



Flexible Ramping Product Refinements

Issue Paper and Straw Proposal

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1. Purpose

This paper summarizes the flexible ramping product issues identified in the CAISO Energy Markets Price Performance Report¹ published on September 23, 2019. The flexible ramping product² was introduced in to the real-time market to manage ramp capability to address uncertainty related to load and variable energy resources that materializes between market runs. Prior to implementation, the CAISO observed that the multi-interval market optimization would solve forecasted net load by utilizing the precise amount of ramp needed across the market horizon. However, when system conditions changed in subsequent market runs, the market would have insufficient ramping capability in the real-time dispatch. The flexible ramping product secures additional ramping capability that can be dispatched in subsequent market runs to cover a range in the forecasted net load. Resources providing this ramping capability are compensated at the marginal opportunity cost for both forecasted movement and uncertainty awards.

The report identified four areas that needed to be addressed through BPM and/or tariff changes. The issues include the following:

Issue	BPM or Tariff Change	Targeted Implementation
Proxy Demand Response Eligibility	BPM only	Fall 2019
Ramp Management between FMM and RTD	BPM only	Fall 2020
Minimum CAISO FRP requirement	BPM only	Fall 2020
Deliverability Enhancement	Both	Fall 2021

As noted above the first three items can be addressed in the near term. The paper discusses the proposed BPM changes. The specific BPM language will be developed through the BPM change management process. For deliverability, the paper discusses the issues and different approaches to minimize procurement of flexible ramping product that is stranded due to transmission constraints within balancing authority areas.

2. Proxy Demand Response Eligibility

Flexible ramping products can be awarded to multiple types of resources, including proxy demand resources (PDR). Recent trends show the market frequently awards flexible ramping product to PDR resources because they have energy bids at or close to the bid cap of \$1,000/MWh. This occurs because the market sees them as economic to provide the upward flexible ramping product because their opportunity cost of providing the flexible ramping product is zero because the PDR is not economic to be dispatched for energy in the binding market interval.

¹ The report is available at <http://www.aiso.com/Documents/FinalReport-PricePerformanceAnalysis.pdf>

² Information on the flexible ramping product design is available at <http://www.aiso.com/Pages/documentsbygroup.aspx?GroupID=24AB06E3-B018-4DEC-8F43-28B8A0E90514>

This issue is currently exacerbated because many PDRs cannot respond to the 5-minute dispatch despite the flexible ramping product capacity being needed in the 5-minute dispatch. Despite this inability to respond to 5-minute dispatches, the CAISO's current market rules assume all PDRs can respond to 5-minute dispatches. If PDRs are unable to respond to five-minute real-time dispatches, the procured flexible ramping product cannot be used as energy in a subsequent RTD run.

In the *Energy Storage and Distributed Energy Resources Phase 3A* initiative, additional bidding options were made available to PDRs. These include a 60-minute and 15-minute dispatchable bid option. Unlike the 5-minute dispatch which has a 2.5 minute notification to curtail load, these options provide 22.5 minutes and 52.5 minutes notification prior to the time load needs to be curtailed. Consistent with newly FERC-approved provisions in section 4.13.3 of the CAISO tariff, PDRs will be able to specify in the Master File how the PDR will bid and be dispatched in the real-time market: in (i) hourly blocks, (ii) fifteen minute intervals, or (iii) five minute intervals. If PDRs do not select an option the CAISO will set five minute intervals as the default. These provisions are effective as of November 13, 2019.

Consistent with existing section 4.6.4, Master File must accurately reflect the design capabilities of the resources. Therefore, scheduling coordinators will be required to ensure their Master File designation appropriately reflects their PDR capabilities and if they do not have the ability to respond to five minute dispatch, the scheduling coordinator should designate their resource as hourly blocks or 15-minute dispatchable. Consistent with section 44.2.3.1, the 15-minute and 60-minute options will not be eligible to be awarded the flexible ramping products. The CAISO will develop a business process to validate that the PDR has selected the correct scheduling/dispatch options. This will address the issue that flexible ramping product is awarded to PDRs that are unable to respond to the 5-minute dispatch.

