PJM Order 2222 Use Case Update

Market Participation and Capacity Capability

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DIRS

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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 **October 2021 DIRS**
  - Proposal items with updated requirements will be noted verbally or visually
  - There will be examples outlined in PJM Proposal slides not captured in this presentation
  - PJM still welcomes comments and questions on updated proposal items during this presentation for consideration

Use Case Updates

- Since last update we have
  - Reintegrated technology details and revised terminology
  - Added detail on compensation for simultaneous load curtailment and injection (referred to as Continuous DER, formerly DRwDI)
  - Expanded AS-Only case: now we discuss both AS-exclusive and comprehensive Capacity, Energy, and AS participation for heterogeneous multi-site DERA
  - Added detail on how multiple DERA aggregating for market participation might look (portfolio-level)
- Today's review will cover each of these updates to some degree

Today's Topics

Topics Relevant to Use Cases

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

Topics Discussed Today

Topic Area
Energy Market Participation Model
Capacity Capability
M&V (Testing)
PAI
Metering (Settlements)
Locational Requirements
Telemetry

See also: **Settlements Metering and Operations Telemetry presentation at October DIRS**

Use Case Characteristics

- Characteristics from **September DIRS**

Composition	Whether diversity exists within the DERA; can be “of resource type” or “of technology type” and at site level, or at DERA level 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 *DGR; DR; DRwDI*
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 Capacity; Energy; Ancillary Services
Sites	Number of geographically distinct sites registered. One or more sites comprise a DERA.

Resource Type is a **market distinction**, not a UC characteristic

Resource Type as Market Distinction

- BTM Generator with max output greater than potential max retail load

Example:

Load Reduction *with Injection* (DRwDI)	… choosing to participate as Load Reduction (DR)	…choosing to participate as Injection *only* (BTMG Injection)
To PJM; 1 MW; 2 MW **or** 0 MW; 2 MW	To PJM; 1 MW; 2 MW **or** 0 MW; 2 MW	To PJM; 1 MW; 2 MW **or** 0 MW; 2 MW
1 MW reduction, 1 MW injection **or** 1 MW reduction **+** 2 MW injection where retail load = 0 *(Max 2 MW injection)*	1 MW reduction **or** 0 MW reduction where otherwise retail load = 0 (*Max 2 MW injection*)	1 MW injection **or** 2 MW injection where retail load = 0 *(Max 2 MW injection)*

BTMG Business Rules: M-14d Appendix A

Use Case Characteristics

- Certain Use Case characteristics updated or eliminated

Resource Type	*Distinguishes the nature of a DERA resource and its contribution to the system* *DGR; DR; DRwDI*

- Removed: Better discussed in markets walkthroughs, see previous slide

Technology Types	*Mechanism or activity by which power is generated or load reduced within DERA* *DGR: Solar, wind, ESR, etc.; DR: Controllable retail load, co-located DGR, etc.*
Technology Types	Mechanism or activity by which power is generated or load reduced within DERA Solar, wind, ESR, controllable retail load, DGR co-located with retail load, etc.

- Revised: DGR distinction deprecated, technology type no longer secondary

Market Participation	Market services the DERA is technically capable of providing Capacity; Energy; Ancillary Services

- Removed: All will be explored, special cases noted where applicable.

Updates to Use Case Characteristics

Composition	Whether diversity exists within the DERA; can be “of resource type” or “of technology type” and at site level, or at DERA level 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
Technology Types	Mechanism or activity by which power is generated or load reduced within DERA Solar, wind, ESR, diesel, controllable retail load, etc.
Sites	Number of geographically distinct sites registered. One or more sites comprise a DERA.

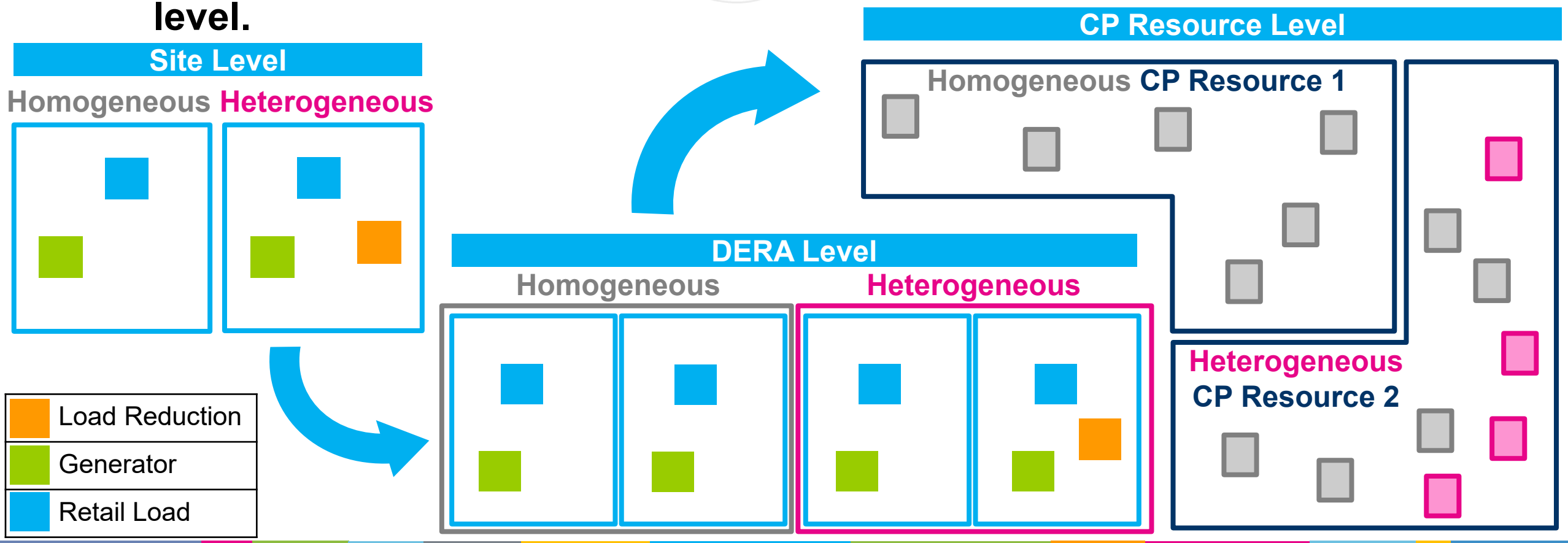
Use Cases: Outline

	Composition	Configuration	Sites	Use Case Goal
1	Homogeneous	Front of the meter	One	• Demonstrate size requirements and their implications.
2	Heterogeneous	Front of the meter	Multiple	• Demonstrate information exchange on an aggregate basis. • Walkthrough utility review with multiple distribution feeders.
3	Homogeneous	Behind the meter	One	• Demonstrate participation for sites co-located with retail load. • Illustrate rules where aggregates contain both potential for transmission injection and load reduction.
4	Heterogeneous	Behind the meter	One	• Demonstrate participation for sites co-located with retail load. • Illustrate rules where aggregates contain both potential for transmission injection and load reduction. • Highlight rules for multiple technology types where necessary.
5	Homogeneous	Behind the meter	Multiple	• Illustrate an aggregation of **many customer sites with BTM generation** wanting to participate in one or multiple markets.
6	Heterogeneous	Behind the meter	Multiple	• Illustrate an aggregation of **many customer sites, each with mixed technology types**, wanting to participate in one or multiple markets.
7	Homogeneous	Behind the meter	Multiple	• Illustrate an aggregation of **many distinct customer sites with load reduction** wanting to participate in one or multiple markets.

Errata: Use Case 5 was labeled as Heterogeneous, but presented as Homogeneous in Sept DIRS—corrected.

