



Market Rule Amendment Proposal

PART 1 – MARKET RULE INFORMATION

Identification No.:	MR-00446-R01		
Subject:	Implementation of the Interim Storage Design		
Title:	Participation and Connection Requirements		
Nature of Proposal:	<input checked="" type="checkbox"/> Alteration	<input type="checkbox"/> Deletion	<input checked="" type="checkbox"/> Addition
Chapters:	2, 4	Appendix:	Appendix 2.2, 4.2, 4.3, 4.24, 4.25
Sections:	Chapter 2: 2.1, 6.1 Appendix 2.2: 1.1, 1.2, 1.5 Chapter 4; 1.1, 3.1, 3.2, 3.6, 4.1, 5.1, 5.2, 5.3, 6.4, 7.1, 7.3A, 7.7, 7.8 Appendix 4.2; 4.3 Appendix 4.24, 4.25; new		
Sub-sections proposed for amending:	Various		

PART 2 – PROPOSAL HISTORY

Version	Reason for Issuing	Version Date
1.0	Draft for Technical Panel Review and Comment	September 8, 2020
2.0	Publish for Stakeholder Review and Comment	September 16, 2020
3.0	Submitted for Technical Panel Vote	October 13, 2020
Approved Amendment Publication Date:		
Approved Amendment Effective Date:		

PART 3 – EXPLANATION FOR PROPOSED AMENDMENT

Provide a brief description of the following:

- The reason for the proposed amendment and the impact on the *IESO-administered markets* if the amendment is not made.
 - Alternative solutions considered.
 - The proposed amendment, how the amendment addresses the above reason and impact of the proposed amendment on the *IESO-administered markets*.
-

Summary

This proposal is focused on including the changes needed to facilitate the connection and registration requirements outlined in Chapters 2 and 4. The language of proposed new sections is typically modelled on existing requirements for other market participants e.g. generators.

Chapter 2 begins by establishing electricity storage as a new class of market participants. It later includes electricity storage into the technical and performance requirements outlined for certain market participants. Appendix 2.1 outlines the requirements for voice communications and monitoring and control upon which electricity storage participants may be subject to.

Chapter 4 begins by outlining the scope of the chapter, including some requirements that pertain to embedded electricity storage participants, even if they are not market participants. It then outlines the performance standards applicable to different types of facilities, including electricity storage, and the obligations of different classes of market participants, including in a new section, electricity storage participants. It includes electricity storage in the need to have a signed connection agreement, along with the compliance, inspection, testing and monitoring requirements. Electricity storage participants will be required to provide to the IESO certain data both at the time of connection, and also on an on-going basis, similar to generation facilities, and these requirements are outlined in Chapter 4 and in the new Appendices 4.24 and 4.25

Background

The IESO proposes to amend the market rules to address a specific set of barriers to the integration of energy storage resources in the IESO's markets. These barriers within the IESO's purview were identified in the December 2018 IESO [report](#), "Removing Obstacles for Storage Resources in Ontario". Addressing these barriers required changes to both Market Rules and Market Manuals, consistent with one of the report's recommendations that the IESO "should review and amend its market rules, where possible, to clarify the participation of storage resources in IESO-administered markets".

The IESO developed a design to integrate electricity storage resources for an interim and longer term period of time. An interim period was needed to facilitate the near term participation of electricity storage resources until the IESO's scheduling and optimization tool can recognize the unique characteristics of energy storage resources: they participate both as a load and a supply and are limited in each by its state of charge. The suite of changes in MR-00446 are designed to both clarify the participation of storage resources in the interim period and include rules that may not need to change to support the long term design.

Both the interim design for integrating electricity storage resources along with draft market rules were reviewed with stakeholders through the [Energy Storage Advisory Group](#). Feedback has been largely supportive of the proposed amendments. Stakeholders had requested clarifications in a few sections and revisions have been made to reflect this feedback.

Discussion

Chapter 2

- 2.1; Adds electricity storage participants as a new market participant class.
- 6.1; Applies technical and performance requirements to electricity storage facilities.

Appendix 2.2

- 1.1; Applies requirements related to voice communication to electricity storage facilities.
- 1.2; Applies monitoring, control and communication requirements to electricity storage facilities.
- 1.5; Outlines the rights for reclassifying facilities by size for the purposes of Chapter 2 Appendix and portions of Chapter 5

Chapter 4

- 1.1; Adds embedded electricity storage participants who may not be market participants to the requirements in the chapter.
- 3.1; Sets out requirements to adhere to data and performance requirements in appendices 4.1 through to 4.4, including those embedded electricity storage participants.
- 3.2; Extends ability to obtain reactive power to electricity storage facilities.
- 3.6; Electricity storage resources must adhere to requirements related to testing and operating according to their connection agreement and providing certain reliability related information. This section is modelled from section 3.4 for generators.
- 4.1; Electricity storage providers must have a signed connection agreement.
- 5.1; Sets out requirements for testing and monitoring equipment, maintaining related records, notification of tests, and responsibilities for costs.
- 5.2; Provides that the IESO may require other tests in addition to tests required by the connection agreement.
- 5.3; IESO may temporary direct the operation of electricity storage facilities and such costs are reimbursable.
- 6.4; IESO may issue a disconnection order if a unit is synchronized to the grid other than in accordance with section 11.2 of chapter 7.
- 7.1; Electricity storage participants shall provide reliability data listed in specific appendices.
- 7.3A; Data outlined in appendix 4.24 shall be provided on a continual basis to the IESO by electricity storage participants. This daily capacity and injection information will be published by the IESO.

- 7.6A; Includes appendix 4.25 in list of appendices in which market participants may propose alternative arrangements.
- 7.7; Electricity storage participants shall notify the IESO where there is an outage in their monitoring and control equipment that could impede their provision of information as per Appendix 4.25.
- 7.8; Provides the IESO with rights to reclassify facilities by size (major, significant, minor, small) for collecting monitoring information and sets out responsibilities of the electricity storage participant if this occurs.

Appendices 4.2 and 4.3; Applies specific performance requirements to electricity storage facilities.

Appendix 4.24; New section that sets out telemetry requirements for electricity storage participants.

Appendix 4.25; New section that sets out telemetry performance standards for electricity storage.

PART 4 – PROPOSED AMENDMENT

Chapter 2

2. Classes of Market Participants

2.1.1 The following classes of persons may apply for authorization to participate in the *IESO-administered markets* or to cause or permit electricity to be conveyed into, through or out of the *IESO-controlled grid*:

2.1.1.1 *generators;*

2.1.1.2 *distributors;*

2.1.1.3 *wholesale sellers;*

2.1.1.4 *wholesale consumers;*

2.1.1.5 *retailers;*

2.1.1.6 *transmitters;*

2.1.1.7 *financial market participants;*

2.1.1.11 *capacity market participants; ~~and~~*

2.1.1.12 *capacity auction participants; and*

2.1.1.13 *electricity storage participants.*

6. Technical Requirements

6.1 Technical Requirements

6.1.1 Each *market participant, embedded generator, embedded electricity storage participant* and *embedded load consumer* shall, in addition to ensuring that its

facilities and equipment meet all other applicable technical requirements set forth in these *market rules* ensure that its *facilities*:

6.1.1.1 meet the applicable technical requirements of Appendix 2.2; and

6.1.1.2 are capable of meeting the performance standards referred to in section 7.3.1.4, [7.3A.1.4](#), 7.4.1.2, 7.5.1.2 or 7.6.1.2, as the case may be, of Chapter 4.

