The Electricity Storage Operating Guide

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Attention: Customer Relations

The Independent Electricity System Operator Box 4474, Station A

Toronto, Ontario M5W 4E5

Customer Relations: Tel: (905) 403-6900

Toll Free 1-888-448-7777

Website: www.ieso.ca

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1. Introduction

The Electricity Storage Operating Guide (ESOG) serves as a transitional framework to support electricity storage[1] market participants in Ontario during the period following the implementation of the renewed market and prior to the launch of the Enabling Resource Program (ERP). This guide outlines how storage resources can effectively participate in IESO-administered markets under this interim period. It provides detailed information on market participation options, the connection process, operational procedures, and relevant market manuals. The ESOG is designed to bridge the gap between the renewed market's market structure and future enhancements, ensuring that storage facilities can be reliably and efficiently integrated into the electricity system while accommodating the unique characteristics of energy storage.

The renewed market was launched on May 1, 2025, and represents a transformative overhaul of the province's electricity market. The program was designed to address long-standing inefficiencies in the legacy market structure, which relied on a two-schedule system that separated dispatch and pricing. This misalignment led to costly out-of-market payments and limited transparency. Key components of the renewed market include the implementation of Locational Marginal Pricing (LMP), which assigns prices to specific grid locations based on real-time supply and demand conditions, and the launch of Ontario's first Day-Ahead Market (DAM), allowing participants to buy and sell electricity a day in advance. These changes enhance price transparency, improve grid reliability, and create new opportunities for energy storage.

ERP is a set of projects that will further support key emerging resources, including electricity storage, into the IESO-administered markets, tools, and processes to provide required system services and contribute to the safe and reliable operation of the bulk power system in Ontario. As part of ERP's Storage and Co-located Hybrid Integration project, ERP will implement an Enhanced Storage Model, building upon the foundational storage model that was implemented in 2021. The project is taking a phased approach to fast-track key storage design features to improve scheduling, reduce manual work for control room operators, and enhance operations for battery storage market participants. The first phase will enable essential functionalities including a bi-directional single resource model for batteries that can both inject and withdraw across a continuous offer curve and improve State-of-Charge (SoC) management by modelling and estimating SoC in IESO tools.

[1] An electricity storage unit is defined as the equipment used for the sole purpose of withdrawing electricity from the electricity system, storing that electricity as energy, and re-injecting it, or a portion thereof, as electricity into the electricity system.

Storage resources connecting prior to the implementation of ERP's Enhanced Storage Model will be integrated under the existing "two-resource model" in accordance with the existing market rules and tool design. Under the two-resource model, storage facilities are modeled as a separate generation and load resources at the same connection point to represent their unique ability to inject and withdraw energy, and participants are required to self-manage their SoC through their dispatch data. While most battery storage resources operating under the two-resource model will transition to the bi-directional single resource model post-ERP, certain storage resources will continue to be represented under the two-resource model. This determination will be made by the IESO as part of ERP.

This guide covers:

- Market Registration guidance for energy storage participants to efficiently register their facilities and resources with the IESO-administered markets.
- The various IESO-administered markets and ancillary service products available for electricity storage participation during the "interim period".
- The IESO connection process applicable for electricity storage facilities.
- Processes and procedures that electricity storage participants must follow once its electricity storage facility is connected and fully operating.
- A high-level overview of some of the market manuals to be most relevant and critical to the near-term integration of electricity storage participants and electricity storage facilities.
- Market Power Mitigation procedures that ensure electricity storage resources participate fairly and competitively in the IESO-administered markets.

2. Interim Period

A foundational storage participation model was implemented in 2021 through the Storage Design Project, along with Market Rule and Market Manual amendments to support the participation of storage resources in the IESO-Administered Markets (IAM). This foundational design allows storage resources to participate under a two-resource model[2], where electricity storage participants are represented with both generation and load resources, for the IESO's dispatch and optimization tools (i.e., the DSO) to recognize their unique ability to inject and withdraw energy. The interim period represents the participation of storage resources under the existing two-resource model, for the period following the implementation of the renewed market until ERP's enhanced storage model can be fully integrated into the DSO.

[2] While most battery storage resources operating under the two-resource model will transition to the bi-directional single resource model post-ERP, certain storage resources will continue to be represented under the two-resource model. This determination will be made by the IESO as part of ERP.

3. IESO-Administered Markets Available for Electricity Storage Participation

During the interim period, electricity storage Market Participants (MPs) may be able to participate in the following products:

- Day-Ahead Market (DAM) and Real-Time Market (RTM)
- Operating Reserve (OR) market
- Capacity Auction

Here are some important considerations if MPs are interested in participating:

- MPs may participate in the various IESO-administered markets as long as their electricity storage facility has a minimum capacity for energy injections and withdrawals greater than 1 MW.
- OR is procured through a competitive market and the capacity auction is a competitive procurement through an annual auction.
- To participate in the real time energy market, OR market and capacity auction, a MP's facility will need to be registered as a dispatchable electricity storage facility.

In order to provide energy and OR, a MP will need to complete the IESO Connection Process as outlined in Section 4 below.

To participate in the capacity auction, the electricity storage facility must be non-committed, meaning that it is not in whole or in part rate-regulated, contracted to the IESO, contracted to the Ontario Electricity Finance Corporation (OEFC), or obligated as a resource backed capacity export to another jurisdiction. Capacity auction considerations can be found in MM 12.

If an electricity storage facility size is less than 10 MW and the MP does not wish to provide OR or participate in the capacity auction, but does want to participate in the energy market, they may register as either a self-scheduling electricity storage facility or a dispatchable facility.

3.1 Further Reading

IESO Ancillary Services Market Webpage

IESO Capacity Auction Webpage

Acronyms Reference Card

Market Rules Chapter 7: System Operations and Physical Markets

Market Rules Chapter 5: Power System Reliability

Market Manual 12: Capacity Auction

4. Connecting and Preparing to Participate in IESO-Administered Markets

To participate in the IESO-Administered Markets (IAM), an electricity storage participant will need to complete a series of actions to ensure its facility can reliability connect to the grid and participate in the IAM. The following sub-sections detail the steps required when connecting and preparing to participate in the IAM.

4.1 IESO Connection Process

MPs are required to go through the IESO Connection Process if they are planning to connect a new facility or modify an existing facility. This includes the provision of new/modifications to the provision of an ancillary service. The Connection Process may involve up to six stages as listed below:

1. Prepare Application
2. Obtain Conditional Approval to Connect
3. Design and Build
4. Authorize Market and Program Participation
5. Register Equipment
6. Commission Equipment and Validate Performance

Participants are required to successfully complete all applicable stages to receive final approval to connect to the IESO-Controlled Grid (ICG) and begin commercial operation. Completing the connection process can take anywhere from a few months to more than three (3) years depending on the complexity of the project. Therefore, it is important that MPs plan according to their desired in-service date.

For more details about this process please refer to the Overview of the Connection Process webpage on the IESO website. The recorded webinar posted on the IESO's Connecting to Ontario's Power System Engagement Page is an additional valuable resource that will provide MPs a better understanding of the connection process including the registration and commissioning processes.

4.1.1 Connection Assessment and Approval Process: Stages (1) to (3)

Specific details referring to the IESO Connection Assessment and Approval (CAA) Process can be found in MM 1.4. CAA Application Form provides guidance on the required information for this stage, including acceptable generic dynamic models listed in MM 1.6 s.5.6, and Electromagnetic Transient Models (EMT) as per the IESO's EMT model requirements, which can be obtained by contacting IESO Connection Assessments. For any questions about stages (1) to (3), please contact IESO Connection Assessments at connection.assessments@ieso.ca.

