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UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: Richard Glick, Chairman;
James P. Danly, Allison Clements,
Mark C. Christie, and Willie L. Phillips.

Modernizing Wholesale Electricity Market Design

Docket No. AD21-10-000

ORDER DIRECTING REPORTS

(Issued April 21, 2022)

1. In this order, we direct each regional transmission organization and independent system operator (RTO/ISO) — specifically, California Independent System Operator Corp. (CAISO); ISO New England, Inc. (ISO-NE); Midcontinent Independent System Operator, Inc. (MISO); New York Independent System Operator, Inc. (NYISO); PJM Interconnection, L.L.C. (PJM); and Southwest Power Pool, Inc. (SPP) (collectively, the RTOs/ISOs) — to submit information to the Commission related to their wholesale markets.¹ In particular, we direct each RTO/ISO to, within 180 days from the date of this order, file with the Commission in this docket a report that describes: (1) current RTO/ISO system needs given changing resource mixes and load profiles; (2) how each RTO/ISO expects its system needs to change over the next five years and over the next 10 years; (3) whether and how each RTO/ISO plans to reform its energy and ancillary services (E&AS) markets to meet expected system needs over the next five years and over the next 10 years; and (4) information about any other reforms, including capacity market reforms and any other resource adequacy reforms that would help each RTO/ISO meet changes in system needs. Public comments in response to the RTO/ISO reports may be submitted within 60 days following the filing of the reports. The Commission will review the reports and comments to determine whether further action is appropriate.

¹ The Federal Power Act (FPA) authorizes the Commission to obtain this information. FPA section 301(b) provides that the Commission shall at all times have access to, and the right to inspect and examine, all accounts and records of public utilities, which includes RTOs and ISOs. 16 U.S.C. § 825(b). FPA section 309 grants the Commission the authority to “perform any and all acts, and to prescribe, issue, make, amend, and rescind such orders, rules and regulations as it may find necessary and appropriate to carry out the provisions of [the FPA].” 16 U.S.C. § 825h.

I. Background

2. RTOs/ISOs administer several markets that facilitate transactions between wholesale buyers and wholesale sellers of electric power. Among those markets are E&AS markets that RTOs/ISOs use to facilitate transactions both of energy and of the ancillary services needed to support the transmission of that energy from wholesale generators to wholesale loads. RTOs/ISOs, like all public utility transmission providers, are required to provide certain ancillary services as part of providing transmission service to customers.² RTOs/ISOs procure certain ancillary services through market-based mechanisms in RTO/ISO-administered E&AS markets. RTOs/ISOs are increasingly facing new operational challenges as the resource mix and customer electric loads change. The resource mix is changing to include more weather-dependent variable energy resources (VERs), electric storage resources, and co-located and hybrid resources. At the same time, customer electric loads are changing due to increased deployment of distributed energy resources and electrification, among other factors. The operational challenges created by these changes have led RTOs/ISOs to consider E&AS market reforms to meet future system needs reliably and at just and reasonable rates.

3. In response to these industry trends and to examine the potential need for market reforms to meet changing system needs, the Commission held two technical conferences on September 14, 2021 (September 14 conference), and October 12, 2021 (October 12 conference), in Docket No. AD21-10-000 (together, E&AS conferences).³ The September 14 conference focused on key drivers of the needs for additional operational flexibility in RTO/ISO E&AS markets, revising existing operating reserve demand curves (ORDC), creating new products to address operational flexibility needs, and RTO/ISO market design issues and tradeoffs to consider in such reforms. The October 12 conference focused on incenting resources to reflect their full operational

² For background on ancillary services in RTO/ISO markets, operational challenges that RTOs/ISOs are facing as resource mixes and customer load profiles change (including variability and uncertainty of net loads), and various reforms introduced or contemplated by RTOs/ISOs to date, see Commission Staff Paper, *Energy and Ancillary Services Market Reforms to Address Changing System Needs*, Docket No. AD21-10-000 (September 7, 2021) (E&AS Staff Whitepaper).

³ *Modernizing Electricity Market Design*, Supplemental Notice of Technical Conference on Energy and Ancillary Services in the Evolving Electricity Sector, Docket No. AD21-10-000 (September 3, 2021) (attaching agenda); *Modernizing Electricity Market Design*, Supplemental Notice of Technical Conference on Energy and Ancillary Services in the Evolving Electricity Sector, Docket No. AD21-10-000 (September 13, 2021) (attaching agenda). Commission staff issued the E&AS Staff Whitepaper ahead of the technical conferences.

flexibility; maximizing the operational flexibility of new and emerging resource types; revising RTO/ISO market models, optimization, and other software elements; and out-of-market operator actions. On December 6, 2021, the Commission invited all interested parties to submit post-conference comments to address issues raised in the E&AS conferences.⁴ Initial comments were due on February 4, 2022, and reply comments were due on March 7, 2022.

A. Conference Discussions and Post-Conference Comments

4. The majority of panelists at the E&AS conferences and post-conference commenters agreed that changes in the resource mix and customer electric loads introduce greater levels of variability and uncertainty in the net loads⁵ that RTOs/ISOs must reliably serve in real time. In turn, this variability and uncertainty creates new operational challenges and associated needs for RTOs/ISOs, referred to herein as “changing system needs.” Changing system needs include the need for greater operational flexibility, characterized by some panelists to include the ability to respond to dispatch instructions, fast ramp-up and ramp-down rates, short start-up and shut-down times, and long-duration delivery of energy.⁶ Although panelists and commenters identified the need for greater operational flexibility as the most important changing system need, they also pointed out other changing system needs driven by the industry trends noted above, such as resource sustainability and dependability.⁷

⁴ *Modernizing Wholesale Electricity Market Design*, Notice Inviting Post-Technical Conference Comments, Docket No. AD21-10-000 (December 6, 2021).

⁵ The E&AS Staff Whitepaper defined net load as load minus the output of non-dispatchable resources. E&AS Staff Whitepaper at 7. According to the E&AS Staff Whitepaper, “net load variability is often described as having two dimensions: (1) expected and reasonably forecastable changes within the operating day and across seasons; and (2) unexpected changes that cannot be forecasted due to the inherent uncertainty of the components of net load (e.g., meteorological conditions).” *Id.* at 8.

⁶ *See, e.g.*, September 14 Conference Tr. 19:20-25, 21:1-5, 38:23-25-39:1-2, 54:7-22; Clean Energy Organizations February 7, 2022 Comments at 12; American Clean Power Association February 4, 2022 Comments at 5; Edison Electric Institute February 4, 2022 Comments at 7.

⁷ *See, e.g.*, ISO-NE February 4, 2022 Comments at 3 (“[O]ur issue is not insufficient investment in ‘flexible’ resources per se. Rather, the concerns we face are centered on energy sustainability and dependability.”); September 14 Tr. 33:12-24; Electric Power Suppliers Association February 4, 2022 Comments at 8.

5. Panelist discussions at the E&AS conferences and post-conference comments did not identify a clear generic or “one-size-fits-all” solution to modernizing E&AS markets to meet changing system needs. Rather, panelists stressed that system needs will differ significantly across RTOs/ISOs, in large part due to differences in resource mixes across RTOs/ISOs and the expected differences in how each RTO/ISO’s system needs will change over time.⁸ While some RTOs/ISOs face an increasing need for sufficient quantities of energy from dispatchable resources in real time, for example, other RTOs/ISOs face an increasing need for faster resource commitment, startup, and ramping.⁹ Panelists at the E&AS conferences also debated whether operational needs driven by net load variability and uncertainty should be reflected in an RTO/ISO’s demand for reserves or reflected in separate and more tailored ancillary services, such as short-term and long-term ramping products.¹⁰ As another alternative to introducing new reserve requirements or ancillary services, panelists also discussed how net load variability and uncertainty could be reflected in changes to look-ahead unit commitment processes, including the look-ahead period that the RTO/ISO uses in its energy dispatch process.¹¹ Panelists generally highlighted the need for each RTO/ISO to develop solutions that reflect its current needs and challenges and stressed that solutions will likely not be identical in the near term, even if common solutions emerge over time.¹²

6. Some panelists commented that reforms beyond the E&AS markets might be necessary, including reforms to other RTO/ISO markets and reforms beyond the control of RTOs/ISOs themselves. Several panelists and post-conference comments advocated for the continued use and importance of capacity markets, with some advocating for capacity market reforms and others suggesting new resource adequacy constructs to meet system needs.¹³ Panelist discussions also referred to several factors outside of RTO/ISO-administered markets that could challenge the RTO’s/ISO’s ability to meet

⁸ See, e.g., CAISO February 4, 2022 Comments at 3.

