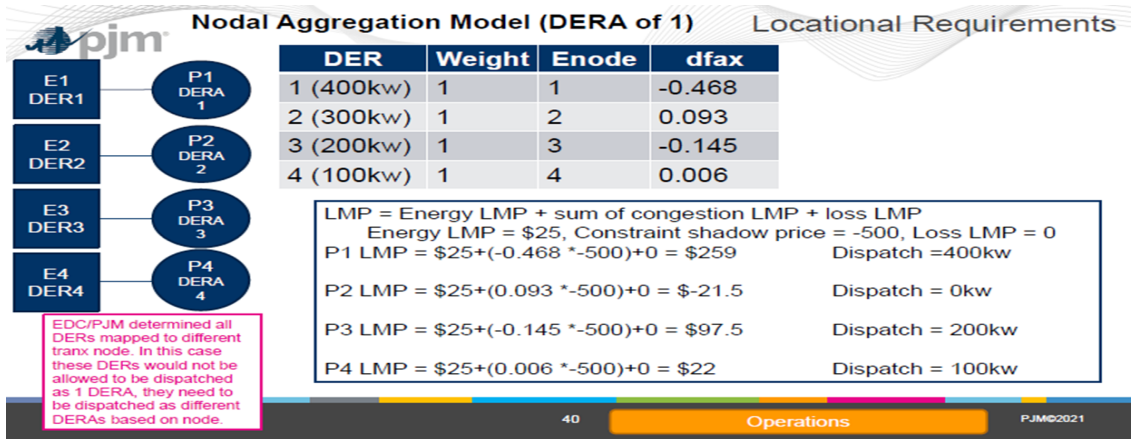
# CLARIFYING QUESTIONS: WEIGHTING FACTORS



Weighting Factors

- DER aggregators will need to provide **resource weighting factors** (distribution factors in FERC Order) for the DERs participation in the DERA.
- Resource weighting factors will be calculated during the registration (via utility review) process based on the nameplate capacity of the resources in the aggregation.
  - Example: DER1 = 1MW, DER2 = 1MW; weighting would be DER1=0.5, DER2=0.5
- Further discussion on updating of weighting factors and the usage of these values are included after the example of locational requirements





Nodal Aggregation Model (DERA of 1) Locational Requirements

E1 DER1 — P1 DERA 1
E2 DER2 — P2 DERA 2
E3 DER3 — P3 DERA 3
E4 DER4 — P4 DERA 4

EDC/PJM determined all DERs mapped to different tranx node. In this case these DERs would not be allowed to be dispatched as 1 DERA, they need to be dispatched as different DERAs based on node.

| DER | Weight | Enode | dfax |
|---|---|---|---|
| 1 (400kw) | 1 | 1 | -0.468 |
| 2 (300kw) | 1 | 2 | 0.093 |
| 3 (200kw) | 1 | 3 | -0.145 |
| 4 (100kw) | 1 | 4 | 0.006 |

LMP = Energy LMP + sum of congestion LMP + loss LMP
Energy LMP = $25, Constraint shadow price = -500, Loss LMP = 0

P1 LMP = $25+(-0.468 *-500)+0 = $259 Dispatch =400kw

P2 LMP = $25+(0.093 *-500)+0 = $-21.5 Dispatch = 0kw

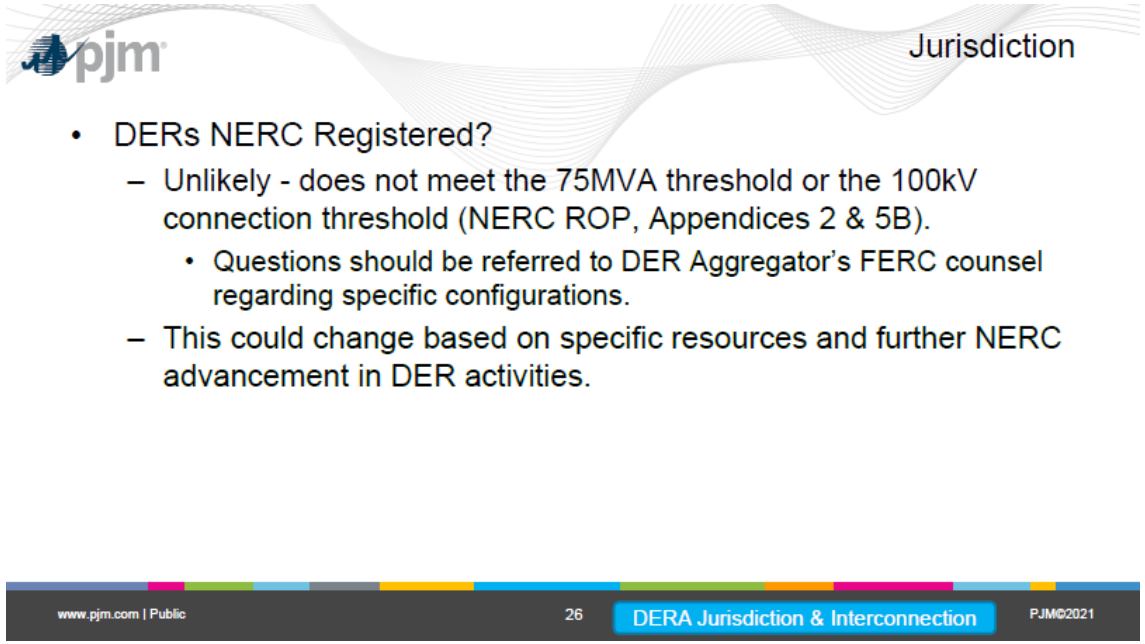
P3 LMP = $25+(-0.145 *-500)+0 = $97.5 Dispatch = 200kw

P4 LMP = $25+(0.006 *-500)+0 = $22 Dispatch = 100kw



1. Possibly establish some predetermined bandwidth for physical operations around the weighting factors for accuracy?
2. Consider seasonal factors by DER technology type?
3. Clarify the use of weighting factors if going to be used for other than in the energy markets.
4. Clarify testing requirements for individual DER, tested individually or via the aggregation?
5. Suggest individual DER site testing with performance permitted in the aggregate.
6. The EDCs would need individual DER data for validation if required.
7. (50) Need clarification regarding the use of Weight and dfax and how they will be used.