Appendix 2.2 – Technical Requirements: Voice Communication, Monitoring and Control, Workstations and Re-Classification of Facilities

1.1 Voice Communications

[1.1.12](#) Each *electricity storage participant* that participates in the *IESO-administered markets* or that causes or permits electricity to be conveyed into, through or out of the *IESO-controlled grid* shall, subject to section 1.1.11, provide and maintain the following voice communication facilities for purposes of communicating with the *IESO*:

[1.1.12.1](#) one high priority path facility and one normal priority path facility at the dispatch centre, control center and authority centre for each of its electricity storage facilities provided that either:

a. the *IESO* has determined that a *high priority path facility* and a *normal priority path facility* are required to enable the *IESO* to maintain *reliable* operation of the *IESO-controlled grid*; or

b. one of the applicable *electricity storage facilities* is a *major electricity storage facility*; or

c. the aggregate of the *electricity storage facility sizes* of the applicable *electricity storage facilities* is 100 MVA or greater.

[1.1.12.2](#) subject to section 1.1.12.1, one normal priority path facility at the dispatch centre, control centre and authority center for each of its *electricity storage facilities* provided that the aggregate of the *electricity storage facility size ratings* of the applicable *electricity storage facilities* is less than 100 MVA;

1.1.12.3 one high priority path facility and one normal priority path facility for each of its *major electricity storage facilities* that are attended electricity storage stations;

1.1.12.4 one commercially available telephone for each of:

a. *its major electricity storage facilities, significant electricity storage facilities and minor electricity storage facilities that are unattended; and*

b. *its self-scheduling electricity storage facilities with an electricity storage facility size of less than 10 MW,*

the telephone number of which shall be provided by the *electricity storage participant* to the *IESO*;

1.1.12.5 one normal priority path facility for each of its *significant electricity storage facilities and minor electricity storage facilities* that is attended.

1.1.13 Each *embedded electricity storage participant* that is not a *market participant* or whose *embedded electricity storage facility* is not a *registered facility* shall, subject to section 1.1.11, provide and maintain the voice communication facilities referred to in sections 1.1.12.1 to 1.1.12.6, as may be applicable, in respect of each of its *embedded electricity storage facilities* that:

1.1.13.1 includes an *electricity storage unit* with a rated *electricity storage unit size* of 20 MVA or higher or that comprises multiple *electricity storage units*, the aggregated *electricity storage unit size ratings* of which equals or exceeds 20 MVA; and

1.1.13.2 has been designated by the *IESO* for the purposes of this section 1.1.13 as requiring such voice communication facilities in order to enable the *IESO* to maintain the *reliability* of the *IESO-controlled grid*.

1.2 Technical Requirements for Monitoring and Control

1.2.7 Each *electricity storage participant* shall, for the purposes of submitting to the energy management system referred to in section 12 of Chapter 5 the monitoring and control information required to be provided by an *electricity storage participant* to the *IESO* pursuant to the provisions of Chapters 4 and 5:

1.2.7.1 provide, maintain and connect to each of its applicable *electricity storage facilities* monitoring and control devices that meet the specifications and other requirements set forth in the *participant technical reference manual*; and

1.2.7.2 provide and maintain, in accordance with the *participant technical reference manual*, a location and supporting *facilities* enabling the installation of a communication terminal point between the monitoring and control devices for each of its applicable *electricity storage facilities* and the real-time communication network channel or channels provided by the *IESO*.

1.5.1A The *IESO* may, for the purposes of this Appendix 2.2 and of section 12 of Chapter 5:

1.5.1A.1 re-classify a *small electricity storage facility* as a *minor electricity storage facility*, a *significant electricity storage facility* or a *major electricity storage facility*;

1.5.1A.2 re-classify a *minor electricity storage facility* as a *significant electricity storage facility* or a *major electricity storage facility*;

1.5.1A.3 re-classify a *significant electricity storage facility* as a *major electricity storage facility*;

where the *IESO* determines that such re-classification is required to enable the *IESO* to maintain the *reliability* of the *IESO-controlled grid*.

1.5.2A The *IESO* may, for the purposes of this Appendix 2.2 and of section 12 of Chapter 5:

1.5.2A.1 re-classify a *major electricity storage facility* as a *significant electricity storage facility*, a *minor electricity storage facility* or a *small electricity storage facility*;

1.5.2A.2 re-classify a *significant electricity storage facility* as a *minor electricity storage facility* or a *small electricity storage facility*;

1.5.2A.3 re-classify a *minor electricity storage facility* as a *small electricity storage facility*;

where the *IESO* determines that such re-classification will not adversely affect the ability of the *IESO* to maintain *reliability* of the *IESO-controlled grid*.

1.5.3 A person whose *facility* has been re-classified pursuant to section 1.5.1, 1.5.1A, or 1.5.2, or 1.5.2A shall ensure that its *facilities* and equipment meet the requirements set forth in this Appendix 2.2 and in section 12 of Chapter 5 applicable to the class of *facility* in which its *facility* has been re-classified.

Chapter 4

1. Introduction

1.1.1 This Chapter sets forth rules to assist the *IESO* in maintaining the *reliability* of the *IESO-controlled grid* by:

1.1.1.1 requiring all *market participants* to adhere to established standards for all equipment *connected* to the *IESO-controlled grid* and to comply with certain other obligations relating generally to *connection* to the *IESO-controlled grid* and to participation in the *IESO-administered markets*; and

1.1.1.2 setting forth certain reliability-related obligations of *embedded generators* [and embedded electricity storage participants](#) that may not be market participants.

3. Performance Standards and Obligations of Market Participants

3.1 General Requirement

3.1.1 The minimum general performance standards for all equipment *connected* to the *IESO-controlled grid* are set forth in Appendix 4.1. Specific performance standards applicable to the equipment of *generators*, [electricity storage participants](#), *connected wholesale customers*, *distributors connected* to the *IESO-controlled grid* and *transmitters* are set forth in Appendices 4.2 to 4.4, respectively.

3.1.2 Each *market participant* shall ensure that its equipment connected to the *IESO-controlled grid* meets all applicable performance standards in Appendix 4.1 and each *generator*, [electricity storage participant](#), *connected wholesale customer*, *distributor* connected to the *IESO-controlled grid* and *transmitter* shall ensure that its equipment connected to or forming part of the *IESO-controlled grid* meets all applicable performance standards in Appendices 4.2 to 4.4, respectively.

- 3.1.3 Each *embedded generator* or *embedded electricity storage provider* shall ensure that its equipment meets all applicable performance requirements in Appendix 4.3.

3.2 Development of Rules for Waivers of Standards

- 3.2.3 A *generator* or *electricity storage participant* may comply with its requirement to provide reactive power either by modifying any of its *generating units* or *electricity storage units* that do not comply with any standard with respect to the provision of reactive power, or by obtaining reactive power from other appropriate *generating units*, *electricity storage units* or *market participants*. The IESO shall determine whether these other *generating units*, *electricity storage units* or *market participants* are in sufficiently close electrical proximity to the non-compliant *generating unit* or *electricity storage unit* so as to provide the comparable or equivalent reactive power.

