Energy Storage Integration: Market Design Concept Proposal Summary

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Agenda

- Background
- Review of Market Design Concept Proposal
  - Minimum size eligibility
  - Aggregations framework
  - Proposed offer parameters for ESRs
  - Scheduling logic
  - Settlements framework
  - Mitigation framework
- Future topics for consideration
- Questions

Previous Discussions

Date	Working Group	Discussion points
08-04-16	Market Issues Working Group (MIWG)	Initial discussion on alternatives for Energy Storage in the NYISO markets
09-29-16	MIWG	Market Design ideas discussion
11-29-16	MIWG	Presentation providing more detail on the Market Design that the NYISO will pursue
05-05-17	MIWG	Presentation addressing the proposed modeling enhancements as the cornerstone of the Energy Storage Integration phase
07-19-17	MIWG	Presentation delving into the eligibility criteria and RT scheduling logic for Energy Storage Resources (“ESRs”).
08-25-17	MIWG	Discussion on the Settlements logic for ESRs.
10-03-17	MIWG	Day-scheduling logic and Mitigation framework
11-02-17	MIWG	Aggregations in the ESR model

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Background

- **Existing market structure could be improved to capture the full value energy storage resources can provide to the wholesale markets.**
  - Improved integration of energy storage resources can increase market efficiency.
  - Capturing unique characteristics of storage will allow the market to leverage, for example, their capability to alleviate energy over-supply, support intermittent generation and smooth load.
- **The NYISO is engaged in a multi-year market design effort: Energy Storage Integration and Optimization.**
- **The 2017 deliverable for "Phase 1," Energy Storage Integration is the Market Design Concept Proposal, which is posted with the meeting materials.**

Participation Model Criteria

- **Operating States: The participation model will recognize three Operating States for ESR – injecting, withdrawing and idle.**
  - ESRs may also be offline (due to outage, etc.)
- **Minimum Size: Consistent with the FERC NOPR on Energy Storage Participation, the NYISO proposes a minimum offer threshold of 0.1 MW/0.1 MWh for ESRs and ESR aggregations.**
  - See, Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, Notice of Proposed Rulemaking, 157 FERC ¶ 61,121 (2016).

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Participation Model Criteria: Aggregations

- As part of the DER Roadmap effort, the NYISO has proposed to permit resource Aggregations (*see* 2/28 – 4/24 – 9/29 – 10/30, 2017, MIWG materials).
- Minimum aggregation offer size of 0.1 MW.
  - Maximum 20 MW individual resource size
  - No maximum aggregation size
- All individual resources in an aggregation must be mapped to the same electrically appropriate sub-zonal transmission node.
- Aggregations of 1 MW or above can offer energy, ancillary services and capacity.
- Aggregations of less than 1 MW can only offer energy and capacity (no ancillary services).
- Aggregations will be required to meet the same obligations as individual resources (*e.g.,* metering, telemetry, bidding, etc.)

Proposed Offer Parameters

- Since ESRs have operating characteristics that the NYISO's existing energy/ancillary service offer parameters do not fully capture, the NYISO proposes to create additional parameters that will reflect the unique characteristics of storage resources.
- The NYISO is evaluating the operational feasibility of the proposed new parameters, to ensure that they will not compromise software performance.

ESR Offer Parameters: Existing Parameters

- Upper Operating Limit (UOL) [MW]
- Minimum Generation [MW]
- Minimum Run Time [Hours]
- Minimum Downtime [Hours]
- Maximum Stops per Day [n]
- Start-up Notification Time [Hours]
- Start-up Cost [$]
- Minimum Generation Cost [$]
- Incremental Bid Curve [$/MWh]
- Response Rates [MW/min] *
- Market Choice [DAM/RTM]
- Unit Operation (Bid mode) [-]
- Fuel Type [-]
- Burdened Fuel Price [$/mmBTU]

(*) Must be updated by the NYISO

ESR Offer Parameters: Proposed Parameters

- Upper Storage Limit [MWh]
- Lower Storage Limit [MWh]
- Minimum Load [MW]
- Maximum Load [MW]
- Minimum Withdrawing Time [Hours]
- Maximum Withdrawing Time [Hours]
- Maximum Run Time [Hours]
- Transition Time [Hours]
- Start-up Load Cost [$]
- Minimum Load Cost [$]
- Additional Response Rate(s) [MW/min] *
- Withdrawing Conversion Losses [%] *
- Injecting Conversion Losses [%] *
- Throughput [MWh/day]
- Energy Level (SoC) Flag *
- Beginning Energy Level

(*) Must be updated by the NYISO

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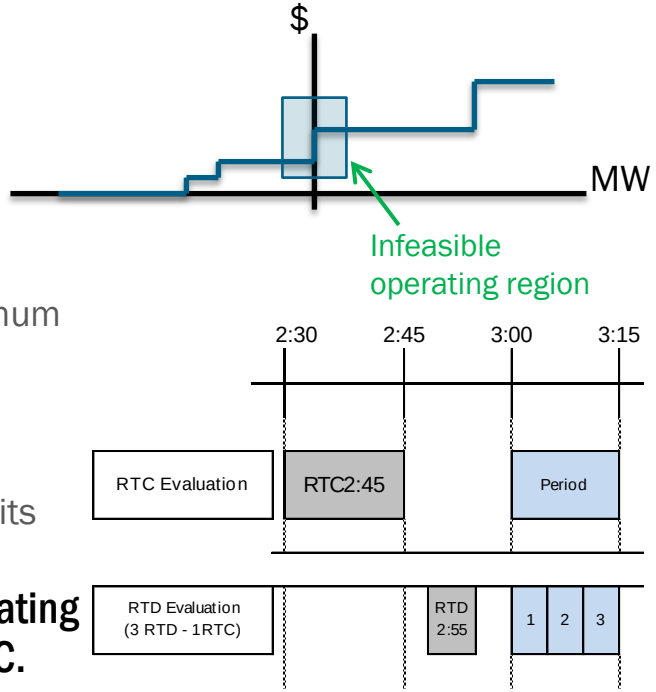
Scheduling Logic