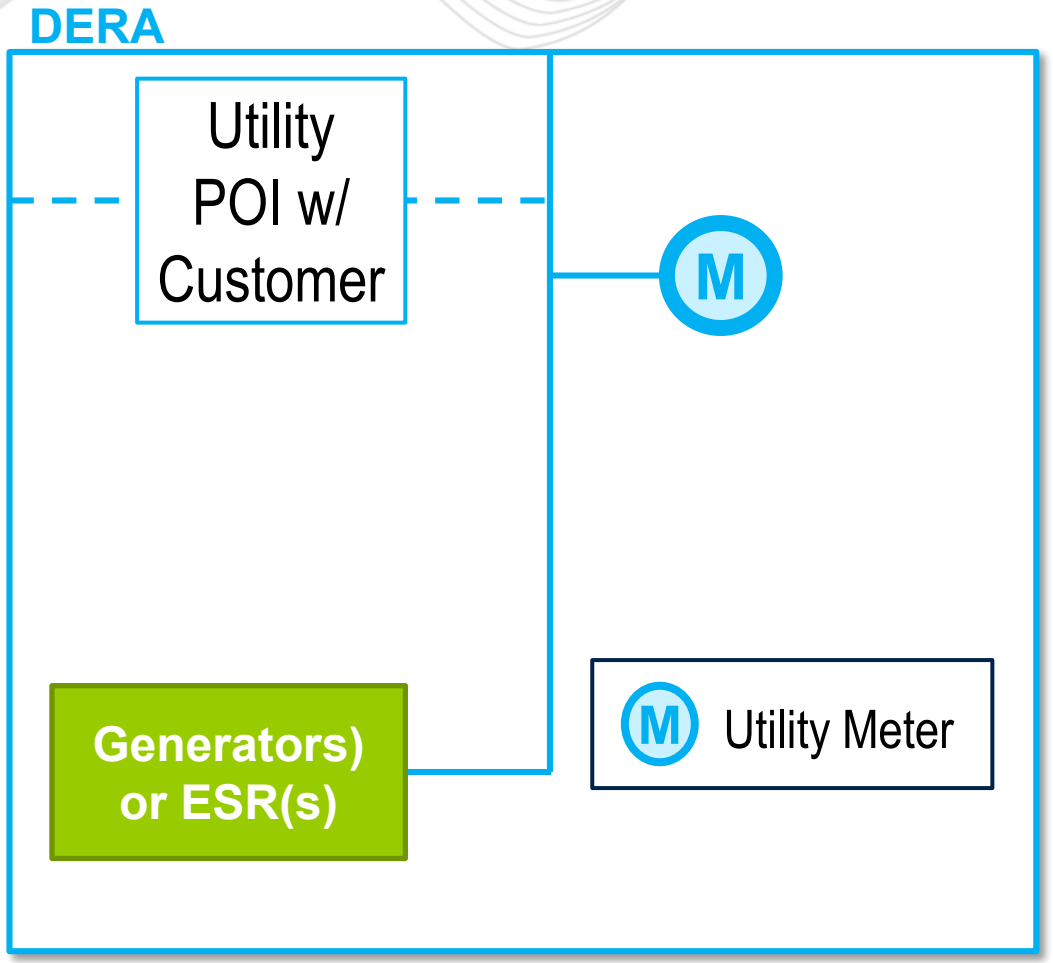
Heterogeneous vs. Homogeneous

- Where diversity exists within the DERA, it can be “of resource type” or “of technology type” and **at site level, or at DERA level, or at CP resource level.**



Use Case 1

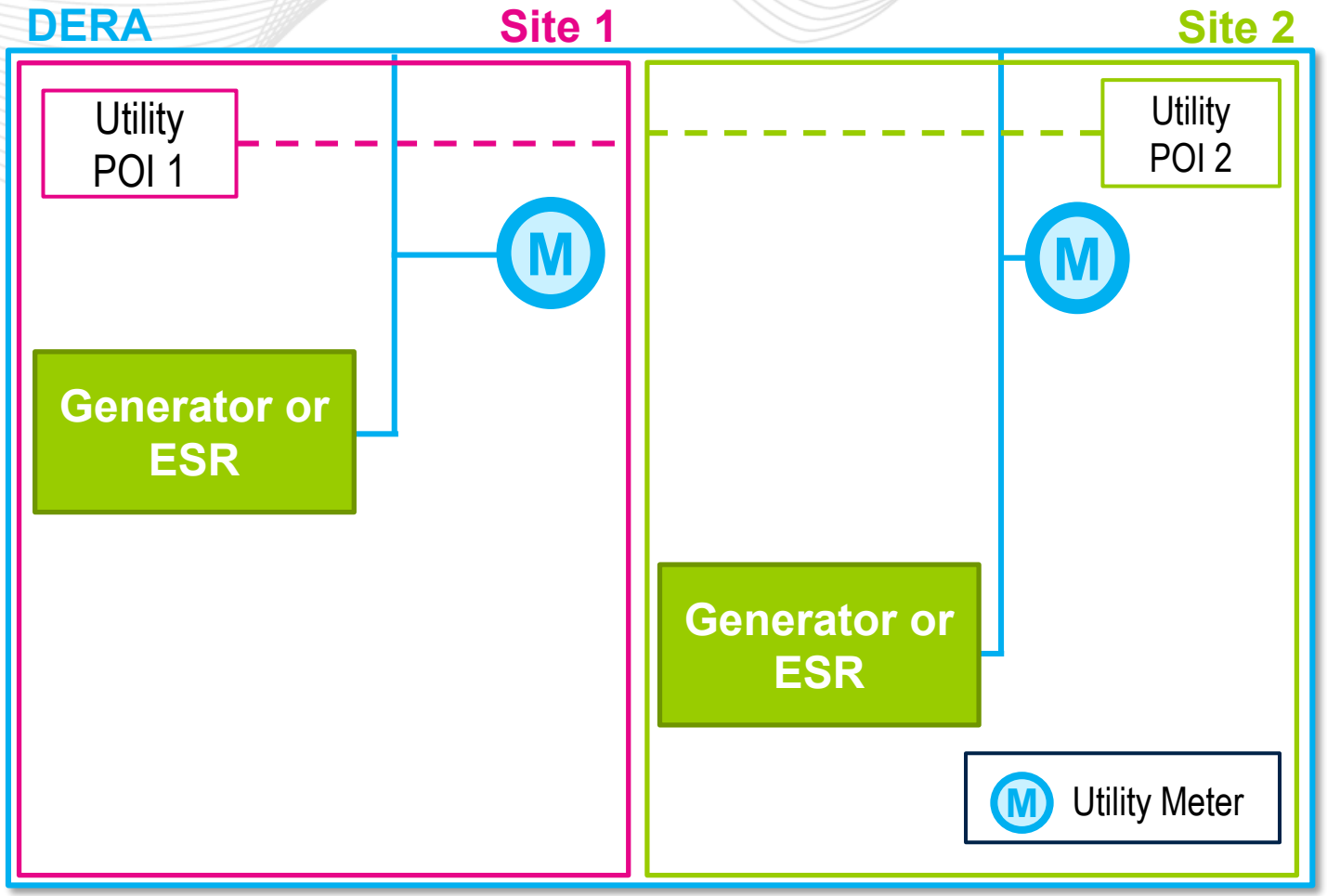
- A single distributed generator or ESR (single fuel type) at a…
- Single geographic site
- Participating as a single DERA
- Not co-located with retail load