3.6 Obligations of Electricity Storage Participants

- 3.6.1 Each *electricity storage participant* that participates in the *IESO-administered markets* or that causes or permits electricity to be conveyed into, through or out of the *IESO-controlled grid* shall:

3.6.1.1 permit and participate in any commissioning, inspection, and testing that the IESO requires of its equipment that is or is to be connected to the *IESO-controlled grid*;

3.6.1.2 operate its equipment in accordance with its *connection agreement*;

3.6.1.3 complete and return to the IESO those portions of the *IESO catalogue of reliability-related information* relevant to its facilities; and

3.6.1.4 notify the IESO upon the submission of a *connection request* to a *transmitter*.

4. Connection Agreements

- 4.1.1 Each *connected wholesale customer* and each *distributor*, ~~and~~ *generator* and *electricity storage participant* connected to the *IESO-controlled grid* shall have a signed *connection agreement*, in such form as may be prescribed by the OEB, with the applicable *transmitter* with whom it is *connected*.

5. Compliance, Inspection, Testing, and Monitoring

5.1 General Requirements

- 5.1.1 Each *transmitter, generator, [electricity storage participant](#), connected wholesale customer or distributor connected to the IESO-controlled grid* shall have the obligation to test and monitor its equipment to ensure and maintain compliance with all applicable *reliability standards* required by these *market rules*. The requirement to conduct and pay for such activities shall be specified in each *connection agreement*. If any *transmitter, generator, [electricity storage participant](#), distributor or connected wholesale customer connected to the IESO-controlled grid* in respect of which no relevant waiver has been granted by the *IESO* fails to comply with the provisions of this Chapter, the *IESO* shall notify the *transmitter* and the connecting party of such non-compliance and shall ask that the parties achieve prompt compliance with this Chapter, subject to the imposition of such penalties for failure to comply as may be specified in these *market rules*. Pending such compliance, the *IESO* may direct the *transmitter* and the connecting party to operate their respective equipment and *facilities* so as to maintain the *reliability* of the *IESO-controlled grid*.
- 5.1.2 The results of all compliance monitoring and performance testing required by this Chapter to be performed shall be made available to the *IESO* upon request.
- 5.1.3 Each *transmitter, generator, [electricity storage participant](#), distributor and connected wholesale customer connected to the IESO controlled grid* shall maintain records that set forth the results of all performance testing and monitoring conducted to demonstrate compliance with this Chapter in each case for 7 years from the date of the testing or monitoring activity. Each *transmitter, generator, [electricity storage participant](#), distributor and connected wholesale customer* shall make such records available to the *IESO* upon request.
- 5.1.4 Parties to a *connection agreement* shall bear the cost of monitoring and testing their equipment and *facilities* for compliance with this Chapter. The *IESO* may request a *transmitter, generator, [electricity storage participant](#), distributor or connected wholesale customer connected to the IESO-controlled grid* to attach to its equipment or *facilities* such test or monitoring equipment as the *IESO* determines appropriate and that is not required by the relevant *connection agreement* to be so attached, provided that such test or monitoring equipment does not adversely affect the performance of the connecting party's equipment or *facilities*. If the test or monitoring equipment required by the *IESO* is intended to provide a general benefit to the *IESO-controlled grid*, and is not otherwise required to ensure compliance of the specific *market participant's* equipment, the *IESO* shall bear the costs of such additional test or monitoring equipment and the costs of operating and attaching such equipment to the *transmitter's, generator's,*

electricity storage participant's, distributor's or connected wholesale customer's equipment or *facilities*. All such costs shall be subject to verification and audit by the *IESO*.

- 5.1.5 Parties to a *connection agreement* that propose to perform a test on equipment that requires a change to the normal operation of such equipment shall give such prior notice to the *IESO* as the *IESO* shall require if such test could have an adverse impact on the *reliable* operation of the *IESO-controlled grid*. If the *IESO* determines that the proposed test could adversely affect the *reliability* of the *IESO-controlled grid*, the *IESO* may direct that the parties modify the testing procedure or the time scheduled for the test to avoid any threat to *reliability*. If such activities cannot avoid a threat to *reliability* to a degree acceptable to the *IESO*, the *IESO* shall not permit the test.
- 5.1.6 Where the *IESO* believes that the equipment of a *transmitter, generator, electricity storage participant, distributor or connected wholesale customer* connected to the *IESO-controlled grid* does not comply with the requirements of this Chapter, and that such non-compliance poses a threat to the reliable operation of the *IESO-controlled grid*, the *IESO* may direct the *transmitter, generator, electricity storage participant, distributor or connected wholesale customer* to modify such equipment to comply with this Chapter.
- 5.1.7 Section 5.1.6 applies regardless of whether a waiver has been granted to the relevant *transmitter, generator, electricity storage participant, distributor or connected wholesale customer* by the *IESO* in respect of the non-complying equipment.

5.2 **IESO-Required Tests of Generators and Electricity Storage Participants**

- 5.2.1 In addition to any tests required by a connection agreement, the *IESO* may require a generator or electricity storage participant to test any generation facility or electricity storage facility connected to the *IESO-controlled grid* in order to determine whether such *facility* meets the requirements of this Chapter. The relevant *generator or electricity storage participant* shall comply with such request. If possible, the *IESO* shall permit such tests to be performed during the next scheduled *planned outage* of the facility. If the *IESO* determines that a test is required for reliability reasons prior to the next scheduled *planned outage* of the *facility*, the *IESO* shall cooperate with the *generator or electricity storage participant* to ensure that the test is conducted in a manner designed to create the minimum impact on the operation of that ~~generation~~ *facility*.

5.3 **IESO-Required Tests of Interconnections**

- 5.3.3 The *IESO* may temporarily direct the operation of *generation facilities or electricity storage facilities* during the testing of *interconnections* if and to the

- extent necessary to obtain operational conditions on the *IESO-controlled grid* that are required in order to achieve valid test results. The *IESO* shall plan the timing of tests so that the duration of the tests and the variation in the *dispatch* of the *generation facility* or *electricity storage facility* relative to its *dispatch* under non-test conditions are minimized to the extent possible.
- 5.3.4 Any costs that are incurred by a *generator* or *electricity storage participant* to assist in the performance of the tests required under section 5.3 that are otherwise unrecoverable shall be recovered from *market participants* in accordance with section 4.8 of Chapter 9. All such costs shall be subject to verification and audit by the *IESO* before being so recovered.
- 5.2.2 Tests conducted under this section 5.2 shall be conducted in accordance with procedures that have been agreed upon by the *IESO* and the relevant *generator* or *electricity storage participant*. The *IESO* shall provide the relevant *generator* or *electricity storage participant* with the parameters of the model derived from such tests.
- 5.2.3 Section 5.1.4 shall apply to determine the allocation to and the recovery by the *IESO* of any costs incurred by a *generator* or *electricity storage participant* to assist in the performance of the tests required under this section 5.2.

6.4 Disconnection During an Emergency or For Safety or Reliability Reasons

- 6.4.2B Where the *IESO* becomes aware that a *generator* or *electricity storage participant* has synchronized (respectively) either a *generation unit* or an *electricity storage unit* to the *IESO-controlled grid* other than in accordance with section 11.2 of Chapter 7, the *IESO* may issue a *disconnection order* directing the relevant *transmitter* to *disconnect* the *generation unit* or *electricity storage unit* from the *IESO-controlled grid*.

7. Provision of Connection-Related Information

7.1 Provision of Information

- 7.1.3 Each *generator* or *electricity storage participant* whose ~~*generation*~~ *facility* is *connected* to the *IESO-controlled grid*, *connected wholesale customer* and *distributor* *connected* to the *IESO-controlled grid*, and *transmitter* shall provide to the *IESO* *connection-related reliability information* as applicable prior to placing any *connected facility* into service.

