



November 20, 2020

Via Electronic Filing

The Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, N.E. Room 1A
Washington, D.C. 20426

Re: *PJM Interconnection L.L.C., Docket No. ER21-278-000*
Effective Load Carrying Capability Construct

Dear Secretary Bose,

Enclosed for filing in the above-referenced proceeding, please find the Comments of the Public Interest Organizations. As indicated by the attached certificate of service, all parties to the proceeding are being served with a copy of this document. Should you have any questions, please do not hesitate to contact me. Thank you.

Sincerely,

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

PJM Interconnection, L.L.C.

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Docket No.

ER21-278-000

COMMENTS OF THE PUBLIC INTEREST ORGANIZATIONS

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I. INTRODUCTION

Pursuant to Rule 211 of the Federal Energy Regulatory Commission’s (the “Commission” or “FERC”) Rules of Practice and Procedure,¹ the Sustainable FERC Project, Natural Resources Defense Council, Union of Concerned Scientists, and Sierra Club (collectively, the “Public Interest Organizations” or “PIOs”) respectfully submit these comments (“Comments”) in support of the proposed revisions to the Reliability Assurance Agreement Among Load-Serving Entities in the PJM Region (“RAA”) and PJM’s Open Access Transmission Tariff (“Tariff”) filed by PJM Interconnection, L.L.C. (“PJM”) in the above-captioned docket (the “ELCC Filing”).²

The purpose of PJM’s ELCC Filing is to make changes necessary to create and implement an Effective Load Carrying Capacity (“ELCC”) construct (the “ELCC Proposal”) for determining the amount of capacity that variable resources (such as wind and solar), limited duration resources (such as energy storage, or “ESRs”), and hybrid resources (such as combined solar and energy storage) (collectively, the “ELCC Resources”) can offer in PJM’s Reliability Pricing Model (“RPM”) capacity market.

As explained in greater depth herein, the PIOs strongly support PJM’s ELCC Filing and urge the Commission to approve it. First, the ELCC methodology for capacity valuation is just and reasonable, and represents an industry standard for modeling the interactive nature of resources on an evolving grid. Second, PJM’s ELCC Proposal is just and reasonable because it accurately models the capacity contributions of the ELCC Resources and corrects important

¹ 18 C.F.R. § 385.211.

² The RAA and the Tariff can be found in PJM’s “Intra-PJM Tariffs” eTariff title. *See* PJM, *Intra-PJM Tariffs*, <https://etariff.ferc.gov/TariffBrowser.aspx?tid=1731>. Terms not otherwise defined herein shall have the same meaning as set forth in the RAA, Tariff, and the Amended and Restated Operating Agreement of PJM (“Operating Agreement”).

flaws in PJM’s current capacity valuation system, including the dramatic undervaluation of ESRs.

II. PROCEDURAL BACKGROUND

A. PJM’s Order 841 Compliance Process

The impetus for PJM’s ELCC Filing originates from PJM’s compliance process pursuant to Order No. 841,³ which requires the removal of barriers to the participation of electric storage resources in FERC-jurisdictional markets.⁴ Order No. 841 directs Regional Transmission Organizations (“RTOs”) and Independent System Operators (“ISOs”) to create a participation model for electric storage resources that will “remove barriers to the participation of [ESRs] in the capacity, energy, and ancillary service markets.”⁵ In March 2018, numerous parties filed requests for rehearing and motions for clarification.⁶ On May 16, 2019, the Commission issued Order No. 841-A, which clarified the requirements of Order No. 841.⁷

On December 3, 2018, PJM filed two Order No. 841 compliance filings containing proposed revisions to its tariffs. First, PJM submitted a proposed set of changes to its resource

³ *Elec. Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 162 FERC ¶ 61,127 (Feb. 15, 2018) (“Order No. 841”), *order on reh’g*, 167 FERC ¶ 61,154 (May 16, 2019) (“Order No. 841-A”), *aff’d sub nom Nat’l Ass’n of Regul. Util. Comm’rs v. FERC*, 964 F.3d 1177 (D.C. Cir. 2020).

⁴ Order No. 841 defines an electric storage resource as “a resource capable of receiving electric energy from the grid and storing it for later injection of electric energy back to the grid.” Order No. 841 at P 29. PJM has adopted essentially identical language as its definition of “energy storage resource.” *Order No. 841 Compliance Filing – ESR Accounting Proposal*, at 7, Docket No. ER19-462-000 (Dec. 3, 2018) (defining “Energy Storage Resource” as “a resource capable of receiving electric energy from the grid and storing it for later injection to the grid that participates in the PJM Energy, Capacity and/or Ancillary Services markets as a Market Participant.”) (“ESR Accounting Model Filing”). Where these Comments refer to ESRs, the intended reference is to Energy Storage Resources as defined by PJM in its tariff.

⁵ Order No. 841-A.

⁶ *See e.g., Mot. for Clarification of PJM*, Docket Nos. RM16-23 and AD16-20 (Mar. 16, 2018); *Req. for Clarification and Reh’g of the Nat’l Ass’n of Regulatory Utility Comm’rs*, Docket Nos. RM16-23 and AD16-20 (Mar. 19, 2018); *Mot. for Clarification and Req. for Reh’g of the AES Companies*, Docket Nos. RM16-23 and AD16-20 (Mar. 16, 2018).

