

Capacity Market Rules for Energy Storage Resources

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Agenda

- **Background**
- **Energy Storage Resource (ESR) overview**
- **Capacity Market Rules**
 - Capacity Market Qualification Rules
 - Capacity Market Eligibility and Participation Rules
 - Derating Factors for Energy Storage Resources
 - Obligations and Other Capacity Market Rules
- **Market Services Tariff Section 5.12**
- **Open Access Transmission Tariff Attachments S and X**

Background

FERC Order No. 841

- On February 15, 2018, FERC issued a final rule to remove barriers to the participation of ESRs in the competitive wholesale markets
- NYISO has been engaged in the development of a participation model for ESRs since 2016

Previous Presentations

- April 24th ICAPWG – Identification of Concepts
- May 23rd ICAPWG - Initial Market Design
- August 7th ICAPWG – Capacity Market Rules for Energy Storage Resources
- August 14th ICAPWG – Capacity Market Rules for Energy Storage Resources

Purpose of Today's meeting

- Review Market Services Tariff Section 5.12 for the tariff changes to incorporate Energy Storage Resources
- Review the OATT Attachments S and X changes to incorporate Energy Storage Resources

Energy Storage Resource Overview

Energy Storage Resource Overview

- **FERC Order No. 841 defines an Energy Storage Resource as “a resource capable of receiving electric energy from the grid and storing it for later injection of electric energy back to the grid”**
 - Examples include:
 - Electrochemical systems
 - Pumped Storage
 - Fly-wheel systems
 - Thermal Storage
 - Compressed Air Storage
- **Initially, we will only be discussing rules for individual, directly metered Energy Storage Resources that participate only in the NYISO’s wholesale markets (sometimes referred to as “front” of the meter)**
 - Dual participation of Energy Storage Resources in wholesale and retail markets will be discussed as part of the DER Participation Model

Capacity Market Rules

Capacity Market Qualification Rules

- **What will an Energy Storage Resource need to be qualified to participate in the Capacity Market?**
 - Satisfaction of all registration requirements, including an effective Interconnection Agreement with the Connecting Transmission Owner (or with the Connecting Transmission Owner and the NYISO, if the resource is subject to the NYISO's interconnection procedures) that allows wholesale market participation
 - Have a minimum injection capability of 0.1 MW or greater
 - Outage Schedules two years forward from the anticipated date of first offer into the capacity market

Capacity Market Qualification Rules (continued)

- **What will an Energy Storage Resource need to be qualified to participate in the Capacity Market?**
 - CRIS obtained through existing NYISO processes
 - Consistent with current practice, CRIS will only be for the Injection capability of the Energy Storage Resource
 - $CRIS = \text{Min}(\text{maximum storage capability, nameplate capacity (i.e. injection capability), ERIS})$
 - For example, a 10 MWh battery with a 20 MW injection capability and ERIS of 15 MW would have $CRIS = 10 \text{ MW}$

Capacity Market Qualification Rules (continued)

- **What will an Energy Storage Resource need to be qualified to participate in the Capacity Market?**
 - Capability to meet the existing 4-hour minimum run-time requirement
 - Energy Storage Resources can derate the capacity of the resource to meet the 4-hour duration requirement
 - For example, a 40 MWh battery with the capability of injecting 20 MW would be able to reduce its capacity to 10 MW for 4 hours to meet the duration requirement.
 - The NYISO is still requiring that these resources be able to perform for the full 4 hours
 - NYISO recognizes the feedback it received that some resources are unable to sustain an injection to the grid for 4 hours
 - » If the resource is unable to sustain the injection to the grid for 4 hours, the NYISO believes that they are ineligible for the capacity market under today's rules
 - Modifications to the minimum run-time duration as well as partial capacity payments for resources that are unable to meet the minimum run-time duration are being evaluated as part of the DER Participation Model
 - If changes are warranted, the NYISO expects that any proposal would be generally applicable to all Capacity Suppliers
 - DMNC test
 - More information on the DMNC test is found on the following slides

