**Update to SAWG**

**on**

**Real-Time Co-Optimization Discussions**

**ERCOT**

**February 25th, 2015**

Item 1: Modify submission rules for linked AS Offers to enhance substitutability:

1. If AS Offer MW has a price for a higher quality AS (e.g. RegUp) but no price for a lower quality AS (RRS) that the Resource is qualified for, then, the price for the higher quality AS is inserted as the price for all the lower qualified AS offers that the QSE has not put a price for. Will need more discussion to cover more scenarios

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | AS Offer MW | RegUp ($/MW) | RRS ($/MW) | NSPIN ($/MW) |
| Current | 10 | 12 |  | 7 |
| Proposed | 10 | 12 | 12 | 7 |

* 1. Please note that this could be done in today’s market design. This is NOT dependent on RT Co-Optimization

Item 2: For RT Co-Optimization, AS Offers for MW capacity must be 0$/MW if that capacity is converted to energy by the optimization engine.

1. More discussion required – need to develop stakeholder consensus
2. With the current AS product set – this rule will apply for On-Line Non-Spin. More discussion needed to see if it applies to RRS (one of the issues here is that RRS capacity could be converted to energy outside of SCED by governors responding to frequency deviations and the QSE submitting the AS Offer may need to put a non-zero RRS offer to capture opportunity cost?)
3. Regulation and truly Off-Line Non-Spin Offers can be non-zero $/MW

Item 3: Rules to setup demand curves for each AS based on ORDC.

1. Should demand curve for RRS follow the ORDC curve all the way or should it be cut-off at the level that ERCOT operations publishes as the RRS requirement
   1. Need to understand the implication of procuring more than what is required – even if it is cheaper. Is this an issue for some market participants that always want to completely self-arrange their obligations?
   2. Where does the demand curve start for Non-Spin on the ORDC? Is it the point on the ORDC after the sum of RegUp and RRS requirement as published by ERCOT ends?

Item 4: Under Real-Time co-optimization when a Resource buys out of its Day ahead AS responsibility, the QSE representing the Resource could get financially harmed by the Real-Time imbalance settlement for energy and AS if it had made sales for AS from that Resource in the Day-Ahead Market. There are specific conditions under which this can occur:

1. System conditions are such that there is shortage/scarcity in one AS but surplus of capacity for energy. i.e. scarcity pricing for AS is not reflected in the energy prices (LMPs)
2. Resource is ramp constrained (how much it can move in 5 minutes) and the awards are limited by this. For example, if a Resource is generating energy at HSL and the next RT co-optimization results in a very high price for RRS, then the Resource MW award for RRS is how much it can be ramped down in 5 minutes.
3. QSE has made a sale of AS on this Resource in the Day-Ahead Market

Note: if a Resource has not made a Day-Ahead Sale for AS, then this scenario does not apply.

An example of this scenario is described in the appendix of this document.

There were lengthy discussions on this topic and below is a summary of findings on what other ISOs do and some of their comments.

1. The ISO practices that were examined are NYISO, MISO and ISO-NE.
2. We were able to discuss this scenario with NYISO and ISO-NE staff. We discussed with a person very familiar with MISO (but not a MISO staff member)
3. NYISO:

As per Attachment J, “Day-Ahead Margin Assurance Payment - DAMAP”, this scenario will lead to a make whole payment to the Resource that is harmed financially.

* 1. There are a host of pre-conditions to be satisfied in order to qualify for this make-whole payment
  2. This make whole is for both energy and AS. The AS make whole payment is a fraction of the make whole payment for energy. In 2013, the total $ amount of the Day-Ahead Margin Payments (for energy and AS) was around 20 $ million.

1. MISO:

Under the “Real-Time Price Volatility Make Whole Payment” there is an item “Day-Ahead Margin Assurance Payment - DAMAP”. Similar to NYISO, this scenario will lead to a make whole payment to the Resource that is harmed financially.

