~~PUBLIC~~

~~POLICY~~

**Market Manual 7: System Operations**

# Part 7.4: IESO-Controlled Grid Operating Policies

**Issue 41.~~1-MRP~~2**
**~~July 14, 2023~~**
**June 7, 2024**

~~This *market manual* is provided for stakeholder engagement purposes. Please note that additional changes to this document may be incorporated as part of future engagement in MRP or other *IESO* activities prior to this *market manual* taking effect.~~

~~**This market manual provides policy statements for reliable operation of the IESO-controlled grid.**~~

~~**IMP_POL_0002**~~

## Document Change History

| Issue | Reason for Issue | Date |
|---|---|---|
| For changes prior to 2017, refer to versions 40.0 and prior. | | |
| 35.0 | Issue released for Baseline 37.1 | June 7, 2017 |
| 36.0 | Issue released for Baseline 41.1 | June 5, 2019 |
| 37.0 | Issue released for Baseline 42.0 | September 11, 2019 |
| 38.0 | Issue released for Baseline 44.0 | September 16, 2020 |
| 39.0 | Updated to meet accessibility requirements pursuant to the Accessibility for Ontarians with Disabilities Act. | December 2, 2020 |
| 40.0 | Issue released in advance of Baseline 45.0. Updated to include electricity storage participation. | February 26, 2021 |
| 41.0 | Issue released for Baseline 48.0 | September 14, 2022 |
| 41.1 | Updated to conform with other MRP market manuals and eliminate duplication between the market rules and the market manuals.<br>Deleted the defined term "registered facility" and replaced with the appropriate defined term (i.e. "facility", "resource" or "generation resource"). | July 14, 2023 |
| 41.2 | Updated for Final Alignment | June 7, 2024 |
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## Related Documents

| Document ID | Document Title |
|---|---|
| ~~MDP_PRO_0040~~MDP_PRO_0040 | Market Manual 7.1: IESO-Controlled Grid Operating Procedures |

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| Reference | Description of Change |
| --- | --- |
| Throughout Section 2.4.1 and 2.4.3 (new) | IMDC-79 version 1: Improving awareness of system operating conditions with updates on the use of publishing advisory notices and grid operating states to inform stakeholders of system and market conditions. Added to include electricity storage participation where required. |
| | |

# Market Transition

A.1.1 This *maket manual* is part of the *renewed market rules,* which pertain to:

A.1.1.1 the period prior to a *market transition* insofar as the provisions are relevant and applicable to the rights and obligations of the *IESO* and *market participants* relating to preparation for participation in the *IESO administered markets* following commencement of *market transition;* and

A.1.1.2 the period following commencement of *market transition* in respect of all the rights and obligations of the *IESO* and *market participants.*

A.1.2 All references herein to chapters or provisions of the *market rules* or *market manuals* will be interpreted as, and deemed to be references to chapters and provisions of the *renewed market rules.*

A.1.3 Upon commencement of the *market transition*, the *legacy market rules* will be immediately revoked and only the *renewed market rules* will remain in force.

A.1.4 For certainty, the revocation of the *legacy market rules* upon commencement of *market transition* does not:

A.1.4.1 affect the previous operation of any *market rule* or *market manual* in effect before the *market transition*;

A.1.4.2 affect any right, privilege, obligation or liability that came into existence under the *market rules* or *market manuals* in effect prior to the *market transition*;

A.1.4.3 affect any breach, non-compliance, offense or violation committed under or relating to the *market rules* or *market manuals* in effect prior to the *market transition*, or any sanction or penalty incurred in connection with such breach, non-compliance, offense or violation

A.1.4.4 affect an investigation, proceeding or remedy in respect of,

(a) a right, privilege, obligation or liability described in subsection A.1.4.2, or

(b) a sanction or penalty described in subsection A.1.4.3.

A.1.5. An investigation, proceeding or remedy described in subsection A.1.4.3 may be commenced, continued or enforced, and any sanction or penalty may be imposed, as if the *legacy market rules* had not been revoked.

# Market Manuals

*Market manuals* set out procedural and administrative details with respect to *market rule* requirements. Where there is a conflict between the requirements described in a *market manual* or appended document, and those within the *market rules*, the *market rules* shall prevail.

# Market Manual Conventions

The standard conventions followed for *market manuals* are as follows:

- the word 'shall' denotes a mandatory requirement;
- references to *market rule* sections and sub-sections may be appreviated in accordance with the following representative format: '**MR Ch.1 ss.1.1-1.2'** (i.e. *market rules,* Chapter 1, sections 1.1 to 1.2).
- references to *market manual* sections and sub-sections may be appreviated in accordance with the following representative format: '**MM 1.5 ss.1.1-1.2'** (i.e. *market manual* 1.5, sections 1.1 to 1.2).
- internal references to sections and sub-sections within this manual take the representative format: 'sections 1.1 – 1.2'
- terms and acronyms used in this *market manual* in its appended documents that are italicized have the meanings ascribed thereto in **MR Ch.11**; and
- data fields are identified in all capitals;

**– End of Section –**

# 1 Introduction

## 1.1 Purpose

This *market manual* contains *IESO* policies for *reliable* operation of the *IESO-controlled grid* (ICG). These policies are intended to:

- provide guidance for the development of *IESO* procedures;
- provide guidance to *IESO* operating staff when confronted with an operational situation that is not addressed in an operating procedure or a *market rule*; and
- help *market participants* meet their obligations to the *IESO* in the operating time horizon.

To the extent practicable, the *IESO* will use available market mechanisms to direct *reliable* operation of the *IESO-controlled grid*. Where the *IESO* determines such mechanisms are unable to achieve *reliable* operation, it will take actions in accordance with the policies contained in this *market manual*.

These policies apply to the *IESO* in its role to fulfill its legislated objects to direct the operation and maintain the *reliability* of *IESO-controlled grid* and to establish and enforce criteria and standards related to the *reliability* of the *integrated power system*.

Operating policies are applied to *facilities* connected to the *IESO-controlled grid*.

Procedural details necessary to implement these policies are outside of the scope of this *market manual*. These details shall be found in the applicable *market manual* of the **MM 7** series.

## 1.2 Hierarchy

Operating policies shall conform to the *Electricity Act 1998, market rules*, *NERC reliability standards* and *NPCC* directories. When the interpretation of an *IESO* operating policy is in question, *IESO* staff shall select the interpretation most consistent with the *market rules*. When the proper interpretation of a *NERC* standard is in question, *IESO* staff shall select the interpretation most consistent with the purpose of the standard and *NERC's* objects to maintain the minimum level of reliability. When the proper interpretation of *NPCC* criteria is in question, *IESO* staff shall select the interpretation most consistent with *NPCC's reliability* objects.

The operating policies of this *market manual* are built on the foundation that Ontario's power system is planned and designed in accordance with the Ontario Resource and Transmission Assessment Criteria (ORTAC). Where existing equipment is insufficient to satisfy ORTAC criteria, special practices shall be documented in operating instructions and followed until the required equipment is in operation.

In case of a discrepancy between this *market manual* and another *manual* in the **MM 7** series, the policies of this *market manual* shall apply. In case of discrepancy between this document and a more stringent *reliability standard*, the *reliability standard* shall apply.

## 1.3 Scope

This *market manual* supplements the following *market rules*:

- MR Ch.1 s.3.1.1: Market Objective
- MR Ch.4 App.4.1: IESO-Controlled Grid Performance Standards
- MR Ch.4 App.4.3: Requirements for Connected Wholesale Customers and Distributors Connected to the IESO-Controlled Grid
- MR Ch.4 App.4.4: Transmitter Requirements
- MR Ch.5 s.1.2.1
- MR Ch.5 s.2.2: Normal Operating State
- MR Ch.5 s.2.3: Emergency Operating State
- MR Ch.5 s.2.4: High-Risk Operating State
- MR Ch.5 s.2.5: Conservative Operating State
- MR Ch.5 s.3.2: Obligations of the IESO
- MR Ch.5 s.3.4.1.5
- MR Ch.5 s.3.6.1.6
- MR Ch.5 s.4.5: Operating Reserve
- MR Ch.5 s.4.6: Reactive Support and Voltage Control
- MR Ch.5 s.4.9: Auditing and Testing of Ancillary Services
- MR Ch.5 s.5.1.2
- MR Ch.5 s.5.2.1
- MR Ch.5 s.5.3.2
- MR Ch.5 s.5.8: Operation Under an Emergency Operating State
- MR Ch.5 s.5.9: Operation Under a High-Risk Operating State
- MR Ch.5 s.5.9A: Operation Under a Conservative Operating State

- MR Ch.5 s.6.4: Submission of Outage Schedules and IESO Approval of Outage Schedules
- MR Ch.5 s.6.5: Information
- MR Ch.5 s.7.7.7: Advisory Notices
- MR Ch.5 s.8.2: Responsibilities of the IESO
- MR Ch.5 s.10.2: Demand Control Initiated by a Market Participant
- MR Ch.5 s.10.3: Demand Control Initiated by the IESO in an Emergency Operating State
- MR Ch.5 s.10.4: Under-Frequency Load Shedding

## 1.4 Contact Information

Changes to this *market manual* are managed via the ~~*IESO* Change Management process.~~*IESO* Change Management process. Stakeholders are encouraged to participate in the evolution of this *market manual* via this process.

