Opinion on Regulation Energy Management

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January 20, 2011

Summary

This opinion comments on the ISO's Regulation Energy Management (REM) proposal which allows energy-limited resources, such as batteries or flywheels, to participate in the ISO's regulation markets. We strongly support the motivation for the REM proposal to expand the set of resources able to participate in the ISO's regulation market. However, a number of grid reliability challenges associated with how energy-limited resources can provide Regulation Up (RegUp) and Regulation Down (RegDown) continuously for 60 minutes argues for a measured approach to introducing this new market feature.

This opinion characterizes the two major reliability challenges associated with allowing energy-limited resources to provide RegUp and RegDown. The first is the need for ISO's real-time market software to issue the appropriate dispatch instructions throughout the operating hour to allow the energy-limited resource to maintain the charge necessary to continue to provide the amount of Regulation Reserve sold for the entire hour. The second issue is whether ancillary service capacity from an energy-limited resource sold as RegUp provides a comparable service to Spinning Reserve from a conventional resource. Traditionally, the market clears ancillary services demand in a fashion that cascades from faster responding products, such as RegUp, to slower responding products such as Spinning Reserve and Non-Spinning Reserve. This allows the CAISO to purchase a larger amount of "superior" reserves when they are offered at lower prices. We discuss challenges associated with continuing this practice for these energy-limited resources.

Because of these reliability challenges, we favor a cautious approach to implementing the REM proposal to limit the risk of unintended negative consequences. The significantly lower prices for RegUp and RegDown after the implementation of the new nodal market design makes it likely that there will be a small amount REM capacity during the initial implementation phase, which should temper the need for explicit market interventions to address these reliability challenges. Nevertheless, we recommend that the ISO carefully monitor the impact of using REM capacity to provide Regulation Reserve on the performance of its energy and ancillary services markets and overall grid reliability.

There are three specific areas that the ISO should monitor. The first is the extent to which the maximum amount of RegUp and RegDown capacity that the ISO allows each energy-limited resource to offer is set to ensure that the resource has sufficient energy to provide the Regulation Reserves sold for the entire operating hour. The second is the relationship between overall system reliability and the share of total RegUp and RegDown being provided by energy limited resources. The third is the relationship between the amount of energy-limited resources providing RegUp that could be used to displace the ISO's spinning reserve requirements and overall system reliability. With these monitoring mechanisms in place and the other minor modifications of the REM proposal suggested in this opinion, we are confident that the ISO operators can limit any adverse reliability consequences associated with using energy-limited resources to provide RegUp and RegDown.

1. Introduction

Energy-limited resources are a necessary source of additional supply of both energy and ancillary services in a wholesale electricity market with an increasing share of intermittent resources. Even without California's ambitious renewable energy goals, there are significant potential reliability and market efficiency benefits from allowing these resources to participate in the ISO's ancillary services and energy markets. The ISO's REM proposal makes creative use of the ISO's 5-minute real-time market to allow an energy-limited resource to sell a frequency response service in the ISO's hourly Regulation Reserve market that it is physically capable of providing for only a short period of time without re-charging.. Real-time dispatch instructions are issued by the ISO operators in order to maintain enough potential energy in the REM resource for it to provide this service for an entire operating hour and beyond.

There are two prerequisites for maintaining the same level of system reliability using energy-limited resources as could be provided by a market utilizing only conventional generation resources to provide Regulation Reserve. One is a deep market for real-time energy so that the recharge energy required by REM resources can be supplied without significantly disrupting the real-time market. The second is a sophisticated 5-minute real-time dispatch algorithm that maintains the level of storage in the energy-limited resource and allows it to provide the Regulation Reserve capacity sold throughout the entire hour. The magnitude and frequency of real-time price spikes in the real-time market documented in the most recent Department of Market Monitoring (DMM) Quarterly Report suggests that using significant amounts REM resources to provide Regulation Reserve may not be advisable during all 5-minute intervals of the year.[1] Substitution of significant amounts of Regulation Reserve from REM resources for Spinning Reserve during the hours containing real-time price spikes could also create reliability challenges.

Nevertheless, we also believe that REM resources can provide significant amounts of quick-response capacity for Regulation Reserve during most hours of the year and that during these hours some of the REM resources providing RegUp can substitute

[1] Quarterly Report on Market Issues and Performance, November 8, 2010, prepared by Department of Market Monitoring (available at http://www.caiso.com/2848/2848983817680.pdf)

for the ISO's Spinning Reserve requirement. For these reasons, we support the goal of the REM proposal, but favor a measured approach to its introduction. We also support symmetric treatment of these resources with other energy limited resources in the ISO control area and suggest a possible modification of the REM proposal that we believe achieves this goal.

