PJM Order 2222 Use Case Updates

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Purpose of Use Cases

- Stress test the DERA model
- Build understanding by filling in details
- Consistent examples to use throughout stakeholder process
- Highlight technology-specific needs
- Ability to iterate and introduce alternatives

Use Case Disclaimer

- This Use Case review may reflect proposal items that have been revised or updated since the most recent PJM Draft Proposal presented at the **August 2021 DIRS**
  - Proposal items with updated requirements will be noted verbally or visually
  - PJM still welcomes comments and questions on updated proposal items during this presentation for consideration

Use Case Updates

- Incorporated feedback from stakeholders
  - Genericize Use Cases; remove technology-specific references
  - Provide more detail on market participation
  - Create new Ancillary Service-only Use Case

- Seeking feedback on the following
  - New Use Case framework
  - Terminology and classification of DERAs
  - Importance of labeling “homogeneous” vs. “heterogeneous”
  - Ancillary Services-only participation proposal

Use Case Characteristics

Composition	Whether diversity exists within the DERA; can be “of resource type” or “of technology type” Homogenous**: only one type is present Heterogeneous: multiple types are present
Configuration	Relation of the DER physical elements to retail load Front of the meter: not co-located with retail load Behind the meter: co-located with retail load
Resource Type	Distinguishes the nature of a DERA resource and its contribution to the system *Details on future slides*
Technology Types	Mechanism or activity by which power is generated or load reduced within DERA DGR: Solar, wind, ESR, etc. DR: Controllable retail load, DGR co-located with retail load, etc.
Market Participation	Market services the DERA is technically capable of providing
Sites	Number of geographically distinct sites registered. One or more sites comprise a DERA.

** DR-only aggregations under the current DR model are technology agnostic and would be considered Homogenous of technology type

Technology Type vs. Resource Type

Resource (DER) Types

- **Distributed Generation Resource (DGR)** - Generator that does not go through the PJM queue but goes through state interconnection process and participates in a DERA.
- **Demand Response** (**DR**) **Resource** – A controlled action by which load is modified specifically for the wholesale market. A resource is defined as a unique EDC account number often referred to as location, premises, or site.
  - DGR action that reduces load for the wholesale market is subject to specific provisions for participation
- **DR w/ Distribution Injection (DRwDI) Resource** – The same as DR but also has Generation that is approved by EDC to inject onto the distribution system. Modelling of this type of resource is still a work in progress but aggregations that include DRwDI may be considered heterogeneous.

See PJM DIRS July 23, 2021 "Proposed DER Terminology Draft"

Technology Type vs. Resource Type

Technology Type

- **DGR** - Solar, wind, ESR, etc.
- **DR** - Various types of load modifying activity, DGR co-located with load, etc.

For the purposes of Use Case discussion

- Revised Use Cases to be technology neutral—where differences exist, differences will be noted under the relevant topic area
- More general categories above are used in place of specifying technology type

Use Cases: Previous Outline

- PJM presented the following Use Case outline at the July DIRS

	Composition	Configuration	Technology Types	Market Participation	Sites	Tx Location	Use Case Goal
1	Homogeneous	Front of the meter	Solar	Cap, En, An	One	Single Primary Node	• Demonstrate size requirements and their implications.
2	Heterogeneous	Front of the meter	Solar + ESR	Cap, En, An	Multiple	Single Primary Node	• Demonstrate how information is exchanged on an aggregate basis. • Highlight any impact to the utility review given multiple distribution feeders
3	Homogeneous	Behind the meter	ESR	Cap, En, An	One	Single Primary Node	• Demonstrate how ESR participates as behind the meter generation with injections in DERA
4	Heterogeneous	Behind the meter	DR + ESR	Cap, En, An	One	Single Primary Node	• Illustrate heterogeneous aggregates with a DR component, Illustrate ESR model within an aggregate.
5	Heterogeneous	Behind the meter	DR + Solar	Cap, En, An	One	Single Primary Node	• Illustrate a NEM component and its implications.
6	Heterogeneous	Behind the meter	Solar + ESR	Cap, En, An	Multiple	Single Primary Node	• Illustrate a multi-site residential aggregation where hybrid solar-storage is in place. • Illustrate a NEM component and its implications, particularly multi-site.

- Potential to simplify Technology Type, eliminate Tx Location, and expand Market Participation

Use Cases: Revised Outline

- Now more generalized with two Cases consolidated into one

	Composition	Configuration	Market Participation	Sites	Use Case Goal
1	Homogeneous	Front of the meter	Cap, Energy, AS	One	• Demonstrate size requirements and their implications.
2	Heterogeneous	Front of the meter	Cap, Energy, AS	Multiple	• Demonstrate how information is exchanged on an aggregate basis. • Highlight any impact to the utility review given multiple distribution feeders
3	Homogeneous	Behind the meter	Cap, Energy, AS	One	• Demonstrate participation options for DGR sites co-located with retail load. • Facilitate discussion around language when referring to DERA type.
4	Heterogeneous	Behind the meter	Cap, Energy, AS	One	• Illustrate data handling when aggregate contains both DGR and DR components. • Facilitate discussion around language when referring to DERA type.
5	Heterogeneous	Behind the meter	AS	Multiple	• Illustrate a residential aggregation of many distinct sites wanting to participate in Ancillary Services markets only.

- Market Participation options will be reviewed in depth for Use Cases 1 - 4

Outline of Topic Areas

Relevant to Use Cases

	Proposal Section
Coordination	Registration
Operations	Locational Requirements
	Weighting Factors
	Telemetry
Market Design	Market Participation Model
	Cost-Based Offers
	Bidding Parameters
	Size Requirements
Settlements	Metering
	Settlement Requirements
	Double Counting
Other	Performance & PAI

Specific market participation options will be discussed in depth for each Use Case

