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## Market Rule Amendment Submission

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This form is used to request an amendment to, or clarification of, the *Market Rules*. Please complete the first four parts of this form and submit the completed form by email or fax to the following:

Email Address: [Rule.Amendments@ieso.ca](mailto:Rule.Amendments@ieso.ca)

Fax No.: (416) 506-2847 Attention: Market Rules Group

**Subject: Market Rule Amendment Submission**

All information submitted in this process will be used by the *IESO* solely in support of its obligations under the *Electricity Act, 1998*, the *Ontario Energy Board Act, 1998*, the *Market Rules* and associated policies, standards and procedures and its license. All submitted information will be assigned the *confidentiality classification* of “Public” upon receipt. You should be aware that the *IESO* will *publish this amendment submission* if the *Technical Panel* determines it warrants consideration and may invite public comment.

Terms and acronyms used in this Form that are italicized have the meanings ascribed thereto in Chapter 11 of the *Market Rules*.

### PART 1 – SUBMITTER’S INFORMATION

Please enter contact information in full.	
Name: <u>IESO Staff</u>	
(if applicable) <i>Market Participant / Metering Service Provider</i> No. <sup>1</sup> : <u>N/A</u>	<i>Market Participant Class</i> : <u>N/A</u>
Telephone: <u>905 403-6955</u>	Fax: _____
E-mail Address: <u>rule.amendments@ieso.ca</u>	

### PART 2 – MARKET RULE AMENDMENT SUBMISSION INFORMATION

Subject: <u>Generation Facility Requirements</u>	
Title: <u>Changes to Facilitate Connections</u>	
Nature of Request (please indicate with x)	
<input checked="" type="checkbox"/> Alteration	<input type="checkbox"/> Deletion
<input type="checkbox"/> Addition	<input type="checkbox"/> Clarification
Chapter: <u>4</u>	Appendix: <u>4.2</u> Sections: _____
Sub-sections proposed for amending/clarifying: _____	

<sup>1</sup> This number is a maximum of 12 characters and does not include any spaces or underscore.

### PART 3 – DESCRIPTION OF THE ISSUE

Provide a brief description of the issue and reason for the proposed amendment. If possible, provide a qualitative and quantitative assessment of the impacts of the issue on you and the *IESO-administered markets*. Include the Chapter and Section number of the relevant *market rules*.

The IESO is proposing to amend the market rules that specify generation facility requirements (Appendix 4.2). The proposed changes would:

- Facilitate public policy objects, e.g. the integration of embedded and other types of generation;
- Ease the market entry process by simplifying and clarifying those requirements; and
- Improve the IESO’s effectiveness in assessing proposed connections.

These specific changes to generation facility requirements were discussed with stakeholders during several [Wind Power Standing Committee](#) meetings and through the stakeholder engagement initiative [SE-57 Embedded and Renewable Generation](#). In February 2009, it was agreed that these changes did not require further review at SE-57 and should proceed through the amendment process without delay.

#### Facilitating Public Policy Objects

Under the existing market rules, almost all of the requirements listed in Chapter 4, Appendix 4.2 apply to embedded generation facilities with net output greater than 50 MVA and embedded generation units rated at 10 MVA or higher. (These market rule requirements do not apply to embedded generation facilities/units smaller than the noted thresholds.)

To facilitate the integration of embedded generation, it is proposed to simplify the requirements for these facilities as follows:

- Fill the gap in the existing requirement for off-nominal frequency capability;
- Express Speed/Frequency regulation requirement that is less technology specific and more measurable; and
- Clarify the low-voltage ride-through requirement.

To make it easier for embedded generators to know their facility requirements under the market rules, it is proposed to move the three remaining applicable provisions to the beginning of Appendix 4.2. These three requirements also represent a subset of the requirements that apply to generation facilities directly connected to the IESO-controlled grid.

Chapter 3, section 3.1.3 specifies that Appendix 4.2 applies to an embedded generation unit rated at 10 MVA or higher or an embedded facility whose net output is greater than 50 MVA. For the sake of consistency and clarity in the language used to describe the thresholds, it is proposed to change the parameter “net output is greater than 50MVA” to “net output 50 MVA or higher”. Revising this threshold would have no impact on the set of requirements that apply to existing facilities under the current and proposed rules.