- **The NYISO proposes that ESRs be scheduled according to their incremental energy bids and operating characteristics.**
  - This approach is consistent with the scheduling logic currently used for generators, which minimizes total production cost while honoring system and resource constraints.
- **ESRs will have the option to provide energy level telemetry (SoC).**
  - The NYISO proposes to include in the new parameters a yes/no Energy Level or SoC "flag" that will allow ESRs to indicate whether they want to provide their Energy Level to the NYISO in RT.
  - This flag will only be available to ESRs with a minimum capability of 1MW/1MWh.

Scheduling Logic: RT Commitment Decision Considerations

- **If a resource has an infeasible 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 an infeasible operating region or a transition time:**
  - RTD will have the capability to dispatch the resource through its full operating range (*i.e.,* injecting/withdrawing).
- **If an ESR has commitment parameters associated with its operating characteristics, the state of the resource will be assigned by RTC.**



Scheduling Logic: Day-Ahead Scheduling

- Similar to the proposed RT scheduling logic, the initial condition for an ESR to be selected will be its incremental energy bid.
  - This will apply for both withdrawing and generating states.
  - Energy level (SoC) will be used as a scheduling constraint.
- ESRs will be scheduled for a single state (withdrawing, generating, or idle/off) for each hour.
- ESRs will be assigned a single hourly output value.
- It will be assumed that ESRs maintain a constant Energy Level for increments in which the ESR does not submit a DAM bid.
  - ESRs will be able to offer capabilities in RT that they were not offered in the DAM. Like other resources, ESRs will be expected to be able to honor DA commitments.
- Conversion losses will also be considered while scheduling ESRs.

Scheduling Logic: Day-Ahead Scheduling (cont.)

- **The NYISO proposes to allow ESRs to provide their Beginning Energy Level as an optional offer parameter.**
  - Beginning Energy Level represents the amount of energy that the ESR will have at the beginning of the operating day.
  - This parameter will only be utilized in the DAM optimization.
  - If a resource chooses not to provide its Beginning Energy Level, the NYISO will set the Beginning Energy Level of the resource within the Energy level constraints (Upper and Lower Charge Limits) while minimizing total system production costs.
- **Because the DAM is an hourly optimization, any time parameters utilized 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.

Settlements Framework

- **The NYISO intends to apply the existing settlements framework used for Generators to ESRs**
  - Certain modifications will be necessary to address unique characteristics of energy storage
- **Existing settlement treatment for over- and under-generation will also be applicable**
  - ESRs will be expected to follow their Base Point Signal within a tolerance of 3% of their maximum capability (UOL/Max. Load).
    - For generating/injecting states, remaining within 3% of the resource's UOL will not incur penalties.
    - For withdrawing states, remaining within 3% of the resource's Max. Load will not incur penalties.
  - Additionally, if an ESR is over-withdrawing energy from the grid, deviating from its Base Point Signal by more than 3% of its Maximum Load, the NYISO proposes to apply a penalty as if the resource were subject to an under-generation sanction.

Settlements Framework: Day-Ahead Margin Assurance Payments (DAMAP)

- **The NYISO proposes to extend its existing DAMAP logic for ESRs in injecting states.**
  - The DAMAP construct aims to protect resources that could have honored their DA schedule in RT, had the NYISO not provided different instructions.
  - Special eligibility provisions may be required for ESRs as they have additional operational capabilities and constraints.
- **For withdrawing states, the NYISO proposes to make ESRs eligible for DAMAP if they were dispatched in RT to a lower withdrawing value than their DA schedule.**
- **An ESR must be capable of honoring its DA schedule in order to remain eligible for DAMAP.**
  - NYISO will determine whether an ESR is capable of honoring its DA schedule via the ESR's RT Energy Level telemetry signal.
  - If the ESR does not provide a RT Energy Level signal, it is at risk of receiving a schedule that it would not be able to meet. Inability to follow NYISO RT dispatch instructions would make the resource ineligible for DAMAP (and potentially subject to other consequences).

Settlements Framework: Bid-Production Cost Guarantee (BPCG)

- BPCG payments protect eligible generators from incurring a net loss over a commitment day.
- Currently, if a resource is committed, but the LBMP revenues are not enough to cover the resource's costs, it might be eligible for a BPCG payment.
- The NYISO proposes to maintain BPCG for ESRs.
  - If an ESR is uneconomically committed for either withdrawing or injecting, it could be eligible for BPCG.

Mitigation

- The NYISO is considering using the same framework to mitigate ESRs that is used for generators today.
  - Reference levels can be established for each new offer parameter in the participation model.
  - 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 (currently NYC).

Future Topics for Consideration

- **The Market Design specifics below will be further discussed in the next market design phase beginning in 2018:**
  - Treatment of Energy Level when scheduling ESRs to provide Regulation
  - Dual-participation provisions
    - The NYISO intends to consider ESR and DER dual participation rules in 2018
  - Capacity market participation
    - The NYISO intends to address ESR and DER capacity market rules in 2018
  - Pricing considerations for ESR minimum generation/load blocks
  - Additional topics that the NYISO may pursue in future years
    - Energy Level/State of Charge (SoC) management

Next Steps

- The NYISO continue to seek stakeholder feedback on the ESR Market Design in 2018.

Feedback

- The NYISO seeks feedback on the materials presented today.

- Email additional feedback to: Daniel F. Noriega dnoriega@nyiso.com

Questions?

We are here to help.

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