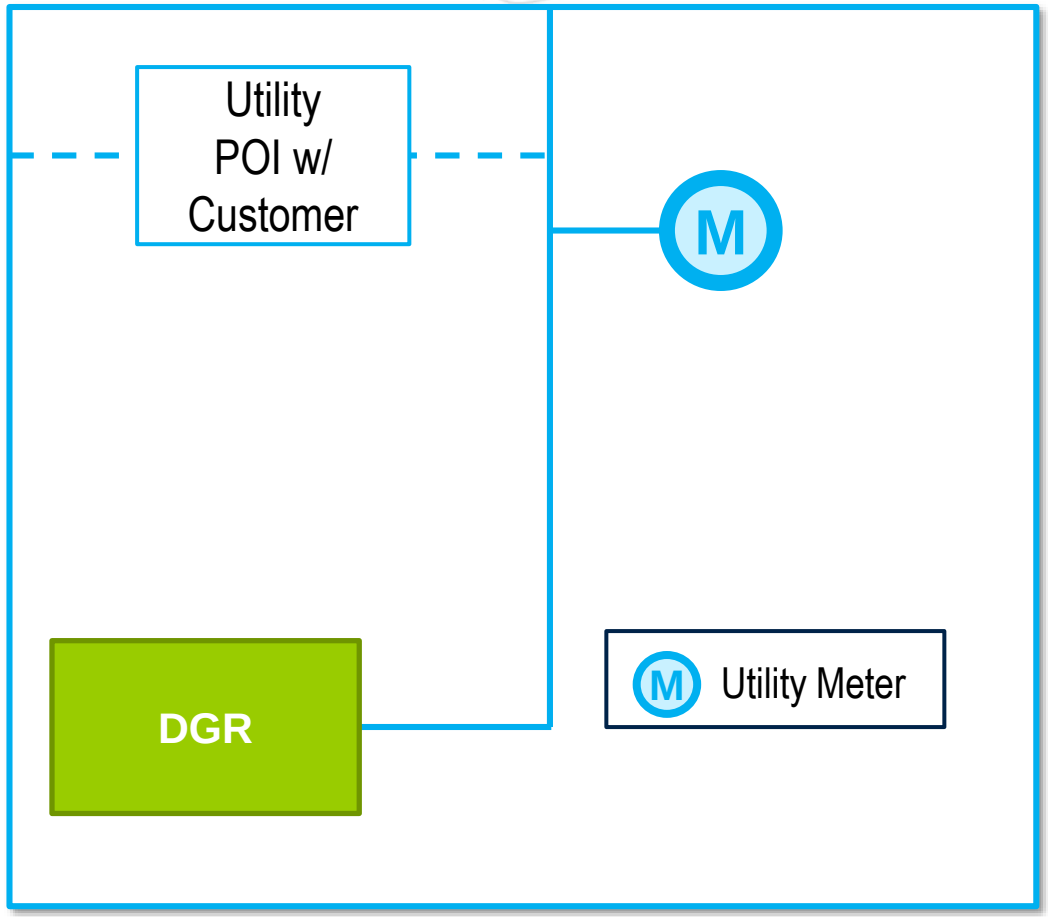
Not Relevant to Use Cases

	Proposal Section
DERA Jurisdiction & Interconnection	Interconnection
	Market Participation Agreements
	Opt-In for Small Utilities
Operations	Operational Needs
Market Design	Type of Technology
Coordination	EDC Coordination
Other	Single vs. Multiple Aggregators

- Topics either universally applicable or addressed in use case design
- Type of Technology not explicit in framework but to be discussed where relevant

Use Case 1

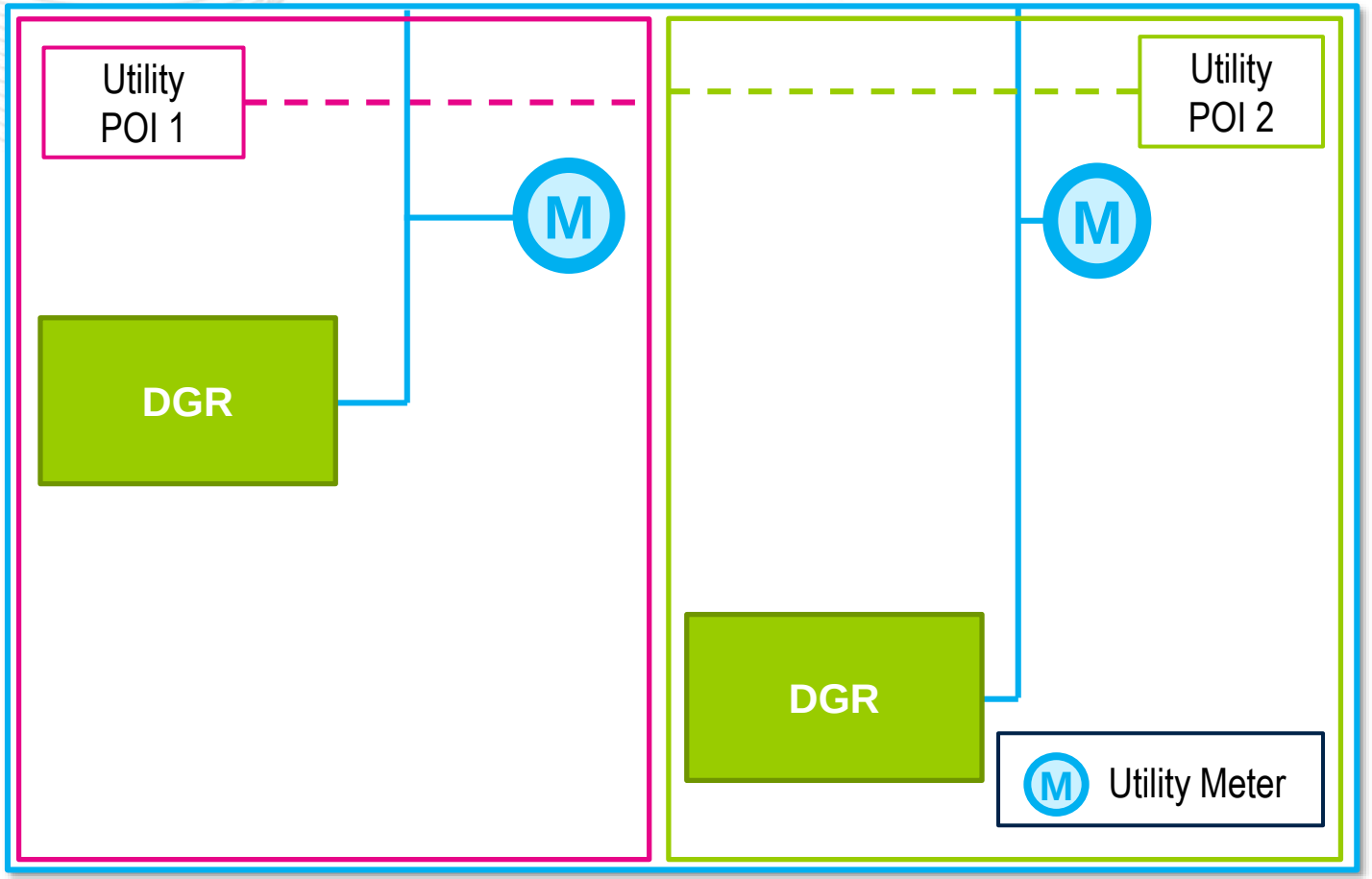
- A single Distributed Generation Resource (DGR)
- Single geographic site participating as a single DERA
- Not co-located with retail load