To contact the *IESO*, you can email *IESO* Customer Relations at ~~customer.relations@IESO.ca~~customer.relations@IESO.ca or use telephone or mail. Telephone numbers and the mailing address can be found on the ~~*IESO* website (http://www.IESO.ca/corporate-*IESO*/contact).~~*IESO* website . *IESO* Customer Relations staff will respond as soon as possible.

**– End of Section –**

# 2 Reliability

## 2.1 Principles

(MR Ch.5 ss.1.2.1, 3.2.1 and 3.2.2)

**Adequacy, System Security, and Re-Preparation Criteria** – The *IESO-controlled grid* shall operate at a level of *reliability* such that the loss of a major portion of the power system (or unintentional separation of a major portion of the power system) will not result from reasonably foreseeable contingencies. This level of *reliability* is achieved by operating the *IESO-controlled grid* to meet *adequacy* criteria for anticipated *demand*, system *security* criteria for specified contingencies, and re-preparation criteria for restoring *reliability* following contingencies.

## 2.2 Communications

### 2.2.1 Policies

(MR Ch.5 s.3.2.2)

**Compliance with reliability standards** – *IESO* communication procedures shall comply with *NERC reliability standards* and *NPCC* directories related to communications. *IESO* requirements for communications are published in ~~**MM 7.1**: System Operations Procedures.~~MM 7.1.

## 2.3 Outage Management

### 2.3.1 Principles

(MR Ch.5 ss.3.2.2 and 6.4)

**Criteria for approval and recall of outages** – When assessing proposed *outages* of *market participant registered facilities* and associated equipment, the *IESO* shall base *outage* approval solely on maintaining *reliable* operation (including overall *adequacy* and operability) of the *IESO-controlled grid*. The *IESO* shall reject, revoke, or recall an *outage* if it presents a risk to the *reliable* operation of the *IESO-controlled grid*.

**No obligation to serve any specific customer** – *Reliability standards* do not impose an absolute requirement to maintain a continuous supply of electricity to any specific customer.

### 2.3.2 Policy

(MR Ch.5 ss.3.2.1, 3.2.2, 6.4 and 6.5)

**IESO outage coordination within Ontario** – The *IESO* shall deal fairly and appropriately with *market participants,* and comply with the applicable *market rules* and *market manuals*. The *IESO* will provide *market participants* with timely and accurate information regarding the *IESO-controlled grid* to facilitate *market participant* coordination of *outages* and provide mechanisms to resolve *outage* conflicts.

**IESO outage coordination outside of Ontario** – The *IESO* shall coordinate *outages* to equipment external to Ontario with authorities in neighbouring jurisdictions to meet *NERC* and *NPCC* obligations, and to satisfy *IESO operating agreements* with interconnected neighbours. The *IESO* will NOT coordinate *outages* to individual customer connections. This obligation rests with the associated *transmitter.*

**Switching configurations for less than 15 minutes** – For switching configurations expected to last not more than 15 minutes, the only system *security* criteria that will be observed are:

- equipment loading shall be within pre-contingency ratings supplied by asset owners; and
- transfers shall be restricted to prevent pre-contingency voltage collapse.

**Additional provisions** – The *IESO publishes* and maintains a *market manual* for *outage* management of *facilities* and equipment connected to the *IESO-controlled grid*, or which may affect the operation of the *IESO-controlled grid*. ~~Refer to **MM 7.3**: Outage Management.~~Refer to **MM 7.3**.

## 2.4 IESO-Controlled Grid Operating States

### 2.4.1 Principles

(MR Ch.5 ss.1.2.1, 2.2, 2.3, 2.4, 2.5, 3.2.1 and 3.2.2)

**Operating states** – The *IESO* operates under a set of grid operating states based on system conditions and the *IESO's* ability to monitor the *IESO-controlled grid*. The *IESO-controlled grid* has four operating states: the *normal operating state, conservative operating state*, *high-risk operating state* (including safe posture), and *emergency operating state*. In addition to the operating states, there is system restoration (~~section 4.5~~section 4.5), which occurs immediately following a contingency that results in loss of load, cascading *outages*, islanding, etc.

**Riskier operating conditions** – Under certain operating conditions (e.g. adverse weather or equipment-related problems), the probability of experiencing certain contingencies increases. The *IESO* may temporarily and selectively increase the level of system *security* to improve *reliability* during a *high risk operating state*.

**Minimizing risk** – Under stressed conditions (e.g. extreme hot or cold temperatures, anticipating energy or capacity deficiencies, or *outages* to *IESO* market or system applications that impact system *security*), the *IESO* will seek to minimize potential risks to the *IESO-controlled grid* or enhance grid resiliency in anticipation of (and after the declaration of) a *conservative operating state*. The *conservative operating state* is available to the *IESO* to help prevent an *emergency operating state*. Under critical conditions (e.g. experiencing *energy* or capacity deficiencies, or a *security* emergency), ~~*non-dispatchable*~~ load shedding may be required. The *IESO* strives to mitigate or avoid ~~*non-dispatchable*~~ load shedding when in an *emergency operating state* by maintaining a variety of control actions to be taken in anticipation of (and after the declaration of) an *emergency operating state*. Refer to the Emergency Operating State Control Actions (EOSCA) list in ~~**MM 7.1**: IESO-controlled Grid Operations Procedures, Appendix~~ **MM 7.1 App.B**.

**IESO actions** – In *high-risk operating states*, *conservative operating states*, and *emergency operating states*, *IESO* control actions to maintain system *security* are more likely to be taken compared to during a *normal operating state.* These actions are structured to:

- preserve system *reliability*; and
- restore normal operation of *IESO-administered markets* as soon as practicable (**MR Ch.5 s.2**).

**Mitigating impacts to the IESO-administered markets** – The *IESO* will strive to mitigate adverse effects on *IESO-administered markets*, while at the same time observing the mutual protection and assistance provisions contained in agreements between the *IESO* and other *reliability* coordinators and balancing authorities*.*

### 2.4.2 Normal Operating State

(MR Ch.5 s.2.2)

**Definition** – In a *normal operating state,* the *IESO* will supply all *non-dispatchable loads* and *price responsive loads* while operating to normal condition limits.

**IESO actions and directions** – The *IESO* shall direct *market participants* to act or to refrain from acting so as to maintain the *IESO-controlled grid* in a *normal operating state* (**MR Ch.5 s.2.2**). The *IESO* will also act or refrain from acting where doing otherwise is likely to lead to a *high-risk* or *emergency operating state* (**MR Ch.5 ss.2.3.2**, **2.4.2** and **5.1.2.6**).

### 2.4.3 High Risk Operating State

(MR Ch.5 ss.2.4 and 5.9)

**IESO actions** – In a *high-risk operating state*, the *IESO* will temporarily and selectively increase the level of system *security* by applying high-risk operating limits. The *IESO* will take actions such as rejection, revocation, or recall of equipment and *facility outages* when necessary to:

- maintain the level of system *security* required during a *high-risk operating state;* and
- allow, after a recognized contingency, the *IESO* to re-establish an acceptable level of system *security* and to re-prepare the *IESO-controlled grid* within the time permitted by *reliability standards*.

**Additional provisions** – The conditions under which a *high-risk operating state* may be declared (along with related policy implementation details) can be found in **MM 7.1**.

