

Enabling Resources Program: Storage and Co-located Hybrid Integration Project

Regulation Service Design

Memo 1.0

Engagement Topic: Regulation Service Design for Storage Resources

Date: October 15, 2026

Purpose

The purpose of this memo is to provide IESO's proposed design for regulation service from battery resources under Phase 2 of the Storage and Co-located Hybrid Integration Project (SHIP). It explains how dispatchable single model storage resources (SMSRs) would provide regulation while participating in the energy and operating reserve markets, and identifies the decisions and outstanding matters relevant to stakeholders. The design supports dependable participation over several consecutive hours to help meet regulation needs throughout the year.

The design builds on the Phase 1 storage participation model. The IESO will utilize this document and materials from subsequent design phases to support the implementation of the design work for SHIP. 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 will be discussed with stakeholders. Detailed settlement provisions will be provided in a subsequent update.

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List of Abbreviations

Abbreviation	Definition
ACE	Area Control Error
AGC	Automatic Generation Control
CAES	Compressed Air Energy Storage
DAM	Day-Ahead Market
DMSR	Dual Model Storage Resource
DSO	Dispatch Scheduling and Optimization
ERP	Enabling Resources Program
EOP	Economic Operating Point
IAM	IESO Administered Market
ICG	IESO-Controlled Grid
MP	Market Participant
MPM	Market Power Mitigation
MRP	Market Renewal Program
MWP	Make Whole Payment
OR	Operating Reserve
PD	Pre-Dispatch
RT	Real-Time
RT-MIO	Real-Time Multi-Interval Optimization
SHIP	Storage and Co-located Hybrid Integration Project
SMSR	Single Model Storage Resource
SoC	State of Charge

Background

The Enabling Resources Program (ERP) Storage and Co-located Hybrid Integration Project (SHIP) is developing an enhanced participation model for storage resources and co-located hybrid facilities. SHIP Phase 1 (SHIP1) establishes the Single Model Storage Resource (SMSR) model, including bidirectional energy offers and state of charge (SoC) management. SHIP Phase 2 (SHIP2) aims to enable battery resources registered as dispatchable SMSRs to provide regulation service while participating in the energy and operating reserve (OR) markets. Note that SHIP2 also aims to resolve tool limitations today that prevent simultaneous OR and regulation participation, which will lay the foundation for allowing all resources that provide regulation services to also provide OR at the same time.

Enabling energy, OR, and regulation service participation for battery energy storage resources enhances the value of procured capacity by allowing these resources to provide the full range of reliability services for which they are technically capable, improving both system efficiency and grid reliability.

Phased Approach

Phase 1 establishes the SMSR model, including bidirectional energy offers and IESO management of state of charge (SoC). Phase 2 builds on that foundation to enable regulation service and address uplift exemptions and further enhancements. As seen in Figure 1 below, SHIP has adopted a phased delivery approach to expedite and prioritize the implementation of essential functionality. Regulation participation depends on the Phase 1 model being in place.

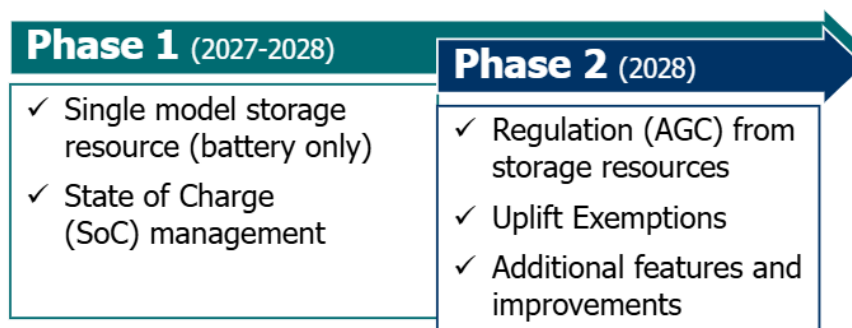


Figure 1: SHIP Scope

Scope of Regulation Service Design

This memo describes the proposed participation, scheduling, control, performance and settlement arrangements for regulation service from batteries. The focus is dispatchable SMSRs. Broader uplift exemptions for charging load are a separate SHIP2 design topic to be discussed in Q1 of 2027, and this memo addresses charging costs only where they relate to regulation service.