Note: This Meter represents status-quo utility interconnection, PJM telemetry or metering are discussed in a later slide.

Use Case 2

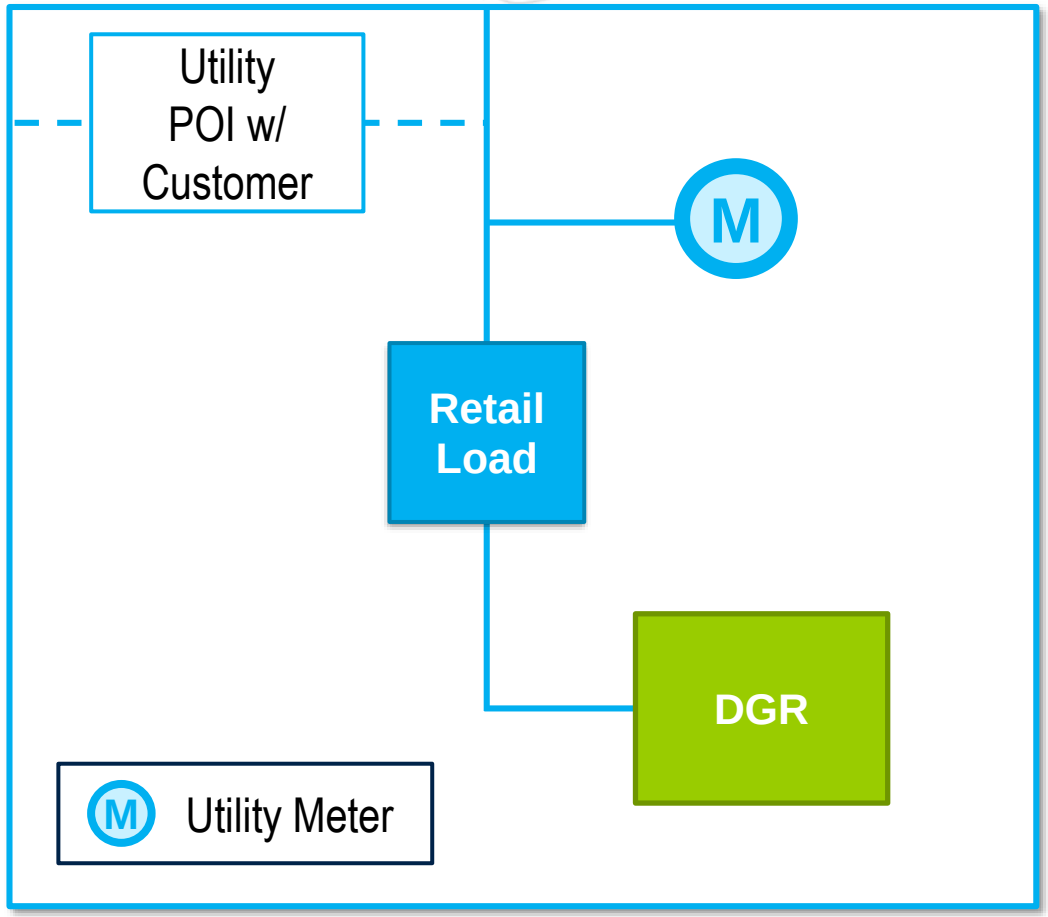
- A single Distributed Generation Resource (DGR) per site
- Operating at multiple geographically distinct sites
- No sites in DERA co-located with retail load



Note: This Meter represents status-quo utility interconnection, PJM telemetry or metering are discussed in a later slide.

Use Case 3

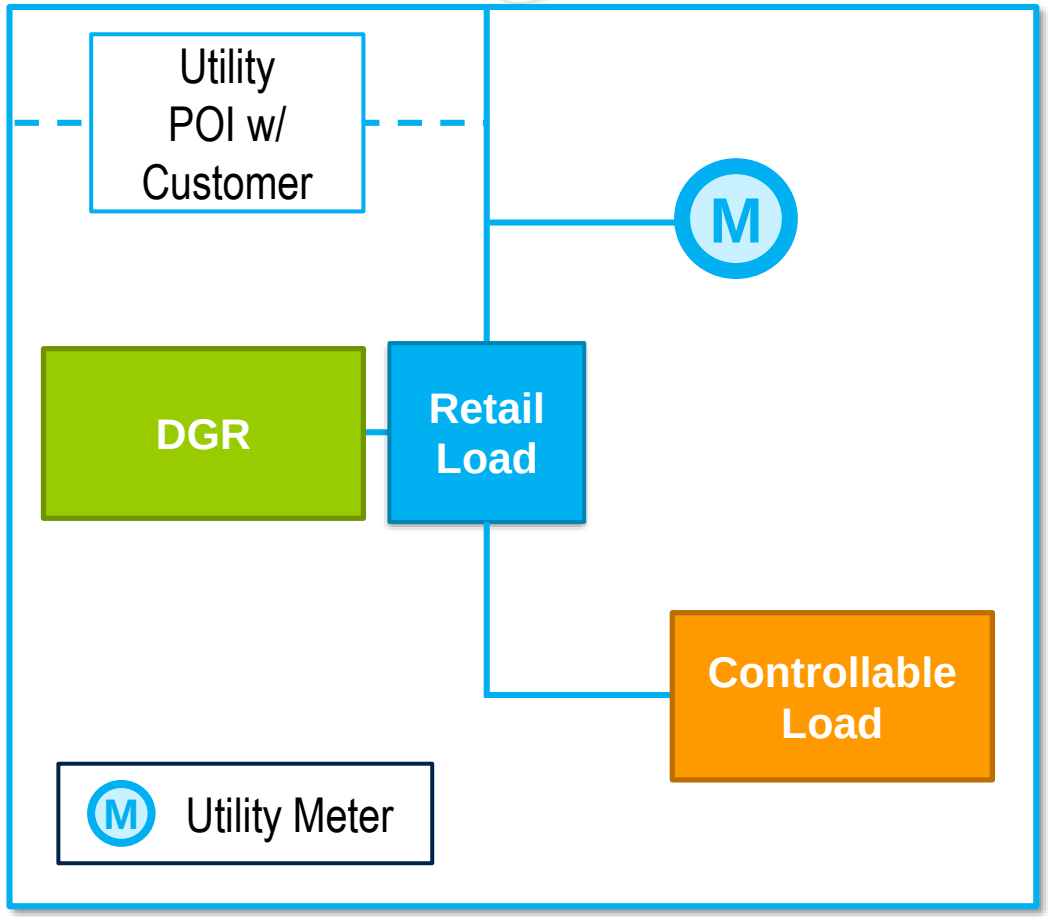
- A single Distributed Generation Resource (DGR)
- Single geographic site participating as a single DERA
- Site co-located with retail load
- Site may inject
- Participation as DRwDI **or** net injection BTMG **or** DR