⁷ Order No. 841-A.

definitions and accounting procedures, in order to facilitate accounting for energy sold to ESRs, docketed at ER19-462.⁸ Second, PJM submitted a proposed set of changes to its market rules to create a participation model for ESRs in all of its markets (the “ESR Participation Model Filing”), docketed at Docket No. ER19-469.⁹

On February 1, 2019, the Commission approved PJM’s ESR Accounting Model Filing.¹⁰ On February 7, 2019, numerous parties, including the PIOs, filed comments on PJM’s ESR Participation Model Filing.¹¹ The PIOs’ comments raised numerous issues, including the assertion by PJM in its transmittal letter for its ESR Participation Model Filing that ESRs would be subject to a ten-hour minimum run-time requirement (the “10 Hour Rule”) in order to participate in PJM’s capacity market, for which PJM relied upon a new interpretation of language from a business manual but not any filed tariff language.¹² The PIOs objected that such a 10 Hour Rule would be unjust and unreasonable, and that it would need in any event to be introduced via filed tariff language rather than the announcement of a new interpretation of a business manual.¹³

On April 1, 2019, the Commission submitted a request to PJM for more information in connection with its ESR Participation Model Filing.¹⁴ On May 1, 2019, PJM submitted its response, which included an amended compliance filing.¹⁵ On October 17, 2019, the

⁸ ESR Accounting Model Filing.

⁹ *Order No. 841 Compliance Filing, ESR Markets and Operations Proposal*, Docket No. ER-19-469-000 (Dec. 3, 2018).

¹⁰ *PJM*, 166 FERC ¶ 61,087 (Feb. 1, 2019).

¹¹ *Protest and Comments of PIOs*, Docket No. ER19-469 (Feb. 7, 2019) (“PIO Comments”); *Protest of the American Wind Energy Ass’n and the Solar Council*, Docket No. ER19-469 (Feb. 7, 2019); *Comments of Advanced Energy Economy*, Docket No. ER19-469 (Feb. 7, 2019); *Protest and Comments of the Energy Storage Ass’n*, Docket No. ER19-469 (Feb. 7, 2019) (“ESA Comments”).

¹² PIO Comments at 6–7.

¹³ *Id.*

¹⁴ *Compliance Filing for Order No. 841*, Docket No. ER-19-469-000 (Apr. 1, 2019).

¹⁵ *Response to April 1, 2019 Request for Additional Information*, Docket No. ER-19-469-000 (May 1, 2019).

Commission issued an order approving PJM’s ESR Participation Model Filing as satisfying Order 841’s requirements, subject to certain modifications.¹⁶

B. The Commission’s Section 206 Investigation

The Commission’s October 2019 Order also addressed matters beyond the scope of Order 841. The October 2019 Order found that the question of whether or not the 10 Hour Rule would be just and reasonable was outside the scope of Order 841.¹⁷ However, the Commission agreed with the PIOs and other commenters that PJM’s minimum run-time requirement must be contained under filed tariff language, rather than business manuals, pursuant to the Commission’s “rule of reason policy,” under which provisions that “‘significantly affect rates, terms, and conditions’ of service” must be included in a filed tariff.¹⁸

Consequently, the Commission directed PJM to file tariff language covering the minimum run-time rules for all resources.¹⁹ The Commission also found that “the record in this proceeding raises concerns that PJM’s application of its minimum run-time rules and procedures to [ESRs] may be unjust, unreasonable, unduly discriminatory or preferential.”²⁰ Accordingly, the Commission initiated, pursuant to Section 206 of the Federal Power Act, a paper hearing in Docket No. EL19-100 to determine whether or not PJM’s minimum run-time rules are unjust, unreasonable, unduly discriminatory or preferential as applied to ESRs.²¹ The Commission set a deadline of December 12, 2019 for PJM to file the requested tariff language and for parties to submit briefing on the application of PJM’s minimum run-time rules to ESRs.²²

¹⁶ *PJM*, 169 FERC ¶ 61,049 (Oct. 17, 2019) (“October 2019 Order”).

¹⁷ *Id.* at P 139.

¹⁸ *Id.* at P 140.

¹⁹ *Id.*

²⁰ *Id.* at P 141.

²¹ *Id.* at P 142.

²² *Id.* at P 143. The Commission ordered that these actions be performed within 45 days of the publication of notice in the Federal Register, and the resultant deadline fell on December 12, 2019.

On November 26, 2019, PJM filed a motion for a 90-day extension for the briefing, until March 11, 2020, in order to allow for stakeholder discussions, including discussion of potential alternative approaches to capacity valuation.²³ On December 6, 2019, the Commission issued an order granting the requested extension.²⁴ On December 12, 2019, PJM filed tariff language addressing the minimum run time procedures for all resources in Docket No. ER20-584.²⁵

On February 27, 2020, after a series of stakeholder discussions, PJM moved to hold the proceedings in Docket Nos. EL19-100 and ER20-584 in abeyance until January 29, 2021 in order to allow time for PJM and its stakeholders to develop an ELCC methodology for capacity valuation that would address the concerns identified in the Commission's October 2019 Order.²⁶

On March 3, 2020, the Commission granted an extension on the deadline for briefs in Docket No. EL19-100 until April 27, 2020. On April 10, 2020, the Commission issued an order (the "April 2020 Order") that consolidated Docket Nos. EL19-100 and ER20-584 and granted an abeyance of those consolidated proceedings until October 30, 2020.²⁷ The April 2020 Order also provided that if PJM submits, pursuant to Section 205 of the Federal Power Act, proposed tariff amendments reflecting a new proposed methodology for capacity valuation prior to October 30, 2020, then the consolidated proceedings will be held in abeyance pending disposition of the Section 205 filing.

