UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators	)))))	RM18-9-000

Post-Technical Conference Comments of the California Independent System Operator Corporation

The California Independent System Operator Corporation (CAISO) supports the adoption of rules that will facilitate participation by aggregations of distributed energy resources in wholesale markets operated by regional transmission operators and independent system operators (RTOs/ISOs). Distributed energy resources can, and do, participate in wholesale markets, and are contributing to grid reliability and resilience in new and important ways. The Commission should not foreclose options for these resources. At the same time, any rules for participation by distributed energy resource aggregations in RTO/ISO should ensure processes, practices, and standards exist for RTOs/ISOs as utility distribution companies to operate the electric grid in a safe and reliable manner.

In 2016, the Commission accepted an initial framework submitted by the CAISO to facilitate participation of aggregations of distribution-connected or "distributed" energy resources in its wholesale markets.[1] This initial framework

[1] *Cal. Indep. Sys. Operator Corp,* 155 FERC ¶ 61,229 (2016).

established rules to enable aggregations of energy resources connected to distribution systems within the CAISO's balancing authority area to participate in the CAISO's energy and ancillary services markets. The Commission accepted the CAISO's tariff revisions, subject to condition.

The CAISO's framework recognizes distributed energy resource aggregations as a new type of market resource similar to a generating facility. The framework also recognizes a distributed energy resource provider as the owner or operator of these aggregations. The distributed energy resource provider can elect to contract with a scheduling coordinator, or become a scheduling coordinator itself, in order to participate in the CAISO's markets.

The CAISO's framework also recognizes that the distributed energy resource provider will also need to interface with the utility distribution company, or metered subsystem, that operates the distribution system in the CAISO's balancing authority area where resources in its aggregation are connected. Facilitating market participation requires coordination between the CAISO and distribution system operators. Since establishing this framework, the CAISO has worked with utility distribution companies and industry participants to explore the coordination requirements to facilitate wholesale market participation, as well as business cases that can take advantage of the CAISO's distributed energy resource aggregation framework. This work continues.

Although several parties have expressed interest and have registered as distributed energy resource providers in the CAISO's market, the CAISO does not have a distributed energy resource aggregation actively participating in its

markets. The CAISO believes there are several reasons for this lack of participation, including (1) the rules for counting distribution energy resource aggregations as resource adequacy resources in California do not yet exist; (2) the existing wholesale distribution access tariff interconnection process for these resources requires additional time and money, which is a barrier to resource development; and (3) given the unresolved policies around multiple use applications and primacy of services, the CAISO's model requires continuous wholesale market participation. Nevertheless, distributed energy resources are participating in the CAISO's markets in growing numbers both individually through the CAISO's participating generator and non-generator resource models, and in aggregate under the CAISO's demand response market participation model.[2] The CAISO's demand response market participation model does not impose the same barriers delineated above; however, it does impose a no-export rule on distributed energy resources since demand response is not a generation supply solution, but a behind-the-meter load modification solution. In other words, aggregated distributed energy resources acting as demand response providers can modify end-use customer load, but cannot "export" energy back onto the grid for compensation.

Based on the record developed in this proceeding, the CAISO recommends that the Commission finalize rules to facilitate wholesale market participation by distributed energy resource aggregations in RTO/ISO markets.

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[2] The CAISO's metering generator output methodology for determining demand response performance is designed specifically for load resources with behind-the-meter generation. *See* Sections 4.13.4.2 and 11.6.2 of the CAISO tariff.

The Commission, however, should provide as much flexibility as possible in requiring RTOs/ISOs to create market participation models. The Commission also should take steps to encourage utility distribution companies connected to transmission under the control of an RTO/ISO to develop and implement procedures to coordinate operation of its transmission and distribution interface, and to ensure that distributed energy resources can operate while not compromising distribution or transmission system reliability. The CAISO expects the growth of distributed energy resources to continue as customers manage their own supply, and state and local communities explore grid resilience benefits of these resources. The Commission should anticipate this transformation of the electric grid system and take proactive steps to ensure that transmission and distribution coordination can effectively occur to ensure safe and reliable electric service.

In these post-technical conference comments, the CAISO responds to selected questions in the Commission's notice dated April 27, 2018.[3] The CAISO has maintained the question numbers as they appear in the Commission's notice.

