

167 FERC ¶ 61,058
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: Neil Chatterjee, Chairman;
Cheryl A. LaFleur, Richard Glick,
and Bernard L. McNamee.

PJM Interconnection, L.L.C.

Docket No. EL18-34-000

ORDER ON PAPER HEARING

(Issued April 18, 2019)

1. On December 21, 2017, pursuant to section 206 of the Federal Power Act (FPA),¹ the Commission instituted an investigation to examine PJM Interconnection, L.L.C.'s (PJM) practices regarding the pricing of fast-start resources and whether PJM should be required to revise its Open Access Transmission Tariff (Tariff).² In the December 2017 Order, the Commission found that PJM's fast-start pricing practices may be unjust and unreasonable because the practices do not allow prices to reflect the marginal cost of serving load, and the Commission identified changes to PJM's Tariff that, upon initial review, would result in rates that are just and reasonable.³ In this order, we direct PJM to revise its Tariff to implement the changes discussed below.

I. Background

2. Fast-start resources are resources that are able to start quickly to meet system needs of a regional transmission organization/independent system operator (RTO/ISO), but are often dispatched to their inflexible economic minimum or maximum operating limits, and thus are not eligible to set prices absent special pricing logic, such as fast-start pricing.⁴ Fast-start pricing allows an RTO's/ISO's software algorithms to incorporate the

¹ 16 U.S.C. § 824e (2012).

² *PJM Interconnection, L.L.C.*, 161 FERC ¶ 61,295 (2017) (December 2017 Order).

³ *Id.* PP 1, 30.

⁴ Many fast-start resources have limited or no dispatch range because their economic minimum operating limits are equal to (or are relatively close to) their

offers of fast-start resources into the market prices for energy and ancillary services, typically by treating fast-start resources as flexible (i.e., fully dispatchable from zero to their economic maximum operating limits) during a pricing run that is performed separately from the dispatch run. Additionally, fast-start pricing allows a fast-start resource to include its commitment costs (i.e., its start-up and no-load costs) in prices, thereby allowing a fast-start resource to recover a portion of its commitment costs through the market rather than through out-of-market uplift payments.

3. The Commission began pursuing reforms related to fast-start pricing as part of its broader price formation initiative.⁵ On December 15, 2016, the Commission issued a notice of proposed rulemaking (NOPR) that preliminarily found that some existing RTO/ISO fast-start pricing practices, or lack of fast-start pricing practices, may not result in rates that are just and reasonable.⁶ As a result, the Commission proposed establishing several requirements regarding the pricing of fast-start resources and sought comment on those proposed requirements and the need for reform discussed in the NOPR.⁷ Based on comments received, the Commission withdrew the NOPR, stating that while it continued to believe that improved fast-start pricing practices have the potential to achieve the goals outlined in the NOPR, it was persuaded to not require a uniform set of fast-start pricing

economic maximum operating limits. A resource that is operating inflexibly at its economic minimum operating limit or economic maximum operating limit is not dispatchable to serve an additional increment or decrement of load, and thus is not eligible to set the locational marginal price (LMP) unless fast-start pricing logic is applied.

⁵ The Commission initiated the price formation proceeding in June 2014 in Docket No. AD14-14-000. *Price Formation in Energy and Ancillary Services Markets Operated by Regional Transmission Organizations and Independent System Operators*, Notice, Docket No. AD14-14-000 (June 19, 2014). During the initial stages of the price formation proceeding, the Commission held a series of public workshops, received comments, and directed the RTOs/ISOs to file reports on several price formation topics, including fast-start pricing. *Price Formation in Energy and Ancillary Services Markets Operated by Regional Transmission Organizations and Independent System Operators*, 153 FERC ¶ 61,221, at P 1 (2015).

⁶ *Fast-Start Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 81 Fed. Reg. 96,391 (Dec. 30, 2016), 157 FERC ¶ 61, 213, at PP 3, 36-37 (2016) (NOPR).

⁷ *Id.* PP 3, 44.

requirements that would apply to all RTOs/ISOs.⁸ Instead, the Commission initiated targeted section 206 investigations focusing on specific concerns with the fast-start pricing practices in New York Independent System Operator, Inc. (NYISO), PJM, and Southwest Power Pool, Inc. (SPP).⁹

4. While the PJM Tariff and other governing documents do not define fast-start resources, PJM has indicated that it identifies a fast-start resource as a combustion turbine that can start within two hours.¹⁰ PJM has also indicated that its day-ahead energy market and real-time energy market clearing algorithms allow online fast-start and block-loaded resources¹¹ to set the LMP in the PJM market.¹²

5. In the December 2017 Order, the Commission preliminarily found PJM's approach to considering fast-start resources when determining real-time dispatch may be inconsistent with the objective of minimizing system production costs.¹³ PJM indicates that its existing real-time energy market clearing process for fast-start resources fails to execute the cost-minimizing dispatch solution.¹⁴

6. PJM currently applies special pricing rules to block-loaded resources that allow such resources to set prices in the pricing run. PJM has stated that, to enable block-loaded resources to set prices, it partially relaxes the economic minimum operating limit

⁸ *Fast-Start Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 161 FERC ¶ 61,293 (2017).

⁹ *N.Y. Indep. Sys. Operator, Inc.*, 161 FERC ¶ 61,294 (2017); December 2017 Order, 161 FERC ¶ 61,295 (2017); *Sw. Power Pool, Inc.*, 161 FERC ¶ 61,296 (2017).

¹⁰ PJM, Report on Price Formation Issues, Docket No. AD14-14-000, at 2 (Feb. 17, 2016) (PJM Report).

¹¹ While the PJM Tariff and other governing documents do not define block-loaded resources, PJM has stated that it identifies a block-loaded resource as a resource that has an economic minimum operating limit equal to its economic maximum operating limit (i.e., it has no dispatchable range). *Id.*

¹² *Id.* at 2-3.

¹³ December 2017 Order, 161 FERC ¶ 61,295 at P 20.

¹⁴ PJM Initial Brief at 12.

of online block-loaded resources by up to 20 percent.¹⁵ Specifically, PJM has stated that its block-loaded pricing logic in its day-ahead energy market clearing algorithm relaxes the economic minimum operating limit for a block-loaded resource by up to 20 percent in order to allow the resource to set day-ahead prices. In the real-time energy market clearing algorithm, the real-time security-constrained economic dispatch application that computes dispatch and pricing solutions applies the block-loaded pricing logic in the pricing run to an online block-loaded resource for the duration of the resource's actual run time, until the resource is released from PJM dispatch.¹⁶ PJM also allows resources with a limited operating range, other than block-loaded resources, to set prices when operating to control a specific transmission constraint.

7. PJM explained that it uses a relatively small economic minimum operating limit relaxation (20 percent) because it seeks to limit the amount of imbalance between dispatched generation and load. Such imbalance occurs when the PJM dispatch run instructs a block-loaded resource to operate at its economic minimum operating limit after the PJM pricing run assumes the resource operates at less than its economic minimum operating limit. This real-time correction results in more generation than load, which is balanced during operation through deployment of frequency regulation resources.¹⁷

II. December 2017 Order

8. In the December 2017 Order, the Commission preliminarily found that the following PJM practices related to the pricing of fast-start resources are unjust and unreasonable: (A) not allowing the economic minimum operating limit of block-loaded resources needed to serve load to be relaxed more than 10 percent; (B) limiting the relaxation of the economic minimum operating limit to only block-loaded resources; (C) determining dispatch instructions in a manner that may be inconsistent with minimizing production costs when considering fast-start resources; (D) not allowing the commitments costs of fast-start resources to be reflected in prices; (E) not requiring fast-

¹⁵ *Id.* at 2-4. While the December 2017 Order indicated that PJM allows the economic minimum operating limit of block-loaded resources to be relaxed by up to 10 percent, on brief PJM explains that it has modified its relaxation threshold from 10 percent to 20 percent. PJM Initial Brief at 4 n.6.

¹⁶ PJM Report at 5.

¹⁷ *Id.* at 6-9, 12.

start resources to have a minimum run time; and (F) allowing resources with start-up times of more than one hour to be eligible for fast-start pricing treatment.¹⁸

9. Additionally, the Commission stated that, upon initial review, it believed that implementing the following changes to PJM's Tariff would result in rates that are just and reasonable:

- A) Allow for relaxation of all fast-start resources' economic minimum operating limits by up to 100 percent, such that the resources are considered dispatchable from zero to their economic maximum operating limit for the purposes of setting prices;
- B) Apply the relaxation of a resource's economic minimum operating limit to all fast-start resources, not just block-loaded fast-start resources;
- C) Consider fast-start resources within dispatch in a way that is consistent with minimizing production costs, subject to appropriate operational and reliability constraints;
- D) Modify pricing logic to allow the commitment costs of fast-start resources to be reflected in prices;
- E) Include in the definition of fast-start resources a requirement that those resources have a minimum run time of one hour or less;
- F) Include in the definition of fast-start resources a requirement that those resources be able to start up within one hour or less (including notification time); and
- G) Set forth its rules and practices regarding the pricing of fast-start resources.¹⁹

10. The Commission explained that it expected the proposed changes would remedy PJM's current fast-start pricing practices that the Commission preliminarily found lead to unjust and unreasonable rates. For instance, the Commission stated that it expected the changes would: more accurately reflect the marginal cost of serving load in periods when dispatching a fast-start resource is the next action taken to meet load; provide price signals that better inform investment decisions; and provide more accurate and

¹⁸ December 2017 Order, 161 FERC ¶ 61,295 at P 9.

¹⁹ *Id.* P 30.

transparent price signals that better reflect the cost of serving load, minimize production costs, and reduce uplift.²⁰

III. Notice of Paper Hearing and Briefs

11. Notice of the institution of the section 206 proceeding in Docket No. EL18-34-000 was published in the *Federal Register*, 82 Fed. Reg. 61,562 (2017), on December 28, 2017. Pursuant to the December 2017 Order, interventions were due on or before January 11, 2018, initial briefs were due on or before February 12, 2018, and reply briefs were due on or before March 14, 2018.

12. Entities listed in the Appendix filed notices of intervention or motions to intervene. Timely initial briefs were filed by Cogentrix Energy Power Management, LLC (Cogentrix); Department of Market Monitoring for the California Independent System Operator Corporation (CAISO Market Monitor); Edison Electric Institute (EEI); Electric Power Supply Association (EPSA) and Independent Power Producers of New York (EPSA/IPPNY); Exelon Corporation (Exelon); FirstEnergy Service Company (FirstEnergy) and Eastern Kentucky Power Cooperative, Inc. (FirstEnergy/EKPC); IMG Midstream LLC (IMG Midstream); Nuclear Energy Institute (NEI); PJM; and PJM Power Providers Group. Monitoring Analytics, LLC, in its capacity as the Independent Market Monitor for PJM (PJM Market Monitor) filed an initial brief out-of-time. Timely reply briefs were filed by Calpine Corporation (Calpine); Delaware Public Service Commission (Delaware Commission); Dominion Energy Services, Inc. (Dominion); EPSA; Exelon; FirstEnergy, AES Ohio Generation, LLC, and EKPC (FirstEnergy/AES/EKPC); Joint Commenters;²¹ PJM; PJM Market Monitor; PJM Power Providers Group; and Shell Energy North America (U.S.), L.P. (Shell). Potomac Economics filed a reply brief out-of-time.

13. PJM filed a motion on February 28, 2018 to reject the comments of the CAISO Market Monitor. PJM and PJM Power Providers Group each filed an answer to other briefs in the proceeding. The PJM Market Monitor and Joint Commenters each filed two answers to other briefs in the proceeding.

²⁰ *Id.*

²¹ Joint Commenters are: American Municipal Power, Inc.; American Wind Energy Association; Delaware Commission; Division of the Public Advocate for the State of Delaware; Natural Resources Defense Council; Sustainable FERC Project; NextEra Energy Resources, LLC; People's Counsel for the District of Columbia; and PJM Industrial Customer Coalition.

IV. Discussion

A. Procedural Issues

14. Pursuant to Rule 214 of the Commission's Rules of Practice and Procedure, 18 C.F.R. § 385.214 (2018), the notices of intervention and timely, unopposed motions to intervene serve to make the entities that filed them parties to this proceeding. Pursuant to Rule 214(d) of the Commission's Rules of Practice and Procedure, 18 C.F.R. § 385.214(d) (2018), we grant the late-filed motions to intervene given the entities' interest in the proceeding, the early stage of the proceeding, and the absence of undue prejudice or delay.

1. Motion to Reject CAISO Market Monitor Comments

15. PJM argues that the CAISO Market Monitor is not affected by fast-start pricing in PJM and urges the Commission to reject the CAISO Market Monitor's comments as outside the scope of this proceeding.²² The PJM Market Monitor argues that the CAISO Market Monitor's comments should be accepted, noting that the market design principles at issue in this proceeding could have implications for other RTOs/ISOs.²³

16. We deny PJM's motion to reject the CAISO Market Monitor's comments. While an entity filing a motion to intervene must demonstrate that it has an interest that may be directly affected by the outcome of the proceeding,²⁴ the Commission's rules do not impose a similar requirement on entities filing comments. Entities seeking to become a party to a proceeding must file a motion to intervene.²⁵ While we discuss the CAISO Market Monitor's comments below, because the CAISO Market Monitor did not file a timely motion to intervene, it is not a party to this proceeding.

B. Substantive Issues

17. Consistent with the preliminary findings in the December 2017 Order, we find that PJM's fast-start pricing practices are unjust and unreasonable because the practices do not allow prices to reflect the marginal cost of serving load. We direct PJM to make the

²² PJM February 28, 2018 Motion at 2-3.

²³ PJM Market Monitor Reply Brief at 9-10.

²⁴ 18 C.F.R. § 385.214(b)(2)(ii) (2018).

²⁵ 18 C.F.R. § 385.214(a)(3) (2018).

following changes to its Tariff, which we find will result in rates that are just and reasonable:

- A) Implement software changes so that fast-start resources are considered dispatchable from zero to their economic maximum operating limits for the purpose of setting prices, as discussed below;
- B) Apply fast-start pricing to all fast-start resources instead of only block-loaded resources;
- C) Alter its real-time energy market clearing process to consider fast-start resources in a way that is consistent with minimizing production costs;²⁶
- D) Include fast-start resources' commitment costs in energy offers by implementing PJM's proposed integer relaxation approach;
- E) Restrict eligibility for fast-start pricing to fast-start resources that have a start-up time (including notification time) of one hour or less and a minimum run time of one hour or less;
- F) Include its fast-start pricing practices in its Tariff;
- G) Include commitment costs in energy prices for fast-start resources in both the day-ahead and real-time markets, and include in its compliance filing a proposal to withhold uplift payments in excess of a fast-start resource's commitment costs;
- H) Implement its proposal to use lost opportunity cost payments to offset the incentive for over-generation or price chasing.

