Regulation Energy Management Straw Proposal

November 15, 2010

Renewable Integration:
Market and Product Review
Phase 1

Regulation Energy Management (REM) Straw Proposal

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1 Introduction

Regulation energy management (REM) is an enhancement of the ISO's current rules for the regulation and real-time energy markets that is designed to remove barriers that limit the full participation of limited energy resources in the ISO's regulation markets. Without REM limited energy resources can participate in the regulation market but only for a portion of their capacity. This enhancement will allow the ISO to utilize these resources for their full range of capacity to provide regulation.

In the day-ahead market, the ISO procures regulation in one hour intervals. In order to receive the capacity payment for regulation ($/MW), a resource must certify that it can produce energy to satisfy a regulation up award and reduce energy production or consume energy to satisfy a regulation down award over the entire hour. Since the ISO procures 100% of the forecasted regulation needs in the day-ahead market, the 60 minute requirement for regulation sold in that market creates a barrier for resources that can provide regulation, but only produce or consume energy for a limited duration. Similarly, the real-time market has a 30-minute requirement for any additional regulation procured. Such limited energy resources could utilize the real time market to manage their ability to provide continuous energy but for the fact that market timelines require the submission of supply bids 75 minutes prior to the operating hour and the real time market does not allow demand bids. REM functionality allows a resource to purchase or sell energy in real-time to meet the continuous energy requirement for regulation in the day-ahead market.

By selecting REM, a resource's scheduling coordinator will allow the ISO to maintain the resource's preferred operating point by balancing the energy dispatched from the resource through the ISO Energy Management System to meet ISO regulation requirements. The ISO will adjust its forecast of demand for the next Real Time Dispatch interval to offset the energy produced/consumed during the previous interval's regulation energy dispatch. By ensuring that the energy offset is met by the real time energy market, a resource which has selected REM can satisfy the 60 minute continuous energy requirement for regulation in the day-ahead market. However, this approach also requires that the resource only provides regulation in intervals when it can be accommodated by the ISO dispatch.

2 Plan for Stakeholder Engagement

Item	Date
Post Straw Proposal	November 15, 2010
Market Surveillance Meeting	November 19, 2010
Stakeholder Comments Due	December 1, 2010
Post Draft Final Proposal	December 13, 2010
Renewable Integration: Market and Product Review Stakeholder Meeting	December 20, 2010
Stakeholder Comments Due	January 5 , 2010
Board Meeting	February 3-4, 2011

3 Background

The ISO has proposed to complete the design of REM in Phase 1 of its stakeholder initiative on Renewable Integration: Market and Product Review (RI-MPR).[1] The ISO and stakeholders previously considered REM as part of the initiative to address the participation of non-generator resources in the ISO's ancillary services market.[2] Stakeholders raised a number of concerns regarding REM during the stakeholder process. Some stakeholders argued that REM constituted a new product and was therefore out of scope for the non-generator resource stakeholder process. Stakeholders argued that any new ancillary service products should be vetted and considered in the broader context of a comprehensive redesign of the ancillary services markets. They also argued that the ISO had not resolved and adequately explained some key design issues. Based on stakeholder feedback, the ISO removed REM from the scope of the non-generator resource ancillary services initiative and committed to the board and stakeholders to address it in Phase 1 of the RI-MPR.

Stakeholders had divergent views on the original proposal published in March 2010. PG&E and SCE argued that REM and traditional regulation are different products and should be priced and procured separately. Beacon Power and the California Energy Storage Alliance (CESA) supported the basic elements of REM because it was consistent with designs of other RTOs/ISOs to enable limited energy storage resources to meet the one hour duration of regulation purchased in the day-ahead market. However, they also expressed concern with the initial limit (a 10 percent cap) proposed by the ISO for the amount of regulation which the ISO market would procure under REM as well as the proposed rules for the disqualification of REM resources if the Real Time Dispatch (RTD) process could not meet forecasted demand. In addition, the ISO's Department of Market Monitoring (DMM) raised several concerns regarding the original proposal including: 1) allowing traditional generators to use REM could potentially be used by generators to withhold capacity from ancillary service markets; 2) the pricing impacts of the proposed10 percent limit on REM participation in the regulation market; 3) disqualifying all REM capacity if RTD could not meet demand; and 4) potential uplift costs resulting from not settling real time energy for REM resources. In light of these concerns, DMM recommended that the ISO delay implementation and revisit the proposed rules in the RI-MPR.