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

Use Case 2

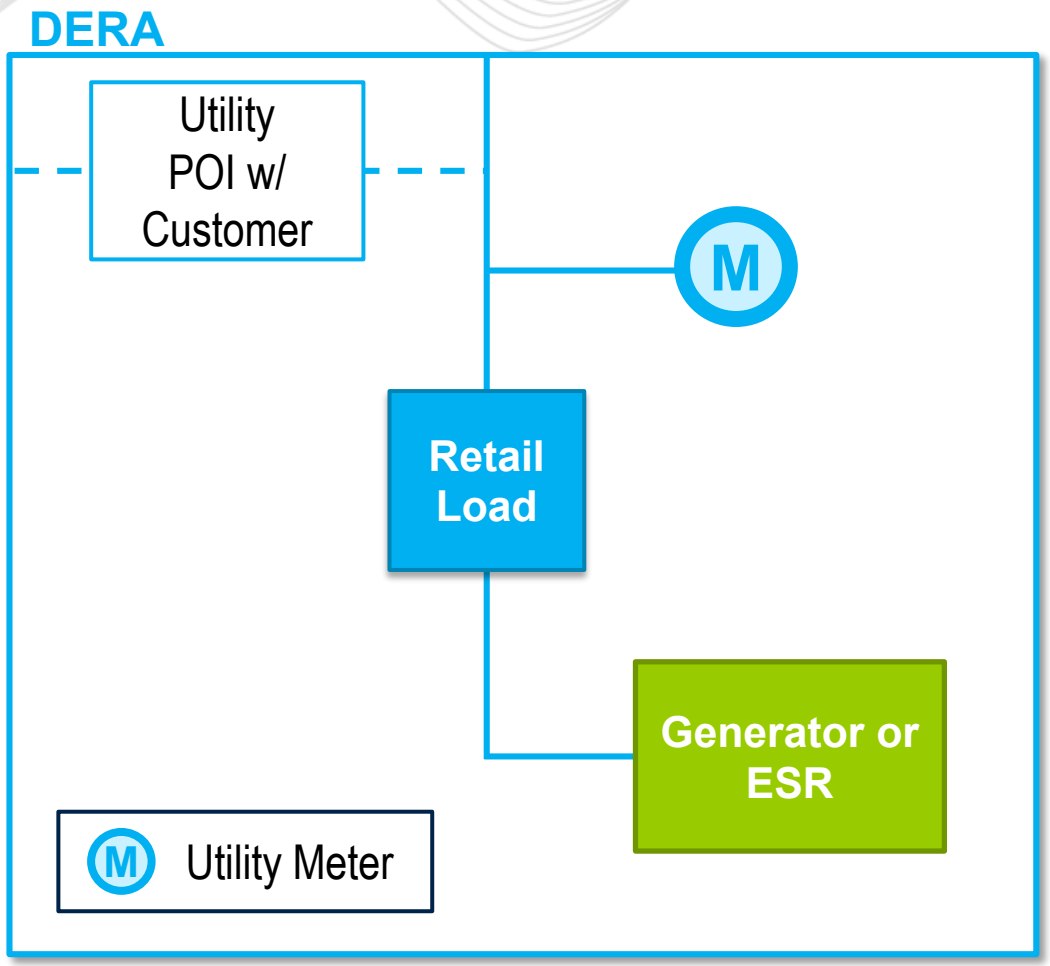
- A single distributed generator or ESR (single fuel type) at…
- Multiple geographically distinct sites
- No sites in DERA co-located with retail load



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

Use Case 3

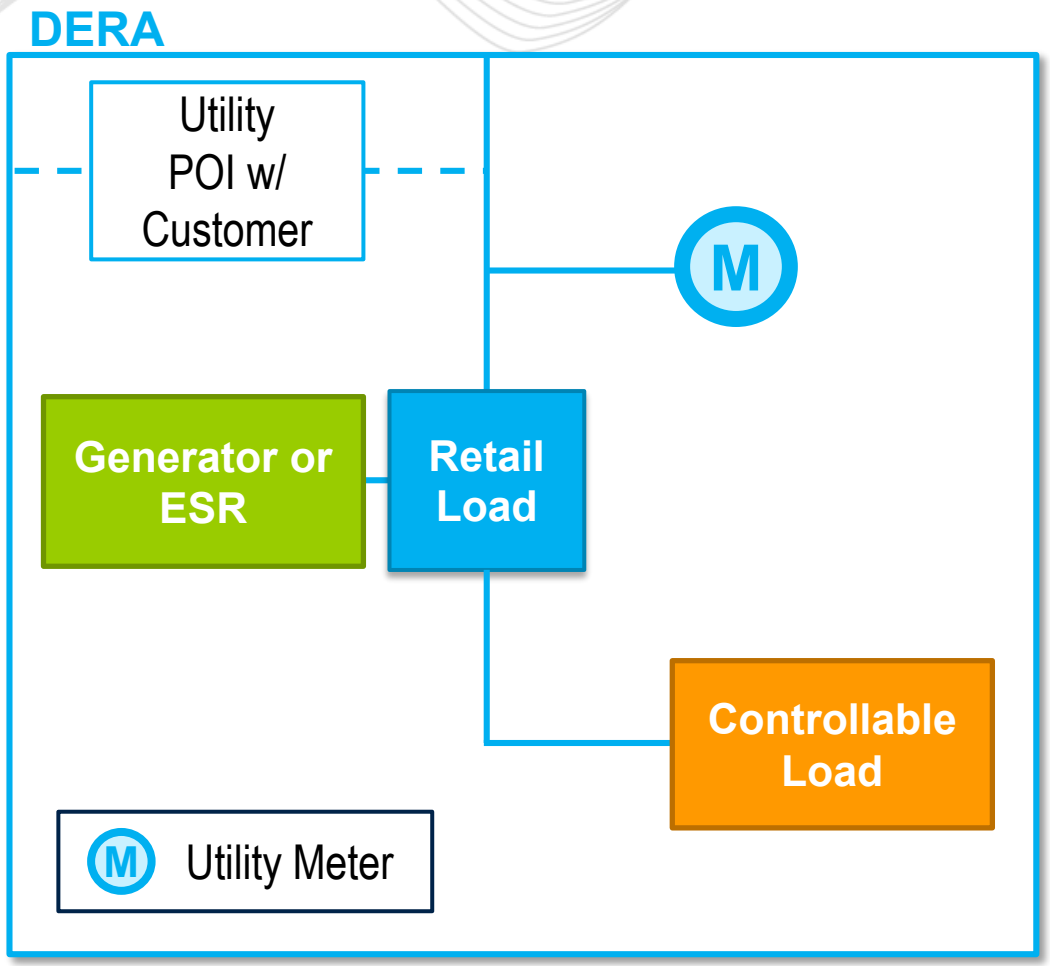
- A single distributed generator or ESR (single fuel type) at a…
- Single geographic site participating as a single DERA
- Site co-located with retail load
- Site may inject
- Can elect market participation as BTMG net injection **or** DR **or** continuous DER



