

Memorandum

To: ISO Board of Governors

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

Date: May 8, 2013

Re: **Decision on FERC Order No. 764 Market Design Changes**

This memorandum requires Board action.

EXECUTIVE SUMMARY

This memorandum describes enhancements Management proposes to make to the real-time market to effectively and efficiently integrate a large amount of renewable variable energy resources into the California ISO's resource fleet. The proposed enhancements will also meet the ISO's compliance obligations under FERC Order No. 764 issued last year. The order required that all FERC-jurisdictional transmission providers provide the opportunity for intra-hour schedule changes in 15-minute increments. This requirement is instrumental to facilitating these proposed enhancements that will create a market structure oriented around renewable resources while eliminating existing market inefficiencies.

Specifically, the ISO proposes to change intertie scheduling and settlement from an hourly to a 15-minute basis, and to establish a 15-minute settlement for internal resources and convergence bids. Management also proposes to retain the existing 5-minute dispatch to provide real-time balancing. Management proposes changes beyond the minimum requirements of Order No. 764, which would consist of only providing an option to schedule on a 15-minute basis on the interties, because the more comprehensive changes Management proposes provide numerous benefits, including:

- A market that is structured around the characteristics of variable energy resources. Not only do these changes accommodate scheduling variable energy resources over the interties, but they also allow all resources to be scheduled more effectively through more granular schedules with shortened forecast lead times.
- Elimination of the settlement uplift charges currently attributable to settling intertie resources at hourly prices while settling internal resources at 5-minute prices. The proposed changes will result in both intertie and internal resources being

scheduled and settled in the same market run. This will eliminate inefficiencies that currently occur, for example, when energy is sold at the interties in the hour ahead scheduling process and then bought back from internal resources in the 5-minute dispatch at higher prices.

- Comply with Order No. 764's requirements to allow for 15-minute energy scheduling, while including provisions for hourly intertie transactions to remain.
- Correct the problems that led to suspension of convergence bidding at the interties. Management proposes to reinstate convergence bidding at the interties after these market changes have been in place for 12 months. This is to allow for a "shakeout" period after the ISO puts these significant market changes in place.

Management proposes the following motion:

Moved, that the ISO Board of Governors approves the proposed market design changes in compliance with FERC Order No. 764 , as described in the memorandum dated May 8, 2013; 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

During the renewable integration market and product review phase II initiative two years ago, Management discussed a potential redesign of the real-time market consisting of a 15-minute internal and intertie resource scheduling, along with a new balancing product, such as a one-minute dispatch, that would meet energy imbalance needs in the timeframe between the 15-minute dispatch and real-time regulation. However, the ISO did not pursue this redesign because the stakeholder process concluded that balancing authorities in WECC were unlikely to adopt intra-hour scheduling in the foreseeable future.

Order No. 764 now provides an incentive for parties to move to more granular scheduling in the West. FERC jurisdictional balancing authorities in the WECC region, as well as some non-FERC jurisdictional balancing authorities, will now offer 15-minute scheduling, which the ISO will have to accommodate. Management proposes to add 15-minute schedules and settlement for both interties and internal resources, but proposes to keep the existing 5-minute dispatch for internal resources and dynamically-scheduled intertie resources rather than adopt a shorter duration balancing product. This is for two reasons: (1) it preserves the pricing information and incentives provided by the existing 5-minute dispatch, and (2) it greatly reduces implementation complexity, time, and costs by using existing market functionality. As a result, the ISO will be able to implement these changes in the spring of next year.

The following sections describe the various elements of Management's proposed real-time market changes:

Financially binding 15-minute energy schedules

The current real-time market is composed of three processes:

- (1) The hour-ahead scheduling process establishes hourly financially binding energy schedules and ancillary services awards for intertie transactions.
- (2) The real-time pre-dispatch runs every fifteen minutes to establish financially binding ancillary services awards and unit commitment for internal generation.
- (3) The 15-minute energy schedules that result from this process are not financially binding under the current market structure.

By creating financially binding 15-minute energy schedules, the proposal aligns the financially binding settlement of energy schedules and ancillary services awards for intertie transactions, internal generation and load through the use of existing market functionality.

