

Technical Rules

DRAFT ONLY

Insert Date (proposed September 2023)

IMPORTANT NOTE: This document is subject to amendment (amendments must be made in accordance with the *Electricity Networks Access Code 2004*). The latest approved version of the Technical Rules (and details of any proposed amendments) are available from the Economic Regulation Authority: <https://www.era.gov.au/electricity/electricity-access/western-power-network/technical-rules>

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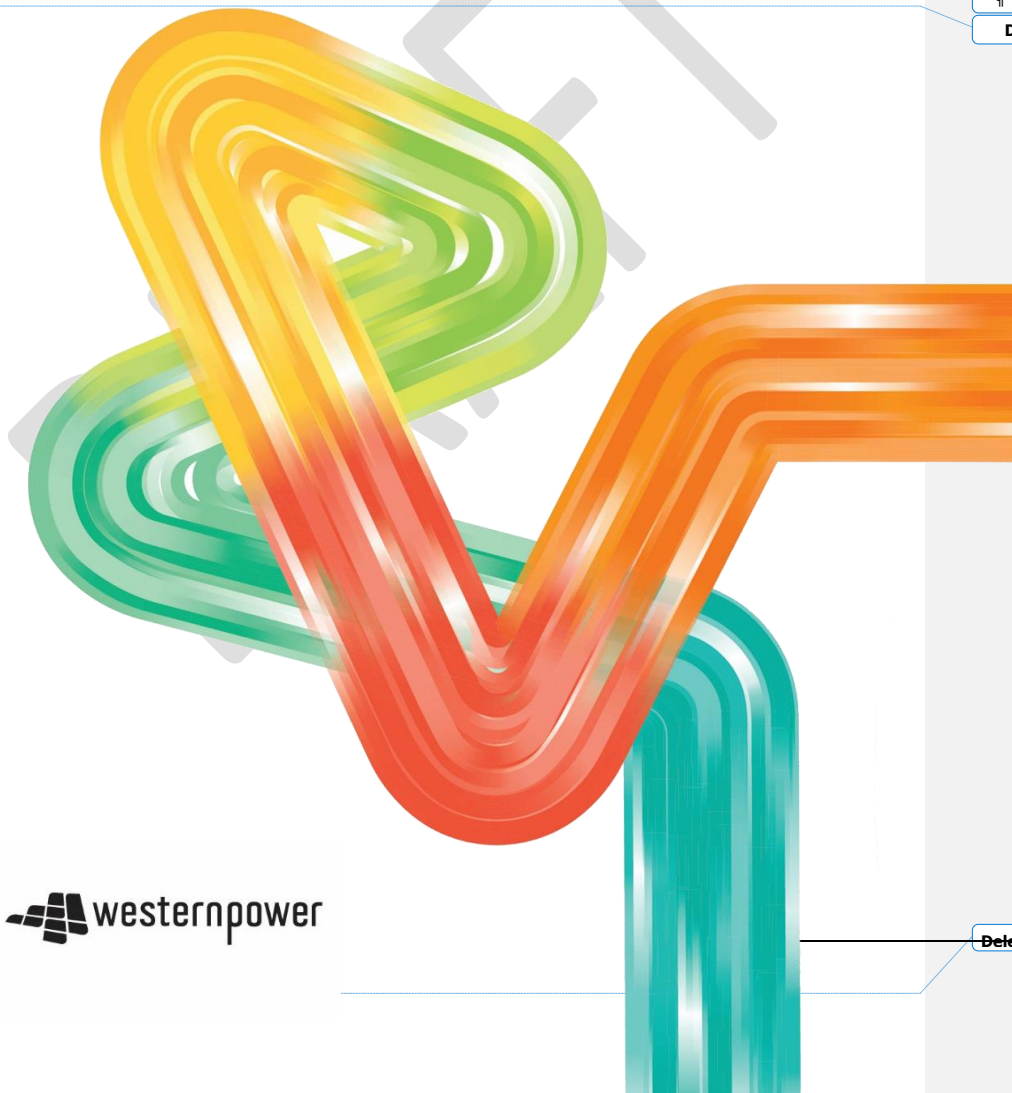
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PREFACE

The Electricity Networks Corporation, trading as Western Power, was established on 1 April 2006 by the *Electricity Corporations Act 2005* (WA). Western Power is required to provide access to capacity in its electricity *transmission and distribution systems* in accordance with the *Electricity Networks Access Code 2004* (WA) (*Access Code*).

Chapter 12 of the *Access Code* fully describes the context, approval, development and application of Technical Rules for covered and non-covered networks. As such, the Economic Regulation Authority (*Authority*) is required to approve and publish Technical Rules (*Rules*) for covered and non-covered networks in coordination with *Network Service Providers*.

These *Rules* detail the technical requirements to be met by:

- 1) Western Power, and
- 2) *Users* who connect *facilities* to the *transmission and distribution systems* that make up the *Western Power Network*.

Prospective *Users* or existing *Users* who wish to connect *facilities* (or modify existing connections) to the *transmission and distribution systems* must first submit an *access application* to Western Power in accordance with the *Access Code*.

Amendments to this document, and variations or exemptions to *Rule* requirements granted to *Users* and *the Network Service Provider*, can only be made in accordance with the *Access Code*.

[INSERT DATE], Revision x (DRAFT)

This *revision* of the Technical Rules contains amendments approved by the *Authority* decision of [insert date]. That decision relates to amendments proposed by Western Power in [insert date], and the approved amendments apply from [insert date].

The decision, approved changes, and further details about the decision made are available from the *Authority* website.

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1. GENERAL	1¶
1.1 INTRODUCTION	1¶
1.2 AUTHORISATION	1¶
1.3 APPLICATION	2¶
1.4 COMMENCEMENT	2¶
1.5 INTERPRETATION	3¶
1.6 THE NETWORK SERVICE PROVIDER AND USERS TO ACT REASONABLY	3¶
1.7 DISPUTE RESOLUTION	3¶
1.8 OBLIGATIONS	3¶
1.9 VARIATIONS AND EXEMPTIONS FROM THE RULES	4¶
2. TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA	6¶
2.1 INTRODUCTION	6¶
2.2 POWER SYSTEM PERFORMANCE STANDARDS	6¶
2.3 OBLIGATIONS OF NETWORK SERVICE PROVIDER IN RELATION TO POWER SYSTEM PERFORMANCE	13¶
2.4 LOAD SHEDDING FACILITIES	20¶
2.5 TRANSMISSION AND DISTRIBUTION SYSTEM PLANNING CRITERIA	20¶
2.6 DISTRIBUTION DESIGN CRITERIA	28¶
2.7 TRANSMISSION AND DISTRIBUTION SYSTEM DESIGN AND CONSTRUCTION STANDARDS	28¶
2.8 DISTRIBUTION CONDUCTOR OR CABLE SELECTION	29¶
2.9 TRANSMISSION AND DISTRIBUTION SYSTEM PROTECTION	29¶
3. TECHNICAL REQUIREMENTS OF USER FACILITIES	35¶
3.1 INTRODUCTION	35¶
3.2 REQUIREMENTS FOR ALL USERS	35¶
3.3 REQUIREMENTS FOR CONNECTION OF GENERATING UNITS	38¶
3.4 REQUIREMENTS FOR CONNECTION OF LOADS	58¶
3.5 USER'S PROTECTION REQUIREMENTS	63¶
3.6 REQUIREMENTS FOR CONNECTION OF SMALL GENERATING UNITS TO THE DISTRIBUTION NETWORK	66¶
3.7 REQUIREMENTS FOR CONNECTION OF ENERGY SYSTEMS TO THE LOW VOLTAGE DISTRIBUTION SYSTEM VIA INVERTERS	75¶
4. INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION	81¶
4.1 INSPECTION AND TESTING	81¶
4.2 COMMISSIONING OF USER'S EQUIPMENT	91¶
4.3 DISCONNECTION AND RECONNECTION	95¶
5. TRANSMISSION AND DISTRIBUTION SYSTEM OPERATION AND COORDINATION	99¶
5.1 APPLICATION	99¶