⁹ See generally Commission Staff Paper, *Energy and Ancillary Services Market Reforms to Address Changing System Needs*, Docket No. AD21-10-000, at 12-13 (September 7, 2021). See, e.g., September 14 Conference Tr. 27:19-25, 28:1-3, 49:7-11; CAISO February 4, 2022 Comments at 3.

¹⁰ See, e.g., September 14 Conference Tr. 89:16-21, 95:2-12.

¹¹ See, e.g., October 12 Conference Tr. 132:13-25.

¹² See, e.g., September 14 Conference Tr. 21:15-24, 64:4-8; EEI February 4, 2022 Comments at 5, 12.

¹³ See, e.g., PJM February 1, 2022 Comments at 5; October 12 Conference Tr. 129:7-12.

future system needs, including transmission-distribution coordination and inflexible fuel supplies.¹⁴

II. Discussion

7. At this time, we do not propose a generic solution to address changing system needs across the RTOs/ISOs because of the diversity of those needs and the lack of a compelling record to support any one-size-fits-all solution for meeting those needs. Instead, we believe that it is appropriate to gather additional information from the RTOs/ISOs, as detailed below, to enhance our understanding of the changing system needs in each RTO/ISO and potential mechanisms for addressing those needs as they change over time. We will review the reports and comments to determine whether further action is appropriate.

8. Below, we provide summaries of comments on the major topics that constitute the reports directed by this order followed by the questions to which RTOs/ISOs must respond. As explained below, we direct RTOs/ISOs to answer questions about the following topics: the system needs that each RTO/ISO currently faces; the changing system needs that each RTO/ISO expects to face over the next five years and over the next 10 years; any E&AS market reforms the RTO/ISO plans to propose and how the RTO/ISO expects those reforms will meet the expected changing system needs over the next five years and over the next 10 years; and potential reforms that may be needed beyond E&AS market reforms discussed at the conference to meet the expected changing system needs, including reforms beyond the domain of the RTOs/ISOs themselves.

A. Current System Needs

1. Comments

9. Panelists and commenters discussed how changes in the resource mix and load profiles have already created new system needs in certain RTOs/ISOs. CAISO panelist Rahul Kalaskar discussed the uncertainty between day-ahead and real-time markets and the need to manage the imbalances resulting from that uncertainty.¹⁵ Kalaskar described that, as the CAISO grid has evolved, the need for energy from dispatchable resources on a five-minute basis and 15-minute basis became the most important system need.¹⁶ Kalaskar further explained that this need motivated CAISO's development of its flexible

¹⁴ See, e.g., October 12 Conference Tr. 236:12-25, 237:1-7; October 12 Conference Tr. 55:1-10

¹⁵ September 14 Conference Tr. 24:4-22.

¹⁶ September 14 Conference Tr. 49:7-13.

ramp product. In comments, CAISO noted that its imbalances between the day-ahead market and the real-time market have sometimes exceeded 6,000 MW in recent years, caused by both differences in granularity between the day-ahead and real-time markets and difficulty in forecasting net load.¹⁷ CAISO also noted in comments that over the last decade, CAISO has observed increasing net load variability and uncertainty between its day-ahead and real-time markets.¹⁸

10. PJM panelist Adam Keech discussed the need to integrate uncertainties into how the demands for ancillary service products are defined.¹⁹ Keech explained that load forecast error is the largest source of uncertainty PJM faces today, but PJM can typically meet this uncertainty using the unloaded capability of generation units it has brought onto the system.²⁰ However, Keech stated that PJM's reserve markets do not clearly value this unloaded capability under the current market design.

11. ISO-NE panelist Mark Karl discussed how the ability of natural gas-fired resources to generate sustainable output is currently the primary focus of ISO-NE's market design efforts.²¹ In comments, ISO-NE expressed a need for the reliable delivery of energy whenever its "just-in-time" resources unexpectedly fail to do so.²² In contrast to other RTOs/ISOs, ISO-NE stated that it has plenty of fast-starting, fast-ramping, and energy storage resources; instead, ISO-NE stated that its key needs are sustainability and dependability of resource output.²³

12. SPP panelist Jodi Woods discussed wind resource deviations as creating a significant need for balancing resources.²⁴ Woods described how SPP's day-ahead wind forecast errors were 4.5% on average throughout 2020, which at times amounted to 950 MW—a level comparable to SPP's second largest single resource contingency. Woods also described instances of day-ahead wind forecast errors reaching 30%, which

¹⁷ CAISO February 4, 2022 Comments at 4-5.

¹⁸ CAISO September 14, 2021 Comments at 1-2.

¹⁹ September 14 Conference Tr. 27:6-18.

²⁰ September 14 Conference Tr. 82:1-20.

²¹ September 14 Conference Tr. 33:12-24.

²² ISO-NE February 4, 2022 Comments at 1.

²³ ISO-NE February 4, 2022 Comments at 3.

²⁴ September 14 Conference Tr. 37:1-15.

in some cases translates to a 6,000 MW deviation—2.5 times greater than the total reserves SPP can access at any given time. SPP MMU panelist Keith Collins explained that, currently, resources are paid to produce energy rather than quickly and accurately follow dispatch instructions.²⁵ Collins explained that the reason VERs do not provide certain capabilities needed for reliable operation is because the market has not asked for them.²⁶

13. MISO panelist Jessica Harrison stated that MISO is currently experiencing changing ancillary service needs.²⁷ Harrison noted that on April 6, 2021, MISO experienced a system ramp need of 6 GW, which was outside the 97th percentile of the past year's 10-minute ramp uncertainty range between intraday commitment and real-time dispatch, and that it occurred after the peak when less ramp capability exists.²⁸ Harrison stated that MISO is seeing ramp shortages increase in frequency.²⁹ Harrison stated that MISO's current approach is to define discrete reserve products that are co-optimized with energy and operating reserves.³⁰

2. Reporting Requirement

14. Based on the record in this proceeding, it appears that the RTOs/ISOs currently face changing system needs that vary significantly by RTO/ISO. The time horizon (minutes, hours, days, seasons) of system needs, particularly with respect to net load variability and uncertainty, also appears to vary significantly across RTOs/ISOs. While currently, RTOs/ISOs with the highest penetration of VERs (e.g., CAISO and SPP) have been the subject of most discussions and market reforms to address net load variability and uncertainty, other RTOs/ISOs also expect their system needs to change in the future, and the Commission and stakeholders would benefit from additional information from all RTOs/ISOs on the subject.

15. As such, we direct each RTO/ISO to submit information related to its current system needs. Specifically:

²⁵ SPP MMU October 8, 2021 Comments at 3.

²⁶ SPP MMU September 13, 2021 Comments at 4-5.

²⁷ September 14 Conference Tr. 200: 23-25.

²⁸ September 14 Conference Tr. 201: 1-8.

²⁹ September 14 Conference Tr. 201: 9-10.

³⁰ September 14 Conference Tr. 201: 12-14.