### 2.4.4 Conservative Operating State

(MR Ch.5 ss.2.5 and 5.9A)

**Purpose and definition** – The *IESO-controlled grid* can be operated in a *conservative operating state* in response to a reliability concern to help prevent an *emergency operating state*. In a *conservative operating state*, the *IESO* may reject, suspend or revoke equipment and *facility outages* to minimize any potential risks to the *IESO-controlled grid* that could occur from non-urgent/routine work or switching of equipment. The *IESO* may also take actions to commit additional *resources* or recall equipment and *resource outages* to enhance grid resiliency. Under a *conservative operating state,* the *IESO-controlled grid* will be operated within equipment and security limits established for a *normal operating state*.

**IT-related outages** – For IT-related *outages* related to the *IESO-administered markets* and/or system applications or tools that affect system *security*, the *IESO* may also take actions such as requesting *market participants* or neighbouring *control area operators* to monitor the *IESO-controlled grid* or interties, respectively, on behalf of the *IESO*. In addition, *market participants* may need to implement manual workarounds to fulfill their obligations (e.g. receive and execute verbal dispatch instructions).

**Additional provisions** – The conditions under which a *conservative operating state* may be declared can be found in **MM 7.1**.

### 2.4.5 Emergency Operating State

(MR Ch.5 ss.2.3, 5.8 and 10.3)

**Pre-contingency** – The *IESO* shall not plan to operate the *IESO-controlled grid* in an *emergency operating state* pre-contingency, including when considering *planned outages*.

**Hierarchy of control actions** – The *IESO* strives to mitigate or avoid ~~*non-dispatchable* -~~load shedding when in an *emergency operating state* by *publishing* and maintaining a hierarchy of control actions to be taken in anticipation of and after the declaration of an *emergency operating state* (refer to the EOSCA list in **MM 7.1**). Temporarily and selectively reducing the level of *system security* by applying emergency condition operating limits is one of the many control actions the *IESO* can take when in an *emergency operating state*.

**All necessary steps** – At all times, the minimum acceptable level of *IESO-controlled grid* system *security* is the level afforded by observance of *emergency* condition operating limits. All necessary steps are to be taken, including the interruption of *non-dispatchable load* or *price responsive load*, to observe the *emergency* condition operating limits.

**Normal actions preferred** – An *emergency operating state* will generally not be declared when normal or routine control actions can resolve the capacity or *energy* deficiency, or return the *IESO-controlled grid* to a studied operating state in a timely manner. Implementation details, including the conditions under which an emergency *operating state* may be declared can be found in **MM 7.1**.

## 2.5 Degraded Transmission Equipment Performance

(MR Ch.5 ss.1.2.1, 3.2.1, 3.2.2, 3.4.1.5 and 3.6.1.6)

**Definition and IESO actions** – A higher than long-term average *forced outage* rate, unanticipated tripping, or unanticipated failure to trip are typical examples of degraded transmission equipment performance. Where transmission equipment has shown degraded performance, or if degraded performance is anticipated, the *IESO* shall take control actions such as the following:

- reschedule routine maintenance work, except work to remedy degraded performance;
- reject or revoke any *planned outages* with Planned, Opportunity, or Information Priority Code anticipated to have an adverse impact on the *IESO-controlled grid*, except for *planned outages* to remedy degraded performance;
- recall any *planned outages* with Planned, Opportunity, or Information Priority Code that may have an adverse impact on the *IESO-controlled grid* associated with the affected portion of the *transmission system;*
- request staffing at transmission stations during periods of routine switching, during periods of high risk of equipment operation, or on a 24/7 basis depending on the severity of equipment degradation;
- adjust *IESO system security* assessments to account for additional elements anticipated to be removed from service due to equipment degradation;

- adjust use of *remedial action schemes (RASs)* to reduce operation of affected *transmission system* equipment; or
- direct *generators* and other *market participants* as required to enhance *reliability*.

**Consultation** – Where time permits, the *IESO* will discuss control actions with the applicable *transmitter* before implementation. Affected *market participants* and *reliability* coordinators shall be advised as appropriate, which may include *publishing* information on areas with degraded transmission equipment performance.

## 2.6 Islanding

(MR Ch.5 ss.1.2.1, 3.2.1, 3.2.2, 3.2.3, 7.7.7 and 8.2.3)

**Notice** – The *IESO* shall notify *generators* and *electricity storage participants* of *outages* that would put their units in an electrical island following a single element contingency to inform their operating decisions.

**No manual constraints down** – The *IESO* shall NOT manually constrain down *resources* pre-contingency in order to assist a rapid collapse of an electrical island. When determining whether an island will survive or collapse, the *IESO* shall assume that inverter-based generation (e.g. wind and solar) will immediately trip in an electrical island where conventional synchronous units cannot meet *demand* in the island.

**No manual constraints up** – The *IESO* shall NOT manually constrain up *resources* pre-contingency in order to assist the survival of an electrical island.

**IESO actions to assist collapse** – The *IESO* shall take available pre-contingency control actions (other than constraining *resources*, such as a configuration change or *RAS* arming) to assist the rapid collapse of an electrical island formed by a single element contingency if:

- *IESO* studies pre-determine that voltage and frequency will not be controlled within acceptable ranges; or
- *IESO* cannot obtain voltage and frequency measurements in the island.

**IESO actions to assist survival** – The *IESO* shall take available pre-contingency control actions (other than constraining *resources*, such as a configuration change or *RAS* arming) to assist the survival of an electrical island formed by a single element contingency if:

- *IESO* studies pre-determine that voltage and frequency will be controlled within acceptable ranges; and
- *IESO* can obtain voltage and frequency measurements in the island.

**Synchronization** – The *IESO* shall synchronize islands only by using breakers that have synchrocheck relays, or a mechanism of ensuring that the circuit breaker closes only if voltages on both sides of the circuit breaker fulfill conditions of magnitude, phase, and slip frequency.

**Operating instructions** – If special islanding practices are developed that differ from the above general policy, these practices shall be documented in operating instructions.

## 2.7 Grid Control Actions

### 2.7.1 Principles

(MR Ch.1 s.3.1.1)

**Maximizing transfer capability** – To satisfy the objective of the *IESO-administered markets*, all practicable control actions shall be taken to maximize transfer capability while observing all *system security* or *adequacy* constraints.

### 2.7.2 Readiness Programs

(MR Ch.5 ss.4.6.2, 4.9.1 and 4.9.2)

**Testing** – To maintain confidence that control actions will be available when called upon, the *IESO* shall test or require *market participants* to test *resources* that are connected to the *IESO-controlled grid*. This testing could be to prepare for the next peak season, or to prepare for extreme conditions that are expected in the next few days. For example, voltage reduction, *operating reserve* activation, and reactive capability will be periodically tested.

**Additional provisions** – *IESO* readiness program implementation details can be found in **MM 7.1**.

### 2.7.3 Network Configuration Change Request

(MR Ch.5 ss.3.2.3 and 6.4)

**IESO assessment** – The *IESO* shall assess proposed network configuration requests to manage individual *delivery point* performance and, through the *outage* management process, approve proposals that do not:

- degrade the *reliability* of the *IESO-controlled grid*;
- reduce a system operating limit or transfer capability;
- result in inconsistent application of established system *security* criteria and *reliability* standards;

- impose additional exposure to loss of essential station service supply to nuclear generating stations;
- expose the *IESO-controlled grid* to additional contingencies that have a material adverse effect on the *reliability* of the *IESO-controlled grid*;
- impose additional risk/restrictions related to post-contingency response to recognized contingencies; and
- interfere with the operation of *IESO-administered markets* (i.e., do not result in changes in generation *dispatch*, market clearing price, or congestion payments).

**Inclusion in operating instructions** – During normal situations, the *IESO* will include such advance-approved proposals in its operating instructions ahead of real-time operations.

**Abnormal conditions** – During abnormal situations (e.g., *forced outages*, responding to contingencies, system restorations, etc.), the *IESO* may deviate from the above provisions while respecting their intent to the extent possible.

### 2.7.4 Control Actions to Increase Transfer Capability

(MR Ch.5 ss.1.2.1 and 3.2.1)

**IESO actions** – To increase transfer capability to improve *reliability* and/or reduce congestion, the *IESO* will assess and may implement control actions such as:

- changing reactive *dispatch*;
- changing transformer winding or phase angle taps;
- load transfers;
- arming *RASs*;
- manually constraining generation and electricity storage up or down;
- opening breakers or switches, including high or low voltage bus tie breakers;
- taking equipment off load; or
- removing equipment from service.

**Transmitter concurrence** – The applicable *transmitter* must concur with a control action that will reduce connection redundancy, or transfer load where *delivery point* performance is substandard.

