

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

Fast-Start Pricing in Markets Operated by)	Docket No. RM17-3-000
Regional Transmission Organizations and)	
Independent System Operators)	

**COMMENTS OF THE
INDEPENDENT MARKET MONITOR FOR PJM**

Pursuant to the notice of proposed rulemaking issued December 15, 2016 (“NOPR”), Monitoring Analytics, LLC, acting in its capacity as the Independent Market Monitor for PJM (“Market Monitor”), submits these comments on the NOPR’s proposal to revise its regulations to require that each regional transmission organization and independent system operator incorporate market rules that meet certain requirements when pricing fast-start resources.¹

I. COMMENTS

A. The NOPR’s Proposed Fast Start Pricing Would Be a Departure from Efficient Marginal Cost Pricing.

In its June 2014 notice initiating its price formation proceedings, the NOPR stated that prices used in energy and ancillary services markets ideally “would reflect the true marginal cost of production, taking into account all physical system constraints, and these

¹ See *Fast-Start Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Notice of Proposed Rulemaking (NOPR), 157 FERC ¶ 61,213 (2016).

prices would fully compensate all resources for the variable cost of providing service.”² Economists recognize that no set of prices achieves both goals in markets with nonconvex production costs.³ ⁴ In market design, a choice must be made between efficient prices and full compensation of costs. The RTOs/ISOs established markets with efficient prices that equal the marginal cost of production by location. Generators that produce output in accordance with these efficient price signals minimize the total market cost of production. For generators with nonconvex costs, marginal cost prices may not cover the total cost of starting the generator and running at the efficient output level. Uplift payments cover the difference. The market equilibrium concept is known as a “marginal cost price equilibrium with transfers.”⁵ The RTOs/ISOs use it to produce an efficient, cost minimizing dispatch.

Uplift is paid based on the offer by the generator. Unlike the resource with an average price below the market price, the resource receiving an uplift payment does not receive any market rents above its offer. Unlike LMP revenue, uplift revenue does not provide a competitive incentive to the generator to offer its cost. Instead, uplift provides an incentive for the resource to overstate its cost in its market offers. The only solution to ensure competitive levels of uplift payment is to cap all offers for the payment of uplift at the resource’s short run marginal cost of production. It is also the simplest solution. As the

² Price Formation in Energy and Ancillary Services Markets Operated by Transmission Organizations and Independent System Operators, Notice, Docket No. AD14-14-000 at 2 (June 19, 2014).

³ See Stoft, *Power System Economics: Designing Markets for Electricity*, New York: Wiley (2002) at 272; Mas-Colell, Whinston, and Green, *Microeconomic Theory*, New York: Oxford University Press (1995) at 570; and Quinzii, “Efficiency of Marginal Cost Pricing Equilibrium,” in *Equilibrium and Dynamics, Essays in Honor of David Gale*, M. Majumdar ed. New York: Palgrave Macmillan (1992).

⁴ The production of output is convex if the production function has constant or decreasing returns to scale, which result in constant or rising costs average costs with increases in output. Production is nonconvex with increasing returns to scale, which is the case when generating units have start or no load costs that are large relative to marginal costs. See Mas-Colell, Whinston, and Green at 132.

⁵ See *id.* at 571.

Commission recognizes, RTOs/ISOs should evaluate the sources of uplift and work to minimize their occurrence. The effort to minimize uplift need not erode market efficiency or system reliability. RTOs/ISOs can achieve reductions in uplift using improvements that reduce costs without any sacrifice of efficient pricing.⁶

The NOPR proposes to reduce uplift by abandoning the markets' efficient marginal cost pricing principle when the market dispatches a subset of resources, fast start units.

The proposed change is fundamental, and is not an incremental change to pricing that would improve market outcomes. RTOs/ISOs should not be required to abandon marginal cost pricing. The precedent such a rule would set in departing from efficient market pricing should be carefully considered.

The shift from marginal cost pricing lies in the NOPR's proposal to include commitment costs, start up and no load costs, of fast start resources in market prices. Market prices would not equal the marginal cost of the next unit of output. Market prices would not support efficient dispatch. The limitation to only fast start resources, those with start times less than ten minutes and minimum run times less than an hour, is arbitrary. It could set a precedent for consideration of inefficient pricing for a broader set of resources, perhaps for all resources.

Average cost pricing is not superior to marginal cost pricing, nor does it justify the NOPR's proposed pricing reforms. Electricity generation is a regulated industry due to the nonconvex cost problem, among other reasons. No unregulated market supports prices that are inconsistent with production decisions. Unregulated prices adjust to efficient levels, and producers that cannot eventually cover their costs under the prevailing prices exit the market.

