Enabling Resources Program: Storage and Hybrid Integration Project

Settlements

Memo 1.0

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Engagement Topic: Settlements Design Element for Storage Resources

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Purpose

The purpose of this document is to provide information on the IESO's market design work with respect to the 'Settlements Design Element' for the storage resource participation model. It articulates how the IESO undertook the design and the decisions that are relevant to stakeholders for the enhanced storage participation model.

The IESO will utilize this document and materials from subsequent design phases to support the implementation of the design work for the Storage and Hybrid Integration Project. This will be captured in future changes to Market Rules, Market Manuals, software interfaces with the IESO, and internal IESO systems and processes. These external changes will be reviewed for input with stakeholders. Any material changes to this design as a result of implementation discovery will be discussed with stakeholders.

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List of Abbreviations

Abbreviation	Definition
CycleDEL	Cycling Daily Energy Limit
DA	Day-Ahead
DAM	Day-Ahead Market
DAM BC	Day-Ahead Market Balancing Credit
DAM MWP	Day-Ahead Market Make-Whole Payment
ELT	Expedited Long-Term
EOP	Economic Operating Point
EMFC	Enhanced Mitigation for Conduct
IAM	IESO-Administered Market
LC	Lost Cost
LOC	Lost Opportunity Cost
LT-1	Long-Term 1
OR	Operating Reserve
ORA	Operating Reserve Accessibility
PD	Pre-Dispatch
RT	Real-Time
RT MWP	Real-Time Make-Whole Payment
SoC	State of Charge

Background

ERP's Storage and Hybrid Integration Project is focused on developing an enhanced participation model for storage resources and co-located hybrid facilities. During the design phase, the IESO proceeded with the core 'Optimization' element within the 'Grid and Market Operations' module, which is a main precursor to design decisions to support other design modules and elements. The 'Settlements' design module describes the Market Settlement process requirements in the day-ahead market and real-time market for a single model storage resource.

Phased Approach

The Storage and Hybrid Implementation Project is adopting a phased delivery approach to expedite and prioritize the implementation of essential functionalities, including:

- Single model storage resource (battery) with bidirectional offers
- State of Charge (SoC) Management

As seen in **Figure 1**, subsequent design phases will implement:

- Regulation service
- Uplift exemptions
- Any required enhancement resulting from Phase 1 implementation

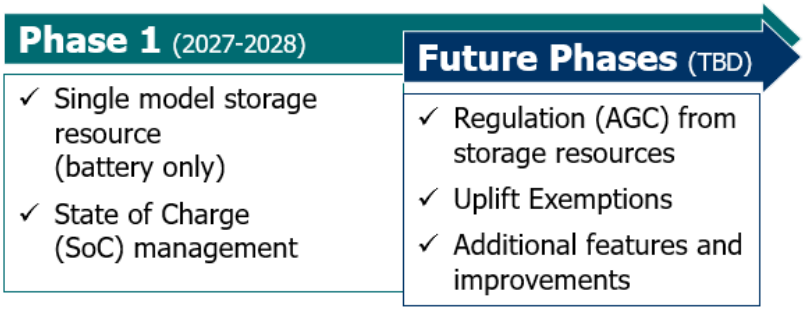

Figure 1: Project Scope

Scope of Impact for Phase 1

For Phase 1 of the enhanced market design, the IESO will focus on Battery Energy Storage Systems (BESS). In subsequent phases, the IESO will consider the applicability of other types of storage technologies and potential nuances that could require additional/different parameters. The scope of design modules and elements for Phase 1 design is depicted in **Figure 2**, with the

focus on 'Settlements' in this document. During Batch 2 Design, the IESO progressed with all the relevant design elements in parallel to expedite delivery.

