

FERC Order 755 Frequency Regulation Compensation

NYISO Proposal – part III

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Agenda

- Background
- Review FERC Order
- Changes since February 2nd MIWG
 - Movement calculation/payment
 - Movement Multiplier
 - Shortage Pricing
 - Bid Floor and Bid Caps
- Next Steps
- Appendix A
 - Detailed Proposal as previously presented
- Appendix B
 - Requested Overview of Opportunity Costs



Background

- On January 19th, 2012 and Feb 2nd, 2012, NYISO presented its proposal to comply with FERC Order 755 regarding Frequency Regulation Compensation.
- Those presentations can be found at: <u>http://www.nyiso.com/public/webdocs/committees/bic_miwg/meeting_materials/2012-01-</u> <u>19/Reg_Compensation.pdf</u>

http://www.nyiso.com/public/webdocs/committees/bic_miwg/meeting_materials/2012-02-02/Order755RegulationCompensation.pdf



FERC Order Requirements (recap)

- Must compensate resources with a Regulation Capacity payment that includes lost opportunity costs.
- Must additionally compensate resources based on their actual Regulation performance.
- •Two-part Regulation bid required.
- •Uniform Regulation Settlement Price must be market based.
- Must treat all resources equally when measuring accuracy responding to regulation signals.
- •Tariff amendments due April 28th, 2012.
- •Implementation complete October 25th, 2012.



Changes/Updates to the NYISO 755 Response



Movement

- Every six-seconds, the NYISO dispatches Regulation-scheduled Resources with an allocated share of the MWs needed for ACE correction. These allocated MWs will now be known as "Movement MWs." Changes in the deployment of resources within AGC are necessary.
- Regulation Movement will be allocated as follows:
 - Allocate Movement MWs to all units proportionally, based on the amount of Regulation Movement MWs they are able to provide in the next six seconds using their six-second response rates.
 - Today, movement is allocated first to Limited Energy Storage Resources (LESRs), and then to units proportionally based on their RTD Regulation Capacity Schedule.
 - AGC will continue to manage around the current state of charge for LESRs.
 - For settlement purposes, Movement MWs for an interval will be the summation of the absolute up and down Movement MWs directed by AGC.
 - An AGC signal directed to a Resource for Energy or for state of charge management will not be counted as a Movement MW for settlement purposes. Any AGC MW directed against ACE for state of charge management will be deducted from the total Movement MWs for settlement purposes.



Movement Bid Weighting

- Prior iterations of our proposal only talked about summing the Regulation Capacity and Regulation Movement Bid Prices together, essentially treating them as equal measures.
- As we continue to analyze historical regulation movement (through manual reverse engineering of the data), it is clear that we experience significantly more than a 1:1 ratio of Movement MWs to Capacity MWh. The long-term average ratio appears to be somewhere between 8:1 to 12:1.
 - In other words, for each MWh of Regulation Capacity the markets procure, we expect to have anywhere from 8-to-12 MWs of Regulation Movement.
 - To illustrate: if the market procures 200MWh of Regulating Capacity, we can expect that, on average, we will instruct anywhere from 1,600 2,400 MWs of Regulation Movement across all of the regulating units over the course of the hour.
 - Caveat: These numbers are illustrative only. As mentioned on the previous slide, we are still in the process of refining our estimates of historical movement.



Movement Bid Weighting

- Given our clearer understanding of the actual regulation movement that occurs, simply summing the two bid components together with equal weightings would undervalue the cost of a bidder with a low Regulation Capacity Bid Price and a relatively high Regulation Movement Bid Price, since we are likely to instruct that resource to move many MWs for each MWh of Capacity they offer.
- Therefore, we will propose to weight/multiply Regulation Movement Bid Prices by the historical ratio of Regulation Movement MW:Regulation Capacity MWh.
- All Regulation Movement Bids will be weighted by the same multiplier.
 - By using a uniform NYCA-wide multiplier on all units' bids, we ensure a consistent evaluation of all regulation bid costs.
- As mentioned on the previous slide, we have not completed our analysis of the historical ratios of Regulation Movement:Regulation Capacity. Therefore, the precise multiplier that will be used has not yet been finalized.
- Similar to the Reserve Demand Curves, the multiplier will be re-evaluated periodically. In addition, should the multiplier cause an operational or reliability problem the ISO may modify it and provide notice to the BIC.



