

Enabling Resources Program: Storage and Hybrid Integration Project

Connection and Registration Design

Memo 2.0

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Engagement Topic: Connection and Registration Design Element for Storage Resources

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Purpose

The purpose of this document is to provide details on the IESO's market design work with respect to the Connection and Registration 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, will be discussed with stakeholders.

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List of Abbreviations

Abbreviation	Definition
AMP	Authorized Market Participation
BESS	Battery Energy Storage Systems
CAA	Connection Assessment and Approval
CMB	Commercial Model Build
CR	Control Room
CRO	Control Room Operator
CROW	Control Room Operations Window
DMSR	Dual Model Storage Resource
DP	Delivery Point
DSO	Dispatch Scheduling and Optimization
EMS	Energy Management System
ERS	Equipment Registration Specialist
ESFA	Energy Storage Facility Agreement
ESSR	Energy Station Service Reimbursement
IAM	IESO administered market
ICG	IESO-Controlled Grid
LMP	Locational Marginal Pricing
MaxSoC	Maximum State of Charge
MinSoC	Minimum State of Charge
MDMS	Meter Data Management System
MIM	Market Information Management system
MP	Market Participant
NDL	Non Dispatchable Load
NM	Network Model
NMB	Network Model Build
OEB	Ontario Energy Board
OMB	Online Model Build
OR	Operating Reserve
PD	Pre-dispatch
S/H	Storage/Hybrid
SIA	System Impact Assessment
SLD	Single Line Diagram
SMSR	Single Model Storage Resource
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 started with the core Optimization element within the Grid and Market Operations module, which is the main precursor to design decisions that support other design modules and elements. The design elements under the Grid and Market Operations module clarify how the storage facility participates in energy and Operating Reserve (OR) markets. This includes what the IESO requires to dispatch resources and consider in the optimization engine across all timeframes.

Phased Approach

The Storage and Hybrid Integration Project has adopted a phased delivery approach to expedite and prioritize the implementation of essential functionality, including:

- Single Model Storage Resource (SMSR);
- State of Charge (SoC) Management.

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

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

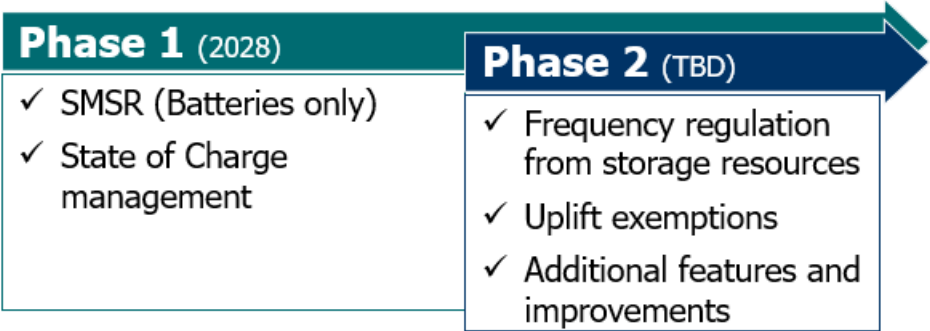


Figure 1: Project Scope

The IESO is targeting a 2028 Phase 1 implementation date.

Scope of Connection and Registration Phase 1 Design

For Phase 1 of the enhanced market design, the IESO will focus on Battery Energy Storage Systems (BESS), i.e., electro-chemical storage resources whose sole purpose is withdrawing electricity from the electricity system, storing that electricity and re-injecting it into the electricity system. The scope of design modules and elements for Phase 1 design is depicted in Figure 1 above with this document focusing on Connection and Registration.

In subsequent phases, the IESO will consider the applicability of other types of storage technologies and potential nuances that may require additional/different parameters.

The IESO’s focus is on single-site, dispatchable storage resources. As registered facilities in the IESO-administered markets (IAMS), each BESS facility should directly interface with the IESO and may be transmission or distribution connected.