4.1.2 Reliable Integration Process: Stages (4) to (6)

The IESO maintains the reliability and operability of the ICG and IAM by ensuring new MPs are appropriately authorized and their applicable facility/equipment is registered well before energization. This sub-section highlights a few key aspects of the Reliable Integration process relevant to electricity storage facilities.

4.1.2.1 Authorize Market and Program Participation – Prudential Security

All MPs with financial exposure in the IAM must meet established prudential requirements. An electricity storage facility may, in a given settlement period, be a net market debtor. To manage this risk, the IESO evaluates credit exposure during the Market Authorization and Participation process. Each prospective participant must provide the necessary information to determine its prudential support obligation. This prudential security framework is designed to ensure a reasonable level of financial security for all market participants.

Electricity storage facilities shall work within the same prudential security framework that is applicable to all MPs. This framework provides security for all MPs against the mutual risk of a default by any MP in the IAM. Under the IESO Market Rules, all MPs may be subject to a default levy in the event that a MP defaults against the electricity market and there is insufficient prudential security to cover that default. Every aspect of today's prudential security framework is intended to minimize that risk for all involved.

The main storage-specific feature of the prudential security framework is the manner in which the IESO determines the MP's prudential support obligation for a storage facility. Here, the IESO will use each facility's:

- Registered cycle efficiency value – i.e., the proportion of energy that is returned for injection into the electricity system after it is withdrawn and stored over a prescribed duration of time.
- Registered maximum state of charge (SOCMAXg) – i.e., the highest certified state of charge to which the energy storage system can be consistently charged without damage beyond expected degradation from normal use.
- Registered duration of service – expressed in minutes, the certified duration of service of the facility is calculated from the Certified Energy Storage Capacity (SOCMAXg) and Certified Power Storage Capacity (Pmax,g) of the facility. Certified quantities are determined during testing.

The amount of energy lost in the process of withdrawing, storing and injecting energy represents the potential financial exposure to the market for energy that will not be returned for sale.

Once an electricity storage facility has been active in the IAM and can demonstrate that it is consistently a net creditor, it can request that the IESO reassess its prudential support obligation.

For more information on what how prudential security is calculated or to address any questions, contact prudential@ieso.ca.

4.1.2.2 Register Equipment

Electricity storage facilities shall be limited to a maximum ramp rate of 100 MW/minute. Please refer to Section 6.1.4 below for additional details.

New dispatchable electricity storage facilities intending to participate in OR, will need to first register their facility without OR and receive their final Registered Approval Notification (RAN). Once the Final RAN is received, the MP will need to start a new registration request to participate in OR. A Conditional RAN will be issued to coordinate and complete the required OR test(s). During the conditional RAN period, the MP can only offer OR during the agreed-upon testing windows established in coordination with the IESO. To learn more about the OR testing procedure, please refer to MM 7.3 s.5.3.4, and MR Ch.5 s.4.9.2.

Real-time data monitoring (i.e., telemetry) is required by the IESO to monitor and model the power system and operate the real-time market. Electricity storage facilities are required to provide additional telemetry points such as status of site controller, status if grid capable, state of charge, ramp rate, set point, etc. Additional details on the required points and timing performance can be found in MR Ch.4 App.4.

New dispatchable electricity storage facilities planning to connect to the ICG, should be aware that the IESO is developing enhanced monitoring requirements, which may include the installation of Phasor Measurement Units (PMUs) in addition to the mentioned telemetry data above. For the latest information and timelines, please visit the stakeholder site.

Additional details referring to the Market Registration process can be found in MM 1.5.

4.1.2.3 Commission Equipment and Validate Performance

A summary of commissioning-related requirements for new electricity storage facilities undergoing commissioning can be found as follows:

1. Planned Outage Requests:
    a. Electricity storage resources are required to submit planned outage requests through the online outage management system (CROW) detailing their commissioning test plans for the planned injections of energy and for the planned withdrawals of energy.
    b. In accordance with the Three-Day Advance Approval Process, planned outage requests must be submitted by the MP at least 5 business days before the start of the planned commissioning date(s).
2. Dispatch Data Requirements for Injections:
    a. During commissioning, storage generation resources are treated as self-schedulers for the purposes of scheduling.
    b. The MP must submit self-schedules during commissioning to indicate their planned injections, in accordance with the commissioning test plans detailed in the planned outage.

c. Any divergence in injections should be reflected in the submitted self-schedules and planned outage test plan as soon as possible.

3. Dispatch Data Requirements for Withdrawals:

    a. During commissioning, storage load resources are treated as non-dispatchable loads (NDL) for the purposes of scheduling.

    b. The MP should not submit bids to withdraw energy during commissioning. However, energy withdrawals should align with the commissioning test plans detailed in the planned outage.

    c. Divergence in withdrawals by more than 20 MW should be reflected in the planned outage test plan as soon as possible.

4. Contacting the Control Room:

    a. The IESO Control Room has two areas of responsibility, Markets and Systems.

    b. MPs should refer to the relevant IESO Training Guides to confirm when it is appropriate to communicate with the Markets or Systems side of the Control Room.

Additional details can be found in MR Ch.7 s.2.2D.6 and MM 7.3. s 3.7.4, 5.1.3 & Appendix A. Additional commissioning details will also be shared, when the MP has reached the appropriate registration stage. This includes exchanging information that will help the IESO to properly validate the facility modelling and its inclusion in the operational and planning tools and to confirm the performance requirements included in the MR.

For any questions about stages (4) to (6), please contact IESO Market Registration at market.registration@ieso.ca.

4.2 Further Reading

Market Manual 1.4: Connection Assessment and Approval

Market Manual 1.5: Market Registration

Market Manual 3.7: Totalization Table Registration

Market Manual 4.3: Operation of the Real-Time Market

Market Manual 7.3: Outage Management

Market Rule Chapter 7: System Operations and Physical Markets

Guide to Prudentials at the IESO

5. Participating in Day-Ahead and Real-Time Markets

The IESO administers a series of markets and related programs that together comprise the province's wholesale electricity marketplace. The following sub-sections summarize key aspects relating to both DAM and RTM participation.

5.1 Day-Ahead Markets

A DAM for electricity is where MPs submit bids and offers a day in advance of operations to secure schedules and prices for the following day. A DAM is a standard component of many electricity markets in North America and around the world. In these markets, most of the supply is scheduled in the DAM and the real-time market is used to balance any deviations that occur between day-ahead and real-time. A DAM for energy and OR encourages efficient market participation by providing MPs with an opportunity to lock in a day-ahead price for their day-ahead schedules.

Day-ahead scheduled transactions are settled at day-ahead prices meaning they are "financially binding". Day-ahead schedules and prices, however, are based on forecasts of next day demand and system conditions, both of which can change by the time real-time comes along. As such, actual real-time operations may need to be different than what was scheduled day-ahead. Real-time, therefore, serves as a balancing market to settle deviations between day-ahead schedules and actual real-time operations. This process of settling both the DAM and the RTM is called "two-settlement."

The DAM operates in Eastern Prevailing Time (EPT). On each pre-dispatch day, MPs submit dispatch data between 06:00 EPT and 10:00 EPT, which is also known as the DAM submission window. Once the DAM submission window closes at 10:00 EPT, the DAM calculation engine starts running. From 10:00 EPT to 13:30 EPT, with limited exceptions, MPs cannot make any revisions to their dispatch data submissions for the next dispatch day. This is known as the DAM restricted window. This allows sufficient time for the calculation of schedules and prices to be completed. IESO approval is required for any new submissions or revisions to dispatch data for the next dispatch day within the restricted window. Such requests are only approved in the rare case of an IESO tool failure that prevents the IESO from receiving dispatch data submissions. If such a tool failure occurs, an advisory notice will be posted on the IESO advisory notice webpage.

For more information on the Day-Ahead Market please refer to MM 4.2.