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

TABLE OF CONTENTS

1.	GENERAL	1
1.1	INTRODUCTION	1
1.2	AUTHORISATION	1
1.3	APPLICATION	2
1.4	COMMENCEMENT	3
1.5	INTERPRETATION	3
1.6	THE NETWORK SERVICE PROVIDER AND USERS TO ACT REASONABLY	3
1.7	DISPUTE RESOLUTION	3
1.8	OBLIGATIONS	3
1.9	VARIATIONS AND EXEMPTIONS FROM THESE RULES	5
2.	TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA	8
2.1	INTRODUCTION	8
2.2	POWER SYSTEM PERFORMANCE STANDARDS	8
2.3	OBLIGATIONS OF NETWORK SERVICE PROVIDER IN RELATION TO POWER SYSTEM PERFORMANCE	18
2.4	LOAD SHEDDING REQUIREMENTS	23
2.5	TRANSMISSION SYSTEM PLANNING CRITERIA	24
2.6	DISTRIBUTION SYSTEM PLANNING CRITERIA	38
2.7	TRANSMISSION AND DISTRIBUTION SYSTEM DESIGN AND CONSTRUCTION STANDARDS	41
2.8	DISTRIBUTION CONDUCTOR OR CABLE SELECTION	41
2.9	TRANSMISSION AND DISTRIBUTION SYSTEM PROTECTION	41
3.	TECHNICAL REQUIREMENTS OF USER FACILITIES	48
3.1	INTRODUCTION	48
3.2	REQUIREMENTS FOR ALL USERS	50
3.3	REQUIREMENTS FOR CONNECTION OF LARGE GENERATING SYSTEMS TO THE TRANSMISSION SYSTEM OR THE HIGH VOLTAGE DISTRIBUTION SYSTEM	55
3.4	REQUIREMENTS FOR CONNECTION OF LOADS	101
3.5	USER'S PROTECTION REQUIREMENTS	108
3.6	REQUIREMENTS FOR CONNECTION OF SMALL GENERATING SYSTEMS TO THE TRANSMISSION OR HIGH VOLTAGE DISTRIBUTION SYSTEM	116
3.7	REQUIREMENTS FOR CONNECTION OF SMALL GENERATING SYSTEMS TO THE LOW VOLTAGE DISTRIBUTION SYSTEM	123
3.8	REQUIREMENTS FOR CONNECTION OF INVERTER ENERGY SYSTEMS CONNECTED TO THE LOW VOLTAGE DISTRIBUTION SYSTEM VIA A STANDARD CONNECTION SERVICE	131
4.	INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION	135
4.1	INSPECTION AND TESTING	135
4.2	COMMISSIONING OF USER'S EQUIPMENT	149
4.3	DISCONNECTION AND RECONNECTION	155
5.	TRANSMISSION AND DISTRIBUTION SYSTEM OPERATION AND COORDINATION	159
5.1	APPLICATION	159
5.2	INTRODUCTION	159
5.3	POWER SYSTEM OPERATION CO-ORDINATION RESPONSIBILITIES AND OBLIGATIONS	159
5.4	TRANSMISSION NETWORK OPERATOR DETAILED OBLIGATIONS	163
5.5	DISTRIBUTION NETWORK OPERATOR DETAILED OBLIGATIONS	167
5.6	USER DETAILED OBLIGATIONS	169
5.7	POWER SYSTEM OPERATING PROCEDURES, PROTOCOLS, AUDITS AND INFORMATION	171
5.8	POWER SYSTEM OPERATION SUPPORT	172
5.9	NOMENCLATURE STANDARDS	174

TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

TABLE OF CONTENTS

ATTACHMENT 1 GLOSSARY	176
ATTACHMENT 2 INTERPRETATION	204
ATTACHMENT 3 SCHEDULES OF TECHNICAL DETAILS IN SUPPORT OF CONNECTION APPLICATIONS	205
ATTACHMENT 4 LARGE GENERATING SYSTEM DESIGN DATA¹	207
ATTACHMENT 5 SUBMISSION REQUIREMENTS FOR ELECTRICAL PLANT PROTECTION	218
ATTACHMENT 6 LARGE GENERATING UNIT OR GENERATING SYSTEM SETTING DATA	221
ATTACHMENT 7 TRANSMISSION SYSTEM AND EQUIPMENT TECHNICAL DATA OF EQUIPMENT AT OR NEAR CONNECTION POINT	222
ATTACHMENT 8 TRANSMISSION SYSTEM EQUIPMENT AND APPARATUS SETTING DATA	225
ATTACHMENT 9 LOAD CHARACTERISTICS AT CONNECTION POINT	227
ATTACHMENT 10 SMALL GENERATING SYSTEM DESIGN AND SETTING DATA (RATED CAPACITY ≤ 5 MVA EXCLUDING INVERTER ENERGY SYSTEMS CONNECTED TO THE LOW VOLTAGE DISTRIBUTION SYSTEM VIA A STANDARD CONNECTION SERVICE)	229
ATTACHMENT 11 TEST SCHEDULE FOR SPECIFIC PERFORMANCE VERIFICATION AND MODEL VALIDATION	236
ATTACHMENT 12 TESTING AND COMMISSIONING OF SMALL POWER STATIONS CONNECTED TO THE DISTRIBUTION SYSTEM	246
ATTACHMENT 13 GUIDANCE ON ECONOMIC JUSTIFICATION	250
RECORD OF AMENDMENTS AND REVISIONS	252

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1. GENERAL

1.1 INTRODUCTION

- (a) This Chapter 1 defines the scope of the *Rules* both as to their content and their application. It provides rules of interpretation and refers to the dispute resolution process. It establishes the obligations of all parties and defines the methods for variations, exemptions, and amendments to these *Rules*.
- (b) The objectives of these *Rules* are that they:
 - (1) are reasonable;
 - (2) do not impose inappropriate barriers to entry to a market;
 - (3) are consistent with *good electricity industry practice*; and
 - (4) are consistent with relevant *written laws* and *statutory instruments*.

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1.2 AUTHORISATION

These *Rules* are made under chapter 12 of the *Access Code*. As applicable, they set out:

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- (a) the required performance standards for service quality in relation to the *power system*;
- (b) the technical requirements for the design or operation of equipment *connected* to the *transmission and distribution systems*;
- (c) the requirements for the operation of the *transmission and distribution systems* excluding the operation of those parts of the *transmission system* under the control of AEMO acting in accordance with the WEM Rules, except under emergency situations as provided for under the WEM Rules;
- (d) the obligations of *Users* to test equipment in order to demonstrate compliance with the technical requirements referred to in clause 1.2(b) and the operational requirements referred to in clause 1.2(c);
- (e) the procedures that apply if the *Network Service Provider* believes that a User's equipment does not comply with the requirements of these *Rules*;
- (f) the procedures for the inspection of a User's equipment;
- (g) the procedures for system tests carried out in relation to all or any part of the *transmission and distribution systems*;
- (h) the requirements for control and *protection* settings for equipment *connected* to the *transmission and distribution systems*;
- (i) the procedures for the commissioning and testing of new equipment *connected* to the *transmission and distribution systems*;

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[CHAPTER 1 - GENERAL](#)

- (j) the procedures for the disconnection of equipment from the *transmission and distribution systems*;
- (k) the procedures for the operation of *generation* that is not under the control of [AEMO](#) but which is *connected*, either directly or indirectly, to the *transmission and distribution systems*;
- (l) the information which each *User* is required to provide the *Network Service Provider* in relation to the operation of equipment *connected* to the *transmission and distribution systems* at the [User's connection point](#) and how and when that information is to be provided;
- (m) the requirements for the provision of [automatic under frequency load shedding](#);
- (n) other matters relating to the *transmission and distribution systems* or equipment *connected* directly or indirectly to the *transmission and distribution systems*; and
- (o) the [network planning criteria for transmission and distribution systems](#).