	Design Module	Design Element
Batch 1	Grid and Market Operations	<ul style="list-style-type: none"> • Optimization (Energy & Operating Reserve)
	Connection and Registration	<ul style="list-style-type: none"> • Connection Assessment and Approval • Market Registration
Batch 2	Grid and Market Operations	<ul style="list-style-type: none"> • Dispatch Data and Other Inputs • Operations Integration
	Market Power Mitigation	<ul style="list-style-type: none"> • Ex-Ante • Ex-Post
	Settlements	<ul style="list-style-type: none"> • Market Settlement
	Contracts	<ul style="list-style-type: none"> • Contract Impacts
Batch 3	Hybrids	<ul style="list-style-type: none"> • Market rules need to be adjusted for the co-located hybrid model with the integration of the new storage model

Figure 2: Design Modules and Elements for Phase 1

Design Principles and Methods

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;
- **Implementation** - 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.

Method

The design and integration of storage will be organized in a build-to-bill format called modules (representing larger functions) and elements (specific functions within a module). The build-to-bill modules and elements are specific to the market participant (MP) 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 based on project dependencies and priorities (i.e., not in a chronological format of a typical build-to-bill decision-making process).

High Level Storage Optimization Design Decisions

The following decisions for the Optimization design element of Phase 1 will be valid for providing Energy and OR services:

- Storage resources will be able to participate in energy and OR from both the injection and withdrawal side of the resource, if they have sufficient capability. Branching from withdrawal to injection within an OR offer will be permitted, under feasible circumstances.
 - Optimization will include the entire offer range to schedule charging and discharging of storage resources for energy and OR. For energy, the offer curve will start from a negative quantity for charging and increase towards the positive direction for discharging. For OR, the offer will span from 0 MWs to positive MWs. OR offer quantities will never be negative because when the storage is discharging, it increases its MWs to provide OR, and when it is charging, it must decrease its charging MWs or stop charging to provide OR.
- The IESO will utilize the following variables to set SoC constraints:
 - SoC Tracker – a rolling total of SoC across hours or intervals;
 - Initial SoC – pre-dispatch (PD) estimate to the next dispatch day, or MP submitted;
 - Min/Max SoC limits – Max and min that a battery resource may be scheduled or dispatched to;
 - Cycle efficiency – energy losses resulting from dispatching the battery; square root of this value is applied on both withdrawals and injections.

Connection & Registration Background

Connection and registration are the two primary elements required to initiate participation in the IESO-controlled grid (ICG). Prospective participants must connect, authorize and register their equipment prior to participating in the market, and the impacts from ERP design will have some impacts on these procedures.

Connection Assessment and Approval

Prospective participants planning to establish or modify a connection to the ICG must obtain IESO approval through the Connection Assessment and Approval (CAA) process. The CAA process enables the IESO to assess the impact of new or modified connections to the ICG on the reliability of the integrated power system.

Overview

Connection Assessment and Approval will encompass all processes and elements included in:

- Prepare Application;
- Obtain conditional approval to connect;
- Design and Build.

The Prepare Application process is the first step in connecting a new resource to the ICG. Outlined on the IESO website (ieso.ca), this process involves identifying the connection points and preliminary design requirements of the new or modified connection facility, undergoing the applicable Distributor's Connection Impact Assessment and preparing a Connection Assessment with the IESO and Transmitter.

Once an application has been submitted and reviewed, qualifying applicants must submit a System Impact Assessment (SIA) and deposit to the IESO. The IESO's Connection Assessment team will evaluate the SIA application to determine if the applicant is eligible for an expedited process and will prepare an SIA agreement for execution by the applicant.

The team will assess the impact of the proposed new or modified connection on the reliability of the integrated power system and issue a draft SIA report to the connection applicant and the transmitter for review and comments. Finally, the Connection Assessments team will issue a Notification of Conditional Approval or Notification of Disapproval with Reasons with the final SIA report.

Limited changes are expected to the SIA application as it already refers to electricity storage resources. Existing single line diagram (SLD) requirements are standard and will not be affected by the design. The Connection Assessments team still requires the connection applicant to include Interconnection Data, System Specification and the equipment datasheet provided by the battery manufacturer.

Organization Authorization

Prior to registering equipment and resources at a facility, an organization must register and authorize with the IESO. This includes registering the organization with the IESO, being authorized to participate in the IAMs or programs and providing prudential support.