Movement Bid Weighting

Example

| | | | | Weighted | | |
|----------|------------|------------|------------|----------------|-----------|------|
| | Regulation | Regulation | Regulation | Movement | | |
| | Capacity | Capacity | Movement | Bid \$ (assume | Composite | |
| Provider | Bid (MWh) | Bid (\$) | Bid (\$) | weight of 10) | Bid (\$) | Rank |
| А | 20 | \$6.75 | \$0.00 | \$0.00 | \$6.75 | 4 |
| В | 100 | \$2.00 | \$1.00 | \$10.00 | \$12.00 | 5 |
| С | 25 | \$0.00 | \$3.00 | \$30.00 | \$30.00 | 8 |
| D | 25 | \$2.50 | \$0.10 | \$1.00 | \$3.50 | 2 |
| E | 35 | \$2.51 | \$0.20 | \$2.00 | \$4.51 | 3 |
| F | 10 | \$15.00 | \$0.00 | \$0.00 | \$15.00 | 6 |
| G | 10 | \$1.00 | \$2.00 | \$20.00 | \$21.00 | 7 |
| Н | 100 | \$1.00 | \$0.21 | \$2.10 | \$3.10 | 1 |
| 1 | 20 | \$6.75 | \$4.00 | \$40.00 | \$46.75 | 9 |



Setting the Regulation Movement Settlement Price during shortages

- When the Regulation demand curve is triggered, by definition there is no marginal unit since the demand curve itself is marginal.
- Under these conditions, the Regulation Movement Settlement Price will be set based on the Regulation Movement Bid Price of the last unit awarded a Regulation Capacity schedule prior to the Regulation demand curve being triggered.
 - The shadow price of the demand curve will set the Regulation Capacity Price
- The last unit awarded a Regulation Capacity schedule is the unit with the highest Regulation Service composite bid price (for DAM) and the unit with the highest Regulation Movement bid price in RT.
 - This is essentially the same method of deriving the Regulation Movement Settlement Price from the Marginal Unit, as we are proposing in non-shortage scenarios.



Bid Floors and Bid Caps

- The bid floor for both Regulation Capacity and Regulation Movement will be \$0.
- The FERC Order necessitates a re-design of the way in which Regulation Service is procured. Until the market experience with this new design matures, the implementation will include temporary bid caps for the Regulation <u>Movement Bid Price</u>.
 - We are not proposing a bid cap on Regulation Capacity_bids at this time.
- To protect against costs increasing exponentially while the market for this new product matures, NYISO will propose to cap Regulation Movement Bid Prices at an amount that ensures the total annual system cost for Regulation Movement does not exceed the average total system cost for Regulation Capacity over the past three years.
 - In other words, since the average annual NYCA-wide payout for Regulation Capacity over the past 3 years was ~\$40million annually, the bid cap for Regulation Movement Bid Prices will be set at a level geared to result in a total system cost for Movement that does not exceed \$40million.
 - NYISO's Market Monitor will review the competitiveness of the regulation market as part of its quarterly and annual market review [duties] to judge the adequacy of the implemented Regulation Movement Bid Price cap, and if necessary, will recommend any changes.



Bid Floors and Bid Caps - continued

- How the bid cap will be derived (numbers are **illustrative only**):
 - \$40m average fuel-adjusted annual total payout for regulation over the past three years.
 - 18 million Movement MWs average per year.

 $40m \div 18m = 2.22$ cap for Regulation Movement Bid Price per MW moved.

- To derive the final Regulation Movement Bid Price cap value, NYISO still must refine its estimates of historical regulation movement.
 - Current estimations would put the bid cap in the \$2-3 a MW moved range.