Panel 1: Economic Dispatch, Pricing, and Settlement of DER Aggregations

1. Acknowledging that some RTOs/ISOs already allow aggregations across multiple pricing nodes, what approaches are available to ensure that the dispatch of a multi-node DER aggregation does not exacerbate a transmission constraint?

[3] Notice Inviting Post Technical Comments dated April 27, 2018, in RM18-9.

The CAISO has an established rule that aggregations of demand response and distributed energy resources must remain within electrically defined zones called a sub-Load Aggregation Points (subLAP). Based on engineering analysis and historical data, subLAPs have minimal price differentiation between the pricing nodes that are within the subLAP. When a threshold of price differentiation exists between pricing nodes, that information is used to define another subLAP and the boundaries between contiguous subLAPs. The challenge is to set a reasonable price differentiation threshold between pricing nodes so that the subLAPs are large enough to develop meaningful sized aggregations but not create or exacerbate transmission constraints. Based on the configuration of the CAISO's system, subLAPs are a reasonable compromise to enable aggregations beyond a single pricing node. The CAISO has also adopted a size limit of 20 MW for distributed energy resource aggregations that span multiple pricing nodes in order to gain experience and ensure no adverse impacts on power flow occur from distributed energy resource aggregations.

2. Because transmission constraints change over time, would the ability of a multi-node DER aggregation to participate in an RTO/ISO market need to be revisited as system topology changes?

The CAISO has established reasonably durable subLAPs where distributed energy resources can aggregate. For example, the CAISO's subLAPs remained the same for nearly 8 years. The CAISO updated these subLAPs on January 1, 2017, and will periodically study the subLAPs to ensure that existing boundaries are stable and persistent congestion is not occurring

within a subLAP. Even when the subLAPs were updated in 2017, the CAISO needed to make only minor adjustments, impacting a relatively small number of demand response resources. The CAISO understands changes to subLAPs may impact various other commercial opportunities such as resource adequacy qualification. For this reason, the CAISO worked closely with its market participants prior to making any changes to its subLAP boundaries. As system topology changes, system operators will need to coordinate with existing multi-node distributed energy resource aggregations and distribution system operators to ensure potential dispatches remain feasible and do not exacerbate congestion on the transmission system.

3. Do multi-node DER aggregations present any special considerations for the reliability of the transmission system that do not arise from other market participants? How could these concerns be resolved?

The dynamic nature of the distribution system can impact the end-to-end feasibility of dispatch instructions for multi-node distributed energy resource aggregations. For example, the distribution system is subject to reconfiguration via switching based on loading of different circuits, or an event that takes a circuit out of service. Multi-node or single-node distributed energy resource aggregations will need to operate in this dynamic environment. For this reason, robust communication protocols, resource management systems, and clear roles and responsibilities must be defined between the transmission and distribution operators to minimize operational risks and maximize end-to-end dispatch feasibility. Without these tools, the dispatch of a distributed energy resource aggregation may not have the expected impact on managing transmission

congestion or serving load. At high-levels of distributed energy resources, distribution system operators will need to develop sophisticated distributed energy resource management systems (DERMS) and distribution facility management systems to facilitate the use of these distributed energy resource aggregations when these resources are providing services to the transmission system.

4. If the Commission requires the RTOs/ISOs to allow multi-node DER aggregations to participate in their markets, how should a DER aggregation located across multiple pricing nodes be settled for the services that it provides? One approach to settling a multi-node DER aggregation could be to pay it the weighted average locational marginal price (LMP) across the nodes at which it is located. What are the advantages and disadvantages of this approach? Are there other approaches that should be considered?

The CAISO's market participation model for distributed energy resource aggregation pays the weighted average LMP across the pricing nodes that define the aggregated resource. This approach reflects the congestion related benefits that an aggregated resource provides to the transmission system and provides a straightforward approach to calculate settlements for a distributed energy resource aggregation.

6. During the technical conference, several panelists indicated that there has been limited interest in using CAISO's DER provider model (DERP). Please explain why DER aggregators have not used that model to date, what other approaches, if any, that DERs are using to access the CAISO and other RTO/ISO markets, and whether those alternative approaches provide adequate RTO/ISO market access for both behind-the-meter and front-of-meter DERs.