The following describes the salient features related to this new market element:

- The real-time market will include both 15-minute and 5-minute financially binding schedules and settlement:
 - It will produce 15-minute schedules and locational marginal prices for all resources, including internal and intertie transactions. Differences between these 15-minute schedules and day-ahead schedules will settle at the 15-minute prices.
 - The real-time market will maintain its existing 5-minute dispatch for internal resources, participating load, and dynamically scheduled intertie transactions. Differences between the 5-minute dispatch and the 15-minute schedule will settle at the 5-minute price.
 - The settlement and maximum metering interval will change from 10 minutes to 5 minutes
- The market process that will produce the 15-minute schedules and prices will begin 37.5 minutes prior to the 15-minute interval and will send the results to market participants 22.5 minutes before the applicable interval. This is designed to initiate the software run in as short of a time as possible prior to the 15-minute interval. Doing so allows the ISO to use the most current forecast for renewable generation which will maximize the accuracy of the market results while maintaining consistency with WECC's deadline for submitting e-tags for intertie transactions, which is 20 minutes prior to the interval. These proposed enhancements result in a significant reduction in lead time, and consequently a

reduction in renewable energy forecast error, compared to the hour-ahead scheduling process that currently schedules interties, which begins 75 minutes in advance of the relevant hour.

- Internal and dynamically-scheduled variable energy resources will be scheduled using resource-specific rolling multi-hour forecasts with 5-minute granularity, as follows:
 - 15-minute schedules will be based on the average of the relevant three 5-minute interval forecasts received 37.5 minutes in advance.
 - 5-minute dispatch will be based on the relevant forecast received 7.5 minutes in advance.
- The real-time market will continue to include an hour-ahead scheduling process. However, it will only be used to schedule intertie transactions that must be fixed for the hour. These fixed hourly schedules are no longer guaranteed the price projected by the hour-ahead scheduling process. Rather, they will be paid the price in each of the 15-minute settlement intervals during the hour they are scheduled.
- The ISO will settle load in the real-time market at load aggregation point prices calculated using an average of the 15-minute and 5-minute prices. The prices will be weighted by the respective load forecasts used by the 15-minute and 5-minute market runs. Load will continue to be metered hourly but will be settled on a 5-minute basis.

Intertie transactions

To accommodate the transition to the 15-minute market structure, Management's proposal includes several options for scheduling intertie transactions (i.e. imports or exports). These include mechanisms to facilitate scheduling variable energy resources and to accommodate hourly schedules. Hourly schedules may remain despite availability of 15-minute scheduling, especially during the transition period as 15-minute scheduling becomes more widespread.

The proposal includes several scheduling options to mitigate the transition challenges to moving to more granular intertie scheduling:

- **15-minute economic bid:** Market participants will be able to submit economic bids that the ISO can schedule in 15-minute intervals based on price. These transactions will be settled at the 15-minute price.

These intertie bids will be cleared in the same optimization as internal resource bids. Consequently, with these proposed real-time market changes, intertie and internal resources will now compete and be priced on an equal basis.

- **Variable energy resource schedules:** Market participants will be able to schedule the output of variable energy resources in 15-minute intervals based on their forecast output. These transactions will be settled at the 15-minute price.

This bidding option, along with the 15-minute economic bid option described above, make Management's proposed market changes compliant with Order No. 764's requirement to provide an option for 15-minute scheduling.

- **Fixed hourly self-schedules:** Market participants will be able to submit self-schedules that are fixed for the hour. These will be settled at the 15-minute prices over the operating hour.
- **Fixed hourly economic bid:** Market participants will be able to submit economic bids for intertie transactions that will be a fixed quantity for the hour and that the ISO can schedule based on price. The ISO will schedule these based on prices projected by the hour-ahead scheduling process, but these transactions will be settled at the actual 15-minute prices over the operating hour.

Since the 15-minute prices the ISO pays for an import may end up being lower than the prices projected by the hour-ahead scheduling process that was used to clear a market participant's fixed hourly import bid, market participants may compensate for this risk by increasing their bid price. Conversely, as market participants may potentially pay more than their bid price for exports, they presumably will lower their bid prices for fixed hourly exports. This effect on the prices of fixed hourly intertie transactions is appropriate and desirable for two reasons: (1) it will transparently price the additional cost of fixed hourly schedules rather than allocating this cost to an uplift charge as is currently done, and (2) it will appropriately value fixed hourly intertie transactions relative to the greater value of 15-minute dispatchable intertie transactions.