Next steps

- March 22, 2012 MIWG Continued discussions
- March/April Tariff language reviewed at MIWG and/or BIC
- •April 28th 2012 –File tariff amendments
- •October 25th, 2012 Deadline to implement solution



Appendix A

Full proposal with examples



NYISO proposal in a nutshell

- Market Participants will offer both a Regulation <u>Capacity bid price</u> (as they do today) and a new Regulation <u>Movement bid price</u> for both the Day-Ahead Market (DAM) and the Real-Time Market (RTS). They will also provide a six-second Regulation Response Rate, in addition to the five-minute Regulation Response Rate.
- Both DAM and RTS will optimize Regulation offers using the combined <u>Capacity bid</u> <u>price</u> and the <u>Movement bid price</u> of each bidder (the two bid components are summed together into a single value).
- Suppliers with DAM Regulation Capacity Schedules will be paid for scheduled Regulation Capacity using the DAM Regulation Capacity Clearing Price.
- Suppliers with RTD Regulation Capacity Schedules will be paid for incremental (above the DAM scheduled) Regulation Capacity using the RTD Regulation Capacity Clearing Price.
- Suppliers with RTD Regulation Capacity Schedules will also be paid for the absolute number of MWs they were instructed to move in real-time by AGC for ACE correction. This settlement will use the RT Regulation Movement Clearing Price.



Day-Ahead

- The Regulation bid price for each Resource passed into the DAM evaluation is the sum of each bidder's Regulation Capacity bid price plus Regulation Movement bid price
 - NYISO recognizes that this involves combining bid prices for different units of measure (\$/MWhrenergy and \$/MWmovement).
 - Summing them together provides a simple mechanism to prevent creating incentives for very expensive movement offers and very low capacity offers.
- DAM Regulation Capacity Clearing Price
 - The DAM Regulation Capacity Clearing Price will reflect only a price for Regulation Capacity, including lost opportunity costs; It will be set as the Regulation Capacity Bid Price plus lost opportunity cost (as determined by the optimization) of the marginal unit.
 - It is possible that the DAM Regulation Capacity Clearing Price will not always be sufficient to cover the bid-in Regulation Capacity costs of all cleared resources due to the two-part bidding that is being summed together. Modifications to Day-ahead BPCG will be necessary to deal with this outcome.
- DAM Settlement is:

DAM Regulation Capacity Schedule * DAM Regulation Capacity Clearing Price

• There is no Regulation Movement scheduled in the DAM. Only a Capacity schedule is awarded. There will also be no DAM Regulation Movement Clearing Price.



Real-time

- The Regulation bid price for each Resource passed into each RTS evaluation is the sum of each bidder's real-time Regulation Capacity bid price plus real-time Regulation Movement bid price.
 - Similar to other ancillary products for capacity the real-time Regulation Capacity bid price must be zero;
 - Market Participants may not increase their Regulation Movement bid price above their accepted DAM Regulation Movement bid price.
- Real-time Regulation Capacity Clearing Prices
 - Regulation Capacity Clearing Prices exclude bid prices for Regulation Movement; It will be set as the lost opportunity cost (as determined by the optimization) of the marginal unit.
- Real-time Regulation Movement Clearing Prices
 - Regulation Movement Clearing Prices will be set at the Regulation Movement bid price of the marginal unit for the interval; (This is a slight revision to the Jan 19th presentation which described the movement clearing price as using the highest movement bid price of the units with a Regulation Capacity Schedule).
 - It is possible that the Real-time Regulation Movement Clearing Price will not always be sufficient to cover the bid-in Regulation Movement costs of all cleared resources. Modifications to RT BPCG will be necessary to deal with this outcome.
- There is no Regulation Movement scheduled in RTS. Only a Regulation Capacity schedule is awarded.
- RT Settlement for Regulation Capacity is:

(RTD Regulation Capacity Schedule - DAM Regulation Capacity Schedule) * RT Regulation Capacity Clearing Price



Movement - continued

- Regulation Performance Index ("PI") NYISO already measures the accuracy of regulating resources via the Regulation Performance Index, as further described in the Billing and Accounting Manual. NYISO is not proposing to change the way the PI is calculated.
 - In order to comply with the FERC order's requirement of applying a standard measurement of accuracy to all resources, NYISO must change the current practice of automatically assigning a Regulation Performance Index = 1 for Limited Energy Storage Resources.

