

174 FERC ¶ 61,034  
UNITED STATES OF AMERICA  
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: James P. Danly, Chairman;  
Neil Chatterjee, Richard Glick,  
Allison Clements, and Mark C. Christie.

Hybrid Resources

Docket No. AD20-9-000

ORDER DIRECTING REPORTS

(Issued January 19, 2021)

1. In this order, we direct each Regional Transmission Organization (RTO) and Independent System Operator (ISO) to submit information related to hybrid resources.<sup>1</sup> Specifically, we seek information in a report from each RTO/ISO regarding four hybrid resource issues: (1) terminology; (2) interconnection; (3) market participation; and (4) capacity valuation. We direct each RTO/ISO to file a report within 180 days from the date of this order that provides: (1) a description of its current practices related to each of these four issues; (2) an update on the status of any ongoing efforts to develop reforms related to each of the four issues; and (3) responses to the specific requests for information contained herein. Public comments in response to the RTO/ISO reports may be submitted within 30 days of the filing of the reports. The Commission will use the reports and comments to determine whether further action is appropriate.

**I. Background**

2. On July 23, 2020, Commission staff held a technical conference to discuss technical and market issues affecting hybrid resources prompted by growing interest in such resources.<sup>2</sup> On August 10, 2020, the Commission issued a Notice Inviting Post-

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<sup>1</sup> The definition of hybrid resources is discussed further below. The terms hybrid resource, co-located resource, and combination resources are all commonly used by industry to refer to the resources discussed herein. For ease of reference, in this order, we refer to all such resources as “hybrid resources.”

<sup>2</sup> *Hybrid Resources*, Notice of Technical Conference, Docket No. AD20-9-000 (Apr. 7, 2020), <https://www.ferc.gov/sites/default/files/2020-06/20200407120752-AD20-9-000.pdf> (Notice of Technical Conference); *Hybrid Resources*, Supplemental Notice of Technical Conference, Docket No. AD20-9-000 (June 16, 2020), [https://elibrary.ferc.gov/eLibrary/filelist?document\\_id=14869484&accessionnumber=202](https://elibrary.ferc.gov/eLibrary/filelist?document_id=14869484&accessionnumber=202)

Technical Conference Comments<sup>3</sup> inviting all interested persons to submit comments to address issues raised both during the technical conference and any questions identified in the July 13, 2020 Supplemental Notice of Technical Conference. Post-technical conference comments were due on September 24, 2020.

## II. Discussion

3. During the technical conference and in post-technical conference comments, most RTOs/ISOs reported that they are currently undertaking work to address the increase in hybrid resources.<sup>4</sup> Given these ongoing efforts, several RTOs/ISOs requested that the Commission either allow such work to continue before taking additional action, or provide for flexibility in any such action.<sup>5</sup> In consideration of these comments, we are not directing specific reforms at this time. However, we believe four categories of issues related to the integration of hybrid resources in wholesale markets (i.e., terminology, interconnection, market participation, and capacity valuation) warrant continued attention and thus, we direct each RTO/ISO to file a report, as discussed more fully below. The reports are due within 180 days from the date of this order. Following the submission of the RTOs'/ISOs' reports, the Commission will allow for public comment. Comments are due within 30 days of the filing of the reports.

### A. Hybrid Resource Issues

#### 1. Terminology

##### a. Background

4. An industry-wide consensus on what constitutes a hybrid resource has not yet emerged. However, these resources are often broken into two general categories: (1) co-located hybrid resources, generally referring to sets of resources that are modeled and

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00616-3067; *Hybrid Resources*, Supplemental Notice of Technical Conference, Docket No. AD20-9-000 (July 13, 2020), <https://www.ferc.gov/sites/default/files/2020-07/AD20-9-000-Supp-Tech-Conf.pdf>.

<sup>3</sup> *Hybrid Resources*, Notice Inviting Post-Technical Conference Comments, Docket No. AD20-9-000 (Aug. 10, 2020).