3. Ramp Management between FMM and RTD

The CAISO procures the flexible ramping product in both the 15-minute market (FMM) and the 5-minute real-time dispatch (RTD). In the FMM, the flexible ramping product covers the uncertainty between the advisory FMM interval and the highest/lowest binding RTD interval for the same 15-minute time interval. This ensures that there is sufficient ramp capability committed to clear RTD.

The FMM is part of the real-time unit commitment (RTUC) process. The RTUC runs every fifteen minutes to determine binding unit commitment decisions for fast and short start units within the RTUC horizon. The RTUC horizon is the next four to seven fifteen-minute intervals, depending on when during the hour the run occurs. The second interval of each RTUC run horizon is designated as the FMM and is the financially binding interval for energy prices and schedules used for settlements. The first interval in an RTUC run horizon, or the interval preceding FMM, is referred to as the buffer interval. The logic of the buffer interval was introduced in the market with the implementation of the FERC Order No. 764 in order to provide sufficient time for tagging purposes once fifteen-minute interties could economically participate in the real-time market. The buffer interval can issue binding unit commitment of fast and short start units. The buffer interval also produces advisory schedules and prices that are not financially binding. The remaining intervals in the horizon can also issue binding unit commitments and also produce advisory schedules and prices.

Currently, the flexible ramping product uncertainty requirement is not enforced in the buffer interval. As a result, the ramping capability procured in the prior RTUC run, when the time interval was financially binding (FMM), may be used to meet the ramping needs of the current market run. When system conditions change between FMM runs there may no longer be any ramping capability available for the RTD intervals within that timeframe; or, even worse, the ramping capability may be lost. Ramping capability is lost when projected start-ups of certain units necessary to carry flexible ramping product are re-optimized in subsequent intervals and no longer determined as needed because of additional ramping capability resulting from the release of the flexible ramping product from the buffer interval to the binding interval.

The CAISO proposes to maintain a portion, up to 100%, of the FRP awards in the buffer interval that were procured in the prior FMM. This will ensure that ramping capability will be preserved for RTD. This can result in a resource not being scheduled in the FMM interval because its ramping capability was secured through a flexible ramping product award in the previous market run. For example, assume a resource with the following characteristics: $P_{min} = 100$ MW, $P_{max} = 200$ MW, and a ramp rate of 5 MW/Minute. In market run #1, the resource receives a binding commitment in FMM and is scheduled for energy at 100 MW and awarded flexible ramping up of 75 MW. In market run #2, if the flexible ramping product requirement is not enforced in the buffer interval, the resource could receive an energy schedule of up to 175 MW in the FMM. However, if the flexible ramping product is enforced in the buffer interval, the resource could receive an energy schedule of up to 125 MW because the 75 MW flexible ramping up award is maintained.

4. Minimum FRP requirement for CAISO

The net import/export capabilities (NIC/NEC) are used as a credit towards a balancing authority area's requirement. The basic idea is that flexible ramping awards can be supplied from other balancing authority areas through the import or export transfer capability. The CAISO has previously found³ that credits on imports and exports were beyond levels that a balancing authority area could feasibly support. As a result, in 2018, the CAISO made an enhancement to limit the amount of flexible ramping product that could be awarded in a balancing authority area to that which could be supported given the import/export transfer capability. With this enhancement, the market can schedule flexible ramping product in a balancing authority area up to the amount of the remaining transfer capacity, thereby making use of any remaining import/export capability but not exceed the amount the balancing authority area could feasibly support for the transfer of energy.

If the import capability is higher than the balancing authority area's flexible ramping product up requirement, then the balancing authority area's flexible ramping product is effectively 0 MW. That is none of the balancing authority area's upward flexible ramping product needs to be awarded to internal resources. Under typical conditions, all balancing authority areas generally have larger import or export

³ This was discussed at the February 2, 2018 Market Surveillance Committee meeting. The presentation is available at <http://www.caiso.com/Documents/Presentation-FlexibleRampingProductPerformanceDiscussionFeb22018.pdf>

limits than their flexible ramping up or flexible ramping down requirement. Within an interconnected system with multiple areas, a flexible ramping product can be counted towards other areas by wheeling through other balancing authority areas. However, only the transfer capability with adjacent balancing authority areas is considered when calculating the net import/export capability. This is true for all balancing authority areas in the EIM footprint.