1. This make whole is for both energy and AS. The AS make whole payment is a fraction of the make whole payment for energy.
2. In 2013, the total $ amount of the Day-Ahead Margin Payments (for energy and AS) was around 80 $ million. Of this 80$ million, approximately 10% is due to AS DAMAP.
3. There are a host of pre-conditions to be satisfied in order to qualify for this make-whole payment
4. URL for further reference:

<https://www.misoenergy.org/_layouts/MISO/ECM/Redirect.aspx?ID=19181>

This is a link to MISO Market Settlements. Of interest are the following documents -Market Settlements (BPM-005), Market Settlements Calculation Guide (MS-OP-029) and Post Operating Processor Calculation Guide (MS-OP-031).

1. ISO-NE:

There is no make whole payment. Conceptually, they disagree that the scenario requires a make whole payment.

* 1. They consider this type of make whole payment sending the wrong incentive of not rewarding for Resource flexibility
  2. From their understanding of the ERCOT market, we do not have “Day-Ahead Make Whole Payment – DAMAP” for energy – so why should ERCOT do it for AS?
     1. In the current ERCOT DAM, ramp constraints are not considered for awarding energy on an hourly interval, but in Real-Time, the 5 minute ramp limits are considered (enforced as HDL/LDL) in the current SCED.

Item 5: How to mitigate the impacts of the scenario described in Item 4 above?

1. Current version of concept paper talks about procuring the entire AS requirement every 5 minutes. Modification is to NOT re-procure the AS (RRS) after UFR deployment
   1. More discussion needed, need to determine if new telemetry (relay+Breaker operation) from UFR Resource required or any other information.
   2. Reducing the AS demand curve will lessen the scarcity pricing level – if going down this path, need more discussion if the level of reduction of the AS demand curve is one for one MW of the UFR deployment or something else.
   3. It does not appear that any of the other ISOs modify their AS demand curves due to any self-deployment of AS (governor response mainly – not much information if other ISOs have significant “ERCOT like” Load Resources under UFR)
2. Do we need to change RRS to a 5 minute product from a 10 minute product?
   1. More discussion needed. The other ISOs have not redefined their 10 minute AS product.
   2. RARF data shows that there are some Resources, which cannot ramp down by 20% of their HRL in 5 minutes. For example, as expected some CLLIG and NUC do not have high enough Ramp Rate Down to back off up to 20 % of RARF submitted HRL.
      1. Require guidance on how to quantify this.
3. If truly Off-Line Non-Spin is called by ERCOT operations, then do not re-procure the Non-Spin capacity deployed from truly off-line Resources
   1. More discussion needed. In the process of discussion with other ISOs
   2. Again note that it does not appear that any of the other ISOs modify their AS demand curve

**Appendix: Example for Item 4**

1. The Real-Time AS Imbalance Settlement equation is shown below:

The Payment (-) or Charge (+) $ = RT\_AS\_MCPC \* (DA\_AS\_Award – RT\_AS\_Award)

RT\_AS\_MCPC = is the real-time clearing price for a given Ancillary Service

DA\_AS\_AWARD = the Day-Ahead Ancillary Service  award/responsibility for a Resource

RT\_AS\_AWARD = the Real-Time Ancillary Service award for a Resource

If the Resource is awarded more AS in Real-Time than its Day-Ahead award/Responsibility, it is paid the Real-Time AS price for the difference between its Day-Ahead and Real-Time AS quantities (MW)

If the Resource is awarded less AS in Real-Time than its Day-Ahead award/Responsibility, it is charged the Real-Time AS price for the difference between its Day-Ahead and Real-Time AS quantities (MW)

1. System wide requirement for 10 minute spinning reserve = 4000 MW – demand curve is a rectangle with 4000 MW wide and a height of 2000 $/MW

There is no other reserve requirement in the system (i.e. simple example with only one type of reserve)

1. Generator G1 with the following parameters and offers:

High Limit = 100 MW

Ramp Rate (up and down) = 2 MW/Min

Energy offer = 100 MW @ 50 $/MWh

10 minute spin reserve offer = 20 MW @ 5 $/MWh  note this capacity is frequency responsive (i.e. this capacity can be converted to energy by governor action in response to frequency deviations outside the governor dead band)