Buyer-side Market Power Mitigation (BSM) of ESRs

- What will an Energy Storage Resource need to be qualified to participate in the Capacity Market?
 - Energy Storage Resources in Mitigated Capacity Zones (i.e., presently NYC and G-J Locality) must be evaluated under the BSM Rules to determine if they are eligible for an exemption or their Offer Floor (i.e., the price at or above which they can offer, and such offers are restricted to the ICAP Spot Market Auction)
 - Energy Storage Resources are eligible to apply for existing Buyer-Side Mitigation exemptions
 - Some stakeholders have suggested that Energy Storage Resources should not be subject to the Buyer-Side Mitigation Rules
 - NYISO is not proposing to modify any of the BSM rules for this filing.
 - NYISO is no longer recommending to modify the rules to subject new entrants 2MWs or less to BSM. Nor is NYISO proposing an ESR specific exemption.

Capacity Market Eligibility and Participation Rules

- What is necessary for an Energy Storage Resource to be eligible to participate in the Capacity Market and for what quantity?
 - Must provide a 4 hour DMNC, consistent with existing rules
 - May provide derated output to meet duration requirements
 - A 4 hour test will ensure accurate accounting of capacity for resources that derate to meet the duration requirements
 - DMNC test length rules may need to be revised depending on the DER Participation Model's rules on the minimum run-time duration and partial capacity payments for resources that do not meet those duration requirements
 - ICAP for Energy Storage Resources will be the minimum of CRIS and DMNC
 - $ICAP = \text{Min}(\text{CRIS}, \text{DMNC})$

Capacity Market Eligibility and Participation Rules (continued)

- What is necessary for Energy Storage Resources to be eligible to participate in the Capacity Market and for what quantity?
 - UCAP for Energy Storage Resources will be the ICAP times the quantity 1 minus the Derating Factor
 - $UCAP = ICAP * (1 - \text{Derating Factor})$
 - Derating factors for Energy Storage Resources will be calculated using the new availability calculation
 - Details on following slides
 - Numeric example later in presentation
 - Energy Storage Resources in Mitigated Capacity Zones will be subject to “Supply Side” Mitigation measures (i.e., the Pivotal Supplier rules)
 - Must identify all “Affiliated Entities” each month
 - Will have a “must offer” obligation if their MW are under the control of a Pivotal Supplier

Derating Factors for Energy Storage Resources

- **How will derating factors for Energy Storage Resources be calculated?**
 - Derating factors for Energy Storage Resources will be calculated based upon a time-weighted UOL availability evaluated against the ICAP sold
 - For each RTD interval that the UOL is adjusted down due to a NYISO or a TO reliability need, the NYISO will replace the UOL with the bid UOL
 - The Normal UOL will be capped against the ICAP Sold, and the number of seconds will be calculated for that interval
 - For the intervals where the unit was on a planned or scheduled outage approved by NYISO operations, the seconds will be set to 0, removing it from the calculation

Derating Factors for Energy Storage Resources (continued)

- How will derating factors for Energy Storage Resources be calculated?
 - Derating factors for Energy Storage Resources will be calculated based upon a time-weighted UOL availability evaluated against the ICAP sold
 - For each month, 4 values will be calculated
 - Total Seconds – Sum of seconds in the month that the unit was not on an approved outage
 - Total Available Capacity – Sum of (Normal UOL for interval * seconds in interval) for the month
 - Total Expected Capacity – ICAP sold * Total Seconds
 - Monthly Availability – Total Available Capacity / Total Expected Capacity

Derating Factors for Energy Storage Resources (continued)

- **How will derating factors for Energy Storage Resources be calculated?**
 - 12-month blocks will be calculated, summing the Total Available Capacity, the Total Expected Capacity, and the availability calculation for the 12-month block
 - The derating factor for Energy Storage Resources will be the average of 6 of the 12-month blocks
 - These will be the same 12-month blocks used in the existing EFORD calculation
 - Derating factor to determine Summer UCAP uses a 12 month period ending in July, August, September, October, November, and December from the prior year
 - Derating factor to determine Winter UCAP uses a 12 month period ending in January, February, March, April, May, and June from the current year
 - Derating Factor = 1 - Availability Factor

Derating Factors for Energy Storage Resources (continued)

