# Operating Characteristics of Energy Storage Resources

## Revised guide to ESR parameters in the NYISO Energy and Ancillary Services markets

September 2018

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## Introduction

The purpose of this document is to provide a clear explanation of how the NYISO plans to account for the unique operating characteristics of Energy Storage Resources (ESRs) within the ESR participation model. The section entitled "Existing Parameters Available to ESRs" provides a list of current Registration and Bid parameters that will be available to ESRs at the time of the 2019 participation model deployment. Descriptions of how ESRs will be able to use those parameters are also provided, as well as the definitions of corresponding operating characteristics mandated by the FERC in Order No. 841.

The section entitled "New Parameters Available to ESRs" lists the operating characteristics that are not available to other Generators today, but which will be available to ESRs when the ESR participation model is deployed in 2019. Descriptions of how they can be used are provided. Related FERC Order No. 841 definitions are also provided, where applicable.

The section entitled "ESR Energy Level and Offer Options" illustrates the permitted combinations of offer modes for ESRs. These are based on the rules applied to traditional Generators which are described in the ISO Procedures.

## Existing Parameters Available to ESRs

| Parameter[1] | Unit | Description | Registration[2] | Amendable[3] | Bid Screen[4] |
|---|---|---|---|---|---|
| Upper Operating Limit (UOL)<br><br>*Maximum Discharge Limit*<br><br>*Minimum Charge Limit* | MW | Maximum MW level at which the ESR is willing to operate. Upon Registration, the MP Administrator must provide the maximum Physical Upper Operating Limit of the ESR. While bidding, the MP Administrator must supply Emergency and Normal Upper Operating Limits that no greater than the Physical Upper Operating Limit. UOL may be used to represent either the Maximum Discharge Limit or the Minimum Charge Limit. Can be a negative number.<br><br>***Maximum Discharge Limit represents the maximum MW quantity that a resource using the participation model for electric storage resources can inject to the grid.***<br><br>***The minimum MW level that a resource using the participation model for electric storage resources can receive from the grid.*** | Yes | No | Required |
| Lower Operating Limit (LOL)<br><br>*Minimum Discharge Limit*<br><br>*Maximum Charge Limit* | MW | Minimum MW level at which the ESR is willing to operate. Upon Registration, the MP Administrator must provide the Physical Lower Operating Limit of the unit. When bidding, the MP Administrator must supply a Lower Operating Limit value that is no less than the Physical Lower Operating Limit. LOL may be used to represent either the Minimum Discharge Limit or the Maximum Charge Limit. Can be a negative number.<br><br>***The minimum MW output level that a resource using the participation model for electric storage resources can inject onto the grid.***<br><br>***Maximum Charge Limit represents the maximum MW quantity of electric energy that a resource using the participation model for electric storage resources can receive from the grid.*** | Yes | No | Required |
| *Minimum Run Time* | Hours | Minimum duration for which the ESR can inject energy. Taken as a consecutive interval. Honored only for the look-ahead horizon of the market offered into (e.g., 24 h for the DAM and 1 h for RT).<br><br>***Minimum Run Time represents the minimum amount of time that a resource using the participation model for electric storage resources is able to inject electric energy to the grid (e.g., one hour).*** | Yes | Yes | N/A |

1. Parameters required by FERC Order No. 841 are listed in ***bold italics*** below their NYISO names and definitions.
2. If "Yes" is indicated in this column, the parameter must be submitted upon Registration. All Registration parameters may be changed upon request, subject to approval from the NYISO (~3 day process).
3. If "Yes" is inidicated in this column, the parameter may be updated by the MP Administrator at any time. Changes will be applied to the next open market interval.
4. For "Required" Bid Screen parameters, if no value is submitted at time of offer, the bid will not pass validation. N/A means the parameter is not available on the bid screen. If "Optional", the field may be left blank.