# CLARIFYING QUESTIONS: WEIGHTING FACTORS (CONT)



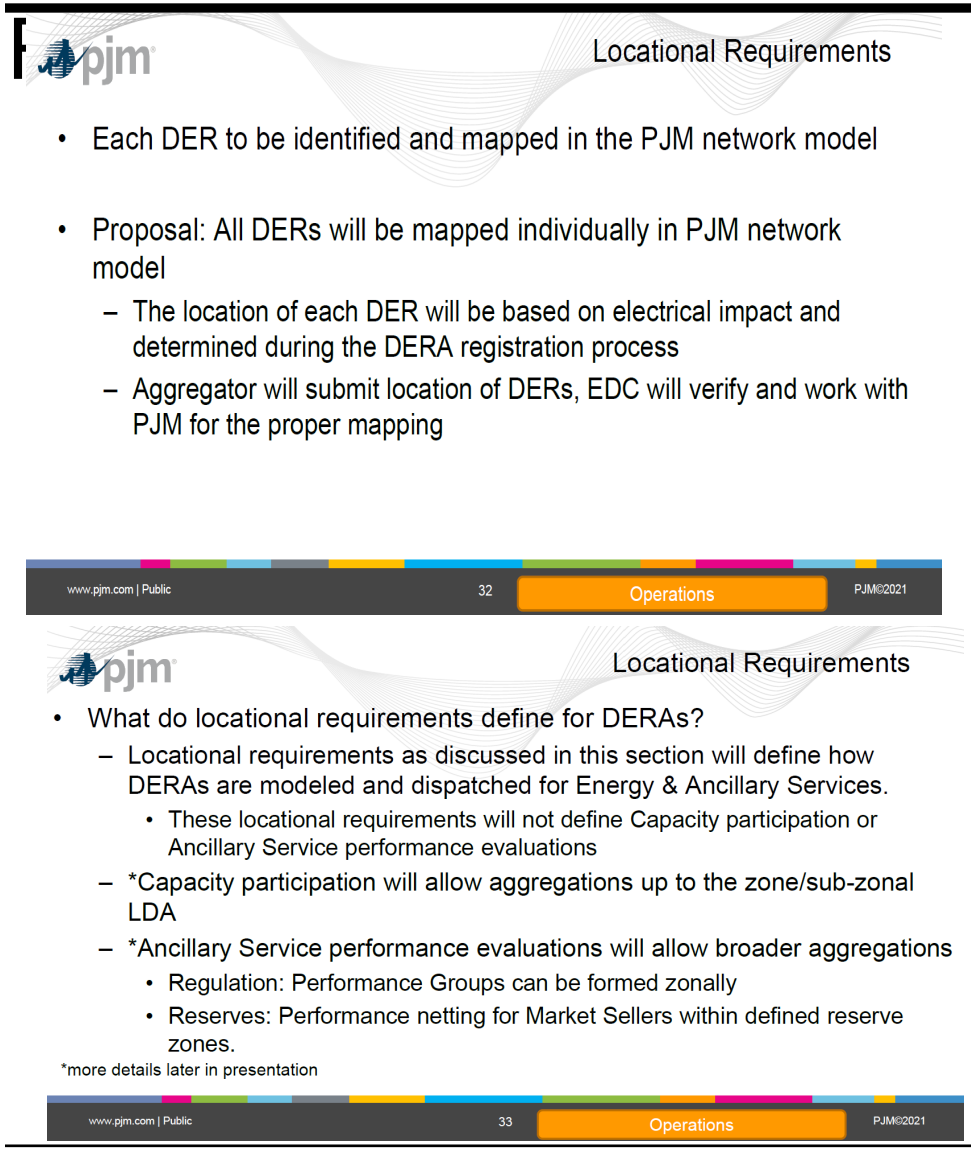

Need clarification how NERC Registration may be impacted based on the DER Aggregation size exceeding the 75MVA size threshold.

1. DERA needs to be the responsible party for these requirements.
2. Possible changes to NERC requirements because of Aggregations, and reclassification of some of these distribution connected DERs that would not otherwise be subject to NERC requirements?
3. Could there be additional contractual requirements pursuant to NERC requirements?

# LOCATIONAL REQUIREMENTS

THE CONTENT OF THIS SLIDE IS INTENDED FOR DISCUSSION PURPOSES ONLY AND REPRESENTS PRELIMINARY VIEWS OF PJM's PROPOSAL TO IMPLEMENT FERC ORDER 2222.

# LOCATIONAL REQUIREMENTS: MAPPING




## Discussion Item

- Individual DERs to be identified and mapped in the PJM network model.

## Concerns

- Mapping requirement detail is needed and should focus on the Aggregation modeling vs. more detailed individual DER modeling.

## Thoughts

- EDCs are responsible for the specific DER data required to effectively map the specific DER to the Enode/Pnode.
- Distribution asset information should not be included in information requested.
- Mapping to only be provided for market participants.

