UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Distributed Energy Resources - Technical Considerations for the Bulk Power System	)	AD18-10-000

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

The California Independent System Operator Corporation (CAISO) submits these comments to help inform the Commission of technical considerations for the bulk power system arising from increasing levels of distributed energy resources. Distributed energy resources are developing in increasing numbers and the CAISO expects the growth of these resources to continue as customers manage their own supply, and states and local communities explore grid resilience benefits of these resources. Approximately 6,000 MW of rooftop solar is already installed in the CAISO's balancing authority area and that amount may double by 2030. The CAISO also expects significant growth in electric storage resources connected to the distribution system both in-front of and behind end-use customers' meters. As a result, the CAISO is already incorporating information about the development and operating characteristics of distributed energy resources into transmission system planning and operations. The CAISO encourages the Commission to continue to work with transmission providers and the North American Electric Reliability Corporation (NERC) to identify and share best practices as the industry learns more about how to integrate high levels of distributed energy resources into

transmission system planning and operations.

In these post-technical conference comments, the CAISO responds to selected questions in the Commission's notice dated April 27, 2018.[1] The CAISO has maintained the question numbers as they appear in the Commission's notice.

Panel 4: Collection and Availability of Data on DER Installations

1. What type of information do bulk power system planners and operators need regarding DER installations within their footprint to plan and operate the bulk power system? Would it be sufficient for distribution utilities to provide aggregate information about the penetration of DERs below certain points on the transmission-distribution interface? If greater granularity is needed, what level of detail would be sufficient? Is validation of the submitted data possible using data available?

The CAISO believes a straightforward data set related to distributed energy resources installations will support reliable planning and operation of the bulk power system. This information includes location, resource type, resource capabilities, and operating characteristics. At a minimum, an understanding of this information at an aggregated level at the transmission and distribution interface, and incorporating operating data into models for validation purposes, will enhance the assessment of how distributed energy resources contribute to the reliability of bulk power system planning and operations. Accessing this information will require deeper levels of coordination between transmission system operators and distribution system operators.

[1] Notice Inviting Post Technical Comments dated April 27, 2018 in AD18-10.

2. What, if any, data on DER installations is currently collected, and by whom is it collected? Do procedures and appropriate agreements exist to share this data with affected bulk power system entities (i.e., those entities responsible for the reliable operation of the bulk power system or for modeling and planning for a reliable bulk power system)? Is there variation by entity or region?

The CAISO obtains information about the amount of distributed energy resource installations and forecasts its future growth within California from the California Energy Commission (CEC) as part of the annual demand forecast. The CAISO obtains locational information about existing and future distributed energy resource installations from participating transmission owners, which secure this information from their distribution system business units. Information regarding capabilities and operating characteristics are not available in most cases. Currently, the CAISO uses default values for capability and operating characteristics recommended by model developers and industry experts in its planning studies. There is an opportunity to refine these processes to ensure accurate and uniform data is available to transmission system operators. The CAISO believes this effort will require greater coordination with participating transmission system owners, distribution system operators, as well as state and local energy agencies.

4. How are long-term projections for DER penetrations developed? Are these projections currently included in related forecasting efforts? Do system operators study the potential effects of future DER growth to assess changing infrastructure and planning needs at different penetration levels?

Within California, the CEC develops an annual energy demand forecast as part of its Integrated Energy Policy Report (IEPR). That forecast includes

estimated penetration levels of distributed energy resources. The CAISO incorporates this demand forecast into its transmission planning process and performs studies to assess changing infrastructure and planning needs. The CAISO incorporates the forecast levels of distributed energy resources into the study base cases. From an operational perspective, the CAISO also requests from load serving entities information on installed distributed energy resources as well as the expected distributed energy resources installation within the next three years. The CAISO uses this information to determine the operational impact distributed energy resources may have on the system.

8. Do the RTOs/ISOs need any directly metered data about the operations of DER aggregations to ensure proper planning and operation of the bulk power system?

RTOs/ISOs will need meter data about the operation of distributed energy resource aggregations in order to financially settle these resources and validate that the aggregated resource performed consistently with its dispatch instructions. RTOs/ISOs do not need to directly poll the distributed energy resource's meter to accomplish these objectives, but RTOs/ISOs will need the distributed energy resources to submit their meter data. This meter data will also help RTOs/ISOs understand how distributed energy resource aggregations are operating, and it could assist with the planning and operating decisions if the resource does not perform consistently with how RTOs/ISOs model the resource in its market applications.

With some exceptions for large distributed connected resources, or resources providing ancillary services, the CAISO does not have real-time data

acquisition or communication technologies in use that would 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 the transmission/distribution interface in order correctly calculate system demand in real-time and maintain supply/demand balance.

11. Is a formal development of a grid architecture that includes distribution and transmission systems necessary to facilitate planning efforts to incorporate DERs?

Transmission system operators can take steps now to incorporate the development of distributed energy resource into planning efforts. These steps may well inform the development of grid architecture necessary to support high levels of distributed energy resources.

12. What specific real-time DER data is needed to manage bulk power system reliability? Why is that data needed? Is there a specific penetration-level of DERs above which real-time data is needed? Without real-time DER data to ensure visibility of DER installations, what, if any, potential challenges and mitigating actions exist for RTOs/ISOs and transmission operators (e.g., the potential need to procure additional contingency reserves)? Please give examples.