In preparing this opinion, the MSC has discussed this topic at several Market Surveillance Committee meetings, most recently on November 19, 2010. In addition, individual MSC members have participated in conference calls and meetings with ISO staff, market participants, and state regulatory staff to discuss the REM proposal. Moreover, we reviewed the written comments provided by stakeholders on the REM proposal. We would like to acknowledge these entities for their very helpful input.

2. Reliability Implications of Providing Regulation from Energy Limited Resources

A conventional generation resource providing RegUp is capable of providing more energy within a pre-specified range above its final energy schedule for that hour. A unit providing RegDown is capable of providing less energy than its final energy schedule for that hour. In either case, a conventional generator is generally capable of being dispatched at the full amount of RegUp or RegDown capacity for the entire hour when this is needed. Thus, there is no need for the ISO operators to make additional energy purchases in the real-time market in order for that generation unit to provide these services for the entire hour or for a longer period of time.

In contrast, for an energy-limited resource to provide Regulation Reserve, the real-time market must dispatch sufficient additional energy to maintain the operating point for the energy limited resource so that it can continue to be responsive to automatic generation control (AGC) signals for the entire operating hour. Moreover, this additional energy dispatched to maintain the operating point of the REM resource must be delivered from a unit able to inject energy into the transmission network, rather than simply from the lowest-priced offer during that dispatch interval. To the extent there is a deep real-time market for additional energy at locations in the grid where these energy-limited resources are located, there are unlikely to be reliability concerns associated with using REM resources to provide Regulation Reserve.

The following example illustrates how a conventional generation resource provides RegUp versus an energy-limited resource. A 100 MW generation unit that sells 10 MW of RegUp for the hour can be dispatched to provide RegUp (additional energy in response to AGC signals) in each of the twelve 5-minute intervals of the operating hour. With a final energy schedule of 80 MW, this 10 MW RegUp sale means that the unit could be operating between 80 MW and 90 MW anytime within the hour, depending on the AGC signals it receives. In contrast, an energy-limited resource needs not just the upward capacity to provide RegUp but also needs available potential energy to response to AGC instructions within the hour. For conventional units, the potential energy to respond is always on hand in the form of fuel. An energy-limited storage unit needs to recharge in order to have the energy capability to deliver its full RegUp capacity on a sustained basis throughout the hour.

However, during the hours when a number of transmission paths are congested, there is a reduced likelihood that the necessary incremental energy from available generation units with unloaded capacity can be feasibly injected into the transmission network to maintain the operating points of all REM resources. The ISO operators may be unable to find enough feasibly located unloaded generation capacity that can be dispatched to provide the necessary energy to the REM units. For example, if a REM unit is located in a generation poor region, it may be the case that the additional energy necessary to maintain the operating point of the REM resource cannot be delivered to the node where the REM unit is interconnected.

Under these circumstances, a REM resource may be unable to provide energy for more than two or three 5-minute intervals without recharge. As a consequence, if there is a sustained need for RegUp resources, REM resources may not provide the same reliability benefit to the system as conventional resources. Such a sustained need would occur, if ever, only when the system is in a very highly stressed state, which is precisely, when RegUp resources are the most valuable. Although the ISO is confident that such episodes will rarely, if ever occur, there is an absence of analysis of high stress periods to confirm this. The analysis on the REM proposal submitted by the DMM on January 6, 2011 suggests that such high stress periods could occur.[2] A close examination of experience of the eastern ISOs with REM-type resources would also have been informative for determining when these high stress periods are likely to create reliability problems.

During stressed system conditions, it may also be unwise to rely on a significant amount of REM resources providing RegUp to reduce the ISO's Spinning Reserve purchases. If a large generation unit fails, then the ISO may need additional energy from the REM resources for a sustained period of time. However, unless there is a sufficient unloaded generation capacity able to inject additional energy in real-time to maintain the operating points of the REM resources, these resources cannot provide the necessary RegUp energy for a very long period time. When there is a limited amount of unloaded available generation capacity in the real-time market, there is a higher risk that an energy-limited resource may be unable to provide energy equal to the amount RegUp capacity sold for the remainder of the operating hour.

It is important to note that there is a tradeoff between using REM resources and just relying on generation resources to provide Regulation Reserve. The technologies that are most likely to provide REM resources, especially storage, will be able to ramp much more quickly than the thermal power plants that provide most Regulation Reserve. This rapid ramp capability is valuable to the system, and will become increasingly so as the penetration of intermittent renewable increases. Whether this makes REM resources on net more or less valuable to the system than more traditional sources of regulation is unclear.