Additional documentation and stakeholder comments regarding the initiative to address the participation of non-generator resources in the ISO's ancillary services market can be found at http://www.caiso.com/2415/24157662689a0.html.

During the July 16, 2010 stakeholder forum and through written comments on the September 20, 2010 issue paper[3] under this initiative, Beacon Power and CESA requested that the ISO include REM within the scope of RI-MPR Phase 1 issues. This view was supported by CPUC as an effort to both facilitate and better understand potential roles for non-conventional sources of system flexibility such as demand response and storage, while other stakeholders contended that REM was a type of new market product that needed further justification before implementation.[4] Beacon and other stakeholders argued that enhancements such as REM to existing market products should be seen as reasonable accommodations for the physical

[1] http://www.caiso.com/27be/27beb7931d800.html; all stakeholder comments below dated October 22, 2010 can be found at this location.
[2] http://www.caiso.com/2415/24157662689a0.html
[3] ISO, Issue Paper: Renewable Integration, Market and Product Review Phase 1 (September 30, 2010), available at http://www.caiso.com/2821/2821c31a21680.pdf
[4] See, e.g., SCE (October 22, 2010) at 4.

characteristics of different technologies that can provide Regulation, similarly to the ISO's efforts to improve modeling of multi stage generation in the energy markets. The ISO agrees with these views and provides further justification for proceeding with REM at this time below.

4 Renewable Integration Study Findings on Regulation Requirements

Several stakeholders have asked for additional justification for REM in the context of assessments of future regulation requirements.[5] The ISO believes that facilitating the provision of regulation by limited energy resources will help address future system requirements. The ISO has not demonstrated the future market value of, or operational need for, any particular type of regulating resource but believes it is appropriate to create a platform that allows more resources to provide regulation. The ISO's renewable integration studies highlight the potential need for additional procurement of both regulation up and regulation down. As shown in Table 1 below, in its study of integration requirements under 20% RPS,[6] expected to be achieved by California in 2012 (using a mix of internal and external renewable resources), the ISO estimated that regulation requirements could increase by almost 40 percent in aggregate during some seasons.[7] This projected requirement is not equally distributed over the operating day: in some hours there may be little additional regulation required, but in others the requirement could be up to three times greater than currently procured to address significant wind and solar ramps.[8]

Table 1: Percentage Increase in Total Seasonal Simulated Operational Capacity Requirements under 20% RPS, 2012 vs. 2006*

	Spring	Summer	Fall	Winter
Total maximum regulation up	35.3 %	37.3 %	29.6 %	27.5 %
Total maximum regulation down	12.9 %	11.0 %	14.2 %	16.2 %

* Note that 2006 is being used as a benchmark year to calculate the incremental operational requirements

The ISO's 20% RPS Study also identified that there is substantial regulation-certified capacity available in the generation fleet to meet the additional requirements: almost 20,000 MW.[9] And the ISO's initial production simulations suggested that the current generation fleet can meet the additional regulation needs in 2012. Hence, the ISO's 20% RPS Study does not establish the market or operational value of additional regulating resources under these changing conditions in the near term (2-3 years).

Beyond the 20% RPS, the ISO's 33% RPS operational simulations suggest continued increases in regulation requirements, with higher regulation ramp rates, depending on where the variable energy resources are located in the West and to some degree by technology type. The

[5] See, e.g., comments by SCE (October 22, 2010) at 4.
[6] California ISO, *Integration of Renewable Resources – Operational Requirements and Generation Fleet Capability at 20% RPS* (August 31, 2010), available at http://www.caiso.com/2804/2804d036401f0.pdf.
[7] Subject to the modeling assumptions explained in the 20% RPS Study.
[8] See, e.g., figures in Section 3.4 and Appendix A in the 20% RPS Study.
[9] See Table 4.2, pg. 70, in the 20% RPS Study.