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

Use Case 4

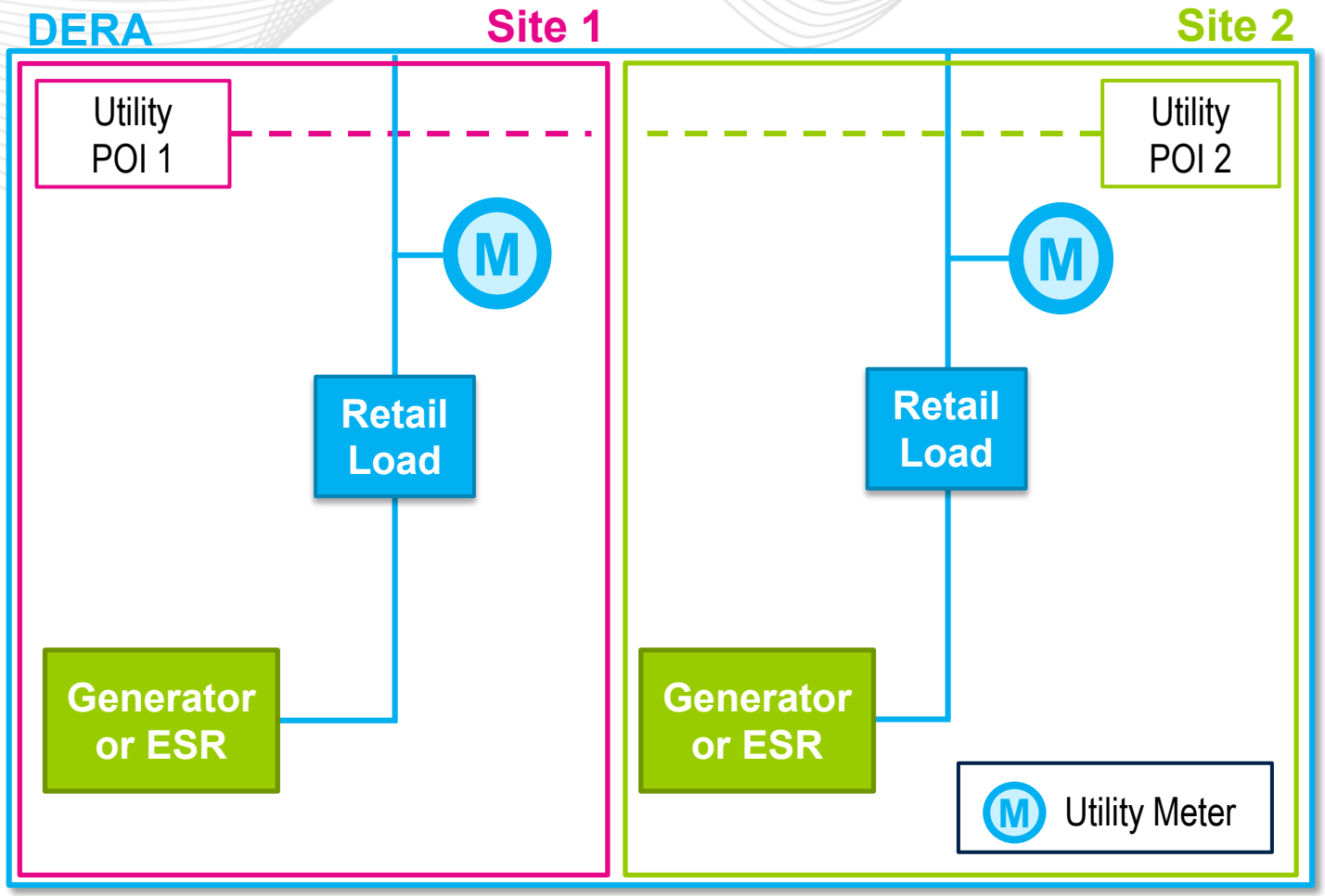
- Both a distributed generator/ESR and an active load reduction located at a…
- Single geographic site participating as a single DERA
- Site co-located with retail load
- Can elect market participation as BTMG net injection **or** DR **or** continuous DER



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

Use Case 5

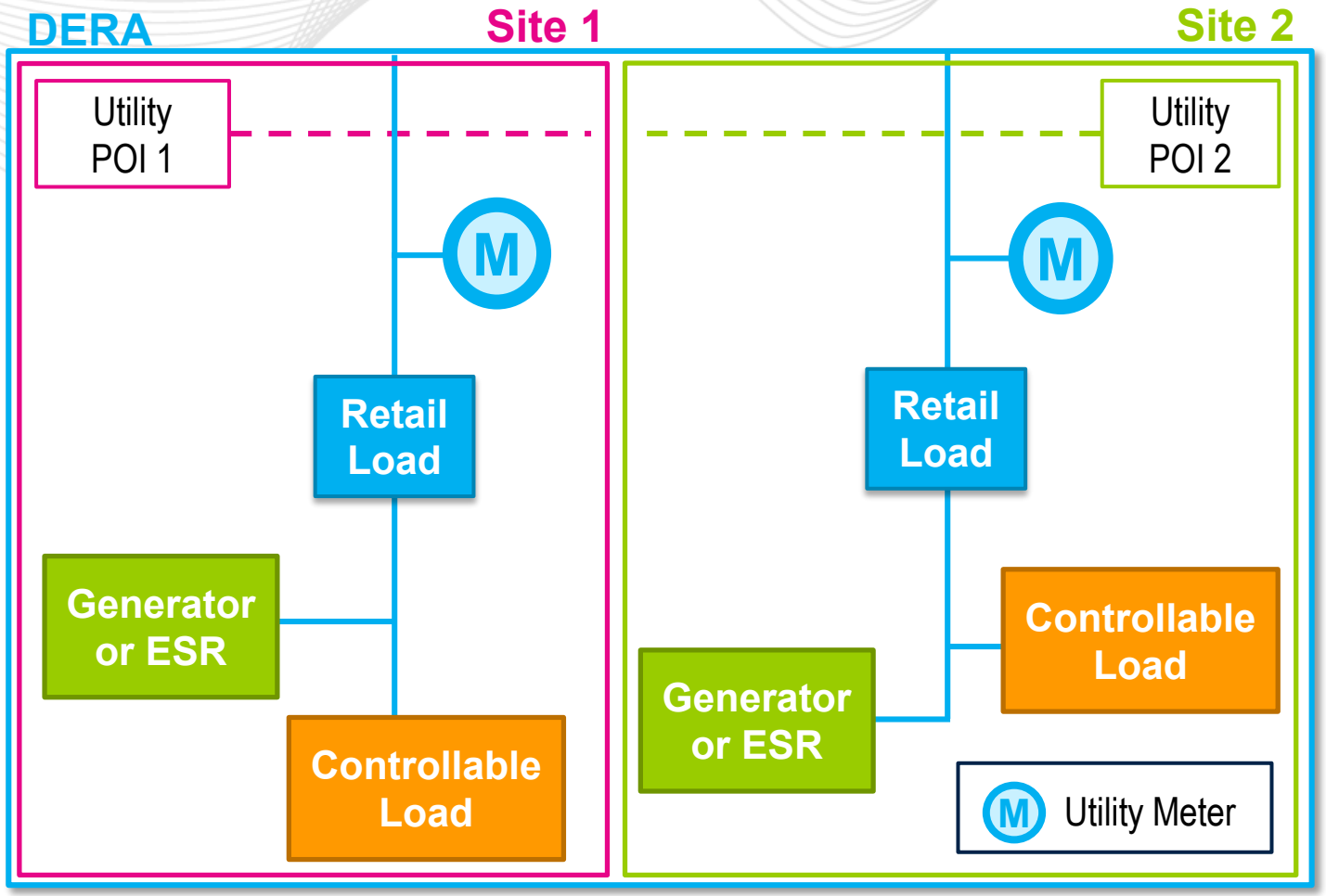
- A single distributed generator(s) or ESR at…
- Multiple distinct sites
- All sites co-located with retail customer load
- Sites may inject
- Can elect BTMG net injection **or** DR **or** continuous DER
- *Will explore both AS-only and comprehensive participation for this case*