The optimal dispatch of fast start resources is a distinct issue. Ideally, the speed and flexibility of the market dispatch software and operational practices would match the speed

⁶ See 2015 State of the Market Report for PJM, Vol. II, Section 4: Energy Uplift.

and flexibility of available generation. Optimal use of fast start resources does not require distortion of prices from their efficient levels.

B. The Proposed Departure from Marginal Cost Pricing is Unsupported.

The NOPR states that LMPs are distorted because block loaded resources are not allowed to set prices, and even if they did, their offer does not include no load and startup costs. The NOPR attributes this distortion to “the fact that a fast-start resource is essentially marginal.” The NOPR states that correcting this distortion should lead to prices that reflect the marginal cost of serving load, reduce uplift and improve price signals to support investment.

The NOPR’s rationale is inconsistent with marginal cost pricing. Under marginal cost pricing, the LMP is set by the resource that provides the next incremental MWh, and the marginal cost of the system is equal to the marginal cost of that next incremental MWh. Due to the constraints imposed by generation owners, block loaded resources do not provide incremental MWh. They provide all or nothing. Therefore, they cannot set the LMP because when operating they do not have capacity available to meet the next incremental MWh.

The NOPR’s statement that this correction will lead to prices that reflect the marginal cost of serving load is not accurate. The proposal will lead to prices nearer to the average cost to serve additional load but not the marginal cost.

The NOPR’s statement that this correction will lead to uplift reduction is accurate. Fast start resources will be paid their total cost via LMP. Therefore, there would not be a need for uplift. This pricing mechanism will drive prices higher, which means that other units will recover more of their costs via LMP. In PJM, fast start resources are not the major source of uplift payments. In PJM uplift typically results from larger units, typically with inflexible operating parameters, that are manually committed by PJM. The reduction in uplift will result from simply increasing the LMPs that these units are paid.

The NOPR does not address the fact that the proposed pricing mechanism will also lead to new uplift payments based on opportunity cost because generators will have to be paid to follow the cost minimizing dispatch signal and ignore the inefficient price signal based on average prices. Generators will follow the price signal which will result in overproduction of energy and PJM will have to dispatch the units down in order to maintain energy balance. There would be an overproduction of energy compared to the energy output that would result from the price set by the incremental costs of the fast start resource. That incremental cost would continue to be the basis for the efficient dispatch signal sent by PJM.

C. Investment Price Signals

The NOPR states that over the long run, LMPs may not reflect the need for fast start resources and fail to provide appropriate incentives for investment. The signal to invest is not only driven by the marginal cost of the marginal resource, it also driven by scarcity pricing, capacity prices, and ancillary service prices. The combination of these prices not only provide incentives to invest but also incentive to retire when a resource's going forward costs and short run costs are not recovered. Setting LMPs at prices artificially high may result in over procurement of capacity, which may not necessarily be fast starting.

Units that are committed to meet peak demand (peakers) cover most of their going forward costs via scarcity pricing and/or capacity market revenues. In RTOs with capacity markets, higher energy prices does not necessary incent investment since those higher energy prices are used as an offset to determine the capacity market offer. Therefore, higher energy prices can result in lower capacity prices.

In the event that the introduction of five minute pricing and settlements is not adequate, a better solution to induce fast start investment in markets with a specific need for fast starting resources would be to create a separate ancillary service product that provides a clear and efficient pricing signal related to the market's requirements.

D. Fast Start Resource Definitions and Resource Eligibility

The Market Monitor agrees with the Commission's definition of fast-start resources (at P 46). A final rule should be clear that the time to start includes the time from when the RTO notifies the resource that it must start to the time the resource is synchronized. The Market Monitor agrees with the Commission that a self-scheduled resource should not be eligible to set prices using modified fast start price setting logic. Self-scheduling is a market participant's strategy or behavior, it is not linked to the operational flexibility of the resource.

The NOPR did not address possible under performance by fast start generating units that could be committed in the real-time market. But the NOPR does not address the issues that arise when market prices are set by an offline unit that does not actually turn on. It is possible that an offline fast start resources may not respond in time as desired by the dispatcher or respond at all. Following the current dispatching practices at PJM, an offline fast start resource may continue to set price for several intervals before the fast start resource responds to the dispatch instruction. To avoid such situations, the Market Monitor recommends that if the Commission proceeds with a final rule that allows offline fast start resources to set price in the real-time market, that rule include consequences for failure to perform including penalties and/or disqualification from the ability to set price.