²³ *Mot. for Extension of time of PJM*, Docket Nos. EL19-100 et al. (Nov. 26, 2019).

²⁴ *Notice Granting Extension of Comment Period*, Docket No. EL19-100 (Nov. 27, 2019).

²⁵ *Compliance Filing Regarding Minimum Run Duration Requirements*, Docket No. EL19-100 (Dec. 12, 2019). FERC's October 2019 Order instructed PJM to file this tariff language in a new "ER" denominated docket. October 2019 Order at 107. Accordingly, PJM filed the tariff language in a new docket, which was assigned Docket No. ER20-584.

²⁶ *Mot. of PJM to Hold Proceedings in Abeyance and for Shortened Comment Period and Expedited Action*, Docket Nos. EL19-100 and ER20-584 (Feb. 27, 2020).

²⁷ *PJM*, 171 FERC ¶ 61,015 (Apr. 10, 2020).

On March 29, 2020, PJM formed a new task force called the Capacity Capability Senior Task Force (“CCSTF”), which was tasked with developing an ELCC proposal.²⁸ After meetings throughout the summer, the CCSTF presented an ELCC proposal to PJM’s Markets and Reliability Committee on September 17, 2020, which approved it in a sector-weighted vote of 3.98/5.²⁹ On the same day, PJM’s Members Committee also reviewed the proposal, and approved it in a sector-weighted vote of 4.05/5, representing 81% approval.³⁰ On September 23, 2020, PJM’s Board of Directors conditionally accepted the substance of the proposal, pending development of final tariff amendment language by PJM staff.³¹ PJM’s Board of Directors subsequently approved the final language prior to filing on October 30, 2020.³²

III. ARGUMENT

A. The ELCC Approach to Capacity Valuation is Just and Reasonable

The purpose of PJM’s capacity construct is to use market-based mechanisms to obtain commitments from sufficient resources to ensure a desired level of reliability.³³ To accommodate a market-based approach, PJM expresses the reliability value of all capacity resources in units of unforced capacity (“UCAP”), which is the installed capacity of a unit rated at summer conditions that is not on average experiencing a forced outage or forced derating.³⁴ Each megawatt (“MW”) of UCAP represents roughly the contribution a theoretical 1 MW generation station that is perfectly available at all times would make to PJM’s ability to serve load.

²⁸ *ELCC 205 Filing*, at 7, Docket No. ER21-278-000 (Oct. 30, 2020) (“ELCC Filing”).

²⁹ *Id.*

³⁰ *Id.* at 7–8.

³¹ *Id.*

³² *Id.*

³³ PJM, RAA (Rate Schedule FERC No. 44) (“RAA”), Article 2; *Compliance Filing Regarding Minimum Run Duration Requirements*, at 3, Docket No. EL19-100-000 (Dec. 12, 2019).

³⁴ RAA, Article 1 at 23 (definition for “Unforced Capacity”).

As PJM’s system has historically been dominated by dispatchable resources (fossil-fuel or nuclear plants), PJM adopted the system of determining UCAP by using a simple rule of a resource’s demonstrated output under summer conditions (referred to as that resource’s installed capacity, or “ICAP”), discounted for that resource’s historical outage rate.³⁵ This method is simple and was reasonably accurate when system resources consisted mostly of traditional baseload and dispatchable generation.³⁶

However, this simple calculation does not apply well to resources with different characteristics than fossil fuel plants: many renewables produce an uncertain amount of power each hour, there is no obvious way to incorporate the duration limits of storage technology, demand response has time of day and duration limits, and so on. Over the years, the share of such total capacity provided by these technologies has grown. In response, PJM has devised a variety of heuristics to determine a UCAP for these resource types,³⁷ along with rules to compensate for the limits of those heuristics.³⁸ As discussed *supra*, the shortcomings of this ad hoc approach attracted Commission concern when PJM determined that the UCAP of ESRs should be based on the output they can sustain for 10 continuous hours.³⁹

PJM now proposes to use the ELCC methodology to measure the UCAP of some resource types. ELCC analysis was introduced over 50 years ago,⁴⁰ and is well-established as an

³⁵ RAA, Schedule 5. *See also* PJM, *PJM Manual 21: Rules and Procedures for Determination of Generating Capacity*, at 12 (Aug. 1, 2019) (“PJM Manual 21”).

³⁶ Though it assumes generation outages are random and uncorrelated, an assumption that was put to the test when stress on the natural gas system caused multiple simultaneous plant outages during the winter of 2014–15.

³⁷ *See, e.g.*, PJM Manual 21, App. B (setting procedures to determine capacity value of wind and solar resources). *See also* PJM, 134 FERC ¶ 61,066 (Jan. 31, 2011) (approving PJM’s proposal to establish various categories of demand response and defining their equivalency with traditional generation).