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

Use Case 6 – New

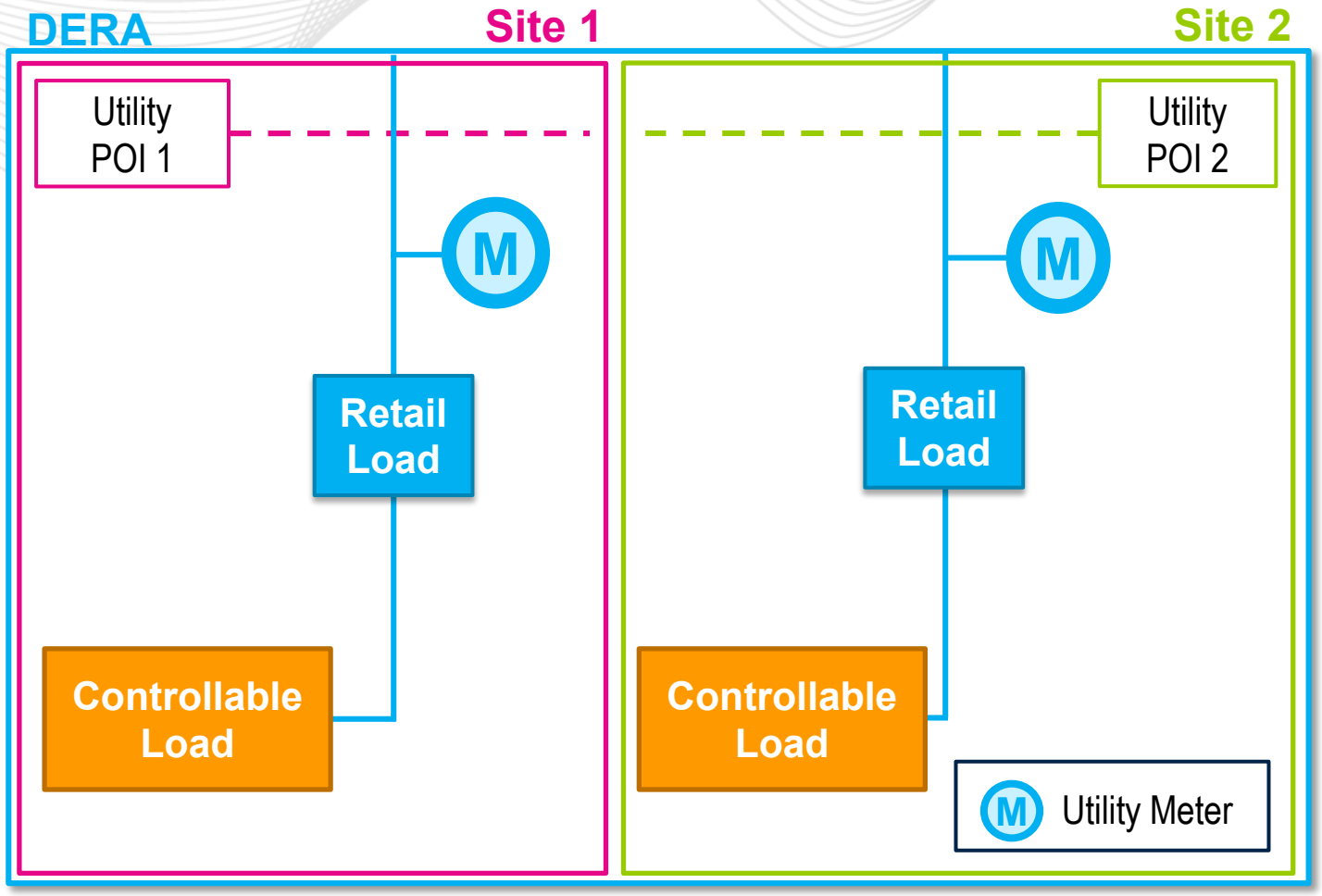
- Same composition and configuration as Use Case 4
- …but the single site is duplicated
- Sites may inject
- Can elect market participation as BTMG net injection **or** DR **or** continuous DER



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

Use Case 7 – New

- A single controllable load at…
- Multiple distinct sites
- All sites co-located with retail customer load
- Can **only participate as a load reduction**—*no possibility of injection*



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

Use Case Walkthrough

Cases 1 - 3

Capacity Capability Follows Resource, Technology Type

DER	Capacity Capability	Testing
FTM Gen	(Status Quo) ICAP*eFORd	Annual summer/winter capacity testing,1 hour test
FTM ESR	(Status Quo) ELCC	Annual summer/winter capacity testing simultaneous with co-located generation for batteries
FTM Solar	(Status Quo) ELCC	Not subject to summer and winter capability testing (M-18)
Demand Response	(Status Quo) Nominated Value based on PLC	Annual DR testing
Continuous DER (DER behind retail load)	Capacity value based on PLC + Capacity value of injection MW	Annual DR testing + verification of generator capacity and injection with test based on technology type
EE	(Status Quo) Nominated Value based on Offer Plan	M&V Audit

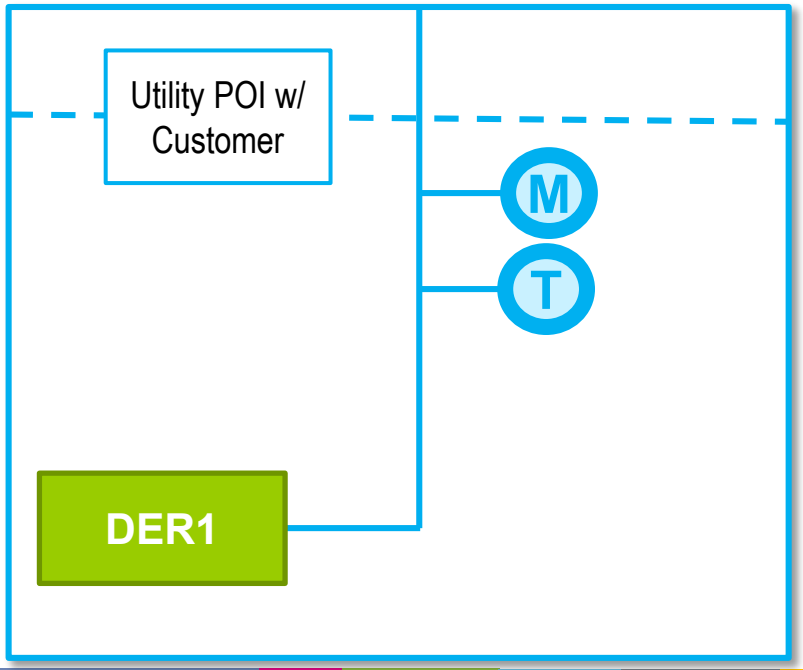
Aggregation for Market Participation

- We illustrated several “levels” to consider when discussing DERAs: the site level, the DERA level, or the CP resource level.
- Although each DERA aggregates to a single node under the current proposal:
- **Market participation opportunities** exist beyond nodal-only participation, and have unique requirements.

Requirements	Capacity	Energy	Ancillary Services Only
Locational Requirement	Aggregate multiple DERAs up to zonal / sub-zonal LDA level	Aggregate DER to a single primary location (nodal)	Aggregate DER up to EDC / TO zone level
DERA Size Requirements	100kw min, no max	100kw min, no max	100kw min, 5MW max

Walkthrough: Use Case 1

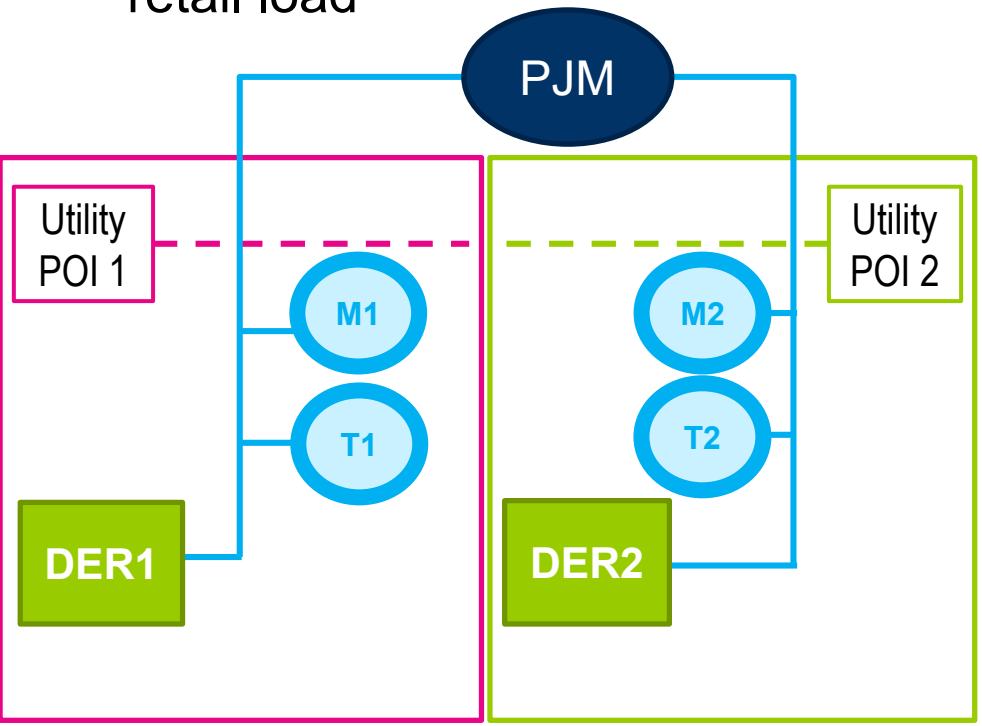
- A single distributed generator or ESR (single fuel type) at a…
- Single geographic site
- Participating as a single DERA
- Not co-located with retail load



