

Energy Storage Integration: DA scheduling and Mitigation

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Overview

- **Background**
 - Previous discussions
 - Modeling enhancements
- **DA Scheduling Logic**
- **Mitigation Framework**
- **Next Steps**

Background

Background

Date	Working Group	Discussion points
08-04-16	Market Issues Working Group (MIWG)	Initial discussion on <u>alternatives for Energy Storage in the NYISO markets</u>
09-29-16	MIWG	<u>Market Design ideas</u> discussion
11-29-16	MIWG	Presentation providing <u>more detail on the Market Design</u> that the NYISO will pursue
05-05-17	MIWG	Presentation addressing the <u>proposed modeling enhancements</u> as the cornerstone of the Energy Storage Integration phase
07-19-17	MIWG	Presentation delving into the <u>eligibility criteria and RT scheduling logic</u> for Energy Storage Resources (“ESRs”).
08-25-17	MIWG	Discussion on the <u>Settlements logic</u> for ESRs.

Proposed ESR Offer Parameters

<i>Registration</i>		<i>Registration / Biddable</i>		<i>Biddable</i>	
Transition Time	[minutes]	Min. Load	[MW]	Incremental Bid Curve	[\$/MW]
Upper Charge Limit	[MWh]	Min. Generation	[MW]	Beginning State of Charge	[MWh]
Lower Charge Limit	[MWh]	Min. Load Cost	[\$]	Ending State of Charge	[MWh]
Charge Rate (Max. Load)	[MW]	Min. Generation Cost	[\$]		
Discharge Rate (UOL)	[MW]	Start-up Cost	[\$]	Bid Modes	[-]
Energy level (SoC)	[Yes/No]	Start-up Load Cost *	[\$]		
Min. Charge Time	[minutes]				
Max. Charge Time	[minutes]				
Min. Run Time	[minutes]				
Max. Run Time	[minutes]				
Min. Downtime	[minutes]				
Withdrawing conversion losses	[%]				
Injecting conversion losses	[%]				
Through-Put *	[MWh]				
Response Rate(s)	[MW/min]				
Start-up Notification Time	[minutes]				
Maximum Stops per Day	[n]				

(*) Parameters not included in 5/5/17 MIWG presentation.

Key

Existing Parameter

Additional Storage Parameter



Feedback Received

- The NYISO is still evaluating what special pricing logic, if any, should be considered for ESR resources.
- Stakeholders have expressed interest in the availability of an optional Energy Level (SoC) signal.
 - The NYISO has taken this into consideration throughout its proposed participation model.

Phase 1

DA scheduling logic

proposal

Proposed Day-Ahead hourly scheduling

- **Similar to the RT scheduling logic, the initial condition for an ESR to be selected is its incremental energy bid, which applies to both withdrawing and generating states.**
 - The Energy level will be considered as a constraint for scheduling the resource.
- **In the DAM, ESRs will be allowed to submit hourly bids no greater than the one-directional withdrawing or generating capability that they can maintain for at least 1 hr.**
 - The NYISO will take into account the Upper and Lower Charge Limits of ESRs to determine this threshold.
- **In the DAM, ESRs will be assigned a single hourly output value. They will receive a single state (withdrawing or generating or idle/off) for each hour.**
- **Conversion losses will also be considered for scheduling ESRs.**

Proposed DA hourly scheduling (cont.)

- **During periods without available bids in the DAM, ESRs will be assumed to have a constant Energy Level.**
 - Example:
 - An ESR with 12 MWh energy available at the end of HB5 without available bids between HB5 and HB10.
 - The NYISO will assume that its available energy level at HB10 is still 12 MWh.
 - ESRs will be able to offer capabilities in RT that they did not offer in the DAM. Nonetheless, resources are expected to be able to honor DA commitments.
- **Because the DAM is an hourly optimization, any times specified by ESRs will be considered as hourly values.**
 - For example, Min. Charge or Run Times shorter than one hour will be rounded to one hour.

Proposed DA hourly scheduling (cont.)

- The NYISO is considering allowing ESRs to utilize the “Beginning State of Charge” parameter in Phase 1 – Energy Storage Integration.
 - ESRs could submit the beginning state of charge that they would like the NYISO to take into account when initializing the DAM optimization.
- The “Beginning State of Charge” would be an optional parameter.
 - If the NYISO had no information regarding the Energy Level of the resource, the NYISO would set the DA beginning state charge of the resource within the Energy level constraints (Upper and Lower Charge Limits) while minimizing total system production costs.

Mitigation framework

ESR Mitigation

- **The NYISO is considering using the same framework to mitigate ESR's as that used for Generators today.**
 - Reference levels can be established for each new parameter proposed for ESRs.
 - Reference levels would use existing Bid-LBMP-Cost hierarchy and be processed through the RLS system.
- **ESRs could be evaluated for conduct and impact for both withdrawing and generating states.**
- **ESRs would be subject to the Automated Mitigation Procedure (“AMP”) if located in an AMP-provisioned area.**

Other considerations

ESR Aggregations

- As part of the DER Roadmap, concepts for the aggregation of distributed resources are being discussed.
- The NYISO is proposing that aggregations comprised solely of Storage resources will utilize the ESR participation model.