³⁸ *See, e.g.*, PJM, 146 FERC ¶ 61,052 (setting limits on various demand response categories based on their availability).

³⁹ October 2019 Order at PP 139–141.

⁴⁰ L.L. Garver, *Effective Load-Carrying Capability of Generating Units*, IEEE Transactions on Power Apparatus and Systems, Vol. PAS-85, Issue 8 (Aug. 1966).

industry best practice for measuring resource adequacy.⁴¹ In recent decades, abundant work has established the applicability of ELCC to measuring resource adequacy in power systems containing significant solar, wind, and storage deployments.⁴² The Midcontinent Independent System Operator (“MISO”) states that “ELCC is the preferred methodology for determining the capacity value of wind” and uses the method to determine wind units UCAP.⁴³ ELCC is also used by CAISO and the California Public Utilities Commission (“CPUC”) for wind, solar photovoltaic, and solar thermal resources.⁴⁴

As described in the Garrido Affidavit, the ELCC methodology uses statistical techniques to compare a range of expected demands for power in each hour of a year with the probability that a grid operator’s generation fleet, taken as a whole, will be able to provide various amounts of power.⁴⁵ The probability that demand exceeds load, summed over all hours of the year, is the “loss of load expectation” (“LOLE”), which PJM aims to maintain at less than 10%, or once every ten years.⁴⁶ The marginal resource adequacy contribution of any individual resource or group of resources can be determined by evaluating the system with and without the resource(s) in question,⁴⁷ making the approach appropriate as a basis for determining the UCAP of market participants.

⁴¹ E. Ibanez & M. Milligan, *Comparing Resource Adequacy Metrics and their Influence on Capacity Value*, National Renewable Energy Laboratory (Apr. 2014), <https://www.nrel.gov/docs/fy14osti/61017.pdf>.

⁴² See, e.g., Bethany A. Frew, *Assessing Capacity Value of Wind Power*, National Renewable Energy Laboratory (Nov. 17, 2016).

⁴³ MISO, *Planning Year 2019-2020 Wind & Solar Capacity Credit*, at 3–6 (Dec. 2018), <https://cdn.misoenergy.org/2019%20Wind%20and%20Solar%20Capacity%20Credit%20Report303063.pdf>.

⁴⁴ CPUC R.17-09-20, *Qualifying Capacity Methodology Manual Adopted 2017*, at 8, <https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442455533>.

⁴⁵ ELCC Filing, Attach. C, Affidavit of Dr. Patricio Rocha Garrido on Behalf of PJM Interconnection, L.L.C. (“Garrido Affidavit”).

⁴⁶ *Id.* at P 18.

⁴⁷ *Id.* at PP 20–22.

This approach directly models resource adequacy at a fine level of detail, and as such, is a significant improvement over the various rules-of-thumb PJM proposes to replace. A key virtue is that ELCC reasonably and fairly provides a common measure of the UCAP value for a variety of resource types. Rather than relying on arbitrary (or at least draconian) dictums such as ‘all capacity must be available at all times,’ an ELCC-based approach takes resources’ physical and operational capabilities as given, and incorporates those particulars in determining an appropriate UCAP value. This supports proper market functioning and price formation by accurately measuring the quantity of UCAP each seller may offer while avoiding arbitrary barriers to entry.

ELCC also captures several specific effects important to modeling contemporary power grids, particular as the resource mix changes to include greater penetrations of wind, solar, and energy storage resources:

- Correlations. PJM’s current rules treat each capacity resource as independently experiencing random outages. This approach fails, potentially dangerously, when a common event can cause multiple outages, such as when cloudy or windless weather, gas pipeline outages, or extreme temperatures impair multiple power plants. In a similar but beneficial effect, the output of solar and demand response often correlates with load, increasing their resource adequacy benefit. ELCC automatically incorporates such effects, so long as they are accounted for in determining the probable output of the generation fleet during each hour.
- Diminishing returns. Related to the above, many technologies initially have high marginal resource adequacy benefits that decrease as more of that technology is deployed. A prominent example is how the marginal value of

adding more solar power declines as net peak loads are shifted away from daylight hours. These effects are captured in ELCC, which will generally show that resources with limited availability or diurnal/seasonal cycles lose UCAP as more of those resources installed. This reasonably and fairly captures the risk associated with building variable or limited-duration resources compared to dispatchable unlimited ones, ensuring that ELCC produces capacity valuations that do not discriminate against or privilege any resource.

- Synergies. In contrast to a traditional approach to capacity valuation that simply examines resource units in isolation, ELCC captures the reality that a fleet made up of resources with complementary characteristics may have a UCAP that is greater than the sum of its individual components. Solar and wind may produce most reliably at different times of the day or year; storage may be particularly well-suited to the short residual afternoon peaks left by solar or the distinctive load shapes created by demand response deployments. Critically, ELCC captures both the benefits and limits of this approach, and measures both the UCAP of, for example, combined wind-solar-storage fleets *and* the amount of traditional dispatchable generation needed to ‘plug the gaps’ left behind by such a fleet.

Based on these features, the PIOs respectfully submit that the ELCC approach reflects current engineering best practices and is a reasonable method to determine the UCAP of a fleet of mixed resources. ELCC is non-discriminatory in that it provides a consistent and rigorous analytical basis for determining the UCAP of resources with differing capabilities. It is also non-discriminatory because it avoids the potentially arbitrary outcomes of applying estimates

developed for one technology to others and the barriers to entry that can arise from setting bright-line market participation criteria.