1. What system needs (type and magnitude) has the RTO/ISO experienced that are attributable to changes in the resource mix and customer load profiles? How do these system needs, including types and magnitudes of net load variability and uncertainty, vary over different time horizons in the E&AS markets? For example, does a particular need exist within a real-time market interval, within an operating day, between day-ahead and real-time markets, across multiple days, and between seasons? RTO/ISO materials, such as previously published RTO/ISO whitepapers or previous filings with the Commission, may be incorporated by reference as needed. What specific resource capabilities could address these needs (e.g., dispatchable generation)?

B. Expected Changing System Needs

1. Comments

16. Panelists and commenters also noted that new system needs will emerge in the future as the resource mix evolves and load profiles change. NYISO panelist Mike DeSocio discussed the expected increases in system needs for resources that will respond in minutes and seconds and provide energy output for hours and days.³¹ DeSocio also discussed increasing risks from correlated output reductions, outages, or maximum generation trips among weather-dependent resources.³² For example, DeSocio explained that weather events such as a hurricane with associated cloud cover could cause a decline in solar output greater than the current single source contingencies that define NYISO's reserve requirements.³³ In comments, NYISO states that it expects an important new system need for dispatchable, emission-free, long-duration resources to manage long periods of reduced VER output, such as low-wind and overcast days.³⁴ NYISO expects extended "energy droughts" to become an increasingly severe risk of the forthcoming resource mix, using the term "energy security" to refer to the myriad risks NYISO sees emerging from this resource mix.³⁵ NYISO explained that, in the future, resource response times will need to be quicker and the duration of sustained energy

³¹ September 14 Conference Tr. 19:20-25.

³² September 14 Conference Tr. 20:1-18.

³³ September 14 Conference Tr. 79:6-23.

³⁴ NYISO February 4, 2022 Comments at 3.

³⁵ NYISO February 4, 2022 Comments at 34.

output will need to be longer than is typical today in order to manage both intermittent resources and energy-limited resources.³⁶

17. In comments, MISO stated that it has distilled the emerging and shifting reliability needs into four categories: uncertainty and variability, resource models and capabilities, location, and coordination.³⁷ MISO explained that its 2021 Markets of the Future report³⁸ put forward a comprehensive vision of the sequence of emerging and shifting needs.³⁹ MISO explained that this vision guides the extensive work MISO is doing to prepare its markets for changing system needs, an effort MISO refers to as “the response to the reliability imperative.”⁴⁰

18. In comments, Electric Power Suppliers Association (EPSA) emphasized the importance of defining a point during the course of change in the resource mix and load profiles that new system needs might emerge or existing system needs might increase significantly.⁴¹ EPSA noted that needs that do not exist or are *de minimis* now might become of critical importance and magnitude in future years. R Street Institute’s Beth Garza claimed that real-time risks and uncertainties are evolving, changing, and growing in many regions, and argued that it is important to continually rethink what are the appropriate reserves to procure to protect against those risks.⁴²

2. Reporting Requirement

19. Based on the record in this proceeding, it appears that all RTOs/ISOs expect system needs to change in the near future, but the particular changes and pace will vary across RTOs/ISOs. Moreover, the discussion around expected changing system needs in this proceeding has been at a relatively high level and therefore lacked specificity about what types of system needs will become more (less) challenging to satisfy; when in the

³⁶ NYISO February 4, 2022 Comments at 6.

³⁷ MISO February 4, 2022 Comments at 5.

³⁸ MISO, *Markets of the Future: A Reliability Imperative Report* (November 2021), <https://cdn.misoenergy.org/MISO%20Markets%20of%20the%20Future604872.pdf>.

³⁹ MISO February 4, 2022 Comments at 5.

⁴⁰ MISO February 4, 2022 Comments at 5.

⁴¹ EPSA February 4, 2022 Comments at 8.

⁴² September 14 Conference Tr. 86:3-19.

future each system need will become more (less) challenging to satisfy; and the magnitude each system need will have such that it becomes more (less) challenging to satisfy.

20. As such, we direct each RTO/ISO to submit information related to expected changes in its system needs. Specifically:

2. Referring to the system needs identified in answering question 1, how does the RTO/ISO expect those system needs to change over the next five years? Over the next 10 years? What does the RTO/ISO expect the magnitude of those system needs to be in five years? In 10 years?
 - 2.1 In answering, please provide a high-level overview of the methods used to develop the system needs forecast over the next five years and over the next 10 years. Please provide a high-level discussion of any industry trends that are particularly important to the RTO's/ISO's forecast, such as electric vehicle adoption, behind-the-meter distributed energy resource deployment, increased demand response participation and price-responsive load, growth in transmission infrastructure, and other trends. In evaluating the impact of such industry trends, how does input from efforts by states, local agencies, and utility programs inform that analysis?
 - 2.2 What time horizons, such as times of day (e.g., minutes, hours), days, or seasons, are expected to present the biggest challenges with respect to net load variability and uncertainty? Why?
3. What new system needs not already described, if any, does the RTO/ISO expect to emerge over the next five years? Over the next 10 years? What are the drivers of those new system needs? Are those new system needs quantifiable, and if so, please provide information on how you have quantified those needs.

C. **Reforms to RTO/ISO Markets and Operations to Manage Expected Changing System Needs**

1. **Comments**

a. **Aligning the Time Horizon and Direction of Ancillary Service Products with System Needs**

21. Discussions at the technical conferences and in comments emphasized the importance of E&AS products that align with the time horizon of system needs, and discussed both shorter-term products (e.g., fast frequency response products) and longer-term products (e.g., multi-hour ramping products) to manage operational needs and uncertainties over different time horizons. Regarding longer-term ramping products,

CAISO panelist Greg Cook noted that CAISO's current real-time ramping product is designed to meet the ramping needs identified between the 15- and five-minute markets, but ramping needs exist over longer time periods (e.g., over several hours). Cook stated that, as a result, CAISO is looking at whether extending the time horizon of the flexible ramping product is needed.⁴³ SPP panelist Jodi Woods explained SPP's plans for a short-term ramp product and an uncertainty product to manage longer-term ramp needs, adding that the uncertainty product would pre-position resources for ramping needs that might arise over a longer time horizon.⁴⁴ ISO-NE panelist Matt White stated that ramping products could help ensure that co-optimized energy and ancillary services dispatch meets needs for both abrupt contingency reserves as the reliability standards require and to meet sustained energy ramps that may be a result of net load changes.⁴⁵ White contended that 10-minute reserves alone will not generally meet broader ramping needs cost-effectively since those needs involve net system load ramp that is longer than the 10-minute contingency requirement.⁴⁶ PJM panelist Adam Keech discussed the need to make new time-differentiated ancillary service products to meet operational needs that occur over different time horizons.⁴⁷

22. Many commenters highlighted the potential value of shorter-term products such as frequency response products. SPP panelist Gary Cate stated that SPP is considering adding a primary frequency response product to its market. Cate noted that, in the short term, such a product ensures that conventional resources are being paid for the services that the market has not typically paid for but that resources have always provided and, in the long term, incents development and clarifies the minimum requirements.⁴⁸ ESIG panelist Debbie Lew noted the ability of wind and solar resources to provide primary frequency response as wind resource penetration has increased, which has resulted in ERCOT lowering its regulation requirements.⁴⁹

23. Many commenters described potential reforms to value resources' downward-ramping capability explicitly and separately from upward-ramping capability,

⁴³ September 14 Conference Tr. 138:16-25, 139:1-6.

⁴⁴ September 14 Conference Tr. 38:3-18.

⁴⁵ September 14 Conference Tr. 222: 9-15.

⁴⁶ September 14 Conference Tr. 222: 16-22.

⁴⁷ September 14 Conference Tr. 28:4-11.

⁴⁸ September 14 Conference Tr. 188:6-11, 188:20-25, 189:1-7.