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1.3 APPLICATION

- (a) In these *Rules*, unless otherwise stated, a reference to the *Network Service Provider* refers to the *service provider* for the *South West Interconnected Network*. The *service provider* for the *South West Interconnected Network*, is the Electricity Networks Corporation, a statutory corporation established by the Electricity Corporations Act (2005) (WA).
- (b) These *Rules* apply to:
 - (1) the *Network Service Provider* in its role as the owner and *operator* of the *transmission and distribution systems*;
 - (2) [AEMO](#) in its role as *operator* of the *power system* [as defined in clause 2.1A of the WEM Rules](#);
 - (3) *Users* of the *transmission or distribution system* who, for the purposes of these *Rules* include:
 - (A) every person who seeks *access* to *spare capacity* or *new capacity* on the *transmission or distribution system* or makes an *access application* under the *Access Code* in order to establish a *connection point* or modify an existing *connection*;
 - (B) every person to whom *access* to [the transmission or distribution system](#) capacity is made available (including every person with whom the *Network Service Provider* has entered into an *access contract* or *connection agreement*).

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1.4 COMMENCEMENT

These *Rules* come into operation on **1 July 2007** (the "*Rules commencement date*"). Where the *Rules* have been amended or revised, the commencement date of each [revision](#) is the date on the cover page unless otherwise indicated.

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1.5 INTERPRETATION

- (a) In these *Rules*, the words and phrases defined in [Attachment 1](#) have the meanings given to them there.
- (b) These *Rules* must be interpreted in accordance with the rules of interpretation set out in [Attachment 1](#) and [Attachment 2](#).

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1.6 THE NETWORK SERVICE PROVIDER AND USERS TO ACT REASONABLY

1.6.1 Importance of objectives

Subject to the *Access Code*, the *Network Service Provider* and *Users* must comply with these *Rules* and act in a manner consistent with the objectives of these *Rules* as set out in clause 1.1(b).

1.6.2 Acting reasonably

- (a) The *Network Service Provider* and *Users* must act reasonably towards each other in regard to all matters under these *Rules*.
- (b) Whenever the *Network Service Provider* or a *User* is required to make a determination, form an opinion, give approval, make any request, exercise a discretion or perform any act under these *Rules*, it must be formed, given, made, exercised or performed reasonably and in a manner that is consistent with the objectives of these *Rules* and be based on reasonable grounds, and not capriciously or arbitrarily refused, or unduly delayed.

1.7 DISPUTE RESOLUTION

All disputes concerning these *Rules* must be resolved in accordance with Chapter 10 of the *Access Code*.

1.8 OBLIGATIONS

1.8.1 General

- (a) *Users* and the *Network Service Provider* must maintain and operate (or ensure their authorised *representatives* maintain and operate) all equipment that is part of their respective *facilities* in accordance with:
 - (1) relevant laws;
 - (2) the requirements of the *Access Code*;
 - (3) the requirements of these *Rules*; and
 - (4) *good electricity industry practice* and applicable *Australian Standards*.

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[CHAPTER 1 - GENERAL](#)

- (b) Where an obligation is imposed under these *Rules* to arrange or control any act, matter or thing or to [make sure](#) that any other person undertakes or refrains from any act, that obligation is limited to a requirement to use all reasonable endeavours in accordance with the *Access Code*, to comply with that obligation.
- (c) If the *Network Service Provider*, [AEMO](#) or a *User* fails to arrange or control any act, matter or thing or the acts of any other person, the *Network Service Provider*, [AEMO](#) or *User* is not taken to have breached such obligation imposed under these *Rules* provided the *Network Service Provider*, [AEMO](#) or *User* used all reasonable endeavours to comply with that obligation.

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1.8.2 Obligations of the *Network Service Provider*

- (a) The *Network Service Provider* must comply with the [power system](#) performance standards described in these *Rules*.
- (b) The *Network Service Provider* must:
 - (1) [make sure](#) that, for [connection points](#) on the [transmission or distribution system](#) every arrangement for [connection](#) with a *User* complies with all relevant provisions of these *Rules*;
 - (2) permit and participate in inspection and testing of *facilities* and equipment in accordance with clause 4.1;
 - (3) permit and participate in commissioning of *facilities* and equipment in accordance with clause 4.2;
 - (4) advise a *User* with whom there is an *access contract* of any expected interruption or reduced level of service at a *connection point* so that the *User* may make alternative arrangements for *supply* during such interruptions;
 - (5) [make sure](#) that modelling data used for planning, design and operational purposes is complete and accurate and, [where there are grounds to question the validity of data](#), undertake tests or require *Users* to undertake tests in accordance with clause 4.1;
 - (6) [review and assess generator performance standards proposed by Generators in accordance with clause 3.3.4; and](#)
 - (7) [maintain a register of performance requirements for User facilities as specified in clause 3.2.6.](#)
- (c) The *Network Service Provider* must arrange for:
 - (1) _____ management, maintenance and operation of the *transmission and distribution systems* such that:
 - (A) when the *power system* is [under](#) normal operating [conditions](#) electricity may be transferred continuously at a *connection point* up to the *agreed capability* of that *connection point*;

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CHAPTER 1 - GENERAL

- (B) the number and impact of interruptions or service level reductions to Users is minimised;
- (2) restoration of the *agreed capability* of a *connection point* as soon as reasonably practicable following any interruption or reduction in service level at that *connection point*; and
- (3) a recovery or contingency plan to be developed and maintained with respect to the restoration of the *agreed capability* of a *connection point* where the *Network Service Provider* does not hold spare replacement plant.

1.9 VARIATIONS AND EXEMPTIONS FROM THESE RULES

1.9.1 User exemptions from these Rules

- (a) An exemption from compliance with one or more of the requirements of these Rules may be granted to a User by the *Network Service Provider* in accordance with sections 12.33 to 12.39 of the *Access Code*.
- (b) Where an exemption granted under these Rules may impact *power system security or power system reliability*, the *Network Service Provider* must consult with AEMO as appropriate before deciding whether to grant the exemption.
- (c) For the avoidance of doubt, no exemption is required when the *Network Service Provider* properly and reasonably exercises a discretion granted to it under these Rules.

Note:
Generator performance standards negotiated and agreed in accordance with these Rules do not require an exemption where the agreed outcome for each standard is within the minimum and ideal generator performance standard.

- (d) An application for an exemption must include the relevant supporting information and supporting justifications.
- (e) Where an exemption or variation from these Rules is granted in accordance with sections 12.33 to 12.39 of the *Access Code*, the *Network Service Provider* must record the exemption or variation.
- (f) In accordance with clause A6.2 of the *Access Code*, these Rules are not required to address the matters listed in clause A6.1 of the *Access Code* to the extent that these matters are dealt with in Chapters 3, 3A and 3B or Appendices 12 or 13 of the *WEM Rules*.

Note:
Clause 1.9.1(f) clarifies that *Generators* who negotiate and agree *generator performance standards* under the *WEM Rules* do not need to negotiate these standards in accordance with these Rules.

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1.9.2 Network Service Provider exemptions from these Rules

Exemptions from one or more requirements of these Rules may be granted to the Network Service Provider and all applicants, Users and controllers of the transmission and distribution systems by the Authority as set out in sections 12.40 to 12.49 of the Access Code.

1.9.3 Amendment to the Rules

- (a) The Authority may amend these Rules in accordance with sections 12.50 to 12.54A of the Access Code.

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1.9.4 Existing equipment and modifications

- (a) All facilities and equipment in the transmission and distribution systems, all connection assets, and all User facilities and equipment connected to the transmission or distribution system existing at the Rules commencement date are deemed to comply with the requirements of these Rules. This also applies to facilities in respect of which Users have signed a connection agreement or projects of the Network Service Provider for which work has commenced prior to the Rules commencement date.

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- (b) Subject to clause 1.9.5, all facilities and equipment installed after the Rules commencement date must comply with the version of the Rules in force at:

- (1) the time the facility or equipment was commissioned, where the facility or equipment forms part of the transmission and distribution systems; or
- (2) the date of the most recent signed connection agreement for User's facilities and equipment where a connection agreement exists, or otherwise the date of commissioning of the facilities and equipment.

- (c) When equipment is upgraded or modified for any reason, the upgraded or modified equipment must comply with the applicable requirements of these Rules in force at the time of the upgrade or modification. This does not apply to other equipment that forms parts of the same facility.

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- (d) The Network Service Provider must develop, maintain, and publish guidelines to inform Users and provide examples of upgrades and modifications as per clause 1.9.4(c), and relevant generator modifications.

1.9.5 Ongoing suitability with the Rules

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- (a) A User or the Network Service Provider must ensure that the capabilities and ratings of their equipment is monitored on an ongoing basis and must ensure its continued safety and suitability as conditions on the power system change.