B. PJM’s ELCC Proposal for Capacity Valuation is Just and Reasonable and Should Be Approved

1. PJM’s ELCC Proposal is Just and Reasonable Because it Reasonably Accurately Models the Capacity Contributions of the ELCC Resources, Including Energy Storage

a) Overview

As explained above, the ELCC methodology, as a general matter, is a just and reasonable approach to capacity valuation. PJM’s specific proposed implementation of ELCC is also just and reasonable, because it will provide for accurate modeling of the capacity contributions of the ELCC Resources. In its ELCC Filing, PJM proposes to apply ELCC to determine UCAP values for three categories of ELCC Resources: ESRs (which PJM includes in a general “Limited Duration Resources” category), wind, solar, and other variable resources (“Variable Resources”), and hybrid facilities comprised of ESRs and Variable Resources (“Combination Resources”).⁴⁸

The first reason why PJM’s ELCC Proposal will produce reasonably accurate results is that it will rely on a comprehensive range of data inputs, enabling it to generate accurate capacity values for resources based on best available information. PJM has indicated that its ELCC analysis will “include[] the following six primary data sources:

1. Historical weather and load data;
2. Historical output of existing Variable Resources;
3. Estimates of putative historical output for planned Variable Resources;
4. Forced outage patterns for Unlimited Resources;
5. Resource deployment forecast; and
6. Modeling parameters for Limited Duration Resources and Combination Resources.”⁴⁹

⁴⁸ ELCC Filing at 8.

⁴⁹ *Id.* at 24.

These inputs enable PJM to develop a model that simulates grid operations at a high level of detail, properly and accurately evaluating the contributions of the ELCC Resources to resource adequacy.⁵⁰

PJM's proposed use of these data inputs shows how they will contribute to ensuring accurate modeling: First, PJM will develop a probabilistic projection of summer and winter load profiles using a range of potential future hourly loads derived from actual weather patterns of previous years; it will simulate the hourly output of each resource category using the same range of weather and other variables, to derive a series of resource-specific availability/unavailability patterns; and then it will simulate economic dispatch following conservative principles that simulate how resources will be used in practice.⁵¹ Because both load patterns and generator output derive from a common set of weather data, PJM's approach captures the correlations between weather, load, and generator performance described above.⁵²

Second, PJM's ELCC Proposal will reasonably implement the modeling of interactivity and synergistic effects between resources that is core to the ELCC methodology. The proposed process does not treat different generation or generation categories units in isolation, but models and values the ability of the entire projected generation fleet when determining their potential capacity values.⁵³ This interactivity is important to modeling reliability as the resource mix changes to include more wind, solar, energy storage, and hybrid facilities.

And this sophisticated calculation cuts both ways: the model will appropriately increase ELCC values for ESRs and variable resources as they are joined by higher levels of

⁵⁰ *Id.* at 24–26.

⁵¹ *Id.* at 26–30.

⁵² Although PJM does not at this time propose to apply ELCC to traditional generation, the method is well suited for characterizing the risks arising from multiple gas-fired units relying on the same pipeline, or of extreme temperatures reducing overall fleet availability.

⁵³ ELCC Filing at 12–13.

complementary resources (e.g., ESR ELCC values will go up as variable resources are integrated at higher levels, and vice versa); but it will also appropriately decrease ELCC values for ESRs and variable resources as the integration rate of those resources increases (e.g., wind resources will see ELCC values drop as more wind resources are integrated).⁵⁴

b) The ELCC Proposal's Storage Modelling is Reasonably Accurate

Given that the ELCC Filing originated from the Commission's Section 206 investigation into PJM's capacity valuation rules for ESRs,⁵⁵ it is important to note that the ELCC Proposal provides for reasonably accurate modeling of the capacity contributions of ESRs (and a marked improvement from the 10 Hour Rule). Notably, the ELCC Filing establishes a 4-hour duration class for ESRs along with three other duration classes ranging up to ten hours,⁵⁶ which help more accurately capture the variety of ways that ESRs can serve grid reliability, including through helping meet peak needs during short periods.

One distinctive feature of ESRs is that they offer a tradeoff between high power for short periods or lower power for longer periods; there may well be situations where reliability is better served, for example, by an additional 5 MW for 2 hours than by 1 MW for 10 hours.⁵⁷ These contributions are possible due to the highly controllable nature of ESRs.⁵⁸ Notably, ESRs can be called upon to provide energy to precisely fill gaps between load and energy produced by other resources.⁵⁹ Approaches that require ESRs to always derate to meet long duration runtime

⁵⁴ ELCC Filing at 14.

⁵⁵ See *supra* Section II.A.

⁵⁶ ELCC Filing at 14.

⁵⁷ See, e.g., Sustainable FERC, *Capacity Value of Storage Resources*, at 4–6 (July 10, 2020) (“Sustainable FERC Report”), <https://www.pjm.com/-/media/committees-groups/task-forces/ccstf/2020/20200710/20200710-item-06c-capacity-value-of-storage-resources.ashx>.

⁵⁸ PIO Comments at 15; ESA Comments, Carden Aff. at P 11.