#### Easing Market Entry and Improving IESO Effectiveness in Assessing Proposed Connections

The proposed changes to generation facility requirements would afford greater clarity through measurable performance requirements and added flexibility to allow emerging technologies to be evaluated on a fair basis. Experience has shown that more specifics are needed in some places to

**PART 3 – DESCRIPTION OF THE ISSUE**

maintain reliability and more clarity is needed in other areas to make the connection assessment process more efficient.

To further simplify Appendix 4.2, it is proposed to re-organize the contents (through an entire re-write) so that it's clear which requirements apply to which type of generation facility. These changes are tracked in the attached Table of Concordance and the existing appendix is attached for reference. The following amendments are proposed to the requirements for generation facilities directly connected to the IESO controlled grid:

- Speed/Frequency Regulation: Extend the requirements to all generation types and add measureable requirements for governor performance.
- Active power: Editorial change for clarification.
- Reactive power: Simplify the requirement by removing the references to leading and lagging power factor. The existing provision requires more capability to withdraw than to provide reactive power to the transmission system whereas a balanced injection and withdrawal reactive requirement is more appropriate. The requirement to provide the entire required range of reactive power for a transmission voltage has been re-expressed in an updated form to match the reactive power range change. The provision regarding continuously available reactive capability is intended to give the IESO latitude to accept less complex and costly connection arrangements that have suitable reliability advantages.
- Voltage regulation: Add a capability requirement for droop systems consistent with present requirement for non-droop systems.
- Excitation System: Remove requirements for distribution connected generation. Clarify voltage response time requirements apply to both positive and negative ceilings. Add performance requirements for high exciter load conditions. The 50.13 reference should be checked to ensure it is still applicable with the latest revision ANSI standard.
- Stabilizer: Add measurable requirements to provide better guidance and specify the type of stabilizer ( $\Delta P\omega$ ) to avoid less stable designs.
- Phase unbalance: Add a measurement location to avoid too onerous a restriction.
- Protection systems and limiters: Make explicit that protection systems and limiters must not unduly restrict equipment capability.
- Performance characteristics: Add a requirement for performance to be consistent with an equivalent synchronous machine with characteristic parameters within typical ranges. Experience has shown generation proponents are being driven towards lower cost options with characteristics that are outside of typical ranges. This new requirement is intended to permit a proper balance between maintaining reliability and removing unnecessary barriers to connection.

**PART 4 – PROPOSAL (BY SUBMITTER)**

Provide your proposed amendment. If possible, provide suggested wording of proposed amendment.

PART 3 – DESCRIPTION OF THE ISSUE

## Appendix 4.2 – Generation Facility Requirements ~~(Embedded and Non Embedded)~~

Each *generation facility* shall comply with the following requirements, provided that a *generation facility* that was in service or that existed and was *licensed* on the date of coming into force of this Chapter 4 shall preserve original excitation system design capabilities and shall not be required to comply with the requirements set forth in rows ~~12-6~~ to ~~15-8~~ of this Appendix until its exciter is replaced. Such *generation facility* shall, until that time, be required to operate in accordance with the design capabilities applicable in respect of each of the items referred to in rows ~~12-6~~ to ~~15-8~~ of this Appendix. New performance requirements shall apply either to new installations or to existing *generation facilities* when equipment is replaced.

[*Note to draft:* For ease of reference, the highlighted text identifies the more substantive changes, i.e. changes that go beyond editorial-type amendments.]