**Implementation** – The *IESO* will implement these control actions, or include them as part of its operational planning assessment of *outage* requests, unless the action:

- fails to conform to a policy contained in this document;

- exposes nuclear generating stations to loss of essential station service supply following an ~~Appendix A, Group 1~~Appendix A, Group 1 contingency; or
- causes post-contingency configurations expected to exceed system *security* restoration timelines.

### 2.7.5 Voltage Control

(MR Ch.5 s.4.6)

**Transmission, operating limits, and equipment ratings** – To maintain transmission line voltages within ranges, to respect system operating limits, and to respect equipment ratings, the *IESO* will *dispatch* the following:

- *generation unit* and *electricity storage unit* reactive power within unit capability;
- reactive control devices subject to *operating agreements*; and
- reactive control devices subject to procurement contracts.

**Connected wholesale customers and distributors** – The *IESO* will *dispatch* the following to meet *connected wholesale customer* or *distributor* voltage needs, as long as these actions do not exceed system operating limits and equipment ratings:

- *generation unit* and *electricity storage unit* reactive power within unit capability; and
- reactive control devices subject to operating agreements.

### 2.7.6 Remedial Action Schemes

(MR Ch.5 ss.8.2.1, 8.2.2, 8.2.2A and 8.2.3)

**IESO directions** – The *IESO-controlled grid* system *security* must be returned to a secure state within times prescribed by *reliability standards* following operation of a RAS. The *IESO* will direct the use of RAS as outlined in *transmitter operating agreements*.

**Application** – A RAS shall not be deployed until it has been classified in the *NPCC* process as Type I, II, or Limited Impact. A Type I *RAS* shall be deployed in a manner consistent with its description in the *NPCC* approval process. Usually a Type I *RAS* is approved for deployment for *outage* conditions, for extreme contingencies, or for unanticipated operating conditions. Usually a Type II or Limited Impact *RAS* is approved with fewer or no deployment restrictions.

**Additional provisions** – Specific criteria for selection of load rejection (L/R), generation rejection (G/R), and generation runback are contained in ~~Appendix B.~~Appendix B. The use of a *RAS* during a *high-risk operating state* shall be subject to the restrictions contained in ~~Appendix C~~Appendix C.

**Exclusion from load rejection** – The *IESO* will allow *market participants* to request an exclusion from L/R for the following reasons:

- public safety hazard;
- potential damage to equipment;
- potential violation of any *applicable law*;
- *outages* to equipment directly associated with L/R tripping or restoration; or
- *outages* to equipment which may degrade the integrity of L/R tripping or restoration (such as, but not limited to, relaying or station supervisory control equipment).

**Restoration of rejection load** – The *IESO* shall direct the restoration of rejected load. Load may be restored following rejection by interrupting other load (i.e., rotating blackout) as a substitute.

### 2.7.7 Voltage Reductions

(MR Ch.5 s.10.3.1)

**IESO directions** – The *IESO* may direct a *market participant* to initiate voltage reductions to prevent or to mitigate an *emergency operating state* resulting from events including:

- equipment thermal overloads;
- insufficient *generation capacity* and electricity storage injection capacity to satisfy non-dispatchable *demand*;
- violations of high-risk, normal, or emergency system operating limits; or
- an event requiring the *IESO* to activate *operating reserve* that is provided by voltage reductions.

### 2.7.8 ~~Non-Dispatchable~~ Load Shedding

(MR Ch.5 s.10.3.1)

**Purpose** – ~~Shedding *non-dispatchable* load~~Load shedding is a permissible *IESO* control action to maintain grid integrity, or to respect safety, equipment, or *applicable law* constraints.

**Deferring or avoiding load shedding** – When a system operating limit is exceeded, ~~*non-dispatchable*~~ load shedding may be avoided or deferred by taking the following steps as required:

1) Disregard high-risk limits and apply normal limits.

   This step will allow an increase in transfer limits constrained by RAS arming restrictions and other restrictions due to a *high risk operating state*.

2) Disregard normal limits and apply emergency condition operating limits.

   This step will allow an increase in transfer limits constrained by contingencies involving more than one element.

**Conditions justifying load shedding** – The *IESO* shall shed load during an *emergency operating state* under the following conditions:

- to alleviate a capacity or *energy emergency*;
- to alleviate or avoid exceeding pre- and post-contingency equipment ratings;
- to alleviate or avoid exceeding pre-contingency voltage collapse, or a steady-state instability; or
- to alleviate or avoid exceeding an interconnection *reliability* operating limit (IROL) or bulk power system (BPS) limit.

**Boundary conditions** – Note that when a transfer is near its limit, both the limit and its associated boundary conditions (e.g. minimum voltage at Longwood, Bruce, etc.) are equally important considerations. As a transfer departs from its limit, boundary conditions become less important, and it may not be necessary to shed ~~*non-dispatchable*~~ load to address a boundary condition exceedance. Discretion to avoid shedding ~~*non-dispatchable*~~ load for a boundary condition exceedance is documented in operating instructions.

**Selecting which load to shed** – When an *emergency operating state* has been declared and reduction in *demand* is required to safeguard the *reliability* of the *IESO-controlled grid*, the *IESO* shall direct manual load shedding to reduce *demand* on the following basis:

- Priority customer loads (refer to ~~**MM 7.10**: Ontario Electricity Emergency Plan)~~MM 7.10) such as hospitals and water treatment plants without backup generators, and electrically driven gas compressors should be avoided when determining what load to shed.
- The amount and location of load to be cut will be selected to solve the operating problem to maintain an adequate level of *IESO-controlled grid adequacy* or system *security*.
- When time permits, load cuts via manual rotational load shedding schemes should be spread equitably across the *IESO-controlled grid* to the extent practicable. Equitable considerations will include magnitude, duration, and frequency of load reductions.

**– End of Section –**

# 3 Adequacy

## 3.1 Principles

(MR Ch.5 ss.1.2.1 and 3.2.1)

**IESO assessment** – The *IESO* shall maintain an adequate supply of generation and transmission to meet forecast Ontario *demand* in the operational timeframe. When assessing generation and transmission *adequacy*, the *IESO* will consider factors including the following:

- *demand* forecast;
- *variable generation* (e.g., wind and solar) forecast;
- load forecast uncertainty;
- additional contingency allowance;
- *operating reserve* requirements;
- generation, electricity storage and demand response availability forecast, which includes the available but not operating (ABNO) units, and generation external to Ontario and associated tie-line capability;
- transmission *facility* capability forecast;
- applicable system operating limits; and
- acceptable voltage ranges.

## 3.2 Resource and Transmission Adequacy

(MR Ch.5 s.4.6.2)

**Assessment frequency** – When assessing *adequacy*, the *IESO* shall compare forecasted *demand* to available *resource* capacity and *energy*, including available *resources* external to Ontario. The *IESO* shall assess *adequacy* for *normal operating states* on a daily basis in its short-term operating assessments, on a weekly basis in its medium-term assessments, and on a less frequent basis in longer-term assessments. For these operating horizons, criteria to identify an acceptable level of *adequacy* (and corrective actions if this level cannot be achieved), can be found in ~~**MM 7.2**: Near-Term Assessments and Reports.~~ MM 7.2.

**Criteria for transmission adequacy** – When assessing transmission *adequacy*, the *IESO* shall compare transmission flow forecasts with the applicable system operating limits under an anticipated range of power system conditions. Transmission is adequate if *demand* forecasts can be supplied without exceeding applicable system operating limits, and acceptable system voltages can be maintained.

## 3.3 Operating Reserve Policy

(MR Ch.5 ss.4.5.1, 4.5.2 and 4.5.5)

**Extent of operating reserve scheduling** – *Operating reserve* shall be scheduled (**MR Ch.5 s.4.5.1**) to ensure *resources* are available to:

- cover or offset unanticipated increases in *demand* during a *dispatch day* or *dispatch hour*;
- cover or offset capacity lost due to a forced or urgent *outage* of generation, injecting *electricity storage facilities*, or transmission equipment; or
- cover uncertainty associated with the performance of *generation resources*, *electricity storage facilities*, or *dispatchable loads* in responding to *IESO dispatch instructions*.

**Commissioning tests** – Additional reserve shall be carried to account for an increased risk of tripping during commissioning tests. No additional *operating reserve* shall be required during a commissioning period when no tests are scheduled that materially increase the risk of unit tripping.