<sup>4</sup> See California Independent System Operator Corporation (CAISO) Comments at 9; ISO New England Inc. (ISO-NE) Comments at 2; Midcontinent Independent System Operator, Inc. (MISO) Comments at 1; New York Independent System Operator, Inc. (NYISO) Comments at 2; PJM Interconnection, L.L.C. (PJM) Comments at 7.

<sup>5</sup> See MISO Comments at 2; NYISO Comments at 2.

dispatched as two (or more) separate resources that usually share a single point of interconnection; and (2) integrated hybrid resources (also referred to as co-controlled or integrated control hybrid resources), generally referring to sets of resources that usually share a single point of interconnection, and are modeled and dispatched as a single integrated resource. Due to the combination of resource types comprising the hybrid resources currently in the RTO/ISO interconnection queues,<sup>6</sup> the July 13, 2020 Supplemental Notice of Technical Conference defined a hybrid resource as “a generation resource and an electric storage resource paired together.”<sup>7</sup> However, during the technical conference some panelists noted that future trends may involve other combinations of resource types and thus may require a broader definition.<sup>8</sup>

**b. Scope of Reporting Requirement**

5. Regarding terminology related to hybrid resources, we direct each RTO/ISO to explain whether it has a definition of hybrid resources in its tariff or in a business practice manual and, if so, to provide the definition and citation in its response. If an RTO/ISO does not have a definition of a hybrid resource in its tariff or a business practice manual, we direct the RTO/ISO to explain whether there are hybrid resources in its interconnection queue, and if so, how the RTO/ISO categorizes such resources, e.g., co-located or integrated hybrid resources. Similarly, if the RTO/ISO does not have a definition, but there are hybrid resources, as described above, participating in the RTO/ISO markets, the RTO/ISO should explain how they have been participating to date—for instance, as a generator or as part of an energy storage participation model. If an RTO/ISO has previously provided such information to the Commission, we direct the RTO/ISO to confirm the information that remains relevant and describe any updates that have occurred.

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<sup>6</sup> An analysis by Lawrence Berkeley National Lab found that “co-located utility-scale generation and battery technologies...are the focus of current commercial activity in the United States.” See Gorman, Will et al., *Motivations and options for deploying hybrid generator-plus-battery projects within the bulk power system* (June 2020), <https://www.sciencedirect.com/science/article/pii/S1040619020300312>.

<sup>7</sup> *Hybrid Resources*, Supplemental Notice of Technical Conference, Docket No. AD20-9-000 (July 13, 2020).

<sup>8</sup> Tr. 15-16:12-12 (Jason Burwen).

## 2. Interconnection

### a. Background

6. RTO/ISO regions are at various stages of addressing potential interconnection issues posed by hybrid resources.<sup>9</sup> One issue raised in the technical conference was how to appropriately model hybrid resources for purposes of interconnection studies. Commenters asserted that, currently, RTOs/ISOs model hybrid resources as they do other resources and such modeling can lead to costly upgrades and may not account for the operating characteristics of hybrid resources and their actual impact on the transmission system.<sup>10</sup> Additionally, hybrid interconnection customers expressed concerns about whether their projects will be modeled to account for their full capability. RTOs/ISOs may require more experience with hybrid resources' operation before determining if new modeling approaches are necessary, given the complexity of the varied operating modes of an integrated hybrid resource. Nevertheless, some commenters noted that a lack of integrated hybrid resource modeling currently is a barrier for interconnection of hybrid resources.<sup>11</sup>

7. For hybrid resources that have not yet entered the interconnection queue, we believe that there are two related issues. First, hybrid resources require that two or more resources be permitted to share a single point of interconnection, and second, the interconnection of hybrid resources can be more efficient if interconnection customers are able to jointly submit a single interconnection request and proceed through the interconnection queue as one project. While it appears that most RTO/ISO regions currently allow customers to co-locate behind a single point of interconnection and proceed as one resource, or are working toward such an approach, a hybrid resource's path for proceeding through the queue may be unclear if details are not included in the tariff or a business practice manual.