<u>All generation facilities connected to the IESO-controlled grid; embedded generation facilities 50MVA or higher, and embedded generation unit 10MVA or higher</u>	
<u>1. Off-Nominal Frequency</u>	<u>Each generation facility shall be able to operate continuously at all levels of active power output between 59.4Hz and 60.6Hz and for a limited time period in the region above straight lines on a log-linear scale defined by the points (0.0s, 57.0Hz), (3.3s, 57.0Hz), (300s, 59.0Hz), and (740s, 59.4Hz).</u>
<u>2. Speed/Frequency Regulation</u>	<u>Each generation facility shall be able to regulate speed with a droop adjustable between 3% and 7%. Any intentional deadband shall not be wider than ±36mHz. The governor shall control speed in a stable fashion in both interconnected and island operation and provide immediate, appropriate, and sustained response to abnormal frequency excursions. The governor shall have the capability to effect a 10% change of rated active power for a 1% change in frequency ramped over 10 seconds. Due consideration will be given to inherent limitations such as mill points. Control systems that inhibit governor response shall be automatically disabled when grid frequency is less than 59.9Hz or greater than 60.1Hz.</u>
<u>3. Low Voltage Ride Through</u>	<u>Each generation facility shall be able to ride through design criteria contingencies assuming standard fault detection, auxiliary relaying, communication, and rated breaker interrupting times unless disconnected by configuration.</u>
<u>All generation facilities connected to the IESO-controlled grid</u>	
<u>4. Active Power</u>	<u>Each generation facility shall be able to operate continuously within ±5% of its rated terminal voltage at all levels of active power output.</u>
<u>5. Reactive Power</u>	<u>Each generation facility shall be able to continuously (i.e. dynamically) inject or withdraw, at its connection point, reactive power up to 30% of its rated active power at all levels of active power output except where a lesser continually available capability is permitted by the IESO. Each generation facility shall be able to continuously supply its entire range of reactive power over a 2% range of connection point voltage. Rated active power is the lesser of the registered maximum continuous active power and 90% of rated apparent power.</u>
<u>6. Automatic Voltage Regulator (AVR)</u>	<u>Each generation facility shall be able to automatically regulate voltage within ±0.5% of any set point within ±5% of rated voltage. The slope <math>\Delta V / \Delta Q_{max}</math> in droop systems shall be adjustable to 0.5%. Each AVR shall regulate voltage except where permitted by the IESO. When multiple generation units are connected to a common bus, each unit's AVR reference shall be compensated to a point as close as practicable to but not farther from this common bus. Reference compensation more than 10% Xd from a common bus shall not be placed in service without IESO approval.</u>

**PART 3 – DESCRIPTION OF THE ISSUE**

<p><u>7. Excitation System</u></p>	<p>Each generation facility shall have the following excitation system capabilities: (a) positive and negative ceilings not less than 200% and 140% of rated field voltage at rated terminal voltage and rated field current; (b) a positive ceiling not less than 170% of rated load field voltage at rated terminal voltage and 160% of rated field current; (c) a voltage response time to either ceiling not more than 50ms for a 5% step change from rated voltage under open circuit conditions; (d) a uniform response between ceilings; and (e) a small signal frequency response (<math>\Delta E / \Delta V_t</math>) magnitude and angle change not more than 3dB and 32° between 0.1 and 10Hz.</p>
<p><u>8. Power System Stabilizer (PSS)</u></p>	<p>Each synchronous <i>generation unit</i> shall have the following power system stabilizer capabilities: (a) a power and speed based (<math>\Delta P_{\omega}</math>) configuration; (b) positive and negative output limits not less than 10% and 5% of rated AVR voltage, (c) phase compensation adjustable to limit angle error within 10° between 0.2 and 2.0Hz, and (d) gain adjustable to within 1/3 and 1/2 the value to elicit poorly damped exciter modes of oscillation.</p>
<p><u>9. Phase Unbalance</u></p>	<p>Each <i>generation facility</i> shall not exceed 1% open circuit phase voltage unbalance at a <u>connection point</u> and shall be able to continuously operate with a phase unbalance of at least 2%.</p>
<p><u>10. Protection and Limiters</u></p>	<p>Each <i>generation facility</i> shall coordinate protection and limiters with short-time capabilities identified in IEEE/ANSI 50.13 and continuous capability determined by either armature current, or field current, or end-region heating.</p>
<p><u>11. Performance Characteristics</u></p>	<p>Each <i>generation facility's</i> performance at its <u>connection point</u> shall be comparable to an equivalent synchronous <i>generating unit</i> with characteristic parameters within typical ranges. Inertia, transient impedance, transient time constants and saturation coefficients shall be within typical ranges (e.g. H &gt; 2.0 Hydraulic, H &gt; 4.0 Thermal, X'd &lt; 0.5, T'do &gt; 2.0, or S1.2 &lt; 0.5) except where permitted by the IESO.</p>

**PART 5 – FOR IESO USE ONLY**

Technical Panel Decision on Rule Amendment Submission: Warrants consideration

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MR Number: MR-00360

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Date Submitted to Technical Panel: July 15, 2009

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Accepted by Technical Panel as: (please indicate with x)  General  Urgent  Minor Date: July 21, 2009

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Criteria for Acceptance: It identifies ambiguity and confusion in the rules and it identifies ways to simplify the market.