- **Fixed hourly economic bid with single intra-hour schedule change:** Similar to the fixed hourly economic bid option described above, market participants will be able to submit economic bids for intertie transactions that will be a fixed quantity for the hour and that the ISO will schedule based on price. As in the previous option, the ISO will schedule these transactions based on prices projected by the hour-ahead scheduling process. However, this option allows for the schedule to be changed once per hour if the 15-minute prices meet criteria specified by the market participant. For example, the ISO would reduce an import schedule to zero if the 15-minute price for the balance of the hour decreases below the price specified by the market participant.
- **Dynamic transfer:** Market participants will continue to be able to establish dynamic transfer arrangements that enable 5-minute dispatch and settlement of intertie transactions. These will be settled similar to internal generation.

When determining the amount of fixed hourly schedules to accept on an intertie, the hour-ahead scheduling process will ensure it reserves intertie capacity for the maximum amount of variable energy resource schedules forecast for all 15-minute intervals in the hour. A penalty will apply if a variable energy resource routinely submits high forecasts to the hour-ahead process because these would displace other intertie resources. This penalty or the 5-minute price, depending on the circumstances, would also be applied to other intertie schedules that are not delivered.

Reinstatement of convergence bidding on the Interties

On November 28, 2011 the ISO suspended convergence bidding on the interties because of excessive settlement uplift charges attributable to convergence bidding on the interties. The market inefficiencies arose because convergence bid positions were closed-out at different prices -- intertie convergence bids were closed-out based on prices established by the hour-ahead scheduling process, while internal node convergence bids were closed-out at the 5-minute price.

As part of the real-time market changes to be made in conjunction with Order No. 764, Management proposes to close-out all convergence bids in the same market optimization. Both intertie and internal node convergence bids will be closed-out at 15-minute prices. This will eliminate the real-time imbalance energy offset settlement uplift charges attributable to intertie and internal node convergence bids closing-out at different prices.

The proposal will also address previous problems related to intertie convergence bids on the interties, in which physical export bids cleared the market at prices higher than their bid price. This problem occurred because the ISO enforced two constraints on each intertie: one that considered only physical intertie transactions, and a second that considered both physical and virtual intertie transactions. Management proposes to address this problem by only enforcing in the integrated forward market the constraint that considers both physical and virtual intertie transactions. This approach may result in physical schedules exceeding an intertie's capacity since a virtual schedule can provide counterflow to relieve congestion. Such an outcome is problematic in that the ISO must comply with a WECC requirement to only accept e-tags up to an intertie's capacity. To address this issue, Management proposes to accept e-tags in economic merit order of the cleared intertie bids up to an intertie's capacity. Any cleared intertie bids above that amount will not be allowed to e-tag prior to start of the real-time market.

Since virtual intertie schedules are only considered by the day-ahead market, and not the real-time market, the physical intertie schedules produced by the real time market will always be within each intertie's capacity. Consequently, the ISO will be able to accept e-tags for all intertie schedules by the real-time e-tag deadline of 20 minutes prior to the operating interval.

Many stakeholders continue to express concern about reinstating convergence bidding concurrent with the proposed design changes. The proposed real-time market changes constitute significant changes to the market, especially to the scheduling and pricing of intertie transactions. In addition, the ISO is planning to implement the Energy Imbalance Market in Fall 2014 which will expand the real-time market to include other balancing authorities. Therefore, Management proposes an initial twelve month period without intertie convergence bidding to allow the ISO and market participants to observe the operation of the new 15-minute market under various seasonal conditions. This is similar to the initial operation of the nodal market, in which there was an initial period without convergence bidding to allow the ISO and stakeholders to address any unanticipated market issues prior to adding the complexity of convergence bidding.