Some changes to regulation scheduling and OR participation would also affect other regulation providers. Their technical capability, contractual arrangements and implementation requirements must be considered when applying these changes. This memo does not change the participation model for other resource types.

The go-live date of enabling batteries to provide regulation service will follow the go-live date of SHIP1.

Design Principles

The ERP market design principles guide design decision criteria to verify that the design meets the needs of the IESO and market participants (MPs). These principles were derived from the foundational Market Renewal Program (MRP) and were considered as part of the long-term vision for storage.

- **Efficiency** – Deliver efficient market outcomes to benefit consumers;
- **Competition** – Provide open, fair, non-discriminatory competitive opportunities to enable MPs to meet evolving system needs.
- **Implementability** – Collaborate with our stakeholders to evolve the market in a feasible and practical manner;
- **Certainty** – Maintain enduring market-based mechanisms that send clear, efficient price signals;
- **Transparency** – Accurate, timely and relevant information is available and accessible to MPs to enable their effective participation in the market;
- **Operability** – The new participation models will improve the IESO's ability to plan/forecast the operational needs of the grid and provide accurate signals to BESS resources.

High Level Regulation Service Design Decisions

The proposed design would make the following decisions and changes to enable batteries to provide regulation service:

Participation Model

- Storage resources will be able to participate in energy and OR while providing regulation by reserving SoC and adjusting operational limits for a regulation schedule.
- A new regulation resource selection procedure will select resources for scheduling based on reliability when more regulation resources are available beyond the regulation requirement. Regulation resources and regulation capacities will be selected before the Day-Ahead Market (DAM) submission deadline similar to the participation model for other regulation resources today.

Regulation Signal and Setpoint Design

- The 100 MW/min ramp rate limit for Electricity Storage Facilities will be removed for storage resources during hours in which the resource is scheduled to provide regulation service to utilize the full ramp capability to manage Area Control Error (ACE) while providing regulation service. The basepoint used as an input to the setpoint calculation and the automatic generation control (AGC) tool will transition linearly between energy dispatches over a five-minute period which alleviates the need for the ramp rate limit.

- The basepoint will be updated immediately in the AGC tool when OR is activated, and remain at the ORA level until OR is deactivated.
- The current bidirectional regulation signal, i.e., a combined Regulation Up and Regulation Down signal, will be retained. Separate Regulation Up and Regulation Down products could provide more flexibility to the system by allowing different amounts of Regulation Up and Regulation Down to be scheduled, but require broader changes to procurement, scheduling, settlements, operational processes, and tools.

Performance Evaluation

- Performance may be evaluated by calculating a performance factor which may be used in the auditing and testing of regulation resources as well as for settlements.

Settlement Considerations

- Global Adjustment considerations for storage providing ancillary services as outlined in Ontario Regulation 429/04.

Eligibility Requirements

- Battery resources providing regulation under this design will participate as dispatchable SMSRs.
- Changes contemplated as part of ERP will enable transmission-connected batteries to provide regulation service. It is anticipated that additional changes to internal processes along with additional coordination with distributors would be required to enable distribution-connected resources to provide regulation service, and these changes are not in SHIP2's scope.

Transparency

- Additional details such as Supplier, Facility, Quantity, and possibly price are proposed to be disclosed for competitive procurements.

Regulation Service Background

Regulation service is an ancillary service that the IESO contracts to help ensure the reliable operation of the power system. Regulation services provide balancing on a granularity as low as every four seconds, within a five-minute dispatch interval, to maintain electricity supply and demand balance within strict tolerances to keep system frequency as close to 60 Hz as possible.