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Priority: High

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Criteria for Assigning Priority: Practical consequences: the proposed changes are likely to be acceptable generally because they are consistent with the purposes of the Green Energy Act in that they would facilitate the integration of renewable energy supply by making it easier to connect to the IESO-controlled grid.

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Not Accepted (please indicate with x):

Clarification/Interpretation Required (please indicate with x):

Technical Panel Minutes Reference: IESOTP 228-1

**PART 3 – DESCRIPTION OF THE ISSUE**

*Technical Panel Comments:* Panel members stated that they may well ultimately have no concerns with the proposed amendment. However, because of the specialized technical nature of the areas addressed, they asked the IESO experts to engage stakeholders from the generator, transmitter and local distribution communities and explain, on almost a line by line basis, the meaning of the proposed changes and the implications in relation to current practices.

Existing Appendix 4.2 – attached for reference

## Appendix 4.2 – Generation Facility Requirements (Embedded and Non-Embedded)

Each *generation facility* shall comply with the following requirements, provided that a *generation facility* that was in service or that existed and was *licensed* on the date of coming into force of this Chapter 4 shall preserve original excitation system design capabilities and shall not be required to comply with the requirements set forth in rows 12 to 15 of this Appendix until its exciter is replaced. Such *generation facility* shall, until that time, be required to operate in accordance with the design capabilities applicable in respect of each of the items referred to in rows 12 to 15 of this Appendix.

<b>Ref</b>	<b>Item</b>	<b>Requirement</b>
1	Reactive Power Capabilities	<ol style="list-style-type: none"> <li>1. A synchronous <i>generation unit</i> shall have the capability to supply at its terminal reactive power within the range 90% lagging (overexcited) to 95% leading (underexcited) power factor based on rated active power at rated voltage. Rated active power shall be the lesser of registered maximum continuous real power and 90% of the unit nameplate MVA.</li> <li>2. A non-embedded <i>generation unit</i> within a <i>generation facility</i> shall have the capability to supply its entire range of reactive power for at least one constant voltage at a <i>connection facility</i> terminal greater than 50 kV. A non-embedded <i>generation unit</i> within a <i>generation facility</i> for which a licence has first been issued on or before the date of coming into force of this Chapter 4, and lacking the capability to meet this requirement, shall maintain its existing capability and shall establish the capability to supply its entire range of reactive power for at least one constant voltage at a <i>connection facility</i> terminal greater than 50 kV upon upgrading of all of the limiting components of its <i>connection facilities</i>.</li> <li>3. Where modifications to a <i>generation facility</i> made before the date of coming into force of this Chapter 4 make it no longer possible to meet these reactive requirements at a new higher active power, <i>generation units</i> within such <i>generation facility</i> shall, if so requested by the IESO, satisfy reactive power requirements based on rated active power before this modification.</li> <li>4. An induction <i>generation facility</i> that is injecting electricity at a nominal voltage of greater than 50 kV, shall have, as measured at its <i>connection point</i>, the same capability to supply reactive power as required of a synchronous <i>generation unit</i> of the same apparent power.  The IESO may permit a lower requirement for an induction <i>generation facility</i> if the IESO identifies during the <i>connection assessment</i> for the <i>facility</i> that the lower requirement will not adversely affect the <i>reliable</i> operation of the IESO-controlled grid. At any time after the <i>connection assessment</i> is complete, the IESO may impose a higher requirement than that identified at the time of the <i>connection assessment</i>, up to the capabilities required of a synchronous generation unit of the same apparent power, if the IESO determines that the higher requirement is necessary to maintain <i>reliable</i> operation of the IESO-controlled grid.</li> <li>5. An induction <i>generation facility</i> that is injecting electricity at a nominal voltage equal to or less than 50 kV, shall have, as a minimum, the capability to reduce its reactive power flow to zero, as measured at the <i>facility's connection point</i>.  The IESO may impose additional reactive power capability requirements, up to the capabilities required of a synchronous <i>generation unit</i> of the same apparent power, if the IESO identifies during the <i>connection assessment</i> for the <i>facility</i> that the additional capability is required to maintain <i>reliable</i> operation of the IESO-controlled grid.</li> </ol>
2	Voltage Variations	Each <i>generation facility</i> shall be capable of operating continuously at full output within $\pm 5\%$ of the <i>generation facility's</i> rated terminal voltage. All plant auxiliaries shall be capable of running continuously within this range. Each <i>generation facility</i> shall not be expected to operate continuously outside this voltage range to satisfy reactive power requirements.
3	Frequency Variations	Each <i>generation facility</i> shall be able to operate continuously at full power in the range 59.4 to 60.6 Hz. Each <i>generation facility</i> shall be capable of operating at full power for a limited period of time at