Register an Organization

Prospective MPs initiate the Register Organization process by submitting information about their organization through the [Register Organization](#) webpage. An organization is expected to provide typical business information (Name, address, HST number, intent of registration, etc.). Additionally, the organization must provide a signed participation agreement and mandatory contacts for the organization.

Once the Register Organization process is complete, the organization will access Online IESO to start the Authorize Market Participation process.

There are no changes to the Register Organization process as a result of storage/hybrid (S/H) Optimization Design.

Authorize Market and Program Participation

An organization must be authorized by the IESO to participate in the IAMs or programs, or to connect a physical facility to the ICG. This process assigns an Equipment Registration Specialist (ERS) in Online IESO by the owner of the facility. The ERS is responsible for submissions of facility and equipment details, covered explicitly in the Record Equipment section. MPs are responsible for submitting an Ontario Energy Board (OEB) operating license.

Electricity storage resources are currently authorized for participation in the market as Electricity Storage Participants, and no changes to the authorized market participation (AMP) process is required. Existing Electricity Storage participation type continues to apply.

Set and Monitor Prudential Support

Prudential support is required in the IESO market to protect the IESO from consumers of electricity that are not able to pay for the electricity they have consumed.

Set Prudential Support handles the work or tasks undertaken by the IESO and MPs in relation to the initial and ongoing assessment of MPs' prudential support obligation. The prudential obligation is calculated based on inputs such as expected injection and/or withdrawals for the highest exposure month (i.e., maximum net exposure).

Resources that supply energy or are net creditors may have a prudential obligation of zero. Prudential support is currently required from storage participants. The assumption is that a storage participant will be a net debtor as the withdrawals are greater than injections resulting from operational losses and various auxiliary loads. The storage participants may request a reassessment of their physical market prudential obligation if they've demonstrated to be a net creditor.

The Monitor Prudential Support process relies heavily on settlement outcomes. Specifically, it uses settlement data to monitor an MP's exposure to the market.

As a result of the introduction of bi-directional resources, the business must ensure that MP dispatch data (withdrawal and injections) is captured in the monitoring tool. Along with understanding any new types of settlement information that will be provided because of ERP implementation, any modifications to existing exposure calculations must be evaluated to properly account for negative generation as well as any SoC implications.

Register Facilities, Resources, and Equipment

The information collected in this stage is necessary to ensure the reliability of the ICG. An organization should begin the process to register their facility equipment in [Online IESO](#) prior to its first energization to the grid. Organizations are required to start their registration activities in advance of the minimum time periods specified in the [Registration Timelines Guide](#).

An MP will initially register equipment, resources and facilities. These will be rolled up into a resource to participate in the energy market. Once a resource has completed commissioning, they can submit a request to participate in OR. Dispatchable generation and load resources at a facility with storage capability would continue to be eligible to provide offers for OR.

As a result of optimization, several resource registration parameters will be introduced or updated. A list of these new/updated parameters is available in Table 1 below.

Table 1: Registration Parameters

Parameter	Units of Measure (if applicable)	Description	Existing for other dispatchable generation resources / Proposed New Storage-specific Parameter	Value Range	Note
Resource Primary Fuel Type	Electricity	Used to ensure that the correct data is populated into the engine.	Existing		
Bid/Offer Type	Dispatchable generation, self-scheduling generation or intermittent generator	Indicator for how the MP will bid in the IAM	Existing		Must consider how to ensure that appropriate flags are applied to support the new dispatchable SMSRs, while also maintaining existing two resource paradigm for some storage resources.
Resource Type	Generation resource (GEN)	Indicator for the type of resource associated with a registered facility, which will be used for submission of dispatch data and to validate that the registered MP is submitting the appropriate dispatch data parameters for the resource type	Existing		