Currently, the CAISO is the largest driver of the system-wide flexible ramping product requirement because it has the largest load and penetration of variable energy resources. The CAISO requirement for the flexible ramping product that must be procured from internal resources is effectively zero⁴ given the large import and export capability of the CAISO. But, since the CAISO has such a large share of the requirement, a portion needs to be procured within the balancing authority area in order to be available for uncertainty that materializes in the CAISO balancing authority area.

The CAISO proposes to enforce a minimum flexible ramping requirement in the CAISO balancing authority area, which will ensure that a minimum amount of the flexible ramping product will be procured from resources within the CAISO balancing authority area. The minimum amount will need to be higher than the historical procurement that resulted from the system-wide flexible ramping product constraint. Over time, based upon its evaluation of historical flexible ramping product procurement, the CAISO will refine the minimum CAISO requirement and the CAISO will update the CAISO minimum requirement through the business practice manual change process, which includes an opportunity for stakeholder input. The CAISO will also evaluate if similar minimum requirements are needed for other balancing authority areas. CAISO will perform the same historical evaluation and discuss its findings through the regularly held Market Performance and Planning Forum meetings. Any changes to such requirements will be proposed to stakeholders through the business practice manual change management process.

5. Deliverability Enhancement

Procurement of the flexible ramping product is based on opportunity costs, which arise from the trade-offs between the need for energy and the need for ramping capability. The market does not consider locational constraints when procuring the flexible ramping product. This results in under-utilization or under-deployment of the flexible ramping product.

The complication relates to congestion from internal constraints within a balancing authority area. The market enforces transmission constraints within each balancing authority area, which allows the market to economically manage congestion. As part of the congestion management process resources can move up if they help to mitigate the congestion, or down if they exacerbate congestion. Since flexible ramping product is not locational-based, this part of congestion management does not explicitly account for the flexible ramping product procurement. As a result, the market can procure upward flexible ramping capacity from resources that are dispatched down for congestion management, which in next

⁴ See figure 73 from the Price Performance Report available at <http://www.aiso.com/Documents/FinalReport-PricePerformanceAnalysis.pdf>

market run if uncertainty materializes cannot be deployed because of the need to manage the congestion. This interplay between congestion and flexible ramping product procurement can be further complicated because the market may find it optimal to allocate upward flexible ramping product capacity precisely to resources dispatched down for congestion management. A similar dynamic exists for downward flexible ramping capacity and resources dispatched higher for energy to provide counter flow to mitigate congestion. However, the market has no mechanism to avoid this outcome.

As discussed in the *Day-Ahead Market Enhancements* initiative, similar deliverability concerns exist for the proposed imbalance reserve product. At this time, the CAISO believes that the approach to address deliverability of the real-time market flexible ramping product can inform the approach to ensure deliverability of the day-ahead imbalance reserve product. The remainder of this section discusses the pros and cons of zonal procurement versus nodal procurement.

5.1 Zonal procurement

Zonal procurement introduces sub-regions within balancing authority areas to distribute the flexible ramping product requirement more granularly in an effort to minimize stranded ramping capability. The zonal approach ensures that the flexible ramping product is not procured predominantly in one area, which would reduce the probability that ramping capability is not available. This is similar to how the CAISO currently procures ancillary services. Because the CAISO could leverage from its existing ancillary service functionality, this option would call for fewer software enhancements and computational requirements.

Similar to how flexible ramping product awards are limited by the EIM transfer capability between balancing authority areas, transmission capability between sub-regions will limit that amount of flexible ramping product awards than can be met by resources outside the sub-region. However, if the zones have internal congestion then the risk remains that flexible ramping product awards will not be deliverable. To the extent that there is persistent internal congestion, this may require that the zone be separated into more granular sub-regions. Again, this is similar to the process the CAISO goes through today to determine the appropriate ancillary services procurement regions.