# NODAL VS. MULTI NODAL PARTICIPATION

Locational Requirements

- Initial proposal: DER Aggregation not allowed beyond a single location (“nodal” from FERC Order)
  - Examples and discussion on following slides

Alternative Approach: A multi-location (“multi-nodal”) model. This model would have increased inefficiencies in dispatch and LMP formation. However, this model would still model DERs nodally and restrict aggregations to utility footprints; this would be an improvement over a zonal aggregation model with respect to operational and pricing concerns.



## Discussion Item

- EDCs support PJM’s proposal for DERA participation to a single Pnode only for Energy Services, Ancillary Services. Zonal, and sub-zonal/Locational Deliverability Area (LDA) for Capacity with individual DER being mapped to a singe Enode. Utility service territory boundaries need to be recognized in nodal participation.

## Concerns

- EDCs recognize potential benefits of addition EE and DR aggregation for capacity market performance, however larger mufti-nodal aggregations will likely come with increased risks of individual DER overrides by EDCs.

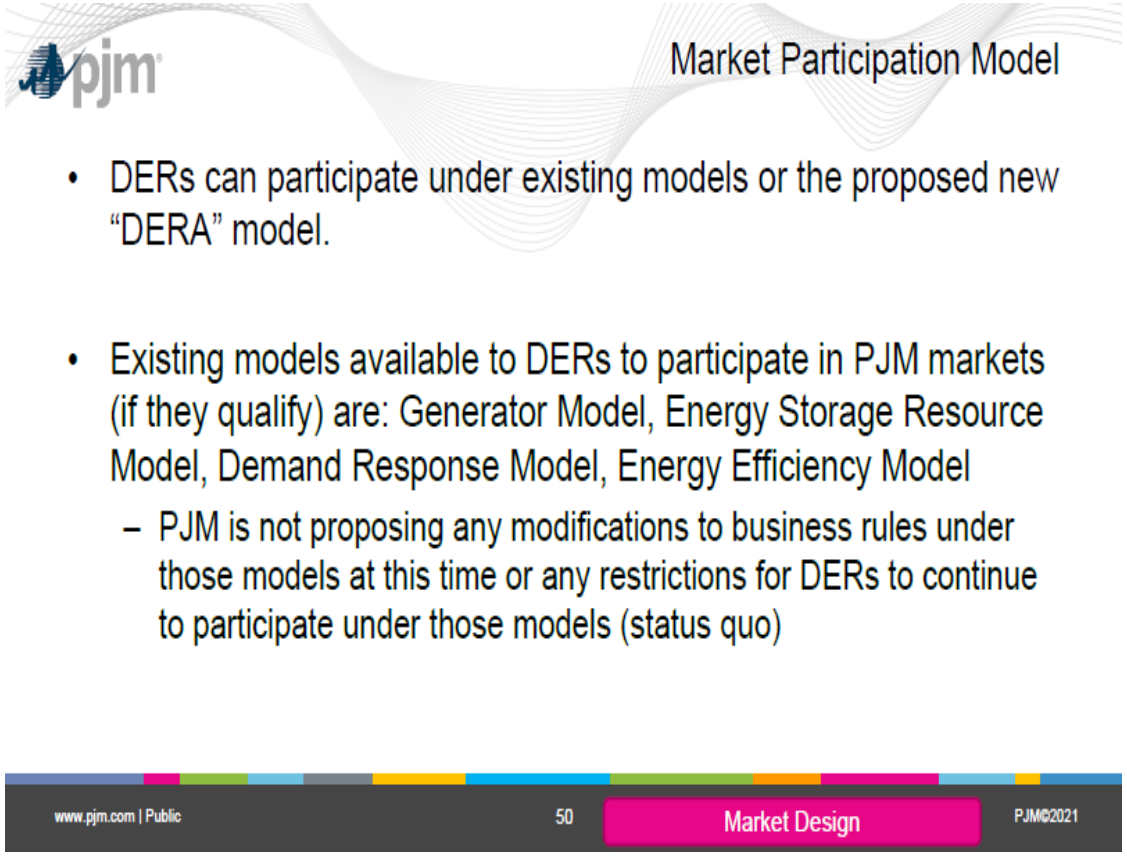
## Thoughts

- EDCs request examples of improved market entry and/or improved DER performance benefits for further consideration of multi-node and/or larger aggregation sizes compared to individual DER performance.
- Need PJM to define how dispatch groups compared to DER Aggregation registrations would be utilized for DERA operations and market performance valuation.

# MARKET PARTICIPATION MODEL

THE CONTENT OF THIS SLIDE IS INTENDED FOR DISCUSSION PURPOSES ONLY AND REPRESENTS PRELIMINARY VIEWS OF PJM's PROPOSAL TO IMPLEMENT FERC ORDER 2222.

# MARKET PARTICIPATION MODELS (50-64)




## Discussion Item

- Agree to retain current market participation models and rules however do not rule out implementing potential changes to allow more consistency with new DERA rules.

## Concerns

- New participation models should have terms consistent with current models to avoid flip flopping.
- DERA Market Participation models need to recognize MOPR and other pending wholesale market rule changes.
- Market Participation models need to accommodate retail DER program participation such as EV or battery charging at retail vs wholesale rates.
- EDCs agree with PJM to permit market participation for mobile DERS at a single location as will be indicated on the registration.

## Thoughts

- EDCs recommend flexibility to avoid ruling out possible changes to existing models for more consistency with DERAs going forward.
- PJM to clarify its preferred positions for DERA Capacity, Energy and Ancillary Services Market participation in their update DERA Proposal on 8/15.