8. For an interconnection project that already has entered the interconnection queue, there are additional challenges if it wishes to add storage in order to become a hybrid resource. The addition of a storage resource to an existing interconnection request might be considered a material modification, and in the event that it is, the interconnection

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<sup>9</sup> See CAISO Comments at 5-7; ISO-NE Comments at 4; MISO Comments at 5-8; NYISO Comments at 4-5; PJM Comments at 5-7.

<sup>10</sup> For example, Enel North America, Inc. (Enel) noted that “[c]urrently multiple ISOs study storage under worst case assumptions and assume that storage will charge during peak periods and discharge during light load periods. This can lead to exorbitant upgrade costs that make projects uneconomic.” Enel Comments at 3.

<sup>11</sup> AWEA Comments at 20; Enel Comments at 6; Savion Comments at 5, 7.

customer would be required to either abandon the addition or lose the project's existing interconnection request queue position.

**b. Scope of Reporting Requirement**

9. We direct each RTO/ISO to provide additional information regarding the interconnection process for hybrid resources. Specifically, the RTO/ISO should describe the interconnection process for both a hybrid resource newly entering the interconnection queue and a resource adding a storage component to an existing interconnection request. The description should include details of interconnection request requirements that are specific to hybrid resources (such as parameters necessary for transmission providers to adequately model hybrid resources), how the RTO/ISO models these types of resources both for reliability and market participation, and how an RTO/ISO would treat a request for the addition of storage to an existing interconnection request. The RTO/ISO should also describe any changes to the tariff or business practice manual that would directly affect the interconnection of hybrid resources and that the RTO/ISO is planning or are being discussed in the stakeholder process. If an RTO/ISO has previously provided such information to the Commission, we direct that the RTO/ISO confirm the information that remains relevant and describe any updates that have occurred.

**3. Market Participation**

**a. Background**

10. Each RTO/ISO has taken at least incremental steps to address the market participation issues posed by the integration of hybrid resources. For example, the Commission accepted CAISO's tariff changes to address barriers to market participation faced by hybrid resources.<sup>12</sup> MISO and NYISO each have initiated stakeholder processes to address barriers to hybrid resource participation in their markets.<sup>13</sup> NYISO's stakeholder process explored market participation for the subset of hybrid resources referred to as co-located, front-of-the-meter generators and energy storage resources, in order to develop modifications to existing market rules to accommodate co-located

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<sup>12</sup> *Cal. Indep. Sys. Operator Corp.*, 173 FERC ¶ 61,146 (2020).

<sup>13</sup> MISO Energy Storage Taskforce Hybrid Resources Discussion Outline (Jan. 2019), <https://cdn.misoenergy.org/20190124%20ESTF%20Item%2004%20Hybrid%20Interconn%20Interconnection311836.pdf>**Error! Hyperlink reference not valid.**; NYISO Hybrid Storage Model (Jan. 2020), [https://www.nyiso.com/documents/20142/10252714/Hybrid%20Storage%20Model\\_MI\\_WG\\_Jan%202013%202019.pdf/caf29abe-a431-a2d1-358d-43326153824a](https://www.nyiso.com/documents/20142/10252714/Hybrid%20Storage%20Model_MI_WG_Jan%202013%202019.pdf/caf29abe-a431-a2d1-358d-43326153824a). **Error! Hyperlink reference not valid.**

storage.<sup>14</sup> NYISO's market design proposal for its co-located hybrid storage model was approved unanimously at its Management Committee meeting on November 18, 2020.<sup>15</sup> NYISO currently plans to file the proposal with the Commission in February 2021.<sup>16</sup> PJM has indicated that it plans to integrate hybrid resources into its Order No. 841<sup>17</sup> participation model<sup>18</sup> and has commenced a stakeholder process to identify requirements necessary for the market participation of hybrid resources, with an initial emphasis on solar-storage hybrid resources.<sup>19</sup> ISO-NE issued guidance on the market participation of