Therefore we believe that it is worthwhile for the ISO to gain experience with significant quantities of REM resources in order to evaluate this question, and to

[2] "Comments on Draft Final Proposal for Regulation Energy Management (REM)," Department of Market Monitoring, January 6, 2011 (available at http://wepex.net/2afe/2afee17a2b670.pdf)

determine whether additional safeguards are needed in case the limited energy storage available in REM resources proves to be a problem when the system is highly stressed. If it turns out that the fast-ramping REM capacity is more valuable for the system than Regulation Reserve from conventional generation resources as the amount of wind and solar penetration increases, while imposing insignificant risks to the system in terms of running out of energy for sustained RegUp generation, then consideration might eventually be given to creating a separate fast ramp regulation product that could also be substituted for regular ramp.

Because of these reliability challenges associated with using energy-limited resources to provide Regulation Reserve, a cautious approach to implementing the REM proposal would limit the risk of unintended negative consequences and maximize the opportunities to learn the costs and benefits of using energy-limited resources in this manner. This could be accomplished by stringent monitoring of the impact of using energy-limited resources to provide Regulation Reserve during the initial implementation stage of the REM proposal. There are three dimensions to this monitoring process.

The ISO should first compare the limits it places on the maximum amount of RegUp and RegDown an energy-limited resource owner can offer into the ISO's Regulation Reserve markets against the unit's actual performance providing Regulation Reserve at that level for the entire hour. The ISO should correlate this comparison with actual real-time system conditions to understand how the risk of Regulation Reserve shortfall from these units varies with real-time system conditions.

Second, the ISO should also monitor the how the aggregate amount of RegUp and RegDown capacity provided by all energy-limited resources for the entire hour compares to total amount sold from these units during that hour. Understanding how the inability to provide the total amount of Regulation Reserve sold from energy-limited resources during the hour varies both spatially and temporally should provide valuable feedback for the design of the mechanism for dispatching real-time energy to maintain sufficient energy in the these resources to provide the Regulation Reserve sold for the entire hour under all possible system conditions.

Finally, the ISO should also monitor the reliability implications of using energy-limited resources providing RegUp to displace the ISO's spinning reserve requirements. As noted earlier, under stressed system conditions with high levels of congestion it may not be possible for the ISO operators to obtain sufficient energy from the real-time market at the locations necessary to allow these resources to provide a product with the same reliability benefits as Spinning Reserve from a generation resource.

ISO should be ready to take action to modify the algorithm for dispatching additional energy from the real-time market to provide additional energy to the REM resources should any of these adverse reliability consequences occur. In the event, that this monitoring and dispatch algorithm modification is ineffective at address these reliability consequences, the ISO may want to consider putting more formal constraints on how and when energy-limited resources can provide Regulation Reserve.

3. Eliminating Potential Subsidies to Energy Limited Resources

Energy-limited resources that are eligible to provide Regulation Reserve should be treated the same way as pre-existing energy limited resources such as pumped storage hydroelectric facilities. We understand there is some ambiguity in how these resources are treated relative to other energy-limited resources in the ISO control area such as pumped storage hydroelectric facilities or other storage facilities.

The REM proposal will require energy-limited resources to purchase to settle the energy they withdraw and inject at the appropriate real-time 5-minute price. This is similar to the requirement for pumped storage facilities. For example, consider a unit that purchases energy in the first 5-minute interval to maintain its operating point into the start of the third interval, and then uses that energy in the second interval to provide RegUp. In this case, the ISO proposal would require a purchase of energy at the 5-minute price in the first interval and sale at the 5-minute price in the second. We strongly support such treatment.

However, as discussed in Section 7.11 of the ISO proposal, such recharging "purchases" by REM resources would be exempt from uplift allocations to measured demand. We believe that the ISO should treat energy purchased by these units in the same manner as energy consumed by pumped storage units or energy consumed by a thermal generation unit. Computing net energy demand (total withdrawals less total injection) for the hour and charging uplifts based on the quantity of positive net demand would be consistent with how these uplifts appear to be handled for other energy-limited resources. We recognize that this change in the allocation of these uplift charges should not delay the implementation of the REM proposal, but the treatment of these charges should eventually be made consistent with how they are treated for other energy-limited resources in the ISO control area.

4. Concluding Comments

We would like to reiterate our support for the intent of the ISO's REM proposal. However, we believe that given coordination between the operation of the REM resources and 5-minute dispatch instructions in the ISO's real-time market necessary to allow these resources to provide Regulation Reserve. A go-slow approach based on the three areas of stringent market monitoring described above is a prudent way forward to ensure a successful rollout of this product with limited risk of adverse consequences. To the greatest extent possible these resources should be treated symmetrically with existing limited energy resources in the settlement process to limit the potential for inefficient use of these resources to provide Regulation Reserve.