⁵⁹ PIO Comments at 15. See also Aramazd Muzhikyan et al., *Limited Energy Capability Resource Duration Requirement for Participation in PJM Capacity Market*, at 2–3, 2019 IEEE Power & Energy Society Innovative

requirements fail to capture this benefit. By including shorter duration classes, PJM’s proposed approach reasonably accurately incorporates this feature of storage resources.⁶⁰

PJM’s preliminary model results show that, under current conditions, a 4-hour ESR has an ELCC of 92% of its nameplate rating, declining to 75% as the amount of ESRs increases to 1,500 MW.⁶¹ This result is reasonably consistent with multiple analyses showing how such an approach enables a more accurate measure of the contribution to reliability by ESRs than that captured by an invariant 10 Hour Rule. One study, commissioned from Astrapé by the Energy Storage Association and NRDC, takes a ‘bottom-up’ approach: it models the PJM grid in detail, simulates how it would perform under many different conditions, and then determines how much generation could be replaced with storage while maintaining the same reliability level.⁶² This approach found that in PJM’s current market, ESRs with continuous operation capability of 4 to 6 hours can provide capacity equivalent to conventional resources until roughly 4,000 MW of 4-hour ESRs are incorporated into PJM’s resource mix,⁶³ and that beyond this level, the value of 4-hour ESRs diminishes.⁶⁴ Since PJM’s current planning peak is 152,647 MW,⁶⁵ this 4,000 MW represents about 3% of peak load.

Smart Grid Technologies Conference (2019) (“IEEE Study”), <https://www.pjm.com/-/media/library/reports-notices/special-reports/2019/esr-duration.ashx?la=en>.

⁶⁰ PIOs believe that ESRs are most accurately measured without fixed duration classes but consider the four-hour class in PJM’s ELCC Proposal to be an approximation within the zone of reasonableness under current conditions.

⁶¹ Patricio Rocha-Garrido, *Public 2nd Draft ELCC Results*, at 5 (Aug. 12, 2020) (“Preliminary ELCC Results”), <https://www.pjm.com/-/media/committees-groups/task-forces/ccstf/2020/20200812/20200812-item-04-2nd-draft-prelim-ELCC-results.ashx>.

⁶² Kevin Carden et al., *Capacity Value of Energy Storage in PJM*, at 2, Astrapé Consulting (July 2019) (“Astrapé Study”).

⁶³ *Id.*

⁶⁴ *Id.* at 20.

⁶⁵ PJM, *2021–2022 RPM Base Residual Auction Parameters*, <https://www.pjm.com/-/media/markets-ops/rpm/rpm-auction-info/2021-2022/2021-2022-bra-planning-period-parameters.ashx?la=en>.

A second study was jointly conducted by PJM staff and Dartmouth College reaches similar results.⁶⁶ It used a ‘top-down’ approach, examining PJM’s historical load shapes and determining how much storage capability would be required to meet any given portion of peak loads. It concluded that storage with a 4-hour duration would have similar reliability value to traditional generation up to “about 3% of the annual peak.”⁶⁷ The study also found that beyond this 3% level, the capacity value of 4-hour storage would begin to decrease.⁶⁸

Thus, PJM’s proposal agrees with other studies that under current conditions, 4-hour ESRs bring roughly the same benefit as a traditional generator with the same maximum output. PJM’s proposed method has the value of 4-hour storage fall off more quickly as more is installed than the other studies. The PIOs attribute this difference partially to PJM’s use of conservative operational assumptions in their model. These assumptions are reasonable given the limited experience with this new resource type.

c) The ELCC Proposal Allows For Operational Improvements

The way PJM dispatches different resources in its ELCC model will necessarily impact how much those different resources provide, and thus their resulting ELCC value. Discussion during the CCSTF revealed that the resource adequacy value of ESRs depends closely on how they are optimized between reserves and energy markets, and how they are operationally coordinated with demand response.⁶⁹

⁶⁶ IEEE Study at 5.

⁶⁷ *Id.*

⁶⁸ *Id.* at 6.

⁶⁹ Sustainable FERC Report at 11–15. *See also* Astrapé Consulting, *Dispatch Effects on Storage ELCC in PJM*, at 5–10 (July 16, 2020), <https://www.pjm.com/-/media/committees-groups/task-forces/ccstf/2020/20200716-workshop/20200716-item-03-dispatch-effects-on-elcc.ashx>.

PJM’s current approach, by its own admission, “conservatively simulates the behavior of” ESRs.⁷⁰ PJM indicated during the stakeholder process that changing its operational protocols is outside the scope of its rule, and fundamentally the ELCC calculation should accurately incorporate the existing protocols. The PIOs agree, but note that as PJM gains experience in how to most effectively use ESRs, the dispatch assumptions used in the ELCC modeling should be updated to reflect those improvements. Those dispatch assumptions are reflected in the “Resource Deployment Forecast” inputs used in the ELCC model. By leaving that deployment forecast to be specified outside of the filed Tariff, PJM provides a reasonable route to incorporate future operational refinements into ELCC calculations.