- What will be the default derating factors for Energy Storage Resources who are just entering the market?
 - For Energy Storage Resources:
 - Once 3 or more resources have entered the market and have data available to calculate derating factors, the NYISO will use the NYISO class average
 - Until there are 3 or more resources, the NYISO will use the NERC reported EFORD for Pumped Storage
 - Resources that have availability data some of the required timeframe but not all of the timeframe will use the default values for the timeframes that are missing

Obligations and Other Capacity Market Rules

- What are the obligations for an Energy Storage Resource that has sold capacity into the NYISO's Capacity Market?
 - Continue to provide 2 year forward outage information
 - Bid/Schedule/Notify for all 24 hours of the DAM for the ICAP equivalent of the UCAP sold
 - ESRs will be obligated to participate in the DAM with a NYISO-managed energy level
 - NYISO-managed energy level will evaluate physical parameters, such as maximum charge level, minimum charge level, roundtrip efficiency, upper and lower storage limits to ensure that resources are given feasible schedules
 - Needed to prevent Infeasible DAM schedules for Energy Storage Resources, which could cause capacity shortfalls in real time

Obligations and Other Capacity Market Rules (continued)

- **What are the obligations for an Energy Storage Resource that has sold capacity into the NYISO's Capacity Market?**
 - Respond to a NYISO SRE
 - Provide State of Charge Telemetry to the NYISO
 - Provides visibility to grid operators on what resources are capable of in real time
 - Subject to penalties/shortfall charges, e.g., for over sale of capacity, failure to Bid/Schedule/Notify
 - Energy Storage Resources will be required to provide GADS information

Tariff

Updates – MST 5.12

■ Sections:

- 5.12.1
- 5.12.1.13
- 5.12.5.1
- 5.12.6.2
- 5.12.8
- 5.12.12.2

MST 5.12.1

- **This section discusses the Installed Capacity Supplier Qualification Requirements**
 - Include minimum size requirement of 0.1 MW for Energy Storage Resources
 - Energy Storage Resources must participate in the DAM with a NYISO-managed energy level

MST 5.12.1.13

- **This section is new to the tariff**
 - Requires a minimum run-time of 4 consecutive hours per day for all capacity resources

MST 5.12.5.1

- This section discusses Operating Data Reporting Requirements for ICAP Suppliers
 - Revisions to explicitly include Energy Storage Resources among the different resource types

MST 5.12.6.2

- **This section discusses the UCAP calculations for different resource types**
 - Revisions to include description of the amount of UCAP an Energy Storage Resource is authorized to supply
 - UCAP based on the individual availability of the ESR in Real Time and calculated by the ISO
 - ISO shall calculate separate Summer and Winter Capability Period UCAP values for ESRs and update seasonally

MST 5.12.8

- **This section discusses UCAP Sales for ICAP Suppliers**
 - Revisions to the Bid, Schedule, Notify obligation
 - ICAP Suppliers must certify UCAP, expressed in terms of ICAP Equivalent, rounded down to the nearest 0.1 MW for Internal ICAP Suppliers, and rounded down to the nearest whole MW for External ICAP Suppliers

MST 5.12.12.2

- **This section describes the Sanctions for Failing to Comply with Bid, Schedule, Notify Requirements**
 - Revisions to update the precision of the Bid, Schedule, Notify obligation
 - ICAP Suppliers must certify UCAP, expressed in terms of ICAP Equivalent, rounded down to the nearest 0.1 MW for Internal ICAP Suppliers, and rounded down to the nearest whole MW for External ICAP Suppliers

Updates – OATT Attachments S and X

■ Sections:

- Attachment S – 25.7.7.2.3
- Attachment S – 25.8.1
- Attachment X – 30.3.2.4
- Attachment X – 30.3.2.6
- Attachment X – Attachment B to Appendix 2

OATT Attachment S – 25.7.7.2.3

- This section discusses the Derating Factor used in calculating UCAP:
 - Specifies that after the completion of Class Year 2017, the UCAP Derating Factor used is the average EFORd for all ICAP providers that are not Intermittent Power Resources, including ESR
 - UCAP Derating Factor for Intermittent Power Resources will be calculated based on their resource type in accordance with ISO Procedures