ISO has presented initial results of the simulation modeling at workshops on the CPUC's long-term procurement planning proceeding (CPUC Rulemaking 10-05-006 *et al.)*, but discussions among interested parties continue about the appropriate assumptions and methods.[10] At the same time, other environmental regulations, including the carbon emissions reductions mandated under California Assembly Bill 32 and rules to eliminate the environmental consequences of once-through cooling, could further change the thermal resource mix and add further constraints on the availability of particular generation resources to provide integration services. While these trends point to the potential value of additional non-generation resources to provide regulation, including significant utility-scale capability,[11] the ISO has not definitively established the market or operational value of different regulating resources under 33% RPS. Nevertheless, the ISO believes that reducing barriers now to participation of non-generation resources in regulation markets will help prepare the power system for future operational requirements.

5 REM is Consistent with Future Market Software Needs

In addition to forecasts of increased regulation requirements, the ISO believes that the REM functionality, while initially applied to small limited energy technologies, is sufficiently general to support other expected software modifications. The objective of REM is to provide the ISO with a method for monitoring and managing the state of charge for resources with a limited energy delivery duration. The software logic used in REM to accommodate a resource with 15 minutes duration is the same as the logic needed to handle any length of duration less than 24 hours, such as 2 hour or 8 hour resources. Hence, REM is providing a base functionality to support dual-mode resources. Dual-mode resources are resources that have the capability to inject and withdraw energy to provide the services the ISO needs to meet the operational needs necessary to reliably manage and operate the grid. The design elements of REM are thus consistent with the ISO's long term market software expectations to support expanded, flexible use of dual-mode resources.

6 Proposed Design Elements of Regulation Energy Management

6.1 REM and Market Product Definition

Stakeholder discussion has centered on whether or not REM is sufficiently different from traditional regulation to warrant creation of a new product. One position is that REM is similar to other software enhancements, such as multi-stage generation, which enable a resource to make its full capabilities available to the ISO market. The opposing view is that REM is a new and unique product from traditional regulation and should be procured and priced separately. The core argument revolves around whether the real-time energy market can appropriately serve as the fuel source for limited energy resources and provide similar regulation service as conventional generation.

The ISO believes the design below addresses issues raised in the prior stakeholder process, including whether and how to settle regulation energy, the maximum procurement target of resources using REM functionality, whether to disqualify resources that use REM when RTD cannot meet forecasted demand, and whether to allow all resources to use REM.

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[10] See updates at http://www.cpuc.ca.gov/PUC/energy/Renewables/100824_workshop.htm.

[11] For example, the ISO has supported the objective stated by the California Clean Energy Future initiative of at least 1000 MW of utility-scale storage by 2020. See http://www.cacleanenergyfuture.org/ .

The ISO's proposed approach to implement software enhancements to maintain the resource's regulating range through the real-time market and measurement of energy provided when responding to regulation signals is similar to the approaches developed by the Midwest ISO, PJM Interconnection and the New York ISO. These ISOs/RTOs do not separate regulation into regulation up and regulation down, but procure a single regulation product which limited energy resources can provide, if these resources agree to allow the market operator to manage their state of charge .

The ISO believes the proposed design for REM reflects software enhancements that will allow limited energy resources to provide regulation on a basis comparable with a generator and does not reflect a new product. The bid timeline of the real time energy market does not enable limited energy resources to manage their state of charge, thus REM removes this barrier while ensuring the ISO receives the quality of regulation the ISO procured in the day-ahead market.