E. Inclusion of Startup and No load Costs in Prices

The Market Monitor does not agree that no load and startup costs should be included in energy prices. There is a fundamental reason to separate no load and startup costs from the incremental costs. These costs do not change with the output of the unit after the unit starts and produces MWh. Incremental costs are the marginal costs of producing the next MWh. Incremental costs are the only costs that should be used for pricing. They provide the signal to resources to produce more or less MWh. Incorporating all three costs into pricing would distort the dispatch signal and fundamentally changes the definition of

the energy price. This approach would reduce uplift at the expense of market efficiency. It has nothing to do with how fast a resource starts.

Block loaded units already include no load costs in energy offers. In PJM, most fast start units are block loaded. As a result, no change of market rules is needed to incorporate no load costs in energy offers for block loaded units. In the fourth quarter of 2016, 47 units offered in the PJM market with start plus notification times of less than ten minutes and minimum run times less than an hour. The vast majority were oil fired combustion turbines. All 47 offered block loaded parameters, an economic minimum output level equal to the maximum output level. Two thirds of the fast start units included the full average heat rate in the incremental energy offer coupled with a zero no load offer. Under current market rules, the market is indifferent between the full inclusion of no load costs in the incremental energy offer and the division of costs between no load and incremental energy for a block loaded resource.

Start costs are different. Their incorporation in the incremental energy offer would change market outcomes and market behavior. The PJM fast start units did not tend to include markup in the price offers for incremental energy costs, including no load. But some fast start units did include substantial markups in start costs. The inclusion of start costs in the fast start price would enhance the ability of fast start units to exercise of market power.

F. Relaxation of Economic Minimum Operating Limit

The Market Monitor does not agree that RTOs should relax the parameters of resources in order to set prices at a level inconsistent with actual unit parameters. Generation resources, for the most part, have a dispatchable range. Generator owners can choose to offer a dispatchable range.

The relaxation of the economic minimum produces an energy imbalance that must be corrected by manually dispatching down generators. This method will lead to different

and inefficient dispatch and pricing signals in the same way as the inclusion of no load and startup cost.

G. Offline Fast Start Resources

The Market Monitor agrees that there are circumstances where the marginal energy resource is an offline fast-start resource but this is unusual in PJM. The Market Monitor understands that PJM's dispatch and pricing software currently has the capability to perform this calculation although it is not clear if PJM employs a look-ahead economic feasibility test.

H. Day-Ahead and Real-Time Market Consistency

The NOPR (at P 44) proposes to require RTOs/ISOs to incorporate fast start pricing in both the day-ahead and real-time markets. The NOPR asserts that the incorporation of the fast start pricing would result in price convergence between day-ahead and real-time markets. Contrary to the NOPR's expectations, expensive fast start resources are unlikely to clear the day-ahead market, increasing the likelihood of price divergence between day-ahead and real-time markets.

Day-ahead market clearing is a result of a twenty four hour joint optimization. The long commitment time horizon affords several opportunities to start cheaper resources ahead of time such that high demand conditions can be met by resources that are not fast start. In contrast, the real-time market clearing involves short duration look ahead optimizations with fewer opportunities to start resources ahead of time to meet load. Real-time events, such as an unanticipated increase in demand, slower than expected ramping of generators, tripping of generators or transmission line outages, may require commitment of the most expensive resources to overcome the short lived shortage situations. These outcomes and conditions do not exist in the day-ahead market.

In PJM, fast start resources are committed in the real-time market much more frequently than in the day-ahead market. In 2016, the 47 fast start resources were dispatched for at least one hour in either the day-ahead or real-time market. Table 1 shows

that in 2016 there were 727 fast start resource-days involving fast start resources that were dispatched only in the real-time market and 108 resource-days involving fast start resources that were dispatched both in day-ahead and real-time markets.

Table 1 Number of fast start resource - days by commitment in 2016

	Number of Fast Start Resrouce-Days
Fast Start Resources Committed in both DA and RT Market	108
Fast Start Resources Committed in RT Market only	727

The fast start resources that were dispatched in the real-time market were more expensive than the fast start resources dispatched in the day-ahead market. Table 2 shows the average operating rate of the fast start resources that were dispatched in both day-ahead and real-time markets and fast start resources that were dispatched only in the real-time market.⁷ In 2016, the operating rate for fast start resources that were dispatched in the real-time market averaged \$141.44 per MWh compared to \$85.69 per MWh for fast start resources that were dispatched both in day-ahead and real-time markets.