Area Control Error (ACE) is a metric for measuring system balance that indicates whether the right amount of power is being generated to meet demand while supporting scheduled net-intertie flows and frequency in the Eastern Interconnection. Maintaining ACE within acceptable bounds through regulation service, and keeping it as close to zero as possible, is essential for reliable operations.

Regulation is currently provided by generation facilities with AGC capability, which permits them to vary their output to deviate either up or down from their economic dispatch instruction within the five-minute dispatch interval, in response to a separate regulation signal sent through telemetry by the IESO in the form of a regulation setpoint.

Sustained Regulation Participation

As discussed in the IESO's 2026 Annual Planning Outlook, additional regulation capability is needed in every hour of the year. Enabling batteries to remain available for several consecutive hours helps meet that continuous regulation need, including periods of sustained regulation up or regulation down which are inherently unpredictable.

Sustained participation also simplifies selecting resources. It reduces the need to replace or rotate batteries frequently as their usable stored energy is depleted or their charging room is exhausted. Coordinating SoC and energy basepoints helps the IESO select regulation capability that can remain available throughout the awarded block even if the block is a 24-hour period.

Basepoints and Regulation Setpoints

A basepoint is the underlying power level around which a resource provides regulation. Under normal operation, it reflects the resource's energy dispatch including the OR activation, if applicable. The regulation setpoint combines that basepoint with the requested regulation adjustment and is the power level the resource is instructed to follow.

For a battery, positive power represents injection into the grid and negative power represents withdrawal. Regulation up increases injection or reduces withdrawal. Regulation down reduces injection or increases withdrawal. A battery can therefore provide regulation while charging, discharging, or operating around zero power, provided it has the necessary power capability and sufficient SoC headroom or footroom.

Why Batteries Need SoC Coordination

Reserving capacity alone does not ensure that the resource can continue to respond to both regulation up and regulation down instructions. A battery at its upper limit of SoC cannot withdraw more energy from the grid and therefore would not be able to provide regulation down capabilities. Likewise, a battery at its lower limit of SoC cannot inject more energy into the grid and therefore would not be able to provide regulation up capabilities.

The proposed design therefore coordinates both power and stored energy by adjusting power limits and adding SoC constraints to the Dispatch Scheduling and Optimization (DSO) System. The IESO's scheduling tools would account for the regulation commitment when determining feasible energy and OR schedules. This builds on the SoC-management approach developed in Phase 1.

Design Decisions

The following sections describe the proposed design and its implications for MPs. They primarily address the intended operating approach. Settlement and implementation details that require further development will follow in a subsequent version of the design. Requirements would be coded in future Market Rule, Market Manual, and/or contractual provisions.

Participation Model

Coordinating Energy and OR with Regulation

The IESO proposes to enable battery SMSRs to provide regulation while participating in the energy and OR markets. The restriction currently in place for all resources, that sets a resource's OR offers to zero during hours in which the resource is scheduled to provide regulation service, would be removed. A resource must have sufficient power, ramp capability and, for a battery, stored energy to deliver the services scheduled together.

Energy and OR would continue to be co-optimized by the DSO. The regulation schedule would be determined beforehand and supplied to the DSO as an input. The DSO would adjust the operating limits and SOC limits to reserve capability above and below the basepoint for regulation. OR scheduling would use the remaining feasible capability and account for the one hour of energy required to deliver an activation.

These reservations would be applied by the IESO's tools and not as a new offer quantity limit. MPs would submit market offers and other dispatch parameters under the applicable requirements as updated by SHIP1. Offer obligations and precise details of the energy reservation constraints will be clarified through the detailed design that will assess and update several IESO processes and requirements documents which would then inform requirements documents for IESO tool updates.