Note: This Meter represents status-quo utility interconnection, PJM telemetry or metering are discussed in a later slide.

Use Case 4

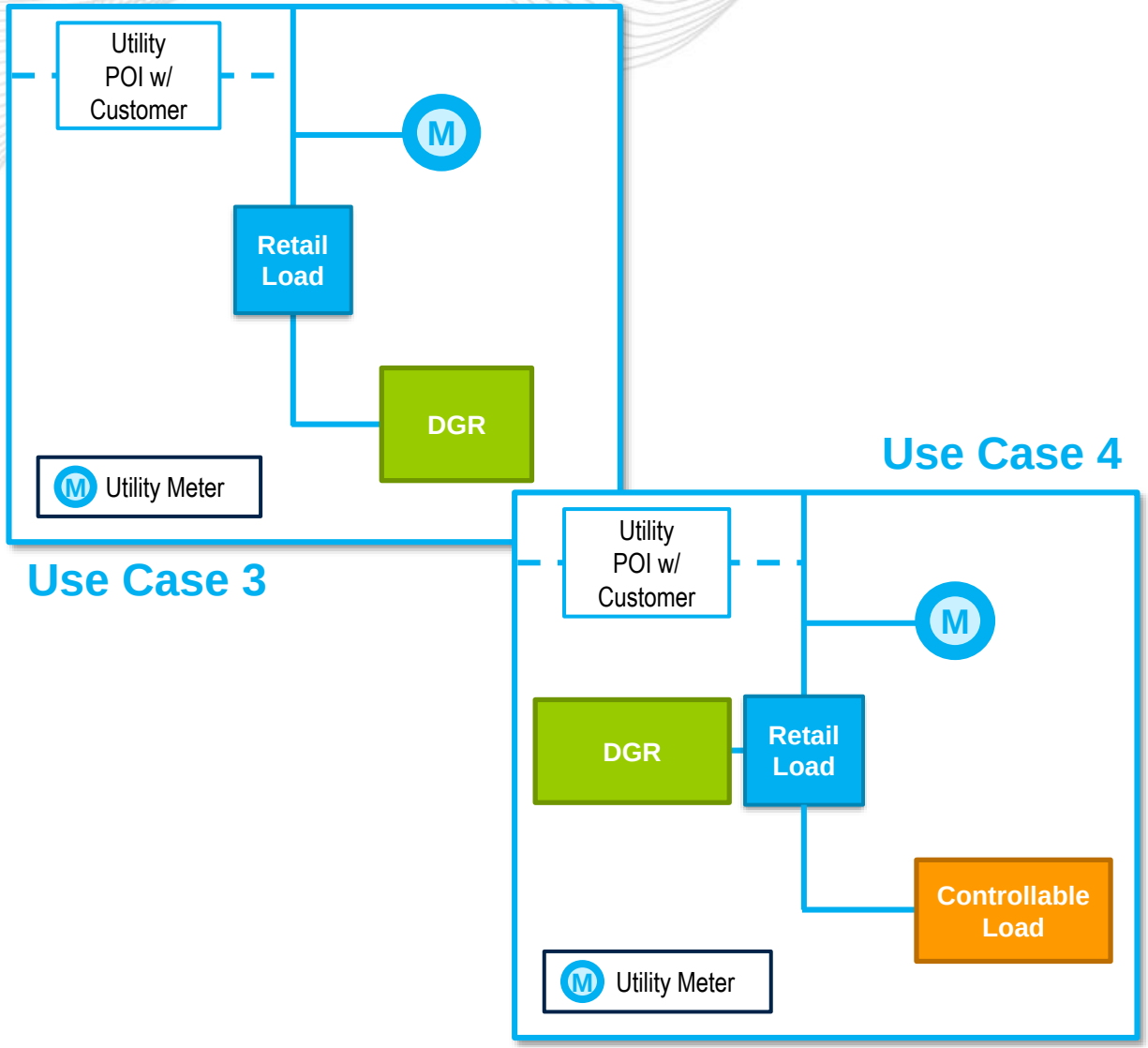
- Both DGR and Controllable Load DR contained within
- Single geographic site participating as a single DERA
- Site co-located with retail load
- Participation as DRwDI **or** net injection BTMG **or** DR



Note: This Meter represents status-quo utility interconnection, PJM telemetry or metering are discussed in a later slide.