18. We direct PJM to submit a compliance filing by July 31, 2019 with proposed tariff changes reflecting the above requirements and the proposed effective date. We also direct PJM to file a one-time informational report by August 30, 2019 explaining how the proposed fast-start pricing tariff provisions do not raise new market power concerns.

1. Fast-Start Pricing

a. December 2017 Order

19. In the December 2017 Order, the Commission found that PJM's practices may not reflect the marginal cost of serving load when a fast-start resource is needed to quickly

²⁶ PJM Initial Brief at 12.

respond to unforeseen system needs, which may result in inaccurate price signals. In turn, the Commission stated that inaccurate price signals then fail to inform investment decisions, including where and when fast-start resources should be built or maintained.²⁷

b. General Support

20. PJM, Calpine, Cogentrix, Dominion, EEI, EPSA, EPSA/IPPNY, Exelon, FirstEnergy/AES/EKPC, IMG Midstream, NEI, PJM Power Providers Group, and Shell generally support implementation of fast-start pricing reforms in PJM. Some commenters encourage the Commission to act expeditiously on fast-start pricing in PJM.²⁸ Exelon notes that the Commission has accepted fast-start pricing in the Midcontinent Independent System Operator, Inc., (MISO), ISO New England Inc., and NYISO, and that the issue is not *whether* PJM should implement fast-start pricing, but *which* fast-start market rules are appropriate for PJM.²⁹

c. Initial Briefs

21. PJM argues that allowing fast-start resources to set prices will lead to improved performance incentives for all resources, particularly during tight system conditions when fast-start resources are most needed. PJM contends that inefficient fast-start pricing rules suppress prices and send the wrong market signals to load and generating resources.³⁰

22. The PJM Market Monitor objects to fast-start pricing – both PJM’s current fast-start pricing practices and the proposed modifications in the December 2017 Order – on a variety of grounds. The PJM Market Monitor states that special pricing rules are not needed for fast-start resources and that including commitment costs of fast-start resources in pricing is not necessary for prices to reflect the marginal cost of serving load. The PJM Market Monitor states that PJM keeps additional capacity online via operating reserve requirements in order to meet an incremental increase in load without committing a new resource. The PJM Market Monitor states that, when operating reserves are insufficient to meet an incremental increase in load, PJM uses scarcity pricing to incentivize new resource commitments. The PJM Market Monitor contends that scarcity

²⁷ December 2017 Order, 161 FERC ¶ 61,295 at PP 1, 15, 17, 23, 25, 28.

²⁸ Calpine Reply Brief at 1-2, 5; Cogentrix Initial Brief at 6; Edison Electric Institute Initial Brief at 4; EPSA/IPPNY Initial Brief at 2, 5; PJM Power Providers Group Initial Brief at 3; Exelon Initial Brief at 3-4.

²⁹ Exelon Reply Brief at 16-17.

³⁰ PJM Initial Brief at 5.

pricing and the impact of operator actions on the definition of scarcity are the underlying problems that fast-start pricing attempts to address and that PJM should address those problems instead. The PJM Market Monitor argues that fast-start pricing rules that treat inflexible resources as flexible for purposes of price-setting actually erode incentives for flexible offers.³¹ The PJM Market Monitor argues generally that fast-start pricing will obstruct cost minimizing commitment and dispatch of resources.³²

23. The PJM Market Monitor argues that fast-start pricing will lead to illogical and inefficient outcomes. The PJM Market Monitor offers an example of a dispatch solution that would have a \$100/MWh fast-start resource set price, the next increment of load provided by a flexible resource at \$50/MWh, and a resource in a neighboring market available to sell to PJM at \$60/MWh. The PJM Market Monitor claims that, when the resource in a neighboring market sees the \$100/MWh price, it will schedule its import into PJM and PJM will need to back down the \$50/MWh flexible resource to accommodate the import, which increases system cost, produces an inefficient result, and creates volatility.³³

24. The CAISO Market Monitor argues that prices determined from a market with separate scheduling and pricing runs, or those which include commitment costs in the determination of per unit power prices, would not reflect actual marginal tradeoffs, and these prices would not give producers and consumers the incentive to follow the efficient dispatch. The CAISO Market Monitor further states that deviation penalties or payments to not deviate from the efficient dispatch do not restore incentive compatibility because market participants would have an incentive to submit bids that do not represent their true costs and valuations.³⁴

d. Reply Briefs and Answers

25. The PJM Market Monitor argues that the Commission should reject PJM's arguments that current PJM pricing practices are inefficient because parameter restrictions prevent certain resources from setting price. The PJM Market Monitor argues against the idea that any combination of prices and out-of-market payments can support efficient commitment and dispatch because the idea ignores impacts on participant behavior and impacts to total market surplus. The PJM Market Monitor argues that fast-start pricing rules harm total producer and consumer surplus via lost opportunity cost

³¹ PJM Market Monitor Initial Brief at 1-4.

³² *Id.* at 2-3, 6, 10.

³³ *Id.* at 6.

³⁴ CAISO Market Monitor Initial Brief at 5-7.

payments. The PJM Market Monitor also argues that fast-start pricing's lost opportunity costs will induce changes in market participant behavior by encouraging participants to alter offer parameters in order to maximize lost opportunity costs. The PJM Market Monitor argues that PJM's uplift statistics are insufficiently accurate to support the idea that fast-start pricing will reduce uplift payments. The PJM Market Monitor further criticizes arguments by Exelon, FirstEnergy, and EKPC as subsidy-seeking and states that a desire to increase generator revenues is not a valid cause for reforming market rules.³⁵ The PJM Market Monitor argues that the influence of fast-start pricing on market participant behavior could harm market efficiency and reliability.³⁶

26. The PJM Market Monitor asserts that the Commission should defend short-run marginal cost pricing, which it states, as currently practiced for most of PJM's market intervals, addresses the appropriate costs and the commercially relevant timeframe for assessing marginality. The PJM Market Monitor argues that commenters advocating for fast-start pricing are assuming away the non-convexities of the electric power markets rather than addressing them. The PJM Market Monitor argues that paying uplift based on flexible parameters is feasible and will enhance market competitiveness. The PJM Market Monitor states that the same inflexible resources that fast-start pricing would allow to set price are actually inflexible by choice and strategy rather than as a function of generator technology. The PJM Market Monitor argues that PJM's true goal behind its brief's proposal is to minimize uplift rather than to allow prices to reflect the marginal cost of serving load.³⁷ Additionally, the PJM Market Monitor states that fast-start pricing adds a new form of uplift – lost opportunity cost payments – without creating savings to offset the additional uplift. As such, the PJM Market Monitor argues that fast-start pricing will decrease surplus in the PJM markets.³⁸

27. The Delaware Commission opposes the Commission's proposed modifications to PJM's fast-start pricing, arguing that separating the pricing and dispatch runs would not maximize total consumer and producer surplus due to the inclusion of new costs that are added to the market (i.e., lost opportunity costs paid to generators in an effort to maintain power balance and limit over-generation). The Delaware Commission states that if the pricing run is separated from the dispatch run, the market surplus allocation would be skewed in favor of suppliers without a commensurate benefit to justify this change. The

³⁵ PJM Market Monitor Reply Brief at 1-8.

³⁶ *Id.* at 2-4; PJM Market Monitor March 29, 2018 Answer at 11-12.

³⁷ PJM Market Monitor March 29, 2018 Answer at 1-9.

³⁸ PJM Market Monitor May 7, 2018 Answer at 1-3.

Delaware Commission asserts that the Commission's proposed reforms would result in load paying more in the pricing run for the exact same set of resources selected in the dispatch run.³⁹

28. Potomac Economics argues that the PJM Market Monitor and the CAISO Market Monitor fail to recognize that the commitment costs of fast-start resources are marginal costs of serving load.⁴⁰ Potomac Economics argues that, as opposed to fast-start resources, long lead-time resources have some flexibility in real time to increase or decrease production, but such adjustments are unrelated to the resource's commitment costs. Therefore, Potomac Economics asserts that the commitment costs of long lead-time resources should not be considered in the determination of real-time LMPs any more than the cost of building the resource in the first place. Potomac Economics states that offline resources that can start fast enough to participate in the real-time market and be deployed economically incur commitment costs as a result of real-time market conditions. Potomac Economics argues these costs are marginal in real time and, therefore, it is appropriate to consider the commitment costs of fast-start resources in the real-time prices.⁴¹

29. Potomac Economics states that short-run price signals are a result of production-cost-minimizing dispatch and are not the cause of minimized production costs, as argued by the PJM Market Monitor. Potomac Economics states that the goal of fast-start pricing is to enable prices to reflect the marginal cost of serving load, rather than to minimize uplift.⁴²

30. Potomac Economics argues that the CAISO Market Monitor's proposal to confine price-setting eligibility to units with flexible operating ranges at the margin would improperly limit the definition of marginal costs to only short-run marginal *dispatch* costs. Potomac Economics argues that the CAISO Market Monitor over-focuses on the marginal tradeoff for these generators because they might have the incentive to not follow dispatch when ramped down to make room when a fast-start resource is brought online and ignores the risk of undermining the fast-start resource's incentive to offer at marginal cost. Potomac Economics contends that while the CAISO Market Monitor describes how deviation penalties and payments present incentive problems under fast-

³⁹ Delaware Commission Reply Brief at 4-6.

⁴⁰ Potomac Economics Reply Brief at 3.

⁴¹ *Id.* at 8.

⁴² *Id.* at 5.

start pricing, the CAISO Market Monitor never explains the extent to which uplift payments present the same problems under its preferred pricing method.⁴³

31. Potomac Economics states that fast-start pricing will improve three features of PJM's markets: performance of the day-ahead market; incentives for imports and exports; and incentives for offering competitively and performing reliably. Potomac Economics argues that if real-time markets understate prices they will undermine key actions by market participants in both the short-run and long-run timeframes. Potomac Economics elaborates that if real-time prices fully reflect the efficient cost of satisfying real-time market demand then it will lead the day-ahead market to produce more complete and more efficient energy schedules and associated generator commitments. Potomac Economics argues that understated real-time prices could similarly establish poor incentives to align imports and exports with prices in the RTO's real-time market. With additional imports drawn in by the higher prices reflecting the market demand, the RTO could "stop committing the high-cost peaking resources and/or turn off high-cost peaking resources that are already online."⁴⁴

32. Exelon argues that the PJM Market Monitor's contention that marginal costs can only be incurred within a five-minute time interval is incorrect. PJM Power Providers Group argues that the definition of marginal cost should not be limited to costs incurred within only one five-minute interval and for only one MWh of power. Exelon argues that the PJM Market Monitor's examples actually show the benefits of fast-start pricing because, rather than inducing volatility, the higher price set by the fast-start resource in the example correctly signals the full cost of serving load and induces cost-effective imports to enter the market. Exelon argues that the CAISO Market Monitor's alternative market model to fast-start pricing obscures the cost of serving load via reliance on uplift payments and suppressed prices.⁴⁵

33. PJM states that it agrees that scarcity pricing reforms are needed and notes that it has a stakeholder group dedicated to discussing changes to price formation issues including reserve procurement and scarcity pricing. However, PJM states that such reforms are out of the scope of this proceeding.⁴⁶ PJM Power Providers Group argues that conservative operator practices preventing scarcity pricing may be worth

⁴³ *Id.* at 5-7.

⁴⁴ *Id.* at 9-10.

⁴⁵ Exelon Reply Brief at 16-19.

⁴⁶ PJM Reply Brief at 3-5.

investigating but that the issue is outside the scope of this proceeding.⁴⁷ FirstEnergy/AES/EKPC contend that the PJM Market Monitor's focus on scarcity pricing misses the point and argues that the only issue in this proceeding is how to effectively meet the Commission's directive to reform PJM's fast-start pricing practices.⁴⁸

34. PJM Power Providers Group states that PJM's existing fast-start pricing rules and practices are unjust and unreasonable because the rules and practices generally prohibit fast-start resources from setting price.⁴⁹

e. Determination

35. In the December 2017 Order, the Commission found that PJM's existing fast-start pricing practices may fail to reflect the marginal cost of serving load, and that adopting the proposed changes identified in that order would lead to prices that more accurately reflect the marginal cost of serving load. We continue to find that fast-start pricing in PJM, with the reforms directed herein, will result in prices that more accurately reflect the marginal cost of serving load. We continue to find that, because of their operating characteristics, fast-start resources are uniquely situated to respond to unforeseen or transient real-time system needs that are short-term in nature. When fast-start resources are committed in real-time, it is often at short notice to meet some system condition or market need over a short time period. Specifically, allowing fast-start resources to participate in setting prices and incorporating commitment costs of fast-start resources in prices more accurately represents the marginal cost of serving load, which will better reflect system needs, and help inform investment decisions. For these reasons, we continue to find that commitment costs of fast-start resources should be considered marginal for the purpose of setting prices in PJM. The Commission made these findings on a preliminary basis in the December 2017 Order, and as discussed below, we continue to support these findings after careful consideration of commenters' arguments.

36. In particular, we find that that commitment costs for fast-start resources are marginal because they are generally incurred in coordination with the real-time dispatch, as noted by Potomac Economics.⁵⁰ We agree with Potomac Economics that long lead-time resources, in contrast to fast-start resources, have some flexibility in real time to increase or decrease production, but that such adjustments are unrelated to the resources'

⁴⁷ PJM Power Providers Group Reply Brief at 9 (citing Stoddard Affidavit at 12-14).

⁴⁸ FirstEnergy/AES/EKPC Reply Brief at 5.

⁴⁹ PJM Power Providers Group Reply Brief at 2-3.

⁵⁰ Potomac Economics Reply Brief at 5.

commitment costs and that the commitment costs of long lead-time resources should not be considered in the determination of real-time prices. We find that fast-start resources that are deployed economically incur commitment costs as a result of real-time market conditions, are considered marginal in real-time, and thus, the commitment costs of these resources should be included in real-time prices.

37. While the Delaware Commission, the PJM Market Monitor, and the CAISO Market Monitor, object to fast-start pricing in general, we note that the Commission has already determined that fast-start pricing reflects the marginal cost of serving load and can result in rates that are just and reasonable.⁵¹ We also note that our investigation in this proceeding seeks to remedy certain issues with PJM's existing implementation of fast-start pricing, and is not proposing that PJM implement an entirely new pricing concept. PJM currently uses fast-start pricing in its markets. Further, we disagree with objections from the Delaware Commission, the PJM Market Monitor, and CAISO Market Monitor that fast-start pricing departs from marginal cost pricing. After considering their arguments, we continue to find that the cost of a decision to start a fast-start resource in real time, typically on short notice to meet some unforeseen or transient system need represents a marginal cost that should be reflected in prices.