Batch #	Design Module	Design Element
1	Grid and Market Operations	Optimization (Energy & Operating Reserves)
2	Grid and Market Operations	Dispatch data and other inputs
	Grid and Market Operations	Operations Integration
	Connection and Registration	Market Registration
		Connection Assessment and Approval
	Settlements	Market Settlement
	Contracts	Contract Impacts
	Market Power Mitigation (MPM)	Ex-ante, ex-post, settlements mitigation
3	Hybrid	All modules

Figure 2: Design Elements and Design Modules for Phase 1 design

The IESO's focus is on single-site, dispatchable storage resources. This enhanced market design will support recent storage procurements via Long-Term 1 (LT1) and Expedited Long-Term (ELT) procurements. Some of these BESS facilities are/will have achieved their Commercial Operation Date before the enhanced participation model is live; the transition of these facilities, and resources that currently participate in the IESO Administered Markets (IAMs) as the foundational dual model storage, to the enhanced model will be discussed with stakeholders later.

Design Methods and Outcomes

Principles

The ERP market design principles guide decision criterion and help to verify the design meets the needs of the IESO and market participants. These principles were utilized for the Market Renewal Program (MRP) and were considered as part of the long-term vision for storage:

- Efficiency - Lower out-of-market payments and focus on delivering efficient outcomes to reduce system costs
- Competition - Provide open, fair, non-discriminatory competitive opportunities for participants to help meet evolving system needs
- Implementation - Work together with our stakeholders to evolve the market in a feasible and practical manner
- Certainty - Establish stable, enduring market-based mechanisms that send clear, efficient price signals
- Transparency - Accurate, timely and relevant information is available and accessible to market participants to enable their effective participation in the market
- Operability – Based on the decisions for this model, can the IESO plan/ forecast the operational needs of the grid, and continue to have the ability to manage the grid, without detriment

Method

The design and integration of storage will be organized in a 'build-to-bill' format called 'modules' (representing larger functions) and 'elements' (more specific functions within a module). The build-to-bill modules and elements are specific to the market participant and IESO processes to bring new resources onto the grid and facilitate their participation in markets and services. Design modules and elements will be engaged on based on project dependencies and priorities (i.e. not in a chronological format regarding a typical build-to-bill decision-making process).

Settlements Design Module

Settlement of DAM and RTM energy and operating reserve using as-submitted or mitigated dispatch data is accomplished through a two-settlement system for dispatchable facilities. This applies to the single model storage resource as well. Any changes to market payments, charges and credits will be impacted by the addition of the new single model storage resource.

The following design elements under settlements will undergo changes:

- Two-settlement for Energy and OR
    - For energy, new DAM and RT charges for bi-directional offers of the single model storage resource
    - No change for OR
- Operating Reserve Non-Accessibility (ORA) charge
    - Subjected to ORA as per current design
- Day-Ahead Markets Make-Whole Payments (DAM MWP)
    - Lost Cost (LC)
- Real-Time Make-Whole Payments (RT MWP)
    - Lost Cost
    - Lost Opportunity Cost (LOC)
- Economic Operating Point (EOP) tool
    - Update required due to the introduction of state of charge (SoC) tracking, new storage constraints, bidirectional energy offers, OR branching capability and derates
- Settlement impacts due to Enhanced Mitigation for Conduct (EMFC)
    - Changes to EMFC data are described in the 'Market Power Mitigation' design memo.

Please note that this is an interim design memo for the 'Settlements Module' and highlights the design for "Two-settlement for Energy and OR" and "ORA Charge" design elements for single model storage resources. Decisions on the remaining settlements topics will be brought forward in Q2 of 2026, as the team gains internal alignment and feedback from stakeholders through engagement or outreach sessions.

Design Decisions

Below details some of the decisions for the 'Settlements' scope described above.

Two-Settlement for Energy and Operating Reserves

In the IESO's renewed market, the two-settlement process for energy and operating reserves is designed to settle the day-ahead market, while the real-time market functions as a balancing market. Day-ahead schedules are financially binding. Accordingly, market participants are required to deliver the day-ahead energy and operating reserve schedules in the real-time market. Any deviations between day-ahead and real-time schedules are settled through the real-time market at the real-time prices, which may result in a financial "buy-back" or "sell-back" of their day-ahead position.