Resources under REM provide the same regulation service to the ISO as traditional generation. All regulation resources must respond to each 4 second energy management system signal and produce/consume the energy necessary to balance the grid as directed by the ISO. Also, REM permits limited energy resource to exceed the current spinning and non-spinning continuous energy requirement which allows higher quality reserves to cascade to lower quality reserves when economic to do so. Finally, resources using REM are subject to the same settlement rules and provisions relating to rescission of ancillary service payments as traditional generation.

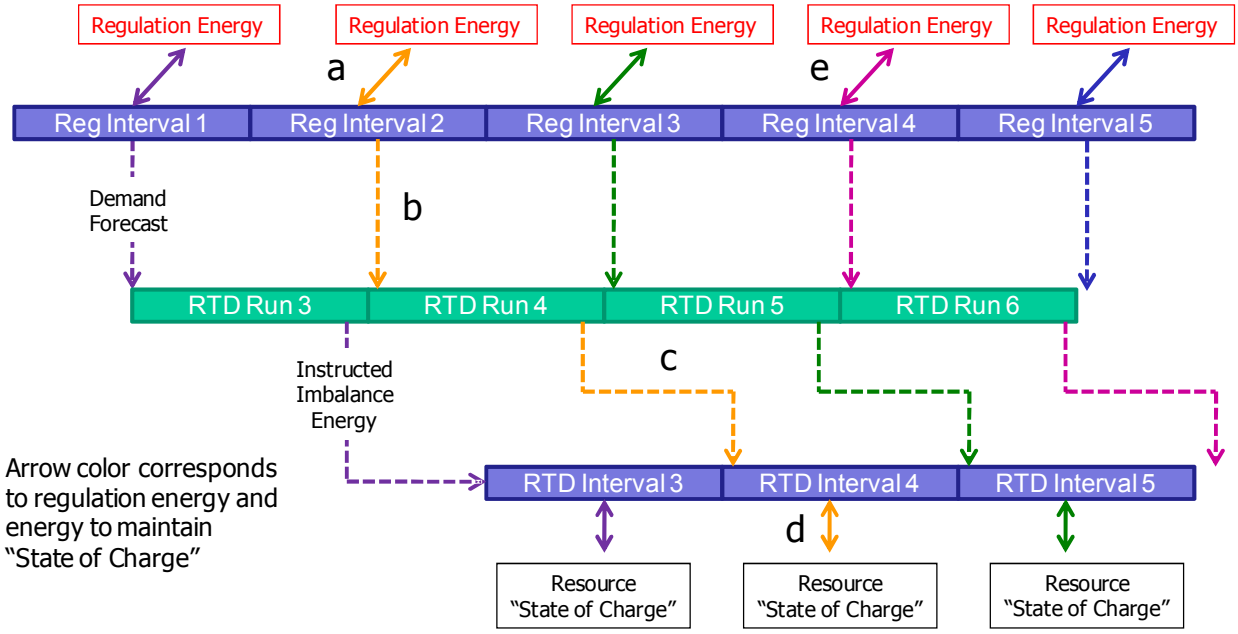
6.2 Overview of Regulation Energy Management

By selecting REM, a resource's scheduling coordinator will allow the ISO to maintain the resource's preferred operating point or state of charge by balancing the energy dispatched from the resource through the ISO Energy Management System to meet ISO regulation requirements. The ISO will adjust its forecast of demand for the next Real Time Dispatch interval to offset the energy produced/consumed during the previous interval's regulation energy dispatch. By ensuring that the energy offset is met by the real time energy market, a resource which has selected REM can satisfy the 60 minute continuous energy requirement for regulation in the day-ahead market.

6.3 Regulation Energy Management Example

In order to account for the energy produced or consumed over a five minute interval, the ISO will calculate and recover the net difference in the real time energy market that returns the resource to the preferred operating point. Figure 1 below illustrates how REM will enable a resource to provide regulation. For example, a resource provides 20MW over the 5 minutes in Interval 2 (see a) to meet ISO regulation up needs as a result of an Energy Management System signal. The ISO then adjusts the forecast of ISO demand up by 20MW for the Real Time Dispatch run for Interval 4 (see b). Then in Interval 4, the real time market has available energy necessary to replace the energy previously provided in Interval 2 (see c). At Interval 4, the resource consumes the 20MW of energy to replace the energy used in Interval 2 and moves back towards the preferred operating point (see d). However, if the ISO requires 20MW regulation up, the resource does not consume the energy because it is used to meet regulation needs (see e). The process is then repeated for each subsequent five minute interval.