38. We disagree with assertions from the PJM Market Monitor and the Delaware Commission that fast-start pricing is likely to reduce market surplus. In the short term, as long as the optimal dispatch is honored, system production costs are minimized and total market surplus is maximized. A separate pricing run, together with lost opportunity cost payments, only *allocates* rather than *determines* short-term market surplus. That is because short-term market surplus is determined (solely) by the dispatch instructions generated by the dispatch run. In the long-term, although the Delaware Commission expresses concerns about load paying more for the same service, we find that the more accurate prices that should result from fast-start pricing will better inform investment decisions and increase overall market surplus.⁵²

⁵¹ *N.Y. Indep. Sys. Operator, Inc.*, 95 FERC ¶ 61,121, at 61,379 (2001); *Midwest Indep. Transmission Sys. Operator, Inc.*, 140 FERC ¶ 61,067, at PP 37-38 (2012).

⁵² *See, e.g., Midwest Indep. Transmission Sys. Operator, Inc.*, 140 FERC ¶ 61,067 at P 39 (2012) (“In the long term, [the Extended LMP algorithm, MISO’s version of fast-start pricing] should also send more effective signals about the need for additional resources in the region. By producing a clearing price that better reflects the most expensive action taken to satisfy demand in the region, the Extended LMP algorithm should promote more efficient development of supply and demand resources in the future.”).

39. The CAISO Market Monitor argues that deviation penalties, as well as payments to not deviate from the scheduling run dispatch, may theoretically create incentives for resources to submit distorted energy offers that do not represent a resource's true marginal cost of production, thereby reducing market efficiency.⁵³ However, we find that the risk of such a strategy producing unprofitable results will deter market participants from offering in such a manner. Furthermore, we agree with Potomac Economics that while fast-start pricing requires the use of deviation penalties or payments to provide generators with an efficient incentive to follow instructions, so does traditional LMP/uplift pricing.⁵⁴ We find that the CAISO Market Monitor's assertions regarding incentive problems associated with deviation penalties or payments are similar to those associated with uplift payments.⁵⁵ As such, we are not persuaded by the CAISO Market Monitor's arguments that fast-start pricing creates greater incentive problems than existing LMP/uplift pricing.

40. We disagree with the PJM Market Monitor's arguments that fast-start pricing will result in an incentive for fast-start resources to reduce the flexibility they offer into the market. We note that if a resource chooses to make itself look less flexible, this would decrease the likelihood of it being economically dispatched and may ultimately lower its revenues over the long-run.

41. Additionally, we find that the advantages of traditional LMP/uplift pricing, as compared with fast-start pricing, are not as stark in practice as some commenters have argued.⁵⁶ In particular, while traditional LMP/uplift pricing incentivizes market participants to follow dispatch instructions, other mechanisms can also be employed to incentivize following dispatch. Here, as discussed below, PJM proposes to use lost

⁵³ CAISO Market Monitor Initial Brief at 6.

⁵⁴ Potomac Economics Reply Brief at 7, 11-12. We also note Potomac Economics' research in the NYISO market with regard to the infrequency of intervals in which dispatchable generators face marginal tradeoffs (i.e., received a physical schedule that was inconsistent with the profit-maximizing level given the clearing price while accounting for ramp rate limitations) that could lead to inefficient incentives. *Id.* at 13.

⁵⁵ *Id.* at 7.

⁵⁶ By "traditional LMP/uplift pricing," we refer to a set of pricing rules that computes energy market prices based only on incremental energy cost offers and instead compensates resources for commitment costs in excess of price-based revenues through direct payments such as uplift payments.

opportunity cost payments to ensure that market participants have the incentive to follow dispatch instructions.

42. We also disagree with the PJM Market Monitor's assertion that the underlying problem is with PJM's scarcity pricing. As stated above, fast-start pricing seeks to establish prices that more accurately reflect the marginal cost of serving load when committing a fast-start resource is the marginal action taken by system operators. By contrast, scarcity pricing seeks to price energy or operating reserve shortages and is unrelated to whether a fast-start resource is used. Therefore, we find that scarcity pricing issues are outside of scope of this proceeding. Similarly, we find the PJM Market Monitor's statements about operator actions are outside of scope of this proceeding.

2. Relaxation of Economic Minimum Operating Limit

a. December 2017 Order

43. In the December 2017 Order, the Commission preliminarily found that PJM's practice of not allowing the economic minimum operating limit of block-loaded resources needed to serve load to be relaxed by more than 10 percent⁵⁷ could restrict the set of dispatch circumstances in which such resources could set prices, and therefore may be unjust and unreasonable. The Commission expressed concern that, without allowing relaxation by up to 100 percent, prices will sometimes be set by the offers from lower-cost flexible units that are dispatched down in order to accommodate the output of fast-start resources. The Commission stated that, as a result, PJM's practices may not reflect the marginal cost of serving load when a fast-start resource is needed to quickly respond to unforeseen system needs, which may result in inaccurate price signals. The Commission noted that inaccurate price signals then fail to inform investment decisions, including where and when fast-start resources should be built or maintained.⁵⁸

44. The Commission concluded that, upon initial review, PJM could remedy this practice that potentially leads to unjust and unreasonable rates by allowing for relaxation of all fast-start resources' economic minimum operating limits by up to 100 percent, such that the resources are considered dispatchable from zero to their economic maximum operating limit for the purposes of setting prices.⁵⁹

⁵⁷ As noted above, the current percentage PJM states that it relaxes block-loaded resources is 20 percent. *See supra* n.15.

⁵⁸ December 2017 Order, 161 FERC ¶ 61,295 at P 15.

⁵⁹ *Id.* P 30.

b. Initial Briefs

45. PJM supports the aims of the Commission's proposal to treat fast-start resources as dispatchable from zero to the resource's economic maximum operating limit during the pricing run, but PJM proposes to use an integer relaxation approach rather than a relaxation of the resource's economic minimum operating limit to achieve this.⁶⁰ PJM argues that integer relaxation, along with separate pricing and dispatch runs, will achieve the Commission's objectives while simplifying implementation.⁶¹ Specifically, PJM explains that integer relaxation naturally incorporates commitment costs into the clearing price, and requires no other changes to the optimization model in the pricing run.⁶² PJM further states that this approach is consistent with MISO's fast-start pricing methodology.⁶³

46. Cogentrix, Exelon, IMG Midstream, and NEI support treating fast-start resources as dispatchable from zero to their economic maximum operating limits for the purpose of setting prices.⁶⁴ NEI argues that fully relaxing the economic minimum operating limits of fast-start resources will improve the transparency of price signals by allowing the marginal price to better reflect system conditions and allowing more units on the margin to set price.⁶⁵ Cogentrix argues that relaxation of the economic minimum operating limit will allow more fast-start resources to set price during tight system conditions. Cogentrix adds that relaxation of the economic minimum operating limit would also result in a reduction of uplift payments.⁶⁶

⁶⁰ As described by PJM, integer relaxation consists of using a separate pricing run in which a fast-start resource's commitment status is allowed to vary between zero and one, with zero representing a resource that is offline and one representing a resource that is online. *See* PJM Initial Brief at 5-8.

⁶¹ *Id.* at 6.

⁶² *Id.* at 7-8.

⁶³ *Id.* at 5.

⁶⁴ Cogentrix Initial Brief at 3; Exelon Initial Brief at 6; IMG Midstream Initial Brief at 4-5; NEI Initial Brief at 5.

⁶⁵ NEI Initial Brief at 5.

⁶⁶ Cogentrix Initial Brief at 3.

47. The PJM Market Monitor opposes the Commission's proposed remedy regarding the relaxation of fast-start resources' economic minimum operating limits. The PJM Market Monitor argues that relaxing the economic minimum operating limit of block-loaded resources to zero would allow resources that cannot supply an additional increment of generation to set price as though they could.⁶⁷ The PJM Market Monitor states that relaxing the economic minimum operating limit to zero would result in an inefficient allocation of resources because the price signal would no longer reflect the true marginal resource.⁶⁸

48. The PJM Market Monitor argues that relaxing the economic minimum operating limit to zero would provide incorrect incentives for generation owners with a portfolio of resources to keep inflexible units in the market, rather than replacing them with flexible units.⁶⁹ The PJM Market Monitor argues that the proposal to relax the economic minimum operating limit of quick-start resources to zero is premised on a set of false assumptions—chiefly, that it is necessary to block-load resources and that it is efficient to let block-loaded or other inflexible resources set price.⁷⁰

c. Reply Briefs

49. In their reply briefs, Calpine, EPSA, Exelon, FirstEnergy/AES/EKPC, PJM Power Providers Group, and Shell express support for treating fast-start resources as dispatchable from zero to their economic maximum operating limits for the purpose of setting prices.⁷¹ Exelon states that in order to fix problems in PJM's pricing, PJM needs to allow inflexible fast-start resources to set price at output ranges between zero and their economic minimum operating limits.

50. Exelon states that PJM's proposed integer relaxation approach will provide a more straightforward and elegant means of achieving the Commission's goals, as well as

⁶⁷ PJM Market Monitor Initial Brief at 4.

⁶⁸ *Id.* at 4.

⁶⁹ *Id.* at 5.

⁷⁰ *Id.*

⁷¹ Calpine Reply Brief at 5; EPSA Reply Brief at 5-8; Exelon Reply Brief at 9-12; FirstEnergy/AES/EKPC Reply Brief at 6-8; PJM Power Providers Group Reply Brief at 2-6; Shell Reply Brief at 3-4.

provide more accurate pricing.⁷² FirstEnergy/AES/EKPC express support for PJM's integer relaxation approach, stating that the approach approximates convex hull pricing, that the Commission has previously found such approximations just and reasonable, and that it would be faster and easier to implement than relaxation of a resource's economic minimum operating limit.⁷³ PJM Power Providers Group argues that integer relaxation achieves the Commission's goals for fast-start pricing, is easier to administer, and easily incorporates commitment costs into the pricing run.⁷⁴ Shell argues that PJM's proposed integer relaxation approach will allow PJM to avoid unnecessary complexity and may be necessary for unspecified future price formation proposals.⁷⁵ EPSA argues that integer relaxation may be more computationally complex than the economic minimum operating limit relaxation, but requests that the Commission direct PJM to implement whichever approach can be implemented more expeditiously.⁷⁶ Calpine recommends that PJM modify its practices to permit all fast-start resources to set price regardless of relaxation method.⁷⁷

51. The PJM Market Monitor and Joint Commenters argue that the Commission should require more information from PJM before accepting PJM's proposed integer relaxation approach. Specifically, the PJM Market Monitor argues that PJM software can already relax resource economic minimum operating limits, so the Commission should require PJM to demonstrate the benefits and costs of implementing fast-start pricing with an alternative approach as opposed to its current software.⁷⁸ Joint Commenters argue that

⁷² Exelon Reply Brief at 11.

⁷³ FirstEnergy/AES/EKPC Reply Brief at 7-8. Dr. David Hunger, who provided an affidavit for FirstEnergy/AES/EKPC, states that the Commission's proposed economic minimum operating limit relaxation method, unlike the integer relaxation approach, would need to adjust energy bids and constraints. Further, Dr. Hunger states that PJM's integer relaxation approach allows fast-start resources to be dispatchable from zero MW to their economic maximum operating limits, incorporates fast start resources' commitment costs into the computation of LMPs, and minimizes uplift. *Id.*, Hunger Aff. at 4-5.

⁷⁴ PJM Power Providers Group Reply Brief at 5.

⁷⁵ Shell Reply Brief at 4.

⁷⁶ EPSA Reply Brief at 7.

⁷⁷ Calpine Reply Brief at 5.

⁷⁸ PJM Market Monitor Reply Brief at 5.

the Commission should defer ruling on PJM's proposed integer relaxation method until PJM provides examples of commitment and settlements, including lost opportunity cost payments.⁷⁹

d. Determination

52. Consistent with the Commission's preliminary finding in the December 2017 Order, we find that PJM's practice of not allowing the economic minimum operating limit of block-loaded resources needed to serve load to be relaxed by more than 10 percent could restrict the set of dispatch circumstances in which such resources could set price. PJM states that on October 4, 2016, PJM increased its relaxation threshold level from 10 percent to 20 percent.⁸⁰ Even with this increase, we remain concerned that without allowing relaxation by up to 100 percent, marginal actions taken by system operators will not be reflected in prices. As a result, PJM's practices lead to prices that fail to reflect the marginal cost of serving load when committing a fast-start resource is the marginal action taken by system operators. These inaccurate price signals then fail to inform investment decisions, including where and when fast-start resources should be built or maintained. For these reasons, we find that PJM's practices are unjust and unreasonable.

53. We are persuaded by PJM's and supporting commenters' arguments that integer relaxation will allow fast-start resources to set price while simplifying implementation of fast-start pricing in PJM. PJM has stated that this approach is more readily implemented with PJM's existing software and naturally incorporates commitment costs into the clearing price compared with economic minimum operating limit relaxation. While we recognize the PJM Market Monitor and Joint Commenters' argument that PJM's software already allows some degree of economic minimum operating limit relaxation, we find that PJM has adequately explained why integer relaxation will be easier to implement. Accordingly, we direct PJM to implement its proposed integer relaxation approach for fast-start resources so that fast-start resources are able to set prices similar to how they would if the resources were considered dispatchable from zero to their economic maximum operating limit for the purpose of setting prices.

54. As discussed above in section IV.B.1.e, we disagree with the PJM Market Monitor that allowing fast-start resources to set price as though they could flexibly serve an additional increment of load would result in prices that no longer reflect the marginal cost of serving load. We also disagree with the PJM Market Monitor that fast-start pricing is

⁷⁹ Joint Commenters Reply Brief at 14-15.

⁸⁰ PJM Initial Brief at 4 n.6.

likely to result in generation owners with a portfolio of resources inefficiently keeping inflexible units in the market. The PJM Market Monitor appears to be noting, among other things,⁸¹ that the ability of a fast-start resource to set prices – and to benefit its affiliated flexible resources with those higher prices – would create an incentive for a generation owner to not retire inflexible fast-start resources, even when market fundamentals would otherwise support retiring those resources. We disagree. Such a strategy would seem particularly speculative and risky to the generator owner. The benefit to such a generator owner in keeping one additional inefficient generator online is likely to be negligible, while the risk of not retiring an inefficient resource when market fundamentals support retiring it would be considerable. Additionally, the PJM Market Monitor fails to recognize that the resources eligible for fast-start pricing treatment are flexible in that these resources can economically respond to unforeseen or transient system needs. The changes required in this order specifically limit fast-start pricing to these resources so as to send appropriate long-run price signals.

