



# Memorandum

**To:** ISO Board of Governors

**From:** Keith Casey, Vice President, Market & Infrastructure Development

**Date:** January 27, 2016

**Re:** **Decision on flexible ramping product proposal**

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*This memorandum requires Board action.*

## EXECUTIVE SUMMARY

Over the past several years, the ISO has implemented several enhancements to its real-time market, which now includes the energy imbalance market (EIM), to effectively manage the integration of variable energy renewable resources to support state and federal policies to decarbonize the grid. In 2011, the ISO implemented a flexible ramping constraint to help ensure sufficient resources were positioned to meet forecast upward ramping needs. At that time, the ISO committed to address limitations of the constraint through the design of a product that would more effectively dispatch resources to meet forecast ramping needs. As a result, Management proposes the flexible ramping product, a key market design enhancement to further ensure that sufficient upward and downward flexible capacity is available and efficiently dispatched in the ISO real-time market.

The flexible ramping product is designed to compensate resources for providing ramping capability as well as incentivize loads, resources, and interties to reduce the significant ramps illustrated by the well-known “duck curve” diagram. If load or supply resources increase the forecast ramp, the market will charge the load or supply resource for the flexible ramping product. If load or supply resources decrease the forecasted ramp, the market will compensate the load or supply resource. In addition, the flexible ramping product is designed to procure additional ramping capacity to meet uncertainty in the net load<sup>1</sup> forecast when it is economic to do so. The market will allocate the cost for the flexible ramping product to cover uncertainty based on a load or supply resource’s forecast error.

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<sup>1</sup> Net load is gross load less wind and solar resource output.

The proposed design significantly improves the management of ramping capacity in the real-time market. As a result, the environmental policy goals across the West can be achieved more efficiently and economically.

Management recommends the following motion:

***Moved, that the ISO Board of Governors approves the flexible ramping product proposal, as described in the memorandum dated January 27, 2016; and***

***Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposed tariff change.***

## **DISCUSSION AND ANALYSIS**

The ISO's real-time market optimizations seeks to ensure sufficient capacity is committed and positioned to allow for efficient and economic load following during each five-minute dispatch interval. Its objective is for these commitments and dispatches to be feasible and sufficient to address a reasonable range of unexpected outcomes. The ISO currently enforces a constraint in the fifteen-minute market that accounts for and awards upward flexible ramping capacity to resources to ensure there is sufficient ramping capacity available to the five-minute real-time dispatch.

Despite this constraint, Management has observed instances where there is insufficient flexible ramping capacity in the five-minute real-time dispatch. In addition, the current constraint does not ensure there is sufficient downward ramping capacity. To address these issues and improve how the ISO compensates resources for providing ramping capacity, Management proposes to replace the flexible ramping constraint with the flexible ramping product.

### ***Background***

In December 2011, the ISO implemented the flexible ramping constraint in the real-time market optimization to address frequent occurrences of insufficient ramping capacity in the five-minute real-time dispatch. At that time, Management committed to start a stakeholder process to develop a flexible ramping product that would address both upward and downward ramping needs. This stakeholder process was initiated in November 2011, however, Management suspended the stakeholder process to develop the fifteen-minute market in response to FERC Order No. 764. This was done to ensure that the flexible ramping product was ultimately compatible with the new fifteen-minute market. The ISO reinitiated the flexible ramping product stakeholder initiative in June 2014.

### ***Compensating resources for ramping capacity***

The flexible ramping product improves on the ISO market's compensation for ramping capacity by explicitly compensating resources for ramping capacity. The real-time market often dispatches resources out of economic merit order for a projected need in a future interval. Under the flexible ramping product, the resource will receive a separate payment in the financially binding interval for this ramping capacity to meet the projected future need. The market will award, price, and settle the flexible ramping product in both the fifteen- and five-minute market.

Currently with the flexible ramping constraint, the market often fails to compensate resources adequately when it is ramping them for a need in a future interval as a result of its multi-interval optimization. The ISO's market is especially advanced in this regard; it performs a multi-interval optimization for every respective run of the fifteen- and five-minute markets that dispatches resources economically over the entire market horizon. However, only a single initial interval is financially binding. The other intervals are only advisory, and the real-time market typically dispatches a resource differently for a given interval as conditions change in successive market runs.

This process often results in the real-time market dispatching a resource to begin ramping in the upcoming financially-binding interval, or holding a resource back, because the market sees that it needs the resource to be at a certain output level in a future interval. In this situation, the financially-binding interval's locational marginal price may not support the resource's bid price, or the resource may not be dispatched for energy for which it is economic, but the market projects the price in this future interval will make up for the shortfall or opportunity cost. However, conditions typically change in successive market runs, where even a small a change can cause the future interval advisory price to not materialize. In such cases, the market undercompensates the resource for ramping to meet the projected need in a future interval.

The flexible ramping product also helps the market avoid spurious price excursions associated with insufficient ramping margin because of forecast errors. These price excursions occur because there is little margin of error between the interval ramping needs in a multi-interval optimization. The flexible ramping product addresses this by maintaining additional ramping capacity on resources, when economic to do so, to ensure sufficient upward and downward flexibility is available.

### ***Forecast ramping between intervals***

As described above, the flexible ramping product procures ramping capacity for both the forecast net load ramp and ramping uncertainty. This first element, the forecast net load ramp, consists of the forecast net load ramp between the financially-binding interval and the subsequent advisory interval. Ramping of load, dispatchable resources, non-dispatchable resources, and interties can create both a demand for ramp and a supply for ramp.