The CAISO expects an increase in the volume of distributed energy resources over the next several years within its balancing authority area. This

expectation informed the development of the CAISO's distributed energy resource aggregation framework as an alternative to facilitate market participation by distributed energy resources.

One of the key challenges to enable aggregations of distributed energy resources to participate as a supply resource on the transmission system is the requirement for deep coordination between the transmission and distribution system operators. Understanding this challenge, the CAISO undertook an effort in 2017 to meet regularly with distribution system operators in its balancing authority area to consider coordination efforts and roles and responsibilities required at the transmission-distribution interface. A fundamental challenge is to ensure that distributed energy resource aggregations are operationally feasible across the distribution and transmission systems. These efforts and findings were documented in a formal white paper available for public review called "*Coordination of Transmission and Distribution Operation in a High Distributed Energy Resource Electric Grid*."[4] The white paper identifies the following key challenges:

- **Transmission and distribution coordination:** Requires new tools, systems, and procedures that enable the effective and timely coordination and dispatch of distributed energy resources in real-time. Ensures energy services provided by aggregated distributed energy resources are feasible and dependable.

[4] A copy of this paper is available on the CAISO website: https://www.caiso.com/Documents/MoreThanSmartReport-CoordinatingTransmission_DistributionGridOperations.pdf.

- **Access to capacity markets and payments:** How to assess a resource's deliverability when its deliverability is highly dependent on the topology of an underlying distribution grid, spread across multiple circuits. How to set a resource adequacy qualifying capacity value for an aggregated resource comprised of a mix of different technologies- solar, storage, electric vehicles, load management.
- **Interconnection barriers and costs:** Energy exporting distributed energy resources are generally subject to interconnection policies and wholesale distribution access tariffs, which can be costly and timely to implement.
- **Lack of clarity around access to multi-value streams in different domains and timeframes:** Issues of primacy and priority- who has "first rights" to these distributed energy resources, *i.e*., the customer, distribution utility or the CAISO. Availability requirements: unlike a traditional resource, a distributed energy resource may only want to offer its availability at certain times or under certain conditions.

The CAISO appreciates that these barriers exist and continues to work with stakeholders, including state regulators, to explore ways to either reduce or eliminate them to facilitate the deployment of distributed energy resource aggregations in the CAISO's markets. In the interim, distributed energy resources continue to participate in the CAISO's markets. Behind-the-meter

resources are increasingly exploring participation in the CAISO's markets through demand response aggregations. Distributed energy resources that meet the minimum size requirements also participate in the CAISO's markets as either a participating generator or non-generator resource.

7. During the technical conference, some panelists noted that for multi-node aggregations (a) there is a need to accurately represent the capabilities of DER aggregations at each node that they are located, and (b) more accurate representation at each node of a multi-node aggregation begins to make the aggregation look like a single-node resource. Some of the benefits discussed of multi-node aggregation included allowing an aggregation of DERs to provide more reliable services to the market and reducing transaction costs as a market participant, among others. Conversely, there was a discussion of the market operator's need to accurately represent the capabilities of the aggregation at individual nodes. Please comment on the benefits of being able to aggregate across multiple nodes versus the market operator's need to accurately represent the capabilities of the aggregation at individual nodes. If multi-node resources present risks or challenges to the system, what are they? Can they be overcome? How?

Multi-node resource aggregations are feasible and utilized by resources in the CAISO's markets today. Allowing multi-node resource aggregations can enable greater market participation by reducing transaction costs and allowing market participants to assemble resources that are appropriately sized for optimization and operation in the wholesale electricity markets. Constraining resources to a single pricing node makes it more difficult to assemble resources that are eligible to meet minimum resource size requirements, and adds effort and cost for both the RTO/ISO and the market participant to manage, dispatch, and settle numerous kilowatt-sized resources. However, using multi-node aggregations does require imposing certain sensible limitations, such as

establishing aggregation zones to minimize congestion impacts.