3. Limiting Fast-Start Pricing to Block-Loaded Resources

a. December 2017 Order

55. In the December 2017 Order, the Commission proposed to require PJM to apply fast-start pricing logic to all fast-start resources, regardless of whether they are block-loaded. PJM's practices regarding the relaxation of the economic minimum operating limit are currently limited to only block-loaded resources. Fast-start resources that are not block-loaded are currently not eligible to set prices when their economic minimum operating limits bind. The Commission expressed concern that prices would not reflect the marginal cost of serving load when a non-block-loaded resource is needed but is not included in the fast-start pricing logic. Therefore, the Commission preliminarily found that such practices may be unjust and unreasonable.⁸²

b. Initial and Reply Briefs

56. PJM agrees with the Commission that fast-start pricing logic should apply to all fast-start resources regardless of technology type, not just to block-loaded resources.⁸³

⁸¹ Below in section IV.B.9.d, we discuss the PJM Market Monitor's concern as it relates to the potential for exercise of market power. Here we address the argument as it otherwise relates to generation owners with a portfolio of resources, and whose other resources may enjoy higher prices as a result of the proposed fast-start pricing.

⁸² December 2017 Order, 161 FERC ¶ 61,295 at P 17.

⁸³ PJM Initial Brief at 11.

PJM concedes that by restricting the relaxation of the economic minimum operating limit to block-loaded resources, PJM's current rules have unduly limited the set of dispatch circumstances in which fast-start resources could set prices.⁸⁴ However, PJM notes that it would be inappropriate to apply fast-start pricing logic to self-scheduled resources, even if they meet the definition of a fast-start resource. PJM argues that the decision to commit a self-scheduled resource – and to incur the commitment costs of doing so – is made outside of the market by the resource owner and not economically by the market or PJM operators.⁸⁵

57. Calpine, Cogentrix, FirstEnergy/EKPC, and NEI support extending fast-start pricing logic to all fast-start resources. Cogentrix argues that PJM should not limit fast-start pricing to block-loaded resources in order to properly reflect the marginal cost of serving load and provide grid reliability.⁸⁶ FirstEnergy/EKPC state that the definition of fast-start resources should be technology-neutral and include non-block-loaded resources.⁸⁷ NEI states that expanding the definition of fast-start resources beyond block-loaded resources would more fully incorporate system costs into market prices and provide more information through price signaling to market participants.⁸⁸

c. Reply Briefs

58. Exelon argues that PJM's proposal to forbid self-scheduled resources from receiving fast-start pricing treatment even when they meet other eligibility criteria addresses matters outside of the instant proceeding. Exelon argues that the Commission should dismiss these arguments and that their proponents should file to open a new and separate proceeding on the respective issues.⁸⁹

d. Determination

59. We find that PJM's practice of applying fast-start pricing only to block-loaded resources is unjust and unreasonable and direct PJM to apply fast-start pricing to all fast-start resources. We remain concerned that under PJM's current practice, prices do not

⁸⁴ *Id.* at 10.

⁸⁵ *Id.* at 11.

⁸⁶ Cogentrix Initial Brief at 4.

⁸⁷ FirstEnergy/EKPC Initial Brief at 8.

⁸⁸ NEI Initial Brief at 5.

⁸⁹ Exelon Reply Brief at 19-20.

reflect the marginal cost of serving load when a non-block-loaded resource is needed but is not included in fast-start pricing logic, and agree with commenters that a technology-neutral approach ensures that no resource that can perform the same service is unnecessarily excluded from fast-start pricing treatment. Therefore, we find that PJM's current practice is unjust and unreasonable. We find that expanding fast-start pricing to dispatchable fast-start resources will enable prices to reflect the marginal cost of serving load, particularly when non-block-loaded fast-start resources are needed. As such, we direct PJM to apply fast-start pricing to dispatchable fast-start resources, not only to block-loaded fast-start resources. This expansion, along with the other reforms directed herein, will make PJM's fast-start pricing practices just and reasonable.

60. We agree with PJM that it would not be just and reasonable to apply fast-start pricing treatment to self-scheduled resources and that fast-start pricing should apply only to resources that submit economic energy offers to the market. We agree with PJM that a self-scheduled resource's commitment decision is made outside of the market by the resource owner and not economically by the market or PJM operators. As such, we find that a self-scheduled resource's commitment costs do not represent marginal costs of serving load because the resource's commitment was not made in response to real-time system needs identified by PJM's operators or dispatch algorithms. We disagree with Exelon's argument that the issue of self-scheduled resources is beyond the scope of this proceeding. While the Commission did not specifically raise this issue in the December 2017 Order, the Commission did raise the issue of which resources should be eligible for fast-start pricing treatment.⁹⁰ PJM proposed to exclude self-scheduled resources from fast-start pricing treatment in its initial brief, and Exelon and other parties had an opportunity to comment on the merits of PJM's proposal.

4. Considering Fast-Start Resources when Determining Real-Time Dispatch

a. December 2017 Order

61. In the December 2017 Order, the Commission preliminarily found that PJM's approach to considering fast-start resources when determining real-time dispatch in its dispatch run may be inconsistent with the objective of minimizing system production costs. Additionally, the Commission preliminarily found that PJM's approach may create reliability issues, may unnecessarily increase the cost of serving load, and therefore may produce rates that are unjust and unreasonable.⁹¹ The Commission stated that an efficient

⁹⁰ December 2017 Order, 161 FERC ¶ 61,295 at PP 17, 25, 28, 30.

⁹¹ *Id.* PP 9-10.

dispatch can only be reliably determined by modeling the actual system costs and actual system constraints within a market run that minimizes production costs. That is, fast-start pricing logic would ideally not change the dispatch of resources away from the cost-minimizing dispatch, but would only alter the manner by which prices are established.⁹²

62. However, as the Commission explained, PJM initially solves a pricing run that allows block-loaded resources' economic minimum operating limits to be relaxed by up to 20 percent for the purposes of determining prices.⁹³ The pricing run achieves a power balance between dispatched generation and load based on the assumed, but not actual, flexibility of these resources. PJM then includes these resources in a dispatch run that honors the resources' economic minimum operating limits, but does not necessarily honor the system power balance. The Commission stated that by not respecting the power balance constraint during dispatch, PJM's process appears to result in dispatch solutions that are not cost-minimizing.⁹⁴

63. The Commission concluded that, upon initial review, PJM could remedy this practice that potentially leads to unjust and unreasonable rates by considering fast-start resources within dispatch in a way that is consistent with minimizing production costs, subject to appropriate operational and reliability constraints.⁹⁵

b. Initial Briefs

64. PJM proposes to implement fast-start pricing using the integer relaxation approach described above⁹⁶ in conjunction with separate dispatch and pricing runs. PJM states that it would alter its real-time energy market clearing process to execute the cost-minimizing dispatch solution, which will produce the dispatch instructions that are sent to supply resources, and then perform a pricing run to determine prices that would not impact the dispatch instructions sent to supply resources. PJM states that it agrees with the

⁹² *Id.* P 18.

⁹³ The December 2017 Order referred to PJM's level of relaxation as 10 percent. On October 4, 2016, PJM increased its relaxation threshold level from 10 percent to 20 percent. PJM Initial Brief at 4 n.6.

⁹⁴ December 2017 Order, 161 FERC ¶ 61,295 at PP 18-20.

⁹⁵ *Id.* P 30.

⁹⁶ *See supra* P 45.

Commission that this approach is more consistent with minimizing production costs than PJM's current approach.⁹⁷

65. Cogentrix agrees with the Commission's proposal to separate dispatch from pricing, which it states will produce transparent prices and reduce uplift. Specifically, Cogentrix argues that PJM should first determine the cost-minimizing dispatch by optimizing the full set of operating limitations on all generators, and that the subsequent pricing run should determine prices while leaving the cost-minimizing dispatch schedule unchanged.⁹⁸

66. While opposing fast-start pricing reforms overall, the PJM Market Monitor criticizes PJM's current fast-start resource commitment practices and states that PJM's real-time commitment practices for fast-start resources are not necessarily cost-minimizing. The PJM Market Monitor states that PJM's operations software does not commit resources in real-time, and that instead PJM operators commit resources in real-time. The PJM Market Monitor argues that discretionary commitments made by PJM operators cannot be assumed to be cost-minimizing and are not based on an overall cost-minimizing optimization. The PJM Market Monitor argues further that resources that are not cost-minimizing should not be allowed to set prices, and that PJM's manual interventions can cause uneconomic commitments to set prices.⁹⁹

c. Reply Briefs

67. PJM Power Providers Group states that PJM's current market design creates energy imbalances by using different resource operating limit assumptions in the pricing run and the dispatch run. PJM Power Providers Group argues that the differences in assumptions result in PJM customers paying for both excess generation and the regulation services needed to correct for excess generation.¹⁰⁰

68. The Delaware Commission argues that the Commission's proposed solution does not maximize total consumer and producer surplus. The Delaware Commission argues that PJM's current markets clear by way of the cost-minimizing dispatch solution, which

⁹⁷ PJM Initial Brief at 12.

⁹⁸ Cogentrix Initial Brief at 5.

⁹⁹ PJM Market Monitor Initial Brief at 7-8.

¹⁰⁰ PJM Power Providers Group Reply Brief at 4.

provides maximum consumer and producer surplus.¹⁰¹ The Delaware Commission argues that, to maximize surplus, both the dispatch and pricing runs must be cost-minimizing—that is, the dollars paid must be minimized.¹⁰² The Delaware Commission argues that, in a market with separate dispatch and pricing runs and where the cost of the pricing run is higher than the dispatch run, a greater share of the existing market surplus accrues to producers. The Delaware Commission argues that, as a result, load would be paying more in the pricing run for the exact same set of resources selected in the dispatch run, leading to an increased cost for the same set of commodities with no commensurate benefits. The Delaware Commissions states that markets with separate dispatch and pricing runs add new costs to the market, specifically lost opportunity costs, and that such new costs demonstrate that surplus is not maximized.¹⁰³

d. Determination

69. We find that PJM’s current approach to considering fast-start resources when determining real-time dispatch is unjust and unreasonable because it is inconsistent with the objective of minimizing system costs, may create reliability issues, and may unnecessarily increase the cost of serving load. By not respecting the power balance constraint in the dispatch run, PJM’s current approach may cause an imbalance between dispatched generation and load, which may potentially cause system control problems and require the use of costly frequency regulation resources to manage this imbalance. By contrast, a dispatch run that respects the power balance constraint will achieve the same delivery of power at a lower cost by making unnecessary the use of resources to manage imbalances. PJM’s current approach therefore unnecessarily increases the cost of serving load and puts stress on the frequency regulation resources that are necessary for maintaining system reliability.¹⁰⁴

70. We also find PJM’s proposal to use an integer relaxation approach in conjunction with separate dispatch and pricing runs to clear its real-time energy market to be a just and reasonable approach. Accordingly, we direct PJM to implement its proposal of altering its real-time energy market clearing process to execute the cost-minimizing dispatch solution, which will produce the dispatch instructions that are sent to supply resources, and then perform a pricing run to determine prices that would not impact the dispatch instructions sent to supply resources.

¹⁰¹ Delaware Commission Reply Brief at 4.

¹⁰² *Id.* at 5.

¹⁰³ *Id.* at 6.

¹⁰⁴ December 2017 Order, 161 FERC ¶ 61,295 at P 19.

71. We disagree with the Delaware Commission's claims that PJM's current markets clear by way of the cost-minimizing dispatch solution. As discussed above, PJM's current use of a pricing run followed by a dispatch run does not minimize costs and creates unnecessary costs, such as costs from managing resultant over-generation.

72. The Delaware Commission also claims that to maximize surplus, both dispatch and pricing runs must be cost-minimizing, and the dollars paid must be minimized. We disagree. Maximizing surplus (or minimizing production cost, in cases where those are the same things) is a distinct concept from minimizing the dollars paid in either a pricing or dispatch run. The Delaware Commission appears to be concerned about the *transfer* of market surplus from consumers to suppliers. As the Commission discussed above in section IV.B.1.e, fast-start pricing produces prices that more accurately reflect marginal cost. Exposing market participants to these prices is not for purposes of transferring market surplus, but instead for purposes of maximizing efficiency. We understand that the Delaware Commission is concerned about short-term transfer of market surplus, but we find that such transfers are not expected to be unreasonable and that more accurate prices better inform investment decisions and increase overall market efficiency.¹⁰⁵

73. We disagree with Delaware Commission's argument that adding lost opportunity costs to the market demonstrates that that surplus is not maximized. As long as the optimal dispatch is honored, system production costs are minimized and total market surplus is maximized. A separate pricing run, together with lost opportunity cost payments, only *allocates* rather than *determines* short-term market surplus. That is because short-term market surplus is determined (solely) by the dispatch instructions generated by the dispatch run.

5. Commitment Costs

a. December 2017 Order

74. In the December 2017 Order, the Commission preliminarily found PJM's practice of not accounting for fast-start resources' commitment costs in its pricing logic may be unjust and unreasonable because it does not accurately represent the marginal cost of

¹⁰⁵ See, e.g., *Midwest Indep. Transmission Sys. Operator, Inc.*, 140 FERC ¶ 61,067, at P 39 (2012) ("In the long term, [the Extended LMP algorithm, MISO's version of fast-start pricing] should also send more effective signals about the need for additional resources in the region. By producing a clearing price that better reflects the most expensive action taken to satisfy demand in the region, the Extended LMP algorithm should promote more efficient development of supply and demand resources in the future.").

serving load. The Commission stated that the costs of commitment decisions for fast-start resources are incurred to serve system needs in a similar way that marginal costs are incurred to serve system needs for a specific time period. The Commission further stated that incorporating commitment costs of fast-start resources in prices more accurately represents the marginal cost of serving load, which will help inform investment decisions. For these reasons, the Commission preliminarily found that commitment costs of fast-start resources in PJM should be considered marginal for the purpose of setting prices in PJM.¹⁰⁶

75. The Commission concluded that, upon initial review, PJM could remedy this practice that potentially leads to unjust and unreasonable rates by modifying its pricing logic to allow the commitment costs of fast-start resources to be reflected in prices.¹⁰⁷

b. Initial Briefs

76. PJM supports reflecting the commitment costs of fast-start resources in prices. PJM states that its proposed integer relaxation approach will include commitment costs in the pricing run.¹⁰⁸ PJM proposes to remove start-up costs from the pricing calculation after a fast-start resource has reached its minimum run time. However, PJM proposes to continue to include no-load costs in the price calculation during the entire time the resource runs because no-load cost is an hourly cost incurred by the resource for its entire run time and continues to be incurred even beyond the minimum run time.¹⁰⁹ As discussed in more detail below, PJM argues that start-up and no-load costs should only be included in the price calculation in LMPs in the market where the commitment decision is made, i.e., either the day-ahead or real-time energy market.¹¹⁰

77. Cogentrix, Exelon, FirstEnergy/EKPC, IMG Midstream, and NEI support reflecting the commitment costs of fast-start resources in prices.¹¹¹ Cogentrix asserts that excluding commitment costs in prices leads to inaccurate prices, system reliability risks,

¹⁰⁶ December 2017 Order, 161 FERC ¶ 61,295 at PP 21, 23.

¹⁰⁷ *Id.* P 30.

¹⁰⁸ PJM Initial Brief at 12-13.