# COST BASED OFFERS (SLIDE 59)


## Discussion Item

- Cost Based Offers

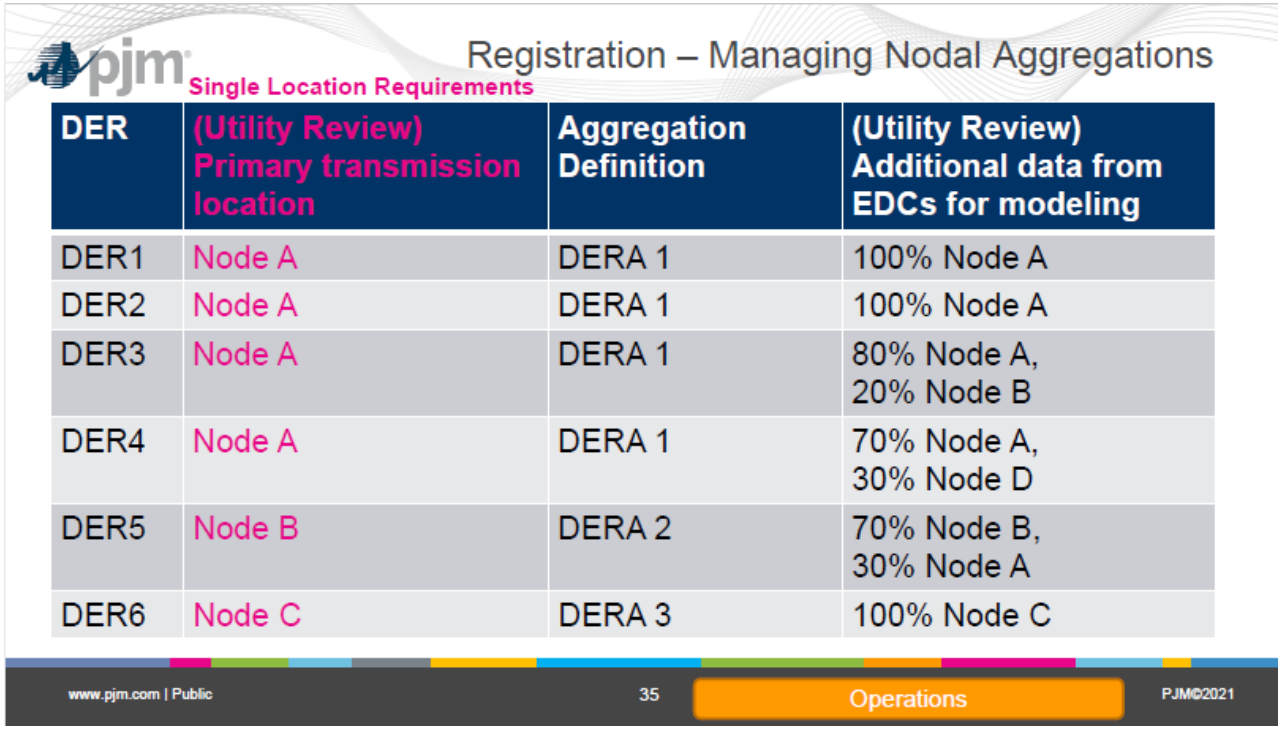
## Concerns

- Further detail for cost-based offers for a DERA vs. individual DER is needed.

## Thoughts

- PJM to provide additional details in their updated DERA proposal on 8/15.

# CLARIFYING QUESTIONS: MARKET PARTICIPATION



Registration – Managing Nodal Aggregations

Single Location Requirements

| DER | (Utility Review) Primary transmission location | Aggregation Definition | (Utility Review) Additional data from EDCs for modeling |
|---|---|---|---|
| DER1 | Node A | DERA 1 | 100% Node A |
| DER2 | Node A | DERA 1 | 100% Node A |
| DER3 | Node A | DERA 1 | 80% Node A, 20% Node B |
| DER4 | Node A | DERA 1 | 70% Node A, 30% Node D |
| DER5 | Node B | DERA 2 | 70% Node B, 30% Node A |
| DER6 | Node C | DERA 3 | 100% Node C |



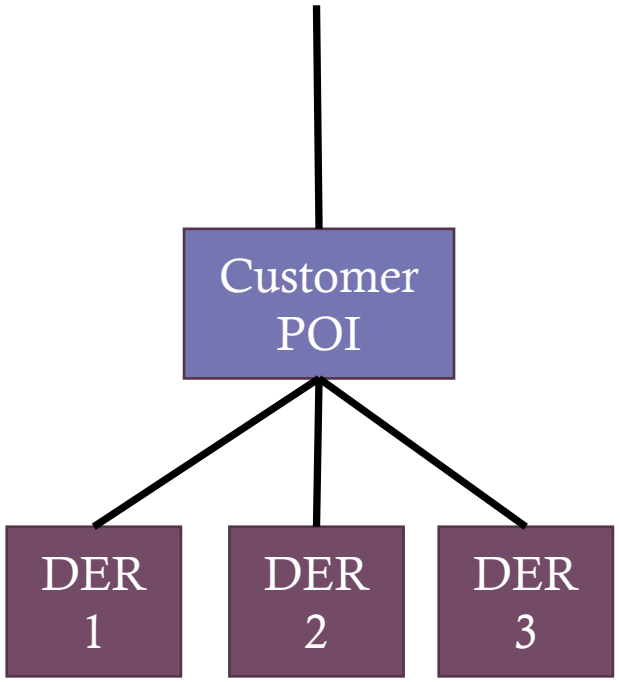
1. Need clarification on what additional data would PJM request from the EDCs about the DER or DERA?