Multi-node aggregations require using distribution factors to model the power flow from the resource and its impact on the transmission system. The CAISO acknowledges that distribution factors can be inaccurate, especially if they are static. The CAISO's distribution energy resource aggregation framework allows for resources to refresh their distribution factors in the bid submission process. This design mitigates the potential for inaccuracies in distribution factors, which can affect price formation. Furthermore, distribution factors are not unique to scheduling distributed energy resource aggregations but are used extensively in the industry today to allocate load since load is not scheduled at each pricing node. The allocation of load across distribution factors also impacts price formation since there are inherent inaccuracies in how load is estimated and distributed, yet this is an acceptable and feasible practice. In the context of distributed energy resource aggregations, enforcing single-node aggregations is not necessary nor likely desirable to manage a system with high-levels of distributed energy resources.

8. **During the panel discussion, CAISO mentioned that it allows multi-node aggregations within a defined set of nodes that have been deemed to have sufficiently little congestion across the nodes. Other panelists expressed a preference for single node aggregations. Are there methods to identify sets of nodes within which aggregation could be allowed that would balance concerns with multi-node aggregations against the benefits of multi-node aggregations. For instance, are there ways to group nodes associated with load centers that would facilitate aggregation while not threatening reliability and undermining the benefits of nodal pricing?**

Methods currently exist to identify sets of nodes within which distributed energy resource aggregations operate without exacerbating constraints on the transmission system. The CAISO believes it can accommodate multi-node aggregations with minimal risk to reliability and market outcomes by setting up zones within the balancing area authority where congestion, *i.e*., nodal price differences, remain insignificant and supply from the group of buses in that zone have similar grid impacts. As referenced in response to question 2 above, the CAISO calls these zones subLAPs. The CAISO has used these subLAPs for demand response resource aggregation purposes since 2010.

9. How are the concerns about constraints on the transmission system different for multi-node demand response aggregations versus multi-node DER aggregations?

The CAISO does not believe any significant distinction exists between multi-node demand response resources in comparison to multi-node distributed energy resource aggregations on managing transmission constraints. Both resource types rely on distribution factors to convey the power flow impacts of the resource. Both resource types, whether consuming energy, curtailing energy, or supplying energy, affect system and local area loading and, therefore, power flows on the system,. Additionally, when a storage device or photovoltaic system is located behind-the-customer-meter, its impact on the grid is similar to a demand response resource in that it can reduce the load, or with storage, can also increase the load observed on the grid similar to how traditional load management can both increase and decrease load. Assuming the distribution system operator can accommodate the operation of both resource aggregations,

the CAISO does not believe there is a significant distinction between multi-node demand response and multi-node distributed energy resources when considering impacts to the transmission system.

Panel 2: Discussion of Operational Implications of DER Aggregation with State and Local Regulators

3. What entities should be included in the coordination processes used to facilitate the participation of DER aggregations in RTO/ISO markets? Should state and local regulatory authorities play an active role in these coordination processes? Is there a need to modify existing RTO/ISO protocols or develop new protocols to accommodate state participation in this coordination? What should be the role of state and local regulators in the NOPR's proposed distribution utility review of DER aggregation registrations?

Coordination processes to facilitate participation of distributed energy resource aggregations in RTO/ISO markets may involve an RTO/ISO, a distribution system operator, an aggregation resource operator, retail customers, and regulatory authorities. The CAISO believes that state and local regulators have a critical role in facilitating participation of distributed energy resource aggregations in RTO/ISO markets. State and local regulators guide resource procurement, distribution system operations, and interconnection processes, and often have authority over metering requirements for distributed energy resources. State and local regulators may need to help resolve controversies that arise in connection with these aspects of distributed energy resource aggregations. In addition, state and local regulators will necessarily play an active role in establishing rules for multi-use applications and resource adequacy value of distributed energy resource aggregations. With respect to this proceeding's proposed distribution utility review of distributed energy resource aggregations, if

a state or local authority adopted rules applicable to its jurisdictional distribution system operators to facilitate participation by distributed energy resource aggregations in RTO/ISO markets, then the state or local regulator would play an oversight role to ensure that jurisdictional utilities under their authority adhere to the terms and conditions of any state-approved process. Additionally, state or local regulators may have general authority over how distribution system operators manage their respective facilities. In the context of the CAISO's distributed energy resource aggregation framework, the CAISO adopted rules that require distributed energy resource providers to comply with applicable utility distribution company tariffs and operating procedures incorporated into those tariffs, as well as applicable requirements of the local regulatory authority. The CAISO also requires distributed energy resource providers to confer with distribution system operators to identify and resolve specific concerns with the potential operation of distributed energy resource aggregations.[5] The CAISO's tariff requires that any disputes regarding these concerns shall be undertaken with the applicable Governmental Authority for the Utility Distribution Company or Metered Subsystem and shall not be arbitrated or in any way resolved through a CAISO dispute resolution mechanism.[6]

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[5] CAISO tariff section 4.17.4.