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- (b) The Network Service Provider may require a User to:

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- (1) demonstrate that their equipment is being monitored on an ongoing basis in accordance with clause 1.9.5(a); and

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

CHAPTER 1 - GENERAL

- (2) upgrade or modify their equipment to ensure that *power system performance standards* in clause 2.2 continue to be met under the most recent version of the *Rules*.
- (c) Where the *Network Service Provider* requires a *change* under clause 1.9.5(b)(2), the *Network Service Provider* must state the reasons for the request, the timing within which the request must be fulfilled, and may consult with *AEMO*.

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[CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA](#)

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2. TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

2.1 INTRODUCTION

[This Chapter 2](#) describes the technical performance requirements of the *power system*, and the obligations of the *Network Service Provider* to provide the *transmission and distribution systems* that will allow these performance requirements to be achieved. In addition, it sets out criteria for the planning, design and construction of the *transmission and distribution systems*.

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[Section 2.2](#) specifies the *power system performance standards* that the *Network Service Provider* seeks to achieve when planning and operating their *transmission and distribution systems* and when negotiating the *connection of new Users*.

[A User](#) should not rely on *power system performance standards* being fully complied with at a *connection point* under all circumstances. During the process of restoring the *power system* from a system shutdown or major *supply disruption*, the *power system* may not meet the *power system performance standards* defined in [section 2.2](#).

2.2 POWER SYSTEM PERFORMANCE STANDARDS

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2.2.1 Frequency variations

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(a) [The frequency operating standards specified in the WEM Rules apply](#) for the *power system* when it is operating as a single interconnected system or as one or more islanded systems created by disconnecting one or more *transmission elements*.

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The accumulated synchronous time error must be less than 10 seconds for 99% of the time.¶

Note:
An island is formed when the *interconnection* between parts of the *interconnected transmission system* is broken, for example if the *interconnection* between the Goldfields region and remainder of the *power system* is broken.

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Table 2.1 Frequency

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2.2.2 Transmission voltage

2.2.2.1 Voltage performance timeframes

(a) [Each of the following timeframes, illustrated in Figure 2-1, should be considered in assessing voltages:](#)

(1) [Transient phase](#) extends for 5 seconds to 10 seconds following a relevant *switching event or credible contingency*. This timeframe allows for *protection operations* to clear any fault, automated *Generator tripping schemes*, *load response to voltage* changes and the response of fast acting *voltage control devices* including automatic *voltage regulators* on *generating systems*, *SVCs* and *STATCOMs*.

(2) [Time Phase 1](#) extends from the end of the transient phase to 30 seconds after a relevant *switching event or credible contingency*. During this time, delayed *auto-reclosing of transmission and distribution lines* occur.

(3) [Time Phase 2](#) extends from 30 seconds to 3 minutes after a relevant *switching event or credible contingency*. During this time *zone substation transformers* may be tapped via automatic *voltage controllers*, automatic *switching of reactors* and *capacitors* may occur and all *loads* that remain *connected to the*

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power system are expected to be restored to the level that existed prior to the switching event or credible contingency.

- (4) Time Phase 3 extends from 3 minutes to 20 minutes after a relevant switching event or credible contingency. During this time manual adjustments to, and switching of, equipment may occur. For example, switching of reactors or capacitors, and adjustment of transformer tap changers, generating systems or other reactive equipment.

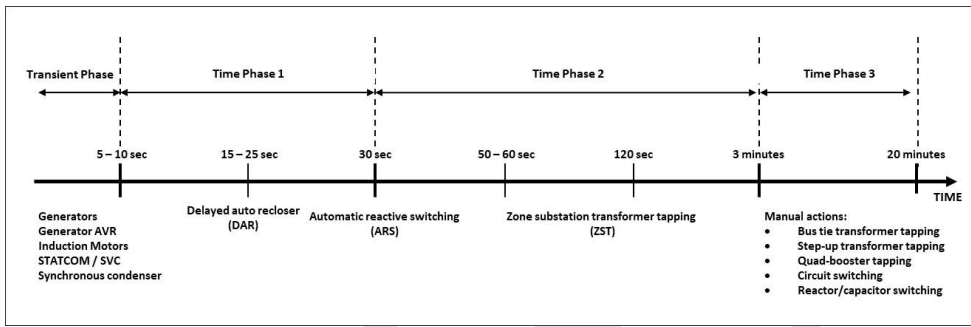


Figure 2-1 Timeframes for the assessment of voltage performance

2.2.2.2 Transmission voltage criteria

- (a) A voltage condition is unacceptable if:
- (1) there is any inability to achieve pre-event steady state voltages on the transmission system within the limits specified in Table 2-1, or
 - (2) after either operational switching or a credible contingency, the affected site remains connected to the transmission system and any of the following conditions apply:
 - (i) the voltage step change at a User connection point exceeds that specified in Table 2-2;
 - (ii) there is any inability following such an event to achieve a steady state voltage on the transmission system as specified in Table 2-3 using manual and/or automatic facilities available, including the switching in or out of relevant equipment, with the assessment made at the end of time phase 3.

2.2.2.3 Transmission pre-event voltage limits in all timescales

- (a) The steady state voltage at all points on the transmission system must not exceed the limits specified in Table 2-1 prior to any switching event or credible contingency.

Table 2-1 Transmission system pre-event steady state voltage limits

<u>Nominal voltage</u>	<u>Planning timescale voltage limits</u>	<u>Operational timescale voltage limits</u>
330 kV	+4% / -4%	+10% / -10%
220 kV	+4% / -4%	+10% / -10%
132 kV	+5% / -5%	+10% / -10%
66 kV	+5% / -5%	+10% / -10%

(b) [The planning timescale voltage limits may be relaxed to meet power transfer requirements if the Network Service Provider assesses that there is sufficient certainty of meeting the voltage limits specified for operational timescales.](#)

2.2.2.4 Transmission voltage step change limits in all timescales

(a) [The voltage step change resulting from switching operations and credible contingencies on the transmission system must not exceed the limits given in Table 2-2 at User connection points that remain connected to the transmission system and connections to the distribution system.](#)

Table 2-2 Transmission voltage step change in all timescales

<u>Event</u>	<u>Post-event voltage step (% of nominal voltage)</u>
frequent operational switching	+/- 3%
infrequent operational switching	+6% / -10%
credible contingency	+6% / -10%

2.2.2.5 Transmission post-event voltage limits in all timescales

(a) [The voltage limits in Table 2-3 are to be observed following the specified event and at the end of time phase 3 as defined in clause 2.2.2.1 \(and shown in Figure 2-1\).](#)

Table 2-3 Post-event steady state transmission voltage limits in all timescales

<u>Nominal voltage</u>	<u>Event</u>	<u>Planning timescale limits (% of nominal voltage)</u>	<u>Operational timescale limits (% of nominal voltage)</u>
330kV	frequent operational switching	+4% / -4%	+10% / -10%
	infrequent operational switching	+4% / -4%	+10% / -10%
	credible contingency	+6% / -6%	+10% / -10%
220kV	frequent operational switching	+4% / -4%	+10% / -10%
	infrequent operational switching	+4% / -4%	+10% / -10%
	credible contingency	+6% / -6%	+10% / -10%
132kV	frequent operational switching	+5% / +5%	+10% / -10%
	infrequent operational switching	+5% / +5%	+10% / -10%
	credible contingency	+7% / -7%	+10% / -10%
66kV	frequent operational switching	+5% / +5%	+10% / -10%
	infrequent operational switching	+5% / +5%	+10% / -10%
	credible contingency	+7% / -7%	+10% / -10%

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2.2.2.6 Transmission transient overvoltage limits

- (a) As a consequence of a switching event or credible contingency the voltage at all locations on the transmission system must remain within the overvoltage envelope shown in Figure 2-2.