**Distribution of operating reserve** – *Operating reserve* shall be scheduled in sufficient quantity and shall be distributed so as to ensure that it can be utilized for any single contingency that results in either generation loss, electricity storage injection loss or both without exceeding equipment or *transmission system* limitations.

Voltage reductions may be used to provide operating reserve.

## 3.4 Area Reserve for Load Security

(MR Ch.5 ss.4.5.1, 4.5.2 and 4.5.5)

**Scheduling** – Area reserves (i.e. reserves that are scheduled or *resources* that are pre-committed to avoid shedding ~~*non-dispatchable* ~~load) shall be scheduled as follows:

- For all **system operating limits:** All available *resources* shall be committed to avoid shedding ~~non-dispatchable load before~~loadbefore a contingency.
- For **IROLs** and **BPS parts** of the system: Non-*energy* limited *resources* shall be pre-committed so that following a single-element contingency, the system can be re-prepared within 30 minutes to operate to IROL and BPS emergency

contingency limits, without ~~shedding non~~shedding*non-dispatchable* *load* or *price responsive* *load*.

**Additional area reserve** – From time to time, the *IESO* may choose to carry additional area reserve beyond those required here for circumstances such as extreme weather forecasts, physical security threats, etc.

**– End of Section –**

# 4 System Security

## 4.1 Principles

(MR Ch.5 ss.3.2.2, 5.1.2 and 5.2.1)

**Overview** – This section describes the level of system security[1] that must be achieved so that the risk of loss or separation of a major portion of the *interconnected system* is reduced to an acceptable level.

**Stability** – The *IESO-controlled grid* must display satisfactory performance before and after *contingency events*. All *IESO* performance criteria must be satisfied, not only the transient and voltage stability criteria, for an operating condition to be deemed stable.

**Operating requirements** – The *IESO-controlled grid* must be operated such that in a normal, planned state, voltages will be within normal limits, equipment loading will be within continuous ratings as supplied by *facility* owners, and transfers will be within system operating limits. For *planned outages* with Planned, Opportunity, or Information Priority Code, equipment may be loaded to long-term *emergency* ratings pre-contingency if authorized by the *facility* owner. Operation within authorized ratings shall be considered sufficient to avoid physical damage, protect safety, and avoid violation of any *applicable law* unless otherwise notified.

**Policies** – The *IESO* will use the following policies to develop operational plans, establish system operating limits and instructions, and operate the *IESO-controlled grid*.

## 4.2 Methodology for Deriving System Operating Limits

(MR Ch.5 ss.3.2.2, 5.1.2, 5.2.1 and 5.3.2)

**BPS, BES and local elements** – System operating limits shall be established[2] by monitoring the system *security* criteria in ~~section 4.3~~section 4.3 on bulk power system (BPS), bulk electric system (BES) and local elements in the following manner:

1. On BPS elements, the system *security* criteria shall be satisfied for any ~~Appendix A Group 1~~Appendix A Group 1 contingency occurring on the BPS. If the *IESO* becomes aware of an ~~Appendix A Group 1~~Appendix A Group 1

[1] "System security" refers to the ability of the power system to withstand sudden disturbances or unanticipated loss of elements.

[2] The *IESO* derives voltage change and stability limits, and monitors thermal limits based on ratings provided by asset owners.

contingency not on the BPS that results in a significant adverse impact to the BPS, the *IESO* must operate the system to respect that event. As Group 1 includes multiple element contingencies, this fulfills requirement R3.3 of ~~NERC standard FAC-011.~~NERC standard FAC-011. The monitoring of all Group 1 contingencies in Ontario on BPS elements satisfies NPCC Directory #1 R13.

2. On BES elements, the system *security* criteria shall be satisfied for any ~~Appendix A Group 2~~Appendix A Group 2 contingency occurring anywhere in Ontario.
3. On Local elements, the system *security* criteria shall be satisfied for any ~~Appendix A Group 3~~Appendix A Group 3 contingency occurring anywhere in Ontario.
4. BPS elements, only for the purposes of system operating limits[3], are determined in the following manner:
    a. Start with all elements identified in accordance with *NPCC's* A-10 test performed on a set of system conditions that covers the range of anticipated operation.
    b. Add elements as necessary when operating conditions are more onerous than those studied in (a).
    c. Remove elements that do not affect neighbouring jurisdictions. Where there is an effect, the *IESO* must obtain concurrence from affected neighbouring jurisdictions before removing the element.
5. BES elements are determined in accordance with *NERC's* BES definition.
6. Local elements are the remainder after BPS and BES elements have been determined.

**Interconnections** – The *IESO* will classify the system operating limits derived using the methodology as noted in points 1 to 3, above, as IROLs based on studied impacts on neighbouring jurisdictions. Where there is an effect, *IESO* will obtain concurrence from affected the neighbouring *reliability* coordinator(s), before removing the IROL designation.

**Contingencies outside Ontario** – If the *IESO* becomes aware of a contingency outside Ontario that materially affects the *IESO-controlled grid,* the *IESO* will observe the impact of that contingency on *IESO-controlled grid* in the same manner as contingencies within the *IESO-controlled grid*.

[3] This section does not concern itself with other uses of BPS for *NPCC* Directory 4 applications for protections.

**Contingencies inside Ontario** – A neighbouring jurisdiction will determine the criteria for assessing effects of contingencies within the *IESO-controlled grid* on their system.

## 4.3 System Security and Modelling Criteria

### 4.3.1 Principles

(MR Ch.5 s.5.2.1)

**Overview** – The derivation of system operating limits shall be done in accordance with the system *security* and modelling criteria described in the following sections.

### 4.3.2 Study Conditions and System Model

(MR Ch.5 s.5.2.1)

**Expected conditions** – The study conditions used shall cover expected operating conditions (e.g. generation *dispatch* and load levels), and shall reflect changes to system topology (e.g. *facility outages*).

**Scope** – The study model for determining system operating limits must include at least the entire *reliability* coordinator area, as well as the critical modelling details from other *reliability* coordinator areas that would impact the *facility* or *facilities* under study.

**Sufficient detail** – The study model must contain a sufficient amount of detail, including representation of the physical and control characteristics of modelled *facilities*, to ensure fulfillment of the *IESO's* mandate to operate the *IESO-controlled grid* reliably.

### 4.3.3 Load Representation

(MR Ch.5 s.5.2.1)

**Pre-contingency** – Constant megavolt-amp (MVA) load models shall be used to assess a pre-contingency state.

**Post-contingency** – Voltage-dependent load models may be used to assess a post-contingency state before and after tap-changer action. The default voltage-dependent load model shall be used unless a different model has been approved by the *IESO*. The default voltage dependant for active (P) and reactive (Q) load shall be defined as follows:

$$P(V) = 0.5 \times P_0 \times \frac{V}{V_0} + 0.5 \times P_0 \times \left(\frac{V}{V_0}\right)^2$$

$$Q(V) = Q_0 \times \left(\frac{V}{V_0}\right)^2 \quad V_0\ P_0,\ Q_0 \text{ are pre-contingency values}$$

$$P(V) = 0.5 \times P_0 \times \frac{V}{V_0} + 0.5 \times P_0 \times \left(\frac{V}{V_0}\right)^2$$

$$Q(V) = Q_0 \times \left(\frac{V}{V_0}\right)^2 \quad V_0\ P_0,\ Q_0 \text{ are pre-contingency values}$$

**Transient load** – In areas where representation of load is critical, such as areas with a material amount of motor load, a detailed representation of transient load behaviour should be attempted.

### 4.3.4 Thermal Rating Policy

(MR Ch.5 ss.5.1.2.1 and 5.2.1)

**Exceedance avoided** – The *IESO* shall not deliberately operate or plan to operate equipment comprising the *IESO-controlled grid* in excess of thermal ratings for such equipment as communicated to the *IESO* by relevant *market participants*. When a critical adverse effect is not apparent to *market participants*, such as a backfeed arising from a recognized contingency at a remote location on the *IESO-controlled grid*, the *IESO* shall take actions to avoid exceeding thermal ratings. When a critical adverse effect is apparent to a *market participant,* and they have control (such as loading of *generator* step-up or dual element spot network [DESN] transformers), the *market participant* shall take action to avoid exceeding thermal ratings.

**Time ratings** – Limited time ratings shall be utilized only if control actions are available to reduce loading to a longer time rating within the interval afforded by a limited time rating. For example, a 15-minute rating may only be utilized if control actions are available to reduce loading to a longer term rating (e.g. a 10-day rating) within 15 minutes. Post-contingency loading shall not exceed the shortest applicable limited time rating.