⁴⁹ September 14 Conference Tr. 30:6-13.

the latter being the typical focus of ancillary service products. In comments, PJM noted that it is considering the separation of some ancillary service products into up and down products.⁵⁰ NYISO panelist Mike DeSocio further noted NYISO has been considering separating its reg up and reg down for the same reasons as PJM.⁵¹ ESIG panelist Debbie Lew emphasized the importance of having “downward” products that value generators’ ability to reduce output or rapidly shut down. Lew noted that despite the importance of downward products, these products do not get as much attention as “upward” products like contingency reserves. CAISO Panelist Rahul Kalaskar described reforms CAISO will be making to its flexible ramping product, including procuring both upward and downward flexibility in the day-ahead market.⁵² In comments, CAISO stated that it plans to introduce new day-ahead imbalance reserves and use the reliability unit commitment process to schedule downward ramping capacity through its day-ahead market enhancements (DAME) initiative.⁵³ Middle River Power noted in comments that a limitation of using contingency reserves and associated ORDC reforms to manage net load variability and uncertainty is that they only procure upward ramping capability and not downward capability.⁵⁴

b. E&AS Markets Fail to Compensate Resources for Costs of Meeting System Needs

24. Despite the widespread use of opportunity cost payments for ancillary service pricing, commenters expressed different views on whether basing compensation on the opportunity cost of foregone energy sales will continue to create proper incentives for resources as energy prices are expected to decline over time. Commenters questioned whether current products and pricing would be adequate for recovering the costs associated with meeting system needs, including operational flexibility needs.

25. Many panelists and commenters questioned whether pricing ancillary services based on the opportunity cost of forgone energy will continue to be appropriate as the resource mix and system needs change over time. ISO-NE panelist Mark Karl opined that compensating resources that provide “on call” energy based on the opportunity cost of forgone energy revenues (derived from Locational Marginal Prices or LMP) may not be sufficient because such resources incur costs, including arranging fuel supplies in

⁵⁰ PJM October 12, 2022 Comments at 3.

⁵¹ October 12 Conference Tr. 117:18-21, 123:15-25.

⁵² September 14 Conference Tr. 58:20-25, 59:1-21.

⁵³ CAISO February 4, 2022 Comments at 8.

⁵⁴ Middle River Power February 4, 2022 Comments at 4.

advance, that might not be recovered through LMPs.⁵⁵ Recurrent Energy panelist Cari VanAmburg Collins contended that the current practice of pricing ancillary service products based on the opportunity cost of selling energy effectively increases a resource's operating costs without increasing its compensation and fails to reflect the value of a resource's flexibility.⁵⁶ SPP MMU panelist Keith Collins observed that, even when LMPs are zero or negative, the opportunity cost of providing reserves might still be non-zero due to volatility in demand for reserves.⁵⁷ Collins argued that an alternative pricing structure for ancillary services based on something other than the opportunity costs of selling energy would make sense.⁵⁸ In comments, Middle River Power similarly contended that ancillary service prices based on opportunity costs are inadequate for incentivizing investment, and that ancillary service payments more generally are currently too low to incentivize investment.⁵⁹

26. Conversely, some panelists argued that ancillary service prices are not too low to encourage investment because they are not designed to encourage investment in the first place and because they will increase in the future. California Public Utilities Commission (CPUC) panelist Mike Castelhana stated that in California, investment decisions are driven by resource adequacy contract revenues instead of through E&AS markets.⁶⁰ Contrary to other panelists, Castelhana expressed comfort with how revenues are split between resource adequacy payments and energy in CAISO.⁶¹ CAISO panelist Greg Cook agreed with Castelhana's statement that flexible ramping product pricing is not meant to incentivize investment, explaining that the price signal is meant to ensure resources follow dispatch instructions and minimize uninstructed deviations.⁶² SPP panelist Gary Cate argued that prices for ramping products will increase in the future.⁶³ Cate explained that, as some traditional resources leave the market in the medium-term,

⁵⁵ September 14 Conference Tr. 48:9-16.

⁵⁶ September 14 Conference Tr. 219:7-25

⁵⁷ September 14 Conference Tr. 238:19-25, 239:1-16

⁵⁸ September 14 Conference Tr., 239:8-16

⁵⁹ Middle River Power February 4, 2022 Comments at 3, 5, 8.

⁶⁰ September 14 Conference Tr. 155:18-25, 156:1-4.

⁶¹ September 14 Conference Tr. 155:18-25, 156:1-4.

⁶² September 14 Conference Tr. 158:19-25, 159:1-8.

⁶³ September 14 Conference Tr. 153:18-25, 153:1-2.

the remaining ones will keep energy prices high enough to still result in higher ancillary services prices based on opportunity costs. Further, Cate expressed expectations that tax credits for renewable resources will phase out, which will further increase ancillary service prices.

c. **Defining Demand Curves for Ancillary Service Products and the Role of the Value of Lost Load (VOLL)**

27. Panelists agreed on the importance of establishing the demand curve for ancillary service products carefully and rigorously, but disagreed on the best approach, particularly with regard to using VOLL in such demand curves. Potomac Economics panelists Pallas LeeVanSchaick and David Patton and Office of the People’s Counsel for the District of Columbia (OPC-DC) panelist Anjali Patel stated that ORDC reforms should be based around VOLL⁶⁴ and the probability of lost load associated with various reserve levels.⁶⁵ Patton argued further that all ancillary service products’ demand curves should be based on the VOLL.⁶⁶ Patton contended that an ancillary service demand curve based on VOLL – especially one that procures more than the minimum reserves required – is defensible even when it produces a relatively low shortage price for the ancillary service product.⁶⁷ Patton contended that such an ancillary service demand curve is more defensible than current curves because it “start[s] with a fundamental value and then [shows] what that [value] implies about each of the products and how to price [them].”⁶⁸ Conversely, some panelists struck a cautionary note regarding use of VOLL in market designs. Monitoring Analytics panelist Catherine Tyler stated that, because it is difficult to be precise when it comes to calculating VOLL and operational uncertainty, the market must approach VOLL-related solutions in a conservative way.⁶⁹ NYISO panelist Mike DeSocio stated that VOLL is an important metric but that it has different meanings depending on the context and that it cannot be relied on solely to establish market

⁶⁴ VOLL represents customers’ willingness to pay for electricity service (or avoid curtailment). *See, e.g.,* London Economics, *Estimating the Value of Lost Load: Briefing paper prepared for ERCOT by London Economics International LLC*, at 6 (2013).

⁶⁵ September 14 Conference Tr. 83:23-25, 84:1-21, 92:14-20, 210:1-17.

⁶⁶ September 14 Conference Tr. 210:1-17.

⁶⁷ September 14 Conference Tr. 211:21-25, 212:1-18

⁶⁸ September 14 Conference Tr. 212:5-8.

⁶⁹ September 14 Conference Tr. 113:3-17.

clearing prices or demand curves.⁷⁰ Patel stated that consumers must be a part of the discussion with regard to calculating VOLL, and that other E&AS markets beyond the reserve market must be considered when determining whether enough resources are being procured.⁷¹

28. Several panelists debated the merits of procuring reserves beyond the minimum levels required by reliability requirements. NYISO panelist Mike DeSocio explained that procuring additional reserves would help NYISO manage instances where uncertainties regarding correlated variable resource output exceed the single source contingencies that define NYISO's reserve requirements.⁷² Conversely, Monitoring Analytics panelist Catherine Tyler argued that using an extended ORDC designed to create a "scarcity adder" to LMP during normal operating circumstances was administrative energy pricing, that such administrative pricing should be limited to reserve shortages, and that using extended ORDCs during normal operating conditions does not have a role in a RTO/ISO with a capacity market.⁷³ Tyler argued that reserves beyond the minimum reliability requirements do not have value, because the actual probability of losing load when the appropriately defined reserve requirements are met is negligible almost all the time.⁷⁴ Tyler stated that it might be appropriate for RTOs/ISOs to extend their reserve requirements based on current operating conditions and operator actions.⁷⁵ However, Tyler emphasized that there are no "real" demand curves for reserves, and warned that setting energy prices based on the ORDC creates a heavy burden to demonstrate that they reflect the customer demand for the associated product.⁷⁶

d. E&AS Markets Pay Resources That Do Not Contribute to Satisfying System Needs

29. Several panelists and commenters asserted that current and proposed E&AS market designs pay equal revenues or prices or both to resources whether or not those resources actually contribute to satisfying system needs. Maryland Office of People's

⁷⁰ September 14 Conference Tr. 103:20-25, 104:1-3.