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<sup>14</sup> NYISO Hybrid Storage: Proposed Market Design Updates and Energy Market Tariff Revisions for Co-located Storage Resources (CSR) (Oct. 2020), [https://www.nyiso.com/documents/20142/15773723/4%20Hybrid%20Storage\\_Energy%20tariff%20ICAPWG%20MIWG%2010.02.20%20final.pdf/856b5bb8-175c-cd27-e972-b72c34e58a19](https://www.nyiso.com/documents/20142/15773723/4%20Hybrid%20Storage_Energy%20tariff%20ICAPWG%20MIWG%2010.02.20%20final.pdf/856b5bb8-175c-cd27-e972-b72c34e58a19). In its draft presentation, NYISO explains that it is proposing that a co-located resource consist of units with distinct bids and settlements, participating under their respective participation models, but with one Billing Organization and bidding agent, and one point of interconnection. *See* p. 10.

<sup>15</sup> NYISO Management Committee Meeting Final Motions (Nov. 2020), <https://www.nyiso.com/documents/20142/16885911/11182020%20MC%20final%20motions.pdf/9929e383-a5a4-2c24-7907-676e81d1559d>.

<sup>16</sup> Hybrid Storage Model: Co-located Storage Resources (CSR) Market Design Proposal (Nov. 2020), [https://www.nyiso.com/documents/20142/16885911/08%20Hybrid%20Storage\\_CSR.pdf/4794c242-a7dd-dc8e-7571-5b4d443a4198](https://www.nyiso.com/documents/20142/16885911/08%20Hybrid%20Storage_CSR.pdf/4794c242-a7dd-dc8e-7571-5b4d443a4198). In this staff presentation, NYISO explains that it plans to submit the hybrid CSR market design proposal to FERC in early February, 2021, with a requested effective date that would allow the tariff changes to go into effect by Q4 2021. *See* slide 26.

<sup>17</sup> *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 841, 162 FERC ¶ 61,127 (2018), *order on reh'g and clarification*, Order No. 841-A, 167 FERC ¶ 61,154 (2019), *aff'd sub nom. Nat'l Ass'n of Regulatory Util. Comm'rs v. FERC*, 964 F.3d 1177 (D.C. Cir. 2020).

<sup>18</sup> PJM Q&A for Electric Storage Resource Participation Model (Feb. 2019), <https://www.pjm.com/-/media/committees-groups/committees/mic/20190206/20190206-item-07c-faq-for-order-841-and-hybrids.ashx>**Error! Hyperlink reference not valid.**

<sup>19</sup> PJM Solar-Battery Hybrid Resources Issue Charge (June 2020), <https://www.pjm.com/~media/committees-groups/committees/mic/2020/20200603/20200603-item-04a-solar-battery-hybrids-issue-charge.ashx>.

hybrid resources under ISO-NE's current market rules and notes that such rules are likely to evolve.<sup>20</sup> SPP is considering issues pertaining to hybrid resource integration in its stakeholder process.<sup>21</sup>

11. While each RTO/ISO that submitted post-technical conference comments<sup>22</sup> noted that hybrid resources could currently participate in its markets in some form, some RTOs/ISOs and other commenters noted that market rules do not always allow such resources to do so fully or efficiently. Electric Power Research Institute (EPRI) asserted that no RTO's/ISO's software presently allows integrated hybrid resources to be appropriately represented in the RTO/ISO security-constrained unit commitment and economic dispatch models because absent a participation model, dispatch does not fully account for their physical and operational characteristics. However, EPRI notes that many proposals to address these concerns are being initiated across the RTO/ISOs.<sup>23</sup> CAISO acknowledged that hybrid resources may face challenges in following dispatch. For example, a hybrid resource may not be able to follow dispatch instructions based on diminished capacity in the variable energy resource or the battery's state of charge.<sup>24</sup> PJM stated that hybrid resources cannot currently schedule charging as negative megawatts or be dispatched to charge, but that it is working with stakeholders to identify whether hybrid resources that charge from the grid should have access to the Energy Storage Resource participation model or whether another participation model is required to allow hybrids to schedule their charging hours.<sup>25</sup> PJM also expressed concern that it is unable to distinguish the behavior of the individual components of an integrated hybrid