Figure 1: REM Energy Offset to Maintain State of Charge



6.4 Qualification as a REM resource

The ISO proposes that a resource can select REM if for reasons related to its technical characteristics the resource requires a real-time energy offset to provide regulation services. Resources such as flywheels, batteries, and some demand response resources may require a real-time energy offset; whereas, a traditional hydro or thermal unit does not. The qualification requirement is similar to the approach for Multi-Stage Generation Resources. This proposal addresses DMM's previous concern that REM would be made available for all resources.

6.5 Determination of Capacity

The ISO proposes to allow a resource using REM to bid capacity based upon the maximum amount of energy which can be delivered and consumed over a fifteen minute interval. The ISO will calculate the amount of hourly day-ahead regulation up capacity using the following formula: MWh delivered over 15 minutes multiplied by 4 with the resource starting at full charged state. The regulation down capacity will be calculated using the following formula: MWh consumed over 15 minutes multiplied by 4 with the resource starting at full discharged state. For example, a fully charged storage device with a discharge rate of 20MW and 5MWh of stored energy would be certified to provide 20MW regulation up. If a resource which is completely discharged has a charge rate of 10MW and 2.5MWh of available storage capacity, the resource would be certified to provide 10MW of regulation down.

6.6 Regulation Energy Management Bidding Process

REM resources must submit separate bids for regulation up and regulation down capacity. The submission of two separate bids does not guarantee that the resource will receive symmetrical regulation up and regulation down awards. Conventional generators are required to have a day-ahead schedule in order to provide regulation. This requires those generators to submit a bid or self-schedule for energy into the day-ahead market. The ISO can

then move these resources up and down to provide regulation based on the set point established in the day-ahead schedule and the regulating range of the resource. Limited energy resources have a set point of zero and will only be providing regulation energy through REM; therefore, these resources will not submit day-ahead energy bids and are not required to have a day-ahead schedule to provide regulation through REM.

Previously, the ISO proposed that a symmetrical bid and award of regulation up and regulation down would be required. However, the ISO procures different quantities of regulation up and regulation down hourly based upon forecasted regulation needs. The ISO needs to co-optimize regulation, operating reserves, and energy bids and there may be instances where a symmetrical award is not the optimal solution. Such as when an hour has significant regulation down requirements and minimal regulation up is required.

6.7 Real-time Communication of Regulation Range to the ISO

In addition to existing regulation telemetry requirements, resources selecting REM must communicate the real-time available capacity to provide regulation up and regulation down. For example, a battery or flywheel must communicate the real-time state of charge and a demand response aggregator must communicate available real-time range of load.

6.8 Settlement of Regulation Capacity and Energy

Previously the ISO proposed not settle real-time imbalance energy for resources participating in REM. Given concerns raised by certain stakeholders that this may not accurately account for the efficiency losses of an REM resource and different energy prices during times of charge and discharge, the ISO is now proposing to settle these resources the same as resources providing traditional regulation. Resources that select REM will receive regulation capacity payments from the day-ahead market. When the ISO dispatches a resource using REM with a regulation up award, the resource will receive the real time LMP. When the ISO dispatches a resource using REM with a regulation down award, the resource will be charged the real time LMP. The real time energy produced/consumed by a resource using REM to maintain the resource's state of charge, including losses, will be settled at the real time LMP. Resources using REM will be subject to the applicable Grid Management Charges for their forward regulation schedules and real time energy.

The settlement of energy addresses the two strongest arguments that REM creates a separate regulation product. First, there are no longer regulation energy settlement difference between REM resources and traditional regulation resources. Secondly, the concern of potentially higher uplift costs if the energy necessary to maintain the state of charge is allocated to measured demand is no longer applicable. In addition, a REM resource now has an incentive to improve charging efficiency to reduce the cost of recharging the resource after a regulation up dispatch.