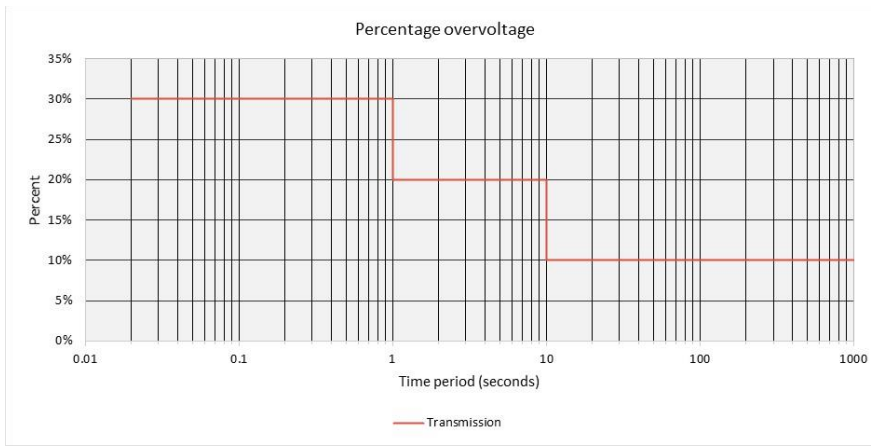


Figure 2-2 Highest acceptable level and duration of AC transient overvoltage on the transmission system

Note:
In Figure 2-2, the percentage voltage level refers to the nominal voltage and the voltage is the RMS phase to phase voltage.

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The frequency operating standards must be satisfied, provided that there is no shortage of spinning reserve in accordance with clause 3.10.2 of the Market Rules, without the use of load shedding under all credible power system load and generation patterns and the most severe credible contingency event.¶
In the event of a loss of interconnecting equipment leading to the formation of an island separate from the rest of the power system, load shedding facilities within the island may be used to ensure that the frequency operating standards specified in Table 2.1 are satisfied within the islanded part of the power system. Once the power system within the island has returned to a steady state operating condition, the “island” frequency range in Table 2.1 will apply until the islanded power system is resynchronised to the main power system.¶
Load shedding facilities (described in clause 2.3.2) may be used to ensure compliance with the frequency operating standards prescribed in Table 2.1 following a multiple contingency event.¶
¶
Steady State Power Frequency Voltage ¶

2.2.2.7 Transmission transient undervoltage limits

- (a) A credible contingency shall not result in the voltage at a generation connection point that remains connected to the transmission system exceeding the registered capability of the generator.
- (b) Infrequent operational switching, such as transformer energisation, shall not result in the voltage User connection points to the transmission system:
 - (1) subject to clause 2.2.2.7(c), falling below 80% of the nominal voltage;
 - (2) remaining below 90% of the nominal voltage for more than 1 second after the switching event.
- (c) Following infrequent operational switching, the voltage at User connection points to the transmission system may be allowed to fall below 80% of the nominal voltage for 100 ms after the switching event but must remain above 70% of the nominal voltage for this period provided there are economic efficiencies and no Users of the system are reasonably expected to be adversely affected.

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(d) The required *voltage performance* under clause 2.2.2.7(b) and 2.2.2.7(c) should be assessed via the appropriate combination of RMS and EMT analysis. Typically, *voltages during transient timescales*:

- (1) following motor starting will be assessed via RMS analysis and should comply with IEC 61000.3.7 section 10;
- (2) following energisation of transformers and switching of lines will be assessed via EMT analysis and evaluated according to the *voltage* on individual phases.

2.2.3 Distribution voltage

2.2.3.1 Distribution steady state voltage limits

(a) Except as a consequence of a non-credible contingency, the minimum *steady state voltage* on those parts of the *distribution system* operating at *voltages* above 1 kV must be 90% of nominal *voltage* and the maximum *steady state voltage* must be 110% of nominal *voltage*.

(b) For the *low voltage distribution system*, the *steady state voltage* must be within:

- (1) ±6% of the nominal *voltage* during normal operating conditions,
- (2) ±8% of the nominal *voltage* during maintenance conditions,
- (3) ±10% of the nominal *voltage* during emergency conditions.

(c) Where more precise control of the *distribution voltage* is required than is provided for under this clause 2.2.3.1, a target range of *voltage* magnitude at a *connection point* may be agreed with a *User* and specified in a *connection agreement*. Where:

- (1) more than one *User* is supplied at a *connection point* such that independent control of the *voltage* supplied to an individual *User* at that *connection point* is not possible, a target must be agreed by all relevant *Users* and the *Network Service Provider*;
- (2) *voltage* magnitude targets are specified in a *connection agreement*, *Users* should allow for short periods where *voltages* vary from the target values by 5%, in the design of their *equipment*.

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Table 2.2 Step - change voltage limits¶

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2.2.3.2 Distribution system voltage step change limits

- (a) The voltage step change resulting from switching operations and credible contingencies on the distribution system must not exceed the limits given in Table 2-4 at User connection points that remain connected to the distribution system.
- (b) Credible contingencies for the purpose of assessing distribution system voltage step change limits are restricted to the tripping of generating units within User facilities.

Table 2-4 Distribution voltage step change limits

Event	Post-event voltage step change⁽⁴⁾ (% of nominal voltage)
<u>Planned routine switching⁽¹⁾</u>	<u>+/- 4.0%</u>
<u>Planned infrequent switching⁽²⁾</u>	<u>+6 % / -10%</u>
<u>Credible contingency⁽³⁾</u>	<u>+6% / -10%</u>
Notes:	
<u>(1) For example, capacitor or reactor switching, transformer tap action, motor starting, start-up and shutdown of generating units, change in operating state of electricity storage facilities.</u>	
<u>(2) Infrequent User facility switching occurring less than once per hour.</u>	
<u>(3) As per clause 2.2.3.2(b), credible contingencies are limited to tripping of generating units within User facilities.</u>	
<u>(4) If necessary, loads may be disconnected to avoid exposing them to post tapping voltages that exceed +10% of the nominal voltage.</u>	

2.2.3.3 Distribution transient overvoltage limits

- (a) As a consequence of a switching event or credible contingency the voltage at:
 - (1) all locations in the distribution system operating at voltages greater than 1 kV must remain within the overvoltage envelope shown in Figure 2-3, and
 - (2) all locations in the low voltage distribution system must remain within the overvoltage envelope shown in Figure 2-4.

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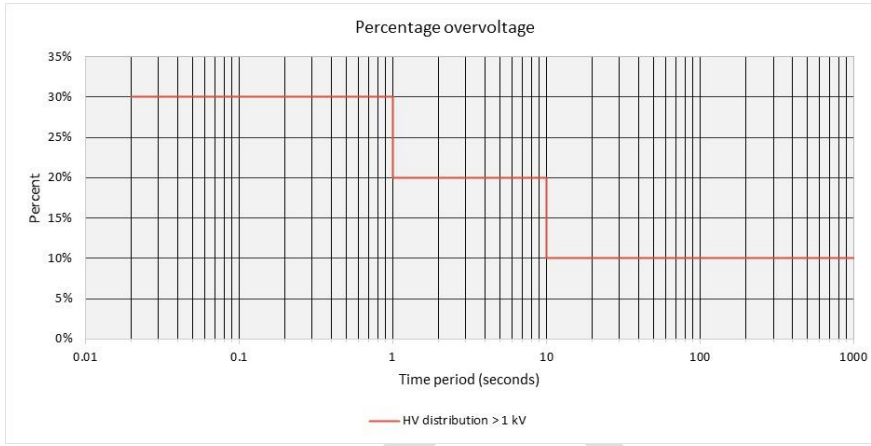


Figure 2-3 Highest acceptable level and duration of AC transient overvoltage on the *distribution system* operating above 1 kV

Note:

In Figure 2-3 the percentage voltage level refers to either the nominal voltage or the mid-point of the target voltage range for a connection point, where such a range has been set in accordance with clause 2.2.3.1(c). For this clause, the voltage is the RMS phase to phase voltage.