Area	Proposal
Energy Market Participation Model	DERA Model, Gen Model or ESR Model ** depending on tech. ** Note: ESR DERA do not receive wholesale charging energy.
Capacity Capability	Calculated Status Quo based on technology - Generator: ICAP * eFORd (either unit-specific, or class average—see M-22, or RAA Sch. 5 Sec. B respectively) - Solar, Wind, or Battery: ELCC
M&V / Testing	Leverage existing business rules: - Generator: 1 hour test for ICAP - Solar, Wind, or Battery: relevant data per M-21 and M-21a
PAI	Expected: Capacity Commitment * BR Actual: PowerMeter data + Ancillary adjustments
Locational Requirements	(Energy, Ancillary) Maps to 1 primary location in PJM (DERA of 1 DER will always meet locational requirements) (Capacity) Can aggregate with other DER for a DER CP Resource within defined LDAs
Metering (Settlements)	Hourly MW values at M meter are submitted to PowerMeter
Telemetry	RT telemetry required for applicable markets

Walkthrough : Use Case 2

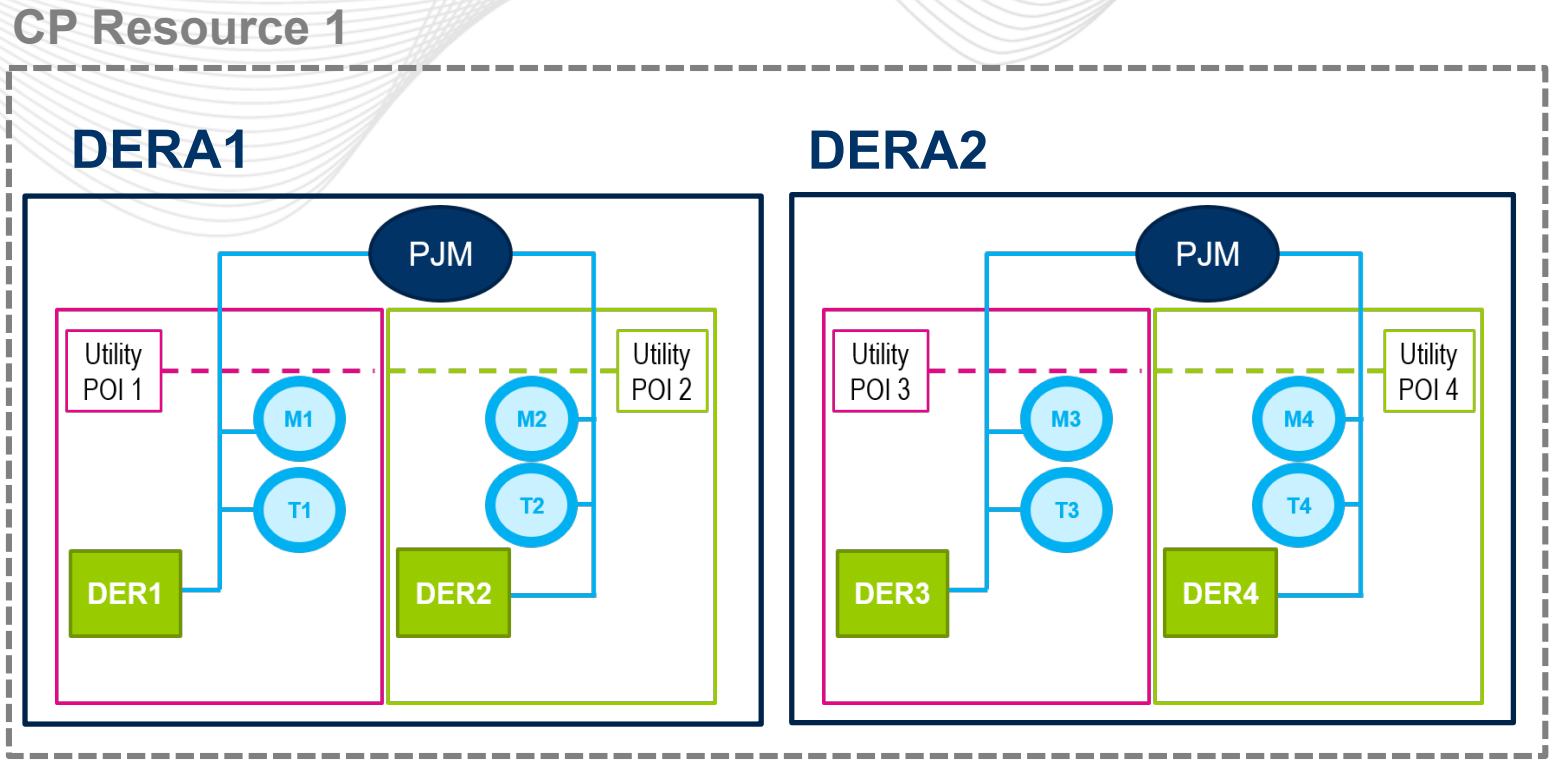
- A single distributed generator or ESR (single fuel type) at…
- Multiple geographically distinct sites
- No sites in DERA co-located with retail load



Area	Proposal
Energy Market Participation Model	Homogenous: DERA Model, Gen Model, or ESR Model, depending on technology present Heterogeneous: DERA Model
Capacity Capability	DERA Capability = DER1 + DER2 (prev. slide) Commitments allocated to DERA CP Resource level
M&V / Testing	M&V and testing at DER level. Leverage existing rules: - Generator: 1 hour test for ICAP - Solar, Wind, or Battery: relevant data per M-21, 21a
PAI	Expected: Capacity Commitment * BR at DER level, aggregated up to DERA and CP resource Actual: PowerMeter data for DERA + Ancillary adjustments
Locational Requirements	(Energy, Ancillary) Maps to 1 primary location in PJM (Ancillary Only) Can map across EDC footprint (Capacity) Can aggregate with other DER for a DER CP Resource within defined LDAs
Metering (Settlements)	Hourly MW values from each DER (M1 and M2) meter submitted to PowerMeter
Telemetry	RT telemetry required for DERA for applicable markets

Use Case 2: RPM Application

- Consider DERA1 and DERA2 as members of a **DERA CP Resource**
- All DER ICAP 5 MW and UCAP 4.8 MW
- DERA1, DERA2 = 9.6 MW capacity each
  - Offers into capacity for 19.2 MW and clears 17.2 MW
  - Allocate commitment down to DERA pro-rata; 8.6 MW and down to DER 4.3 MW