⁷¹ September 14 Conference Tr. 105:20-106:16.

⁷² September 14 Conference Tr. 80:5-24.

⁷³ September 14 Conference Tr. 89:8-21.

⁷⁴ September 14 Conference Tr. 90:5-11.

⁷⁵ September 14 Conference Tr. 90:19-25, 91:1-6.

⁷⁶ September 14 Conference Tr. 91:7-14.

Counsel panelist Bill Fields clarified that policies which simply increase reserve requirements fail to incentivize flexibility.⁷⁷ Fields explained that this is because such policies increase revenues to both flexible and inflexible resources without providing resources any incentive to be more flexible. PJM Industrial Customer Coalition panelist Susan Bruce similarly noted that ORDC reforms such as those proposed in PJM increase payments to inflexible resources and require customers to support resources that are not helping to meet system needs.⁷⁸ In a similar theme, ISO-NE panelist Mark Karl explained the importance of making sure that if quick start resources are needed, compensation goes to quick start resources and not to slower moving resources that just happen to be online when quick start is needed.⁷⁹ Competitive Power Ventures panelist Sherman Knight noted that the energy markets pay the same amount to units that submit different ramp rates⁸⁰ and contended that assigning value to resource flexibility is important.⁸¹ Monitoring Analytics panelist Catherine Tyler stated that PJM needs to account for capacity resource performance, noting that there have been situations in PJM where resources' energy market offers are flexible but the resources' actual performance is not and fails to meet capacity performance requirements.⁸² PJM panelist Adam Keech noted his concern that PJM's current day-ahead 30-minute reserve product does not give resources the incentive to purchase fuel and deliver energy in real time when reserves are called upon.⁸³

e. **Undue Discrimination in E&AS Market Rules**

30. Discussions at the technical conferences and in comments raised the possibility that there is some discrimination in current E&AS markets and that future reforms should not introduce further discrimination. In comments, American Clean Power Association and Clean Energy Organizations⁸⁴ recommended that the Commission initiate an FPA

⁷⁷ October 12 Conference Tr. 212:6-14.

⁷⁸ September 14 Conference Tr. 44:1-7.

⁷⁹ September 14 Conference Tr. 47:10-16.

⁸⁰ October 12 Conference Tr. 19:12-18.

⁸¹ October 12 Conference Tr. 21:5-12.

⁸² October 12 Conference Tr. 33:8-23.

⁸³ September 14 Conference Tr. 52:5-21.

⁸⁴ Clean Energy Organizations include the following entities: Sierra Club; Natural Resources Defense Council; Sustainable FERC Project; NW Energy Coalition;

section 206⁸⁵ proceeding against transmission providers with discriminatory rules or practices that restrict participation in certain markets or services based upon resource class rather than resource capabilities, either *de facto* or facially, such as MISO.⁸⁶ American Clean Power Association also recommended in comments that the Commission take action against policies and practices that are unduly preferential toward inflexible resources.⁸⁷ Conversely, Vistra stated that claims that current market rules “subsidize” or “accommodate” inflexibility are misguided and argues that the physical and operational characteristics of conventional resources should be recognized in the RTO/ISO unit commitment and dispatch process, just as the Commission required RTOs/ISOs to do for storage resources in Order No. 841.⁸⁸

31. Enel North America panelist Betsy Beck noted that there are still exceptions such as the inability of dispatchable variable energy resources to participate in SPP’s regulation market.⁸⁹ EPSA stated that current RTO/ISO market rules generally do not prevent new and emerging resource types from participating in E&AS markets.⁹⁰ EPSA nonetheless emphasized the importance of using and increasing market competition to satisfy system needs, stating that any resource technically capable of providing a product or service should be allowed by market rules to do so.⁹¹ Edison Electric Institute emphasized the importance of avoiding undue preference in paying generators that perform differently the same amount, and avoiding undue discrimination in imposing requirements on some resources but not others while providing the same compensation.⁹²

Conservation Law Foundation; the American Council on Renewable Energy; and Enel North America, Inc.

⁸⁵ 16 U.S.C. § 824e.

⁸⁶ American Clean Power Association February 4, 2022 Comments at 6; Clean Energy Organizations February 7, 2022 Comments at 5.

⁸⁷ American Clean Power Association February 4, 2022 Comments at 2-3.

⁸⁸ Vistra Corp. March 7, 2022 Comments at 9-10.

⁸⁹ October 12 Conference Tr. 82:14-23, 83:6-20, 84:3-19, 85:4-8.

⁹⁰ EPSA February 4, 2022 Comments at 5.

⁹¹ EPSA February 4, 2022 Comments at 5.

⁹² Edison Electric Institute February 4, 2022 Comments at 6.

f. **Operator Tools, Improved Forecasting, and Other Solutions to Operational Challenges Associated with Changing System Needs**

32. Discussions at the technical conferences and in comments identified challenges to existing RTO/ISO operational practices and corresponding solutions, such as improvements in forecasts and tools for assisting operators, that RTOs/ISOs are developing in the near term. Some panelists opined that many RTO/ISO system operators have come to distrust the ability of E&AS market software to commit and dispatch resources efficiently, which can lead to prolonged and pervasive interventions that distort market prices. ESA Panelist Jason Burwen said that, at times, operators use out-of-market actions to secure flexibility, which fails to send accurate price signals about the value of flexibility to the system and inefficiently compensates inflexible generators.⁹³ CAISO panelist Chris Bossard described how relatively rare events can lead system operators to distrust the market and operations software and make persistent corrections to the commitment and dispatch instructions issued by the software.⁹⁴ Bossard described how an unmet need for frequency regulation or automatic generation control that materializes as rarely as twice a year can compel operators to commit resources year-round to satisfy that need.⁹⁵ Panelist Keith Collins from the SPP MMU stated that integrating VERs into SPP has led to operator interventions and subsequent price distortions.⁹⁶

33. NYISO panelist Mike DeSocio explained that system operators need tools so that the E&AS markets continue to support the actions they are taking; otherwise, grid operators will be forced to take reliability-related actions that might undermine price formation.⁹⁷ Even with such tools, however, DeSocio explained that the best way to incorporate grid operator decisions in NYISO is through market products, such as a synchronous reserve product or potentially new ancillary services.⁹⁸ SPP panelist Yasser Bahbaz described software tools that he and others at SPP are currently developing to give operators more insight into upcoming changes on the system and help them avoid

⁹³ October 12 Conference Tr. 90:1-14.

⁹⁴ October 12 Conference Tr. 221:15-25, 222:1-25.

⁹⁵ October 12 Conference Tr. 222:1-25.

⁹⁶ September 14 Conference Tr. 197:9-13.

⁹⁷ September 14 Conference Tr. 102:8-17.

⁹⁸ September 14 Conference Tr. 103:7-11.

making overcorrections or price-distortive interventions in grid operations.⁹⁹ CAISO panelist Chris Bossard mentioned that having greater granularity in the day-ahead market, specifically by moving to 15-minute intervals, would significantly improve operators' confidence in the schedules created by RTO/ISO market software.¹⁰⁰ Bossard stated that a 15-minute interval in the day-ahead market would accurately represent within-hour ramping capabilities, which are a critical system need in CAISO.