¹⁰⁹ *Id.* at 13.

¹¹⁰ *Id.*

¹¹¹ Cogentrix Initial Brief at 5; Exelon Initial Brief at 6; FirstEnergy/EKPC Initial Brief at 8-9; IMG Midstream Initial Brief at 1; NEI Initial Brief at 5.

and improper valuation of the services fast-start resources provide.¹¹² Exelon contends that failure to reflect commitment costs in prices distorts clearing prices and causes excessive uplift, and notes that commitment costs must be incurred to reliably operate the system.¹¹³ FirstEnergy/EKPC state that the no-load costs of fast-start resources should be reflected in prices at all times when these resources are running and eligible to set price.¹¹⁴ NEI states that including commitment costs of fast-start resources improves the transparency of price signals because the costs must be incurred to serve load but are not currently reflected in prices.¹¹⁵

78. The PJM Market Monitor opposes reflecting the commitment costs of fast-start resources in prices. The PJM Market Monitor argues that, when commitment costs are included in prices, the energy market's price fails to represent the short-run marginal cost. Further, the PJM Market Monitor argues that the introduction of lost opportunity cost payments will require new charges borne by consumers that will change incentives. The PJM Market Monitor states that including commitment costs in prices creates a tradeoff between minimizing production costs and reducing uplift.¹¹⁶ The PJM Market Monitor also argues that including commitment costs in prices encourages resources to make inflexible offers.¹¹⁷ The PJM Market Monitor states that commitment costs are already accounted for in the commitment problem solved by PJM's market software and that market prices should result from the software's solution to the dispatch problem, without a pricing run. The PJM Market Monitor states that the lack of consideration of commitment costs in pricing should not be considered a limitation of PJM's market software.¹¹⁸

c. Reply Briefs

79. FirstEnergy/AES/EKPC, EPSA, Calpine, and Exelon support PJM's proposal. FirstEnergy/AES/EKPC state that PJM's proposal would efficiently and effectively

¹¹² Cogentrix Initial Brief at 5.

¹¹³ Exelon Initial Brief at 6.

¹¹⁴ FirstEnergy/EKPC Initial Brief at 8-9.

¹¹⁵ NEI Initial Brief at 5.

¹¹⁶ PJM Market Monitor Initial Brief at 3.

¹¹⁷ *Id.* at 5.

¹¹⁸ *Id.* at 7.

incorporate the costs of fast-start resources into prices.¹¹⁹ FirstEnergy/AES/EKPC agree with PJM's proposal to include start-up and no-load costs over all periods in which these costs are incurred, including the allocation of no-load costs across all operating hours.¹²⁰ Further, FirstEnergy/AES/EKPC argue that PJM's proposed integer relaxation approach automatically applies start-up costs of fast-start resources to the minimum run time while continuing to incorporate the relevant no-load costs for the entire operating period.¹²¹ FirstEnergy/AES/EKPC states that including fast-start resources' start-up and no-load costs in price-setting will fix a flaw in the current market structure and enable LMPs to reflect the true costs of fast-start resources.¹²² Calpine agrees that the commitment costs of fast-start resources should be reflected in prices and states that these costs should align with its real-time software's marginal look-ahead period of two hours, as proposed by PJM.¹²³ EPSA agrees with the Commission that including commitment costs in prices more accurately represents the marginal cost of serving load.¹²⁴ Exelon supports PJM's proposal to allocate no-load cost across all operating hours.¹²⁵

80. The Delaware Commission opposes including the commitment costs of fast-start resources for purposes of setting price. The Delaware Commission argues that including commitment costs would allow inflexible fast-start resources to set price but prevent flexible fast-start resources from receiving the correct price signals. The Delaware Commission states that flexible fast-start resources would instead receive lost opportunity cost payments, which masks the appropriate price signals associated with efficient dispatch and diminishes the competitiveness of the market. The Delaware Commission contends that including commitment costs would increase reliance on uplift payments, particularly during periods of system stress where fast-start resources are needed most.¹²⁶

¹¹⁹ FirstEnergy/AES/EKPC Reply Brief at 2.

¹²⁰ *Id.* at 4.

¹²¹ *Id.* at 7-8.

¹²² *Id.* at 4.

¹²³ Calpine Reply Brief at 5-6.

¹²⁴ EPSA Reply Brief at 6.

¹²⁵ Exelon Reply Brief at 12.

¹²⁶ Delaware Commission Reply Brief at 2-4.

d. Determination

81. Consistent with the December 2017 Order, we find that failing to include commitment costs for fast-start resources in prices would not accurately represent the marginal cost of serving load, and therefore find PJM's current practice of not incorporating fast-start resources' commitment costs in its price-setting logic is unjust and reasonable. As noted above, because of their operating characteristics, fast-start resources are uniquely situated to respond to unforeseen or transient real-time system needs. When fast-start resources are committed in real-time, it is often at short notice to meet some unforeseen or transient system condition or market need over a short time period, and, as such, we find that the commitment costs for such a resource should be considered marginal costs. Thus, we find that incorporating commitment costs of fast-start resources in prices more accurately represents the marginal cost of serving load, which will better reflect system needs, and help inform investment decisions, as discussed above in section IV.B.1.e. In addition, if commitment costs are not included, the marginal resource must be compensated through out-of-market uplift payments, which provide a less transparent price signal than compensating resources through market clearing prices that reflect the marginal cost of production. Accordingly, we direct PJM to reflect the commitment costs of fast-start resources in prices by implementing its proposed integer relaxation approach for fast-start resources. We find that PJM's proposal to include no-load costs in prices for the resource's entire commitment period (rather than only for the resource's minimum run time) is a reasonable approach to pricing fast-start resources, and accordingly we direct PJM to implement this approach.

82. We disagree with the PJM Market Monitor's argument that including commitment costs in prices would not allow the energy market price to represent the short-run marginal cost. By choosing not to include commitment costs, prices may fail to accurately reflect the marginal cost of serving load and make underlying system conditions transparent to the marketplace. Fast-start resources are uniquely situated to respond to unforeseen or transient system needs. Commitment costs are directly related to the marginal actions taken to respond to such system needs and prices should reflect the value these resources provide. We are also not persuaded by arguments made by the Delaware Commission that including commitment costs would result in flexible fast-start resources receiving lost opportunity cost payments instead of correct price signals, and an increased reliance on uplift payments, as discussed in more detail in section IV.B.1.e. Additionally, as discussed below in section IV.B.10.d, we find that PJM's lost opportunity cost compensation proposal is an appropriate approach for preventing resources from deviating from PJM's dispatch instructions.

6. Start-Up and Minimum Run Time Requirements

a. December 2017 Order

83. PJM allows resources capable of starting up within two hours of being notified to be eligible for fast-start pricing treatment. In the December 2017 Order, the Commission expressed concern that resources with start-up times in excess of an hour may lack the flexibility to operate in a manner consistent with unforeseen real-time needs. The Commission stated that the commitment and dispatch of resources with start-up times in excess of an hour do not appear analogous to a marginal decision, and therefore applying fast-start pricing logic to such resources could result in prices failing to reflect the marginal cost of serving load. Therefore, the Commission preliminarily found that PJM's practice may result in rates that are unjust and unreasonable.¹²⁷

84. The Commission viewed PJM's minimum run time requirement similarly. PJM's Tariff does not include a minimum run time requirement for a resource to be eligible for fast-start pricing treatment. In the December 2017 Order, the Commission expressed concern that resources with minimum run times in excess of an hour may lack the flexibility to operate in a manner consistent with transient real-time needs. The Commission stated that the commitment and dispatch of resources with a minimum run time in excess of an hour does not appear analogous to a marginal decision, and therefore applying fast-start pricing logic to such resources could result in prices failing to reflect the marginal cost of serving load. Therefore, the Commission preliminarily found that it may be unjust and unreasonable for resources with a minimum run time of greater than one hour to receive fast-start pricing treatment.¹²⁸

85. The Commission concluded that, upon initial review, PJM could remedy these practices that potentially lead to unjust and unreasonable rates by including in the definition of fast-start resources a requirement that those resources: (1) be able to start up within one hour or less (including notification time); and (2) have a minimum run time of one hour or less.¹²⁹

b. Initial Briefs

86. PJM proposes alternative start-up and minimum run time requirements of two hours or less. PJM states that the composition of generation fleets and operational

¹²⁷ December 2017 Order, 161 FERC ¶ 61,295 at P 28.

¹²⁸ *Id.* P 25.

¹²⁹ *Id.* P 30.

practices differ from region to region, and that the definition of a fast-start resource should also differ by region such that the desired pricing outcomes and uplift reduction are achieved. PJM states that its real-time software tool – PJM’s Intermediate Term Security Constrained Economic Dispatch (IT SCED) – has a two-hour look-ahead window, and that resources with a minimum run time of two hours or less and a start-up time of two hours or less are reflective of the truly marginal decisions made by PJM operators. PJM contends that its proposed definition aligns with its IT SCED.¹³⁰

87. PJM further argues that expanding the start-up and minimum run time criteria from one hour to two hours could further reduce uplift by including more resources in fast-start pricing. PJM states that its generating fleet of approximately 178,000 MW contains fewer than 8,000 MW of resources that have start-up and minimum run times of one hour or less. PJM explains that expanding the definition of fast-start resources to resources with start-up and minimum run times of two hours or less would include an additional approximately 17,000 MW in fast-start pricing, and thereby provide an opportunity to reduce approximately 57 percent of the uplift in PJM. PJM includes a table that showing that all units (excluding hydroelectric plants) with start-up and minimum run times of one hour or less account for approximately 20 percent of PJM’s uplift payments in 2017; and that all units (excluding hydroelectric plants) with start-up and minimum run times of two hours or less account for approximately 57 percent of PJM’s uplift payments in 2017.¹³¹

88. Cogentrix, Exelon, FirstEnergy/EKPC, NEI, and PJM Power Providers Group support PJM’s proposed fast-start resource definition.¹³² Cogentrix contends that the definition of a fast-start resource should include resources with a start-up time of 30 minutes or less, start-up and notification time of two hours or less, and a minimum run time of two hours or less.¹³³ Cogentrix argues that using the Commission’s proposed definition will not capture flexible natural gas generators that offer ramping capabilities critical for system reliability and resource adequacy.¹³⁴ Exelon asserts that PJM’s proposed fast-start resource definition is needed to align with the set of resources that are

¹³⁰ PJM Initial Brief at 14-15.

¹³¹ *Id.* at 15-16.

¹³² Cogentrix Initial Brief at 4; Exelon Initial Brief at 5; FirstEnergy/EKPC Initial Brief at 8; NEI Initial Brief at 5; PJM Power Providers Group Initial Brief at 4.

¹³³ Cogentrix Initial Brief at 5.

¹³⁴ *Id.* at 5-6.

eligible to be committed in PJM's IT SCED.¹³⁵ NEI states that the Commission should exercise caution in limiting the definition of fast-start resources. NEI argues that using time limits, such as limits on minimum run time, to define fast-start resources is of less importance than correctly assessing which resources are needed to serve load and correctly characterizing marginal units.¹³⁶

89. Exelon and FirstEnergy/EKPC argue that PJM's proposed fast-start resource definition is appropriate given the characteristics of the PJM generation fleet and urge the Commission to permit regional variation in the fast-start resource definition.¹³⁷ Exelon maintains that market rules do not need to be identical among RTOs/ISOs to be just and reasonable and that approving PJM's proposed fast-start resource definition would be consistent with the Commission's past deference to regional preferences and system characteristics. Exelon also argues that the Commission implicitly acknowledges with its establishment of separate 206 investigations for NYISO, PJM, and SPP that the characteristics of fast-start resources and fleet composition may differ across RTOs/ISOs.¹³⁸ FirstEnergy/EKPC state that the definition of a fast-start resource should align with PJM's resource composition.¹³⁹

90. Dominion, IMG Midstream, Joint Commenters, and the PJM Market Monitor oppose PJM's proposed fast-start resource definition and dispute the arguments that a resource with a two-hour start-up time can be viewed as marginal. IMG Midstream argues that the Commission should define a fast-start resource as one that can start in 10 minutes or less because PJM relies on such units to maintain reliability in real-time and characterizes a two-hour start-up time as "glacial."¹⁴⁰ IMG Midstream asserts that, at a maximum, the Commission should define a fast-start resource as one that has a start-up time of no more than 30 minutes.¹⁴¹ Moreover, IMG Midstream contends that the Commission did not meet its burden of proof in proposing a one-hour start-up time in the

¹³⁵ Exelon Initial Brief at 5.

¹³⁶ NEI Initial Brief at 5.

¹³⁷ Exelon Initial Brief at 5; FirstEnergy/EKPC Initial Brief at 8.

¹³⁸ Exelon Initial Brief at 5.

¹³⁹ FirstEnergy/EKPC Initial Brief at 8.

¹⁴⁰ IMG Midstream Initial Brief at 5, 8-9.

¹⁴¹ *Id.* at 10 (citing PJM Interconnection, L.L.C. Comments to Notice of Proposed Rulemaking, Docket No. RM17-3-000, filed February 28, 2017, at 4-5).

December 2017 Order given the Commission's stated goals in the price formation proceeding and the evidence developed in the NOPR proceeding. IMG Midstream argues that the Commission can only meet its burden of proof by explaining how a one-hour start-up time criterion satisfies the Commission's stated goals of providing accurate incentives and transparent pricing signals.¹⁴²

91. The PJM Market Monitor asserts that PJM overstates the amount of uplift that fast-start pricing has the potential to reduce because there are other categories of uplift that cannot be addressed by fast-start pricing, and fast-start pricing would create a new category of uplift with PJM's proposed lost opportunity cost payments.¹⁴³ Dominion argues that it would be better for this proceeding to produce a precise definition of fast-start resources now that the Commission will uphold later, as opposed to the Commission accepting an overly broad definition and later developing a new definition for a subset of "faster-start" resources.¹⁴⁴

c. Reply Briefs

92. The PJM Market Monitor, Dominion, and Joint Commenters filed reply briefs opposing PJM's proposed fast-start resource definition.¹⁴⁵ Dominion and Joint Commenters support the Commission's proposed one-hour start-up and minimum run time requirements.

93. The PJM Market Monitor asserts that the configuration of PJM's software does not define what resource is marginal in the energy market. The PJM Market Monitor asserts that basing the fast-start resource definition on PJM's IT SCED settings would set the precedent that RTO/ISO software design drives market design, rather than the other way around, and would enable PJM to revise the definition of what is marginal at its own discretion by simply changing software settings.¹⁴⁶

¹⁴² *Id.* at 4-10.

¹⁴³ PJM proposes to pay lost opportunity costs to incentivize following dispatch. PJM Initial Brief at 18.

¹⁴⁴ Dominion Initial Brief at 4.

¹⁴⁵ Dominion Reply Brief at 3-4; Joint Commenters Reply Brief at 2-15; PJM Market Monitor Reply Brief at 4-5.