Reserving State of Charge for Regulation Service

The DSO would reserve stored energy above the minimum SoC limit for regulation up and charging room below the maximum SoC limit for regulation down. Energy and OR schedules would be assessed against these adjusted limits. With the SoC reservations in place and assuming sufficient SoC headroom/footroom is available, the battery will be able to provide regulation up or regulation down at the full regulation capacity regardless of whether its basepoint is charging, discharging, or sitting at zero.

The proposed approach differs by scheduling timeframe. For the Day-Ahead Market and Pre-Dispatch timeframe, energy to support one hour of the scheduled regulation capacity as headroom and footroom should be reserved to account for worst-case situations where the regulation signal is either full regulation up on a discharging basepoint or full regulation down on a charging basepoint for a whole hour.

In real-time, energy to support 10 minutes of the scheduled regulation capacity as headroom and footroom, including considerations for charging and discharging efficiency, should be reserved to maintain SoC margin to provide either full regulation up or full regulation down for the next five-minute interval. A ten-minute margin allows time for the DSO to move the basepoint as a result of the SoC constraint becoming a binding constraint and time for the battery power to reflect the new basepoint, while also insuring against telemetering issues. When the SoC constraint is a binding constraint, charging or discharging basepoints may be uneconomic; however, the action is necessary to ensure that the resource continues to provide full regulation service capabilities and support reliable operation of the grid.

Selecting Regulation Resources

As battery participation increases the available supply of regulation capacity, offered regulation may exceed the capacity required by the system. A selection process will be needed to avoid scheduling more regulation than required and unnecessarily restricting capability available for energy and OR.

The proposed process would select resources in the pre-DAM timeframe. MPs must submit regulation offers by 9:00 AM EPT. A reliability-based objective will be used for selection with constraints and validations applied based on the IESO's regulation requirement, offered capacity, resource availability, registered regulation capabilities and applicable contractual requirements. MPs would be informed of the resulting hourly regulation schedules by 10:00 AM EPT. Scheduled quantities will be used as constraints on available energy and OR for subsequent DAM scheduling.

Cost-based selection was considered and will continue to be investigated. The need for cost-based selection would grow as the available regulation capacity grows.

Regulation Signal and Setpoint Design

Energy Ramps and Fast Regulation Response

For an SMSR providing regulation service, the proposed design would remove the 100 MW/min limit while the resource follows its regulation setpoint. The energy basepoint used by AGC would change linearly between successive energy dispatches over five minutes to alleviate the concerns that drive the need for the 100 MW/min ramp rate limit. Note that this requires an IESO tool update to implement.

Responding to an OR Activation

When OR is activated, the proposed design would update the AGC basepoint immediately following the activation instruction. The AGC tool would then calculate regulation setpoints around the revised basepoint until OR is deactivated.

Regulation down during an OR activation can place actual output below the OR activation basepoint. This issue along with the transition following OR deactivation requires further discussions related to compliance methodology that will be discussed in a subsequent version of the design.

Bidirectional Regulation Product

The existing bidirectional regulation signal will be retained. Separate Regulation Up and Regulation Down products could provide more flexibility in a future change to the system, but may require broader changes to procurement, scheduling, settlements, and operational processes and tools. The priority of SHIP2 is to enable batteries to provide regulation service to support meeting the increased need for regulation service in the coming years as discussed in the 2026 Annual Planning Outlook, and splitting the product to Regulation Up and Regulation Down could have schedule impacts.

Performance Evaluation

To ensure accuracy and efficiency, a performance evaluation is proposed for resources providing regulation. Performance may be evaluated monthly and used in the auditing and testing of regulation resources, per the IESO Market Rules (Chapter 5, Section 4.9).

This market design introduces a performance management concept that is being contemplated. Additional details for performance management and other potential payments would be discussed and determined during procurement design activities.