7.1.7 Each *embedded electricity storage participant* whose *embedded electricity storage facility* includes an *electricity storage unit* with an *electricity storage unit size* greater than 10 MVA and that is designated by the *IESO* for the purposes of this section 7.1 shall provide to the *IESO* the information described in Part A of Appendix 4.6 as may be requested by the *IESO*.

7.1.8 Each *embedded electricity storage participant* that:

7.1.8.1 participates in the *IESO-administered markets* and whose *embedded electricity storage facility* includes an *electricity storage unit* with an *electricity storage unit size* of 1 MW or higher;

7.1.8.2 is a non-market participant and whose *embedded electricity storage facility* includes an *electricity storage unit* with a maximum *electricity storage unit size* of 10 MVA or higher,

and that is not required to provide data pursuant to section 7.1.7, shall provide the *IESO* with the data listed in Part B of Appendix 4.6.

7.3A Monitoring Information Provided by Electricity Storage Participants to the IESO

7.3A.1 Subject to section 7.3A.2, in order to permit the *IESO* to direct the operations of the *IESO-controlled grid*, each:

7.3A.1.1 *electricity storage participant* (i) whose *electricity storage facility* is connected to the *IESO-controlled grid*, or (ii) that is participating in the *IESO-administered markets*; and

7.3A.1.2 *embedded electricity storage participant* (i) that is not a market participant or whose *embedded electricity storage facility* is not a registered facility; (ii) whose *embedded electricity storage facility* includes an *electricity storage unit* with a rated *electricity storage unit size* greater than 20 MVA or that comprises multiple *electricity storage units*, the aggregated *electricity storage unit size* ratings of which exceed 20 MVA; and (iii) that is designated by the *IESO* for the purposes of this section 7.3A.1 as being required to provide such data in order to enable the *IESO* to maintain the reliability of the *IESO-controlled grid*,

shall provide the *IESO* with the data listed in Appendix 4.24 on a continual basis. Such data shall not be modified by the *electricity storage participant* and shall be provided:

7.3A.1.3 with equipment that meets the requirements set forth in Appendix 2.2 of Chapter 2; and

7.3A.1.4 subject to section 7.6A, in accordance with the performance standards set forth in Appendix 4.25.

7.3A.2 Section 7.3A.1 does not apply to:

7.3A.2.1 a small electricity storage facility

7.3A.3 The IESO shall publish, as soon as practicable following each dispatch hour, the actual electricity storage capacity (in MW) and hourly injections of energy (in MWh) for each electricity storage unit based on information provided to it by market participants. Electricity storage capacity and energy production for electricity storage units with a rated electricity storage unit size of less than 20 MVA can be aggregated by station.

7.6A Alternative Arrangements for Submission of Data Measurements

7.6A.1 *Market participants* may propose to the IESO an alternative arrangement to make data measurements or equipment status changes available to the IESO communications interface within times different than those specified in Appendix 4.19, 4.21, 4.22, ~~or 4.23,~~ or 4.25.

7.7 Reliability, Maintenance and Repair of Monitoring and Control Equipment

7.7.2 Each person referred to in section 7.7.1 and 7.3.2A shall respond to an *outage* of or defect in the equipment referred to in section 7.7.1 or the applicable *market manual*:

7.7.2.1 immediately, in the case of equipment relating to *facilities* to which the high performance information monitoring standard applies pursuant to Appendices 4.19 to 4.23 and Appendix 4.25 other than *significant generation facilities*, ~~and significant dispatchable load facilities~~ and significant electricity storage facilities;

7.7.2.2 no later than the next day following the day on which the *outage* or defect is discovered, in the case of equipment relating to *significant generation facilities*, significant electricity storage facilities, *significant dispatchable load facilities*, *variable generation*, and *facilities* to which the medium performance information monitoring standard applies pursuant to Appendices 4.19 to 4.23 and Appendix 4.25.

7.8 Re-Classification of Facilities

7.8.2A The *IESO* may, for the purposes of sections 7.3A:

7.8.2A.1 re-classify a *small electricity storage facility* as a *minor electricity storage facility*, a *significant electricity storage facility* or a *major electricity storage facility*;

7.8.2A.2 re-classify a *minor electricity storage facility* as a *significant electricity storage facility* or a *major electricity storage facility*;

7.8.2A.3 re-classify a *significant electricity storage facility* as a *major electricity storage facility*;

where the *IESO* determines that such re-classification is required to enable the *IESO* to maintain the *reliability* of the *IESO-controlled grid*.

7.8.2B The *IESO* may, for the purposes of sections 7.3A:

7.8.2B.1 re-classify a *major electricity storage facility* as a *significant electricity storage facility*, a *minor electricity storage facility* or a *small electricity storage facility*;

7.8.2B.2 re-classify a *significant electricity storage facility* as a *minor electricity storage facility* or a *small electricity storage facility*;

7.8.2B.3 re-classify a *minor electricity storage facility* as a *small electricity storage facility*;

where the *IESO* determines that such re-classification will not adversely affect the ability of the *IESO* to maintain *reliability* of the *IESO-controlled grid*.

7.8.3 A person whose *facility* has been re-classified pursuant to section 7.8.1, ~~or 7.8.2~~ 7.8.2A or 7.8.2B shall:

7.8.3.1 ensure that its *facilities* and equipment meet the requirements set forth in section 7.3, 7.4, 7.5 or 7.6, as the case may be; and

7.8.3.2 comply with the requirements of section 7.7,

applicable to the class of *facility* in which its *facility* has been re-classified.

Appendix 4.2 – Requirements for Generation and Electricity Storage Facilities Connected to the IESO-Controlled Grid

The performance requirements set out below shall apply to *generation facilities* subject to a *connection assessment* finalized after September 21, 2020. Performance of alternative technologies

shall be comparable with that of conforming conventional synchronous generation with an equal apparent power rating.

These performance requirements shall also apply to *electricity storage units* at all times while connected to the *IESO-controlled grid*, unless the *IESO* identifies specific performance requirements that are not applicable to an *electricity storage unit* for those with a *connection assessment* finalized after **new effective date**. Due consideration will be given to inherent limitations.

Each *generation facility* that was authorized to *connect* to the *IESO-controlled grid* prior to September 21, 2020 shall remain subject to the performance requirements in effect for each associated system at the time its authorization to *connect* to the *IESO-controlled grid* was granted or agreed to by the *market participant* and the *IESO* (i.e. the “original performance requirements”). These original performance requirements shall prevail until the main elements of an associated system (e.g. governor control mechanism, main exciter, power inverter) are replaced or substantially modified. At that time, the associated system that is replaced or substantially modified shall meet the applicable performance requirements detailed below. All other systems, not affected by replacement or substantial modification, shall remain subject to the original performance requirements.