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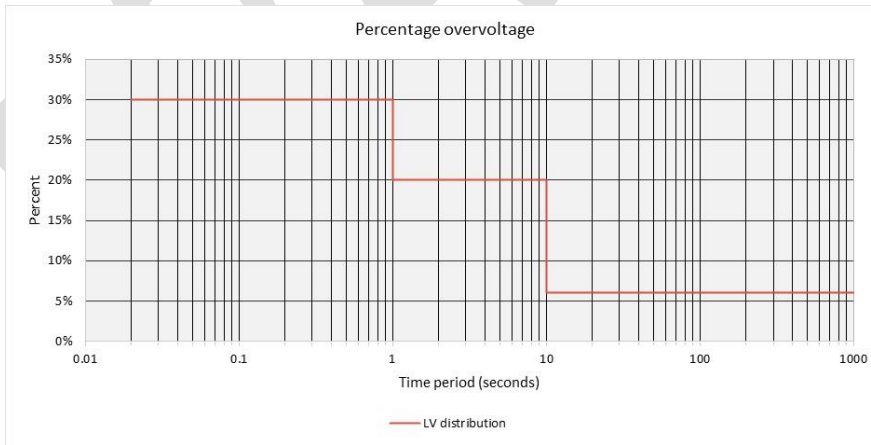


Figure 2-4 Highest acceptable level and duration of AC transient overvoltage on the *low voltage distribution system*

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2.2.4 Flicker

(a) Rapid *voltage* fluctuations cause changes to the luminance of lamps which can create the visual phenomenon called flicker. Flicker severity is characterised by the following two quantities, which are defined in AS/NZS 61000.3.7 (2001):

- (1) P_{st} – short-term flicker severity term (obtained for each 10 minute period);
- (2) P_{lt} – long-term flicker severity (obtained for each 2 hour period).

(b) Under normal operating conditions, flicker severity caused by *voltage* fluctuation in the *transmission and distribution system* must be within the planning levels shown in Table 2-5 for 99% of the time.

Table 2-5 Planning levels for flicker severity

Flicker Severity Quantity	LV (415 V)	MV (≤ 35 kV)	HV-EHV (> 35 kV)
P_{st}	1.0	0.9	0.8
P_{lt}	0.65	0.7	0.6

Notes:

- 1. These values were chosen on the assumption that the transfer coefficients between MV or HV systems and LV systems are unity. The planning levels could be increased in accordance with AS 61000.3.7 (2001).
- 2. The planning levels in Table 2-5 are not intended to apply to flicker arising from contingency events and other uncontrollable events in the power system.

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Notes:¶

- 1. These values were chosen on the assumption that the transfer coefficients between MV or HV systems and LV systems are unity. The planning levels could be increased in accordance with AS 61000.3.7 (2001).¶
- 2. The planning levels in Table 2.3 are not intended to apply to flicker arising from contingency and other uncontrollable events in the power system, etc.¶

¶

2.2.5 Harmonics

Under normal operating conditions, the harmonic *voltage* in the *transmission and distribution systems* must not exceed the planning levels shown in Table 2-6 and Table 2-7 (as applicable) appropriate to the *voltage* level, whereas the interharmonics *voltage* must not exceed the planning levels set out in AS/NZS 61000.3.6 (2001).

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Table 2.6 Distribution planning levels for harmonic voltage in networks with system voltage less than or equal to 35 kV (in percent of the nominal voltage)

Odd harmonics non-multiple of 3		Odd harmonics multiple of 3		Even harmonics	
Order h	Harmonic voltage %	Order h	Harmonic voltage %	Order h	Harmonic voltage %
5	5	3	4	2	1.6
7	4	9	1.2	4	1
11	3	15	0.3	6	0.5
13	2.5	21	0.2	8	0.4
17	1.6	>21	0.2	10	0.4
19	1.2			12	0.2
23	1.2			>12	0.2
25	1.2				
>25	$0.2 + 0.5 \frac{25}{h}$				
Total harmonic distortion (THD): 6.5 %					

Table 2.7 Transmission planning levels for harmonic voltage in networks with system voltage above 35 kV (in percent of the nominal voltage)

Odd harmonics non-multiple of 3		Odd harmonics multiple of 3		Even harmonics	
Order h	Harmonic voltage %	Order h	Harmonic voltage %	Order h	Harmonic voltage %
5	2	3	2	2	1.5
7	2	9	1	4	1
11	1.5	15	0.3	6	0.5
13	1.5	21	0.2	8	0.4
17	1	>21	0.2	10	0.4
19	1			12	0.2
23	0.7			>12	0.2
25	0.7				
>25	$0.2 + 0.5 \frac{25}{h}$				
Total harmonic distortion (THD): 3 %					

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

Notes:

- The planning levels in Table 2.6 and Table 2.7 are not intended to apply to harmonics arising from uncontrollable events such as geomagnetic storms, etc.
- The total harmonic distortion (THD) is calculated from the formula:

$$THD = \frac{U_{nom}}{U_1} \sqrt{\sum_{h=2}^{40} (U_h)^2}$$

where:

- U_{nom} = nominal voltage of a system;
- U_1 = fundamental voltage;
- $U_{h,u}$ = harmonic voltage of order h expressed in percent of the nominal voltage.

- Table 2.6 and Table 2.7 are consistent with AS 61000 (2001).

2.2.6 Negative phase sequence voltage

The 10 minute average level of negative phase sequence voltage at all connection points must be equal to or less than the values set out in Table 2.8.

Table 2.8 Limits for negative phase sequence component of voltage (in percent of the positive phase sequence component)

Nominal system voltage (kV)	Negative sequence voltage (%)
> 100	1
10 – 100	1.5
< 10	2

2.2.7 Electromagnetic interference

Electromagnetic interference caused by equipment forming part of the transmission and distribution system must not exceed the limits set out in Tables 1 and 2 of AS/NZS 2344 (2016).

2.2.8 Transient stability

The power system must be planned to ensure disturbances on the transmission or distribution systems caused by a credible contingency, following a credible fault event, shall not exceed the performance requirements of any generating system.

Transient stability is achieved if the power system is able to reach an acceptable steady state condition following a disturbance.

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

2.2.9 Oscillatory stability

(a) The power system must be adequately damped after system oscillation triggered by a small disturbance or a large disturbance.

(b) A system oscillation triggered by any small disturbance or large disturbance shall conform to the following criteria:

- (1) the damping ratio of the oscillation must be at least 0.1;
- (2) the halving time of any oscillation is not to exceed 5 seconds; and
- (3) allow Generators to maintain continuous uninterrupted operation.

Note:
A halving time ≤ 5 seconds is equivalent to a damping coefficient –0.14 nepers per second or less.

(c) To assess the damping of power system oscillations during operation, or when analysing results of tests such as those carried out under clauses 4.1.3, 4.1.7 and 5.7.6, the Network Service Provider must take into account statistical effects. Therefore, the power system damping operational performance criterion is that at a given operating point, real-time monitoring or available test results show that there is less than a 10 percent probability that the halving time of the least damped mode of oscillation will exceed ten seconds, and that the average halving time of the least damped mode of oscillation is not more than five seconds.

2.2.10 Voltage stability

(a) The power system must achieve voltage stability for any disturbance resulting from a credible contingency. For all credible contingencies, the criteria set out in clauses 2.2.2 and 2.2.3 must be met to ensure voltage stability.

(b) There must be sufficient static and dynamic reactive power capability available to maintain steady state voltage control allowing for credible variations in load and generation patterns, and reasonable variations in the availability of reactive equipment.

2.3 OBLIGATIONS OF NETWORK SERVICE PROVIDER IN RELATION TO POWER SYSTEM PERFORMANCE

2.3.1 Flicker

(a) To ensure that the flicker level at any point of common coupling on the transmission or distribution system does not exceed the maximum levels specified in clause 2.2.4, the Network Service Provider must, where necessary and after consultation with the relevant Users, allocate flicker emission limits to Users in accordance with clauses 2.3.1(b) and 2.3.1(c).

(b) The Network Service Provider must allocate contributions to limits no more onerous than the lesser of the acceptance levels determined in accordance with the stage 1 and the stage 2 evaluation procedures defined in AS/NZS 61000.3.7 (2001).

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The

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In addition to the requirements of clauses 2.2.8(a) and 2.2.8(b), the halving time of any electro-mechanical oscillations must not exceed 5 seconds.¶
Short Term

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Stable voltage control must be maintained following the most severe

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Temporary Over-Voltages¶
As a consequence of a

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

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- (c) If the *User* cannot meet the contribution calculated by using the method of clause 2.3.1(b), then the *Network Service Provider* may use, in consultation with the party seeking *connection*, the stage 3 evaluation procedure defined in AS/NZS 61000.3.7 (2001).
- (d) The *Network Service Provider* must verify compliance of *Users* with allocated flicker emission levels. The contribution may be assessed by direct measurement or by calculation from the available data for the *load* and the *power system*. In verifying compliance, measurements of flicker must be carried out according to AS/NZS 61000.3.7 (2001).