2. Why the use of 25kW for Planned DER participation? Seems too small and could lead to considerable evaluation efforts.
   - Limitations to Planned DER should be like other Planned Capacity Resources for the BRA.
   - Consider Planned DER limitations in the 3IA to require a valid interconnection

# SINGLE VS. MULTIPLE CUSTOMER AGGREGATOR

THE CONTENT OF THIS SLIDE IS INTENDED FOR DISCUSSION PURPOSES ONLY AND REPRESENTS PRELIMINARY VIEWS OF PJM's PROPOSAL TO IMPLEMENT FERC ORDER 2222.

# SINGLE VS. MULTIPLE DER AGGREGATOR (50-65)




## Discussion Item

- Metering & Telemetry requirements will be different if a single DERA vs multiple DERA for BTM DERs.

## Concerns

- EDCs will need individual DER meter data to effectively validate settlements and to determine impacts to retail bills. How would individual DER data be communicated to the EDCs if not required by PJM?
- Individual DER injections may or may not be noticed at the retail meter or POI meter if multiple DERs and load exists and likely the best starting point for DER Aggregations.
- Individual DERs not being installed primarily for market participation, instead being utilized to support another DER function i.e. fast charging using ES & PV or to support resiliency for back up power.
  - ✓ Market Participation of individual DERs or the DERA will be an important detail in the interconnection study process
- Many issues and concerns with DER submetering including submetering accuracy, ownership, costs.

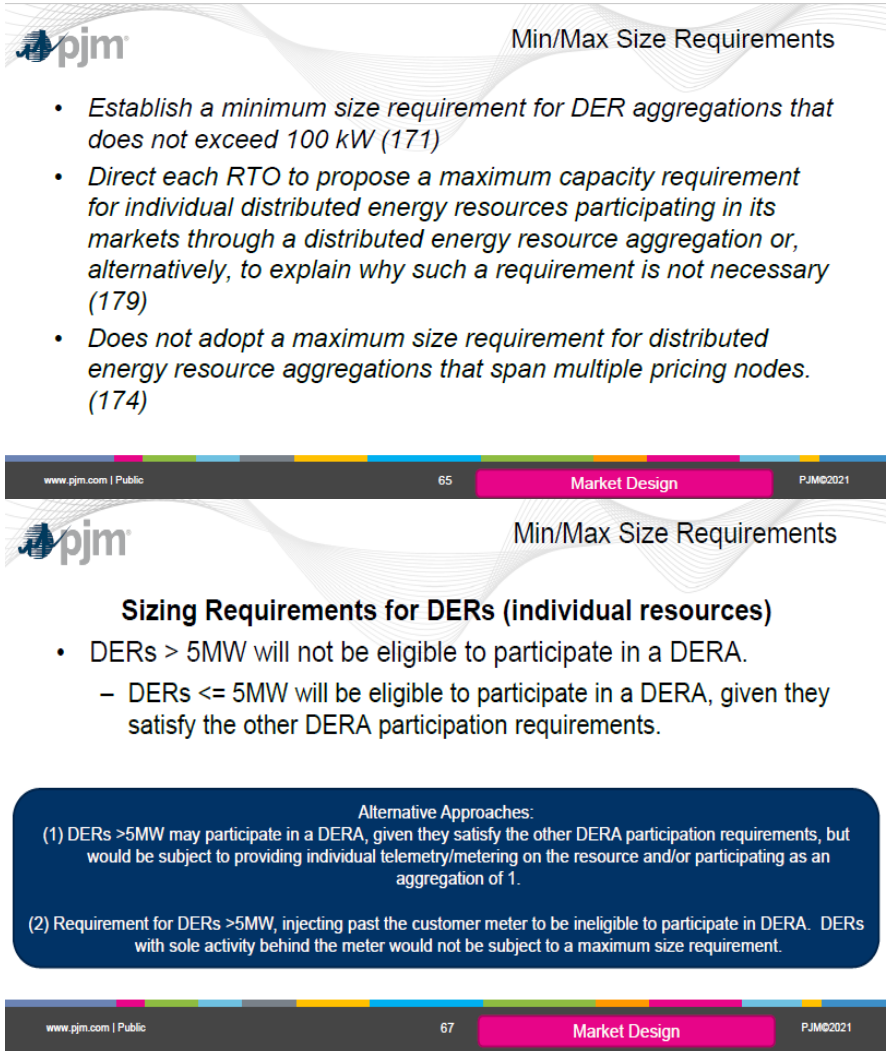
## Thoughts

- PJM to consider only a single DERA use case for each customer premise or POI meter initially. If no retail DER, export via the retail meter or POI meter could be considered a wholesale injection. If a retail DER like NEM on site, either retail NEM metering needed to retain NEM provisions or decision to move to entirely wholesale participation.
- Retail programs and bill management likely the primary reason for BTM DER installation with wholesale market participation a secondary role. Costs for submetering, coordination and settlements will be costly with potential further impacts to EDCs retail billing process.

# DER AGGREGATION SIZE REQUIREMENTS

THE CONTENT OF THIS SLIDE IS INTENDED FOR DISCUSSION PURPOSES ONLY AND REPRESENTS PRELIMINARY VIEWS OF PJM's PROPOSAL TO IMPLEMENT FERC ORDER 2222.

# DERA SIZE REQUIREMENTS (SLIDES 65-69)



Min/Max Size Requirements

- *Establish a minimum size requirement for DER aggregations that does not exceed 100 kW (171)*
- *Direct each RTO to propose a maximum capacity requirement for individual distributed energy resources participating in its markets through a distributed energy resource aggregation or, alternatively, to explain why such a requirement is not necessary (179)*
- *Does not adopt a maximum size requirement for distributed energy resource aggregations that span multiple pricing nodes. (174)*

www.pjm.com | Public 65 Market Design PJM©2021

Min/Max Size Requirements

**Sizing Requirements for DERs (individual resources)**

- DERs > 5MW will not be eligible to participate in a DERA.
  - DERs <= 5MW will be eligible to participate in a DERA, given they satisfy the other DERA participation requirements.