<b>Ref</b>	<b>Item</b>	<b>Requirement</b>
		frequencies as low as 58.8 Hz. Each <i>generation facility</i> shall not trip for underfrequency excursions that are above a straight line defined on a linear-log plot of time and frequency by the points (300s, 59.0Hz) and (3.3s, 57.0 Hz) unless the <i>IESO</i> accepts other trip settings. Immediate tripping is allowed below 57.0 Hz.
4	Phase Unbalance	Phase voltage unbalance of <i>generation facilities</i> shall be limited to 1% measured with the units operating unsynchronised. <i>Generation facilities</i> shall be able to continuously operate with a phase unbalance of 2%.
5	Connection Equipment	All equipment connecting the <i>generation unit's</i> terminal to the <i>IESO-controlled grid</i> shall be able to conduct for at least 4 hours the <i>generation unit's</i> rated apparent power, being the product of root-mean-square (rms) voltage and the rms current, minus auxiliary power requirements necessary to operate the unit at maximum output and minus a fair portion of the common service load required to run the entire <i>generation facility</i> .
6	[Intentionally left blank]	
7	Protective Systems and Relaying System Requirements	Protection systems shall be constructed and maintained in accordance with all applicable <i>reliability standards</i> .
8	[Intentionally left blank] Line	
9	<i>IESO</i> Monitoring and Telemetry Requirements	<i>Generation facilities</i> that are required by this Chapter 4 to be monitored shall provide suitable space and facilities for the installation of telecommunications equipment to interface with the <i>generator's</i> data acquisition equipment. Data monitoring equipment shall be compatible with the <i>IESO</i> telecommunications interface and meet the requirements of this Chapter 4 and of Appendix 2.2 of Chapter 2, if such equipment is not already installed on the date of coming into force of this Chapter 4. Any such new installation shall be done at the <i>generator's</i> cost.
10	Communication Facilities	Communication facilities are required for several or all of the following functions: protective relaying, SCADA, <i>IESO</i> energy management system, voice communication, <i>automatic generation control (AGC)</i> , and <i>special protection systems (generation rejection or runback)</i> . Details depend on the size and specific location of the generating plant under consideration
11	Testing/ Compliance Monitoring	<i>Generators</i> shall test and maintain their equipment in accordance with all applicable <i>reliability standards</i> .