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2.3.2 Harmonics

- (a) To ensure that the harmonic or interharmonic level at any *point of common coupling* on the *transmission or distribution system* does not exceed the maximum levels specified in clause 2.2.5, the *Network Service Provider* must, where necessary and after consultation with the relevant *Users*, allocate harmonic emission limits to *Users* in accordance with AS/NZS 61000.3.6 (2001).
- (b) The *Network Service Provider* must verify compliance of *Users* with allocated harmonic or interharmonic emission levels. The contribution may be assessed by direct measurement or by calculation from the available data for the *User's facility* and the *power system*.
- (c) The measurement must be carried out according to AS/NZS 61000.4.7 (1999). Harmonics must generally be measured up to h=40. However, higher order harmonics up to 100th order may be measured if the *Network Service Provider* reasonably considers them to be of material concern.

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2.3.3 Negative phase sequence voltage

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- (a) If the maximum level of negative phase sequence *voltage*, as specified in Table 2-8, is exceeded at any *connection point* on the *transmission or distribution system*, the *Network Service Provider* must remedy the problem to the extent that it is caused by the *transmission and distribution systems*.
- (b) If, in the *Network Service Provider's* opinion, the problem is caused by an unbalance in the phase currents within a *User's* equipment or *facilities*, it must require the *User* to remedy the unbalance.

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2.3.4 Electromagnetic interference

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The *Network Service Provider* must respond to all complaints regarding electromagnetic interference in a timely manner and undertake any necessary tests to determine whether or not the interference is caused by equipment forming part of the *transmission and distribution systems*, and whether or not it exceeds the limits specified in clause 2.2.7. If the complaint is substantiated by tests, the *Network Service Provider* must, as soon as reasonably practicable, take any necessary action to reduce the interference to below the maximum prescribed levels.

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

2.3.5 Power system stability and dynamic performance

2.3.5.1 Stability and modelling guidelines

- (a) The Network Service Provider must develop, publish and maintain 'Generator and Load Model Guidelines'.
- (b) The 'Generator and Load Model Guidelines' should clarify:
 - (1) the Network Service Provider's approach to developing and maintaining accurate computer models; and
 - (2) the requirements for Users to provide computer models and associated information for new connections or modifications to existing facilities.
- (c) The 'Generator and Load Model Guidelines' should be consistent with the generation system model procedure specified in clause 3A.4.2 of the WEM Rules.

2.3.5.2 Stability and modelling obligations

- (a) The Network Service Provider must plan, design and construct the transmission and distribution systems so that the power system stability criteria specified in clauses 2.2.8 to 2.2.10 are met for credible system load and generation patterns, and the most critical, for the particular location, credible contingency without exceeding the rating of any power system component or, where applicable, the allocated power transfer capacity.
- (b) The Network Service Provider should ensure that simulation completed to assess power system stability appropriately consider both the short-term and longer-term response of the power system to credible contingencies.
- (c) To ensure compliance with clause 2.3.5.2(a), the Network Service Provider must simulate the dynamic performance of the power system. Dynamic models of individual components must be verified and documented in accordance with the 'Generator and Load Model Guidelines'.

2.3.5.3 Validation of modelling results

- (a) The Network Service Provider must take all reasonable steps to ensure that the results of the simulation and modelling of the power system in accordance with the requirements of clauses 2.3.5.2 and Chapter 3 are valid. This may include power system and plant performance tests in accordance with section 4.1.

2.3.6 Determination of power transfer limits

- (a) The Network Service Provider must determine power transfer limits for equipment forming part of the transmission and distribution systems.

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 the part of the transmission system affected;¶
 the contingency events modelled;¶
 an overview of the investment decision and the reasons for modelling particular contingency events; and ¶
 the impact of contingency events on the maximum power transfer capability.¶
 In planning the transmission and distribution system, the Network Service Provider must:¶
 assume a transmission and distribution system operating configuration with equipment out of service for maintenance where this is provided for in the planning criteria specified in clause 2.5; and¶
 use a total fault clearance time determined by the slower of the two protection schemes, where the main protection system includes two protection schemes. Where the main protection system includes only one protection scheme, the back-up protection system total fault clearance time must be used for simulations; and¶
 In determining the credible system load and generation patterns to be assumed for the purpose of short term stability analysis, the Network Service Provider must consult with System Management. Where practical, and with the agreement of System Management, the Network Service Provider should set power transfer limits for different power system conditions, as provided for in clause 2.3.8(a), so as not to unnecessarily restrict the power transfer capacity made available to Users.¶
Short Term Voltage Stability¶
 The assessment of the compliance of the transmission and distribution systems with the different short term voltage (...)

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

- (b) The *power transfer* limits must be expressed as limits advice developed in accordance with the procedure defined in clause 2.27A.11 of the WEM Rules and provided to AEMO as specified in the clause 2.27A of the WEM Rules.

2.3.7 Monitoring and assessment of power system performance

- (a) The *Network Service Provider* must monitor the performance of the *power system* on an ongoing basis and ensure that the *transmission and distribution systems* are augmented as necessary so that the *power system* performance standards specified in section 2.2 continue to be met irrespective of changes in the magnitude and location of *connected loads* and *generating units*.
- (b) The *Network Service Provider* must ensure that system performance parameter measurements to ensure that the *power system* complies with the performance standards specified in clauses 2.2.1 to 2.2.6 are taken as specified in Table 2-9. Records of all test results must be retained by the *Network Service Provider* and made available to the *Authority* or AEMO on request.

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Where the *power transfer* limit assessed in accordance with clause 2.3.8(a) is determined by the thermal rating of *equipment*, short term thermal ratings should also be determined and applied in accordance with *good electricity industry practice*.¶
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Assessment of Power System Performance¶

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Table 2.9 Power quality parameters measurement

Parameter	Value measured	Frequency of measurement	Minimum measurement period	Data sampling interval
Fundamental Frequency	mean value over interval	Continuous	all the time	10 seconds
Power-frequency voltage magnitude	mean rms value over interval	In response to a complaint, or otherwise as required by the <i>Network Service Provider</i> .	one week	10 minutes
Short-term flicker severity	P _{st}	In response to a complaint, or otherwise as required by the <i>Network Service Provider</i> .	one week	10 minutes
Long-term flicker severity	P _{lt}	In response to a complaint, or otherwise as required by the <i>Network Service Provider</i> .	one week	2 hours
Harmonic / interharmonic voltage and voltage THD	mean rms value over interval	In response to a complaint, or otherwise as required by the <i>Network Service Provider</i> .	one week	10 minutes
Negative sequence voltage	mean rms value over interval	In response to a complaint, or otherwise as required by the <i>Network Service Provider</i> .	one week	10 minutes

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Notes:

1. The power quality parameters, except fundamental frequency and negative sequence voltage, must be measured in each phase of a three-phase system.
2. The fundamental frequency must be measured based on line-to-neutral voltage in one of the phases or line-to-line voltage between two phases.
3. Other parameters and data sampling intervals may be used to assess the *Network Service Provider's transmission and distribution system and User system performance during specific events*.

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Notes:¶
 1. The power quality parameters, except fundamental frequency and negative sequence voltage, must be measured in each phase of a three-phase system.¶
 2. The fundamental frequency must be measured based on line-to neutral voltage in one of the phases or line-to-line voltage between two phases.¶
 3. Other parameters and data sampling intervals may be used to assess the *Network Service Provider's transmission and distribution system and User system performance during specific events*.¶
 Page Break

LOAD SHEDDING FACILITIES¶
Settings of Under-Frequency Load shedding Schemes¶
 The settings for the under-frequency load shedding (UFLS) scheme are stated in Table 2.8.¶
 Switchable capacitor banks at substations must be shed in accordance with Table 2.8. ¶
Table 2.8 Under-frequency load shedding scheme settings for the South West Interconnected Network¶
 Stage

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(c) The *Network Service Provider* must ensure that sufficient monitoring is in place to assess the performance of the power system against the performance standards specified in clause 2.2. Monitoring systems should be capable of assessing whether power quality standards are being achieved at key locations across the network and capturing the dynamic response of the power system to disturbances with sufficient resolution to

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confirm that the power system stability and system strength requirements are being achieved.