Alternative Approaches:
(1) DERs >5MW may participate in a DERA, given they satisfy the other DERA participation requirements, but would be subject to providing individual telemetry/metering on the resource and/or participating as an aggregation of 1.

(2) Requirement for DERs >5MW, injecting past the customer meter to be ineligible to participate in DERA. DERs with sole activity behind the meter would not be subject to a maximum size requirement.

www.pjm.com | Public 67 Market Design PJM©2021

## Discussion Item

- Min-Max size requirements around DERAs

## Concerns

- There is no one right size for every situation or market and by establishing a maximum size, participation will likely be limited.

## Thoughts

- EDCs recommend to start small initially and increase sizing based on participation experience.
- EDCs support following current Demand Response (DR) rules for Aggregation size requirements.
  - ✓ Assumes individual DERs => 100 kW can participate in all markets currently
  - ✓ FO222 focuses on <100kW DER that cannot currently participate directly in the wholesale markets
  - ✓ Aggregation should permit minimum aggregation levels to facilitate market participation without excessive aggregation sizes that will contribute to many EDC overrides of DER Aggregation participation.
    - DER Aggregation should be limited to one DER greater than 100 Kw
    - Consideration for DER injections and load drop to be considered in aggregation size determination. A 1MW battery can produce a 2 MW swing unlike DR only as load drop

# METERING & TELEMETRY

THE CONTENT OF THIS SLIDE IS INTENDED FOR DISCUSSION PURPOSES ONLY AND REPRESENTS PRELIMINARY VIEWS OF PJM's PROPOSAL TO IMPLEMENT FERC ORDER 2222.

# METERING & TELEMETRY(SLIDES 47-48)


## Discussion Item

- Metering and Telemetry Requirements

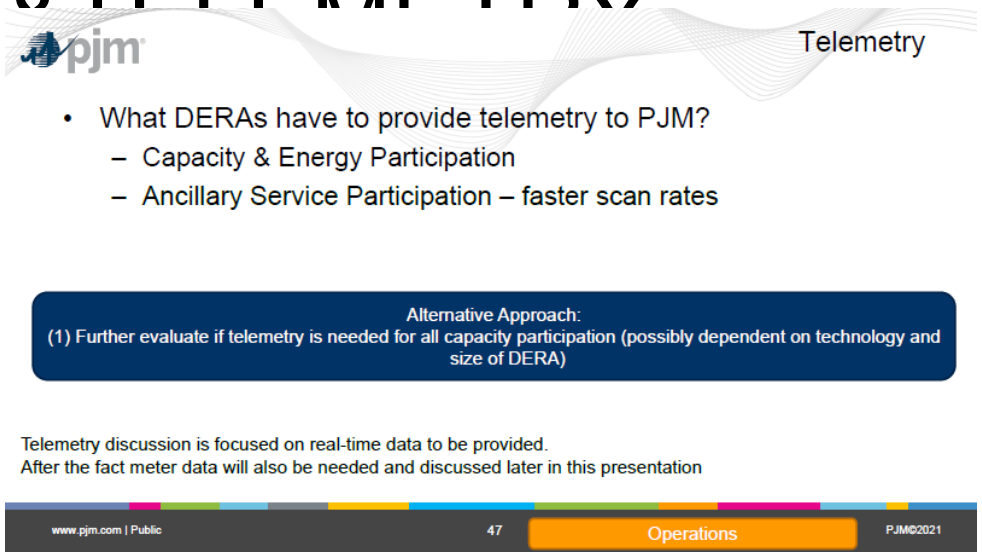
## Concerns

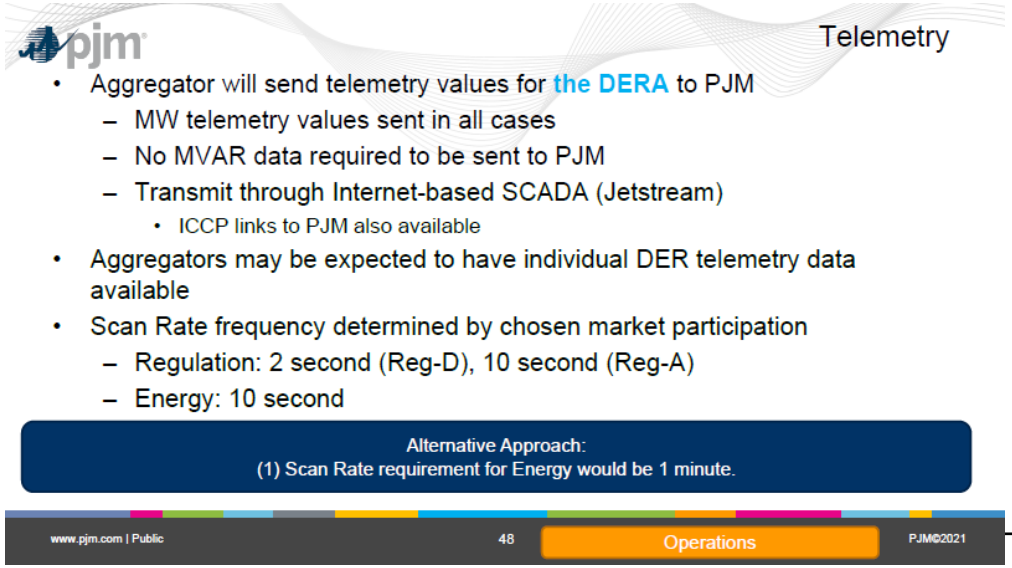
- Metering and Telemetry Requirements remain undefined.
- How will individual DER data be communicated to the EDCs if not required by PJM?