Second, the PIOs note that in future filings, PJM should consider adding another ESR duration class at two hours, to enable those yet-shorter-duration ESRs to participate at their full capacity potential. While PJM is correct to note that “a 2-hour storage resource can join the 4-hour class by using an Effective Nameplate Capacity of 50 percent of the maximum power rating, since such a resource could run for four hours at half power,”⁷¹ this merely captures the lower bound for those resources. This observation does not justify a policy that effectively imposes on those 2-hour ESRs the same arbitrary restriction that was imposed on 4-, 6-, and 8-hour resources under PJM’s previous 10 hour rule. The PIOs do not object to the 4-hour requirement as unduly discriminatory under current conditions, but note that this could change under different circumstances.⁷²

⁷⁰ ELCC Filing at 30 (also noting that the model simulates dispatch of demand-side resources after all other resources, likely reducing their modeled participation).

⁷¹ *Id.* at 14.

⁷² In particular, short duration/high power storage brings an outsized reliability benefit in systems with either high ramp requirements or very “peaky” net load.

Lastly, while the ELCC Filing represents an important step forward for ESRs and hybrid resources, particularly through its modeling of the synergistic effects of wind, solar, and energy storage, the PIOs look forward to further development of modeling for hybrid facilities. The ELCC Filing essentially treats hybrid facilities (Combination Resources, in PJM's parlance) as two separate facilities. While the overall inter-resource interactivity modeled by the ELCC Proposal reasonably captures much of the benefit of hybrid facilities, it does not capture the more fine-grained co-optimization possible for the operation of the components of a hybrid facility. The PIOs anticipate that PJM's understanding, treatment, and procedures for hybrid facilities to evolve, much as has been the case for the familiar combination of combustion turbines and steam turbines we know as combined cycle plants.

2. PJM's ELCC Proposal Corrects an Unjust and Unreasonable Status Quo for ESRs

An additional reason that the Commission should approve the ELCC Proposal is that it corrects an unjust and unreasonable status quo for ESRs. The 10 Hour Rule currently applied by PJM dramatically undervalues the capacity contributions of ESRs because it fails to allow ESRs to provide capacity according to their full technical capability.⁷³ While ESRs are energy-limited (they can store a limited quantity of energy) they are also precisely dispatchable (they can be dispatched nearly instantaneously with no minimum run time or downtime).⁷⁴ Notably, ESRs can be called upon to provide capacity at any point of the peak load curve to precisely fill gaps between load and energy produced by other resources.⁷⁵ In contrast, as the PIOs have previously

⁷³ This result is not only unjust and unreasonable, it is also inconsistent with the policy objectives of Order No. 841. PIO Comments at 8.

⁷⁴ ESA Comments, Carden Aff. at P 11.

⁷⁵ PIO Comments at 15. *See also* IEEE Study at 2–3.

commented, the 10 Hour Rule “is equivalent to valuing storage as if it were a non-dispatchable, block-loaded resource similar to demand response.”⁷⁶

As noted above, following consideration of comments on PJM’s Order No. 841 compliance filings (including the PIOs’ comments), the Commission took note of these problems. The Commission found that the record indicated that PJM’s capacity valuation rules for storage may be “unjust, unreasonable, unduly discriminatory or preferential” because the 10 Hour Rule may not be “based on a sound consideration of physical and operational characteristics” of ESRs.⁷⁷

As discussed above, multiple studies have shown that the invariant imposition of a 10 hour runtime requirement prevents ESRs from making substantial capacity contributions possible at shorter runtimes.⁷⁸ This undervaluation of the capacity of ESRs has significant real world consequences. As the PJM Cities and Communities Coalition has pointed out, cities in the PJM Region are often host to highly polluting peaking power plants that could be replaced with ESRs if the technical capability of ESRs to help meet peak load was accurately valued.⁷⁹ The impacts of such peaking power plants tend to fall disproportionately on low-income communities and communities of color, raising serious environmental justice issues.⁸⁰

In sum, PJM’s ELCC Proposal, which was the product of extensive stakeholder discussions over the summer,⁸¹ should be approved because it provides a reasonable way forward

⁷⁶ October 2019 Order at P 140.

⁷⁷ ELCC Filing at 5–6.

⁷⁸ See *supra* Section III.A.1.b. As noted above, two independent studies show that ESRs with a 4-hour runtime could contribute approximately 3% of PJM’s peak load under current conditions.

⁷⁹ PJM Cities and Communities Coalition, *PJM CCC Policy Statement on the Benefits of Reducing Barriers to Energy Storage in the PJM Region* (Nov. 18, 2020), <https://files.wri.org/s3fs-public/uploads/pjmccc-storage-policy-statement.pdf>.

⁸⁰ *Id.*

⁸¹ As PJM’s ELCC Filing notes, the CCSTF met 13 times, and various stakeholders, including the PIOs, participated in additional meetings with PJM staff. ELCC Filing at 7.

to correct pressing problems with how ESRs are treated in the capacity market. While the ELCC Proposal has significant technical merits, most importantly its accurate modeling of ESRs and the other ELCC Resource, its correction of an unjust, unreasonable, and unsustainable status quo furnishes an independent reason for approval.