Performance may be evaluated monthly by calculating a performance factor as follows:

$$PF_m = 100\% - MAE\%_m$$

Where:

PF_m = The performance factor achieved based on the average mean absolute error as a percentage of regulation capacity achieved over the settlement month "m"

$MAE\%_m$ = The average of the hourly mean absolute errors, expressed as a percentage of regulation capacity provided during each hour in which regulation service was provided during the settlement month "m", as follows:

$$MAE\%_m = \frac{100}{H_m} \sum_{h=1}^{H_m} \frac{MAE_h}{RC_h}$$

Where:

H_m = The total number of hours during the settlement month "m" in which regulation service was provided

RC_h = Regulation capacity provided during hour "h"

MAE_h = The mean absolute difference between the actual output and the requested regulation setpoint during hour "h"

$$MAE_h = \frac{1}{N_h} \sum_{t=1}^{N_h} |MW_t - SP_t|$$

Where:

N_h = Number of seconds within hour "h" during which regulation service was provided

MW_t = The actual output of the Regulation Resource at point "t" (second)

SP_t = Requested regulation setpoint at point “t” (second)

The average of the hourly mean absolute errors, expressed as a percentage of regulation capacity provided during each hour in which regulation service was provided during the settlement month “m” indicates how far, on average, the actual output of the regulation resource or facility was from the requested setpoint relative to the regulation capacity provided during all dispatch intervals during month “m”. A smaller $MAE_{\%m}$ is better. An $MAE_{\%m}$ of a specified threshold would be considered good performance and allows for telemetry communication delays and primary frequency response requirements.

Settlements

The settlement design to be addressed in a subsequent version of this design must account for the interaction between regulation commitments and the energy and OR markets. The proposed operating model can affect charging and discharging schedules and the energy available for energy and OR market participation. Reserving SoC for reliable regulation can force uneconomic charging or discharging, and the detailed settlement design must address those dispatch outcomes. Make-Whole Payments, Economic Operating Point, and Market Power Mitigation concepts will also be discussed in the subsequent version of this design. Global Adjustment for storage providing ancillary services will be treated consistent with Ontario Regulation 429/04. Details for other potential payments will be discussed and determined during procurement design activities.

Eligibility Criteria

The proposed battery participation model is for dispatchable SMSRs with the capability to receive and follow AGC setpoints and provide the necessary telemetry. Eligibility to provide regulation would be subject to applicable technical, testing, and contractual requirements. Participation in regulation service through the dual model storage resource (DMSR) model that may be used by compressed air energy storage facilities, pumped hydro storage facilities, or emerging storage technologies is not included in this design.

Changes contemplated as part of ERP will enable transmission-connected batteries to provide regulation service. It is anticipated that additional changes to internal processes along with additional coordination with distributors would be required to enable distribution-connected resources to provide regulation service, and these changes are not in SHIP2’s scope.

Transparency

Additional details are proposed to be disclosed such as Supplier, Facility, Quantity, and possibly price for competitive procurements. A one-time, historical, normalized sample regulation signal has been published on the [IESO Ancillary Services webpage](#) to facilitate more productive discussions in determining the market design for enabling batteries to provide regulation service.

The IESO will continue to publish Adequacy Reports containing the hourly regulation requirement quantities for the IAMs. The IESO will continue to publish the number of facilities, quantity of regulation service and annual financial amount on an annual basis on the IESO Ancillary Services webpage in accordance with the IESO Market Rules (Chapter 7, Section 9.8).

Next Steps

The IESO thanks stakeholders for their valuable inputs to this design and seeks written feedback from them on the same. Some critical design topics remain under development and require further refinement to ensure robust and transparent implementation including settlement design, Make-Whole Payment design, Economic Operating Point design, Market Power Mitigation design, and considerations for assessing compliance. An updated market design including the proposed design for these topics, and accounting for feedback from the October 2026 stakeholder engagement session, will be shared in an IESO stakeholder engagement session in Q1 of 2027 which will include an opportunity to provide feedback.