[6] *Id.*

Panel 3: Participation of DERs in RTO/ISO Markets

3. What other options besides the NOPR's proposed limits on dual participation exist to address issues associated with the participation of DERs or DER aggregations in one or more retail compensation programs or another wholesale market participation program at the same time as it participates in a wholesale DER aggregation? Is there a way to coordinate DER participation in multiple markets or compensation programs? Is a possible solution having a targeted prohibition, such as the limitation placed on net-metered resources in CAISO?[7] Are there other means?

The CAISO's distributed energy resource aggregation framework requires continuous wholesale market participation. As part of its framework, the CAISO also developed protections to ensure that distributed energy resources already participating in a retail net energy metering program, which does not expressly permit wholesale market participation, are not part of an aggregation.

The CAISO acknowledges the need to explore how to accommodate multiple use applications for distributed energy resources. This flexibility will help optimize the use of distributed energy resources. In coordination with stakeholders, including the California Public Utilities Commission (CPUC), the CAISO is working to assess the feasibility of implementing multiple-use applications for distributed energy resources. The CPUC has formed a working group to examine these issues. The CAISO anticipates that this work will ultimately lead to an assessment of tariff and market design changes through a CAISO stakeholder initiative to accommodate multiple-use applications. For purposes of any final rule adopted in this proceeding, the CAISO urges the

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[7] CAISO tariff section 4.17.3(d).

Commission to recognize that market participation by distributed energy resources will continue to evolve and not to prescribe a framework that may prevent multiple-use applications.

Panel 6: Coordination of DER Aggregations Participating in RTO/ISO Markets

9. During the technical conference, panelists highlighted the importance of coordination procedures and frameworks. Should coordination frameworks for DER aggregation, particularly between RTOs/ISOs and distribution utilities, be required or encouraged to be developed between the appropriate entities?

The CAISO reiterates that it continues to work collaboratively with distribution system operators and affected interests to develop and implement procedures to coordinate operation of the transmission and distribution interface, and to ensure that distributed energy resources can operate while not compromising distribution or transmission system reliability. Coordination frameworks between RTOs/ISOs and distribution system providers will be necessary to support wholesale market participation by distributed energy resource aggregations. The CAISO recommends that in connection with any participation model for distributed energy resource aggregations, the Commission could direct RTOs/ISOs to submit a report on the status of efforts to develop coordination frameworks for distributed energy resource aggregations.

Panel 7: Ongoing Operational Coordination

1. What real-time data acquisition and communication technologies are currently in use to provide bulk power system operators with visibility into the distribution system? Are they adequate to convey the information necessary for transmission and distribution operators to assess distribution system conditions in real time? Are new systems or

approaches needed? Does DER aggregation require separate or additional capabilities and infrastructure for communication and control?

With some exceptions for large distributed connected resources, or resources providing ancillary services, the CAISO does not have real-time data acquisition and communication technologies in use that provide visibility into the distribution system. As more behind-the-meter resources are connected to the distribution system it will be necessary to monitor the transmission/distribution interface, especially when reversals of power flow occurs from the distribution system to the transmission system. In real-time, the load observed on the electric grid is calculated every four seconds by summing the net-interchange together with the production of all internal generation. With high levels of distributed energy resources, the CAISO will need telemetry at transmission/distribution interfaces in order correctly calculate system demand in real-time and maintain supply/demand balance.

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Respectfully submitted,

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CERTIFICATE OF SERVICE

I certify that I have served the foregoing document upon the parties listed on the official service list in the captioned proceedings, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.2010).

Dated at Folsom, California, this 26th day of June, 2018.

/s/ Grace Clark
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