# Existing Parameters Available to ESRs (cont.)

| Parameter[1] | Unit | Description | Registration[2] | Amendable[3] | Bid Screen[4] |
|---|---|---|---|---|---|
| Incremental Bid Curve | $/MWh | A series of monotonically increasing steps that indicate the quantities of Energy for a given price that an ESR is willing to supply to the NYISO. ESRs will utilize this mechanism to specify price points for both injecting and withdrawing energy. Hours for which the bid curve applies must be specified. For DAM bids, if an expiration date is not specified, the offer is assumed to be valid indefinitely. | No | No | Required |
| Market Choice | - | MP Administrator must select whether to offer into the DAM or RTM, or both. | No | No | Required |
| Unit Operation Offer Options | - | ESRs may submit offers in one of four modes: ISO-Committed Flexible, ISO-Committed Fixed, Self-Committed Flexible and Self-Committed Fixed. Details regarding the various bid modes may be found in Section 4 of the NYISO Services Tariff. While operating as NYISO-Managed, ESRs must offer as ISO-committed Flexible. | No | No | Required |
| Response Rates<br><br>*Charge Ramp Rate*<br><br>*Discharge Ramp Rate* | MW/Min | How quickly the ESR can respond to dispatch instructions from the NYISO under various operating conditions.<br><br>***The speed at which a resource using the participation model for electric storage resources can move from zero output to its Maximum Charge Limit.***<br><br>***The speed at which a resource using the participation model for electric storage resources can move from zero output to its Maximum Discharge Limit.*** | Yes | No | N/A |
| Fuel Type | | Typically used by traditional (fossil-fuel) generators. If no Fuel Type is provided, the NYISO evaluates the bid against the Reference Level for the Generator based on its primary Fuel Type. | No | No | Optional |
| Burdened Fuel Price | $/mmBtu | Typically used by traditional (fossil-fuel) generators. In-day per unit cost of fuel, including raw fuel price, taxes, and the adder as defined in the Reference Level Software User's Guide.[5] | No | No | Optional |

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3. If "Yes" is inidicated in this column, the parameter may be updated by the MP Administrator at any time. Changes will be applied to the next open market interval.
4. For "Required" Bid Screen parameters, if no value is submitted at time of offer, the bid will not pass validation. N/A means the parameter is not available on the bid screen. If "Optional", the field may be left blank.
5. New York Indep. Sys. Operator, Inc., Reference Level Software User's Guide. Available at thils lnk: http://www.nyiso.com/public/webdocs/markets_operations/documents/Manuals_and_Guides/Guides/User_Guides/RLS_UG.pdf

## New Parameters Available to ESRs

| Parameter[1] | Unit | Description | Registration[2] | Amendable[3] | Bid Screen[4] |
|---|---|---|---|---|---|
| Beginning Energy Level[5]<br><br>***State of Charge*** | Ratio | The ratio of the amount of energy currently stored to the amount of energy that could be stored at the beginning of the market interval. Estimated by the MP Administrator for the first hour of the DAM; retrieved from the ESR's telemetry in RT.<br><br>***State of Charge represents the amount of energy stored in proportion to the limit on the amount of energy that can be stored, typically expressed as a percentage. It represents the forecasted starting State of Charge for the market interval being offered into.*** | No | No | Required for DAM only |
| Upper Storage Limit[5]<br><br>***Maximum State of Charge*** | MWh | Maximum energy the ESR is physically capable of storing.<br><br>***Maximum State of Charge represents a State of Charge value that should not be exceeded (i.e. gone above) when a resource using the participation model for electric storage resources is receiving electric energy from the grid (e.g. 95% State of Charge).*** | Yes | No | N/A |
| Lower Storage Limit[5]<br><br>***Minimum State of Charge*** | MWh | Minimum energy the ESR is physically capable of storing.<br><br>***Minimum State of Charge represents a State of Charge value that should not be exceeded (i.e. gone below) when a resource using the participation model for electric storage resources is injecting electric energy to the grid (e.g. 5% State of Charge).*** | Yes | No | N/A |
| Roundtrip Efficiency[5] | Ratio | The ratio of energy that can be injected to the grid (in MWh) to energy that must be withdrawn (in MWh). Applied as a multiplier only to the withdrawing region of NYISO-Managed ESRs. | Yes | No | N/A |
| Energy Level Mode | - | If "NYISO-Managed" is selected, the NYISO will honor the ESR's Upper and Lower Storage Limits using the provided Beginning Energy Level and Roundtrip Efficiency values. If "Self-Managed" is selected, Upper Storage Limit, Lower Storage Limit, Roundtrip Efficiency, and Beginning Energy Level will not be considered by the market optimization. | No | No | Required |

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3. If "Yes" is inidicated in this column, the parameter may be updated by the MP Administrator at any time. Changes will be applied to the next open market interval.
4. For "Required" Bid Screen parameters, if no value is submitted at time of offer, the bid will not pass validation. N/A means the parameter is not available on the bid screen. If "Optional", the field may be left blank.
5. Parameter is only honored in the market optimization for ESRs that offer as NYISO-Managed.