Category	<i>Generation facilities or electricity storage facilities</i> directly connected to the <i>IESO-controlled grid</i> shall have the capability to:
1. Off-Nominal Frequency Operation	Operate continuously between 59.4 Hz and 60.6 Hz and for a limited period of time in the region bounded by straight lines on a log-linear scale defined by the points (0.0 s, 57.0 Hz), (3.3 s, 57.0 Hz), and (300 s, 59.0 Hz) and the straight lines on a log-linear scale defined by the points (0.0 s, 61.8 Hz), (8 s, 61.8 Hz), and (600 s, 60.6 Hz).
2. Speed/Frequency Regulation	Regulate speed/frequency with an average droop based on maximum active power adjustable between 3% and 7% and set at 4% unless otherwise specified by the <i>IESO</i> . Regulation deadband shall not be wider than $\pm 0.06\%$. Speed/frequency shall be controlled in a stable fashion in both interconnected and island operation. A sustained 9% change of <u>applicable</u> rated active power <u>as defined in category 4</u> after 10 s in response to a step change of speed of 0.5% during interconnected operation shall be achievable. Due consideration will be given to inherent limitations such as mill points and gate limits when evaluating active power changes. Control systems that inhibit primary frequency response shall not be enabled without <i>IESO</i> approval.
3. Voltage Ride-Through	Ride through routine switching events and design criteria contingencies assuming standard fault detection, auxiliary relaying, communication, and rated breaker interrupting times unless disconnected by configuration. For Inverter-based units, momentary current cessation or reduction of output current during system disturbances is not permitted without <i>IESO</i> approval.
4. Active Power	Continuously supply all levels of active power output within a $\pm 5\%$ range of its rated terminal voltage. Rated active power is the smaller output at either rated ambient conditions (e.g. temperature, head, wind speed, solar radiation) or 90% of rated apparent power. <u>For <i>electricity storage facilities</i>, rated active power values shall be separately specified for both injection and withdrawal operations.</u> To satisfy steady-state reactive power requirements, active power reductions to rated active power are permitted.

5. Reactive Power	Continuously (i.e., dynamically) inject or withdraw reactive power at the high-voltage terminal of the main output transformer ¹ up to 33% of <u>the applicable</u> rated active power at all levels of active power output , and at the typical <i>transmission system</i> voltage, except where a lesser continually available capability is permitted with the <i>IESO's approval</i> . A conventional synchronous unit with a power factor range of 0.90 lagging and 0.95 leading at rated active power connected via a main output transformer impedance not greater than 13% based on <i>generation unit</i> rated apparent power is acceptable. Reactive power losses or charging between the high-voltage terminal of the main output transformer and the <i>connection point</i> shall be addressed in a manner permitted by <i>IESO</i> approval.
6. Automatic Voltage Regulator (AVR)	Regulate voltage automatically within $\pm 0.5\%$ of any set point within $\pm 5\%$ of rated voltage at the low-voltage terminal of the main output transformer if the transformer impedance is not more than 13% based on the rated apparent power of the <i>generation facility</i> , <u>or electricity storage facility</u> or at a point approved by the <i>IESO</i> . Reactive power-voltage droop or AVR reference load current compensation shall not be enabled without <i>IESO</i> approval. The equivalent time constants shall not be longer than 20 ms for voltage sensing and 10 ms for the forward path to the exciter output.
7. Excitation System for Synchronous Machines <u>Generation Units</u> Greater than 20 MVA or <u>any</u> Synchronous Machines <u>Generation within Facilities</u> Greater than 75 MVA	Provide (a) Positive and negative ceilings not less than 200% and 140% of rated field voltage, respectively, while supplying the field winding of the <i>generation unit</i> <u>or electricity storage unit</u> operating at nominal voltage under open circuit conditions; (b) An excitation transformer impedance not greater than 10% on excitation system base; (c) A voltage response time to either ceiling not more than 50 ms for a 5% step change from rated voltage under open-circuit conditions; and (d) A linear response between ceilings.
8. Power System Stabilizer (PSS) for Synchronous Machines within Facilities <u>Generation Units</u> Greater than 20 MVA or <u>Synchronous Generation Facilities</u> or Greater than 75 MVA	Provide (a) A change of power and speed input configuration; (b) Positive and negative output limits not less than $\pm 5\%$ of rated AVR voltage; (c) Phase compensation adjustable to limit angle error to within 30° between 0.2 Hz and 2.0 Hz under conditions specified by the <i>IESO</i> , and (d) Gain adjustable up to an amount that either increases damping ratio above 0.1 or elicits poorly damped exciter modes of oscillation at maximum active output unless otherwise specified by the <i>IESO</i> . Due consideration will be given to inherent limitations. <u>For electricity storage units, Power System Stabilizer shall be disabled while withdrawing.</u>
9. Phase Unbalance	Provide an open circuit phase voltage unbalance not more than 1% and operate continuously with a phase voltage unbalance as high as 2% at the high-voltage terminal of its main output transformer.
10. Armature and Field Limiters	Provide short-time capabilities specified in IEEE/ANSI 50.13 and continuous capability determined by either maximum field current, maximum stator current, core-end heating, or minimum field current. More restrictive limiting functions, such as steady state stability limiters, shall not be enabled without <i>IESO</i> approval.
11. Technical Characteristics	Exhibit, at the high-voltage terminal of its main output transformer, performance comparable to an equivalent synchronous <i>generation unit</i> with characteristic parameters within typical ranges. Inertia, unsaturated transient impedance, transient time constants, and saturation coefficients shall be within typical ranges (e.g. $H > 1.2$ Aero-derivative, $H > 1.2$ Hydroelectric units less than 20 MVA, $H > 2.0$ Hydroelectric units 20 MVA or larger, $H > 4.0$ Other synchronous units, $X'd < 0.5$, $T'd0 > 2.0$, and $S1.2 < 0.5$) except where permitted by <i>IESO</i> approval.
12. Reactive Power Response to Voltage Changes of Inverter-Based Units	For a constant voltage at the high-voltage terminal of the main output transformer, achieve a sustained reactive power change of 30% of <i>generation facility</i> <u>or electricity storage facility</u> rated apparent power at the low-voltage terminal of the main output transformer within 3s following a step change no larger than 4% to the AVR voltage reference. AVR response to the voltage error signal must be consistent over the entire operating range.

¹ A main output transformer steps up the voltage from the *generation unit/facility* to the transmission voltage level.

Appendix 4.3 – Requirements for *Connected Wholesale Customers and Distributors Connected to the IESO-Controlled Grid*

The performance requirements set out below shall apply to *connected wholesale customers and distributors* that are connecting equipment or *facilities* to the *IESO-controlled grid* or to their *distribution systems* after [new effective date].

Equipment connected within a *connected wholesale customer's* or *distributor's facilities* or *distribution systems* that was authorized to *connect* prior to [new effective date] shall remain subject to the performance requirements in effect at the time its authorization to *connect* was granted (i.e. the “original performance requirements”). These original performance requirements shall prevail until the main elements of an associated system are replaced or substantially modified. At that time, the associated system that is replaced or substantially modified shall meet the applicable performance requirements detailed below. All other systems not affected by replacement or substantial modification, shall remain subject to the original performance requirements.