**Monitoring** – The scope of thermal monitoring will be established in *operating agreements* between *IESO* and *transmitters*.

### 4.3.5 Pre-contingency Voltage Range

(MR Ch.4 App.4.1, 4.3 and 4.4; MR Ch.5 s.3.2.3)

**IESO-controlled grid ranges** – The *IESO-controlled grid* shall be operated in the voltage ranges shown in Table 4-1Table 4-1 under pre-contingency conditions and following re-preparation unless affected equipment owners have agreed to a wider range.

**Transmission and distribution ranges** – For transmission voltages, the values are from **MR Ch.4**. For distribution voltages, the values are based on Canadian Standards Association (CSA) Standard 235.

**Table 4-1: Pre-Contingency Voltage Limits**

| Nominal Bus Voltage | Transmission Stations 500 kV | Transmission Stations 230 kV | Transmission Stations 115 kV | Transformer Station (Load Facility) Low Voltage at 44 kV, 27.6 kV, 13.8 kV |
|---|---|---|---|---|
| Maximum Continuous | 550 kV | 250 kV | 127 kV* | 106% of nominal |
| Minimum Continuous | 490 kV | 220 kV | 113 kV | 98% of nominal |

* In portions of northern Ontario, the maximum continuous voltage for the 115 kV system can be as high as 138 kV.

**Exceptions** – Exceptions to maximum and minimum voltages must be documented in relevant operating instructions.

### 4.3.6 Post-contingency Voltage Change Limits

(MR Ch.4 App.4.1, 4.3 and 4.4; MR Ch.5 s.3.2.3)

**Post-contingency limits** – *Transmission system* voltage changes following recognized contingencies (i.e., after the contingency has been cleared) shall be limited as shown in ~~Table 4-2,~~Table 4-2, unless the equipment owner has agreed to a wider voltage change limit. Voltage declines are intended to ensure power quality, and therefore are assessed at the high voltage terminals of stations with load other than station service load. Voltage rises are assessed at all of the buses mentioned in the table. Operating instructions must document exceptions to voltage change limits, for example voltage rise restrictions due to equipment limitations, employed in system operating limit derivation.

**Table 4-2: Post-Contingency Voltage Change Limits**

| Transmission Bus Designation | Operating Condition | Contingency Type | Change Before Tap Changer Action | Change After Tap Changer Action |
|---|---|---|---|---|
| BPS | Normal | Single-element | 5% | 10% |
| BPS | Normal | Double-element | 10% | 15% |
| BPS | Emergency | Single-element | 10% | 15% |
| BES and Local | All | Single-element | 10% | 15% |

## 4.3.7 Voltage Stability

(MR Ch.5 s.5.2.1)

**Power-voltage analysis** – Voltage stability for power transfers for all anticipated operating states shall be demonstrated using power-voltage (PV) analysis accordingly:

- a power transfer corresponding to Point 'A', which if increased by 10%, is less than the power at the critical point of the pre-contingency PV curve; and
- a power transfer corresponding to Point 'B', which if increased by 10%, is less than the power at the critical point of the post-contingency PV curve.

**Pre- and post-contingency power-voltage curves** – When producing a pre-contingency PV curve, manual actions such as reactive shunt switching together with transformer tap-changer action, are permitted. When producing a post-contingency PV curve, only automatic control actions (e.g. generation *automatic voltage regulation (AVR)*, *RASs*, and automatic under-load tap-changes) shall be modelled.

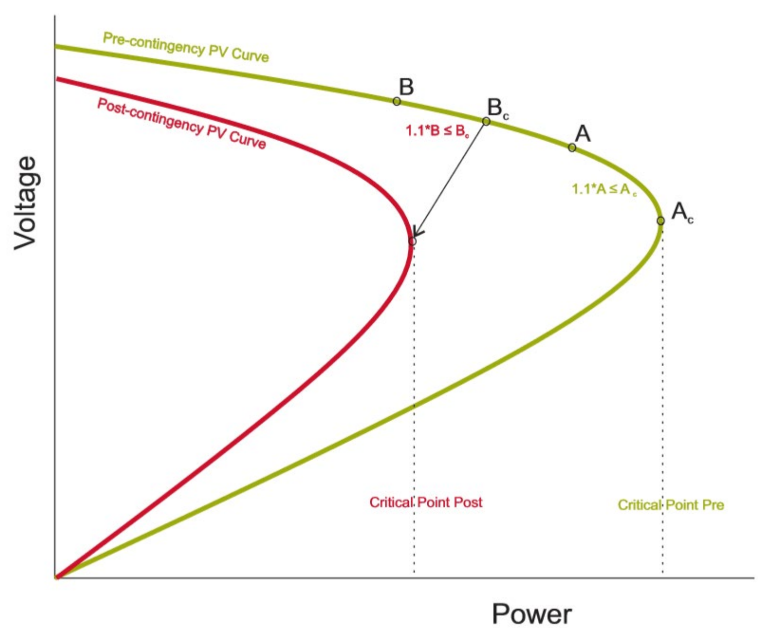


**Figure 4-1: Typical Power-Voltage Curves**

## 4.3.8 Transient Stability

(MR Ch.5 s.5.2.1)

**Synchronous units** – For acceptable transient rotor angle stability, synchronous units remaining connected to *IESO-controlled grid* shall not lose synchronism for the applicable contingencies in Appendix A with due regard to reclosure. Transient angle stability shall be maintained if the critical parameter is increased by 10% to allow margin.

**Simulation** – The 10% increase in the critical parameter can be simulated by generation or load changes beyond the forecast load or generation capabilities even after eliminating *station service* load. Conditions at margin shall be as realistic as reasonably achievable. The use of negative values of local load is preferable to increasing local generation beyond its maximum capability. Negative load used for margin must have a constant MVA characteristic.

**Field-measured data unavailable** – Design operating times of fault detectors, auxiliary relays, trip modules, communication media, breakers, etc., may be used for calculating switching times when reliable field-measured data are not available.

### 4.3.9 Small Signal Stability

(MR Ch.5 s.5.2.1)

**Damping factors** – The required damping factors at various conditions on the *IESO-controlled grid* are tabulated in ~~Table 4-3.~~Table 4-3.

**Table 4-3: Acceptable Damping Factors**

| System Condition | Damping Factor |
|---|---|
| Pre-contingency | > 0.03 |
| Post-contingency: Before any automatic *response* | > 0.00 |
| Post-contingency: After automatic *responses*, before manual system adjustments | > 0.01 |
| Following re-preparation of the system: After system adjustments | > 0.03 |

**Single dominant mode of oscillation** – For swings characterized by a single dominant mode of oscillation, the damping may be calculated directly from the oscillation envelope.

**Additional considerations** – For a damping factor of 0.03, the magnitude of oscillations must be reduced to 39% of initial values within five periods. For a damping factor of 0.01, the magnitude of oscillations must be reduced to 39% of initial values within 15 periods. For swings not characterized by a single dominant mode, then the damping factors should be derived via a more detailed modal analysis.

### 4.3.10 Protection Relay Margin

(MR Ch.5 s.5.2.1)

**BES and BPS element relay margins** – Following fault clearing, or the loss of an element without a fault, the margin on all instantaneous and timed distance relays at stations that are part of the BES or BPS, including *generator* loss of excitation and out-of-step relaying, must be at least 20% and 10% respectively.

**Local element relay margins** – The margin on all relays at local system stations, generator loss of excitation and out-of-step protections on small *generating units*, or those associated with transformer backup protections, must be at least 15% on all instantaneous relays, and 0% on all timed relays having a time delay setting less than or equal to 0.4 seconds. For all relays having a time delay setting greater than 0.4 seconds, the apparent impedance may enter the timed tripping characteristic, provided that there is a margin of 50% on time. For example, the apparent impedance does not remain within the tripping characteristic for a period of time greater than one-half of the relay time delay setting.

**System relay margins** – The margin on all system relays, such as change of power relays, must be at least 10%.

### 4.3.11 Automatic Reclosure

(MR Ch.5 ss.5.1.2 and 5.2.1)

**Temporary contingencies** – The *IESO* will use automatic reclosure to more quickly restore the integrity of the *IESO-controlled grid* following contingencies that are not permanent. Experience has shown many faults on the overhead transmission circuits to be temporary. Automatic reclosure for transformer, bus, or cable protection should only be approved in exceptional circumstances, as these faults are more likely to be permanent.