## Thoughts

- Decisions needed for EDCs to determine meter data and telemetry requirements:
  - ✓ Multiple or single DERA per customer site?
  - ✓ How to address simultaneous retail and wholesale grid injections?
  - ✓ EDC Metering and Telemetry requirements for billing/ settlements and system operations may not be recognized in PJM's proposal and needs to be considered by retail commissions.
  - ✓ State Commissions need to weigh in on DER submetering and telemetry accuracy requirements and costs that will likely be needed to facilitate retail billing adjustments due to DER/DERA market participation.
  - ✓ Will also need to consider impacts to retail programs like Net Energy Metering (NEM), EV and ES off peak charging rates, Non-Wires Alternative (NWAs).

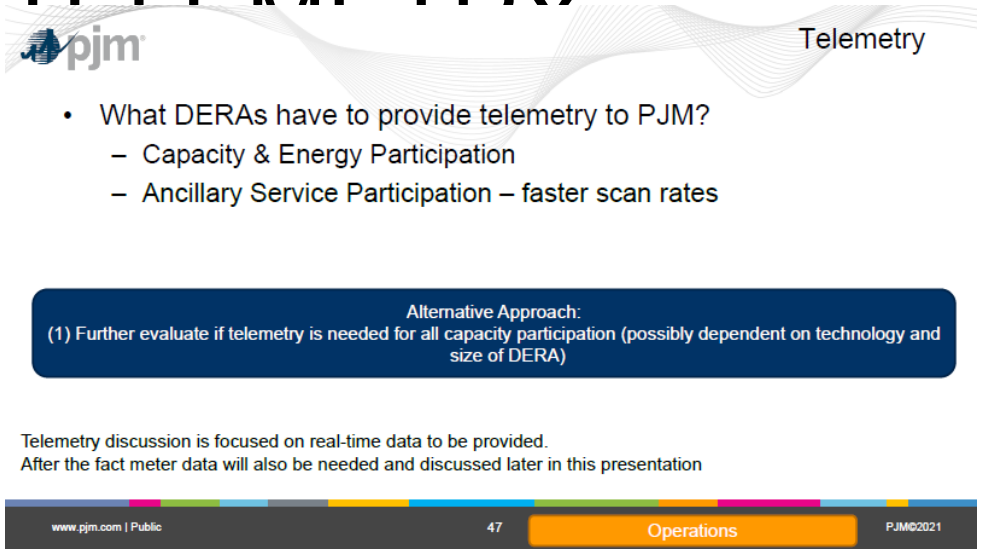
# CLARIFYING QUESTIONS: METERING & TELEMETRY

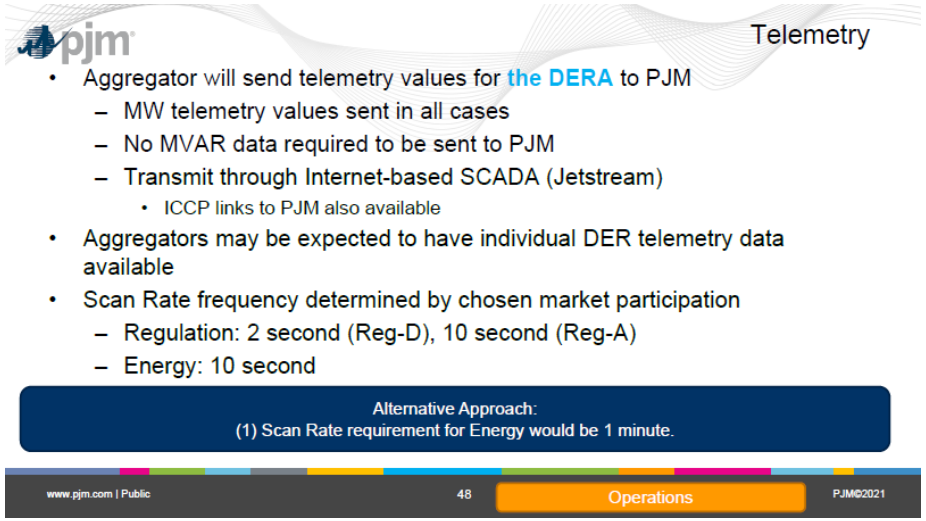



1. Can PJM provide the metering and telemetry requirements used for DR and expected for DERs by Market?
   a. Provide a breakdown of metering and data being used for billing/settlements vs operational data and their associated accuracy requirements.
   b. Also identify how this could change due to an FO-2222 Aggregation.
2. What information will be required for EE and DR resources in an Aggregation?
3. Assuming the current meter accuracy requirements for each market will be applicable to a DERAs, how will PJM validate DER submetering accuracy?