¹⁴⁶ PJM Market Monitor Reply Brief at 4.

94. The PJM Market Monitor states that uplift in PJM is fairly low and that PJM paid only \$43 million in day-ahead and real-time uplift to combustion turbines and diesel generators with start-up and minimum run times of two hours or less, which amounts to 33 percent of total uplift (\$128.8 million in 2017).¹⁴⁷ The PJM Market Monitor asserts that the proportion of total uplift paid to resources that start in one or two hours does not determine efficient market design and that the relative differences in uplift between resources with one-hour and two-hour start-up and minimum run times is not a justification for determining whether a fast-start resource's commitment is marginal. The PJM Market Monitor argues that PJM's proposed fast-start resource definition, compared to the Commission's proposed one-hour start-up time and minimum run time definition, will actually increase uplift by increasing the difference between the pricing and dispatch runs, which will create inefficient five-minute price signals and create the need for additional lost opportunity cost payments.¹⁴⁸

95. Dominion asserts that a more expansive fast-start resource definition could block efforts to incentivize the development of truly fast-start resources in the future.¹⁴⁹ Joint Commenters assert that by limiting the start-up time to one hour, the Commission's proposed requirement increases the likelihood that PJM will see the short-term tradeoffs associated with committing a fast-start resource given that the resource could come online within the IT SCED evaluation window.¹⁵⁰

96. Joint Commenters argue that PJM's proposed definition departs from the principle of marginal cost and that PJM would be an outlier among RTOs/ISOs. Joint Commenters further state that a start-up time cutoff between 10 and 30 minutes would better align with other RTOs/ISOs.¹⁵¹ Joint Commenters, citing testimony from The Brattle Group, also argue that the IT SCED cannot evaluate the cost implications of committing a resource with two-hour start-up and minimum run times within the IT SCED's current two-hour look-ahead window because the look-ahead window would need to be four hours to

¹⁴⁷ *Id.* at 6. The same values for the same types of resources with one-hour start-up and minimum run times was \$13.7 million and 10.6 percent, respectively. *Id.*

¹⁴⁸ *Id.* at 5-7.

¹⁴⁹ Dominion Reply Brief at 4.

¹⁵⁰ Joint Commenters Reply Brief at 8.

¹⁵¹ *Id.* at 4-5, 8-9; Joint Commenters March 29 Answer at 1-2.

perform such an evaluation.¹⁵² Joint Commenters also note that the IT SCED's two-hour look-ahead window is long enough to evaluate the short-term tradeoffs associated with committing a fast-start resource with one hour start-up and minimum run times.¹⁵³ Additionally, Joint Commenters note that PJM operators use IT SCED as one of several advisory tools, and that operators, and not the IT SCED software, actually commit resources.¹⁵⁴

97. Joint Commenters argue that PJM's attempt to use the generation fleet composition in support of its proposed fast-start resource definition lacks merit because PJM provides no information about how its fleet composition differs from other RTOs'/ISOs', and state that PJM and MISO have similar generation fleets.¹⁵⁵ Joint Commenters also note that PJM previously stated in its NOPR comments that a "one hour limitation on the minimum run time is suitable for PJM" and implied that a 30-minute start-time would be appropriate for the region.¹⁵⁶ Joint Commenters assert that PJM provides no information about the impact its proposed start-up and minimum run time requirements will have on uplift. Joint Commenters notes that PJM only states that its proposed two hour fast-start resource definition would "provide an opportunity" to reduce uplift compared to a definition with a one hour startup time. Joint Commenters also note that several factors cause uplift in PJM, and fast-start pricing will not eliminate all uplift.¹⁵⁷

¹⁵² Joint Commenters Reply Brief at 6-8; *see also* Joint Commenters March 29 Answer at 4.

¹⁵³ Joint Commenters Reply Brief at 8.

¹⁵⁴ *Id.* at 7 n.20.

¹⁵⁵ Joint Commenters note that PJM and MISO have similar proportions of resources with one- and two-hour minimum run times; 6 and 8 percent, respectively. Joint Commenters Reply Brief at 9-10 (citing The Brattle Group, *Evaluation of PJM's Fast-Start Pricing Proposal*, Samuel A. Newell, *et al.*, at 5-6., March 14, 2018).

¹⁵⁶ *Id.* at 10.

¹⁵⁷ *Id.* at 11-12.

98. Many commenters support PJM's proposed two-hour start-up and minimum run time requirements.¹⁵⁸ Several commenters agree with PJM's proposed fast-start resource definition (specifically the two-hour start-up time) because the timing coincides with the IT SCED.¹⁵⁹ EPSA argues that PJM's proposed two-hour minimum run time requirement would smooth out fast-start pricing's impacts on energy prices during ramping events, citing the testimony of its expert, Paul Sotkiewicz.¹⁶⁰ Dr. Sotkiewicz suggests that, due to the way the IT SCED handles uncertainty,¹⁶¹ the IT SCED already makes the commitment of faster-starting, shorter-commitment-time resources appear more valuable because operators can wait longer to make a commitment decision until more accurate information regarding load needs and generator performance is obtained. Dr. Sotkiewicz therefore argues that allowing resources with start-up times of two hours to set price does not diminish incentives to increase flexibility.¹⁶² Dr. Sotkiewicz also argues that minimum run times are a way to get more run time out of resources which are more likely to have start-based long-term maintenance triggers.¹⁶³

99. PJM and EPSA argue that PJM's proposed fast-start resource definition is appropriate given the characteristics of the PJM generation fleet and urge the Commission to permit regional variation in the fast-start resource definition.¹⁶⁴ For example, PJM contends that reflecting the regional differences of PJM's operating fleet in the implementation of fast-start pricing is essential to meeting the Commission's price

¹⁵⁸ Calpine Reply Brief at 6-7; EPSA Reply Brief at 8-10; Exelon Reply Brief at 3-9; FirstEnergy/AES/EKPC Reply Brief at 10-11; PJM Power Providers Group Reply Brief at 6-7; Shell Reply Brief at 3.

¹⁵⁹ Calpine Reply Brief at 6-7; EPSA Reply Brief at 9; FirstEnergy/AES/EKPC Reply Brief at 10-11; PJM Power Providers Group Reply Brief at 6.

¹⁶⁰ EPSA Reply Brief at 10 (citing Sotkiewicz Aff. at 18-19).

¹⁶¹ Sotkiewicz explains that the uncertainty derives from the multiple scenarios run in the IT SCED based on forecasts of load, generator performance, and interchange. Sotkiewicz Aff. at 15.

¹⁶² *Id.* at 16-17.

¹⁶³ *Id.* at 18.

¹⁶⁴ EPSA Reply Brief at 3, 5, 8-9; PJM Reply Brief at 13. *See also* Shell Reply Brief at 3 (stating PJM's proposed approach is reasonable and tailored to its market).

formation objective of clearing prices that reflect the true cost to serve load.¹⁶⁵ EPSA argues that PJM's proposed definition balances unique aspects of the PJM region, generation mix, and operating practices in a way that improves price formation.¹⁶⁶

100. PJM argues against the PJM Market Monitor's assertions that fast-start pricing will erode incentives for flexible offers and contradict LMP-based market design. PJM claims that PJM's current rules result in flexible resources rarely collecting any infra-marginal rents and thus discourage flexible resources from offering their true capabilities, a phenomenon that PJM has attempted to remedy through Parameter Limited Schedule (PLS) rules. PJM argues that allowing inflexible resources to set price will allow flexible resources, formerly operating at the margin, to become infra-marginal and collect infra-marginal rents and, in so doing, will incentivize flexible resources to offer their full flexible capability. PJM argues that fast-start pricing will shift costs from uplift to prices and, in so doing, both remove subsidies to load-serving entities via socialization of uplift costs driven by suppressed load schedules and increase competition for market revenues. PJM argues that attempting to eliminate inflexible resources pursues an arbitrary goal of forcing the electric power market onto a hypothetical textbook convex model which, while it might avoid market design complexities, would not necessarily yield the lowest cost to consumers.¹⁶⁷

101. In response to IMG's argument for a 10-minute start-up time requirement, PJM states that the more restrictive the fast-start resource definition is, the less uplift is reduced or costs at the margin are properly reflected, and the more likely it is that current price formation issues persist.¹⁶⁸ Calpine and FirstEnergy/AES/EKPC argue that reducing uplift is an important price formation goal.¹⁶⁹ Exelon claims that PJM's proposed fast-start resource definition increases market efficiency because it allows more efficient and/or flexible resources to compete with fast-start resources on a level playing field.¹⁷⁰

¹⁶⁵ PJM Reply Brief at 13.

¹⁶⁶ EPSA Reply Brief at 3, 5, 8-9.

¹⁶⁷ PJM Reply Brief at 5-7.

¹⁶⁸ *Id.* at 12-13.

¹⁶⁹ Calpine Reply Brief at 6-7; FirstEnergy/AES/EKPC Reply Brief at 10-11.

¹⁷⁰ Exelon Reply Brief at 7-8 (citing Schnitzer Testimony at 11).

102. PJM Power Providers Group argues that resources have been developed in response to the two-hour look-ahead window in the IT SCED. Citing accompanying testimony from Robert Stoddard, PJM Power Providers Group argues that the IT SCED's two-hour commitment window supports a two-hour start-up time criterion for fast-start resources in PJM. PJM Power Providers Group states that PJM's optimization engine has made two hours the benchmark for defining fast-start resources. PJM Power Providers Group argues that PJM's current resource mix and operating practices justify a two-hour start-up time criterion.¹⁷¹

d. Answers

103. PJM argues that the parties opposing its proposal misunderstand the IT SCED optimization process, specifically, the length of intervals across the two-hour look-ahead window.¹⁷² PJM argues that the IT SCED is capable of capturing the entire commitment period for a resource with two-hour start-up and minimum run times because the fourth interval in the IT SCED two-hour look ahead window spans 120 minutes and does not begin until two hours into the IT SCED case.¹⁷³ PJM states that this forecast period was intentionally set to ensure that the IT SCED can assess the full cost of committing a resource with a two-hour start-up and two-hour minimum run time.¹⁷⁴

¹⁷¹ PJM Power Providers Group Reply Brief at 6.

¹⁷² In its April 19 answer, PJM explains that each IT SCED case contains four intervals, spaced over a two-hour look ahead window. Each interval varies in length from 15 to 120 minutes, and may overlap with other intervals. The fourth interval in an IT SCED case begins at the end of the two-hour look ahead window, and lasts for 120 minutes. Thus, from the time the case is executed to the end of the fourth interval, each IT SCED case lasts approximately four hours and 15 minutes. PJM Answer to Reply Briefs (April 19, 2018) at 5.

¹⁷³ According to PJM, the IT SCED time horizon varies slightly because it is offset from the Real-time Security Constrained Economic Dispatch (RT SCED) application, which runs concurrently with IT SCED but over the next 10 minutes in real time. The first IT SCED interval starts earlier than the RT SCED interval, at the first quarter hour that is at least a half hour from the time the case is executed. PJM Answer to Reply Briefs (April 19, 2018) at 5.

¹⁷⁴ PJM Answer to Reply Briefs (April 19, 2018) at 4-6.

104. Joint Commenters state that the longer the time between a resource's commitment in the IT SCED and its actual operation, the greater the forecast uncertainty and risk that the associated resource is not in fact less expensive than other available resources.¹⁷⁵

e. Determination

105. We find that resources with start-up or minimum run times in excess of an hour lack the flexibility to operate in a manner consistent with unforeseen or transient real-time needs, and, therefore, commitment and dispatch of such resources are not analogous to a marginal decision. Applying fast-start pricing logic to such resources would result in prices failing to reflect the marginal cost of serving load. Therefore, we conclude that PJM's practice of allowing resources with start-up and minimum run times of more than one hour to receive fast-start pricing treatment is unjust and unreasonable.

106. We direct PJM to include in its definition of fast-start resources a requirement that they be able to start up within one hour or less (including notification time) and have a minimum run time of one hour or less. We find that this requirement will limit fast-start pricing treatment only to those resources whose commitment and dispatch can be considered analogous to a marginal decision. This requirement ensures that fast-start resources are sufficiently flexible to be able to quickly start up and shut down in response to real-time system needs.¹⁷⁶

107. We disagree with IMG Midstream that the record does not support a one-hour start-up time requirement.¹⁷⁷ We acknowledge that there is no bright line between what is marginal and what is not marginal. However, the commitment of a resource with one-hour start-up and minimum run times is more closely analogous to a marginal decision than the commitment of a resource with two-hour start-up and minimum run times. Moreover, we disagree with IMG Midstream's argument that the Commission can only meet its burden of proof by explaining how a one-hour start-up time criterion satisfies the Commission's price formation goals. Rather, as a proceeding instituted by the Commission under section 206 of the FPA, the Commission must demonstrate that PJM's existing practice is unjust, unreasonable, or unduly discriminatory, or preferential, and that the replacement is just and reasonable.

¹⁷⁵ Joint Commenters March 29 Answer at 4.

¹⁷⁶ In general, a resource's ability to quickly start-up, ramp up or down, and shut down quickly places fewer constraints on the RTO/ISO operator and thus gives the operator more flexibility to operate the system efficiently.

¹⁷⁷ IMG Midstream Initial Brief at 5-7.

108. We are not persuaded that PJM's proposal to allow fast-start resources to have start-up and minimum run times of two hours or less is just and reasonable. We are also not persuaded by the commenters' arguments supporting PJM's proposed definition of a fast-start resource. First, we do not find persuasive arguments that because PJM uses its IT SCED to make operational decisions within a two-hour look-ahead window, resources with two-hour start-up and minimum run times should be considered marginal for the purpose of setting price. We agree with the PJM Market Monitor that the configuration of PJM's software should not define the resources eligible for fast-start pricing. PJM and other commenters fail to explain why the IT SCED's look-ahead timeframe should define whether a resource is considered marginal for pricing purposes.

109. Second, we are not persuaded by PJM's argument that start-up and minimum run time criteria of two hours rather than one hour should be adopted because it would result in less uplift. While reducing uplift may be one benefit of fast-start pricing, fast-start pricing is intended to allow prices to better reflect the marginal cost of serving load. While expanding fast-start pricing treatment to a broader set of resources could at times result in less uplift, such an expansion would apply fast-start pricing treatment to resources where the commitment and dispatch of those resources are not analogous to a marginal decision. More importantly, fast-start pricing reforms provide additional transparency by more accurately pricing the marginal cost of responding to unforeseen or transient system needs. Fast-start resources as defined by the Commission possess unique operating characteristics that enable system operators to economically address such system needs.