1. G1 Day Ahead Awards:

G1 Energy Award= 80 MW, LMP = 60 $/MWh

G1 Spin Award = 20 MW, Spin MCPC = 15 $/MW

Total Revenue   = 80\*(60) + 20\*(15) = 5100 $ for an hour or 5100/12 = 425 $/MW every 5 minutes

1. In real-time, G1 has the same parameters and offer costs for energy and Spin:

High Limit = 100 MW

Ramp Rate (up and down) = 2 MW/Min

Energy offer = 100 MW @ 50 $/MWh

10 minute spin reserve offer = 20 MW @ 5 $/MWh  note this capacity is frequency responsive (i.e. this capacity can be converted to energy by governor action in response to frequency deviations outside the governor dead band)

1. @Time T1: Real-Time conditions exactly match Day-Ahead and

G1 energy Award/base point = 80 MW, LMP = 60 $/MWh

G1 Spin Award = 20 MW, Spin MCPC = 15 $/MW

RT energy imbalance settlement/5 min = 60\*(80-80)/12 = 0$/5 min

RT spin imbalance settlement/5/min =15\*(20-20)/12=0$/5 min

1. @Time T1+5: Real time conditions are such that there is more Spin offers available at $7/MW from other resources, but G1 is still in the money for energy. G1 is given 90 MW energy (limited by ramp rate)

G1 energy Award/base point = 90 MW, LMP = 55$/MWh

G1 Spin Award = 10 MW, Spin MCPC = 7$/MW

RT energy imbalance settlement/5 min = (-1)\*55\*(80-90)/12 = -45.833$/5 min (payment)

RT spin imbalance settlement/5 min = (-1)\*7\*(20-10)/12= 5.833$/5 min (charge)

Note: G1 has bought 10 MW out of its Day-Ahead spin responsibility, but is still financially ahead $40

1. @Time T1+10: Same conditions as at T1+5, G1 gets more energy award as it can ramp up

G1 energy Award/base point = 100 MW, LMP = 55$/MWh

G1 Spin Award = 0 MW, Spin MCPC = 7$/MW

RT energy imbalance settlement/5 min = (-1)\* 55\*(80-100)/12 = -91.667$/5 min (payment)

RT spin imbalance settlement/5 min = (-1)\*7\*(20-0)/12= 11.667$/5 min (charge)

Note: G1 has bought 20 MW out of its Day-Ahead spin responsibility, but is still financially ahead $80

1. @Time T1+15: There is an event that reduces the amount of spinning reserves available in the system, but there is a lot of capacity available for energy. G1 output is 100 MW, due to ramp rate limitations, the maximum its output can ramp down to is 90 MW (2 MW/min \* 5 minutes = 10 MW), the maximum spin award it can get is 10 MW.

G1 energy Award/base point =90 MW, LMP = 100$/MWh

G1 Spin Award = 10 MW, Spin MCPC = 2000$/MW

RT energy imbalance settlement/5 min = (-1)\*100\*(80-90)/12 = -83.333$/5 min (payment)

RT spin imbalance settlement/5 min = (-1)\*2000\*(20-10)/12= 1666.667$/5 min (charge)

Note: G1 has bought 10 MW out of its Day-Ahead spin responsibility and is CHARGED 1583.33 $/5min

Note: in this time interval, the scarcity price for Spin does NOT get reflected into the energy price as there is excess capacity available for energy. The 100 $/MWh for energy is just for illustrative purpose to show that it does not incorporate the spin scarcity pricing (there is no lost opportunity in selling energy versus Spin)

For example, the system conditions at T1+15 can be:

Total online capacity on the system = 60,000 MW

Total Real-time load on the system = 50,000 MW

System wide requirement for 10 minute spinning reserve = 4000 MW – demand curve is a rectangle with 4000 MW wide and a height of 2000 $/MW

Total capacity available for 10 minute spinning reserve = 3900 MW ( this number can be a combination of limits based on ramp rates of individual resources or limited number of MWs from available offers for reserves that can be used for 10 minute spinning reserve or limit on the maximum spinning reserve that can be awarded to a single resource)

In this interval, Resource G1 is buying back 10 MW at 2000 $/MW but is NOT able to compensate this loss through the sale of energy which is priced at 100 $/MW.