5.2 Real-Time Market

The RTM continuously balances supply and demand in five-minute intervals by dispatching generation and load resources while procuring OR in accordance with established industry standards. Market prices reflect prevailing system conditions, including demand variability, transmission constraints, and resource availability.

The RTM calculation engine employs multi-interval optimization to determine both energy dispatch instructions and OR schedules every five minutes. The RTM operates in Eastern Standard Time (EST), all year round. This market also serves as the primary balancing mechanism for energy and operating reserve to settle any deviations from DAM schedules.

5.3 Further Reading

Market Manual 4.2: Operation of the Day-Ahead Market

Market Manual 4.3: Operation of the Real-Time Market

Introduction to Ontario's Physical Markets

Guide to IESO Market Calculation Engines

6. Submission of Dispatch Data and Self Schedules in Day-Ahead and Real-Time

Dispatchable generators and the injection resource of dispatchable electricity storage facilities submit offers to sell energy or to provide OR. Dispatchable loads and the withdrawing resource of dispatchable electricity storage facilities submit bids to buy energy or submit offers to provide OR. Self-scheduling electricity storage facilities, submit self-schedules for the injection resource and bids to buy energy in the DAM as a Price Responsive Load (PRL) for the withdrawing resource.

Collectively, all information included in bids, offers, or self-schedules are referred to as 'dispatch data.' Dispatch data includes several elements, not limited to but most notably: price/quantity pairs (for dispatchable resources), self-schedules (for self-scheduling resources), ramp rates, and the facility's 'Resource ID'.

MPs enter bids, offers, and self-schedules via the Energy Market Interface (EMI) in hourly blocks. Given that dispatchable electricity storage facilities are registered as both dispatchable generators and dispatchable loads, and self-scheduling electricity storage facilities are registered as a self-scheduling generation resource(s) and PRL resource(s), when submitting dispatch data, you are expected to follow the generator, dispatchable load, and self-scheduling generation facility requirements as outlined by the following technical guides:

- Submitting, Revising and Cancelling Energy Bids
- Submitting, Revising and Cancelling Energy Offers
- Submitting, Revising and Cancelling Operating Reserve Offers
- Submitting, Revising and Cancelling Schedules and Forecasts

Note: these guides outline how electricity storage participants participating in real-time markets are to submit dispatch data. MPs should, however, refer to MR Ch.7 s.3 and MM 4.1 to understand their obligations under the market rules and associated policies when submitting, revising or cancelling dispatch data, with specific attention to the details around signaling state of charge capability changes in the IESO's mandatory window and real-time energy and OR dispatch data obligations.

6.1 Energy Market Participation

Electricity storage facilities participating in the IESO energy market must be aware of specific operational and procedural requirements. These include, but are not limited to, how and when energy offers or bids can be revised, the appropriate use of Available Declaration Envelope (ADE) requests, and restrictions around submitting energy offers and bids in the same hour. For a comprehensive list of requirements, participants should refer to MR Ch.7 s.3 and MM 4.1.

6.1.1 Establishing Availability Declaration Envelope (ADE) and Applicable Reasons for ADE Expectations

Participation in DAM for energy[3] is a pre-requisite to participating in the RTM for energy during the ensuing dispatch day. It is through the DAM process that MPs will secure their ADE for the next dispatch day. The ADE represents the maximum quantity of energy that can be included in real-time dispatch data.

Like other dispatchable resources, dispatchable storage facilities are required to establish an ADE for their corresponding generator and load resources in the DAM for any dispatch hour that they want to inject or withdraw, respectively. Self-scheduling electricity storage resources, while not subject to ADE requirements or related subsequent restrictions, are also required to submit self-schedules or energy bids in the DAM if they intend to inject or withdraw energy the next day.

Establishing an ADE in DAM, allows MPs to later make revisions for submitted data (in accordance with applicable Market Rules), approaching Real-Time operations. If an ADE has not been established in DAM, MR Ch.7 s.3.1.14 outlines various reasons for when an ADE exemption shall be approved which include the following:

- The resource returns from an outage earlier than planned.
- The IESO has solicited additional offers or bids.
- The increase is required to prevent the resource from operating in a manner that would endanger the safety of any person, damage equipment, or violate any applicable law.

Reasons other than those listed above, or in MR Ch.7 s.3.1.14, for receiving an ADE exemption are not valid, and such requests will be rejected by the IESO.

6.1.2 Energy Offer/Bid Revision Restrictions

When revising daily or hourly dispatch data, MPs must be aware that restrictions may apply depending on the timing of the revision. These restrictions determine how offer or bid values can be changed and whether the IESO will accept the modifications. For example, changes made before the Mandatory Window (more than two hours before real-time) are generally unrestricted, while changes inside the Mandatory Window (closing ten minutes prior to the start of the dispatch hour) requires IESO approval and may be subject to specific criteria outlined in the applicable Market Manuals.

Figure 1 and **Figure 2**, illustrate a basic overview of the timeframes when restrictions apply for how dispatch data may be changed, for Daily and Hourly dispatch data.

[3] DAM participation for OR is not a pre-requisite for participating in the real-time market for OR.

Figure 1 | Daily Dispatch Data Revision Restrictions

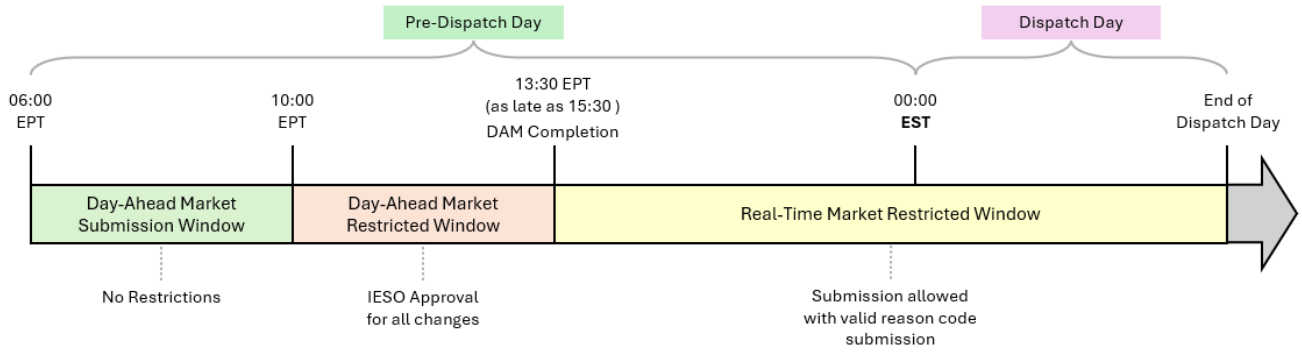
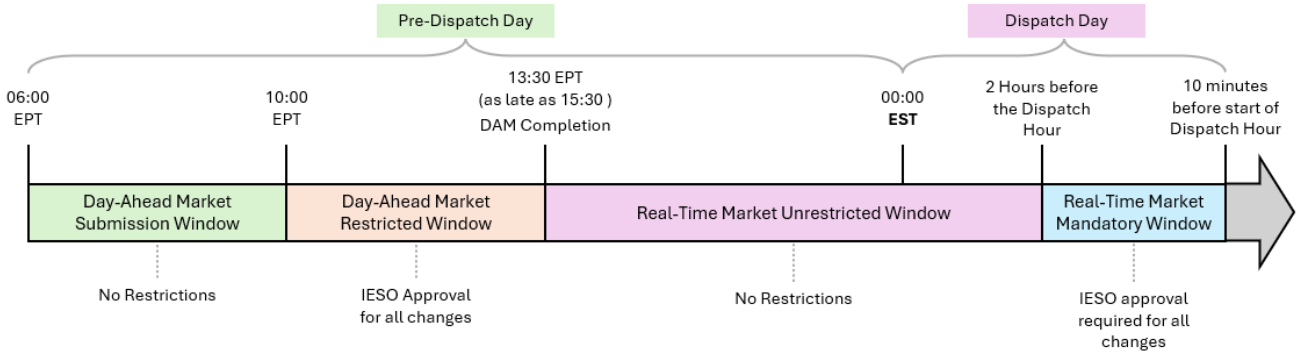


Figure 2 | Hourly Dispatch Data Revision Restrictions



6.1.3 No-Overlapping Rule

When submitting both an energy offer and energy bid for an electricity storage resource in the same hour, it is important to offer and bid in accordance with the "no-overlap rule". The "no-overlap rule" stipulates that no single bid price in the bid curve of that electricity storage resource may be equal to or greater than the lower of: (i) any offer price of that electricity storage resource and (ii) the lowest price in that electricity storage resource's energy offer reference level value. See MR Ch.7 s.21.4, for additional details.