This market design principle will be applied consistently to single model storage resources; therefore, no modifications to the two-settlement process are required for single model storage resources. However, new settlement charge codes will be required to support their participation in the market. These charge codes will be designed to accommodate potential future expansion to other non-conventional resources during future phases of the ERP project.

Decision:

Two new settlement charge codes for energy will be introduced to settle Day-Ahead (DA) and Real-time (RT) market energy for single model storage resources. The two settlement charges are categorized into resource types (e.g. dispatchable generation, dispatchable loads, imports, exports, etc.). This would create a new charge type associated with resource type for single model storage resources in DA and RT.

The two-settlement calculations and charge codes for operating reserve remain unchanged.

Rationale:

1. Consistent treatment of storage resources that aligns with other resources for two-settlement calculations and charge codes for energy and operating reserve

Operating Reserve Non-Accessibility

Inaccessible Operating Reserve provides the incentive to resources to be available when activated to provide scheduled operating reserve. If a resource is unable to deliver the MWs, the stand-by payments for the unattainable operating reserve will be clawed back.

While single model storage resources have the unique characteristic of being able to both inject and withdraw energy to provide operating reserves, there are certain situations where the resource may not be able to achieve potential OR activation which can have significant impact on reliability of the grid.

Below are two scenarios under which storage resources may not be able to provide scheduled operating reserves:

Scenario 1:

A storage resource is scheduled in RT to generate at 90 MWs and it has a maximum capacity to generate energy as per energy price curve of 100 MW. It is also scheduled to provide operating reserve of 10MWs. Based on its metered data it is injecting 92 MWs hence 2 MWs of the 10 MWs of operating reserve is inaccessible.

Scenario 2:

A storage resource has a maximum operating reserve offer at 200 MW and is scheduled to provide 180 MWs of operating reserves. The maximum capacity to generate energy is 100 MWs, and the day-ahead engine schedules it to charge at 80 MWs to meet peak demand later in the day. The resource responds to dispatch, but metered data shows that its consumption is at 78 MWs. For the resource to meet 180 MWs, it would need to reduce consumption by 78 MWs and inject 102 MWs. Given that the maximum capacity for energy is 100 MW, 2 MWs of the operating reserve is inaccessible. While this is expected to be a rare occurrence given the fast ramp rates of storage resources, nonetheless, it has been considered in the design of inaccessible OR for completeness

Decision:

Consistent with other conventional resources, battery storage resources will be subjected to inaccessible operating reserves incentives, unless it is activated for operating reserves.

Given that a single model storage resource can discharge and charge when providing operating reserves the Total Accessible Operating Reserve (TAOR) needs to be modified to

account for this unique characteristic.

When the resource is injecting or withdrawing energy in an interval, TAOR will be determined as follows:

$$TAOR = AQEW + (MaxCap - AQEI)$$

where:

$AQEW$ is the allocated quantity (in MWh and up to 3 decimal places) of energy withdrawn by market participant 'k' at primary registered wholesale meter 'm' in metering interval 't' of settlement hour 'h', as defined in Market Rules Appendix 9.2, section 8

$AQEI$ is the allocated quantity (in MWh and up to 3 decimal places) of energy injected by market participant 'k' at primary registered wholesale meter 'm' in metering interval 't' of settlement hour 'h', as defined in Market Rules Appendix 9.2, section 8

$MaxCap$ is the maximum limit for market participant 'k' for delivery point 'm' used in determining the real-time schedule for generation in the dispatch scheduling and pricing process for metering interval 't' in settlement hour 'h'

Rationale:

1. Consistent treatment of storage resources that aligns with other resources
2. Stand-by operating reserve payments are uplifted to the market. When a single model storage resource is unable to deliver the scheduled MWs, this creates an unfair cost to the market.

Next Steps

Several critical settlements design elements remain under development and require further refinement to ensure robust and transparent implementation. Some of the key design topics are DAM MWP, RT MWP and EOP design based on MWP decisions. Make-whole payments and Economic Operating Profit designs will be brought forward in Q2,2026.

These components are essential for accurately reflecting resource economics and preventing risk for financial exposure for market participants.