<i>Ref</i>	<i>Item</i>	<i>Requirement</i>
	<b>Generator Controls</b>	
12	Excitation System Performance	<p>1. Each synchronous <i>generation unit</i> rated at 10 MVA or higher shall be equipped with an excitation system with:</p> <ul style="list-style-type: none"> <li>• A voltage response time not longer than 50 ms for a voltage reference step change not to exceed 5%;</li> <li>• A positive ceiling voltage of at least 200% of the rated field voltage, and</li> <li>• A negative ceiling voltage of at least 140% of the rated field voltage.</li> </ul> <p>This performance requirement would not apply to a <i>generation unit</i> rated at 10 MVA or higher where the <i>IESO</i> determines through the <i>connection assessment</i> for that <i>generation unit</i>, that a lower requirement would not adversely impact the <i>reliable</i> operation of the <i>IESO-controlled grid</i>. In these circumstances, the synchronous <i>generation unit</i> shall be equipped with an excitation system with:</p> <ul style="list-style-type: none"> <li>• An excitation system nominal response of at least 0.50 and</li> <li>• A positive ceiling voltage at least 150% of rated field voltage</li> </ul> <p>2. Each synchronous <i>generation unit</i> rated at less than 10 MVA shall be equipped with an excitation system with:</p> <ul style="list-style-type: none"> <li>• An excitation system nominal response of at least 0.50 and</li> <li>• A positive ceiling voltage at least 150% of rated field voltage</li> </ul> <p>This performance requirement would not apply to a <i>generation unit</i> rated at less than 10 MVA where the <i>IESO</i> determines through the <i>connection assessment</i> for that <i>generation unit</i>, that a higher requirement is required to maintain <i>reliable</i> operation of the <i>IESO-controlled grid</i>. In these circumstances, the synchronous <i>generation unit</i> shall be equipped with an excitation system with:</p> <ul style="list-style-type: none"> <li>• A voltage response time not longer than 50 ms for a voltage reference step change not to exceed 5%;</li> <li>• A positive ceiling voltage of at least 200% of the rated field voltage, and</li> <li>• A negative ceiling voltage of at least 140% of the rated field voltage.</li> </ul>
13	Automatic Voltage Regulator	<p>Each synchronous <i>generating unit</i> shall be equipped with a continuously acting automatic voltage regulator (AVR) that can maintain terminal voltage under steady state conditions within <math>\pm 0.5\%</math> of any set point within <math>\pm 5\%</math> of rated voltage.</p> <p>Each induction <i>generation facility</i> that is injecting electricity at a nominal voltage of greater than 50 kV shall be equipped with a voltage regulation system (VRS) that provides comparable performance to that of the AVR of a synchronous <i>generation unit</i> of the same apparent power.</p> <p>Each AVR and VRS shall regulate voltage except where permitted by the <i>IESO</i>.</p> <p>Automatic set point adjustments shall be suspended when terminal voltage deviates from a fixed set point by an amount not to exceed <math>\pm 2\%</math> of the fixed set point.</p> <p>Where multiple <i>generation units</i> are connected to a common bus, each <i>generation unit's</i> AVR reference shall be compensated to a point as close a practicable to but not farther than this common bus. The reach of AVR compensation shall not exceed 10% of the <i>generation unit's</i> synchronous direct axis impedance from the common bus. <i>IESO</i> approval is required for all other schemes that compensate the AVR to a point other than the <i>generation unit's</i> terminals.</p>
14	Power Factor Regulator	<p>Each synchronous <i>generation unit</i> connected to the system at a voltage under 50 kV shall be provided with a power factor regulator or VAR regulator. A power factor regulator shall be capable of maintaining a power factor within <math>\pm 1\%</math> between 90% lagging and 95% leading. A VAR regulator shall be capable of maintaining reactive power within <math>\pm 2.5\%</math> of rated MVA. The power factor or VAR regulator shall have an adjustable effective response time between 10 to 60 seconds.</p>
15	Power System Stabilizer	<p>Each synchronous <i>generating unit</i> that is equipped with an excitation system that meets the performance requirements specified in sub-section 1 of section 12 above, shall also be equipped with a power system stabilizer. The power system stabilizer shall, to the extent practicable, be tuned to increase damping torque without reducing synchronizing torque.</p>

<b>Ref</b>	<b>Item</b>	<b>Requirement</b>
16	Speed Governor	<ul style="list-style-type: none"> <li>• Each synchronous <i>generation unit</i> with a nameplate rating of greater than 10 MVA shall be operated with a speed governor. The governor shall have a permanent speed droop that can be set in the range between 3% and 7% and the intentional deadband shall not be wider than <math>\pm 36</math> mHz .</li> <li>• The above droop and deadband requirements shall apply to an entire combined-cycle <i>generation facility</i>.</li> <li>• The governor shall be able to arrest the unit's speed, following full load rejection to prevent a trip due to overspeed, and shall demonstrate stable performance with adequate damping under all operating conditions.</li> <li>• Governors shall control speed in a stable fashion during both island and interconnected operation.</li> <li>• To the extent practical governors shall provide immediate, appropriate and sustained response to abnormal frequency excursions.</li> <li>• Control systems that inhibit governor response shall be automatically disabled by frequency deviations not larger than <math>\pm 100</math> mHz.</li> </ul>

**TABLE OF CONCORDANCE – REVISION TO APPENDIX 4.2**

**How to use this table:** The left-hand column lists provisions by reference numbers assigned in the existing Market Rule Appendix 4.2. The middle column identifies where the provision would be located after the proposed changes. The comments in the right-hand column describe shortcomings of existing provisions and the nature of proposed changes.