Load or supply resources that increase the forecast ramp between intervals will be charged for the flexible ramping product. Load or supply resources that decrease the forecast ramp between intervals will receive a payment for the flexible ramping product. Settling ramping capacity directly between load or supply resources that consume ramping capacity and those that provide ramping capacity will help manage the ramping need illustrated by the “duck curve” diagram by incentivizing load serving entities to have a portfolio of both dispatchable and non-dispatchable resources that can follow their load profile.

### ***Ramping uncertainty***

In addition to procuring ramping capacity for the forecast net load ramp, the flexible ramping product will procure an additional amount of ramping capacity for ramping uncertainty. Absent a flexible ramping product requirement, the market will solve only for expected load and system conditions. This limits the ability of the real-time dispatch to meet changes in system conditions between the fifteen-minute market and five-minute real-time dispatch, and between subsequent market runs of the five-minute dispatch.

To address this forecast uncertainty, the flexible ramping product procures ramping capacity in addition to that needed to meet the forecast net load ramp. It will only do this if the expected benefits of this additional ramping capacity exceed its costs. This is determined by calculating the probability of a power balance violation due to a deficiency in ramping energy and the associated costs to the market and comparing this to the costs to procure ramping capacity. For example, assume there is a 5 percent probability that a shortage in supply will trigger a power balance violation and trigger the upward power balance relaxation parameter of \$1,000/MWh used by the market. The flexible ramping product will assume it is economic to procure additional flexible ramping up capacity until the cost of doing so is greater than \$50.00/MWh (5% x \$1000/MWh). All supply and demand that cause forecast uncertainty economically benefit from the market procuring additional flexible ramping capacity at a price up to \$50.00/MWh.

Unlike forecast ramping between intervals, there cannot be a direct settlement between those requiring ramping capacity and those providing ramping capacity to cover uncertainty in the net load forecast. This is because the market may not need to use, and consequently attribute to a specific load or supply resource, the flexible ramping capacity procured to cover uncertainty.

Consequently, the market will allocate the costs of the ramping capacity it procures to cover uncertainty based on a load's or a supply resource's contribution to this uncertainty. It will do this by evaluating each load's or supply resource's contribution to this uncertainty over each month. The market will do this in two-tiers:

- It will allocate the costs in the first tier pro-rata between load, generation, and imports/exports based upon the observed forecast error of each category relative to the other two categories.
- It will allocate the costs in the second tier using a different methodology for load, generation, and imports/exports, respectively. It will allocate costs to load based on gross uninstructed imbalance energy. It will allocate costs to generation based on gross observed forecast error plus uninstructed imbalance energy. It will allocate costs to imports/exports to deviations from schedules. The cost allocation for generation considers uninstructed imbalance energy to provide an additional incentive to follow dispatch instructions.

### ***Energy imbalance market***

The energy imbalance market includes an hourly resource sufficiency evaluation to ensure balancing authorities in the EIM have sufficient participating resources within their balancing authority area to meet their expected energy imbalances prior to benefiting from using more economic resources outside their balancing authority area. The current resource sufficiency evaluation only considers upward ramping capacity. Since the flexible ramping product will also manage downward ramping capacity, Management proposes to add a downward ramping test to the hourly resource sufficiency evaluation. If a balancing authority fails the downward ramping test, incremental EIM transfers out of the balancing authority area will not be allowed.

The costs of meeting the flexible ramping constraint are allocated directly to the EIM entity and the EIM entity subsequently allocates the costs to its customers according to the EIM entity's Open Access Transmission Tariff. This was appropriate initially with the flexible ramping constraint because both the compensation and cost allocation in the ISO was based upon a FERC settlement. However, with the redesign of the flexible ramping constraint into the flexible ramping product, resource compensation and cost allocation are key design elements that should apply across the real-time market footprint to ensure resources respond to ISO dispatches equally. Therefore, Management proposes that all loads, resources, and interties will be settled in the same manner *i.e.*, based on forecast ramping between intervals. In addition, the cost allocation of ramping capacity to meet uncertainty within an EIM balancing authority area will be allocated to both participating and non-participating resources in the same manner across the entire EIM footprint.

### **POSITIONS OF THE PARTIES**

Stakeholders support the flexible ramping product proposal which is the result of a lengthy stakeholder process. The Market Surveillance Committee has provided a formal opinion on Management's proposal and the Department of Market Monitoring has provided comments in their Market Monitoring Report. A stakeholder comment matrix is included in appendix A.

When the ISO started the flexible ramping product stakeholder process, the ISO and stakeholders anticipated that the flexible ramping product would be an economically bid capacity product, allow procurement of both upward and downward ramping capacity, and procure the product in the day-ahead market. As the stakeholder initiative progressed, the ISO and stakeholders challenged the appropriateness of economic bidding because in the real-time market, the need for a capacity bid could not be justified since there is no additional cost for an out-of-merit dispatch beyond the opportunity cost of not being dispatched when the energy bid is economic.

In addition, the ISO determined that the benefits of procuring the flexible ramping product in the day-ahead market were not significant enough to overcome the inefficiencies caused by different settlement and dispatch periods between the day-ahead and real-time market. Therefore, Management does not propose to include these features in the day-ahead market; instead, the flexible ramping product is focused on improving managing ramping capacity in the real-time market by including a downward product, maintaining ramping capacity in the 5-minute real-time dispatch, and replacing the settlement and cost allocation of the current flexible ramping constraint.

## **CONCLUSION**

Management seeks Board approval of the flexible ramping product proposal as described in this memorandum. The flexible ramping product enhances the ISO's advance real-time market by improving the management of ramping capacity, accurately compensating flexible resources, and appropriately allocating ramping costs. These features will incentivize greater participation of flexible resources, which will improve the ability of the market optimization to manage increasing levels of variable energy resources.