Management proposes to phase in convergence bidding on the interties through the use of “position limits,” which limit the MW quantity of convergence bids that may be submitted by a scheduling coordinator to a percentage of the intertie transfer capability. Specifically, Management proposes the following schedule for phasing in convergence bidding on the interties:

Position Limit	Schedule
0%	15-minute market implementation to 12 months
5%	12 months to 20 months
25%	20 months to 24 months
50%	24 months to 28 months
No Limit	28 months

Participating Intermittent Resource Program (PIRP)

Order No. 764 provides an opportunity to create a market structure oriented around renewable resources. The addition of 15-minute schedules and settlement establish a market structure that is superior to the existing PIRP settlement provisions. Moreover, changes to the PIRP are required for it to be consistent with the new real-time market structure. The following outlines Management’s proposed changes to PIRP under the new real-time market structure:

- Currently, the ISO schedules PIRP resources in the real-time market based on a forecast generated 90 minutes prior to the operating hour and fixed for the entire hour. This forecast output is settled at the average 5-minute price. Under Management’s proposed changes to the real-time market, the ISO will create 15-minute schedules for PIRP resources based on forecasts generated 37.5 minutes prior to the 15-minute interval. This provides significant benefits. First, it provides for a 15-minute forecast to be scheduled in the market compared to the current hourly forecast. Second, the forecast lead time is shortened substantially and the forecast is updated four times per hour rather than once per hour. Finally, the 15-minute price should be less volatile than the 5-minute price

previously applied to the output forecast for the hour, greatly reducing variable energy resources' exposure to price volatility.

- Currently, PIRP resources' imbalances from hourly schedules are netted over the month and settled at the average monthly 5-minute price. This is appropriate in the current market to mitigate against real-time price risk because the imbalances from the hourly forecast can be significant.

Under Management's proposal, the ISO will no longer net these imbalances over the month. PIRP resource imbalances will be substantially reduced under the new market structure as a result of being measured against the much more accurate forecast and granular 15-minute schedules. Management has used actual market data to compare the existing PIRP settlement provisions to those it proposes for the real-time market changes. The analysis shows that the vast majority of PIRP resources will receive more real-time market revenues under the new approach.

- Currently, the ISO does not have a market mechanism for dispatching PIRP resources down in the real-time market based on economic bids. Management's proposal includes the ability of PIRP resources to provide economic bids indicating their willingness to be curtailed in overgeneration conditions. This provides significant benefits to both the PIRP resources and the ISO's ability to maintain system reliability. By providing the ability for PIRP resources to submit economic bids, these resources can be paid to curtail output when needed to address system conditions.

Submitting economic bids will also make PIRP resources eligible for bid cost recovery. Bid cost recovery shields PIRP resources from real-time price risk by guaranteeing the PIRP resource will not be charged an amount greater than its bid price for imbalance energy in the 5-minute dispatch.

To address ongoing operational issues, Management proposes to implement the economic bidding feature of PIRP in Fall 2013, earlier than the rest of the real-time market changes which Management plans to implement in Spring 2014. During this interim period (Fall 2013 to Spring 2014), in the intervals that the ISO dispatches a PIRP resource different from the PIRP forecast, the resource will not be eligible for the PIRP monthly netting of uninstructed imbalance energy for the applicable hour.

Management proposes to establish a process to identify existing PIRP resources that have operational characteristics or contractual limitations that require additional protective energy settlement measures under the proposed market design changes. This will further ensure that a PIRP resource is not significantly financially disadvantaged by the new real-time market structure and modifications to the existing PIRP settlement provisions. This process will be used to identify if there are any

impacted resources, so that protective measures can be developed that address the specific issues identified.

Management proposes that PIRP resources will have 30 days from the May Board of Governors meeting (June 14, 2013) to notify the ISO that they meet the specified criteria and request protective measures to address their operational characteristics. Management proposes that it would develop protective measures only if resources are identified that meet the criteria below:

1. A material portion of the existing plant's output uses technology that lacks the ability to receive and follow ISO curtailment dispatches or is contractually prohibited from curtailing output; and
2. The PIRP resource bears the imbalance market costs under its existing Power Purchase Agreement (PPA).

If protective measures are developed, they would remain in effect for the remainder of the resource's existing PPA. Management also proposes to allow protective measures for a minimum of one year, if a resource's existing PPA expires between now and one year after implementation of the proposed market design changes to PIRP.

Based on data provided by the three investor-owned utilities, Management anticipates the number of resources meeting these criteria to be extremely limited and therefore believes it is best to address their particular circumstances on a case by case basis. If Management identifies any resources that meet the criteria above, it will commence a stakeholder process to develop any protective measures needed to address the operational characteristics of these resources.