# CLARIFYING QUESTIONS: METERING & TELEMETRY



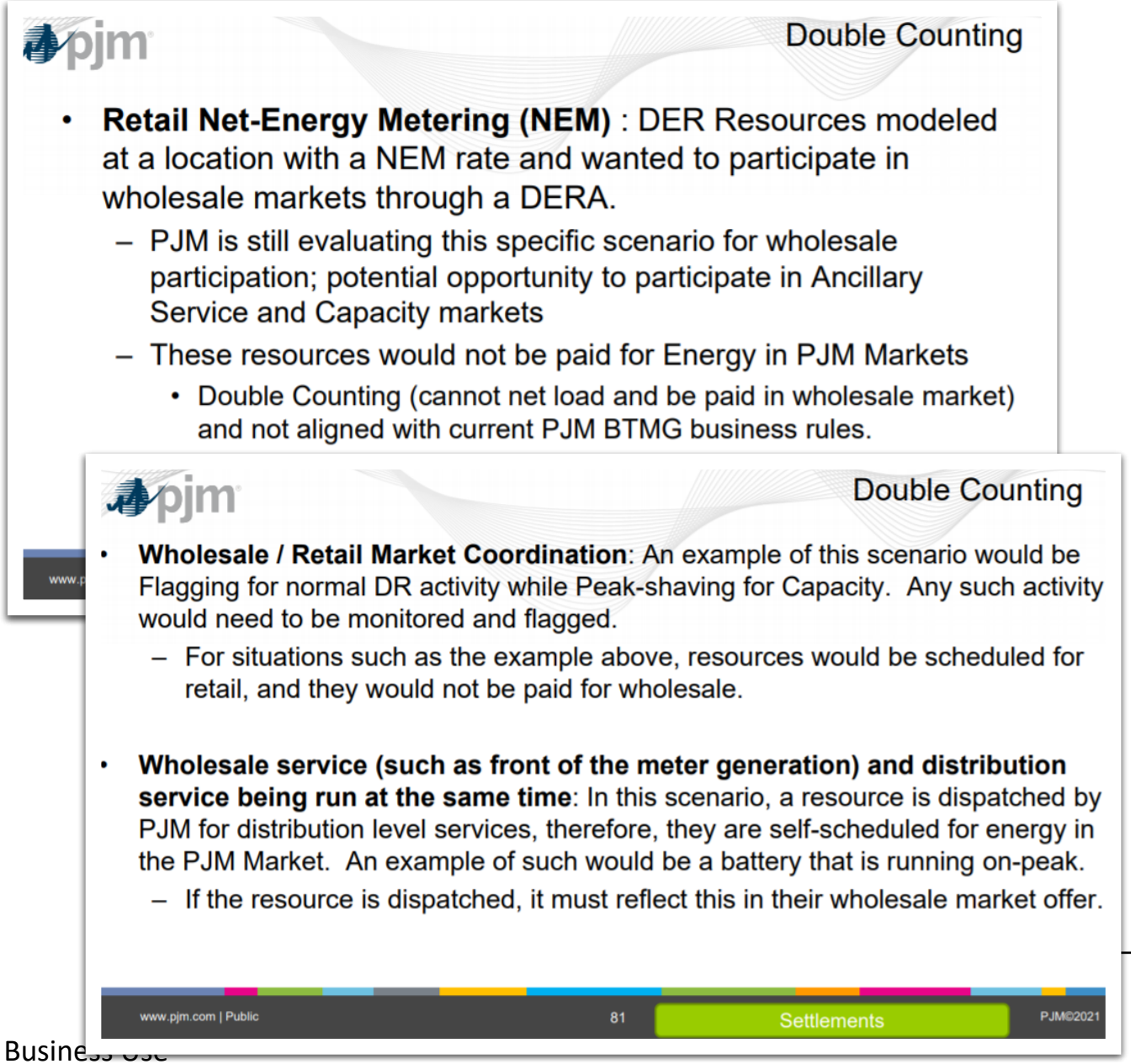




1. Need clarity on Energy Storage – will FO-841 rules be implemented for wholesale transactions where charge/discharge/constant run modes information needs to be maintained?
2. Need specific use cases. (May also have a tie-in for microgrids)
3. Concern if energy storage is in charging mode – could create artificial congestion (not part of aggregation); then other aggregated assets inject to take advantage of price spike and congestion caused by the storage resource.
   a. May need a request for clarification to FERC and/or PJM.

# SETTLEMENT REPORT OUT

Heather Svenson

# EDC FEEDBACK ON PJM STRAW PROPOSAL – DOUBLE COUNTING



pjm

Double Counting

- **Retail Net-Energy Metering (NEM)** : DER Resources modeled at a location with a NEM rate and wanted to participate in wholesale markets through a DERA.
  - PJM is still evaluating this specific scenario for wholesale participation; potential opportunity to participate in Ancillary Service and Capacity markets
  - These resources would not be paid for Energy in PJM Markets
    - Double Counting (cannot net load and be paid in wholesale market) and not aligned with current PJM BTMG business rules.

pjm

Double Counting

- **Wholesale / Retail Market Coordination**: An example of this scenario would be Flagging for normal DR activity while Peak-shaving for Capacity. Any such activity would need to be monitored and flagged.
  - For situations such as the example above, resources would be scheduled for retail, and they would not be paid for wholesale.
- **Wholesale service (such as front of the meter generation) and distribution service being run at the same time**: In this scenario, a resource is dispatched by PJM for distribution level services, therefore, they are self-scheduled for energy in the PJM Market. An example of such would be a battery that is running on-peak.
  - If the resource is dispatched, it must reflect this in their wholesale market offer.

www.pjm.com | Public 81 Settlements PJM©2021

EDC Feedback:

- As directed by FO-2222, DERs should not be compensated twice for the same service
  - DERs participating in retail programs cannot participate in any PJM wholesale market individually or through a DERA
- *Example*: It would be improper for a DER receiving a retail rate credit for electricity through a state net metering program to receive any credit for the very same electricity in the PJM wholesale markets.
- Need to ensure fair and equitable wholesale rate and pricing treatment of DERs in conjunction with state jurisdictional and/or RERRA guidance
- Market participation as either, but not both, wholesale or retail to be determined at meter level as defined by individual EDCs