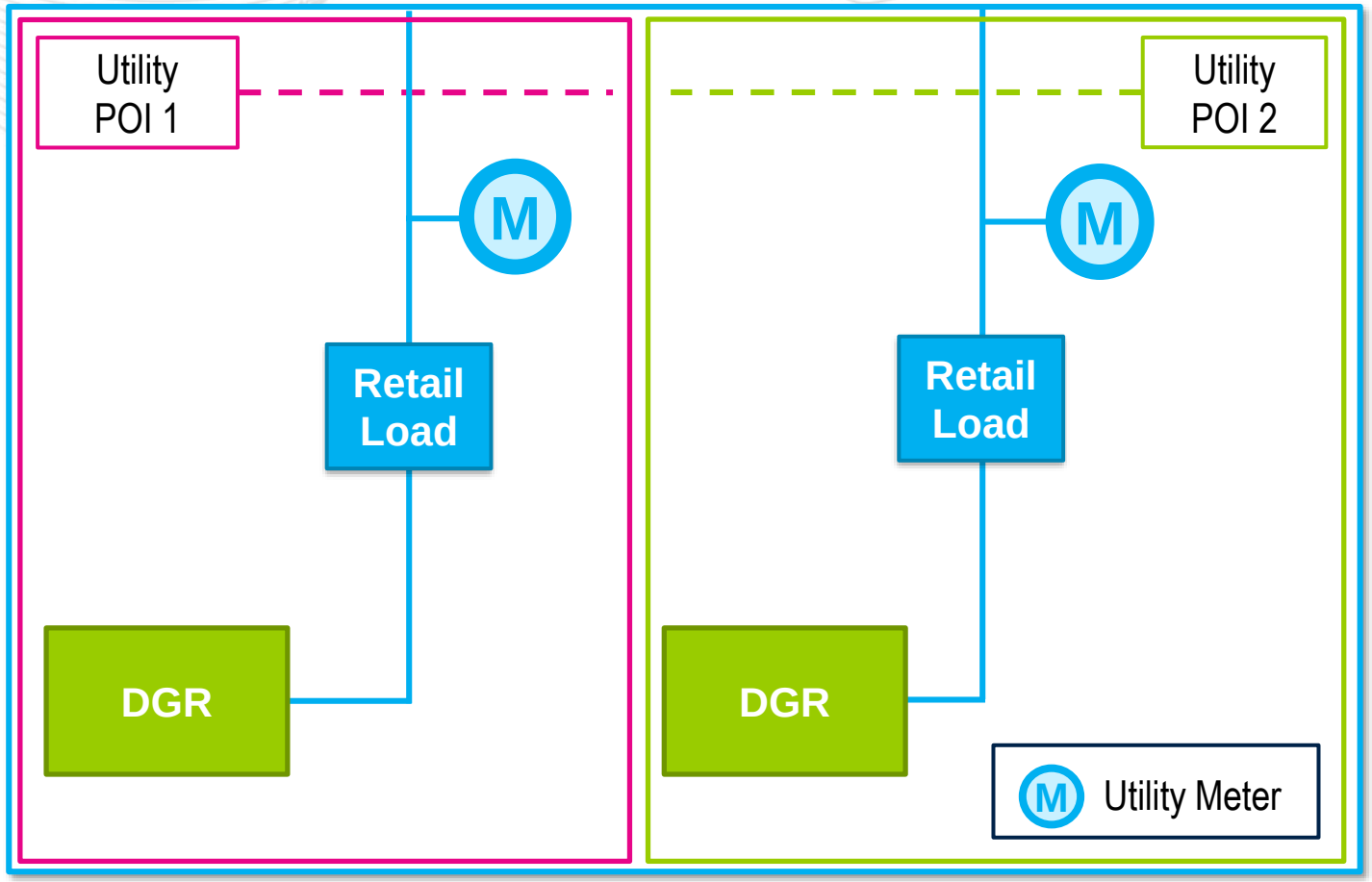
Composition and Terminology

- Should we continue to parse “homogeneous vs. heterogeneous”?
  - FERC Order
  - Many tech types, many resource types already allowed in proposal
  - Worth continuing to emphasize or has the distinction been transcended?



Use Case 5

- DGR contained within DERA
- Operating at multiple geographically distinct sites
- All sites co-located with retail customer load
- Sites may inject
- **Desires to aggregate broadly for AS-only participation**



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AS Performance Aggregation

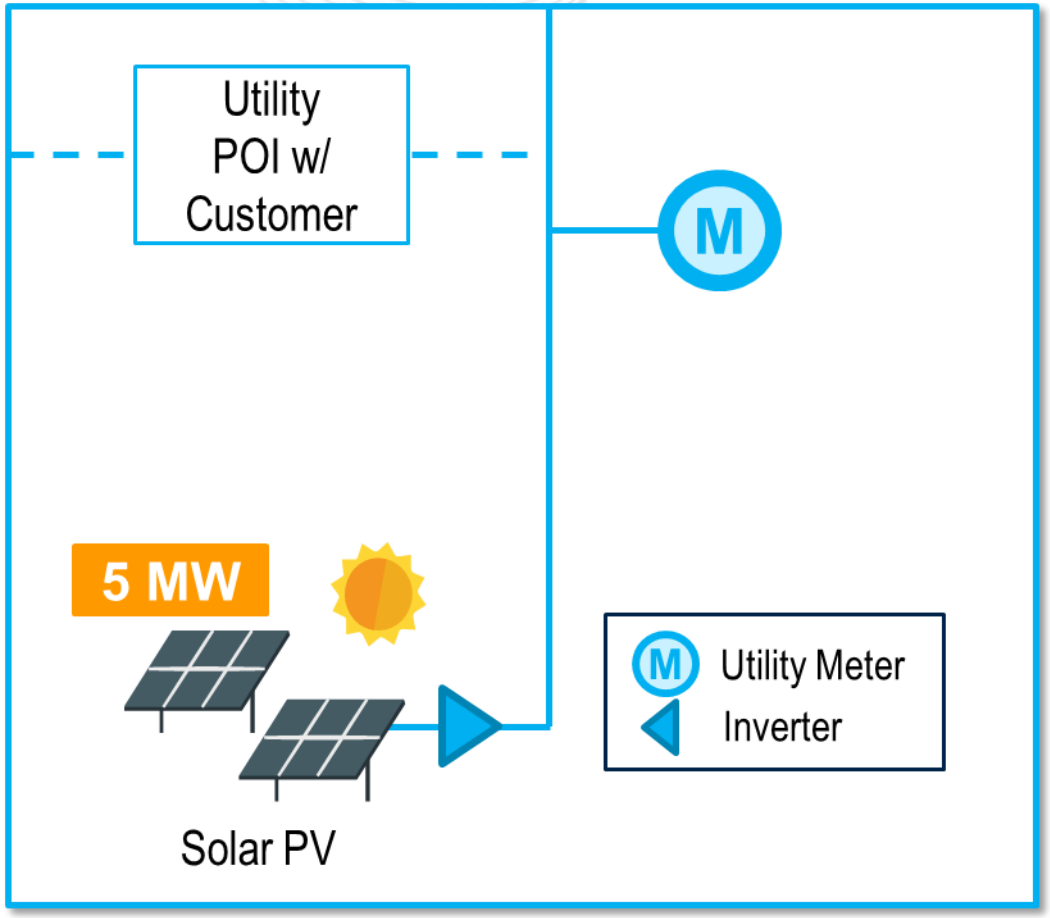
- Status Quo
  - AS performance aggregation is at a single node
- Proposed
  - AS performance aggregation for DERA participating be at the **EDC level** within a **single TO zone**
  - AS-only would include Regulation and Reserve participation
  - Telemetry requirements would remain dictated by existing market requirements