Figure 3 illustrates an example bid and offer curve for an electricity storage resource. The diagram on the left is an invalid submission of offer and bid dispatch data, while the diagram on the right is a valid submission.

Figure 3 | Examples Illustrating Invalid & Valid Bid/Offer Curve Submission

6.1.4 Energy Ramp Rate Instruction

Electricity storage facilities are critical assets in supporting system reliability and restoring the network during contingencies due to their fast, near-instantaneous ramping capabilities. However, while these fast-acting characteristics are beneficial in contingency response, they can pose challenges to system stability under normal operating conditions. Such behavior can negatively impact the Area Control Error (ACE), which the IESO must manage in accordance with North American Electric Reliability Corporation (NERC) standards.

To mitigate adverse impacts and maintain balance, all electricity storage facilities shall be limited to a maximum ramp rate of **100 MW/minute (1.67 MW/second)** when responding to 5-minute energy dispatch instructions. This maximum rate applies equally when injecting (discharging) or withdrawing (charging) active power. This limit applies exclusively to 5-minute energy dispatch signals and does not apply to the facility's response to operating reserve activations, frequency excursions, voltage changes, or Remedial Action Scheme runbacks.

6.1.5 Managing State-of-Charge

In absence of SoC modeling in the IESO's tools under the two-resource storage model, electricity storage MPs are responsible for managing their resource's SoC during day-to-day operations by means of their dispatch data.

Maximum Daily Energy Limit

The Maximum Daily Energy Limit (MaxDEL) dispatch data parameter may be utilized by electricity storage participants to indicate the total amount of energy that a dispatchable storage resource registered to inject can supply within a dispatch day. Utilizing MaxDEL to reflect a resource's state of charge limitations will limit the schedules to inject from the **DAM and pre-dispatch calculation engines** and ensure the resource is not scheduled beyond a feasible amount of energy for the day.

When entering a MaxDEL, participants should use 'fuel availability' as a reason code. Entering zero indicates that no energy is available from the resource, and if no value is submitted, it will be assumed that the resource has unlimited energy. The MaxDEL can also be revised in the pre-dispatch timeframe to more accurately reflect any changes to fuel availability (e.g., the MaxDEL may be increased to signal an increase of the state of charge) and the intention of operation for the dispatch hour.

Energy Bids and Offers

Effective SoC management is also facilitated through modifying bids and offers, which differs procedurally across different timeframes: **before the Mandatory Window**, **inside the Mandatory Window**, and **after the close of the Mandatory Window**. It is essential that participants take proactive steps as early as possible when they identify that future dispatch instructions may not be feasible based on the projected SoC of their resource.

6.1.5.1 Before the Mandatory Window

Before the Mandatory Window, defined as the period more than two hours before real-time operations, MPs may modify bids and offers without IESO approval, subject to applicable Market Rules. During this time, a MP should assess future pre-dispatch schedule feasibility, and if they determine their resource may not be able to follow dispatch instructions due to SoC limitations, they should withdraw energy and/or OR offers or bids accordingly. This helps the IESO maintain accurate visibility of system conditions and improves overall dispatch efficiency.

When making changes to dispatch data in EMI to manage SoC limitations, such changes should be accompanied by the OTHER Reason Code with "**SOC**" entered into the OTHER REASON field.

6.1.5.2 Inside of the Mandatory Window

Once inside the Mandatory Window (i.e., within two hours of real-time operations), any changes to bids and offers require approval from the IESO Control Room. Effort should be made to assess before the mandatory window, if possible, but if a MP determines that future dispatches are not feasible due to SoC constraints within the mandatory window, they must submit the appropriate revisions in EMI for approval. Such revisions should be submitted as early as possible, and ideally no later than 5 minutes before the mandatory window cut-off (i.e., fifteen minutes prior to real-time operations) to allow sufficient time for IESO operators to review and approve the changes prior to the closing of the mandatory window (i.e. ten minutes prior to real-time operations). A telephone call to the IESO Control Room **is not** required to report revisions in hourly energy bid and offer quantities required to manage limitations due to SoC. However, participants are required to notify the IESO Control Room for any revisions to OR offers, or for energy bid or offer revisions unrelated to SoC. Note, only **quantity reductions and withdrawals** are permitted to bid and offers; price changes are not allowed. Per Section B.7 of MM 4.1 Appendix B, such revisions in EMI should be accompanied by the OTHER Reason Code with "**SOC**" entered into the OTHER REASON field.

6.1.5.3 After the Close of the Mandatory Window

Despite best efforts to forecast SoC limitations ahead of time, there may be situations where an electricity storage resource is unable to follow dispatch instructions in real-time (i.e., during the current dispatch hour) due to SoC limitations. In such cases, MPs must act promptly to ensure compliance to support system reliability. Below are two common scenarios and the appropriate actions to take:

Scenario 1 - Electricity storage resource reaches maximum SoC in the current hour when acting as a dispatchable load

Under this scenario, the MP should:

1. Contact the IESO Control Room as soon as possible
2. Revise dispatch data (bids) in EMI to reflect the resource's expected capability in **future hours**
    a. Note: For bid changes within the Mandatory Window for future hours, changes should adhere to the criteria as mentioned in MM 4.1 App. B Table B-2.
3. Reject any further dispatches to consume in the current hour, as needed.

Scenario 2 - Electricity Storage resource reaches minimum SoC in the current hour when acting as a dispatchable generator

Under this scenario, the MP should:

1. Contact the IESO Control Room as soon as possible
2. Submit a derate/outage slip to reflect the resource's availability and drive proper dispatches for the remainder of the current hour (and next hour if the request was made after the close of the Mandatory Window for the next hour)

3. Revise dispatch data (offers) in EMI to reflect the resource's expected capability in **future hours**
    a. Note: For offer changes within the Mandatory Window of future hours, changes should adhere to the criteria as mentioned in MM 4.1 App. B Table B-2.
4. Reject any further dispatches to inject in the current hour, as needed.

6.1.6 Electricity Storage Facility Load Status Restrictions

Under MR Ch.7 s.3.3.3.1 and MM 4.1 s.2.4.1, electricity storage facilities with a dispatchable load component are **not permitted** to change their load status to non-dispatchable.

6.2 Operating Reserve Market Participation

The IESO operates three OR markets:

- 10-minute synchronized (10S)
- 10-minute non-synchronized (10N)
- 30-minute reserve (30R)

Dispatchable electricity storage facilities may elect to offer any class of OR on solely a generation resource, on solely a load resource, or on both a generation resource and a load resource (subject to bid and offer restrictions specified below). Electricity storage facilities participating in OR markets must coordinate their participation in both the energy and OR markets and meet specific requirements related to how OR is offered. This includes bid and offer restrictions in the same and subsequent dispatch hours, duration of service obligations, and Reserve Loading Point submissions. These requirements vary depending on whether the electricity storage facility is offering OR as a generator or as a load. For full details, refer to MR Ch.7 s.3.6 and 21.6 and MM 4.1 s.3.2 and App. A.3.