C. PJM Should Conform its Interconnection Procedures to Be Consistent with its ELCC Proposal and its Tariff

In order to ensure that PJM’s ELCC Proposal is implemented in the manner described in PJM’s ELCC Filing, it is essential that PJM conform the interconnection procedures in its business manuals to be consistent with the ELCC Proposal and its Tariff. As the Commission has instructed, “the filed and accepted tariff is the governing document and not the Business Practice Manuals - the former has precedence over the latter and not the other way around.”⁸²

As discussed above, the heart of PJM’s ELCC Proposal is establishing an accurate, just and reasonable ELCC methodology for determining the UCAP capacity valuation assigned to the ELCC Resources.⁸³ Capacity resources may, in general, offer up to their UCAP in PJM’s capacity market. However, this is constrained by each resource’s Capacity Interconnection Rights (“CIRs”), which measure how much output the capacity resource has the right to inject into the grid.⁸⁴ As part of the interconnection process, resources apply for their CIRs, and may be required to pay for transmission upgrades to support those CIRs. PJM’s Tariff provides that resources may receive CIRs “commensurate with the size in megawatts of the generation,” but

⁸² *MISO*, 117 FERC ¶ 61,113, 61,597 (Oct. 26, 2006); *See also MISO*, 122 FERC ¶ 61,172, 61,965 (Feb. 25, 2008) (“To the extent the Business Practice Manuals contain greater detail than the tariff...the greater detail supplements the tariff and does not override the tariff.”); *Midwest Indep. Transmission Sys. Operator, Inc. Pub. Utilities with Grandfathered Agreements in the Midwest ISO Region*, 108 FERC ¶ 61,163, 62,012 (Aug. 6, 2004) (“We share WEPCO’s concern that the Business Practice Manuals should not take precedence over the TEMT.”).

⁸³ *See supra* at Sections III.A–B.

⁸⁴ Tariff, Section 1 (definition of “Capacity Interconnection Rights”).

leaves the specific determination of this value to PJM business manuals.⁸⁵ Thus, any limit set by PJM's business manuals on a resource's ability to apply for CIRs functions as a *de facto* limit on that resource's UCAP capacity valuation.⁸⁶

Wind and solar resources, which fall within the Variable Resources category of the ELCC Resources, may find themselves in such a situation. Eligibility for CIRs is set in PJM's Manual 21,⁸⁷ which sets CIR eligibility for wind and solar resources based on their average summer peak hour output.⁸⁸ The summer average peak hour output of solar resources in PJM appears to support eligibility for CIRs ranging from 38% to 60% of nameplate capacity,⁸⁹ while preliminary results show solar resources in PJM assigned a UCAP of 65% of nameplate capacity under the ELCC methodology.⁹⁰

Thus, a portion of resources' ELCC capacity value may be stranded and undeliverable due to business manual provisions limiting eligibility for transmission service, resulting in an inconsistency with the UCAP capacity valuation determined pursuant to the ELCC Proposal's methodology. This result would be inconsistent with language in PJM's Tariff specifying that “[w]hen a Generation Interconnection Customer's generation is accredited as deliverable through the applicable procedures in Part VI and Part VI of the Tariff, the Generation Interconnection Customer also shall receive Capacity Interconnection Rights commensurate with the size in megawatts of the generation as identified in the Interconnection Service Agreement.”⁹¹

⁸⁵ Tariff, Section 230.2.

⁸⁶ We emphasize that we are concerned with limits of general applicability, not specific circumstances that make CIRs difficult or impossible to obtain at a particular location.

⁸⁷ PJM Manual 21, Section 1.

⁸⁸ *Id.* Section 1.1.7.

⁸⁹ PJM, *Class Average Capacity Factor—Wind and Solar Resources* (June 2017), <https://www.pjm.com/-/media/planning/res-adeq/class-average-wind-capacity-factors.ashx?la=en>.

⁹⁰ Preliminary ELCC Results at 5.

⁹¹ Tariff, Section 230.2.

To avoid the problem of business manual language overriding tariff language, the PIOs respectfully request that the Commission clarify its expectation that PJM, consistent with its Tariff, allow ELCC Resources to apply for sufficient CIRs to support their full ELCC capacity value.⁹² To the extent that amendments to PJM's manuals may be needed to ensure such consistency with the Tariff, the PIOs respectfully request that the Commission clarify its expectation that PJM will make such necessary conforming amendments to avoid a conflict between business manual language and filed Tariff language.

IV. CONCLUSION

In recent years, markets have been driving significant investment in wind, solar, energy storage, and hybrid facilities in the PJM Region. The ELCC Proposal contained in PJM's ELCC Filing represents a just and reasonable way of modeling the reliability contributions of these resources, and corrects an unjust and unreasonable status quo that dramatically undervalues the capacity contributions of energy storage. For the reasons explained in these Comments, the PIOs respectfully request that the Commission approve PJM's ELCC Filing.

November 20, 2020

Respectfully submitted,

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⁹² *MISO*, 122 FERC ¶ 61,172, 61,965 (Feb. 25, 2008); *MISO*, 117 FERC ¶ 61,113, 61,597 (Oct. 26, 2006); *Midwest Indep. Transmission Sys. Operator, Inc. Pub. Utilities with Grandfathered Agreements in the Midwest ISO Region*, 108 FERC ¶ 61,163, 62,012 (Aug. 6, 2004).

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CERTIFICATE OF SERVICE

I hereby certify that the foregoing has been served in accordance with 18 C.F.R. § 385.2010 upon each party designated on the official service list in this proceeding, by email.

Dated: November 20, 2020

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