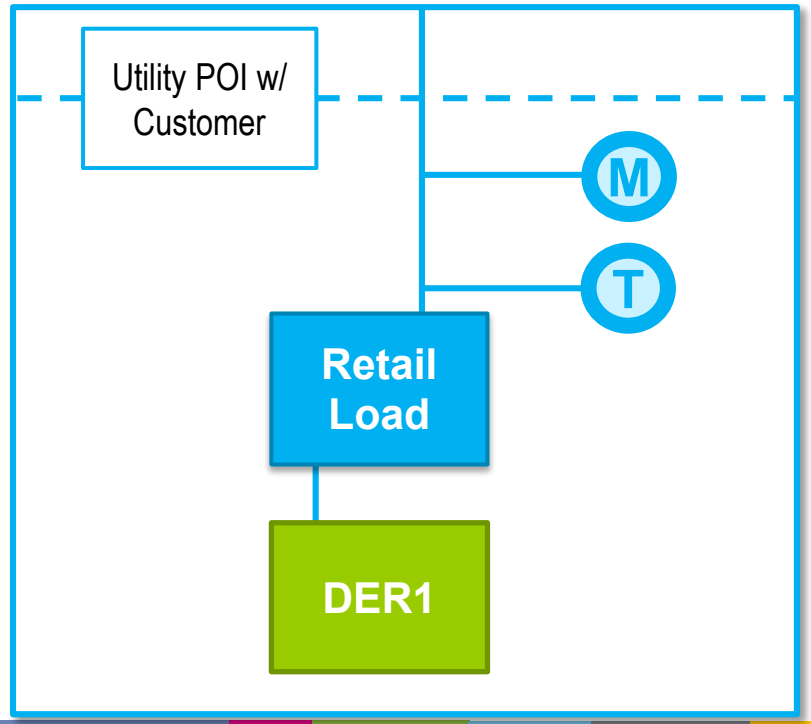
PAI: For a Performance Assessment,

Actual - Expected = (DER1 Actual - Expected) + (DER2 Actual - Expected) + (DER3 Actual - Expected) + (DER4 Actual - Expected)

Expected = Commitment *BR , Actual = PowerMeter Data

Walkthrough: Use Case 3

- A single distributed generator or ESR (single fuel type) at a…
- Single geographic site participating as a single DERA
- Site co-located with retail load



Area	Proposal
Energy Market Participation Model	DERA Model, or ESR model if energy storage
Capacity Capability **Details provided on the following slides.**	Option 1: Participate as BTMG Option 2: Participate as DR Option 3: FTM Option 4: Participate as Continuous DER (formerly: DRwDI)
M&V / Testing	Based on technology type, see previous case
PAI	Expected: Capacity Commitment * BR Actual: PowerMeter data + Ancillary adjustments
Locational Requirements	(Energy, Ancillary) Maps to 1 primary location in PJM (DERA of 1 DER will always meet locational requirements) (Capacity) Can aggregate with other DER for a DER CP Resource within defined LDAs
Metering (Settlements)	Hourly MW values at M meter submitted to PowerMeter or DR Hub if relevant
Telemetry	RT telemetry required for DERA for applicable markets Individual resources do not need telemetry **(Ancillary Only) can submeter DER1 for regulation**

Use Case 3: Participation as BTMG Injection

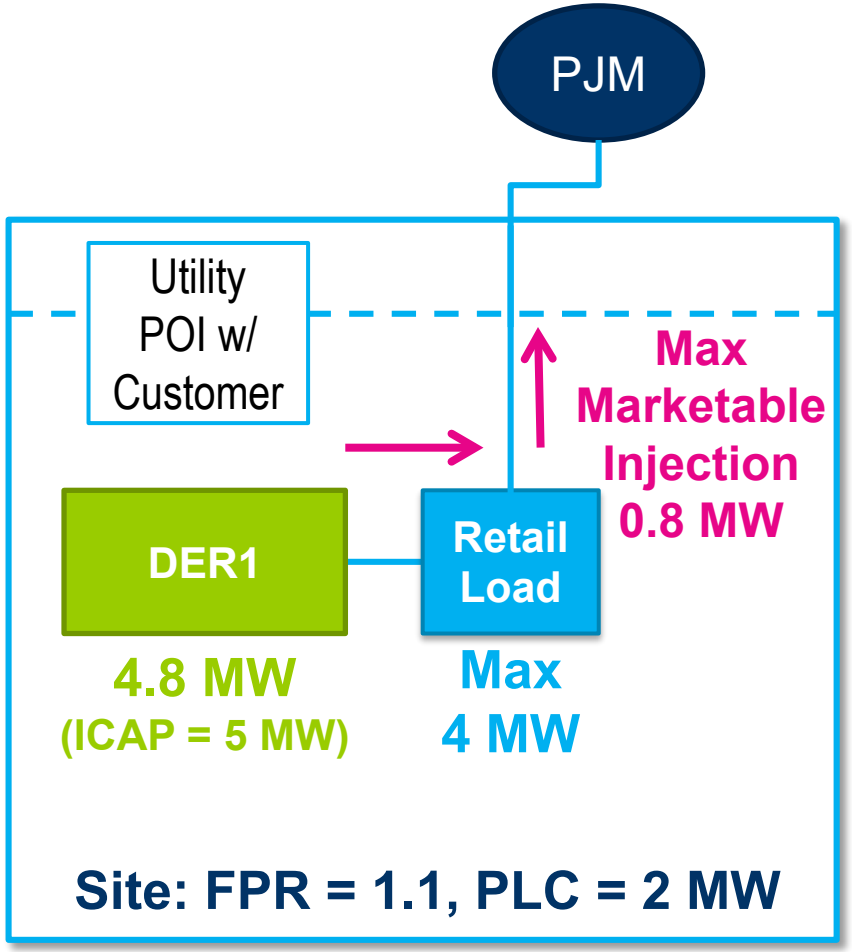
- **Retail Load = 4 MW max**
- **FPR = 1.1, PLC = 2 MW**
- **DER1 = 5 MW ICAP, 4.8 MW UCAP**

Option 1: BTMG = net injections only = 4.8 MW – 4 MW = **0.8 MW**

*Option 2: DR Only (resource cannot inject) = PLC * FPR = 2.2 MW*

Option 3: Bring resource front-of-meter = FTM = 4.8 MW

Note: "Injection" in this case refers to distribution injection, a capability that is to be studied and vetted by EDC prior to approval in Registration process.



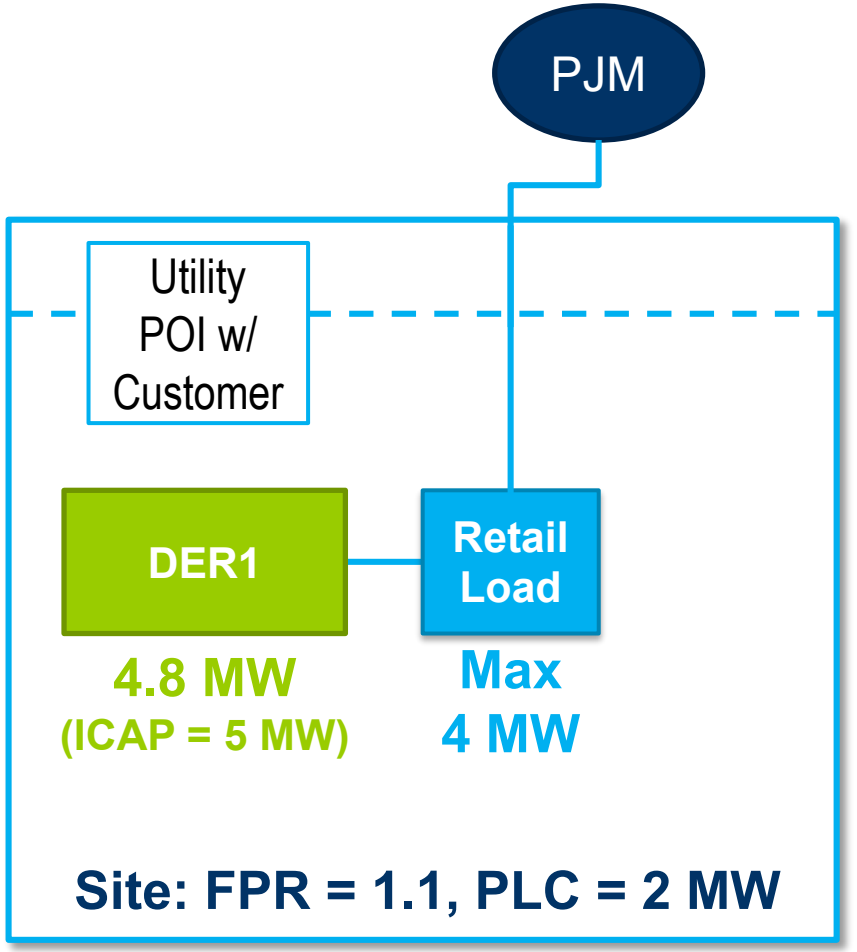
Use Case 3: Participation as DR-Only

- **Retail Load = 4 MW max**
- **FPR = 1.1, PLC = 2 MW**
- **DER1 = 5 MW ICAP, 4.8 MW UCAP**