Parameter	Units of Measure (if applicable)	Description	Existing for other dispatchable generation resources / Proposed New Storage-specific Parameter	Value Range	Note
Bi-directional Resource Flag	Boolean (Yes/no)	Determines whether a resource has both a positive and negative dispatch range.	New	Y/N	
Operating Reserve (OR) Class	All types, 30 min, 10 min non-spin and 10 min spinning, no OR	Identifier for whether the MP is eligible to provide the following ORs: synchronized ten-minute OR, non-synchronized ten-minute OR and thirty-minute OR	Existing		
Maximum Bid/Offer Ramp Rate	MW/min	Maximum ramp rate of a generation resource that is registered as a dispatchable generation facility. This value is used to validate the submission of energy ramp rate and OR ramp rate as dispatch data	Existing	TBD	Used to validate and will be the largest value that the storage resource could achieve.
Maximum Generator Resource Active Power Capability (max	MW	Maximum positive active power capability of the resource to validate the submission of offers for energy or	Existing (Renamed)	0-9999.9	This is the maximum injection capability

Parameter	Units of Measure (if applicable)	Description	Existing for other dispatchable generation resources / Proposed New Storage-specific Parameter	Value Range	Note
injection) Upper Power Operating Limit		operating reserve as dispatch data			
Maximum Negative Generator Resource Active Power Capability (max withdrawal) Lower Power Operating Limit	MW	Maximum negative active power capability of the resource to validate the submission of offers for energy or operating reserve as dispatch data	New	-9999.9 – 0	This denotes what the max withdrawal capability of the resource is. This could hypothetically also be the Maximum load active power if we want to utilize existing parameters and can be applied to the generator resource.
Minimum Generator Resource Capability	MW	The minimum injection the generating resource must be injecting at, without station service being supplied by the unit, to ensure it does not become unstable.	Existing	0-9999	This is the EXISTING minimum field for a generator resource, recorded in the Customer Data Management System (CDMS) and used to determine the lowest level that a generator can inject at in

Parameter	Units of Measure (if applicable)	Description	Existing for other dispatchable generation resources / Proposed New Storage-specific Parameter	Value Range	Note
					various downstream processes and systems.
Real-Time Energy Market Flag	Y/N	Identifies that this resource participates in the IAM	Existing	Y/N	Added based on the Register Facility Help File document
Electricity Storage Resource Flag	Y/N	This flag identifies if a resource is an electricity storage resource	Existing	Y/N	Added based on the Register Facility Help File document
Quick Start Flag	Y/N	Identifies that the registered resource is associated with generation units that are capable of injecting energy into the ICG within five minutes of receiving a dispatch instruction from an offline state	Existing	Y/N	The IESO will determine if this can be auto populated based on other responses
Cycle Efficiency	Decimal value	This value is applied to the withdrawal MWh to account for efficiency losses on the withdrawal and injection when the resource is scheduled. It should not account for other draw on the	New	0.0 – 1.0	Used as the default value to appropriately determine the SoC of the battery. This may be superseded by a daily dispatch

Parameter	Units of Measure (if applicable)	Description	Existing for other dispatchable generation resources / Proposed New Storage-specific Parameter	Value Range	Note
		battery, such as auxiliary load etc.			data submission.
Absolute Maximum State of Charge (Absolute MaxSoC)	MWh	The maximum SoC availability of the SMSR that could be utilized by the IESO. Indicates the MWh max that the battery will be charged to.	New	0-9999.9 MWh	Accessing the range between the registered MaxSoC and Absolute MaxSoC may be achieved through an optional daily hourly dispatch data submission for MaxSoC, which cannot exceed the Absolute MaxSoC. This validation will take place in the Market Information Management system (MIM).
Absolute Minimum State of Charge (Absolute MinSoC)	MWh	The minimum SoC availability of the SMSR that could be utilized by the IESO. Indicates the MWh min that the battery will be discharged to.	New	0-9999.9 MWh	Accessing the range between the MinSoC and Absolute MinSoC may be achieved through an optional daily hourly dispatch data submission for MinSoC

Parameter	Units of Measure (if applicable)	Description	Existing for other dispatchable generation resources / Proposed New Storage-specific Parameter	Value Range	Note
					which cannot be lower than the Absolute MinSoC. This validation will take place in MIM.
Minimum State of Charge (MinSoC)	MWh	The lowest energy amount to which the SMSR can be consistently discharged without damage beyond expected degradation from normal use.	New	0-9999.9 MWh	This will primarily be for validation purposes to verify the operating range of the resource or changes submitted via hourly dispatch data.
Maximum State of Charge (MaxSoC)	MWh	The maximum energy amount to which the SMSR can be consistently charged without damage beyond expected degradation from normal use.	New	0-9999.9 MWh	This will primarily be for validation purposes to verify the operating range of the resource or changes submitted via hourly dispatch data.