Once sub-regions have been established, an approach to how the requirement is established for each sub-region is needed. Currently a requirement is calculated for each balancing authority area individually and for the whole EIM footprint. It may not be practical to perform the same calculation for each individual sub-region. Therefore, the distribution of the system requirement may not be based upon the actual uncertainty in a given sub-region, but by for example the net load ratio share by sub-region. This can lead to higher costs as minimum requirements could award the flexible ramping product to higher cost resources internally to a sub-region even though in this interval the transmission constraints between sub-regions were not binding. This may also lead to additional unit commitment within a zone to cover the worst case scenario within the zone. Lastly, rules will need to be developed to allow operators to block certain resources from being awarded the flexible ramping product. The CAISO operators currently can block certain resources from being awarded ancillary services if it is determined that the resources capacity will be unavailable due to congestion.

5.2 Nodal procurement

Nodal procurement ensures that both energy and flexible ramping awards are transmission feasible. This requires the introduction of deployment scenarios to ensure that energy plus upward flexible ramping product awards and energy less downward flexible ramping product awards are transmission feasible. This ensures that upward flexible ramping product awards are not given to resources located behind a transmission constraint and downward flexible ramping product awards are not given to resources providing counter flow to resolve a transmission constraint.

The nodal approach is a more durable solution to address operational concerns and more accurately price flexibility. As more solar, wind and other zero marginal energy cost resources make up a larger portion of the generation fleet, the marginal cost of energy will be lowered. The compensation of flexible generation will come more from flexible ramping product payments than energy payments.

However, the implementation complexity and computational requirements necessary to move to locational flexible ramping product are significant. In addition, because system conditions may change congestion patterns from the time the flexible ramping product was awarded, the nodal approach does not ensure 100% deliverability. The nodal approach only can ensure that the market does not award to resources that it knows at the time of the applicable market run would not be deliverable.

In looking forward to applying a nodal approach for the imbalance reserve product, the introduction of multiple deployment scenarios may necessitate the need for a congestion hedge for the ramping capability being held in addition to energy.

6. Stakeholder Engagement and Next Steps

Stakeholder input is critical for developing market design policy. The schedule proposed below allows several opportunities for stakeholder's involvement and feedback.

6.1 Schedule

Table 1 lists the planned schedule for the *Flexible Ramping Product Refinements* stakeholder process.

Table 1 : Proposed schedule for the FRP Refinements stakeholder process

Item	Date
Post Issue Paper/Straw Proposal	November 14, 2019
Stakeholder Conference Call	November 21, 2019
Stakeholder Comments Due	December 5, 2019
BPM Language within a Proposed Revision Request - PDR	ASAP

BPM Language within a Proposed Revision Request – Buffer & Minimum	Aligned with Fall 2020 release
Deliverability Enhancements	TBD

The ISO will discuss this issue paper/straw proposal during a stakeholder conference call on November 21, 2019. The ISO requests that stakeholders submit written comments by December 5, 2019 to InitiativeComments@caiso.com.

6.2 EIM Governing Body Role

The rules that govern decisional classification were amended in March 2019 when the Board adopted changes to the Charter for EIM Governance and the Guidance Document. An initiative proposing to change rules of the real-time market now falls within the primary authority of the EIM Governing Body either if the proposed new rule is EIM-specific in the sense that it applies uniquely or differently in the balancing authority areas of EIM Entities, as opposed to a generally applicable rule, or for proposed market rules that are generally applicable, if “an issue that is specific to the EIM balancing authority areas is the primary driver for the proposed change.”

This initiative does not satisfy the first test, because any proposed rules would be generally applicable to the entire ISO market footprint, rather than EIM-specific. Moreover, primary driver for pursuing these objectives is not an issue that is specific to the EIM balancing authority areas. The improvements to FRP deliverability will seek to minimize instances where ramping capability is stranded behind all kinds of transmission constraints. While EIM transfer limits are one type of constraint, they are only one of several types. Moreover, the CAISO identified the need for this initiative based on a study of pricing in the CAISO’s balancing authority area. Accordingly, this initiative would fall entirely within the advisory role of the EIM Governing Body.

Stakeholders are encouraged to submit a response to the EIM categorization in their written comments following the conference call for the Issue Paper/Straw Proposal, particularly if they have concerns or questions