OATT Attachment S – 25.8.1

- **This section discusses the amount of CRIS an ESR can request through the Class Year process:**
 - Specifies that ESR projects requesting CRIS in a Class Year cannot exceed the minimum of:
 - Maximum storage capability
 - Nameplate capacity (i.e. injection capability) of the facility
 - The facility's requested ERIS

OATT Attachment X – 30.3.2.4

- This section discusses the amount of CRIS an ESR can request:
 - CRIS of a Large Facility that is an ESR cannot exceed:
 - Maximum storage capability
 - Nameplate capacity (i.e. injection capability) of the facility
 - The facility's requested ERIS

OATT Attachment X – 30.3.2.6

- This section discusses Increases in Established CRIS:
 - Added cross references to requests to increase in CRIS not to exceed the levels permitted by Section 30.3.2.4 of Attachment X

OATT Attachment B to Appendix 2

- This section discusses the data form to be provided by the Developer with the Interconnection Facilities Study Agreement
 - Energy Storage Resources must provide, in addition to information already in Appendix 2, as applicable:
 - Energy storage capability in MWh
 - Duration for full discharge (*i.e.*, injection) in Hours
 - Duration for full charge (*i.e.*, withdrawal) in Hours
 - Maximum withdrawal from the system (*i.e.*, when charging) in MW
 - Inverter manufacturer, model name, number, and version
 - Primary frequency response operating range for electric storage resource
 - Maximum and Minimum State of Charge in %

Next Steps

- Future BIC to present Market Design

Feedback/Questions?

- Email additional feedback to: ztsmith@nyiso.com and deckels@nyiso.com

Appendix

UOL Calculation Examples

(see slides 40-45 for examples)

UOL Calculation Examples

- **Go through an example of the proposed derating factor calculation for ESRs for an individual resource**
 - Look at derating factor calculation over a 12-month period and hourly period
 - Look at how derating factor changes for a resource that is NYISO-managed vs self-managed in Real Time

UOL Calculation Example 1

Month	ICAP Sold for DAM	Total Seconds	Total Available ICAP	Total Expected ICAP	Monthly Availability
1	30	2678400	79220050	80352000	98.6%
2	30	2419200	70044000	72576000	96.5%
3	30	2678400	79100100	80352000	98.4%
4	30	2592000	76300630	77760000	98.1%
5	30	2678400	77021000	80352000	95.9%
6	32	2592000	78476000	82944000	94.6%
7	32	2678400	81324000	85708800	94.9%
8	32	2678400	80456000	85708800	93.9%
9	30	2592000	74500700	77760000	95.8%
10	30	2678400	79000000	80352000	98.3%
11	30	2592000	76000100	77760000	97.7%
12	30	2678400	79242420	80352000	98.6%
Average availability factor			930685000	961977600	96.7%
Average derating factor					3.3%

- **Example of calculation over 12-month period**
 - Total Seconds – Sum of seconds in the month that the unit was not on an approved outage
 - Total Available ICAP – Sum of (Normal UOL for interval * seconds in interval) for the month
 - Total Expected ICAP – ICAP Sold * Total Seconds
 - Monthly Availability – Total Available ICAP / Total Expected ICAP

UOL Calculation Example 2

Interval Begin	UOL	Delta between intervals	ICAP Sold for Month	Provided Impact	Available ICAP	Expected ICAP	Hourly Availability
12:00	30	300	30	30	9000	9000	100%
12:05	30	300	30	30	9000	9000	100%
12:10	30	300	30	30	9000	9000	100%
12:15	30	300	30	30	9000	9000	100%
12:20	30	300	30	30	9000	9000	100%
12:25	30	300	30	30	9000	9000	100%
12:30	30	180	30	30	5400	5400	100%
12:33	30	120	30	30	3600	3600	100%
12:35	28	300	30	28	8400	9000	93.3%
12:40	28	300	30	28	8400	9000	93.3%
12:45	28	360	30	28	10080	10800	93.3%
12:51	28	240	30	28	6720	7200	93.3%
12:55	28	300	30	28	8400	9000	93.3%
Average availability factor					105000	108000	97.2%
Average derating factor							2.8%