34. Panelists and commenters also highlighted the need for improved forecasting and improved practices around the use of forecasts in operations. SPP panelist Jodi Woods discussed how, as more wind and solar enter SPP's resource mix, better forecasting and greater abilities to respond to changes in resource output will be a concern for SPP.¹⁰¹ National Renewable Energy Laboratory (NREL) panelist Bethany Frew argued that the benefits of forecast improvements will be limited unless the time horizons of those forecasts are explicitly linked to some decision process in the system.¹⁰²

2. Reporting Requirement

35. Based on the record in this proceeding, RTOs/ISOs and the broader industry are contemplating different E&AS reforms for the near term to address changing system needs. It further appears that each reform is designed to address specific system needs and market conditions in each RTO/ISO, and no single E&AS market reform that addresses all system needs and all market conditions has been identified. Commenters have raised several points of consideration, including the value of reforms that direct payments to the resources that actually help to meet system needs instead of paying all resources. Other commenters stressed the importance of ensuring any new or revised products are purchased in quantities and at prices that accurately reflect system needs.

36. As such, we direct each RTO/ISO to submit information related to its planned reforms to its E&AS markets. The Commission will not regard responses to these questions as a commitment by the RTO/ISO to develop or propose such reforms. Specifically:

4. Discussions at the technical conferences and in comments noted failures of E&AS market designs to incent resources to offer and perform in a manner that meets system needs that are present now or expected to emerge in the

⁹⁹ October 12 Conference Tr. 220:14-25, 221:1-12.

¹⁰⁰ October 12 Conference Tr. 218:2-17.

¹⁰¹ September 14 Conference Tr. 36:18-25.

¹⁰² October 12 Conference Tr. 137: 19-23.

near-term. However, we note that much of the discussion indicated that system needs will continue to change significantly beyond the near-term, which could increase the adverse impacts of current flaws in E&AS market designs. Such increases in adverse impacts, such as insufficient operational flexibility in real-time, could threaten reliability and could also increase out-of-market actions and associated impairments to price formation.

Referring to the changing system needs discussed in questions 2 and 3, to what extent are current RTO/ISO E&AS market products and compensation schemes not designed to procure the resource capabilities needed to meet these expected changing system needs? To what extent are such prices and products unable to adequately compensate the resources possessing the capabilities necessary to meet these expected changing system needs? To what extent does the risk of disorderly retirements of resources with capabilities that are needed to address such needs (e.g., fast ramping dispatchable resources) increase if E&AS markets are not reformed? Why?

5. Much of the discussion at the technical conferences and in comments about planned reforms concerned near-term reforms that the RTO/ISO is currently developing with stakeholders or has recently implemented to manage system needs emerging in the near-term. However, much of the discussion signaled that system needs will continue to change significantly over time beyond the near-term. The following questions seek to understand how the RTO/ISOs are considering and working to identify and address longer-term future needs through E&AS market reforms.

Referring to the changing system needs discussed in questions 1, 2, and 3, what planned E&AS market reforms is the RTO/ISO contemplating or other stakeholder processes, if any, is the RTO/ISO conducting related to meeting those expected changing system needs? How will those specific reforms or stakeholder processes help the RTO/ISO meet those expected changing system needs?

6. Several commenters questioned the incentives created by current E&AS market designs and planned E&AS market reforms. Commenters raised many market design considerations as important for ensuring that E&AS markets incentivize resources to offer and perform in ways that support system needs. For example, some commenters argue that some E&AS market designs pay resources who make no contribution to satisfying system needs or encourage behavior that creates challenging conditions for operators. Commenters also discussed whether current compensation schemes for ancillary services products, such as using opportunity costs, will continue to be appropriate as the resource mix evolves over time. Over the next five years, and over the next 10 years, how

well will existing RTO/ISO market designs together with planned reforms adequately incentivize resource behaviors that will enable the RTO/ISO to meet its changing system needs?

- 6.1 Discussions at the technical conferences and in comments emphasized the importance of having E&AS products match the time horizon and direction of system needs and uncertainties through shorter-term products (e.g., fast frequency response products and 10- or 15-minute ramp product), and longer-term products (e.g., multi-hour ramp products). However, commenters also noted that RTO/ISO system needs vary, and no “one-size-fits-all” E&AS reform currently exists to meet the unique needs of each RTO/ISO. We are requesting additional details on how the RTOs/ISOs plan to tailor their E&AS market reforms to their unique needs and why the reforms they are considering are appropriate to meet their expected system needs.

How will existing E&AS market designs together with planned E&AS market reforms create appropriate incentives for existing resources to respond to system needs on operational time horizons (e.g., instantaneously, within five minutes, within 10 or 15 minutes, within one to four hours, etc.), and in the appropriate direction (up versus down)?

- 6.2 Parties presented different views on whether the widespread use of opportunity cost-based ancillary service pricing will continue to sufficiently incent and compensate resources for meeting system needs as the resource mix and system needs evolve in the future. Given the critical role RTO/ISO resources play in meeting system needs, more information on how E&AS markets will provide adequate compensation for these costs is needed.

How will existing E&AS market designs together with planned E&AS market reforms create sufficient fixed cost recovery under existing pricing methods (i.e., opportunity costs, shortage pricing, etc.) for resources to make needed investments, remain in service, and continue to offer the capabilities necessary to meet changing system needs?

- 6.2.1 How will existing E&AS market designs together with planned E&AS market reforms create an efficient long-run price signal for investment in new resources with the capabilities necessary to meet changing system needs?

- 6.3 Panelists agreed on the importance of establishing demand curves for ancillary service products carefully and rigorously but disagreed on the best

approach, particularly with regard to using VOLL in such demand curves. While some panelists argued that VOLL should be the basis for all demand curves, others highlighted shortcomings of VOLL and suggested alternative approaches. Given the importance of defining demand curves for ancillary service products, further clarification of how such curves will be defined in future E&AS market reforms is needed.

Regarding E&AS products for which the RTO/ISO is contemplating reforms, to what extent will the reforms ensure that the E&AS products have well-defined demand curves that are rigorously designed to reflect system needs and transparently specify the quantity demanded by the market?

- 6.4 Many commenters raised concerns regarding the risk that E&AS market reforms will pay the incorrect resources, for example, paying all resources instead of resources that actually contribute to resolving system needs. Given the importance of ensuring appropriate incentives and compensation to resources that contribute to satisfying system needs, further clarification of how future E&AS market reforms will ensure appropriate compensation (e.g., that only resources that help operators meet system needs are paid) is needed.

Regarding E&AS products for which the RTO/ISO is contemplating reforms, to what extent will the reforms ensure that the E&AS products direct compensation to resources that contribute to satisfying the particular system need(s) the product is designed to address and not to resources that do not make such contributions?

- 6.5 Discussions at the technical conferences and in comments raised the possibility that there is some discrimination in current E&AS markets and stressed that any future reforms should not introduce further discrimination. Given the importance of avoiding undue discrimination in E&AS markets reforms and the disagreement about the degree of undue discrimination in E&AS markets, further clarification on how RTOs/ISOs will avoid or eliminate undue discrimination in future E&AS market reforms is needed.

Regarding E&AS products for which the RTO/ISO is contemplating reforms, including reforms to resource eligibility rules, to what extent will the reforms ensure that the E&AS products permit all resources technically capable of providing a product or service to offer to do so?

7. Discussions at the technical conferences and in comments identified challenges to existing RTO/ISO operational practices and corresponding solutions, such as

improvements in forecasts and tools to assist operators that RTOs/ISOs are developing or plan to develop. While discussions centered on changing operational practices such as these in the near-term, other discussions indicated that system needs and the associated operational challenges will continue to change significantly beyond the near-term. As such, more clarification about how RTOs/ISOs intend to improve operational practices beyond the near-term is needed.

Referring to the changing system needs discussed in questions 2 and 3, how does the RTO/ISO expect to alter its operational practices, if at all, in order to successfully manage changing system needs over the next five years and over the next 10 years?

7.1 How does the RTO/ISO expect to meet challenges related to forecasting customer loads and variable energy resource outputs?

7.2 What model improvements, new operational tools, refinements to existing operational practices, or market software enhancements, if any, does the RTO/ISO expect to develop and/or deploy?