## New Parameters Available to ESRs (cont.)

| Parameter[1] | Unit | Description | Registration[2] | Amendable[3] | Bid Screen[4] |
|---|---|---|---|---|---|
| Minimum Withdrawing Time<br><br>***Minimum Charge Time*** | Hours | Minimum duration for which the ESR can withdraw energy. Taken as a consecutive interval. Honored only for the look-ahead horizon of the market offered into (e.g. 24 h for the DAM and 1 h for RT).<br><br>***Minimum Charge Time represents the shortest duration that a resource using the participation model for electric storage resources is able to be dispatched by the RTO/ISO to receive electric energy from the grid (e.g., one hour).*** | Yes | Yes | N/A |
| Maximum Withdrawing Time<br><br>***Maximum Charge Time*** | Hours | Maximum duration for which the ESR can withdraw energy. Taken as a consecutive interval. Honored only for the look-ahead horizon of the market offered into (e.g. 24 h for the DAM and 1 h for RT).<br><br>***Maximum Charge Time represents the maximum duration that a resource using the participation model for electric storage resources is able to be dispatched by the RTO/ISO to receive electric energy from the grid (e.g.,four hours).*** | Yes | Yes | N/A |
| ***Maximum Run Time*** | Hours | Maximum duration for which the ESR can inject energy. Taken as a consecutive interval. Honored only for the look-ahead horizon of the market offered into (e.g. 24 h for the DAM and 1 h for RT).<br><br>***Maximum Run Time represents the maximum amount of time that a resource using the participation model for electric storage resources is able to inject electric energy to the grid (e.g., four hours).*** | Yes | Yes | N/A |
| Opportunity Cost | $/MW | Economic parameter that will be calculated by the NYISO's Market Monitoring and Mitigation Analysis (MMA) team. ESRs and other resources will be able to use this to override the value calculated by default by MMA. All submissions will be subject to Energy market mitigation. | No | No | Optional |

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3. If "Yes" is inidicated in this column, the parameter may be updated by the MP Administrator at any time. Changes will be applied to the next open market interval.
4. For "Required" Bid Screen parameters, if no value is submitted at time of offer, the bid will not pass validation. N/A means the parameter is not available on the bid screen. If "Optional", the field may be left blank.

## ESR Energy Level and Offer Options

| DAM Offer | | Permitted RTM Offers | |
|---|---|---|---|
| **Energy Level Mode** | **Unit Operation Mode** | **Energy Level Mode** | **Unit Operation Mode** |
| NYISO-Managed | ISO-Committed Flex | NYISO-Managed | ISO-Committed Flex |
| | | Self-Managed | ISO-Committed Flex<br>Self-Committed Flex<br>Self Committed Fixed* |
| Self-Managed | ISO-Committed Flex | NYISO-Managed | ISO-Committed Flex |
| | | Self-Managed | ISO-Committed Flex<br>Self-Committed Flex<br>Self Committed Fixed* |
| Self-Managed | Self-Committed Flex | Self-Managed | Self-Committed Flex<br>Self Committed Fixed* |
| Self-Managed | ISO-Committed Fixed** | Self-Managed | Self-Committed Fixed |
| Self-Managed | Self-Committed Fixed | Self-Managed | Self-Committed Fixed |
| No DAM Offer | | NYISO-Managed | ISO-Committed Flex |
| | | Self-Managed | ISO-Committed Flex<br>Self-Committed Flex<br>Self Committed Fixed |

*With approval from the NYISO

** Units may only bid as ISO-Committed Fixed if qualified by the NYISO