6.2.1 Bid & Offer Restrictions

When offering OR as a **generator** for a dispatch hour, the electricity storage facility:

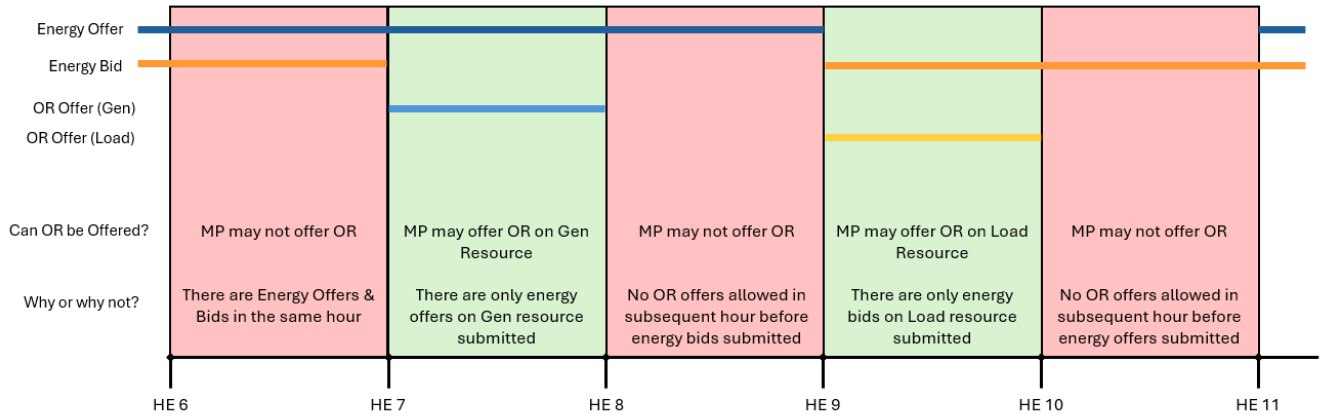
- must submit a corresponding energy offer for at least the same MW quantity as the OR offer.
- cannot simultaneously offer OR as a load or bid as a load in the Energy market during the same dispatch hour and the subsequent dispatch hour.
- must be able to sustain the level of OR offered for at least one hour when activated.

When offering OR as a **load** for a dispatch hour, the electricity storage facility:

- must submit a corresponding energy bid for at least the same MW quantity as the OR offer.
- cannot simultaneously offer OR as a generator or offer as a generator in the Energy market during the same dispatch hour and the subsequent dispatch hour.
- must be able to maintain a zero-consumption level for at least one hour when activated.

Figure 4 illustrates an example scenario where an electricity storage facility submits energy offers, energy bids, and operating reserve offers on both the generator and load resource, over several hours, following the rules mentioned above.

Figure 4 | Offer & Bid Restrictions Example



6.2.2 Duration of Service

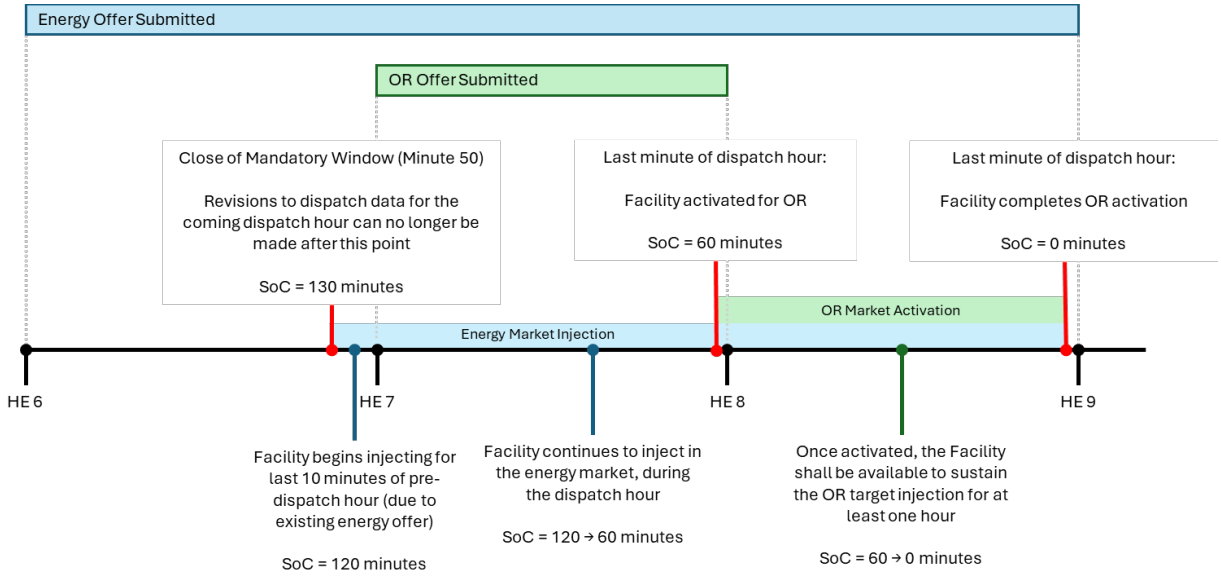
To ensure reliability, electricity storage facilities must maintain sufficient duration of service when offering OR. This requirement is assessed at the end of the real-time Mandatory Window (i.e., 10 minutes prior to the applicable dispatch hour). The duration of service requirement depends on whether the electricity storage participate is offering OR as a generator or as a load.

When offering OR as a generator, the electricity storage facility must have at least 130 minutes of available energy at the end of the Mandatory Window for the applicable dispatch hour. This is to account for the following:

- 10 minutes: Time between Mandatory Window close and start of the dispatch hour
- 60 minutes: Potential activation as late as minute 59 of the dispatch hour
- 60 minutes: Obligation to be available to sustain an OR activation for at least one hour

Figure 5 illustrates the required 130 minutes of available energy for generator resources, when offering OR.

Figure 5 | Generator Resource Available Energy

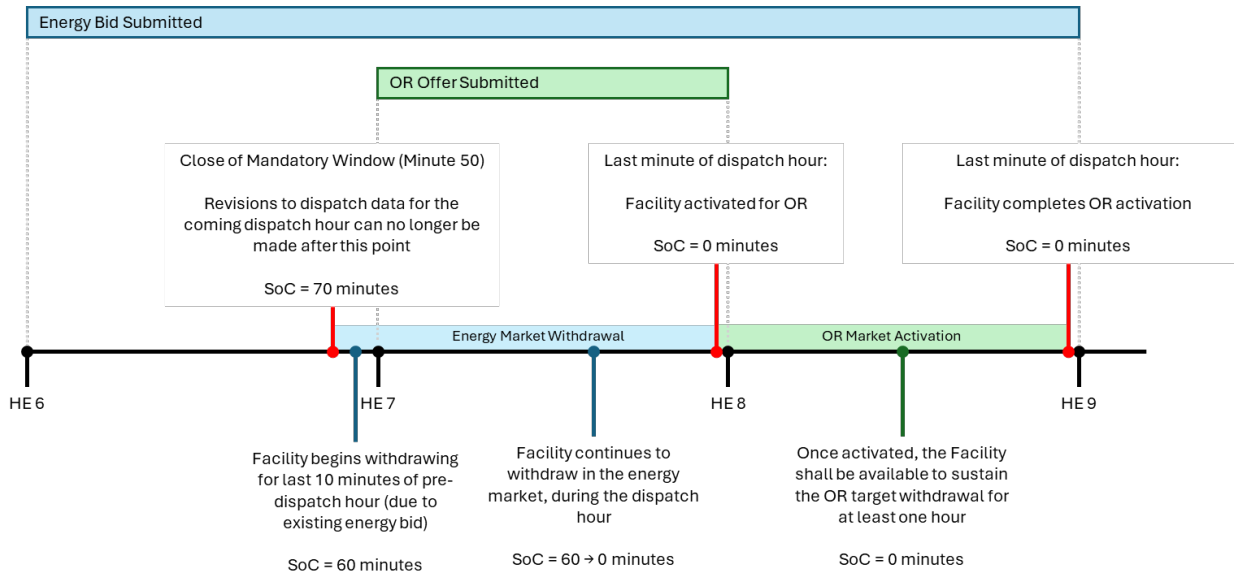


When offering OR as a load, the electricity storage facility must have at least 70 minutes of available energy at the end of the Mandatory Window for the applicable dispatch hour. This is to account for the following:

- 10 minutes: Time between Mandatory Window close and start of the dispatch hour
- 60 minutes: Potential activation as late as minute 59 of the dispatch hour

Figure 6 illustrates the required 70 minutes of available energy for load resources, when offering OR.