- 8 Some discussions in the comments and technical conferences noted that while many RTOs/ISOs are creating new E&AS products to incentivize flexibility, existing E&AS market designs might be incentivizing inflexibility. Some discussions specifically referred to uplift payment policies and operational parameters such as economic minimums as creating incentives for inflexibility. Given the importance of E&AS markets incentivizing resource capabilities and performance that help to meet system needs, more information about how future reforms will address possible incentives for inflexibility is needed.

Beyond the reforms discussed in answering questions 4-7, what other reforms to current RTO/ISO E&AS market rules may be required in the future given the RTO's/ISO's expected changing system needs and shortcomings of current E&AS market designs? Why? For example, are changes to resource eligibility rules for ancillary services or uplift policies expected to be necessary?

D. Other Potential Reforms

1. Comments

a. Capacity Markets and Resource Adequacy Policies

37. Despite the focus of the E&AS conferences on E&AS market products and reforms, several panelists and commenters expressed support for the continued use of capacity markets and resource adequacy policies for satisfying system needs. In

comments, LS Power and PJM offered support for the use of capacity markets in addition to E&AS markets to satisfy system needs.¹⁰³ NYISO panelist Mike DeSocio commented that instead of focusing on capacity market reforms to create flexibility or flexibility products, the focus should be on proper capacity accreditation.¹⁰⁴ MISO panelist Jessica Harrison stated that although MISO is contemplating modifications to ancillary service products, MISO is also looking at capacity market reforms.¹⁰⁵ Reliable Energy Analytics encouraged the Commission to consider the impacts of behind-the-meter resources when analyzing any market designs around resource adequacy.¹⁰⁶

b. Potential Reforms to NERC Reliability and Planning Criteria and for Coordination with Distribution-Connected Resources

38. Several commenters emphasized a need for certain reforms beyond RTO/ISO-administered markets. MISO panelist Laura Rauch explained that in the future there might be more forms of demand response, distributed resources, behind-the-meter generation, and load-modifying resources.¹⁰⁷ Rauch further explained that the RTO/ISO might also lack information as to whether a demand response resource has been called upon to serve local reliability needs and is therefore unavailable for dispatch, underscoring the importance of coordination across the wholesale and retail markets. ETI panelist Noha Sidhom similarly stressed the importance of increased coordination between the wholesale and retail levels.¹⁰⁸ Monitoring Analytics panelist Joseph Bowring stated that demand side is a potentially incredibly flexible resource but is treated in PJM as a non-economic resource.¹⁰⁹ Electricity Consumers Resource Council (ELCON) panelist Karen Onaran also noted the importance of demand response.¹¹⁰

¹⁰³ LS Power February 4, 2022 Comments at 1-2; PJM February 1, 2022 Comments at 5.

¹⁰⁴ October 12 Conference Tr. 129:7-12.

¹⁰⁵ September 14 Conference Tr. 203:13-21.

¹⁰⁶ Reliable Energy Analytics September 20, 2021 Comments at 2.

¹⁰⁷ October 12 Conference Tr. 236:12-25, 237:1-7.

¹⁰⁸ October 12 Conference Tr. 205:19-23, 206:1-4, 234:18-25, 235:1-11.

¹⁰⁹ September 14 Conference Tr. 232:1-6.

¹¹⁰ October 12 Conference Tr. 24:5-25:10.

39. EPISA noted that, in an evolving grid, the planning criteria and associated planning horizons may need to change; planning processes and market design may need to change with them.¹¹¹ EPISA stated that NERC, the RTOs/ISOs, or other designated reliability entities may need to reconsider the reliability and planning criteria upon which current RTO/ISO market design is based, to reflect not only the frequency of potential loss-of-load events, but also their severity and duration.

c. **Challenges Caused by Inflexible Fuel Markets and Calls for Greater Gas-Electric Coordination**

40. Several panelists and commenters explained how inflexibility in the fuel supply can create inflexibility among generation resources. NYISO panelist Nicole Bouchez and NYISO's subsequent comments explained that self-scheduling is often used to accommodate inflexible fuel supply contracts.¹¹² Bouchez and NYISO's subsequent comments argued that the Commission should focus on getting entities to negotiate more flexible fuel supply contracts for resources and, in the case of natural gas, on getting pipelines to provide gas as flexibly as possible. In comments, the SPP MMU explained that when natural gas pipelines enforce ratable take contracts, a natural gas resource's output can be fixed throughout the day (i.e., zero flexibility).¹¹³ Monitoring Analytics panelist Catherine Tyler noted generally that inflexibility in natural gas markets limits flexibility in electric markets.¹¹⁴

2. **Reporting Requirement**

41. Based on the record in this proceeding, it appears that reforms beyond the scope of RTOs/ISOs E&AS markets may be necessary to address changing system needs. As such, we direct each RTO/ISO to submit information related to potential reforms that may be necessary to meet changing system needs. Specifically:

9. Despite the focus of the E&AS technical conferences on E&AS markets, several panelists and commenters expressed support for the continued use and importance of capacity markets and potentially new resource adequacy constructs to satisfy future system needs. Given the focus of the record thus far on potential E&AS market reforms to satisfy operational flexibility needs and

¹¹¹ EPISA February 4, 2022 Comments at 9.

¹¹² October 12 Conference Tr. 55:1-10; NYISO February 4, 2022 Comments at 23-24.

¹¹³ SPP MMU October 8, 2022 Comments at 4.

¹¹⁴ October 12 Conference Tr. 36:5-9.

other system needs, the Commission would like to give RTOs/ISOs and other commenters the opportunity to comment on other possible reforms beyond E&AS market reforms that should be considered to meet changing system needs.

For RTOs/ISOs that administer a capacity market, what capacity market reforms, if any, is the RTO/ISO considering to meet expected system needs in the future? For RTOs/ISOs that do not administer a capacity market but rely on a different resource adequacy construct, what reforms, if any, is the RTO/ISO considering to that construct to meet changing system needs?

- 9.1 What new capacity accreditation methods, if any, is the RTO/ISO considering for its resource adequacy processes? How will such new capacity accreditation methods help the RTO/ISO satisfy expected changing system needs?
 - 9.2 What new products that value flexible attributes, if any, should be introduced in resource adequacy constructs, including capacity markets? Would such a change support adequate price signals for the investment and/or retention of resources with the capabilities needed to address emerging needs?
10. While this proceeding focused on RTO/ISO markets, several panelists and commenters noted challenges to meeting RTO/ISO system needs that arise from sources beyond the RTO/ISO markets themselves. Panelists and commenters noted potential reforms necessary to address challenges related to coordination between adjacent balancing authorities, coordination between transmission and distribution operations, and inflexibility in the fuel supply of certain resources. Given the lack of record thus far on these challenges and potential reforms, more information is needed to ensure RTOs/ISOs can continue to meet system needs as they evolve in the future and identify and address any obstacles to that objective.

What reforms beyond those to the RTO's/ISO's tariff(s) does the RTO/ISO believe might be needed to address expected changing system needs?

- 10.1 What reforms to reliability requirements, such as reforms to NERC standards, might be necessary?
- 10.2 What reforms to policies for coordinating operations with adjacent balancing authority areas in both RTO/ISO and non-RTO/ISO regions might be necessary?

- 10.3 What actions should the Commission consider taking to encourage coordination between the electricity transmission and distribution system operators in order to address challenges arising from limited visibility into distribution-connected resources?
- 10.4 What reforms to other services within the Commission's jurisdiction, such as natural gas transportation services, should the Commission consider in order to improve operational flexibility in the fuel supply?
11. While the questions in this order have asked about a five-year and 10-year time horizon, what activities, if any, is the RTO/ISO undertaking to consider changing system needs that could materialize beyond the 10-year time horizon?
12. If RTO/ISO market design changes beyond the RTO/ISO's planned E&AS market reforms discussed in answering questions 4-7 are necessary to manage expected changes in system needs, how can the Commission best assist RTOs/ISOs and their stakeholders in reforming their markets in the future?

