

**UNITED STATES OF AMERICA  
BEFORE THE  
FEDERAL ENERGY REGULATORY COMMISSION**

Reactive Power Requirements )  
for Non-Synchronous Generation )  
\_\_\_\_\_ )

Docket No. RM16-1

**Comments of the  
California Independent System Operator Corporation**

**I. Introduction**

The California Independent System Operator Corporation (CAISO) submits these comments in support of the Federal Energy Regulatory Commission’s proposal to require that all synchronous and non-synchronous resources that execute new generator interconnection agreements provide reactive power capability to the electricity grid.<sup>1</sup> Significant changes in the CAISO’s resource portfolio as well as inverter technology enhancements support the Commission’s proposal.

Over the course of the last year, the CAISO has explored similar rule changes to its interconnection requirements through a stakeholder initiative.<sup>2</sup> In its initiative, the CAISO and its stakeholders developed proposed uniform requirements for non-synchronous resources to provide reactive power capability with the objective of replacing the current system impact study assessment approach to determine whether non-synchronous resources must provide reactive power capability as a condition of

---

<sup>1</sup> *Reactive Power Requirements for Non-Synchronous Generation*, Proposal to Revise Standard Generator Interconnection Agreements; RM16-1 (2015).

<sup>2</sup> More information about the CAISO’s initiative is available at the following webpage: <http://www.caiso.com/informed/Pages/StakeholderProcesses/ReactivePowerRequirements-FinancialCompensation.aspx>

interconnection. Although the rules developed by the CAISO and its stakeholders are similar to the Commission's proposal, some of the CAISO's proposed technical specifications slightly differ from the Commission's proposal. The CAISO has suspended its initiative to allow time for the Commission to complete this proceeding.<sup>3</sup>

## **II. The changing nature of the resource portfolio interconnected to the CAISO controlled grid and inverter technology enhancements support adoption of the Commission's proposal**

Generation resources are the primary source of reactive power capability on the transmission system. The proliferation of non-synchronous resources is significantly changing the landscape of the CAISO controlled grid.<sup>4</sup> In 2014, the CAISO had over 11,000 MW of variable energy resources interconnected to the electricity grid under its operational control. By 2024, the CAISO projects that this amount will exceed 20,000 MW. The majority of these variable energy resources will likely be non-synchronous wind and solar photovoltaic resources. In addition, the CAISO's balancing authority area is experiencing significant growth of distribution-connected behind-the-meter solar photovoltaic resources. As non-synchronous resources increase in number and size, they are displacing synchronous resources that currently provide dynamic reactive capability to the grid. Moreover, while the CAISO's peak demand is gradually increasing, the minimum demand on the system is not increasing proportionately.<sup>5</sup> This data suggests that on some days, especially on weekends and holidays, the CAISO's

---

<sup>3</sup> See, CAISO market notice dated January 11, 2016 at the following website: <http://www.caiso.com/Documents/ReactivePowerRequirements-FinancialCompensationInitiativeSuspended.htm>

<sup>4</sup> CAISO Reactive Power Requirements and Financial Compensation Issue Paper dated May 5, 2015 at 5-6. [http://www.caiso.com/Documents/IssuePaper\\_ReactivePowerRequirements\\_FinancialCompensation.pdf](http://www.caiso.com/Documents/IssuePaper_ReactivePowerRequirements_FinancialCompensation.pdf)

<sup>5</sup> *Id.* at 14-15.

supply portfolio will be comprised largely of non-synchronous resources that have displaced synchronous resources. If resources interconnecting to the CAISO controlled grid do not have reactive power capabilities, the CAISO system could face a greater risk of experiencing voltage problems. Accordingly, the CAISO believes it is appropriate and necessary to adopt uniform rules requiring non-synchronous resources interconnecting to the CAISO controlled grid to provide reactive power capability in a manner comparable to the reactive power capability provided by synchronous resources.

During its stakeholder initiative, the CAISO conducted outreach to manufacturers of inverters used by non-synchronous resources to assess the costs of including reactive power capability as a percentage of project costs. Based on this outreach, the CAISO understands that approximately five percent of total plant cost for non-synchronous resources is attributable to inverters and associated equipment. Given that non-synchronous resources require inverters to transmit direct current energy onto an alternating current electric system, the incremental costs for adding reactive power capabilities are significantly less than five percent of project costs. Inverter manufacturers also informed the CAISO that reactive power capability is now a standard feature of inverters used in most non-synchronous resource applications. These manufacturers informed the CAISO that typically these inverters are capable of providing 0.95 leading and lagging power factor at full real power output at the resource's point of interconnection.