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<sup>20</sup> ISO-NE Market Participation Options for Combined Intermittent/Electric Storage Facilities (Apr. 2020), <https://www.iso-ne.com/static-assets/documents/2020/04/20200408-co-located-market-participation.pdf>.

<sup>21</sup> SPP Electric Storage Resource Steering Committee Meeting Minutes, Item E2 (Mar. 2020), <https://www.spp.org/documents/61731/esrsc%20minutes%20&%20attachments%2020200303.pdf>.

<sup>22</sup> The Commission received post-technical conference comments from five RTOs/ISOs: CAISO, NYISO, MISO, PJM, and ISO-NE.

<sup>23</sup> EPRI Comments at 8-9.

<sup>24</sup> CAISO Comments at 11.

<sup>25</sup> PJM Comments at 8.

resource when the resource owner manages the operation of the resource, which can also lead to a reduction in PJM's situational awareness.<sup>26</sup>

**b. Scope of Reporting Requirement**

12. We direct each RTO/ISO to describe how hybrid resources are currently participating in its wholesale energy, ancillary services, and capacity markets. This should include the services that hybrid resources are eligible to provide and how modeling and bidding is accomplished for such resources. Where the RTO/ISO has modeling and bidding provisions unique to hybrid resources, it should enumerate such provisions. If no specific provisions exist, the RTO/ISO should provide an explanation of whether and how hybrid resources have participated in its markets to date. If hybrid resources are not able to provide certain services, the RTO/ISO should provide an explanation of why they are not able to provide such services. In addition, we direct each RTO/ISO to describe any changes to its tariff or business practice manuals that relate to the market participation of hybrid resources and that the RTO/ISO is planning or that are currently being discussed in the stakeholder process. If RTOs/ISOs have submitted such information to the Commission previously, we direct that each RTO/ISO confirm the information that remains relevant and include any updates that have occurred.

**4. Capacity Valuation**

**a. Background**

13. With respect to determining the capacity value for hybrid resources, RTOs/ISOs have generally incorporated hybrid resources into their existing methods for determining resource capacity values. The RTOs/ISOs are at various stages of either considering or proposing changes to more distinctly accommodate the unique characteristics of hybrid resources. As briefly outlined below, several RTOs/ISOs provided post-technical conference comments addressing the current method that they use to determine the capacity value for hybrid resources, as well as any plans for evaluating specific changes necessary for accommodating hybrid resources.

14. According to MISO and ISO-NE, there is no immediate need for unique capacity accreditation for hybrid resources and their current methods are sufficient for the short-term.<sup>27</sup> With respect to a dedicated capacity valuation method for hybrid resources,

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<sup>26</sup> PJM Comments at 4.

<sup>27</sup> ISO-NE Comments at 17; MISO Comments at 16.

MISO asserted that an Effective Load Carrying Capability (ELCC) analysis<sup>28</sup> may be appropriate after a significant volume of hybrid resources are placed in service and begin providing operational data.<sup>29</sup> ISO-NE explained that it is currently evaluating the ability of an ELCC analysis to value hybrid resources' contributions in order to inform any potential future improvements.<sup>30</sup>

15. Citing to its work over the last several years on Behind-the-Meter Net Generation Resources, Energy Storage Resources, and Distributed Energy Resources, NYISO stated that the integration of hybrid resources "need not be any more complex than other non-traditional configurations."<sup>31</sup> NYISO explained that its Co-located Storage Resource and Hybrid Storage Resource proposals being considered in the stakeholder process will similarly "reflect the market administration and grid operational needs and the needs of its stakeholders."<sup>32</sup>