Category	Requirement
1. Power Factor	<i>Connected wholesale customers and distributors connected to the IESO-controlled grid shall operate at a power factor within the range of 0.9 lagging to 0.9 leading as measured at the defined meter point.</i>
2. Under Frequency Load Shedding	<i>Connected wholesale customers and distributors connected to the IESO-controlled grid may be required to participate in under frequency load shedding</i>
3. Special Protection Systems	<i>Connected wholesale customers and distributors connected to the IESO-controlled grid may be required to participate in special protection systems.</i>
4. Voltage Reduction	<i>Distributors connected to the IESO-controlled grid with directly connected load facilities of aggregated rating above 20 MVA and with the capability to regulate distribution voltages under load, shall install and maintain facilities and equipment to provide voltage reduction capability.</i>
5. [Intentionally left blank]	
6. [Intentionally left blank]	
7. [Intentionally left blank]	
8. [Intentionally left blank]	
9. Testing and Compliance Monitoring	<i>Connected wholesale customers and distributors connected to the IESO-controlled grid shall test and maintain their equipment in accordance with all applicable reliability standards.</i>
10. Metering	<i>Connected wholesale customers and distributors connected to the IESO-controlled grid shall comply with metering codes and standards set by the IESO.</i>
11. Voltage Ride-Through	<i>Equipment connected within a connected wholesale customer's or a distributor's facility or distribution system that is connected to the IESO-controlled grid shall ride through routine switching events and design criteria contingencies on the transmission system assuming standard fault detection, auxiliary relaying, communication, and rated breaker interrupting times unless either disconnected by configuration or a failure to do so has been assessed and confirmed by the IESO as having no material adverse effect on the operation of the IESO-controlled grid.</i>
12. Generation Units and Electricity Storage Units	<p>Any generation unit or electricity storage unit connected within a <i>connected wholesale customer's</i> or a <i>distributor's facility</i> or <i>distribution system</i> that is connected to the <i>IESO-controlled grid</i> shall meet, at a minimum, the performance requirements for Off-Nominal Frequency Operation (category 1), Speed/Frequency Regulation (category 2), and Voltage Ride-Through (category 3) specified in Appendix 4.2.</p> <p>If a <i>connected wholesale customer</i> injects active power into the <i>IESO-controlled grid</i>, all performance requirements specified in Appendix 4.2 are applicable to the <i>generation units</i> and <i>electricity storage units</i> installed within their <i>facility</i>.</p>

Note: These performance requirements shall apply to *electricity storage units* at all times while connected within a *connected wholesale customer's or distributor's facilities or distribution system that is connected to the IESO-controlled grid*, unless the *IESO* identifies specific performance requirements that are not applicable to an *electricity storage unit* for those with a *connection assessment* finalized after [effective date]. Due consideration will be given to inherent limitations.

Appendix 4.24 – IESO Monitoring Requirements: Electricity Storage Participants

The following information, as a minimum, shall be available on a continual basis to the *IESO* from:

- (a) any *electricity storage participant* (i) whose *electricity storage facility* is connected to the *IESO-controlled grid*, or (ii) that is participating in the *IESO-administered markets*; and
- (b) any *embedded electricity storage participant* (i) that is not a *market participant* or whose *embedded electricity storage facility* is not a *registered facility*; (ii) whose *embedded electricity storage facility* includes an *electricity storage unit* with an *electricity storage unit size* rated at greater than 20 MVA or that comprises multiple *electricity storage units*, the aggregated *electricity storage unit size* ratings of which exceeds 20 MVA; and (iii) that is designated by the *IESO* for the purposes of section 7.3.1 of this Chapter as being required to provide such data in order to enable the *IESO* to maintain the *reliability* of the *IESO-controlled grid*.

<u>TYPE</u>	<u>INFORMATION REQUIREMENTS</u>
<u>Major electricity storage facility</u>	<p><u>Monitored Quantities</u></p> <p>1. Active Power (MW) and Reactive Power (MX) injected or withdrawn</p> <p>a) The standard requirement for active and reactive power is the provision of net MW and net or gross MX. Gross MW and gross or net MX are also to be provided, if designated by the <i>IESO</i> as required for:</p> <p>(i) <u>determination of operating security limits;</u></p> <p>(ii) <u>to maintain reliable operation of the IESO-controlled grid;</u></p> <p>(iii) <u>for compliance monitoring purposes; or</u></p> <p>(iv) <u>if provision of only the standard requirement values as defined above would have a negative impact on other market participants through reduced operating security limits.</u></p> <p>b) <u>For electricity storage units with an electricity storage unit size greater than or equal to 100 MVA, the standard requirement as defined in part a) for each electricity storage unit shall be provided, and gross MW and gross or net MX for each electricity storage unit shall be provided if designated by the IESO as required using the criteria listed above in part a).</u></p> <p>c) <u>For electricity storage units with an electricity storage unit size of less than 100 MVA:</u></p> <p>(i) <u>for a group of electricity storage units if those electricity storage units are similar in size and operating characteristics, the standard requirement as defined in part a) shall be provided as</u></p>

<u>TYPE</u>	<u>INFORMATION REQUIREMENTS</u>
	<p><u>a total for these <i>electricity storage units</i>, and total gross MW and MX shall be provided if designated by the <i>IESO</i> as required using the criteria listed above in part a); or</u></p> <p><u>(ii) if designated by the <i>IESO</i> as required for determination of operating <i>security limits</i> or to maintain reliable operation of the <i>IESO-controlled grid</i> or for compliance monitoring purposes, the standard requirement as defined in part a) for each <i>electricity storage unit</i> shall be provided, and gross MW and gross or net MX for each <i>electricity storage unit</i> shall be provided if designated by the <i>IESO</i> as required using the criteria listed above in part a).</u></p> <p><u>d) For <i>electricity storage facilities</i> that have been aggregated pursuant to Chapter 7 section 2.3:</u></p> <p><u>(i) the standard requirement as defined in part a) shall be provided as an aggregated total, and an aggregated total gross MW and gross or net MX shall be provided if designated by the <i>IESO</i> as required using the criteria listed above in part a); or</u></p> <p><u>(ii) if so designated by the <i>IESO</i> as required for determination of operating <i>security limits</i> or to maintain <i>reliable</i> operation of the <i>IESO-controlled grid</i> or for dispatch compliance monitoring purposes, the standard requirement as defined in part a) for each <i>electricity storage unit</i> shall be provided, and gross MW and gross or net MX for each <i>electricity storage unit</i> shall be provided if designated by the <i>IESO</i> as required using the criteria listed above in part a).</u></p> <p><u>2. State of Charge and Charge Limit</u></p> <p><u>a) For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, the <i>state of charge</i> of the applicable <i>electricity storage unit</i> or <i>electricity storage facility</i></u></p> <p><u>b) For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, the economic maximum charge limit and the economic minimum charge limit expressed in MWh as per the applicable <i>market manual</i>.</u></p> <p><u>3. Base point</u></p> <p><u>a) For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, providing <i>regulation</i>, the basepoint, if applicable, of the <i>electricity storage unit</i> expressed in MW, according to the applicable <i>market manual</i>.</u></p> <p><u>4. Dynamic Maximum and Minimum Power</u></p> <p><u>a) For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, the economic maximum power mode and economic minimum power mode, expressed in MW.</u></p> <p><u>5. Voltage:</u></p> <p><u>a) For each <i>electricity storage unit</i>, unit terminal voltage, except if <i>electricity storage units</i> are connected to a common low voltage bus section, then the bus section voltage is adequate for those <i>electricity storage units</i>.</u></p> <p><u>6. Equipment Status</u></p> <p><u>a) Voltage Control status and stabilizer status (if applicable) for each <i>electricity storage unit</i> with an <i>electricity storage unit size</i> > 100 MVA. When applicable, stabilizer status reporting is only required if it can be switched off by electricity storage participant personnel remotely or at the facility.</u></p> <p><u>b) AGC status for each <i>electricity storage unit</i> providing <i>regulation</i>.</u></p> <p><u>c) Voltage control status and stabilizer status (if applicable) for each <i>electricity storage unit</i> with an <i>electricity storage unit size</i> < 100 MVA if the status of this equipment is designated by the <i>IESO</i> as required for determination of operating security limits or to maintain reliable operation of the <i>IESO-controlled grid</i>. When applicable, stabilizer status reporting is only required if it can be switched on or off by market participant operating personnel remotely or at the <i>facility</i>.</u></p> <p><u>d) Synchronizing Breaker status for each <i>electricity storage unit</i>. Where a <i>electricity storage facility</i> is designed such that no low voltage synchronizing breaker is installed for each <i>electricity storage unit</i>, the status of the appropriate HV breaker(s) and disconnect switch(es) normally used to isolate the electricity storage unit must be provided. Where this results in access to the</u></p>