Figure 6 | Load Resource Available Energy



6.2.2.1 Duration of Service Example

The following example (**Figure 7**) illustrates why sufficient duration of service is required when offering OR into the market. In this scenario, it is assumed that a 200 MW / 800 MWh BESS, with 50% SoC available (400 MWh), offers and gets scheduled in the following manner:

Figure 7: Duration of Service Scenario

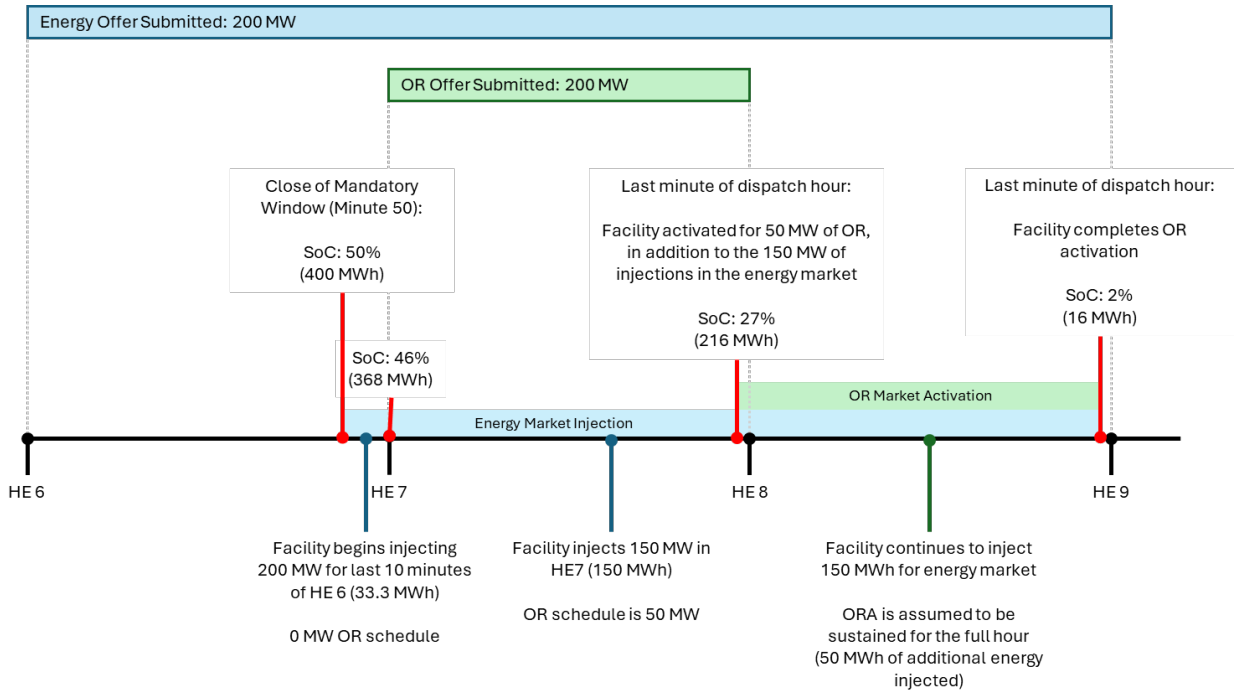


Table 1: Duration of Service Scenario Summary

	HE6	HE7	HE8
Energy Offered (MW)	200	200	200
OR Offered (MW)		200	
Energy Injected (MWh)	33	150	150
OR Scheduled (MW)		50	
OR Activated (MWh)			50*

*OR is activated in the last minute of HE7

In this scenario, a 50% SoC at the close of the Mandatory Window for the applicable dispatch hour was sufficient to comply with both the energy and OR dispatches received by the electricity storage resource. If the SoC would have been less than 48%, the electricity storage facility would have had insufficient duration of service to fulfil its dispatches and hence would have been required to adjust their offers in accordance with Section 6.1.5 to ensure feasibility.

6.2.3 Reserve Loading Point

For conventional generators offering 10S reserve, a minimum energy output, represented as the **Reserve Loading Point (RLP)**, is required to provide their full OR schedule. However, due to the flexible nature of electricity storage facilities, they can still provide 10S from an idle position (i.e., at a 0 MW setpoint) in the energy market.

As a temporary workaround to accommodate this operational characteristic, an electricity storage facility offering 10S reserve as a **generator** can:

- submit the minimum allowable RLP value of 0.1 MW in accordance with MM 4.1 s.3.1.4.
- maintain its idle position despite the resulting 0.1 MW energy dispatch.

When offering OR as a **load**, a RLP is not applicable, and the value submitted for any class of OR must be equal to 0 MW.

6.2.4 Modifying Operating Reserve Offers

Participants are to modify or withdraw their OR offers, including in the Mandatory Window, if they are unable to provide the full amount of OR, or if the duration of service requirement is not met.

6.3 Further Reading

Market Manual 4.1: Submitting Dispatch Data in the Physical Markets

Market Rule Chapter 7: System Operations and Physical Markets

7. Outage Management

MPs must request permission and receive advance approval from the IESO for any planned outages to ensure that there is no adverse impact to the reliability and/or operability of the IESO-controlled grid. Outage requests are submitted via the Control Room Operations Window (CROW) outage coordination and scheduling system. All other non-planned outages (i.e., forced, urgent, information and opportunity outages) can be submitted to the IESO as a notification or a late request for advance approval. The various outage types are listed below:

Outage Type	**Description**
Forced	Non-discretionary outages on equipment that has been automatically or manually removed from service for equipment protection, public safety, environmental concerns or regulatory requirements are classified as forced outages. Such outages have little to no timing flexibility and have precedence.
Urgent	Non-discretionary outages on equipment that must be manually removed from service for equipment protection, public safety, environmental concerns or regulatory requirements are classified as urgent outages.
Planned	Discretionary outage requests that are scheduled to perform preventive maintenance, repairs, inspections, de-staffing and testing for facilities/equipment are classified as planned outages.
Opportunity	Outage requests where market participants are presented with an unexpected opportunity to accomplish work that was not previously planned.
Information	Outages that are exempt from typical submission requirements but are submitted for informational purposes only.

7.1 Further Reading

Market Manual 7.3: Outage Management

8. Policies and Procedures Relating to Reliability Operations of the IESO Controlled Grid

MPs play an important role along with the IESO in ensuring the reliable operations of the IESO-controlled grid. As such, the IESO has established various procedures and policies to guide market participants. These procedures and polices relate to adequacy and system security which are the components of reliability.

Adequacy refers to the ability of the power system to supply the electrical demand on the system, considering scheduled and reasonably expected unscheduled outages of system elements. System security refers to the ability of the power system to withstand sudden disturbances or unanticipated loss of elements.

MM 7.1 documents the key procedures used by the IESO and MPs to ensure the reliability of the IESO-controlled grid. Here MPs can find their responsibilities and the IESO's responsibilities under various operating states and operating conditions, how they and the IESO Control Room should be communicating with each other under different situations and what is expected with respect to voltage control and frequency regulation.