**III. The system impact study approach is no longer an efficient means to determine whether non-synchronous resources can interconnect safely and reliably without providing reactive power capability**

In light of the changing resource mix that is occurring in the CAISO balancing authority area, system impact studies may not always identify deficiencies in reactive power support and absorption because they do not study all conditions that occur. In particular, deficiencies can occur during off peak conditions and on days with high levels of variable energy resources and low demand periods or during periods when transmission infrastructure or synchronous resources are out of service.<sup>6</sup> System impact studies will not capture these deficiencies. Instead, the case-by-case approach relies heavily on the assumptions of future conditions, which may not prove true and does not plan for unpredicted events. For example, a two month outage of a combined cycle plant or the loss of a transmission element may easily create unforeseen voltage issues that require the capability to supply or absorb reactive support. As a result, relying on a system impact study approach places a level of subjectivity in studying operating scenarios because of the numerous combinations of generation resources and transmission facilities out on maintenance, load levels, and non-synchronous resource production levels. Under the current approach, non-synchronous resources may at times be allowed to interconnect without comparable requirements that apply to synchronous resources, resulting in potential reactive power deficiencies on the system until transmission planners can address them through the authorization and development of transmission infrastructure additions. The Commission's proposal

---

<sup>6</sup> *Id.* at 11-13. See discussion of CAISO system impact study process to assess reactive power capability for non-synchronous resources.

would mitigate this result and facilitate more effective and efficient system operations and planning.

**IV. The Commission should make revisions to its standard interconnection agreements effective for all newly interconnecting resources**

The CAISO supports the Commission's proposal to require all newly interconnecting resources (*i.e.*, new generators seeking to interconnect to the transmission system and all existing non-synchronous generators making upgrades to their generation facilities that require new interconnection requests), both synchronous and non-synchronous, to provide reactive power as a condition of interconnection as of the effective date of its final revision to standard interconnection agreements. This is appropriate because interconnection customers should adhere to the conditions of interconnection at the time they execute an agreement to obtain interconnection service.<sup>7</sup>

In its stakeholder initiative, the CAISO had proposed to apply its uniform rules for non-synchronous resources to provide reactive power capability to its upcoming interconnection queue cluster that opens April 1, 2016 and all future clusters. If adopted in a timely manner, the Commission's proposal will permit the CAISO to apply the new rules to interconnection customers that enter the interconnection queue cluster that opens April 1, 2016 and all future queue clusters because resources in the CAISO's upcoming interconnection queue clusters will not execute agreements for interconnection service until after some level of interconnection study has occurred, which will take more than one year to occur. The need to apply a uniform rule to the CAISO's interconnection queue cluster and future clusters will ensure these

---

<sup>7</sup> *W. Deptford Energy, LLC v. FERC*, 766 F.3d 10 (D.C. Cir. 2014).

interconnection customers do not lean on existing non-synchronous resources that do provide reactive power capability. As interconnection customers propose projects to meet California's 50 percent renewable portfolio standard, a uniform standard for reactive power capability as a condition of interconnection will promote voltage stability on the CAISO controlled grid and mitigate the possibility that the system impact study process will not identify a reactive power capability need. In addition, the Commission's proposal will ensure interconnection customers seeking to develop non-synchronous resource that entered the interconnection queue in earlier years, but have not executed agreements for interconnection service, adhere to the interconnection rules in effect at the time they execute such an agreement. The ISO strongly supports this element of the Commission's proposal.

**V. The CAISO supports the Commission's proposal to require non-synchronous resources to control voltage at the point of interconnection**

The Commission's proposal would require that non-synchronous resources provide 0.95 leading/lagging power factor at their point of interconnection. The CAISO supports using this point of demarcation as the location to which non-synchronous resources should control reactive power capability. This approach is consistent with the applicable point of control for reactive power capability the CAISO applies when the system impact study indicates that a non-synchronous resource must provide reactive power capability to safely and reliably interconnect to the grid.

This approach will also provide interconnection customers with flexibility in how they design their projects to ensure that reactive power capability is made available to the CAISO controlled grid. During its stakeholder initiative, some stakeholders advocated that the CAISO should allow non-synchronous resources to opt for the same

reactive power requirements that are applicable to synchronous resources under the CAISO tariff, *i.e.* 0.90 lagging to 0.95 leading power factor at the resource's generator terminals. The CAISO strongly opposes this position because non-synchronous resources often utilize multiple transformers, collection circuits and stations to transmit real power from the generator terminal to the point of interconnection with the CAISO grid. This can effectively negate the reactive power capability of the resource at the point at which it interconnects with the CAISO controlled grid because the resource is compensating for voltage at its generator terminal. In contrast, synchronous resources are typically connected to the transmission grid by a single transformer step-up bank via a short generator tie-line, which allows the resource effectively to provide dynamic reactive power support at the point of interconnection with the CAISO controlled grid.