As a result, if fast start resources are used to set price the result will likely be increased divergence in day-ahead and real-time prices and not increased convergence.

⁷ Operating rate is defined as the per MWh cost of committing a new unit, which includes the no load cost, startup cost, and incremental energy cost of operating the unit for minimum run duration.

Table 2 Number of unit days and average operating rate of fast start resources dispatched in the PJM market by month in 2016

Month	Fast Start Resource - Days		Average Operating Rate (\$/MWh)	
	DA and RT	RT Only	DA and RT	RT Only
January-16	8	56	94.42	161.53
February-16	5	28	32.71	113.94
March-16	7	58	23.19	116.41
April-16	1	25	28.59	127.77
May-16	2	61	27.86	135.34
June-16	14	30	38.83	144.98
July-16	12	154	130.86	148.22
August-16	35	153	137.33	151.24
September-16	1	76	14.29	135.20
October-16	13	18	16.38	133.67
November-16	4	31	26.41	120.18
December-16	6	37	139.36	153.22
Year 2016	108	727	85.69	141.44

In the NOPR (at P44), the Commission acknowledges the observed dispatching trend when they conclude that “fast start resources are frequently used to quickly respond to real-time system conditions.” As a result, if the fast start resources are allowed to include start up and no load costs in their incremental offer curves, the most likely result is high clearing prices in the real-time market, lower clearing prices in the day-ahead market, increasing price divergence between the two markets.

I. Additional Comments

The NOPR is inconsistent with the least cost market solution.

The NOPR proposes (at P 42) to allow offline fast start resources to be eligible to set prices only if a transmission constraint is violated or if ancillary service shortage conditions exist. To accommodate this requirement, the RTO/ISO needs to evaluate the commitment of new fast start resources within the single period real-time optimization.

In the commitment optimization problems used by the RTO/ISO, no load cost, startup cost, short run marginal cost, minimum run time, transmission penalty factors and

reserve penalty factors constitute key parameters in evaluating if a unit needs to be committed. The sequence of multi-interval look ahead commitment optimizations conducted by PJM, known as Intermediate Term Security Constrained Economic Dispatch (ITSCED), evaluate the tradeoffs between ramping up existing units, starting a new units and incurring penalties to meet higher load within the decision time horizon.⁸ In PJM, ITSCED simultaneously optimizes four intervals that span between 125 and 135 minutes in the future.

The time-coupled optimizations are precisely equipped to evaluate situations such as whether it is economical to start a new unit to meet a short duration increase in load versus a prolonged increase in load.⁹ In some situations it may be cheaper to violate a transmission constraint or violate a reserve requirement, particularly when the increase in load is only for a brief period of time, versus starting a new resource and incurring the cost of starting up the unit and running it for its minimum run time. Alternatively, in some situations, it may be cheaper to start the new unit.

In PJM, implementing the NOPR's proposal for offline fast start resources to set prices, implies that the RTO/ISO must evaluate the resources within the 15-minute look ahead real time optimization (RTSCED), which is a single period optimization.¹⁰ The evaluation of expensive fast start resources in this single period optimization deprives the RTO/ISO of the option to achieve a least cost commitment solution. In that short decision time horizon, it may be optimal to start a new resource to meet the load. However it may

⁸ PJM's ITSCED is a coupled four interval optimization that looks ahead 125 minutes to 135 minutes in the future.

⁹ Most commonly in PJM, short duration shortages are primarily due to slower than expected ramping up of generators.

¹⁰ See NOPR at P 57.

not be optimal within a decision time horizon that spans beyond 15 minute time interval, particularly when the shortage is only for a short period of time.

The problem that is created is that the RTSCED would need to make commitment decisions for a 15 minute period that will have multi period consequences that cannot be evaluated by RTSCED. If a unit owner can force the payment of uplift by including a one hour minimum run time, then the NOPR approach would create opportunities to exercise market power. Market participants should not be forced to pay uplift in a situation where the uplift is not subject to an optimization, as would be the case under the NOPR proposal because the RTSCED would not evaluate the resource's full minimum run time. If this approach were to be taken, no uplift should be paid to units committed by RTSCED in order to align incentives with market signals.

J. The NOPR's Proposed Fast Start Pricing Would Not Be Effective in the PJM Market

The NOPR proposed market design change would not make any significant difference in PJM because there is only a relatively small number of resources to which the fast start logic would apply and these units are not a significant source of uplift.

II. CONCLUSION

The Market Monitor respectfully requests that the Commission afford due consideration to these comments as the Commission resolves the issues raised in this proceeding.

Respectfully submitted,



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