6.9 Maximum Regulation Procured from Resources Using REM

Previously, the ISO proposed a maximum procurement limit for REM equal to 10% of the total Regulation requirement to allow for operational experience with limited energy resources, while expecting to increase the cap over time.[12] A number of stakeholders argued against the cap, noting that it could limit the development of commercial-scale limited energy storage in

[12] E.g., ISO, Issues Paper (September 30, 2010), op cit., pg. 36.

California.[13] On further examination, the ISO believes that there will be sufficient experience gained through the interconnection of limited energy resources over time that an initial cap on procurement is not needed. In addition, the cap could have resulted in different prices for the same regulation service because if the cap was binding REM resources would clear at a lower price.

6.10 Substitution for Spinning Reserves

Resources under REM will be allowed to cascade and substitute for spinning or non-spinning reserves when it is economic to do so. REM functionality enables limited energy resources to meet the continuous energy requirement for day-ahead regulation of 60 minutes. This exceeds the continuous energy requirement for spinning and non-spinning reserves of 30 minutes. The current market design cascades regulation up at a system level to meet spinning reserve requirements, if economic to do so. Only the awarded regulation up capacity award applies to cascading. There are no lower quality products that regulation down can substitute.

6.11 Cost Allocations to Measured Demand

Resources under REM will be not be allocated uplifts that apply to measured demand since the resource only consumes energy to return the energy at a later time.

6.12 Disqualification of REM Resources

In the event that RTD cannot meet the CAISO forecast of CAISO demand plus the REM energy offset, the ISO will disqualify resources under REM from providing regulation. This rule recognizes that the combination of the resource's discharge/charge rate and the real-time market are needed to meet ISO regulation requirements. The shortfall will be allocated on a pro-rata basis to all resources current utilizing REM. For example, if the energy offset for all REM resources is 20MW, however, RTD can only clear 15MW, the 5MW shortfall will be distributed to all REM resources based upon their awarded capacity. The shortfall that results from insufficient stored energy will be subject to no-pay as outlined in section 6.13.

Previously the ISO proposed to disqualify all REM resources. The modified rule above addresses DMM's concerns that by disqualify the full regulation capacity instances of scarcity pricing may occur where REM resources had sufficient capacity available not to trigger scarcity pricing.

6.13 Criteria for Rescission of Payments for Regulation Capacity

Under the ISO's proposal, resources selecting REM are subject to rescission of payments for regulation capacity as outlined in the ISO tariff section 8.10.8.6.

Additional information regarding rescission of payments for regulation capacity is available in section 5 of the ISO's Compliance Monitoring BPM.

6.14 Interconnection Procedures or Aggregation Arrangements

Resources selecting REM will be subject to applicable generator interconnection procedures or an ISO approved aggregation arrangement.

[13] See, e.g., Beacon (Oct. 19, 2010), at 3-5; CESA, pg 2

6.15 Implementation of Mileage Payment

Some stakeholders[14] have advocated that the ISO should provide an additional payment to regulation resources based upon their movement from the preferred operating point. A "mileage payment" would be an administrative payment based upon sum of the absolute value of all deviations from the resources preferred operating point in response to ISO regulation signals. While there may be merit in implementing such a payment, as has been done in ISO New England, this would be a fundamental change in how the ISO procures and pays for regulation services and as such is within scope of the larger market product discussion in RI-MPR Phase 2. REM implements functionality that manages the real-time energy offset necessary to allow limited energy resources to meet the existing definition of regulation. If in the future, a new payment approach was implemented, the REM functionality is still required.

7 Next Steps

The ISO will present the REM Straw Proposal during the Market Surveillance Committee meeting on November 19, 2010. Stakeholders should submit written comments by December 1, 2010 to RI-MPR@caiso.com

[14] See, e.g., Beacon (Oct. 19, 2010), pg 7;