Current Ref	Future Ref	Comments
1	5	Requirements for distribution-connected generation have been removed and for transmission connection generation have been re-expressed and simplified. To assist proponents and to cater for a wider range of technology, reactive requirements have been expressed at the connection point to the ICG. The capability to withdraw reactive power has been reduced for transmission-connected generation and a provision has been made to enable a lesser dynamic requirement for intermittent generation.
2	4	The capability to operate at full active power over a $\pm 5\%$ terminal voltage range has been corrected to require this capability at all active power output levels. The reference has been re-labeled as “Active Power Capability”
3	1	The gap in existing requirement for off-nominal frequency capability between 300s and continuous operation has been filled. An editorial change has been proposed to require this capability be available at all active power levels.
4	9	The phase unbalance requirement has been fine-tuned to avoid being unnecessarily onerous by specifying at point of connection to the transmission system as the measurement point.
5	deleted	The requirements for connection equipment are not necessary in Appendix 4.2 as suitable provisions exist elsewhere.
6	deleted	“Intentionally left blank” removed
7	10	The existing requirement: “Protection systems shall be constructed and maintained in accordance with all applicable reliability standards” is already specified in Ch 4 §2. Experience has shown the present rules need improvements to avoid tendencies that unduly restrict equipment capability. The proposed change makes it explicit that protection systems and limiters must not unduly restrict equipment capability.
8	deleted	“Intentionally left blank” removed
9	deleted	Telemetry requirements are not needed in Appendix 4.2 as suitable provisions exist in Ch 4 §7.
10	deleted	Communication requirements are not needed in Appendix 4.2 as suitable provisions exist in Ch 4 §7.
11	deleted	Testing and compliance requirements are not needed in Appendix 4.2 as suitable

Current Ref	Future Ref	Comments
		provisions exist in Ch 4 §4 and §5.
12	7	Excitation system performance requirements intended for distribution-connected generation have been removed. The requirements for transmission-connected generation have been re-expressed in more measurable manner to better guide proponents. The voltage response time requirement has been more clearly worded to apply to both positive and negative exciter ceilings. A requirement to limit ceiling drop under load has been proposed to plug a gap.
13	6	A capability requirement for droop systems consistent with present for non-droop systems has been proposed. Droop designs are common in wind farms.
14	deleted	Power factor regulation requirements intended for distributed generation have been removed.
15	8	Power system stabilizer requirements have been made more measurable to provide an appropriate level of guidance. Experience has shown the existing formulation tune stabilizers to the extent practicable to increase damping torque without reducing synchronizing torque needs improvement. Experience has shown that it is necessary to require a capability to implement a ( $\Delta P\omega$ ) stabilizer design.
16	2	To take advantage of the capability of newer technology, droop requirements have been extended to all forms of generation. Experience has shown the present governor requirements are not specific enough to provide an appropriate level of guidance. The presently undefined notions of immediate and sustained are given clear measures in the proposed change.
n/a	3 (new)	A Low-Voltage-Ride-Through (LVRT) capability requirement has been added as this provision has been a standard feature in connection assessments. The requirement is necessary to mitigate the risk of insecure operation if material amounts of distributed-connected generation trip unexpected for contingencies on the transmission system. The proposed rule is cast in a form designed not only to assist IESO assessments but also to guide proponents.
n/a	11(new)	A requirement has been added that performance be consistent with an equivalent synchronous machine with characteristic parameters within typical ranges. Other Appendix 4.2 requirements have been formulated on the basis that machine characteristics are within these typical ranges. Experience has shown generation proponents are being driven towards lower cost options with characteristics that are outside of typical ranges that do not enhance reliability to the extent anticipated. This new requirement is intended to permit a proper balance to be struck between maintaining reliability and removing unnecessary barriers to connection.