MPs will also find in this manual the hierarchal list of control actions that the IESO can take leading up to and during an "emergency operating state." The actions taken by the IESO with regards to a MPs facility will be dependent on whether they are registered as a dispatchable electricity storage facility or a self-scheduling electricity storage facility.

MM 7.4 provides policies and principles used to guide the development of IESO procedures and control actions and can assist market participants in meeting their obligations in the operational time frame.

8.1 Contacting the IESO Control Room

If an electricity storage facility has been designated by the IESO through the registration process as a facility that has an impact on the reliability of the ICG, they should promptly report to the IESO all matters that affect the operation of the ICG. Communication shall be made by telephone to the IESO control room staff.

8.2 Further Reading

Market Manual 7.1: IESO-Controlled Grid Operating Procedures

Market Manual 7.4: IESO Controlled Grid Operating Policies

9. Market Power Mitigation

A competitive electricity market depends on fair and open participation from all market players. However, due to physical limitations in the transmission system and the need to maintain system reliability, there may be situations where a participant could influence market outcomes—this is known as market power.

To prevent this, the IESO has a Market Power Mitigation (MPM) framework in place. This framework helps ensure that no participant can unfairly benefit by withholding supply—either economically or physically.

- **Economic withholding** happens when a participant offers partial or all of their available supply at prices significantly above the IESO's reference levels.
- **Physical withholding** occurs when a participant chooses not to offer partial or all of their available capacity into the market.

When the IESO identifies potential market power behavior, it reviews both financial and operational data to determine whether mitigation is necessary. If mitigation is required, the IESO may replace the submitted offer with a mitigated offer based on reference levels to maintain competitive pricing and system reliability. For full details, refer to the MR Ch.7 s.22.

9.1 Reference Levels and Reference Quantities for Energy Storage Facilities

Determining reference levels and reference quantities is a prerequisite for dispatchable electricity storage resources to participate in the energy and OR markets. These reference levels and quantities serve as benchmarks for evaluating whether a facility's market offers reflect the exercise of market power. They are typically based on a combination of historical operating costs, technical characteristics, and external market data. By comparing submitted offers to these reference levels and quantities, the IESO can identify and mitigate potential market power, helping to ensure fair pricing and system reliability. For detailed guidance on preparing and submitting reference level data, participants should consult MM 14.2 or contact the IESO's Market Assessment and Compliance Division (MPM@ieso.ca) for support.

9.1.1 Reference Levels: Ex-Ante Mitigation

Reference levels are used to assess ex-ante market power mitigation for economic withholding to determine day-ahead schedules and pre-dispatch schedules for a dispatch day. The IESO may apply conduct and impact tests to assess economic withholding of energy and OR in any dispatch hour.

Reference Levels are determined for both financial and non-financial dispatch data parameters:

- **Financial Parameters**: A dispatchable electricity storage resource will have an energy offer reference level and an operating reserve offer reference level for the resource associated with its injections, and an operating reserve offer reference level for the resource associated with its withdrawals.

- **Non-Financial Parameters**: Energy and OR ramp rate reference levels are required for dispatchable electricity resources.

9.1.2 Reference Quantities: Ex-Post Mitigation

Reference quantities are used to assess ex-post market power mitigation for physical withholding in both or either of the day-ahead market and the real-time market for a dispatch day.

For the dual model storage resource, the energy reference quantity for the generation resource at the electricity storage facility is the resource's maximum potential output less outages or derates times 1 hour of discharging for each dispatch day. There is no energy reference quantity for the load resource at the electricity storage facility. Energy storage facilities offering in the OR market, either as a generator resource or load resource, have an OR reference quantity of 0 MW.

The IESO may apply conduct tests and impact tests to assess physical withholding of energy and OR. The physical withholding framework applies to all 24 hours of all dispatch days (i.e., there is no consideration of business days versus non-business days). Absence of an offer in a dispatch hour will be considered as 0 MW for the conduct test.

Example: Physical Withholding of Energy

The following example illustrates the physical withholding process for an electricity storage resource in the energy market:

- Per MM 14.2 s.9.6.1, the energy reference quantity for the generation resource at the electricity storage facility is the resource's maximum potential output less outages or derates times 1 hour of discharging for each dispatch day (i.e., Maximum Generator Resource Active Power Capability - Outage MW + Modifier). This means that the generation resource only needs to offer its available capacity for a minimum of one hour in the dispatch day with respect to physical withholding.
- A conduct test will be performed in any dispatch hour when criteria specified in MR Ch.7 s.22.15.4 is met (i.e., resource energy LMP >$25, resource capacity >10 MW, and one of Narrow Constrained Area, Dynamic Constrained Area, Broad Constrained Area or Global Market Power condition is present).
- If an electricity storage resource fails a conduct test for physical withholding in DAM or RTM, then the IESO will carry out the impact test to assess physical withholding pursuant to MR Ch.7 s.22.15.8 and MM 14.1 s.5.6.3.
- From all dispatch hours within a dispatch day where conduct test was failed, a single dispatch hour will be selected to carry out the impact test.
- Only if the impact test fails, the IESO will issue a first notice to communicate its findings of an instance of physical withholding and the procedural steps and timelines pursuant to MR Ch.7 s.22.15.18 will apply.

9.2 Further Reading

Market Rule Chapter 7: System Operations and Physical Markets

Market Manual 14.1: Market Power Mitigation Procedures

Market Manual 14.2: Reference Level and Reference Quantity (RLRQ) Procedures

10. Settlements

Market participants are settled based on their operations in the IAM. The following sub-sections highlight some aspects of the settlement process relevant to electricity storage facilities participating in the IAM.

10.1 Station Service Rebates

Electricity storage facilities in the IAM consume energy to support their own station service needs. Metered MPs for certain electricity storage facilities may be eligible for a reimbursement of the hourly uplifts and non-hourly settlement amounts related to the volume of energy consumed as electricity storage station service. Refer to MR Ch.9 ss.2.2.13 and 2.2.16 to find the eligibility requirements and the specific conditions for this rebate.

If an MP believes that their electricity storage facility is eligible for electricity storage station service rebate, they should:

- Download IMO_FORM_1419 "Application for Designation of a Facility for Station Service Rebate" from the IESO web site.
- Complete all applicable sections; and
- Submit the form to the IESO in accordance with MM 5.5 s.2.27.

The IESO will:

- review the application.
- request additional information in order to assess the application, if necessary.
- determine if the electricity storage facility meets the requirements for the rebate designation; and
- notify the MP in writing of our determination.

If an electricity storage facility meets the requirements for rebate designation, the IESO will adjust the hourly uplifts and non-hourly settlement amounts that may have accumulated at the electricity storage station service delivery point. As described in MR Ch.9 s.2.2.13, this occurs when the injection of energy by the electricity storage facility as a whole exceeds the withdrawal of energy by the electricity storage facility as a whole during a given metering interval, and such accrual of allocated quantity of energy withdrawn (AQEW), results in hourly uplift, non-hourly uplift settlement amounts, or both, accruing at the delivery point, during any metering interval within the energy market billing period.

Reimbursement amounts are calculated at month-end and are applied to the last trading day of the month on the preliminary settlement statement and the final settlement statement for each electricity storage facility as charge type 119 – Station Service Reimbursement Credit.

The offsetting charge type 169 – Station Service Reimbursement Debit is included on the preliminary settlement statement and the final settlement statement. As described in MR Ch.9 s.4.14.12, this charge will be allocated to all real-time load resources, electricity storage resources that are registered to withdraw, and exports based on their proportionate share of energy withdrawn (allocated and scheduled quantity of energy withdrawn).

See MM 5.5 for further details.