On some weekend days, approximately 25 percent of the CAISO's system demand is served by distributed energy resources, over which the CAISO has no real-time visibility. There is also no requirement for the CAISO to have real-time

visibility on the aggregated production of distributed energy resources at the transmission distribution interface. As a result, it is challenging to compare a forecast of distributed energy resource output against actual production. Ultimately, planners, as well as operators, need to benchmark actual production from distributed energy resources against forecast production within a certain area to determine how distributed energy resources contribute to the reliability and resilience of the electric grid system, as well as what resources and tools are needed to manage any uncertainty and variability they may create.

Panel 5: Incorporating DERs in Modeling, Planning, and Operations Studies

1. What are current and best practices for modeling DERs in different types of planning, operations, and production cost studies? Are options available for modeling the interactions between the transmission and distribution systems?

The CAISO's modeling practice is consistent with NERC's distributed energy resource modeling guideline. The CAISO continues to participate in industry forums to develop best practices for modeling distributed energy resources. For planning and operational purposes, the CAISO models distributed energy resources that generate energy, such as roof-top solar, as an aggregated resource. The CAISO models in-front-of-the-meter resources that are 10 MW or greater as individual resource at the transmission/distribution interface. For distributed energy resources that perform more like a load modifier, e.g. energy efficiency and demand response, the CAISO models these resources as aggregated negative load at the transmission/distribution interface. Energy storage is modeled as a resource with both positive and negative outputs. At this time, there are limited options available for modeling the

interactions between transmission and distribution systems. One approach to consider is whether to assess resources and loads behind a transmission/distribution interface as one resource comprised on multiple sub-resources. From the perspective of the transmission system, this resource could both generate electricity and consume electricity. The CAISO expects there will be significant work to enhance modeling of distributed energy resources in the coming years. Critical to this effort will be what information the CAISO can incorporate into its models relating to the operation of, and changing topology of, the distribution systems in its balancing authority area.

2. To what extent are capabilities and performance of DERs currently modeled? Do current modeling tools provide features needed to model these capabilities?

The composite load model that the CAISO uses to model distributed energy resources that generate energy provides features to model capabilities such as reactive power and ride-through capabilities. The CAISO notes that models are evolving as the modern-day inverters incorporate technological enhancements to provide capabilities of providing essential reliability services. The composite load model the CAISO plans to use in its 2018-2019 transmission planning process cycle includes the latest *DER_A model* that represents behind-the-meter solar. This version provides features needed to model advanced inverter capabilities as compared to models used in previous years.

3. What methods, such as net load, composite load models, detailed models or others, are currently used in power flow and dynamic models to represent groups of DERs at the bulk power system level? Would more detailed models of DERs at the bulk power system level provide better visibility and enable more accurate assessment of their impacts on system conditions? Does the appropriate method for grouping DERs vary by penetration level?

The CAISO uses a composite load model. This model deconstructs load into different components, including distributed generation. More detailed modeling of distributed generation in terms of different resource types, such as battery storage, will help increase the accuracy of the CAISO's planning and operational assessments. Currently, the CAISO's model only allows for a single aggregation behind each transmission/distribution interface. As such, the CAISO groups distributed energy resources, regardless of the penetration level of different resource types. In the future, if the model allows for multiple aggregations behind a transmission/distribution interface, the CAISO will explore grouping distributed energy resources based upon the penetration levels of each resource type.

4. Do current contingency studies include the outage of DER facilities, and if they are considered, how is the contingency size chosen? At what penetration levels or under what system conditions could including DER outages be beneficial? Are DERs accounted for in calculations for Under Frequency Load Shedding and related studies?

As part of the CAISO's planning assessments, it does not model outages of distributed energy resources in its contingency studies, unless the distributed energy resources are participating generators, in which case the outage information is reported to the CAISO. However, the CAISO assesses various

baseline scenarios, which include different output levels for distributed energy resources. Furthermore, the CAISO performs sensitivity studies that vary output levels from distributed energy resources.

5. What methods are used to calculate capacity needed for balancing supply and demand with large amount of solar DER (ramping and frequency control) and determining which resources can provide an appropriate response?

The CAISO performs an annual study to calculate flexible resource adequacy capacity requirements. The process starts with a survey for all load serving entities to provide data for load and renewable capacity under their control, as well as distributed energy resources located on their systems if the load serving entity is also a distribution utility. The CAISO determines the flexible capacity requirement by calculating the maximum three-hour ramping using the load and renewable generation profiles. All participating resources that meet the CAISO's requirements to provide flexible resource adequacy requirements may do so.

6. For planning efforts, how are model parameters determined and incorporated into existing models using currently available data on DER capabilities? What types of validation techniques are used for the data in these models and how often are they applied?

The CAISO's parameters for modeling distributed energy resource capabilities are based on recommendations from its model development group, industry practice, and inputs from participating transmission owners. Currently, there are no established techniques for validating distributed energy resource capabilities included in the CAISO's models. The CAISO is considering a pilot

project to explore developing such validation practices.

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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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