Note - As a result of the changes in the Optimization design, the Internal Service Load (ISL) parameter has been removed from scope for this phase of the project. MPs will still be required to register an ISL for their equipment and resources, however, the IESO is requesting that MPs submit a value of 0 for their ISL where applicable.

Record Equipment

The Record Equipment process starts when MPs submit registration requests. MPs submit facility, resource and equipment information, and establish the MP Owner, Operator and Registered MP role relationships for the resources that will participate in the market.

Online IESO will guide the ERS to define and submit equipment parameters required for their facility to be registered. These data parameters include information about the physical equipment that will be connected to the ICG and information about the resources that will be used to participate in the IAM.

As a result of Optimization design, the IESO must modify an existing or introduce a new type of Generating Unit to facilitate the changes introduced by Phase 1. This involves updating various registration parameters to allow for negative values (bi-directionality), limited ramp rate and SoC management. Some reporting tools that post on seasonal capabilities may use Derived Parameters computed at the resource level to create reports. New derived minimum values will be added to ensure accurate accounting and reporting for withdrawal capabilities.

The IESO will create a new Equipment Type (Battery Inverter), based on the existing PV Inverter equipment type. The equipment will include modifications to the Generating Unit section to include bi-directional flag; negative capability parameters and the battery inverter will be updated to include SoC. These updated parameters will propagate as new fields for SMSRs.

Information from the Generating Unit and connected Equipment are rolled up to form a resource that can participate in the market. New fields must be created for these resources so that information can be passed into the market. The IESO will continue to assign the resource name, resource ID and delivery point (DP) identifiers for each registered resource associated with a physical facility.

Once the IESO reviews and approves the submitted equipment information, the IESO will collaborate with the MP to create resource records for the equipment that will be modeled in the IESO network model and used to participate in the IAM.

Prepare for Operations

After the IESO verifies the facility registration information submitted by the MP, the IESO will complete a series of internal activities that are required to consider the facility, resources and equipment as registered.

Prepare for Operations delivers IESO operational readiness and completes all IESO internal activities required to prepare staff and systems for commissioning or for in-service operations. This includes building the Network and Commercial models and completing all other tasks that are related to IESO operational readiness.

Participation in dispatch testing in the Sandbox will continue to be required while the resource is being commissioned. No changes will be made to dispatch testing procedures.

Wholesale Metering

Metering data is the basis for producing settlement ready delivery point data for determination of the settlement amounts for all resources settled in the IAM.

Some of the existing registered storage facilities will transition from the dual model storage resource (DMSR) to an SMSR. This transition will require de-registration and re-registration of the existing metering installations to consider the new storage resource(s).

The assessment provided below summarizes the assumptions and impact analysis for Wholesale Metering requirements related to new storage resource integration as part of the ERP Single Resource / Hybrid Integration project. It outlines potential impacts on metering processes, systems, governance, metering re-registration and energy uplifts, along with recommendations for implementation.

- The Energy Delivery Point associated with the new storage resource will have the same structure as the existing DPs associated with other resources modeled in our commercial model.
- The Transmission DP associated with the storage facility containing new storage resources will have the same structure as the existing transmission DPs associated with other facilities.
- The design solution regarding the exemptions from uplifts on energy withdrawn as fuel for the sole purpose of being able to provide services back to the grid at a future point in time will be similar to the generation station service rebate (GSSR)/energy station service reimbursement (ESSR) or rebate methodology outlined in the relevant Energy Storage Facility Agreement (ESFA) contracts.
- The dispatch instructions for the new storage resources are recorded in the MIM database as positive and negative dispatch instructions to indicate the injection or withdrawal of the storage unit.
- The ongoing Meter Data Management System (MDMS) Replacement project will not change the current metering business processes and functionality of the metering systems.

The roles, activities and tasks of the existing metering processes will remain the same.