POSITIONS OF THE PARTIES

Stakeholder input has generally recognized that the proposed design will help integrate variable energy resources, help to resolve existing issues with the pricing of intertie transactions, and address price volatility that currently exists in the 5-minute market. The following addresses the major concerns raised during the stakeholder process. A detailed stakeholder comment matrix is attached.

Issue 1: Management's proposal only to guarantee bid prices of intertie transactions on a 15-minute basis and not to guarantee the price for hourly schedules will conflict with the western bilateral energy market currently oriented around hourly energy and transmission purchases. This conflict could result in less liquidity and higher prices at the interties. As a result, market participants may engage in fewer real-time intertie transactions with the ISO and will incorporate a high risk premium into offers for hourly energy at the interties.

Response: The move to a 15-minute energy market over the interties is necessary to reliably integrate renewable resources and is consistent with Order No. 764. The

bilateral markets throughout the West will inevitably evolve to transact energy on a 15-minute basis to balance variable energy resources' schedule changes. The ISO's proposed approach accommodates hourly intertie schedules but creates economic incentives to bid energy on a 15-minute basis, which will provide a proper valuation of hourly and 15-minute intertie schedules.

Issue 2: Separately settling the 15-minute market schedules and the 5-minute real time dispatch may provide an incentive for resources to deviate from ISO dispatch instructions to arbitrage prices between the two markets. This could consist of an intertie transaction not delivering the amount dispatched in the 15-minute market or an internal generator deviating from its 5-minute real-time dispatch. A related concern is that a variable energy resource potentially could manipulate its forecast used for the 15-minute market to create differences with its 5-minute real time dispatch with commensurate profits.

Response: The respective market price appropriately values the cost of undelivered schedules. However, the ISO will monitor for deviations and propose deviation penalties in the future, if appropriate. In addition, the proposed market rules will allow the ISO to require a variable energy resource to use the ISO's forecast if a resource persistently submits forecasts with excessive error.

Issue 3: The ISO should maintain existing tariff provisions for variable energy resources participating in the participating intermittent resource program to net real time energy imbalances over the month.

Response: As described earlier, market participants will not need the netting provision under the new market design. First, variable energy resource forecasts will be generated 37.5 minutes prior to the start of the 15-minute market interval. In contrast, forecasts today are generated 90 minutes prior to the hour, which are flat for the entire hour. Second, variable energy resources will receive a financial position in real-time in the 15-minute market, which should have less volatile prices than the 5-minute prices in real time dispatch. Third, the ISO is proposing to establish a process to identify existing PIRP resources that have operational characteristics or contractual limitations that require additional protective energy settlement measures under the proposed market design changes. This process will be used to identify if there are any impacted resources, so that protective measures can be developed that address the specific issues identified.

Issue 4: The ISO's proposal to issue intertie dispatches for the 15-minute scheduling intervals at 22.5 minutes before the start of the interval, when updates to the energy portion of e-tags are due 20 minutes before the start of interval, will allow too little time, i.e. 2.5 minutes, for market participants to update the e-tags for schedule changes within the hour. A related concern is that some unforeseen sort of mechanical seams issue could arise with an adjacent balancing authority that does not accommodate 15-minute scheduling.

Response: In response to this specific concern, the ISO included a feature that will update e-tags by proposing an hourly option for the ISO to initiate intra-hour changes, which will expedite other balancing authority area's approval of the change. In addition, pursuant to WECC e-tagging rules, balancing authorities have an additional 10 to 15 minutes (depending on whether the change is at the top of an hour or within an hour) to confirm the e-tag changes before initiating the ramp for the schedule change. Discussions with neighboring balancing authorities confirm that they can accommodate 15-minute schedule changes.

The Market Surveillance Committee and the Department of Market Monitoring both support Management's proposal. The MSC's Final Opinion as well as a memo by the Department of Market Monitoring are attached for your reference.

CONCLUSION

Management respectfully requests Board approval of the FERC Order No. 764 market design changes as described in this memorandum. The proposed real-time market design enhancements will provide a market structure to effectively integrate a large amount of variable energy renewable resources within California and across the West and comply with FERC Order No. 764. The proposed design also effectively addresses observed market inefficiencies with the existing real-time market.