**Two stages** – Automatic reclosure is normally comprised of two stages; re-energization from a single preferred breaker with under-voltage supervision and time delay followed by reclosing of the remaining breakers with synchrocheck supervision.

**Settings and selection requirements** – Circuits are normally automatically re-energized following a fault clearing by protection systems. Upon successful re-energization, the remaining breakers shall be automatically reclosed. Failure to automatically re-energize from the single preferred breaker is deemed to be unsuccessful reclosure. The following sub-sections outline settings and selection requirements for automatic reclosure:

#### 4.3.11.1 Re-energization

- A faulted circuit should be automatically re-energized from a single preferred breaker with under-voltage supervision and a minimum time delay of five seconds. Automatic re-energization shall be initiated following damping of system oscillations. Stability-sensitive areas should have a nominal time delay of 10 seconds or longer to initiate automatic re-energization. Areas where studies indicate that higher speed reclosure has no material adverse effects on the system *security* of the *IESO-controlled grid*, re-energizing with a time delay of less than five seconds is permitted.
- The breaker chosen for the re-energization of the circuit shall be the one that would result in the least disruption in the event of a breaker failure upon an unsuccessful re-energization. Experience has shown there is a higher-than-average risk of breaker failure in an open-close-open sequence.

- The re-energizing breaker shall be at a terminal remote from steam turbine units. If possible, re-energizing should be initiated at a breaker at a terminal remote from *generation units*.
- Automatic re-energization time delay settings for adjacent transmission circuits on common towers are selected to mitigate the risk of re-energizing onto two faulted circuits at the same time.

#### 4.3.11.2 Reclosing of the Remaining Breakers

- The remaining breakers shall automatically reclose with synchrocheck supervision. Where there is no electrically close generating station, voltage presence supervision with a nominal time delay of 0.5 seconds may be used.
- Automatic reclosing must not result in a sudden power change exceeding 0.5 per unit of its MVA rating on steam turbine *generation units* rated greater than 10 MVA. *Market participant* agreement shall be obtained prior to allowing a higher value of sudden power change.
- Automatic reclosure shall not be used to re-synchronize a *generation unit* that has separated from the transmission system.
- On those circuits where only high speed (i.e. less than one second) unsupervised automatic reclosure is available, it should normally be blocked.

**Withstanding unsuccessful automatic re-energization** – System operating limits shall be derived such that the system must successfully withstand an unsuccessful automatic re-energization (i.e., an open-close-open sequence) operation.

### 4.3.12 Manual Reclosure

(MR Ch.5 ss.5.1.2, 5.2.1)

**Application** – Following an unsuccessful automatic reclosure, or an *outage*, a circuit will normally be manually re-energized from the preferred breaker used for automatic reclosure.

**Withstanding manual energization** – The *IESO-controlled grid* must be able to withstand manual energization of a faulted element without prior readjustment of generation levels, unless specific operating instructions to the contrary are provided.

**No excessive sudden power change without market participant agreement** – Manual reclosure of the remaining breakers after energization must not result in a sudden power change exceeding 0.5 per unit of its MVA rating on steam turbine *generation units* rated greater than 10 MVA. *Market participant* agreement shall be obtained prior to allowing a higher value of sudden power change.

## 4.4 Frequency Regulation

(MR Ch.5 App.4.2)

**Requirements** – *Generators* and *electricity storage participants* are required to be able to operate within the range of frequencies specified in **MR Ch. 4 App. 4.2**: Requirements for Generation and Electricity Storage Facilities Connected to the IESO-controlled Grid. This appendix also specifies the required settings for speed/frequency regulation.

**Additional provisions** – ~~**MM 7.1**: IESO-Controlled Grid Operating Procedures~~MM 7.1 explains how generators and *electricity storage participants* are required to operate during abnormal system frequencies.

### 4.4.1 Automatic Under Frequency Load Shedding

(MR Ch.5 s.10.4.1)

**IESO administration** – The *IESO* shall administer an automatic under-frequency load shedding (UFLS) program to stabilize frequency. This program shall take into consideration the manner in which the *IESO-controlled grid* is likely to separate in the event of a system disturbance, compensation for early generation tripping, and *planned outages* with Planned, Opportunity, or Information Priority Code to UFLS equipment.

**Additional provisions and priority customers** – *IESO* requirements for the UFLS program are contained in **MM 7.1**. ~~Priority customer loads (refer to **MM 7.10**: *Ontario Electricity Emergency Plan*)~~Priority customer loads (refer to MM 7.10) such as hospitals and water treatment plants without backup *generators*, and electrically driven gas compressors should be considered by *distributors* and *connected wholesale customers* when satisfying UFLS program requirements.

## 4.5 Restoration of System Security

### 4.5.1 Principles

(MR Ch.5 s.5.10.2)

**Restoration as soon as possible** – The *IESO* shall use all appropriate means to re-prepare the system to satisfy system operating limits corresponding to *emergency* condition operating limits as soon as possible. The *IESO* will endeavour to shorten the duration of an *emergency operating state*.

**Foreseen and acceptable consequences** – The consequences of control actions to return to a studied operating state must be both foreseen and acceptable. The intentional loss of a major portion of the system, or the intentional separation of a major portion of the system, are unacceptable consequences.

### 4.5.2 Policies

(MR Ch.5 s.5.10.2)

**Minimum acceptable level** – The minimum acceptable level of *IESO-controlled grid* system *security* is the level afforded by observance of *emergency* condition operating limits. All necessary steps are to be taken, including the interruption of *non-dispatchable load* and *price responsive load*, in accordance with ~~section 2.7.8~~section 2.7.8 of this *market manual* to observe *emergency* condition operating limits.

**BPS and interconnections** – The *IESO* shall use all available means to re-prepare BPS parts of the system and IROL interfaces to *emergency* condition operating limits within 30 minutes following any respected contingency. The 30-minute period starts following the occurrence of the contingency.

**Mandatory planning** – The *IESO* must have plans to re-prepare BPS parts of the system and IROL interfaces to *emergency* condition operating limits within 30 minutes following the occurrence of respected contingencies. Re-preparation plans shall not utilize control actions that increase *non-dispatchable load* and *price responsive load* shedding until *resources* have been committed in accordance with the Area Reserve criteria in ~~section 3.4~~section 3.4 of this *market manual*.

**Publication** – The *IESO publishes* and maintains a power system restoration plan for Ontario in the event of a complete or partial blackout of the *IESO-controlled grid* (refer to ~~**MM 7.8**: *Ontario Power System Restoration Plan*).~~MM 7.8).

**– End of Section –**

# Appendix A: Recognized Contingencies

The types of contingencies that must be respected on elements[4] that form the BPS and BES are, at a minimum, specified by *NPCC* and *NERC* respectively. The types of contingencies that must be respected on the remaining local elements are specified by the *IESO*. The consequences of Group 1, Group 2, and Group 3 contingencies must be considered on BPS, BES, and local elements respectively; with due regard for how auxiliaries at generation, electricity storage and transmission stations are supplied by the *IESO-controlled grid*.

Single-element contingencies result in the clearing of a single protection zone, with the exception of inadvertent breaker opening contingencies. A single protection zone may comprise more than one element. To restore system *security*, it can be assumed that only one element was faulted, and the other elements comprised within a single protection zone can return to service. The timing of the return to service depends upon the particulars associated with the fault location. System *security* must be restored considering all elements that cannot be returned to service within 30 minutes.

When the *IESO-controlled grid* is in a *high risk operating state*, the *IESO* may operate the system to withstand contingencies more severe than those specified below for a *normal operating state*.

## A.1 Group 1 – Contingencies

### A.1.1 Normal Operating State

When the *IESO-controlled grid* is in a *normal operating state*, the Group 1 contingencies are:

(i) A permanent three-phase fault on any element with normal fault clearing.

(ii) Simultaneous permanent single-phase-to-ground faults on the same or different phases of each of two adjacent transmission circuits on a multiple transmission circuit tower, with normal fault clearing. If multiple circuit towers are used only for station entrance and exit purposes, and if they do not exceed five towers at each station, this condition is an acceptable risk and is excluded.

(iii) A permanent single-phase-to-ground fault on any element with delayed fault clearing.

(iv) Loss of any element or circuit breaker without a fault.

[4] An element is defined as *generator*, transmission circuit, transformer, shunt device, or bus section.