- **Example to break down the actual Real Time calculation**
 - Provided Impact = $\min(\text{UOL}, \text{ICAP Sold for Month})$
 - Total Available ICAP – Sum of (Normal UOL for interval * seconds in interval) for the month
 - Total Expected ICAP – ICAP Sold * Total Seconds
 - Hourly Availability – Available ICAP / Expected ICAP

UOL Calculation Examples (continued)

- **Comparison of a resource that is NYISO-managed one day and self-managed another day**
 - The resource is assumed to be “drained” for the same periods of time between the two days

UOL Calculation

Example 3a

- Example of derating factor calculation by hour for a single day for a NYISO-managed resource
 - An ESR that is NYISO-managed and flexible in Real Time is still considered to have its full UOL even if it is drained of its energy
 - The resource is drained from hours 12-23

Hour	ICAP Sold for DAM	UOL	State of Charge	Total Seconds	Total Available ICAP	Total Expected ICAP	Hourly Availability	
0	10	10	40	3600	36000	36000	100%	
1	10	10	40	3600	36000	36000	100%	
2	10	10	40	3600	36000	36000	100%	
3	10	10	40	3600	36000	36000	100%	
4	10	10	40	3600	36000	36000	100%	
5	10	10	40	3600	36000	36000	100%	
6	10	10	40	3600	36000	36000	100%	
7	10	10	40	3600	36000	36000	100%	
8	10	10	40	3600	36000	36000	100%	
9	10	10	30	3600	36000	36000	100%	
10	10	10	20	3600	36000	36000	100%	
11	10	10	10	3600	36000	36000	100%	
12	10	10	0	3600	36000	36000	100%	
13	10	10	0	3600	36000	36000	100%	
14	10	10	0	3600	36000	36000	100%	
15	10	10	0	3600	36000	36000	100%	
16	10	10	0	3600	36000	36000	100%	
17	10	10	0	3600	36000	36000	100%	
18	10	10	0	3600	36000	36000	100%	
19	10	10	0	3600	36000	36000	100%	
20	10	10	0	3600	36000	36000	100%	
21	10	10	0	3600	36000	36000	100%	
22	10	10	0	3600	36000	36000	100%	
23	10	10	0	3600	36000	36000	100%	
Average availability factor						864000	864000	100%
Average derating factor								0%

UOL Calculation

Example 3b

- Example of derating factor calculation by hour for a single day for a self-managed resource
 - An ESR that is self-managed in Real Time is considered to have its UOL = 0 for the times when the resource is drained of its energy
 - The resource is drained from hours 12-23

Hour	ICAP Sold for DAM	UOL	State of Charge	Total Seconds	Total Available ICAP	Total Expected ICAP	Hourly Availability	
0	10	10	40	3600	36000	36000	100%	
1	10	10	40	3600	36000	36000	100%	
2	10	10	40	3600	36000	36000	100%	
3	10	10	40	3600	36000	36000	100%	
4	10	10	40	3600	36000	36000	100%	
5	10	10	40	3600	36000	36000	100%	
6	10	10	40	3600	36000	36000	100%	
7	10	10	40	3600	36000	36000	100%	
8	10	10	40	3600	36000	36000	100%	
9	10	10	30	3600	36000	36000	100%	
10	10	10	20	3600	36000	36000	100%	
11	10	10	10	3600	36000	36000	100%	
12	10	0	0	3600	0	36000	0%	
13	10	0	0	3600	0	36000	0%	
14	10	0	0	3600	0	36000	0%	
15	10	0	0	3600	0	36000	0%	
16	10	0	0	3600	0	36000	0%	
17	10	0	0	3600	0	36000	0%	
18	10	0	0	3600	0	36000	0%	
19	10	0	0	3600	0	36000	0%	
20	10	0	0	3600	0	36000	0%	
21	10	0	0	3600	0	36000	0%	
22	10	0	0	3600	0	36000	0%	
23	10	0	0	3600	0	36000	0%	
Average availability factor						432000	864000	50%
Average derating factor								50%

The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits to consumers by:

- 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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