Build Online Model

Online Model Build (OMB) process consists of Network Model Build (NMB) and Commercial Model Build (CMB). The commercial model consists of market-only entities created from the Network Model to enable a more complex electricity market, which is primarily a single schedule market with Locational Marginal Pricing (LMP).

The SMSR for battery storage will be modeled as generators in the network model. The change in the network model is that these generators will be bi-directional, represented by positive active megawatt readings for injection and negative active megawatt readings for charging, generally referring to withdrawal capability of the storage resource.

To model an SMSR in the online model, the following technical data and information must be collected:

- 1) Technical data of the equipment and resources, such as breakers/disconnects, buses, transmission lines, transformers, generators (market resources, single storage resource), auxiliary load or station service load, etc. The Minimum Active Power Capability of the generator will be negative.

- 2) Single Line Diagram that shows the connection between the facility and ICG, and the configuration of facility.
- 3) Operational telemetry information, including SoC in MWh and optional percentage SoC.
- 4) Delivery point, electrical bus and price-location for commercial model.
- 5) Telemetered SoC will be mapped to the storage(s) modeled with SMSR (generator) when it is implemented in the network model. A new NMB template will be created for network model build.
- 6) If a storage resource participates in OR, it will be handled in the same way that a current market resource with OR is handled, and no additional change is needed from the online model (network model and commercial model) perspective.
- 7) Zonal Demand and Primary Demand calculations will be revised to exclude charging MW of SMSRs.

SCADA/Energy Management System (EMS) must be updated to be able to manage the negative generation and capability curve over both positive and negative active and reactive power output. Each storage resource will be modeled as a generator at a separate low-tension bus and will use the DPGen in the commercial model.

Station Service and Auxiliary loads associated to SMSRs will not be treated as non dispatchable loads (NDLs) and therefore will not be included in the commercial model.

Commission Equipment

Commission Equipment implements all requests requiring commissioning tests to bring new or changed facility equipment into service. This includes verifying and approving commissioning test plans and updating equipment parameters based on commissioning test results. The end state of the commissioning process will be the validation that equipment meets the requirements of the market rules, and completion of the market registration process.

When commissioning, the resource will still operate under an SMSR, meaning that the online model requirements will apply, although they will participate as a self-scheduler during this time. There will be certain exclusions and requirements to support this period of the resource's operation and to adapt the self-scheduling model for the SMSR:

- SMSRs generally participate like self-scheduling generators under existing requirements but utilizing negative generator characteristics. When injecting they will provide their self-schedule with a positive MW quantity, when withdrawing they will provide their self-schedule with a negative MW quantity.
- LMP pricing will apply whether injecting or withdrawing during all timeframes.
- SoC will not be modeled when entering self-schedules, the resource will manage these and must submit self-schedules that respects its own SoC limitations.

SoC will not be modeled or submitted by MPs during this commissioning period. MPs will pay or be paid LMP.

A self-scheduling procedure has been developed for the SMSR to commission their facilities. This self-scheduling procedure will not be for enduring participation, only for the commissioning of resources that will be newly registered or transitioned to this new dispatchable SMSR.

The commissioning facilities will perform the required testing as self-scheduling SMSRs in the IAM. There will be no modeling of SoC or Cycle Efficiency. Managing SoC during commissioning will be the responsibility of the MP.

MPs will follow the typical commissioning process described in Figure 3 below. For clarity, there is no change in the process but there are changes in how MPs will complete some steps within the process.