•NYISO proposes to use the PI in RT settlements for regulation movement:

RT Regulation Movement settlement = Total Regulation Movement MW * RT Regulation Movement Clearing Price * Regulation Performance Index



Movement - continued

- •In addition, NYISO proposes a Regulation Performance Charge:
 - For regulating providers selected for capacity by RTD, but not responding (or responding poorly) to AGC 6-second signals, there will be a charge applied.
 - The charge will be based on the RTD Regulation Capacity MWs which were not actually provided, plus 10%. The calculation will use the higher of the RT Regulation Capacity Clearing Price or the DAM Regulation Capacity Clearing Price.
 - The purpose of the 10% adder is to prevent the no-risk option of being scheduled Day-Ahead and in real time for Regulation Capacity and not performing when instructed.

Regulation Performance Charge = (((RTD Regulation Capacity Schedule * Reg Perf Index) - RTD Regulation Capacity Schedule) * 1.1) * Max(DAM Regulation Capacity Clearing Price, RT Regulation Capacity Clearing Price)

• Example

Unit A with a 10MW RTD Regulation Capacity Schedule, a 0.6 Reg Performance Index, and a DAM Regulation Capacity Clearing Price = \$7

- Regulation Performance Charge = (((10MW * 0.6) 10MW)) * 1.1) * \$7
- Regulation Performance Charge = -4MW * 1.1 * \$7
- Regulation Performance Charge = \$30.80



Movement Example

 Assumes 104 mws of movement, prorated across the three resources based on 6 second capability.

Regulation Movement MWs

| Provider | RegMW _{Movement} | Response Rate | | |
|----------|---------------------------|---------------|--|--|
| А | 34.67mw | 1.2mws per 6s | | |
| В | 57.77mw | 2.0mws per 6s | | |
| D | 11.56mw | 0.4mws per 6s | | |

Settlement for regulation movement in one RT interval

| Provider | RegMW _{Movement} | Reg Perf Index | RTD RegPrice _{Movement} | Movement Payment | |
|----------|---------------------------|----------------|-------------------------------------|---------------------|--|
| А | 34.67 | 1.0 | \$0.80 | \$27.74 | |
| В | 57.77 | 0.8 | \$0.80 | \$36.97 | |
| D | 11.56 | 0.2 | \$0.80 | \$1.85 | |



Movement – historical examples

- Determining the precise amount of Regulation Movement MWs instructed by AGC solely for ACE correction is not possible with the current data available. However, we manually reverse-engineered the data in six different hours to estimate the amount of Regulation Movement MWs instructed by AGC for ACE correction across all regulating units during those hours:
- Monday, January 23 2012, HB06
 - Regulation Capacity for the hour = 275MWh
 - Average of RTD Regulation Capacity Prices = \$7.25
 - Estimated Movement MWs during hour = 2,280mws
- Friday, December 9 2011, HB08
 - Regulation Capacity for the hour = 275MWh
 - Average of RTD Regulation Capacity Prices = \$20.00
 - Estimated Movement MWs during hour = 1,250mws
- Tuesday, November 22 2011, HB07
 - Regulation Capacity for the hour = 275MWh
 - Average of RTD Regulation Capacity Prices = \$6.00
 - Estimated Movement MWs during hour = 2,164mws

- Saturday, August 13 2011, HB03
 - Regulation Capacity for the hour = 175MWh
 - Average of RTD Regulation Capacity Prices = \$5.75
 - Estimated Movement MWs during hour = 3,310mws
- Monday, April 12th, 2010, HB10
 - Regulation Capacity for the hour = 200MWh
 - Average of RTD Regulation Capacity Prices = \$32.00
 - Estimated Movement MWs during hour = 1,242mws
- Thursday, March 18 2010, HB17
 - Regulation Capacity for the hour = 275MWh
 - Average of RTD Regulation Capacity Prices = \$32.00
 - Estimated Movement MWs during hour = 1,368mws