(v) A permanent single-phase-to-ground fault on a circuit breaker, with normal fault clearing.

(vi) Simultaneous permanent loss of both poles of a direct current bipolar *facility*.

(vii) The failure of a circuit breaker associated with a RAS to operate when required following the loss of any element or circuit breaker without a fault, or a permanent single-phase-to-ground fault (with normal fault clearing) on any element.

### A.1.2 Emergency Operating State

When the *IESO-controlled grid* is in an *emergency operating state*, the Group 1 contingencies are:

(i) A permanent three-phase fault on any element with normal fault clearing.

(ii) A permanent single-phase-to-ground fault on any element with normal fault clearing.

(iii) Single pole block with normal clearing in a monopolar or bipolar high voltage direct current (HVDC) system.

(iv) Loss of any element or circuit breaker without a fault.

## A.2 Group 2 – Contingencies

When the *IESO-controlled grid* is in a *normal operating state* or *emergency operating state* the Group 2 contingencies are:

(i) A permanent three-phase fault on any element with normal fault clearing.

(ii) A permanent single-phase-to-ground fault on any element with normal fault clearing

(iii) Loss of any element or circuit breaker without a fault.

(iv) Single pole block with normal clearing in a monopolar or bipolar HVDC system.

## A.3 Group 3 – Contingencies

When the *IESO-controlled grid* is in a *normal* or *emergency operating state*, the Group 3 contingencies are:

(i) A permanent phase-to-phase-to-ground fault on any element with normal fault clearing.

(ii) A permanent single-phase-to-ground fault on any element with normal fault clearing

(iii) Loss of any element or circuit breaker without a fault.

**– End of Appendix –**

# Appendix B: Load and Generation Rejection and Generation Runback Selection Criteria

## B.1 Load Rejection (L/R) Selections

a. L/R should be selected to satisfy the following in order of priority:

(i) **System security:** L/R selections must satisfy system security requirements for specific station and/or a specific megawatt requirement (to within an acceptable deadband). L/R must be selected such that the resulting transmission conditions do not prevent L/R actions to alleviate the system *security* concerns. L/R selections in the vicinity of a natural or man-made disaster must not hamper *emergency* measures.

(ii) **Sensitivity:** Priority customer loads (refer to ~~Market Manual 7.10: Ontario Electricity Emergency Plan~~Market Manual 7.10: Ontario Electricity Emergency Plan) such as hospitals and water treatment plants without backup *generators*, and electrically driven gas compressors should be avoided when determining what load to shed.

(iii) **Minimize Number of Stations:** The number of stations selected for rejection should be minimized.

(iv) **Trip History:** L/R selections should attempt to equalize the number of L/R operations for each station over the long term and minimize the exposure of any station to two successive L/R operations.

(v) **Area Fairness:** Where L/R may be available for selection in more than one area, the stations selected for L/R should be distributed among each participating area. This *distribution* should be in approximate proportion to the percentage of the total load supplied by all areas involved in the scheme.

b. Opening bus tie breakers to increase *non-dispatchable load* or *price responsive load* lost by configuration shall be considered as L/R.

c. L/R selections will be minimized where affected *IESO-controlled grid delivery points* are not within *reliability* performance standards.

d. L/R selected to relieve post-contingency thermal overloading shall be:

(i) Sufficient to comply with the thermal rating policy.

(ii) Sufficient to prevent loading beyond the long-time ratings if the lack of fast-acting control actions combined with the complexities of post-rejection operation will jeopardize respecting long-time ratings within the appropriate "limited" time.

## B.2 Generation Rejection Selections

a. Generation Rejection (G/R) should be selected to satisfy the following in order of priority:

(i) **System Security:** G/R requirements must satisfy system *security* requirements for specific unit selections and/or specific megawatt requirement (to within an acceptable deadband).

(ii) **Minimize Number of Units:** The number of units selected and total amount selected for G/R should be minimized within the constraints imposed by plant and system operating conditions.

(iii) **Trip History:** Selections should attempt to equalize the number of unit trips based on history.

b. G/R selections for single element contingency events shall be minimized.

c. G/R selected to relieve post-contingency thermal overloading shall be:

(i) Sufficient to comply with the thermal rating policy.

(ii) Sufficient to prevent loading beyond the long-time ratings if the lack of fast-acting control actions combined with the complexities of post-rejection operation will jeopardize respecting long-time ratings within the appropriate "limited" time.

d. G/R selections should avoid manual corrective measures following a G/R operation,

e. G/R selections should be made on a reasonable effort basis to address *market participant resource* concerns such as the:

(i) Maximum number of units selected within a single control center,

(ii) Minimum number of unselected *generation units*, and

(iii) Unavailability or preferences of specific units for G/R selection.

## B.3 Generation Runback Selections

All policies in place for G/R apply equally to Generation Runback.

**– End of Appendix –**

# Appendix C: RAS Restrictions during High Risk Operating State

The following contingency types apply to **115 kV**, **230 kV** and **500 kV** systems.

**Table C-1: RAS Restrictions during High Risk Operating State**

| **Contingency Type** | ***High Risk Operating State* Due to Adverse Weather within the Weather Advisory Area (refer to notes A, B, C and D)** | ***High Risk Operating State* Due to Conditions not within the Weather Advisory Area (refer to notes A, B and C)** |
|---|---|---|
| Recognized Double Element | No restrictions to G/R or L/R | The primary concern is adverse effects of a false RAS operation. The following restrictions therefore apply:<br>• G/R or runback is permissible provided its use is minimized.<br>• L/R is permissible, provided *IESO-controlled grid* system *security* criteria could not otherwise be satisfied. |
| Recognized Single Element | G/R or runback is permissible, provided:<br>• Arming is limited to outage periods or short-duration periods, or<br>• Its magnitude is reduced during adverse weather periods<br>G/R is permissible, provided the only other alternative is to remove the unit from service, or the unit would be automatically removed from service as a result of the initiating contingency.<br>L/R is permissible provided *IESO-controlled grid* system *security* criteria could not otherwise be satisfied. | |

A. A RAS must NOT be utilized if a fail-to-trip condition is suspected.

B. A RAS may be selectively used to provide additional system *security* beyond normal criteria, provided the restrictions in ~~Table C-1~~Table C-1 are observed.

C. The restrictions in this table do not apply to RAS selections for extreme contingencies.

D. The Weather Advisory Area is within 50 km of the circuits for which the RAS is selected.

**– End of Appendix –**

# List of Acronyms

| Acronym | Term |
|---|---|
| ABNO | available but not operating |
| *AVR* | *automatic voltage regulation* |
| BES | bulk electric system |
| BPS | bulk power system |
| DESN | dual element spot network |
| EOSCA | *emergency operating state* control actions |
| G/R | *generation* rejection |
| HVDC | high voltage direct current |
| IROL | interconnection *reliability* operating limit |
| kV | kilovolt |
| L/R | load rejection |
| MR | *market rules* |
| MVA | megavolt-amp |
| *NERC* | *North American Electric Reliability Corporation* |
| *NPCC* | *Northeast Power Coordinating Council, Inc.* |
| ORTAC | Ontario Resource and Transmission Assessment Criteria |
| PV | power-voltage |
| RAS | remedial action scheme |
| UFLS | under-frequency load shedding |

**– End of Section –**

# References

| Document ID & Link | Document Title |
|---|---|
| ~~MDP_RUL_0002~~MDP_RUL_0002 | Market Rules for the Ontario Electricity Market |
| ~~PRO-408~~PRO-408 | Market Manual 1.5: Market Registration Procedures |
| ~~MDP_PRO_0024~~MDP_PRO_0024 | Market Manual 2.8: Reliability Assessments Information Requirements |
| IMP_PRO_0034 | Market Manual 4.3: Operation of the Real-Time Markets |
| ~~IMP_PRO_0033~~IMP_PRO_0033 | Market Manual 7.2: Near-Term Assessments and Reports |
| ~~IMP_PRO_0035~~IMP_PRO_0035 | Market Manual 7.3: Outage Management |
| ~~IMO_PLAN_0001~~IMO_PLAN_0001 | Market Manual 7.8: *Ontario Power System Restoration Plan* |
| ~~IMO_PLAN_0002~~IMO_PLAN_0002 | Market Manual 7.10: Ontario Electricity Emergency Plan |
| ~~IESO_PRO_0874~~IESO_PRO_0874 | Market Manual 11.2: Ontario Reliability Compliance Program |

**– End of Document –**