Option 1: BTMG = net injections only = 4.8 MW – 4 MW = 0.8 MW

Option 2: DR Only (resource cannot inject) = PLC * FPR = **2.2 MW**

Option 3: Bring resource front-of-meter = FTM = 4.8 MW



Use Case 3: Participation as FTM

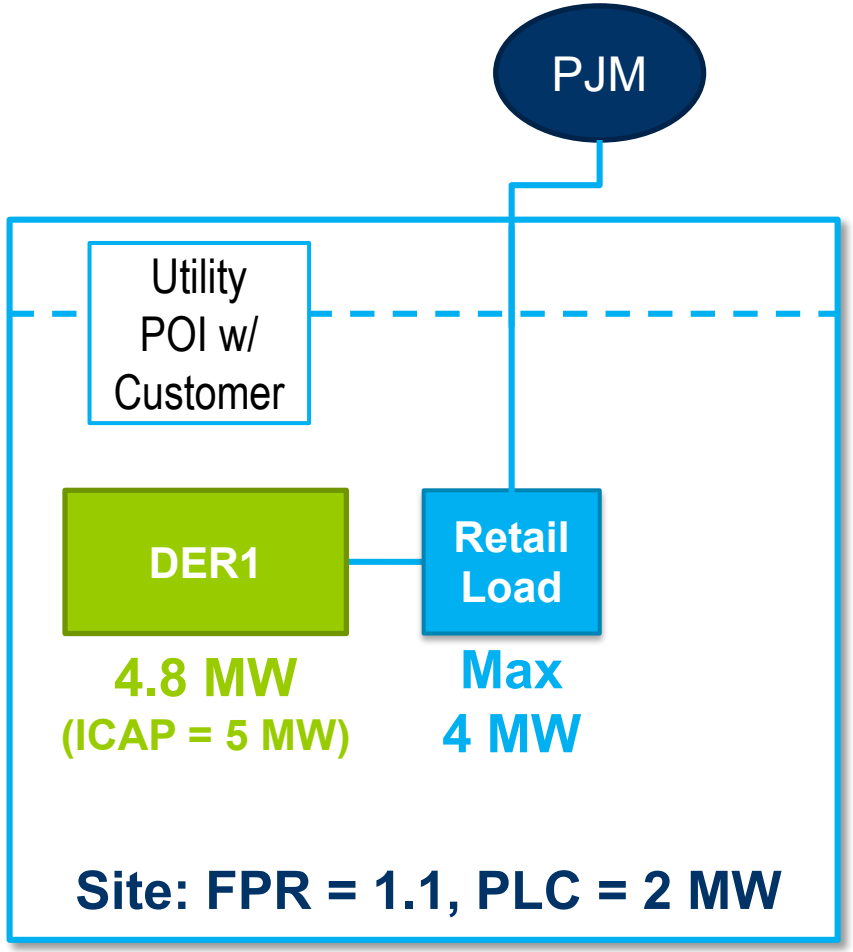
- **Retail Load = 4 MW max**
- **FPR = 1.1, PLC = 2 MW**
- **DER1 = 5 MW ICAP, 4.8 MW UCAP**

Option 1: BTMG = net injections only = 4.8 MW – 4 MW = 0.8 MW

*Option 2: DR Only (resource cannot inject) = PLC * FPR = 2.2 MW*

Option 3: Bring resource front-of-meter = FTM = **4.8 MW**

Note: FTM DER participating in Capacity are subject to MOPR and MSOC.

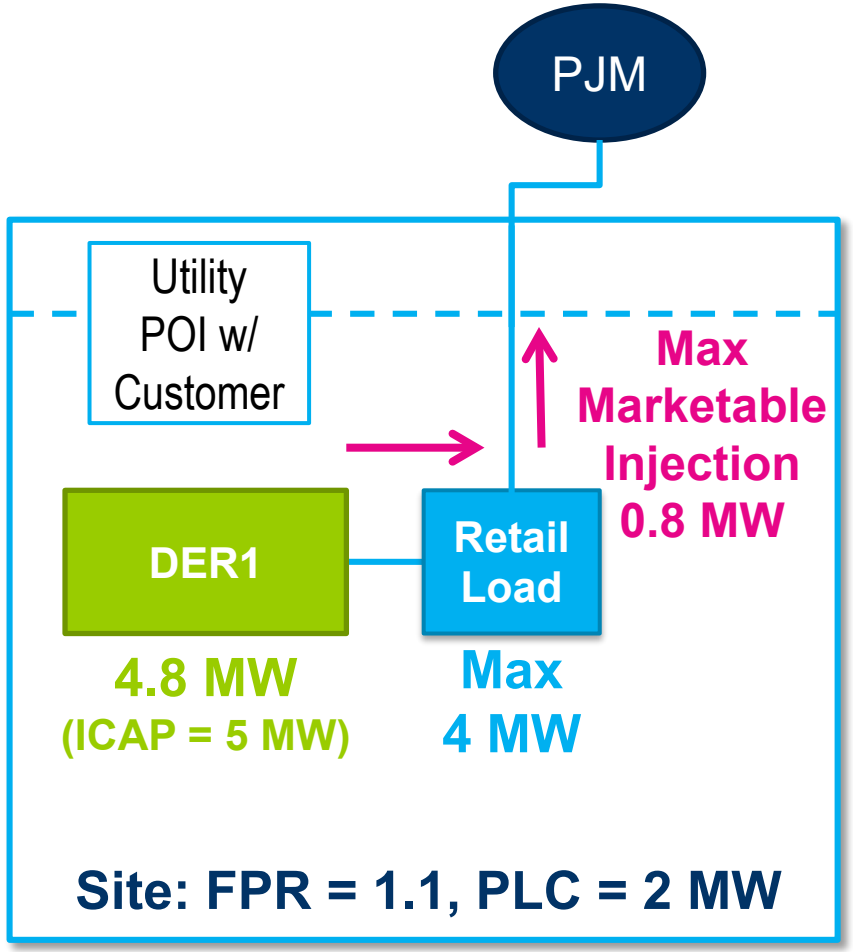


Use Case 3: Participation as Continuous DER

- **Retail Load = 4 MW max**
- **FPR = 1.1, PLC = 2 MW**
- **DER1 = 5 MW ICAP, 4.8 MW UCAP**

Option 4: Continuous DER

- Acknowledges all load reduction (PJM), net load (retail) and injections (PJM) in valuation
- Two part calculation
  - DR: 2 MW PLC * FPR factor = 2.2 MW capability
  - Injection: 4 MW max load, 4.8 MW UCAP = 0.8 MW capability
- Total Capacity Capability= 3.0 MW
- Add back to PLC for PJM dispatch



Use Case Walkthrough: Potential Next Steps

- Next steps for Order 2222 use cases
  - Explore additional areas of proposal in greater depth
  - Complete tables shown today for Use Cases 4 and beyond
  - Illustrate multiple-DERA aggregation for capacity and ancillary services market participation in more detail
  - Address any feedback

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DERA Use Case Development