Mitigation and controls

- •As per the order's requirement to submit tariff provisions for market power mitigation measures under the redesigned Regulation market design, NYISO is currently considering appropriate conduct and impact thresholds.
 - Reference levels will need to be established in Reference Level Software for Regulation Movement Bid Price and 6-Second Response Rates.
- Implementation will include temporary bid caps for Regulation Movement Bid Price until sufficient market history with bidding behavior and regulation movement can be analyzed.
- •NYISO's proposal includes combining the two-part bid prices to prevent a high/low bidding game between Capacity and Movement bids.
- •NYISO's existing rules preventing suppliers of Accepted DAM Regulation from increasing Regulation bid prices between day-ahead and real-time will be applied to the new Regulation Capacity and Movement bid prices.



Miscellaneous Settlements

- The FERC Order will result in significant differences in the Regulation market from the current market design. Therefore, miscellaneous settlements, besides those directly related to providing Regulation service, require modification.
- Persistent Under-Generation Charges charge which may be applied to non-regulating resources whose actual performance is below their schedule.
 - Current formula, eligibility, and exclusions will remain exactly as they are today, with the exception that the Marginal Clearing Price of Regulation used will be the higher of the RT Regulation Capacity Clearing Price or DAM Regulation Capacity Clearing Price.
- Overgeneration Charges charge which may be applied to wind resources who fail to reduce output when under a Wind Output Limit instruction from the NYISO.
 - Current formula, eligibility, and exclusions will remain exactly as they are today, with the exception that the Marginal Clearing Price of Regulation used will be the higher of the RT Regulation Capacity Clearing Price or DAM Regulation Capacity Clearing Price.



Miscellaneous Settlements continued

- <u>Bid Production Cost Guarantee (BPCG)</u> current BPCG formulas do not fully consider regulation service cost. Changes to the design and pricing of regulation service in response to FERC Order 755 necessitate modifications to existing DAM and RT BPCG formulas.
 - Current DAM BPCG:
 - Hourly DAM BPCG = Energy Bid Cost + Mingen Cost + Startup Cost
 - Energy Revenue Net Ancillary Services Revenue (NASR)

Daily BPCG = Max (\sum Hourly DAM BPCG, 0)

where NASR = VSS payment + Max (DAM Reg. Service payment – DAM Reg. Bid Cost, 0) + (DAM Reserves payment – DAM Reserves Bid Cost)

Note: LESRs are currently ineligible for DAM BPCG.

- Proposed change to NASR component in DAM BPCG:
 - NASR = VSS payment + <u>(DAM Reg. Capacity Service payment DAM Reg.</u> <u>Capacity Bid Cost</u>) + (DAM Reserves payments – DAM Reserves Bid Cost)
 - Allow LESRs to be eligible for the NASR component of the formula (other components will remain zero for LESRs).



Miscellaneous Settlements continued

• Current RT BPCG:

Hourly RT BPCG = \sum ((Increm. Energy Cost + Mingen Cost – Energy Revenue – (NASR_{TOT} - NASR_{DA}) – RRAP + RRAC) x int sec/3600) + Startup Cost

Daily RT BPCG = Max (\sum Hourly RT BPCG, 0)

where NASR_{TOT} = VSS payment + Max (RT Reg. Service payment – RT Reg. Bid Cost, 0) + (RT Reserves payment – RT Reserves Bid Cost) + VSS LOC RT Reg. Service payment is based on a performance index = 1

Note: LESRs are currently *ineligible* for RT BPCG.