NERC's 2012 Special Assessment Interconnection Requirements for Variable Generation report explains how synchronous resources provide a level of support that is equivalent to 0.95 leading and lagging power factor at the resource's point of interconnection. NERC states that, in general, a synchronous resource with a reactive capability of 0.9 lag and 0.983 lead (measured at the generator terminal) that is connected to the transmission system through a transformer and has a leakage reactance of 14 percent on the resource's Mega-volt ampere base, can provide the equivalent leading and lagging power factor at the transmission interface, if the transmission system is at nominal voltage, *i.e.*, 100 percent.<sup>8</sup>

---

<sup>8</sup> NERC's Special Assessment Interconnection Requirements for Variable Generation, September 2012 at 20-21. [http://www.nerc.com/files/2012\\_IVGTF\\_Task\\_1-3.pdf](http://www.nerc.com/files/2012_IVGTF_Task_1-3.pdf)

**VI. The Commission should permit transmission providers to propose related rules pertaining to non-synchronous resources providing reactive power capability as a condition of interconnection**

As part of any order adopting revisions to the standard *pro forma* interconnection agreements, the Commission should recognize that transmission providers may specify technical requirements as appropriate for how resources should regulate voltage as part of their compliance filings. For example, in its initiative, the CAISO has proposed technical specifications for voltage regulation including a requirement that non-synchronous resource control reactive power capability by an automatic system. The Commission should accept any related rules that transmission providers demonstrate are appropriate for non-synchronous resources to control voltage at the point of interconnection.

**VII. The Commission should continue to acknowledge that regional differences exist regarding reactive power compensation**

As part of its proposal, the Commission states that non-synchronous generators would be eligible for the same payments for reactive power as other generators, and any compensation would be based on the cost of providing reactive power.<sup>9</sup> The Commission seeks comment on whether the existing methods used to determine reactive power compensation are appropriate for wind generators and, if not, what alternatives would be appropriate.<sup>10</sup>

---

<sup>9</sup> Proposal to Revise Standard Generator Interconnection Agreements at P 12.

<sup>10</sup> *Id.* at P 18.



The Commission should continue to acknowledge that various approaches to compensate resources for reactive power capability exist in different regions.<sup>11</sup> The CAISO currently compensates resources for providing reactive power outside of a standard required range when the CAISO directs a resource to reduce its real power output to provide reactive power. In the context of its stakeholder initiative that the CAISO recently suspended, the CAISO explored various alternative compensation approaches for resources providing reactive power capability.

In its draft final proposal, the CAISO concluded that providing reactive power capability is a good utility practice, essential for generating and delivering real power to the grid, and resources have the opportunity to recover capital costs when they construct or retrofit their facilities. Additionally, the CAISO concluded that most manufacturers now routinely include reactive power capability as standard equipment in the inverters used by non-synchronous resources. For these reasons, the CAISO's draft final proposal reflects that the CAISO will not propose to adopt a new capability payment for reactive power.

The CAISO does, however, support comparable treatment for synchronous and non-synchronous resources in terms of compensation. In this regard, the CAISO would compensate non-synchronous resources, as it does synchronous resources, for the providing reactive power outside of a standard required range when the CAISO directs a resource to reduce its real power output to provide reactive power.

---

<sup>11</sup> See generally Commission Staff Report, *Payment for Reactive Power* issued in AD14-7 date April 22, 2014 <http://www.ferc.gov/legal/staff-reports/2014/04-11-14-reactive-power.pdf>

## VIII. Conclusion

The Commission should adopt its proposal to require all newly interconnecting generators, including both synchronous and non-synchronous generators, to provide reactive power capability to the electric grid. Changes in the CAISO's resource portfolio as well as inverter technology enhancements support the Commission's proposal for non-synchronous resources to make reactive power capability available and control voltage at the point of interconnection. Finally, as part of its order adopting revision to the standard interconnection agreements, the Commission should continue to recognize that appropriate regional differences exist for reactive power compensation.

Dated: January 27, 2016

Respectfully submitted,

**By: /s/ Andrew Ulmer**

Roger E. Collanton  
General Counsel  
Anthony Ivancovich  
Deputy General Counsel  
Andrew Ulmer  
Director, Federal Regulatory Affairs  
California Independent System  
Operator Corporation  
250 Outcropping Way  
Folsom, CA 95630  
Tel: (916) 608-7209  
Fax: (916) 608-7222  
[aulmer@caiso.com](mailto:aulmer@caiso.com)

## CERTIFICATE OF SERVICE

I hereby certify that I have served the foregoing document upon the parties listed on the official service lists in the above-referenced 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 27<sup>th</sup> day of January 2016.

*/s/ Anna Pascuzzo*  
Anna Pascuzzo