<u>TYPE</u>	<u>INFORMATION REQUIREMENTS</u>
	<p><u>majority of breakers on a bus, the status of the remainder of the breakers shall be provided to complete the bus configuration.</u></p> <p>e) <u>Where a <i>electricity storage facility</i> is designed such that there are disconnect switches in parallel, or directly in series, with the synchronizing breaker, the status of those switches is also required.</u></p> <p>f) <u>Special Protection System status for each applicable <i>electricity storage unit</i>.</u></p>
<p><u>Significant electricity storage facility and minor electricity storage facility connected to IESO-controlled grid</u></p>	<p><u>Monitored Quantities</u></p> <p>1. <u>Active Power (MW) and Reactive Power (MX) injected or withdrawn:</u></p> <p>a) <u>The standard requirement for active and reactive power is the provision of net MW and net or gross MX facility. Gross MW and gross or net MX are also to be provided, if designated by the IESO as required for:</u></p> <p>(i) <u>determination of operating security limits;</u></p> <p>(ii) <u>to maintain reliable operation of the <i>IESO-controlled grid</i>;</u></p> <p>(iii) <u>for compliance monitoring purposes; or</u></p> <p>(iv) <u>if provision of only the standard requirement values as defined above would have a negative impact on other <i>market participants</i> through reduced operating security limits.</u></p> <p>b) <u>For <i>electricity storage facilities</i> that have not been aggregated pursuant to Chapter 7 section 2.3:</u></p> <p>(i) <u>for a group of <i>electricity storage units</i> if those <i>electricity storage units</i> are similar in size and operating characteristics, the standard requirement as defined in part a) shall be provided as a total for these electricity storage units, and total gross MW and gross or net MX shall be provided if designated by the IESO as required using the criteria listed above in part a);</u></p> <p>(ii) <u>if designated by the IESO as required for determination of operating security limits or to maintain reliable operation of the IESO-controlled grid or for compliance monitoring purposes, the standard requirement as defined in part a) for each electricity storage unit shall be provided, and gross MW and gross or net MX for each electricity storage unit shall be provided if designated by the IESO as required using the criteria listed above in part a).</u></p> <p>c) <u>For <i>electricity storage facilities</i> that have been aggregated pursuant to Chapter 7 section 2.3:</u></p> <p>(i) <u>the standard requirement as defined in part a) shall be provided as an aggregated total, and an aggregated total gross MW and gross or net MX shall be provided if designated by the IESO as required using the criteria listed above in part a); or</u></p> <p>(ii) <u>if so designated by the IESO as required for determination of operating security limits or to maintain reliable operation of the IESO-controlled grid or for dispatch compliance monitoring purposes, the standard requirement as defined in part a) for each electricity storage unit shall be provided, and gross MW and gross or net MX for each <i>electricity storage unit</i> shall be provided if designated by the IESO as required using the criteria listed above in part a).</u></p> <p>2. <u>Voltage:</u></p> <p>a) <u>For <i>electricity storage units</i> that are VAR dispatchable, unit terminal voltage, except if the electricity storage units are connected to a common low voltage bus section, then the bus section voltage is adequate for those electricity storage units.</u></p> <p>3. <u>State of Charge and Charge Limit</u></p> <p>a) <u>For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, the state of charge of the applicable <i>electricity storage unit</i> or <i>electricity storage facility</i></u></p> <p>b) <u>For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, the economic maximum charge limit and the economic minimum charge limit expressed in MWh as per the applicable <i>market manual</i>.</u></p> <p>4. <u>Dynamic Maximum and Minimum Power</u></p> <p>a) <u>For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, the economic maximum power mode and economic minimum power mode, expressed in MW.</u></p>

<u>TYPE</u>	<u>INFORMATION REQUIREMENTS</u>
	<p><u>5. Base point</u></p> <p><u>a) For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, providing <i>regulation</i>, the basepoint, if applicable, of the storage unit expressed in MW, according to the applicable <i>market manual</i>.</u></p> <p><u>4. Equipment Status</u></p> <p><u>a) Automatic Voltage Control and stabilizer status (if applicable) for each <i>electricity storage unit</i> if the status of this equipment is designated by the IESO as required for determination of operating security limits or to maintain reliable operation of the IESO-controlled grid. When applicable, stabilizer status reporting is only required if it can be switched on or off by the <i>market participant</i> operating personnel remotely or at the facility.</u></p> <p><u>b) Synchronizing Breaker Status for each <i>electricity storage unit</i>. Where an <i>electricity storage facility</i> is designed such that no low voltage synchronizing breaker is installed for each <i>electricity storage unit</i>, the status of the appropriate HV breaker(s) and disconnect switch(es) normally used to isolate the <i>electricity storage unit</i> must be provided. Where this results in access to the majority of breakers on a bus, the status of the remainder of the breakers shall be provided to complete the bus configuration.</u></p> <p><u>Where an <i>electricity storage facility</i> is designed such that there are disconnect switches in parallel, or directly in series, with the synchronizing breaker, the status of those switches is also required.</u></p> <p><u>c) Special Protection System status for each applicable <i>electricity storage unit</i>.</u></p>
<p><u>Self-scheduling electricity storage facility with a name-plate rating of less than 10 MW</u></p>	<p><u>Monitored Quantities</u></p> <p><u>1. Active Power (MW) and Reactive Power (MX) injected or withdrawn:</u></p> <p><u>a) The standard requirement for active and reactive power is the provision of net MW and net or gross MX. Gross MW and gross or net MX are also to be provided, if designated by the IESO as required for:</u></p> <ul style="list-style-type: none"> <u>(i) determination of operating <i>security limits</i>;</u> <u>(ii) to maintain reliable operation of the <i>IESO-controlled grid</i>;</u> <u>(iii) for compliance monitoring purposes; or</u> <u>(iv) if provision of only the standard requirement values as defined above would have a negative impact on other <i>market participants</i> through reduced operating <i>security limits</i>.</u> <p><u>b) For <i>electricity storage facilities</i> that have not been aggregated pursuant to Chapter 7 section 2.3:</u></p> <ul style="list-style-type: none"> <u>(i) for a group of <i>electricity storage units</i> if those <i>electricity storage units</i> are similar in size and operating characteristics, the standard requirement as defined in part a) shall be provided as a total for these <i>electricity storage units</i>, and total gross MW and gross or net MX shall be provided if designated by the <i>IESO</i> as required using the criteria listed above in part a);</u> <u>(ii) if designated by the <i>IESO</i> as required for determination of operating <i>security limits</i> or to maintain reliable operation of the <i>IESO-controlled grid</i> or for compliance monitoring purposes, the standard requirement as defined in part a) for each <i>electricity storage unit</i> shall be provided, and gross MW and gross or net MX for each <i>electricity storage unit</i> shall be provided if designated by the <i>IESO</i> as required using the criteria listed above in part a).</u> <p><u>c) For <i>electricity storage facilities</i> that have been aggregated pursuant to Chapter 7 section 2.3:</u></p> <ul style="list-style-type: none"> <u>(i) the standard requirement as defined in part a) shall be provided as an aggregated total, and an aggregated total gross MW and gross or net MX shall be provided if designated by the <i>IESO</i> as required using the criteria listed above in part a); or</u> <u>(ii) if so designated by the <i>IESO</i> as required for determination of operating <i>security limits</i> or to maintain reliable operation of the <i>IESO-controlled grid</i> or for <i>dispatch</i> compliance monitoring purposes, the standard requirement as defined in part a) for each <i>electricity storage unit</i> shall be provided, and gross MW and gross or net MX for each <i>electricity storage unit</i> shall be provided if designated by the <i>IESO</i> as required using the criteria listed above in part a).</u>