10.2 Transmission Charges

As determined in Ontario Energy Board Decision and Order EB-2022-0325, exemption to transmission charges for transmission-connected energy storage facilities when these facilities are scheduled for operating reserve, providing reactive power support, providing regulation service, responding to a real-time IESO energy dispatch, or responding to an IESO reliability directive to begin effective April 1, 2026.

10.3 Global Adjustment

A Class B electricity storage facility is defined in Ontario Regulation 429/04 as a Class B facility that withdraws electricity from the ICG or the distribution system of a licensed distributor for the sole purpose of storing the electricity temporarily and then conveying that electricity or a portion of that electricity back into the ICG or distribution system of a licensed distributor. The portion of electricity that is stored and conveyed back into the ICG or distribution system of a licensed distributor is exempt from Class B Global Adjustment (GA) charges. To receive the Class B charge exemption, MPs are required to provide a self-declaration, in the form of an email or a signed draft declaration, to attest that their facility meets the definition of a Class B electricity storage facility, as defined in Ontario Regulation 429/04. Please submit the form to settlement.support@ieso.ca.

Subject to compliance with all regulatory requirements, a Class B electricity storage facility may become eligible to participate in the ICI program (i.e., to be treated as a Class A facility) after the facility has registered withdrawals from the ICG or distribution system of a licensed distributor for the entire duration of a base period (i.e., from May 1 to April 30 of the following calendar year).

10.4 Charge Types and Equations

See MM 5.5 and MM 5.6 for settlement programs that apply to electricity storage and cross reference with applicable charge type in the IESO's Charge Types and Equations technical reference manual.

10.5 Further Reading

Market Manual 5.5: IESO-Administered Markets Settlement Amounts

Market Manual 5.6: Non-Market Settlement Programs

Charge Types and Equations

Introduction to the Settlement Process

11. Reliability Standards

MPs are required to comply with the market rules. MPs that meet the applicability criteria established by the IESO are also required, under the market rules, to comply with all reliability standards, including applicable North American Electric Reliability Corporation (NERC) Reliability Standards and Northeast Power Coordinating Council (NPCC) Criteria. NERC and NPCC are standards authorities that define the reliability requirements for planning and operating the interconnected North American Bulk Electric System. The IESO, through its Market Assessment and Compliance Division (MACD), monitors and enforces MPs' compliance with reliability standards.

For a high-level overview of the various documents and processes applicable to monitoring and enforcing compliance with reliability standards in Ontario, please refer to MM 11.0.

To understand how NERC reliability standards and NPCC criteria apply to an MP's facility, please refer to MM 11.1.

The Ontario Reliability Compliance Program (ORCP) is part of the larger Compliance Monitoring and Enforcement Program (CMEP) designed and executed in accordance with the MACD delegated authority to monitor and enforce compliance with market rules, including reliability standards. For more details about the ORCP, which encompasses all activities undertaken by MACD to monitor compliance with reliability standards, please refer to MM 11.2.

For a list of reliability-related information that is required to be shared between a MP and the IESO in relation to maintaining the reliability of the ICG, please refer to MM 11.3.

If an electricity storage facility has been deemed a Bulk Electric System facility by the IESO in accordance with MM 11.1 but the MP wishes to seek an exemption, they can submit a request to the IESO. For information on the Bulk Electric System exemption process and what is involved, please refer to MM 11.4.

The IESO has an obligation to maintain up-to-date models of the ICG, by ensuring resources' physical characteristics and performance are accurately represented. By extension, these models allow the IESO to reliably plan and operate the ICG. For information related to a MP's requirement for submitting relevant data to the IESO, as per applicable NERC Reliability Standards, please refer to MM 11.5.

If an MP has specific requirements related to reliability standards compliance, please contact the IESO at orcp@ieso.ca.

11.1 Further Reading

Market Manual 11.0: Reliability Compliance Monitoring and Enforcement Overview

Market Manual 11.1: Applicability Criteria for Compliance with NERC Reliability Standards and NPCC Criteria

Market Manual 11.2: Ontario Reliability Compliance Program

Market Manual 11.3: Reliability Information Catalogue

Market Manual 11.4: Ontario Bulk Electric System (BES) Exception

Market Manual 11.5: Model Validation of Generation and Energy Storage Facilities and Other Devices

12. Reliability Outlook and Reliability Assessments Information Requests

To help the IESO prepare and publish its Reliability Outlook, where security and adequacy are assessed over an 18-month period, a MP will need to provide information about its facility annually between March 1 and April 1 or as soon as possible when material changes are anticipated. If delays in receiving this information occurs, the IESO reserves the right to follow up with the MPs who did not submit on time and/or ask for clarification pertaining to the information obtained. For more information about this process, please refer to MM 2.11.

MPs will also need to provide the IESO information about their facility and its plans for the period beyond the 18-month period for the period covering the next 10 years and 6 months starting from July 1 of the current calendar year. This information is to be submitted annually between March 1 and April 1. For more information about this process, please refer to MM 2.8.

Electricity storage participants with further questions regarding either of these processes can contact the IESO via forecasts.assessments@ieso.ca.

12.1 Further Reading

Market Manual 2.8: Reliability Assessments Information Requirements.

Market Manual 2.11: Reliability Outlook and Related Information Requirement

13. Participation Requirements for Elective Programs

The IESO has elective programs that electricity storage facilities may be able to participate in. Each of these programs have unique participation requirements and could require additional operational needs from the MP if actively participating in them. Additional information on these elective programs and their requirements is detailed in the following sub-sections.

13.1 Compliance Aggregation Program

The IESO's Compliance Aggregation Program (CAP) allows participants to aggregate resources, particularly those that do not qualify for model aggregation, for the purpose of compliance monitoring. Through CAP, dispatch instructions can be shared among authorized resources, providing operational flexibility while maintaining compliance with IESO requirements. Both electricity storage resources registered to inject and withdraw may be eligible to participate in the CAP.

13.1.1 Further Reading

Market Manual 1.5: Market Registration

Market Manual 3.7: Totalization Table Registration

Market Manual: 4.3: Operation of the Real-Time Market

IESO's Market Rule Interpretation Bulletin (IMO_MKRI_0001 Version 7.0)

13.2 Capacity Export Requests

MPs could be eligible to participate in Capacity Export Opportunities with their injection unit (i.e., generator resource), subject to Market Rules, Market Manuals, and IESO approval.

MPs with Ontario-based generating capacity that the IESO has determined to be surplus to Ontario's reliability and planned resource adequacy requirements have the opportunity to export their surplus capacity to designated external control areas during specified periods of time.

These MPs (referred to as Prospective Capacity Sellers) are required to secure IESO approval before they can participate in a Capacity Export Opportunity.

Electricity storage participants with further questions regarding this program can contact the IESO via Operational_Assessments@ieso.ca.

13.2.1 Further Reading

MPs can find more details about this program and which external control areas are currently participating in Market Manual 13.1: Capacity Export Requests.

13.3 Capacity Auction

Capacity auctions acquire capacity for a one-year commitment period, which consists of up to two obligation periods. Capacity auction participants may acquire capacity obligations in either one or both obligation periods.

MPs may be eligible to participate through the use of their generator resource if they have a non-committed dispatchable electricity storage facility.

Electricity storage participants with further questions regarding this program can contact the IESO via customer.relations@ieso.ca.

13.3.1 Further Reading

Market Manual 12.0 Capacity Auction

Guide to Capacity Auction Activities via Online IESO

Capacity Auction: How to Submit a Capacity Qualification Request

– End of Document –

Independent Electricity System Operator
1600-120 Adelaide Street West
Toronto, Ontario M5H 1T1

Phone: 905.403.6900
Toll-free: 1.888.448.7777
E-mail: customer.relations@ieso.ca

ieso.ca

@IESO_Tweets
linkedin.com/company/IESOs

ieso
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