Appendix

Recap of Use Case 1 Walkthrough

July 23 DIRS

- MW values added to use cases to help illustrate registration process



Use Case 1: Registration

DERA Registration															
DERA	Start Date	End Date	Status	Site Resource Type	Name	Address	Markets	EDC	Transmission Zone	EDC Account Number	Max Load (kW)	Max Injection (kW)	Max En. Offer (kW)	Pricing Point	Agreements
DERA 1	---	---	---	Distributed Generator	---	---	Cap, En, A/S	---	---	---	0	5000	5000	Node A	---

Distributed Generation Resource(s)	Load Reduction Method				
Generation (kW)	Refrigeration (kW)	HVAC (kW)	Lighting (kW)	Generator (kW)	Process (kW)
5000	N/A	N/A	N/A	N/A	N/A

5 MW PV

DERSP submits the data, EDC reviews

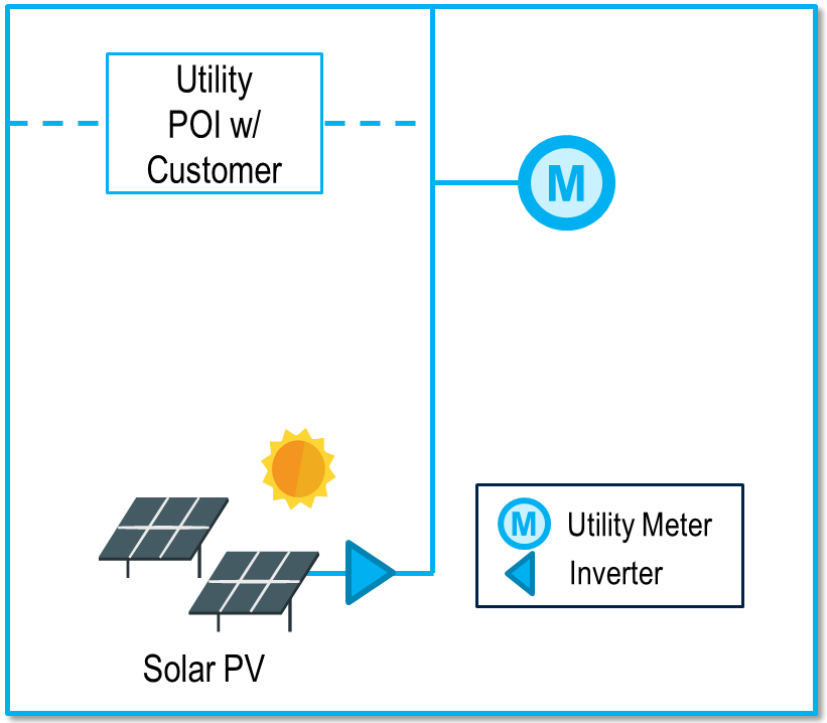
EDC provides the data

Procedural information

- Interconnection is handled by EDC—DERA do not enter the PJM New Services Queue
- Additional DGR data for PJM Planning will be required (inverter type, etc.) (more details in August DIRS)
- EDCs review information and provide approve/deny status

Size Requirements

DERA Requirements (Draft)	Use Case 1
DER with greater than 5MW of injection MW will not be eligible to participate in DERA	• DER (Solar Resource) is less than or equal to 5MW MFO



Locational Requirements

DERA Requirements (Draft)	Use Case 1
All DER participating in a DERA must be mapped to the same primary Tx node Resource that impacts multiple transmission nodes should be reflected in modeling review between EDC and PJM	• Single site, single resource • Verification with EDC on mapping node(s) *(Example on following slides)*

Information needed for modeling - the “Factors”

- (input → registration process) **Capability Factors** (At DER level)
  - PJM will determine a capability factor, based on nameplate of DERs in a DERA. These will not be updated unless the aggregation changes and it is reviewed and approved by PJM/EDC.
- (input → registration process) **Locational Factors** (At the DER level)
  - This is the mapping that the EDC/Aggregator provides for transmission location(s) (all DERs in aggregation sharing primary node), during registration process. This will not be updated unless reviewed and approved by PJM/EDC.
- (operations/markets) **Modeling Impact Factor** (At the DERA level)
  - The factor to be used in pricing/dispatch. PJM will calculate from the capability factor and locational factor. There will not be a dynamic update of this value (hourly/daily) but can change over time if DERA changes occur (via registration process).
- (operations/markets) **Weighting Factors** (AKA “distribution factors” from Order 2222)
  - Defined as the breakdown of which DERs are responding to the dispatch signal – would be a RT update from the aggregator. Order ties this to multi-nodal aggregations.
  - Given PJM preference for a “single location” approach, we will **not require weighting factors** for initial implementation.