110. Third, PJM, Exelon, and FirstEnergy/EKPC contend that the definition of a fast-start resource should also differ by region such that the desired pricing outcomes and uplift reduction are achieved and that, therefore, PJM's proposed fast-start resource definition is appropriate given the characteristics of the PJM generation fleet. While the Commission affords regional flexibility to RTOs/ISOs, the Commission's rationale for fast-start pricing aims at ensuring that prices better reflect the marginal costs of production when resources are responding to unforeseen or transient system needs. Neither PJM nor the commenters have supported how the characteristics of PJM's generation fleet make PJM's proposed fast-start resource definition better reflect the marginal costs of production when resources are responding to unforeseen or transient system needs than the definition required in this order.

7. Tariff Language

a. December 2017 Order

111. In the December 2017 Order, the Commission preliminarily found that PJM's practices related to fast-start pricing significantly affect the rates, terms, and conditions of service and, as such, must be filed with the Commission as part of the PJM Tariff.¹⁷⁸

b. Initial Briefs

112. PJM agrees that fast-start pricing rules should be reflected in PJM's governing documents and states it will file fast-start pricing revisions to its Tariff and Operating Agreement upon the Commission's ruling in this proceeding.¹⁷⁹

113. The PJM Market Monitor states that PJM's current fast-start pricing practices have appeared to be implemented at the discretion of PJM operators, are not applied to all combustion turbines, and appear nowhere in the PJM tariff or manuals. The PJM Market Monitor states that PJM engages in discretionary manual market interventions in a manner that is not predictable or transparent.¹⁸⁰

c. Determination

114. We find that PJM's practices related to fast-start pricing significantly affect the rates, terms, and conditions of service and therefore direct PJM on compliance to file its fast-start pricing rules with the Commission as part of the PJM Tariff. The FPA requires all practices that significantly affect rates, terms, and conditions of service to be on file with the Commission, and these practices must be included in a Commission-accepted tariff.¹⁸¹ PJM's fast-start pricing practices have a material effect on electric rates because

¹⁷⁸ December 2017 Order, 161 FERC ¶ 61,295 at P 29.

¹⁷⁹ PJM Initial Brief at 3.

¹⁸⁰ PJM Market Monitor Initial Brief at 8.

¹⁸¹ 16 U.S.C. § 824d(c) (2012); *Demand Response Coalition v. PJM Interconnection, L.L.C.*, 143 FERC ¶ 61,061, at P 17 (2013); *Cargill Power Markets, LLC v. Public Service Company of New Mexico*, 141 FERC ¶ 61,141, at P 14 (2012); see generally *Prior Notice and Filing Requirements under Part II of the FPA*, 64 FERC ¶ 61,139 (1993) (explaining Commission jurisdiction with respect to all rates and charges that are "for or connected with" and all agreements that "affect or relate to" jurisdictional activities).

they affect prices in the PJM energy market. For example, allowing fast-start resources to set prices by relaxing their economic minimum operating limits and including fast-start resources' commitment costs in their offers can affect the market clearing price. Because PJM's fast-start pricing practices significantly affect the rates, terms, and conditions of service, we require PJM to reflect its fast-start pricing rules in its Tariff.¹⁸²

8. Commitment Costs in the Day-Ahead and Real-Time Markets

a. December 2017 Order

115. In the December 2017 Order, the Commission did not discuss whether fast-start pricing should be applied in the day-ahead market or how fast-start resources' commitment costs should be included in prices if they clear some quantity in both the day-ahead and real-time markets.

b. Initial Briefs

116. PJM proposes to apply fast-start pricing in the day-ahead market and include commitment costs only in the market (day-ahead or real-time) in which the commitment decision is made. PJM argues that commitment costs associated with the day-ahead market should be considered sunk costs in the real-time market, and that incorporating such costs in only one market is necessary to ensure prices accurately reflect commitment decisions at the time they are made. PJM states that it is critical to eliminate the possibility that a resource that has already been made whole for its commitment costs in the day-ahead market could collect those costs again in the real-time market if it is dispatched above its day-ahead schedule.¹⁸³

117. The PJM Market Monitor states that including the same resource's commitment costs in both the day-ahead and real-time markets could result in double recovery of costs. However, the PJM Market Monitor also argues that including the commitment costs of resources committed in day-ahead market prices but not in real-time prices would create a significant inconsistency between day-ahead and real-time prices. The PJM Market Monitor adds that this different treatment would create an arbitrage

¹⁸² PJM may, on compliance, propose revisions to other governing documents as necessary. Consistent with the Commission's "rule of reason" policy, PJM may include implementation details related to fast-start pricing in its business practice manuals. *See Preventing Undue Discrimination and Preference in Transmission Service*, Order No. 890, 118 FERC ¶ 61,119, at PP 1649-51 (2007).

¹⁸³ PJM Initial Brief at 13.

opportunity for virtual traders, and that virtual transactions could not eliminate the inconsistency between the day-ahead and real-time energy prices.¹⁸⁴

c. Reply Briefs

118. In response to the PJM Market Monitor's concerns that including commitment costs in the market in which the commitment decision is made would lead to arbitrage opportunities with the real-time market, PJM asserts that the PJM Market Monitor provides no evidence of the potential for false arbitrage and states that the Commission has approved a similar arrangement in MISO.¹⁸⁵

119. Several commenters oppose PJM's proposal to include commitment costs only in the prices of the market in which the commitment decision is made. PJM Power Providers Group argues that PJM should include commitment costs in prices for both the day-ahead and real-time markets even if a resource was already committed in the day-ahead market. PJM Power Providers Group explains that PJM's proposal may create an arbitrage opportunity exclusive to owners of fast-start resources. PJM Power Providers Group states that, under PJM's proposal, a given day-ahead market interval's price could be set by a fast-start resource while the corresponding real-time market interval's prices could be set by a flexible, non-fast-start resource. PJM Power Providers Group argues that the price difference would enable arbitrage via virtual bidding. PJM Power Providers Group contends that, more importantly, only the fast-start resource owner would have knowledge of the arbitrage opportunity because only the owner would know that its offer set the day-ahead price.¹⁸⁶

120. The Brattle Group report submitted by Joint Commenters asserts that PJM's proposal to exclude the commitment costs of fast-start resources committed in the day-ahead market from real-time prices would understate real-time prices in intervals when fast-start resources are marginal but previously committed in the day-ahead market and lead to the double payment of lost opportunity cost payments as prices increase in both

¹⁸⁴ PJM Market Monitor Initial Brief at 10; PJM Market Monitor March 29, 2018 Answer at 12-13.

¹⁸⁵ PJM Reply Brief at 8 (citing *Midwest Indep. Transmission Sys. Operator, Inc.*, 140 FERC ¶ 61,067 (2012); *Midwest Indep. Transmission Sys. Operator, Inc.*, Docket No. ER12-668-002 (July 30, 2012) (delegated order); *ISO New England Inc.*, Docket No. ER15-2716-000 (Oct. 19, 2015) (delegated order)).

¹⁸⁶ PJM Power Providers Group Reply Brief at 7-8.

markets.¹⁸⁷ Exelon also argues that PJM's proposed treatment of fast-start resource commitments costs will induce virtual traders to submit trades that will destabilize market prices. Exelon asks the Commission to reject PJM's proposal, which Exelon argues will cause day-ahead and real-time prices to diverge.¹⁸⁸

d. Determination

121. We find PJM's proposal fails to accurately include a fast-start resource's commitment costs in both the day-ahead and real-time markets. We find that such an omission would hinder price transparency and limit convergence between the day-ahead and real-time markets, resulting in rates that are not just and reasonable. Under identical market conditions, the day-ahead and real-time markets could produce different energy prices because the day-ahead market does not incorporate the commitment costs of fast-start resources in energy prices. Further, we agree with the PJM Market Monitor, PJM Power Providers Group, and Exelon that PJM's proposal may provide an arbitrage opportunity for virtual traders. Accordingly, we direct PJM to include a price-setting fast-start resource's commitment costs in both the day-ahead market and the real-time market. We find that such a directive would allow fast-start resources the opportunity to set price in both the day-ahead and real-time markets, avoid arbitrage opportunities that increase divergence between these markets, and promote price transparency.

122. However, we also agree with concerns from PJM and the PJM Market Monitor that incorporating commitment costs in both markets would not eliminate the possibility that a resource that has already been made whole for its commitment costs in the day-ahead market could collect those costs again in the real-time market, if it is dispatched above its day-ahead commitment.¹⁸⁹ Consistent with the PJM Power Providers Group's suggestion, we also require PJM to include in its compliance filing a proposal to withhold

¹⁸⁷ The Brattle Group, *Evaluation of PJM's Fast-Start Pricing Proposal* by Samuel A. Newell, *et al.* (March 14, 2018) at 7-9. *See also* Joint Commenters Reply Brief at 14 n.38.

¹⁸⁸ Exelon Reply Brief at 3, 12-16.

¹⁸⁹ As the PJM Market Monitor notes, under integer relaxation, a fast-start resource dispatched in the day-ahead market at a level below its economic maximum output would only recover a portion of its commitment costs and PJM would subsequently provide an uplift payment to cover the rest of the commitment costs. The PJM Market Monitor explains that, if the same resource was dispatched at a higher output in the real-time market, that resource would recover the same portion of its commitment costs that it recovered in the day-ahead market. PJM Market Monitor Answer at 13-14.

uplift payments in excess of a fast-start resource's commitment costs in order to eliminate the possibility that a fast-start resource can over-recover its commitment costs.¹⁹⁰

9. Market Power

a. December 2017 Order

123. In the December 2017 Order, the Commission did not discuss whether allowing fast-start resources to set price could result in the exercise of market power.

b. Initial Briefs

124. The PJM Market Monitor contends that PJM's approach to fast-start pricing would create new potential market power issues and states that the PJM market rules should be modified to ensure that offers are competitive. The PJM Market Monitor argues that adopting PJM's proposed revisions to its fast-start pricing practices would require PJM to revise the Three Pivotal Supplier (TPS) test,¹⁹¹ which is applied only to the dispatch run, because different constraints may bind between the proposed dispatch and pricing runs. Given this difference, the PJM Market Monitor argues that the TPS test should be performed twice—once for the pricing run and once for the dispatch run. The PJM Market Monitor also asserts that fast-start pricing would increase the need for aggregate market power mitigation rules as it enhances a fast-start resource's ability to exercise market power because that resource can include commitment costs in its offer and set prices at higher levels.¹⁹² The PJM Market Monitor states that PJM market rules do not impose a cap on commitment costs, and asserts that the commitment costs of fast-start resources should be verified prior to being included in prices, similar to the requirement

¹⁹⁰ PJM Power Providers Group Answer at 3.

¹⁹¹ The TPS test defines which suppliers have market power based on their ability to provide congestion relief. Specifically, the TPS test determines whether the supply of any Market Seller, when combined with the two largest available suppliers, can supply enough megawatts to relieve a binding transmission constraint. If the megawatts of any Market Seller being tested, when combined with the two largest available suppliers other than that Market Seller, are required to relieve a constraint, the offer of that Market Seller's resource fails the TPS test and the offer is mitigated to the lower of the resource's cost-based or market-based offer at its economic minimum operating limit. The ranking of the offers is determined by evaluating the dispatch cost of both offers (at the economic minimum operating limit).

¹⁹² PJM Market Monitor Initial Brief at 12-13.

for cost-based incremental energy offers above \$1,000/MWh.¹⁹³ Moreover, the PJM Market Monitor states that Order No. 831's cost-based verification requirement for energy offers exceeding \$1,000/MWh excludes start-up costs and no-load costs.¹⁹⁴ The PJM Market Monitor argues that, if start-up and no-load costs are to be included in prices, commitment costs should be capped or subjected to cost-based verification over certain limits.¹⁹⁵ Moreover, the PJM Market Monitor adds that the peaking segment of the supply curve – where fast-start resources fall – is uncompetitive because it is highly concentrated. Accordingly, the PJM Market Monitor states that the Commission should require PJM to include a process for mitigation of market power for fast-start resources.¹⁹⁶

c. Reply Briefs

125. PJM argues that the PJM Market Monitor's concerns about market power are outside the scope of this proceeding and argues that the introduction of fast-start pricing will not create new market power concerns. PJM asserts that a higher number of units eligible to set price would increase, not decrease, competition and that potentially higher prices would not necessarily be due to market power, but rather, would be due to more accurately reflecting the cost of serving load. PJM acknowledges the PJM Market Monitor's contention that the pricing run may produce a different set of binding constraints than the dispatch run. PJM states that the transitory market power mitigated by the TPS test arises from physical conditions on the system during the dispatch run, however, and that conditions modeled in the pricing run will not create any new market power. PJM states that the TPS test will be applied during commitment and dispatch processes, so any resources with market power will already have their offers mitigated prior to the pricing run. As such, PJM states that the existing TPS test will not be changed with the implementation of fast-start pricing. PJM states that rules preventing inflexible resources from setting LMP were not originally designed as a way to mitigate market power and that PJM and the PJM Market Monitor are currently capable of

¹⁹³ *Id.* at 11.

¹⁹⁴ *Id.* (citing *Offer Caps in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 831, 157 FERC ¶ 61,115, at P 208 (2016)).

¹⁹⁵ *Id.*

¹⁹⁶ *Id.* at 12 (asserting that the average HHI market concentration index for the peaking segment of the PJM supply curve is near 6000, which is well above the 1800 HHI cutoff defining the market as highly concentrated).

policing the operating parameters of these units as they already do for more complex flexible units.¹⁹⁷

126. FirstEnergy/AES/EKPC contend that market power concerns regarding PJM's proposal are unsubstantiated. Specifically, they argue that the PJM Market Monitor incorrectly applies an HHI value of approximately 6000 to the peaking segment of PJM's supply curve. FirstEnergy/AES/EKPC contend that HHIs are not measured by segments of the supply curve, but are instead based on how much supply of the relevant product is located in the relevant geographic market. Further, FirstEnergy/AES/EKPC state that PJM's fast-start resource mix does not indicate market power.¹⁹⁸

d. Determination

127. We disagree with the PJM Market Monitor's contention that PJM must modify the TPS test and other mitigation rules to account for fast-start pricing. We find there to be a lack of sufficient evidence at this time that such modifications are necessary, and as such we are not persuaded by the PJM Market Monitor's assertions that the modifications are necessary. Accordingly, we do not require PJM to include any particular revisions to its market power mitigation rules as part of its fast-start pricing compliance filing, such as revisions to the TPS test or the verification of start-up and no-load costs, as the PJM Market Monitor suggests.

128. Nevertheless, we believe that the PJM Market Monitor has correctly identified the potential for the pricing run to produce a different set of binding constraints than the dispatch run, which could impact the mitigation of the incremental energy offer. Accordingly, we direct PJM to file a one-time informational report explaining why implementing the fast-start pricing changes required in this order does not raise market power concerns relating to different power flows in the dispatch and pricing runs and the existing TPS test evaluating market power in the dispatch run only.¹⁹⁹ We require PJM to file the informational report by August 30, 2019, one month after the deadline for PJM to submit a compliance filing, so that addressing these questions will not impede PJM's compliance efforts.