<u>TYPE</u>	<u>INFORMATION REQUIREMENTS</u>
	<p><u>2. Voltage:</u></p> <p>a) For <i>electricity storage units</i> that are VAR dispatchable, unit terminal voltage, except if the <i>electricity storage units</i> are connected to a common low voltage bus section, then the bus section voltage is adequate for those <i>electricity storage units</i>.</p> <p><u>3. State of Charge and Charge Limit</u></p> <p>a) For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, the state of charge of the applicable <i>electricity storage unit</i> or <i>electricity storage facility</i></p> <p>b) For each <i>electricity storage unit</i> or <i>electricity storage facility</i> the economic maximum charge limit, the economic minimum charge limit expressed in MWh</p> <p><u>4. Dynamic Maximum and Minimum Power</u></p> <p>a) For each <i>electricity storage unit</i>, the economic maximum power mode and economic minimum power mode, expressed in MW.</p> <p><u>5. Base point</u></p> <p>a) For each <i>electricity storage unit</i>, providing <i>regulation</i>, the basepoint of the applicable <i>electricity storage unit</i> expressed in MW according to the applicable <i>market manual</i>.</p> <p><u>6. Equipment Status</u></p> <p>a) Automatic Voltage Control status and Stabilizer status (if applicable) for each <i>electricity storage unit</i> if the status of this equipment is designated by the IESO as required for determination of operating <i>security limits</i> or to maintain reliable operation of the <i>IESO-controlled grid</i>. When applicable, stabilizer status reporting is only required if it can be switched on or off by <i>market participant</i> operating personnel remotely or at the <i>facility</i>.</p> <p>b) Synchronizing Breaker Status for each <i>electricity storage unit</i>. Where an <i>electricity storage facility</i> is designed such that no low voltage synchronizing breaker is installed for each <i>electricity storage unit</i>, the status of the appropriate HV breaker(s) and disconnect switch(es) normally used to isolate the <i>electricity storage unit</i> must be provided. Where this results in access to the majority of breakers on a bus, the status of the remainder of the breakers shall be provided to complete the bus configuration.</p> <p>Where an <i>electricity storage facility</i> is designed such that there are disconnect switches in parallel, or directly in series, with the synchronizing breaker, the status of those switches is also required.</p> <p>c) Special Protection System status for each applicable <i>electricity storage unit</i>.</p>
<u>Small electricity storage facility</u>	<u>None</u>
<u>Minor electricity storage facility that is embedded in a distribution system and registered as a dispatchable electricity storage participant</u>	<p><u>Monitored Quantities</u></p> <p>1. Total active power (MW) output of the individual <i>electricity storage unit</i> or of the aggregated resource.</p> <p>a) Unit status if the <i>facility</i> is comprised of a single <i>electricity storage unit</i>.</p> <p>b) Aggregated resource status if the <i>facility</i> is comprised of aggregated resources, i.e. if at least one unit of the aggregated resource is synchronized, the aggregated resource is synchronized or if no unit in the aggregated resource is synchronized, the aggregated resource is not synchronized.</p> <p>c) Reactive Power (MX) output, if requested by the IESO for reliable operation of the <i>IESO-controlled grid</i>, of individual <i>electricity storage units</i> or of the aggregated resource.</p> <p>d) Unit terminal voltage (kV) if requested by the IESO for reliable operation of the <i>IESO controlled grid</i></p>

<u>TYPE</u>	<u>INFORMATION REQUIREMENTS</u>
	<p>2. <u>State of Charge and Charge Limit</u></p> <p>a) <u>For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, the <i>state of charge</i> of the applicable <i>electricity storage unit</i> or <i>electricity storage facility</i> expressed as a percentage</u></p> <p>b) <u>For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, the economic maximum charge limit, the economic minimum charge limit expressed in MWh</u></p> <p>3. <u>Dynamic Maximum and Minimum Power</u></p> <p>a) <u>For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, the economic maximum power mode and economic minimum power mode, expressed in MW.</u></p> <p>4. <u>Base point</u></p> <p>a) <u>For each <i>electricity storage unit</i> or <i>electricity storage facility</i>, providing <i>regulation</i>, the basepoint, if applicable, of the <i>electricity storage unit</i> expressed in MW according to the applicable <i>market manual</i>.</u></p>

Appendix 4.25 – IESO Monitoring Requirements: Electricity Storage Performance Standards

The following performance standards, as a minimum, shall be achieved on a continual basis by all *electricity storage participants* referred to in section 7.3.A of this Chapter when monitored by the *IESO*. Needs of the state estimation process or other reasons may result in additional requirements. The direction of all real and reactive power flows shall be indicated measurements.

<u>FUNCTION</u>	<u><i>Major electricity storage facility or significant electricity storage facility</i></u> (High Performance)	<u><i>Minor electricity storage facility and self-scheduling electricity storage facility (electricity storage facility unit size <10MW)</i></u> (Medium Performance)	<u><i>Small electricity storage facility</i></u>
<u>Data measurements available at the <i>IESO</i> communications interface</u>	<u>Less than 2 seconds from change in field monitored quantity</u>	1. <u>Less than 10 seconds from change in field monitored quantity</u> or 2. <u>If the <i>minor electricity storage facility</i> is embedded within a <i>distribution system</i>, less than one minute from change in field monitored quantity unless otherwise designated by the <i>IESO</i> to maintain the <i>reliability</i> of the <i>IESO-controlled grid</i>.</u>	<u>Not applicable</u>

<u>FUNCTION</u>	<u>Major electricity storage facility or significant electricity storage facility</u> (High Performance)	<u>Minor electricity storage facility and self-scheduling electricity storage facility (electricity storage facility unit size <10MW)</u> (Medium Performance)	<u>Small electricity storage facility</u>
<u>Equipment status change available at the IESO communications interface</u>	<u>Less than 2 seconds from field status change</u>	<u>1. Less than 10 seconds from field status change or</u> <u>2. If the minor electricity storage facility is embedded within a distribution system, less than one minute from change in equipment status unless otherwise designated by the IESO to maintain the reliability of the IESO-controlled grid.</u>	<u>Not applicable</u>
<u>IESO scan period for data measurements</u>	<u>Maximum:* 4 seconds</u>	<u>Minimum:** 4 seconds</u>	<u>Not applicable</u>
<u>IESO scan period for Equipment Status</u>	<u>Maximum:* 4 seconds</u>	<u>Minimum:** 4 seconds</u>	<u>Not applicable</u>
<u>Data Skew</u>	<u>Maximum: 4 seconds</u>	<u>Not applicable</u>	<u>Not applicable</u>

* The IESO may scan more frequently than the maximum.

** The IESO may scan less frequently than the minimum.