Example: Developing Modeling Impact Factors

DER	Capability Factor	Aggregation Definition	Locational Factors	Modeling Impact Factors
DER1	0.25	DERA 1	100% Node A	0.25 – node A
DER2	0.25	DERA 1	100% Node A	0.25 – node A
DER3	0.25	DERA 1	80% Node A 20% Node B	0.20 – node A 0.05 – node B
DER4	0.25	DERA 1	70% Node A 30% Node D	0.175 – node A 0.075 – node D
DER5	1	DERA 2	70% Node B 30% Node A	0.70 – node B 0.30 – node A
DER6	1	DERA 3	100% Node C	1.0 – node C

DERA 1
0.875 – Node A
0.050 – Node B
0.075 – Node D

DERA 2
0.70 – Node B
0.30 – Node A

DERA 3
1.0 – Node C

Locational Requirements Example

- Assumes resource maps solely to 1 transmission node, based on distribution system normal configurations
  - Switching and distribution configuration changes will be covered in more detail at August DIRS

DER	Capability Factor	Aggregation Definition	Locational Factors	Modeling Impact Factors	Primary Node
DER1	1.0	DERA 1	100% Location A	100% Node A	Node A

Notes
CF based on size and capability of each DER. LF determined by location and electrical impact of each DER, including CF. MIF determined by LF "in aggregate," using CF alongside LF takes into consideration other DER within the DERA.

Locational Requirements Example 2

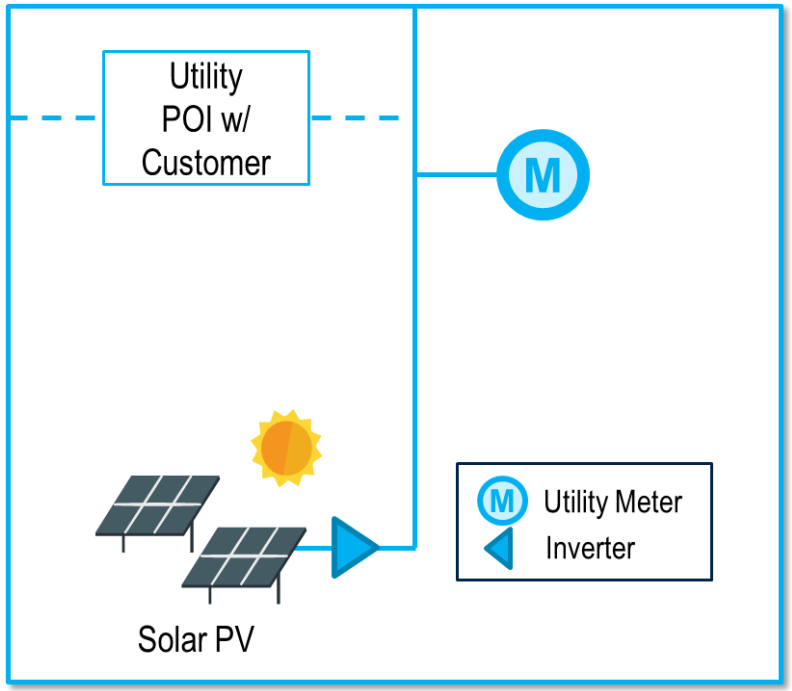
- Assumes resource maps to 2 transmission node, based on distribution normal configurations
  - Switching and distribution configuration changes will be covered in more detail at August DIRS

DER	Capability Factor	Aggregation Definition	Locational Factors	Modeling Impact Factors	Primary Node
DER1	1.0	DERA 1	75% Location A 25% Location B	0.75 Node A 0.25 Node B	Node A

Notes
CF based on size and capability of each DER. LF determined by location and electrical impact of each DER, including CF. MIF determined by LF "in aggregate," using CF alongside LF takes into consideration other DER within the DERA.

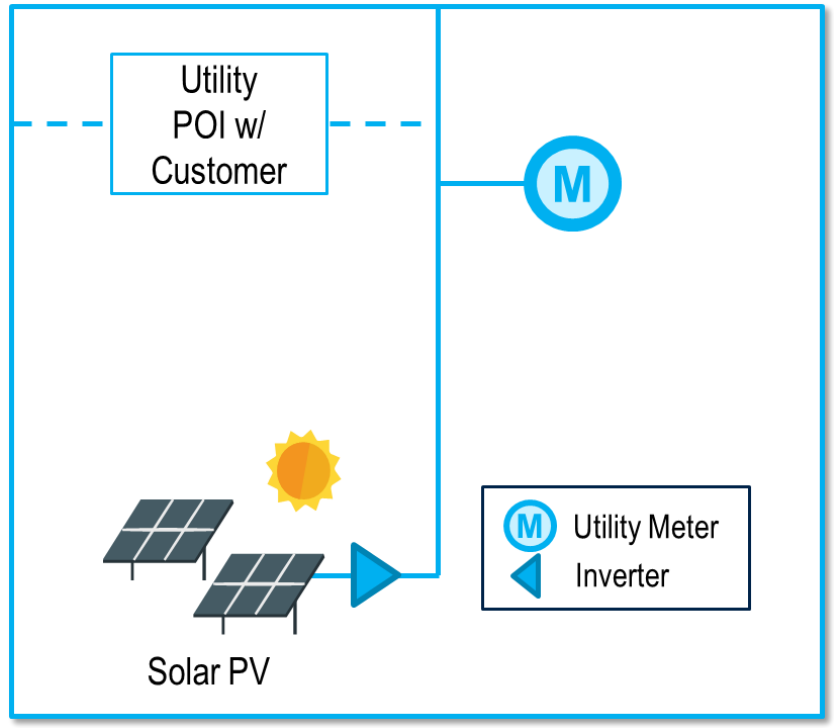
Telemetry Requirements

DERA Requirements (Draft)	Use Case 1
Telemetry provided for DERA (not individual DERs) Telemetry required for all DERA >=0.1MW	• PJM is not proposing to send curtailment flags to DERAs regardless of underlying technology types • Solar telemetry will inform the solar forecast