- Proposed change to NASR component in RT BPCG :
 - NASR_{TOT} = VSS payment + <u>(RT Reg. Capacity Service payment RT Reg. Capacity</u> <u>Bid Cost + RT Reg. Movement payment - RT Reg. Movement Bid Cost</u>) + (RT Reserves payments – RT Reserves Bid) + VSS LOC Reg Movement Payment is based on a performance index = 1
 - Allow LESRs to be eligible for the NASR component of the formula (other components will remain zero for LESRs).



Appendix B

- Requested Opportunity Costs Overview
 - Risk Adder
 - Cross Product Opportunity Costs
 - Intertemporal Opportunity Costs



Risk Adder

- Unit A 1 MWh of regulation (current regulation market)
 - \$0.20 Buy-out risk
 - Unit A expects to be scheduled day-ahead to provide 1MWh of regulation for 2000 hours during the year
 - Price history shows that Unit A can expect to pay, on average, \$4 more during its buy-out hours than it was paid day-ahead.
 - To cover the risk of buying out over 100 hours (due to trip offs, less expensive real-time only competitors, etc) throughout the year, Unit A adds \$0.20 to their bids.

| | Unit A's | | <u># of</u> | <u># of</u> | | | | | | |
|---------------------|----------|--------|------------------|------------------|---------|---------|------------|--------------|-------|-----------|
| | Cost per | Bid | <u>scheduled</u> | <u>scheduled</u> | Cost of | | # of hours | Avg RT Price | Buy- | Uncovered |
| Column1 | MWh | Amount | hours DAM | hours HAM | service | Revenue | buying out | above DAM | out | costs |
| If bid at cost | \$2.00 | \$2.00 | 2000 | 1900 | \$4,000 | \$4,000 | 100 | \$4 | \$400 | \$400 |
| Bid with risk added | \$2.00 | \$2.20 | 2000 | 1900 | \$4,000 | \$4,400 | 100 | \$4 | \$400 | \$0 |



Cross Product Opportunity Costs

- Market clearing price for each ancillary product is equal to the shadow price of the ancillary product constraint
- Shadow price is equal to the change in total production cost, including energy and other ancillary products, as a result of scheduling resources to provide the ancillary product
- In effect, the shadow price includes the bid price for the ancillary product of the marginal resource plus any margins this unit would have earned for energy or other ancillaries *but for* those schedules being reduced to provide the ancillary service



Simple Cross Product LOC Example

Assume all units are fully dispatchable from 0-100 MW Load=220 Reserve Requirement =25

| | | | | Schedules | | | |
|--------|-----|----------|-------------|-------------|---|--------|----------|
| | | Energy | Reserve Cap | Reserve Cap | | | |
| | UOL | (\$/MWh) | (MW) | (\$/MWh) | | Energy | Reserves |
| Unit A | 100 | 40 | 10 | 10 | 0 | 95 | 5 |
| Unit B | 100 | 45 | 10 | | 6 | 90 | 10 |
| Unit C | 100 | 50 | 10 | | 2 | 35 | 10 |
| | | | | | | 220 | 25 |

LBMP \$50 Res Price \$20 1. Unit C set the price for Energy @ \$50

 Unit A and B are both backed down for reserves, therefore, the Reserve Shadow Price is Unit A's LOC (difference between LBMP and the unit's energy bid) plus the availability bid:

\$50 - \$40 + \$10 = \$20



Intertemporal LOCs

- Intertemporal lost opportunity costs (LOCs) occur across time periods.
- Scheduling decisions in the current (t₁) interval may impact the schedules in future (t₂ to t_n) intervals. Foregone profits in future intervals are intertemporal LOCs that are incorporated into the prices in the current interval.



Intertemporal LOCs

Example:

- Gen. A has a limited fuel supply (e.g. water) and is willing to sell power now for \$20/MW, or to keep it and sell it later for \$30/MW.
 - There is a \$10 opportunity cost associated with selling the power now.
- Do both of these time periods occur within the same scheduling horizon? (e.g. SCUC)
 - If yes, then the optimization will calculate the intertemporal LOCs and incorporate them into the applicable prices.
 - If no, then Gen. A would include the intertemporal LOCs into its bids.