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Dynamic Ramp Rate In Ancillary Service Procurement

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Currently, the amount of ancillary service (AS) that can be awarded for different AS types in DA and RT markets for a resource under energy/AS co-optimization is governed by the fixed ramp rate specific to the AS type (either the operating reserve ramp rate or the regulation ramp rate). Specifically, the deployment time of a given AS type is calculated as the AS award amount divided by the AS fixed ramp rate. As all reserves procured by the CAISO are of 10-minute nature, the total deployment time over all reserves of a given direction, either up or down, from a given resource has to be within 10 minutes. For example, let the fixed regulation up ramp rate be 5MW/minute and the fixed spin ramp rate be 10MW/minute. Then awarding 50MW regulation up alone or 100MW spin alone will not violate the 10-minute deployment time requirement. Other combination of AS awards could be 25MW regulation up and 50MW spin where the deployment time is also 10 minutes in total. Optimization determines the award amounts of regulation-up and spin along with energy schedules on the basis of bid cost minimization. Please refer to the technical bulletin for simplified ramping for the ramp sharing method that CAISO uses when procuring energy and various ancillary service products[1].

Such approach of accounting the amount of reserve that can be procured is not realistic. In fact, the ramp rate of generation dispatch could depend on the MW dispatch level of the resource. This is the so-called dynamic (or operational) ramp rate which has been applied in limiting the change in MW generation levels between two adjacent time intervals since the start of the new market. The use of a fixed ramp rate to award AS whereas energy ramping is governed by the operational ramp rate could mean that awarded reserves may not be deliverable in 10 minutes because the resource is at a MW level that the operational ramp rate is slower. This problem raises AS deliverability and system reliability concerns and results in increased use of exceptional dispatch to move resources to an energy level capable of supporting the faster ramp rate in the event of contingency.

To address these concerns, the CAISO will start using the energy operational ramp rate in conjunction with the fixed AS ramp rate for AS procurement within the co-optimization formulation. Specifically, the ramp rate of AS at a given MW level is the minimum between the operational ramp rate at the MW level and the

[1] http://www.caiso.com/2437/2437db41245c0.pdf

fixed AS ramp rate. The ramp rate of AS could be dynamic, namely, depending on the MW level for dynamic ramping in energy.

To demonstrate this concept, consider an example using same ramp rates for regulation-up and spin as above. The regulation range is from 0MW to 300MW. In addition, the operational ramp rate of energy is as follows:

From 0 to 150MW, ramp rate = 6MW/minute

From 150 to 300MW, ramp rate = 10MW/minute

Because the fixed regulation-up ramp rate is below the dynamic ramp rate of energy, the regulation-up ramp rate under the new formulation is the same as its fixed ramp rate at 5MW/min over the entire MW range of regulation.

On the other hand, since energy ramp rate at 6MW/minute between 0 to 150MW is below the fixed ramp rate of spin at 10MW/minute, the slower ramp rate of energy is in effect in procuring spin over such MW range. The dynamic ramp rate for spin is the same as ramp rate of energy under the new formulation.

If the generation scheduled at 50MW, then possible AS awards for this resource are 50MW regulation-up alone or 60MW spin alone. The 60MW Spin is limited by the 6MW/min operational ramp-rate when taking the minimum of operational ramp-rate and Spin ramp-rate. Theoretically, there are infinite many combinations in regulation-up and spin awards as long as the total deployment time is within 10 minutes. On the other hand, should the generation scheduled at 200MW, possible AS awards are 50MW regulation-up alone or 100MW spin alone as well other combinations satisfying the total 10-minute deployment time requirement. Optimization will determine the final schedule of energy and AS of different types through bid cost minimization of both energy and ancillary services.

The operational 10 minute ramp capability based on the energy schedule will be used to determine the amount of spin award. To demonstrate how the 10 minute ramp capability is determined when a resource's energy schedule is at a level such that the resource would ramp across operational ramp-rate segments within 10 minutes we will use same example as above. However, in this case the resource is scheduled for energy at 100MW. At 100MW the resource could ramp:

From 100MW to 150MW or 50MW in 8.333 minutes and then ramp for another 1.666 minutes at 10 MW/min or 16.66 MW more before the 10 minutes expired. Therefore at 100MW the total 10 minute ramp capability of the resource is 66.67MW based on the operational ramp-rate of the resource.

Therefore in this case at 100MW the resource could provide up to 66.67MW of spinning reserve.

Using the combination of the operational ramp-rate of energy and the fixed operating reserve ramp rate and fixed regulation ramp rate to limit the amount of A/S award will ensure the resource awarded A/S are deliverable. This will be achieved optimally by either awarding the amount of A/S that is deliverable based on the energy schedule of the resource and/or schedule the energy at a level that supports the resource's A/S award.