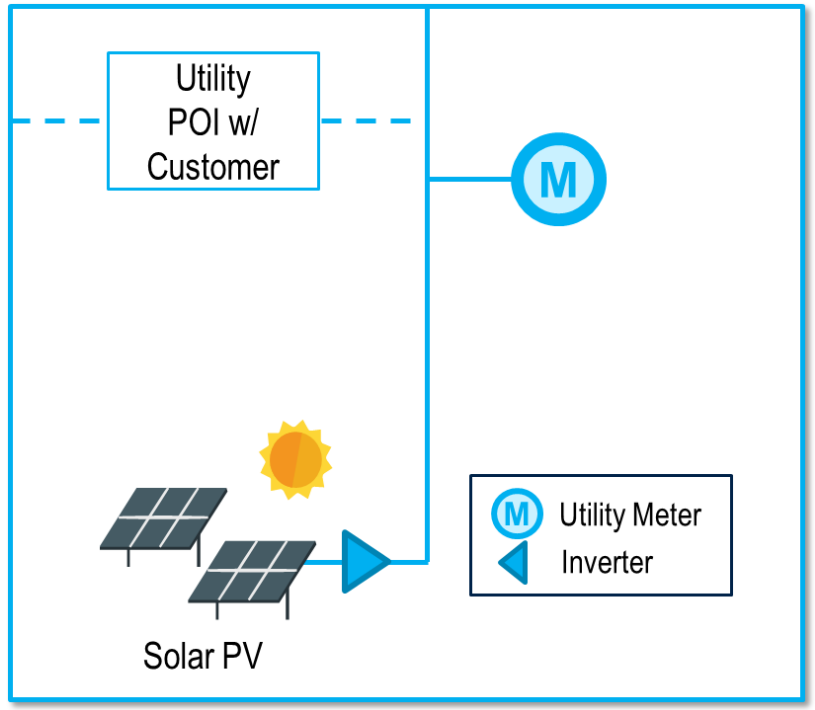
Market Participation Eligibility and Aggregation

DERA Requirements (Draft)	Use Case 1
DERA eligible for Capacity, Energy and Ancillary Services, where technically capable Additional ‘grouping’ of aggregations for performance available consistent with existing rules	Eligible for all markets, where technically capable



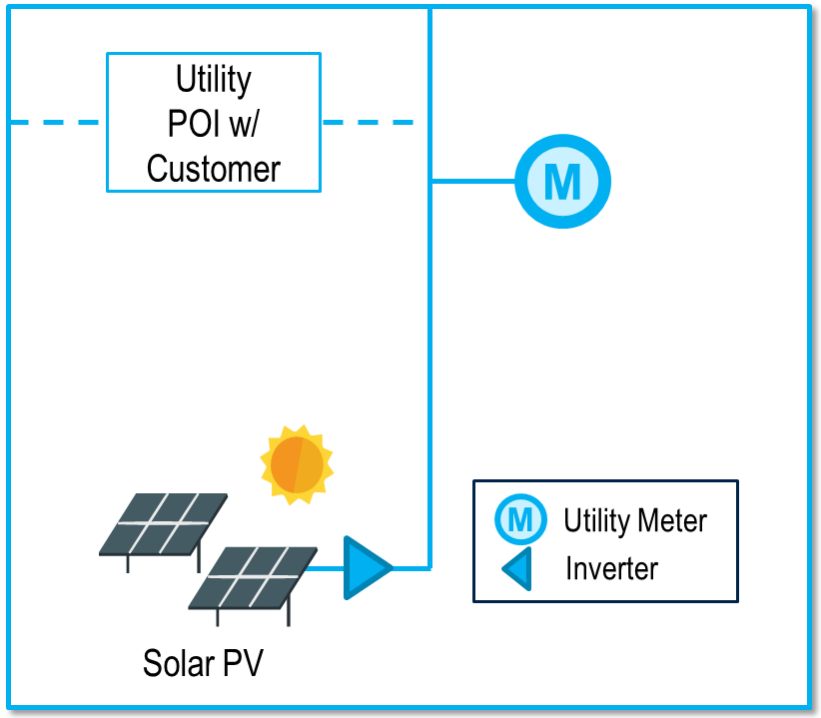
Metering Requirements

DERA Requirements (Draft)	Use Case 1
Meter data submitted to PowerMeter by 4 PM next business day Meter data submitted for aggregation (DERA)	Status Quo



Cost Based Offers

DERA Requirements (Draft)	Use Case 1
DERA will participate in Energy under a no-commitment, no-dispatch model – **No cost offer required** DERA will participate in Energy under a no-commitment model, PJM dispatch available - **Cost Offers Required** - Homogenous DERA follows M15 rules - Heterogeneous DERA must offer $0	Status Quo



- Examples are simplistic as a starting point.
- Highlight the necessary settlement process bifurcation when load response is present within an aggregate
- Iterations on settlement calculations to be provided at future DIRS to demonstrate additional settlement scenarios (PAI, overrides, ESR charging, etc.)
  - Welcome suggestions on settlement scenarios or details that are important to explore further

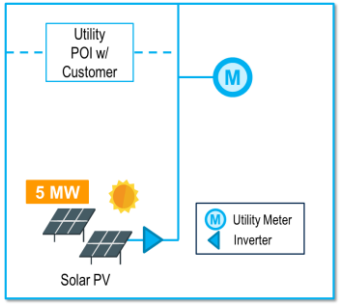
Use Case 1: Performance & Settlements

Generator LMP Charge Summary

RT PJM Energy Price	150
PNODE RT Congestion Price	0.3
PNODE RT Loss Price	-1.25

EPT Hour Ending	DA Scheduled MWh	DA PJM Energy Price ($/MWh)	DA Spot Market Energy Charge ($)	PNODE DA Congestion Price ($/MWh)	DA Transmission Congestion Charge ($)	PNODE DA Loss Price ($/MWh)	DA Transmission Loss Charge ($)	RT Generation (MWh)*	Bal Generation (MWh)	Bal Spot Market Energy Charge ($)	Bal Transm. Congestion Charge ($)	Bal Transm. Loss Charge ($)
11	5	100	-500	0.25	-1.25	-1.5	7.5	4	-1	150	2.5	1.25
12	5	100	-500	0.25	-1.25	-1.5	7.5	4	-1	150	2.5	1.25
13	5	100	-500	0.25	-1.25	-1.5	7.5	4	-1	150	2.5	1.25
14	5	100	-500	0.25	-1.25	-1.5	7.5	4	-1	150	2.5	1.25
15	5	100	-500	0.25	-1.25	-1.5	7.5	5	0	0	0	0
16	5	100	-500	0.25	-1.25	-1.5	7.5	5	0	0	0	0
17	5	100	-500	0.25	-1.25	-1.5	7.5	5	0	0	0	0
18	5	100	-500	0.25	-1.25	-1.5	7.5	5	0	0	0	0

- Generator portion of aggregate billed as such



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DERA Use Case Development