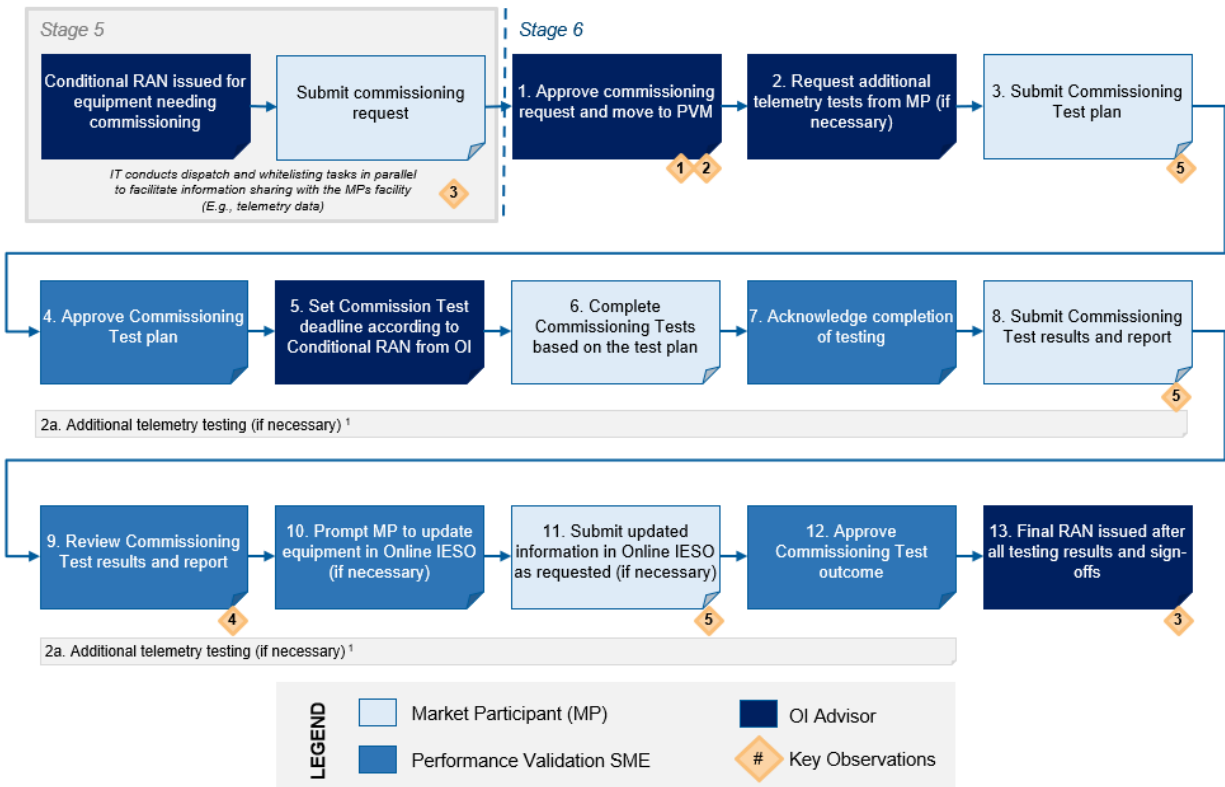


Figure 3: Commissioning Process

The following primary resource parameters will be used by the DSO to schedule the resource and set the HOL and LOL which can be further restricted by offers.

Table 2: Commissioning Validation Parameters

Registration Parameters Unique to Self Scheduling Single Resource Storage			
Parameter	Unit	Timeframe	Definition
Maximum Generator Resource Active Power Capability	MW	Registration	Existing parameter for dispatchable generators, but in this case refers to the maximum active injection capability of the resource to validate the submission of offers for energy.

Registration Parameters Unique to Self Scheduling Single Resource Storage			
Parameter	Unit	Timeframe	Definition
Maximum Negative Generator Resource Active Power Capability	MW	Registration	The maximum withdrawal active power capability of the resource to validate the submission of offers for energy as dispatch data. This is expected to be a negative value, which can be augmented through registration.

Commissioning facilities will submit a Commissioning Test Plan to the IESO for approval. There must be a single test plan that covers all testing the MP is conducting, whether it is injection, withdrawal, or both. Test plans should include additional granularity when testing both injection and withdrawals. Specifically, this should include the intervals or times when changes are expected to occur. MPs are encouraged to plan major shifts in input and output (like a full range test) outside of the immediate 'top of the hour', i.e., in the five minutes before and after the start of each hour (INT1 and INT12). These tests could be executed ten minutes past or ten minutes prior to the hour. To facilitate the entry of test plans, planned outage requests must be submitted in the Control Room Operations Window (CROW - online outage management system) in accordance with the Three-Day Advance Approval Process. Requests must be submitted by the MP at least five business days before the start of the planned commissioning date(s). The MP will only have to submit one planned outage request that encompasses injection, withdrawal, or both. Commissioning test plan submissions must include:

- 1.) Times of synch and de-synch from grid;
- 2.) Energy and reactive output levels;
- 3.) Timing of ramp rates associated with changes in energy and reactive output levels;
- 4.) Run-back or trip tests for commissioning generation facility.