Next Steps

- The NYISO will continue to evaluate the operational feasibility of the proposed ESR scheduling logic.
- During Q4-2017, the NYISO will discuss additional ESR modeling and settlements considerations

Feedback

- The NYISO seeks feedback on the materials presented today.
- Email additional feedback to: Daniel F. Noriega
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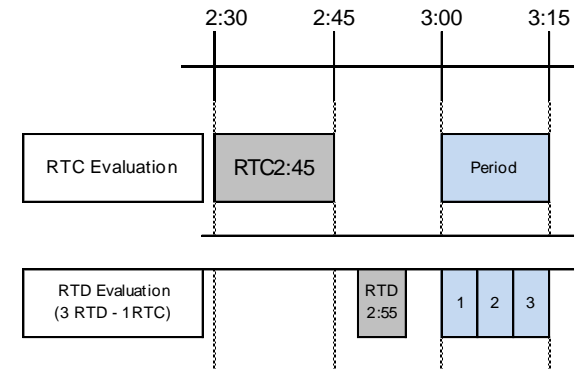
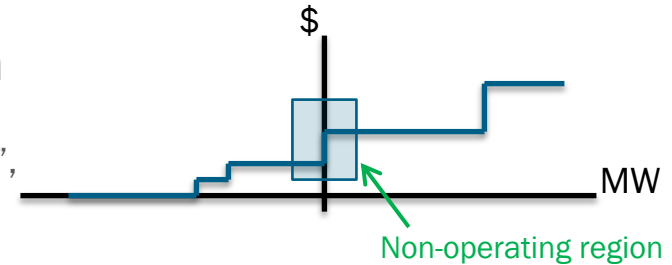
Questions?

We are here to help.

Appendix

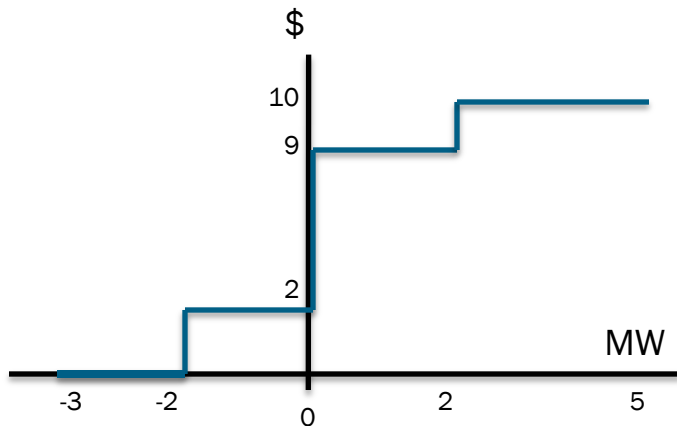
RT Commitment Decision Considerations

- If a resource has a non-operating region and/or a transition time:
 - Three possible operating states will be recognized; “Injecting”, “Withdrawing”, and “Idle”.
 - Decisions to change operating states will be made by RTC.
 - The resource must be able to maintain each state for a minimum of 15 minutes.
- If a resource does not have a non-operating region or a transition time:
 - RTD will have the capability to dispatch the resource through its full operating range (i.e. injecting/withdrawing).
- To the extent that commitment parameters are associated with scheduling the resource, the state of the resource will have to be assigned by RTC.



Example

- The example will use the following bid curve and parameters
- Ramp constraints and start-up costs will not be considered (Lithium-ion battery, for example)
- The resource will be providing energy only



Bid Curve	
MW	Value
-2	0
0	2
2	9
5	10

Parameters	Units	Value
UOL	MW	5
Max. Load	MW	-3
Transition Time	Min	5
Min. Load	MW	-1
Min. Generation	MW	1
Withdrawing losses	%	4%
Injecting losses	%	4%
Energy Level (SoC)	-	Yes
Upper Charge Limit	MWh	5
Lower Charge Limit	MWh	0.5
Charge Rate	MW	-3
Discharge Rate	MW	5
Min. Charge Time	Min	0
Max. Charge Time	Min	240
Min. Run Time	Min	0
Max. Run Time	Min	500

Values will change through the examples.

Example

<i>Parameters</i>	<i>Units</i>	<i>Value</i>
UOL	MW	5
Max. Load	MW	-3
Transition Time	Min	5
Min. Load	MW	-1
Min. Generation	MW	1
Withdrawing losses	%	4%
Injecting losses	%	4%
Energy Level (SoC)	-	Yes
Upper Charge Limit	MWh	5
Lower Charge Limit	MWh	0.5
Charge Rate	MW	-3
Discharge Rate	MW	5
Min. Charge Time	Min	0
Max. Charge Time	Min	240
Min. Run Time	Min	0
Max. Run Time	Min	500

Bid Curve	
MW	Value
-2	0
0	2
2	9
5	10

- Since the resource has a non-operating region, it will be committed by RTC. Therefore, the minimum state duration will be 15 minutes (1 RTC interval). It will be committed by RTC.
- The resource is providing an Energy level signal.
- Assume Min. Load and Min. Generation costs are low enough for the resource to be scheduled.

Example

<i>RTC</i>	<i>LBMP</i> [USD]	<i>Optimal Dispatch</i> [MW]	<i>Actual Dispatch</i> [MW]	<i>Total withdrawing</i> [MWh]	<i>Total injecting</i> [MWh]	<i>Energy level</i> [MWh]
t-1	-	-	-	-	-	1.50
0:00	-1.00	-3.0	-3.0	-0.7	0.0	2.22
0:15	3.00	0.0	0.0	0.0	0.0	2.22
0:30	4.00	0.0	0.0	0.0	0.0	2.22
0:45	7.00	0.0	0.0	0.0	0.0	2.22
1:00	10.00	5.0	2.1	0.0	0.5	1.72
1:15	12.00	5.0	5.0	0.0	1.2	0.52
1:30	9.00	2.0	0.0	0.0	0.0	0.52
1:45	8.00	0.0	0.0	0.0	0.0	0.52
2:00	7.00	0.0	0.0	0.0	0.0	0.52
2:15	6.00	0.0	0.0	0.0	0.0	0.52

- Because the resource is providing an Energy level signal, RTC will honor the Upper and Lower charge limits.

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- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system



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