¹⁹⁷ PJM Reply Brief at 10-12.

¹⁹⁸ FirstEnergy/AES/EKPC Reply Brief at 2, 12.

¹⁹⁹ This report will not be noticed for comment or require Commission action.

129. Specifically, in the informational report, we direct PJM to answer the following questions:

- A) Explain in detail how PJM's existing market power mitigation practices would mitigate *pricing run* market power, if at all;
- B) Describe scenarios in which a resource could attain pricing run market power without attaining dispatch run market power, and assess whether these scenarios are likely to occur;
- C) PJM acknowledges the PJM Market Monitor's contention that the pricing run may produce a different set of binding constraints than the dispatch run.²⁰⁰ However, PJM states that the transitory market power mitigated through the use of the TPS test and offer-capping arises from physical conditions on the system during the dispatch run and that conditions modeled in the pricing run will not create any new market power concerns.²⁰¹ Explain how, if the set of binding constraints occurring in the pricing run differs from those in the dispatch run, the application of mitigation due to physical conditions during the dispatch run prevents the creation of new conditions that may make it possible for a resource to exercise market power during the pricing run;
- D) Explain the changes necessary for PJM to apply the TPS test to both the dispatch run and the pricing run and any burdens associated with these changes, including computational burden. Examples of associated burdens could include expenditures, person-hours, and computational hardware upgrades. Explain how much additional run time per market interval would be needed to apply the TPS test to both the pricing run and dispatch run;
- E) PJM currently has separate procedures for addressing market power in energy offers via the TPS test and subsequent mitigation on the one hand, and preventing opportunistic start-up and no-load offers via verification procedures on the other.²⁰² Explain how PJM's current procedures will address the PJM

²⁰⁰ PJM Reply Brief at 11-12.

²⁰¹ *Id.*

²⁰² PJM Tariff §§ 1.9.7(b)(i)-(ii).

Market Monitor's cost verification concerns related to the inclusion of commitment costs in energy offers.²⁰³

130. With regard to the PJM Market Monitor's assertion that commitment costs should be capped or subjected to cost-based verification over certain limits, we note that energy offers of fast-start resources that include the fast-start resource's commitment costs are subject to the Commission's offer cap requirements in Order No. 831.²⁰⁴ Specifically, when commitment costs are included in energy offers for fast-start resources, such offers must be capped at the higher of \$1,000/MWh or the resource's verified cost-based offer, and such offers are also subject to the \$2,000/MWh cap for verified cost-based offers.²⁰⁵ In implementing the fast-start pricing changes required in this order, PJM must apply the Commission's offer cap requirements to fast-start resources' composite energy offers, which include the resources' commitment costs. Further, we note that the PJM Tariff contains procedures for verifying commitment costs and restrictions on start-up and no-load offers intended to prevent opportunistic behavior.²⁰⁶ Because of that, we find additional verification or mitigation provisions governing start-up and no-load offers to not be needed to implement fast-start pricing. Additionally, with regard to the PJM Market Monitor's argument that the peaking segment of the supply curve is uncompetitive because it is highly concentrated, we expect that PJM's response to Question C in the informational report²⁰⁷ will address this concern.

²⁰³ PJM Market Monitor Initial Brief at 11.

²⁰⁴ [*Offer Caps in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 831, 157 FERC ¶ 61,115 \(2016\)](#), *order on reh'g and clarification*, Order No. 831-A, 161 FERC ¶ 61,156 (2017).

²⁰⁵ *Midcontinent Indep. Sys. Operator, Inc.*, 161 FERC ¶ 61,155, at P 20 (2017), *order on reh'g and compliance*, 162 FERC ¶ 61,270, at PP 27-31, *reh'g denied*, 165 FERC ¶ 61,004 (2018) (finding that the offer cap reforms of Order No. 831 should apply to fast-start resources' adjusted energy offers, which include the resources' commitment costs).

²⁰⁶ In particular, PJM Tariff sections 1.9.7(b)(i) and 1.9.7(b)(ii) describe procedures restricting the calculation and offer behavior of start-up and no-load costs.

²⁰⁷ *See supra* P 0.

10. Over-Generation and Price-Chasing Behaviors

a. December 2017 Order

131. In the December 2017 Order, the Commission encouraged PJM to develop a mechanism to address over-generation and price-chasing to the extent PJM identified these issues as potential problems. The Commission listed as potential approaches for PJM to consider “penalizing uninstructed deviations, settling over-generated MWh at only standard LMP ... or providing for lost opportunity cost payments.”²⁰⁸

b. Initial Briefs

132. PJM proposes to limit redispatched resources’ incentives to deviate from dispatch instructions by providing them lost opportunity cost payments. PJM states that lost opportunity costs would be equal to the difference between the profit a resource would have received if it operated at its profit-maximizing output, and the profit it received based on following PJM’s dispatch instructions. PJM proposes to provide lost opportunity cost credits to all eligible, online resources in both the day-ahead and real-time energy markets.²⁰⁹

133. Cogentrix argues that PJM should consider addressing possible over-generation due to generators that are being dispatched down to accommodate fast start resources. FirstEnergy/EKPC agree that additional rules may be needed to address over-generation that could result when the economic minimum operating limits of block-loaded resources are fully relaxed.²¹⁰

c. Reply Briefs and Answers

134. FirstEnergy/AES/EKPC support PJM’s proposal to compensate resources that follow their dispatch instructions with lost opportunity cost credits. FirstEnergy/AES/EKPC argue that implementing a lost opportunity cost payment mechanism will give generators more incentive to include the most accurate operating

²⁰⁸ December 2017 Order, 161 FERC ¶ 61,295 at P 31.

²⁰⁹ PJM Initial Brief at 16-18.

²¹⁰ FirstEnergy/EKPC Initial Brief at 9.

characteristics in their offers, which will provide additional system flexibility and lead to a more efficient dispatch.²¹¹

135. The PJM Market Monitor argues that PJM's proposed lost opportunity cost payments are a new form of uplift payments that would undermine the transparent functioning of the market because the uplift payments would be non-public. The PJM Market Monitor also argues that including commitment costs in prices lowers total market surplus because the lost opportunity cost payments introduce a new cost to the market that changes incentives and introduces inefficiencies.²¹²

136. PJM counters that the PJM Market Monitor's assertions are unsubstantiated and that total market surplus will not be affected. PJM states that because there are separate pricing and dispatch runs, changing the pricing logic and introducing lost opportunity cost payments will not change the total market surplus but only how market surplus is allocated.²¹³

137. Joint Commenters assert that PJM provides no information about the impact its proposed lost opportunity cost payments will have on uplift, and that without such information it is impossible for PJM to claim that its proposal for two-hour start-up and minimum run time requirements would result in significantly less uplift. Joint Commenters state that lost opportunity cost payments will create a new pool of uplift that could result in an increase in total uplift.²¹⁴ Dominion notes that PJM has not vetted the allocation of lost-opportunity-cost charges through the stakeholder process.²¹⁵

d. Determination

138. In the December 2017 Order, the Commission recognized that fast-start pricing may create an incentive to deviate from PJM's dispatch instructions in order to take advantage of higher prices that result from fast-start pricing. This problem is particularly acute for resources that incur lost opportunity costs as a result of being dispatched down to accommodate fast-start resources. PJM has proposed to use lost opportunity cost

²¹¹ FirstEnergy/AES/EKPC Reply Brief at 9-10.

²¹² PJM Market Monitor Initial Brief at 4; PJM Market Monitor Reply Brief at 2-4; PJM Market Monitor March 29, 2018 Answer at 11-12; PJM Market Monitor May 7, 2018 Answer at 1-2.

²¹³ PJM April 19, 2018 Answer at 2.

²¹⁴ Joint Commenters Reply Brief at 12.

²¹⁵ Dominion Reply Brief at 3.

payments to offset the incentive for over-generation or price chasing. We find PJM's proposal a just and reasonable and an effective approach to mitigate economic incentives to price chase.

139. We disagree with commenters who argue that PJM's proposal undermines transparency and decreases market surplus, as discussed in Section IV.B.1.e. Lost opportunity cost payments are a reasonable approach to maintaining proper incentives for lower cost flexible resources to follow PJM's dispatch instructions. These payments are meant to influence the behavior of a specific generator to avoid over-generation, rather than send a signal broadly to the market about the cost of serving load.

11. Applying Fast-Start Pricing Rules to Reserves

a. December 2017 Order

140. In the December 2017 Order, the Commission did not discuss applying fast-start pricing rules to reserves.

b. Initial Briefs

141. PJM proposes to apply "a method similar to the integer relaxation methodology" to certain resources in its synchronized and non-synchronized reserve markets. PJM states that certain resources, specifically block-loaded synchronous condensers and demand response resources, are ineligible to set the synchronized reserve clearing price. Therefore, PJM asserts, synchronized reserve market clearing prices do not reflect such resources' commitment costs. PJM states that uplift payments in the synchronized reserve market account for 65 percent of the total compensation provided for synchronized reserves in PJM. Furthermore, PJM states that the same phenomenon occurs in the non-synchronized reserve markets, and thus, certain inflexible resources are committed to provide reserves but are not permitted to set the non-synchronized reserve price. PJM asserts that synchronous condensers and demand response resources in the reserve markets meet the definition of fast-start resources. As such, PJM proposes to apply "a methodology similar to the integer relaxation methodology" to synchronous condensers and demand response resources participating in PJM's reserve markets. PJM argues that the Commission should allow these resources to set the reserve price in the same manner as fast-start resources would set the energy market price.²¹⁶

c. Determination

142. We find that PJM's proposal to apply "a methodology similar to the integer relaxation methodology" to synchronous condensers and demand response resources

²¹⁶ PJM Initial Brief at 9-10.

participating in PJM's reserve markets is beyond the scope of this section 206 proceeding, which is limited to PJM's practices regarding the energy market pricing of fast-start resources. If PJM wishes to propose an expansion of its integer relaxation methodology, or some similar methodology, to synchronous condensers and demand response resources participating in PJM's reserve markets, PJM may submit an FPA section 205 filing with PJM's specific proposal and methodology.

12. Other Issues

a. Initial Briefs

143. FirstEnergy/EKPC argue that the Commission should also direct PJM to file tariff revisions to compensate resources for meeting fuel diversity, security, reliability, and resiliency needs.²¹⁷ FirstEnergy/EKPC contend that improvements to fast-start pricing will likely produce limited benefits and not sustain the market over the long-term.²¹⁸

144. The PJM Market Monitor requests that, if the Commission directs PJM to implement fast-start pricing, the Commission should clarify that incorporating commitment costs for any resources other than fast-start resources contradicts the Commission's price formation goals.²¹⁹

b. Reply Briefs

145. Potomac Economics agrees with the PJM Market Monitor's request that the Commission clarify that PJM should not include in prices the commitment costs of any resources other than fast-start resources. Potomac Economics points to the PJM Market Monitor's statements that PJM has previously proposed including commitment costs in energy offers for all resources, a proposal with which both the PJM Market Monitor and Potomac Economics disagree. Potomac Economics clarifies its position as supporting the inclusion of commitment costs in energy offers only for fast-start resources, differentiating from the PJM Market Monitor's position that no commitment costs should be included in energy offers.²²⁰

²¹⁷ FirstEnergy/EKPC Initial Brief at 10-12.

²¹⁸ *Id.*

²¹⁹ PJM Market Monitor Initial Brief at 13-14.

²²⁰ Potomac Economics Reply Brief at 5.

146. Joint Commenters assert that expanding the concept of fast-start pricing to all inflexible resources is unjust and unreasonable and requests the Commission clarify that any action on fast-start pricing in no way endorses other energy market pricing reforms that PJM is pursuing.²²¹

c. Determination

147. We find that the other issues noted above are beyond the scope of this FPA section 206 proceeding, which is limited to PJM's practices regarding the energy market pricing of fast-start resources. Specifically, we note that the Commission is currently considering issues regarding grid resilience in RTOs/ISOs in Docket No. AD18-7-000. Additionally, the Commission did not initiate investigation into the issue of pricing reforms for non-fast-start resources in this proceeding, and we clarify that the determinations in this order only relate to fast-start resources.

The Commission orders:

(A) The Commission finds that PJM's existing fast-start pricing practices are unjust and unreasonable, as discussed in the body of this order.

(B) PJM is hereby directed to make a compliance filing by July 31, 2019, as discussed in the body of this order.

(C) PJM is hereby directed to file an informational report by August 30, 2019, as discussed in the body of this order.

By the Commission.

(S E A L)

Nathaniel J. Davis, Sr.,
Deputy Secretary.

²²¹ Joint Commenters Reply Brief at 2, 15-17.

APPENDIX: List of Intervenors

Notices of Intervention

Delaware Public Service Commission

Maryland Public Service Commission

Pennsylvania Public Utility Commission

Public Utilities Commission of Ohio

Motions to Intervene

Advanced Energy Economy

Allegheny Electric Cooperative, Inc.

Ameren Services Company

American Electric Power Service Corporation

American Municipal Power, Inc.

American Petroleum Institute

American Public Power Association

American Wind Energy Association

Calpine Corporation

Cogentrix Energy Power Management, LLC

Direct Energy, Direct Energy Business, LLC, and Direct Energy Business Marketing, LLC

District of Columbia Office of the People's Counsel

Dominion Energy Services, Inc.

Duke Energy Corporation

East Kentucky Power Cooperative, Inc.

EDF Renewable Energy, Inc.

Edison Electric Institute

EDP Renewables North America LLC

Electric Power Supply Association

E.ON Climate & Renewables North America, LLC

Exelon Corporation

FirstEnergy Service Company

Illinois Citizens Utility Board

IMG Midstream LLC

Invenergy LLC

LS Power Associates, L.P.

Monitoring Analytics, LLC, in its capacity as the Independent Market Monitor for PJM

National Rural Electric Cooperative Association

NextEra Energy Resources, LLC

NRG Power Marketing LLC and GenOn Energy Management, LLC

Panda Power Funds

PJM Interconnection, L.L.C.

PJM Power Providers Group

PPL Electric Utilities Corporation

Public Citizen, Inc.

Public Service Electric and Gas Company, PSEG Power LLC, and PSEG Energy

Resources & Trade LLC

Retail Energy Supply Association

Shell Energy North America (U.S.), L.P.

Southern Company Services, Inc. (on behalf of Alabama Power Company, Georgia Power Company, Gulf Power Company, Mississippi Power Company, and Southern Power Company)

Southern Power Company

Out-of-Time Motions to Intervene

AES Ohio Generation, LLC

American Council on Renewable Energy

Delaware Division of the Public Advocate

Dynegy Marketing and Trade, LLC

Illinois Commerce Commission

New Jersey Board of Public Utilities

Nuclear Energy Institute

PJM Industrial Customer Coalition

Potomac Economics

Sustainable FERC Project and Natural Resources Defense Council

Vitol, Inc.