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 comments in response to the informational reports may be submitted within 60 days of the filing of the reports, as discussed in the body of this order.

By the Commission. Commissioner Danly is concurring with a separate statement attached.
Commissioner Christie is concurring with a separate statement attached.

(S E A L)

Kimberly D. Bose,
Secretary.

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Modernizing Wholesale Electricity Market Design

Docket No. AD21-10-000

(Issued April 21, 2022)

DANLY, Commissioner, *concurring*:

1. I concur with today's order directing each regional transmission organization and independent system operator to answer questions and submit information related to their wholesale markets because the Commission is always entitled to ask questions and get information.¹

2. What is needed here is a sincere effort to take the lessons learned in our markets and reevaluate whether and how those markets work. A single, basic set of questions must be at the heart of our examination: are price signals providing the proper incentives for the orderly entry and exit of the correct type and quantity of generation to ensure resource adequacy and reliability? If not, why not, and what needs to change? What we should not do is try to engineer a record by which we might later justify Commission action in pursuit of narrow, preordained policy goals.

For these reasons, I respectfully concur.

James P. Danly
Commissioner

¹ See *Modernizing Wholesale Elec. Mkt. Design*, 179 FERC ¶ 61,029 (2022).

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Modernizing Wholesale Electricity Market Design Docket No. AD21-10-000

(Issued April 21,2022)

CHRISTIE, Commissioner, *concurring*:

1. While I recognize that the primary focus of the reports ordered herein is on the energy and ancillary services (E&AS) markets, a subject of discussion at two technical conferences held by the Commission last year,¹ the recent capacity auction results in the Midcontinent Independent System Operator (MISO) are only the latest evidence that the future of all RTO/ISO market constructs should be considered in this effort.²
2. For immediate purposes, I suggest we need to expand the scope of this Order's mandated reports beyond just E&AS market constructs. If we choose to exercise the Commission's discretion to direct the RTOs and ISOs to invest the significant time and

¹ The two technical conferences were held on September 14, 2021 and October 12, 2021, as part of Docket No. AD21-10-000, *Modernizing Electricity Market Design*.

² See, e.g., Jeffrey Tomich, *Soaring prices signal challenges ahead for Midwest grid*, ENERGYWIRE, Apr. 18, 2022 ("David Patton, MISO's independent market monitor, said during a MISO call on Friday that the auction results are 'the outcome we've been worried about for a decade.' MISO market rules that suppressed capacity prices in previous years, he said, have led to the retirement of otherwise economic power plants. And steps to improve the market have proven 'woefully inadequate,' he said.") (available at <https://www.eenews.net/articles/soaring-prices-signal-challenges-ahead-for-midwest-grid/>); Ethan Howland, *Capacity prices jump across MISO's central and northern regions, driven by supply shortfall*, UTILITY DIVE, Apr. 18, 2022 ("MISO's market is flawed, according to [David] Patton. 'If we're going to say that reliability is an imperative, we need to fix this market because we can't expect the market to support reliability if we know that it's not designed to produce efficient economic signals,' Patton said during the conference call. . . . In the last four years, power plants totaling 4 GW to 5 GW retired, even though they appear 'clearly economic,' Patton said. 'Our capacity market doesn't price capacity efficiently, so it sends out a clear economic signal to retire.'") (emphases added) (available at <https://www.utilitydive.com/news/capacity-prices-auction-miso-midcontinent/622186/>).

resources necessary to produce these reports on the long-term future workings of RTO/ISO E&AS markets, we should also ask the RTOs and ISOs to expand the scope of their reporting to include a few fundamental questions about market constructs that are particularly pertinent to the future reliability challenges each will experience as the generation mix changes. Those areas explicitly deal with how pricing and compensation potentially affects reliability in *all* market constructs.

3. Last year, we also held two technical conferences – one on March 23, 2021 and one on May 25, 2021 – in the same docket in which today’s Order is issued (Capacity Market Technical Conferences).³ In the Capacity Market Technical Conferences, an important discussion took place and questions arose about the role of capacity markets in achieving reliability and resource adequacy. As of now, the Commission has taken no additional action related to the record developed in the Capacity Market Technical Conferences.

4. Today’s Order recognizes that “[b]ased on the record in this proceeding, it appears that reforms beyond the scope of RTOs/ISOs E&AS markets may be necessary to address changing system needs.”⁴ I agree. Moreover, as some of the questions asked herein already go beyond strictly E&AS questions,⁵ I propose asking several additional questions. Specifically, I propose fundamental questions regarding pricing and compensation in the energy, ancillary services and capacity markets that merit discussion due to their potential impact on reliability and fairness to consumers. For example, I

³ March 16, 2021, Supplemental Notice of Technical Conference on Resource Adequacy in the Evolving Electricity Sector, Docket No. AD 21-10-000, *Modernizing Electricity Market Design* (noticing March 23, 2021 technical conference); May 17, 2021 Supplemental Notice of Technical Conference on Resource Adequacy in the Evolving Electricity Sector: ISO New England, Docket No. AD 21-10-000, *Modernizing Electricity Market Design* (noticing May 25, 2021 technical conference). See March 23, 2021 Technical Conference on Capacity Markets and Resource Adequacy Opening Remarks of Commissioner Mark C. Christie (“While these multi-state administrative constructs called capacity markets may have been based on a sound or at least defensible economic theory at the beginning 15 years ago, does the reality of politics and rent-seeking in a large multi-state RTO simply make it impossible for these constructs to consistently deliver on the economic goal of reliable power at the least cost . . . ?”) (available at <https://www.ferc.gov/news-events/news/technical-conference-capacity-markets-and-resource-adequacy-opening-remarks>).

⁴ *Modernizing Wholesale Electricity Market Design*, 179 FERC ¶ 61,029, at P 41 (2022).

⁵ See, e.g., Questions 9, 9.1 and 9.2.

think it is time to put the all-important question of the continued use of locational marginal pricing (LMP) in these market constructs on the table for serious scrutiny and discussion.⁶

5. To that end, I would ask the RTOs and ISOs, in preparing the reports required by this order (as well as commenters to those RTO/ISO reports), to address these additional topics:

- 1) Are the RTO/ISO markets compensating dispatchable resources appropriately in all markets? Are pricing policies causing premature retirements of dispatchable resources that may threaten reliability (as the MISO Midwest results may indicate)?⁷
- 2) Are intermittent and hybrid resources compensated appropriately to ensure reliability?
- 3) Is it appropriate to continue to use LMP in energy and capacity markets? Does the continued use of LMP threaten reliability as the generation mix changes? Does the use of LMP ensure that consumers get the benefit of low clearing prices? Is there a better pricing model than LMP in RTO/ISO markets to achieve reliability and fairness to consumers?
- 4) Are capacity markets appropriate to use for resource adequacy? If not, is there a better alternative to capacity markets? Should capacity markets be purely residual or mandatory?
- 5) How will compliance with Order No. 2222 mandating the participation and compensation of aggregated distributed energy resources (DERs) in RTO/ISO markets affect the answers to questions 1-4 above?

⁶ See, e.g., Tony Clark and Vincent Duane, “Stretched to the Breaking Point: RTOs and the Clean Energy Transition,” July 2021 at 5 (“ . . . RTOs need to come to terms with the reality that we may be rapidly moving towards a post-marginal price world. . . . [T]hat new paradigm will have enormous implications for the viability of the RTO model.”) (available at <https://www.wbklaw.com/wp-content/uploads/2021/07/Wholesale-Electricity-Markets-White-Paper-07.08.21.pdf>).

⁷ See, n.2 *supra*.

6. I believe these are compelling questions that belong in any comprehensive look at the future of RTO/ISO market constructs, their pricing and compensation policies, and their effects on the goal of reliable service at just and reasonable rates to consumers. I ask that the RTOs/ISOs respond to these questions, as well as those entities that comment on the RTO/ISO responses.

For these reasons, I respectfully concur.

Mark C. Christie
Commissioner