16. CAISO stated that in California, local regulatory authorities generally define capacity values for resource adequacy, and that the California Public Utility Commission (CPUC) uses an ELCC method for capacity valuation.<sup>33</sup> However, as part of its resource adequacy enhancement stakeholder process, CAISO also stated that it is proposing an Unforced Capacity accounting method, which would entail assigning a resource

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<sup>28</sup> MISO currently employs an ELCC analysis that uses probabilistic modeling to calculate the maximum quantity of Unforced Capacity that can be offered or provided by intermittent generation (e.g., wind), in order to determine the contribution that those resources can make to overall system adequacy. *See Midcontinent Indep. Sys. Operator, Inc.*, 173 FERC ¶ 61,139, at PP 10, 53 (2020).

<sup>29</sup> MISO Comments at 17.

<sup>30</sup> ISO-NE Comments at 17.

<sup>31</sup> NYISO Comments at 6. While NYISO references Docket No. ER19-2276-000, which established an ELCC method to value the capacity contributions of Distributed Energy Resource Aggregations, NYISO does not indicate whether it will consider expanding the use of this method to hybrid or co-located resources.

<sup>32</sup> NYISO Comments at 7.

<sup>33</sup> CAISO Comments at 15. According to CAISO, the CPUC's ELCC method for hybrid resources involves accounting for the energy needed to charge a hybrid resource's storage component, as well as a reduction in capacity for the intermittent component's expected loss of load. With respect to co-located resources, CAISO stated that the CPUC's capacity valuations simply sum the resource adequacy valuations of the respective components.

adequacy credit based on the average availability of a hybrid or co-located resource during the critical hours of need on the system for the quantity of resource adequacy capability, with a targeted implementation by 2023.

17. According to PJM, its current capacity valuation method does not adequately accommodate “closed-loop” hybrid resources because their energy storage components are currently unable to charge from the grid—meaning that charging the storage component is a direct constraint on the intermittent component’s capacity value.<sup>34</sup> On October 30, 2020, PJM filed a proposal to implement an ELCC construct for determining the relative amount of capacity that variable, limited duration, and combination resources may offer in PJM’s capacity market or provide in a Fixed Resource Requirement capacity plan.<sup>35</sup> In response to this filing, the Commission issued a deficiency letter on December 22, 2020, citing the need for additional information about the proposal.<sup>36</sup>

**b. Scope of Reporting Requirement**

18. We direct each RTO/ISO to explain how the capacity value of hybrid resources is currently determined in its markets. We direct each RTO/ISO to describe the method used and any changes to how it calculates capacity values for hybrid resources it is planning or that are currently being discussed in its stakeholder process. If an RTO/ISO has previously provided such information to the Commission, we direct that the RTO/ISO confirm the information that remains relevant and include any updates that have occurred.

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<sup>34</sup> PJM Comments at 13-14.

<sup>35</sup> In that filing, PJM defines a “combination resource” as “a Generation Capacity Resources that has a component with the characteristics of a Limited Duration Resource combined with either a component that has the characteristics of an Unlimited Resource or a component that has the characteristics of a Variable Resource. Combination Resources, for example, might be solar-battery hybrids or Hydropower with Non-Pumped Storage.” PJM Interconnection, L.L.C., Transmittal, Docket No. ER21-278-000, at 15 (filed Oct. 30, 2020).

<sup>36</sup> *PJM Interconnection, L.L.C.*, Deficiency Letter, Docket No. ER21-278-000 (Dec. 22, 2020) (delegated order).

The Commission orders:

(A) Each RTO/ISO is hereby directed to submit informational reports within 180 days from the date of this order, as discussed in the body of this order.

(B) Public comment in response to the informational reports may be submitted within 30 days of the filing of the reports.

By the Commission.

( S E A L )

Nathaniel J. Davis, Sr.,  
Deputy Secretary.