Commissioning facilities will be treated as unavailable for the purpose of calculating available capacity in IESO adequacy assessments, as per the current approach.

To submit dispatch data, the commissioning electricity storage facility must apply to register as a self-scheduling facility to submit the necessary dispatch data for testing. Requests to be registered as a self-scheduling resource must be made to the IESO with a minimum of six business advance days notice.

If the resource undergoing commissioning testing forms part of an aggregate, the whole aggregate will be treated as a self-scheduling generation facility. For clarity, the MP must ensure that an offer for the resources will be reflected at the facility level. i.e., if a facility is comprised of two resources, the MP can submit offers for one or both, as long as the total output is reflected at the facility level when operating.

General Offer / Dispatch Guidelines

Energy

MPs should try to group tests together so that the facility does not go from withdrawal to injection or vice versa more than necessary. MPs should try to submit economic schedules for

the average output of the resource for each hour of testing. This will include injections (positive MW quantities) and withdrawals (negative MW quantities). Where possible, facility output should be maintained for the full hour. Full range (branching) tests going from maximum withdrawal to maximum injection or vice versa should try to use the top of the hour dispatch change in off peak hours. Coordination by phone with the IESO control room (CR) will be required in real-time to ensure the system can support the test.

The tables below show an example of an injection, withdrawal and full range commissioning test for an SMSR that is testing 50 MW capability.

Table 3: Injection Test (one offer submitted; must be economic)

P/Q Pair	Price (\$/MW)	Quantity (MW)	Price to Schedule (\$/MW)	MW that could be scheduled
1	\$-2,000	50	\$-1,999.99 to \$2,000.00	Inject 50 MW

Table 4: Withdrawal Test (one offer submitted; must be economic)

P/Q Pair	Price (\$/MW)	Quantity (MW)	Price to Schedule (\$/MW)	MW that could be scheduled
1	\$2,000	-50	\$-2000.00 to \$1999.99	Withdraw 50 MW

Table 5: Full Range Test (one offer submitted; must be economic)

Hour	Price (\$/MW)	Quantity (MW)	Price to Schedule (\$/MW)	MW that could be scheduled
HE12	\$2,000	-50	\$-2000.00 to \$1999.99	Withdraw 50 MW
HE13	\$-2,000	50	\$-1,999.99 to \$2,000.00	Inject 50 MW

For HE12, the resource will pay any price from \$-2000 up to \$1999.99 to withdraw 50 MW and for HE13, the resource will accept any price from \$2000 down to \$-1999.99 to inject 50 MW. This schedule provides as much certainty as possible within the IAM structure so that the resource will be scheduled for the desired MW quantities in both hours.

The MP is responsible for economically scheduling their resources to perform the tests outlined in their Commissioning Test Plan in all market timeframes.

If the commissioning generation facility intends to deviate from the current self-schedule offer for any reason, offers should be updated outside the mandatory window and the IESO should be notified by phone of the deviation from the test plan.

The MP is accountable to economically schedule the active power schedules they require to execute their test plan, and these must be entered into the DAM and the RT. Examples are provided to ensure economic scheduling in the DAM and RT dispatch timeframes.

Telemetry Testing

During the commissioning process, MPs are able to test and verify the values of the parameters below and what the expected outcomes of each parameter will be on their scheduling.

- Cycle Efficiency SoC - Test that verifies the Cycle Efficiency values via the SoC telemetry. i.e., if the MP enters a 90% Cycle Efficiency, it is expected that a 100 MWh withdrawal will result in a 94.86 MWh SoC that can be reinjected back into the grid. If the MP would like to inject 100 MW, they would have to operate at 105.41 MW to meet the 100 MW dispatch.
- Confirmation that telemetry values are accurate and align with the values that the IESO control room operators (CROs) are seeing. This will be completed via phone call from MP to the IESO CR while injecting and withdrawing to ensure both parties are displaying the correct values.