2.3.8 System restart capability

- (a) The Network Service Provider must provide any assistance sought by AEMO to develop the SWIS restart plan.
- (b) The Network Service Provider must plan the network to provide the capability required to restart the power system in accordance with the SWIS restart plan developed by AEMO.
 - (1) The transmission and distribution systems should be designed to provide sufficient switching capability to enable the establishment of restart pathways identified in the SWIS restart plan.
 - (2) The Network Service Provider should consider the expected times to resupply substations following a system shutdown when designing substation plant and equipment (e.g., batteries used for communication, secondary systems and protection devices).

2.3.9 System strength

- (a) The Network Service Provider must plan and develop the transmission and distribution systems to maintain system strength in accordance with the WEM Rules.

Note:

The intention of clause 2.3.9(a) is to enable the Network Service Provider to invest network solutions as well as trigger processes in the WEM Rules for the procurement of non-co-optimised essential system services to maintain system strength.

When fulfilling the obligations in clause 2.3.9(a), the Network Service Provider should continue to consider the stability requirements in clauses 2.2.8, 2.2.9 and 2.2.10 and the protection requirements set out in section 2.9 of these Rules and should align with any relevant procedures developed by AEMO under the WEM Rules.

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- (b) Where a non-co-optimised essential system service is to be used to maintain system strength, the Network Service Provider must request the Co-ordinator of Energy to trigger the procurement process in accordance with sections 3.11A and 3.11B of the WEM Rules.

2.4 LOAD SHEDDING REQUIREMENTS

- (a) The Network Service Provider must develop and maintain an automatic under frequency load shedding system that complies with the UFLS Specification Document developed in accordance with clause 3.6.6 of the WEM Rules.
- (b) The Network Service Provider may require Users to make a portion of their load available for automatic under frequency or under voltage load shedding, or both. The Network Service Provider may require a User to provide control and monitoring equipment for the load shedding facilities. The amount of load available to be shed and the frequencies or voltages or both at which load must be shed must be specified in the relevant connection agreement.

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

2.5 TRANSMISSION SYSTEM PLANNING CRITERIA

2.5.1 Application

Section 2.5 sets out the *transmission system planning criteria*. The Network Service Provider must design the *transmission system* in accordance with the applicable *transmission system planning criteria* described below.

Note:

The *transmission system planning criteria* represents the minimum requirements for the planning and operation of the SWIS as will typically apply in most situations. In many cases, the standard ratings of *transmission equipment* will result in *transmission capacity* in excess of the minimum requirements outlined in the criteria. Where this is the case, it is not expected that the *transmission capacity* will be reduced such that it only meets the minimum requirement of those criteria. For example, it may not be beneficial to reduce the ratings of overhead lines to reflect lower loading levels that have arisen due to changes in *generation* or demand patterns.

2.5.2 Overview and general requirements

(a) The *transmission system planning criteria* is presented according to the functional parts of the *transmission system*. These parts are the *generation connections*, the *demand connections*, the *sub transmission system*, and the *Main Interconnected Transmission system* (or *MITs*). These parts are illustrated schematically in Figure 2-5.

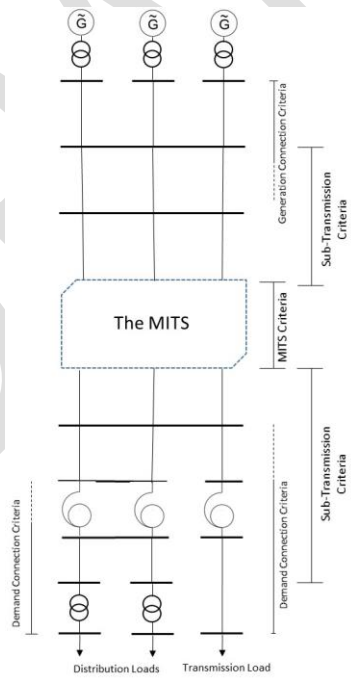


Figure 2-5 Overview of Main Interconnected Transmission system with Generator and Demand Connections

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Deleted: in this clause 2.5 apply only to the *transmission and distribution systems* and not to *connection assets*.

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Transmission system ¶
The *Network Service Provider* must design

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

- (b) In the context of the SWIS, the MITS comprises:
- (1) all 330 kV terminal stations and transmission circuits connected to the 330 kV network by three or more 330 kV circuits;
 - (2) all terminal stations providing direct connection to generation in excess of 600 MW; and
 - (3) the transmission circuits connecting terminal stations in 2.5.2(b)(2) to the transmission elements specified in 2.5.2(b)(1).
- (c) In the context of the SWIS, sub transmission system means any part of the transmission system that is not part of the MITS.
- (d) In the context of the SWIS, generation connection means the assets connecting generation to the transmission system.
- (e) In the context of the SWIS, demand connection means the assets connecting demand to the transmission system.
- (f) More than one set of planning criteria may apply to parts of the transmission system, where this occurs all applicable planning criteria must be met.

Note:

As illustrated in Figure 2-5, there will be parts of the SWIS where more than one set of planning criteria applies. In such places the requirements of all relevant criteria must be met. An example is where sites are composite and have a mixture of demand and generation connections. In this case, the security afforded to the demand and generation connection elements shall be not less than that provided for a typical demand or generation connection of an identical size.

- (g) The Network Service Provider may design to standards higher than those set out in clauses 2.5.4 (Demand connection planning criteria) and 2.5.5 (Main Interconnected Transmission System and sub transmission system planning criteria), provided the higher standards can be economically justified and the potential power system security and power system reliability effects of the higher standard have been considered.
- (h) The Network Service Provider may design to standards lower than those set out in clause 2.5.4 (Demand connection planning criteria) provided the lower standards can be economically justified and the potential power system security and power system reliability effects of the lower standard have been considered.

Note:

An example of when the Network Service Provider may design to standards lower than those set out in the demand connection planning criteria include the 220 kV line supplying the Eastern Goldfields region. An unplanned outage on this 220 kV line may result in a loss of supply to the Eastern Goldfields region. However, arrangements are in place with local generation to supply the Kalgoorlie-Boulder city and Coolgardie town loads during such an outage.

It may also be prudent to design to lower standards when providing supply for remote townships.

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A sub-network of the transmission system designed to the N-0 criterion will experience the loss of the ability to transfer power into the area supplied by that sub-network on the loss of a transmission element. Following such an event this power transfer capability will not be restored until the transmission element has been repaired or replaced.¶
The N-0 criterion may be applied to sub-networks with a peak load of less than 20 MVA and to zone substations with a peak load of less than 10 MVA. The N-0 criterion also applies to

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Note: ¶
In the event of an

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Deleted: <#>interconnection supplying

Deleted: <#> the power system is expected to split into two islands. Arrangements

Deleted: <#>an interconnection outage but Users outside these areas will need to make their own arrangements for any back-up generation requirement.

Deleted: <#>For a sub-network designed to the N-0 planning criteria, the Network Service Provider must use its best endeavours to transfer load to other parts of the transmission or distribution system to the extent that this is possible and that spare power transfer capacity is available. If insufficient back-up power transfer capacity is available, load shedding is permissible. Where a supply loss is of long duration, the Network Service Provider must endeavour to ration access to any available power transfer capacity by rotating the load shedding amongst the Consumers affected.¶
At zone substations subject to the N-0 criterion, the Network Service Provider may, at its discretion, install a further supply transformer if insufficient back-up power transfer capacity is available to supply loads by means of the distribution system to allow planned transformer maintenance to occur at off peak times without shedding load.¶

N-1 Criterion¶

Any sub-network of the transmission system that is not identified within this clause 2.5.2 as being designed to another criterion must be designed to the N-1 planning criterion.¶
For sub-networks designed to

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

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- (i) Guidance on economic justification applicable to clauses 2.5.2(g) and 2.5.2(h) is given in Attachment 13.
- (j) The Network Service Provider must develop and review at least every three years, a guideline (the Transmission Planning Guideline) that sets out (but is not limited to):
 - (1) the application of the requirements in clause 2.5 of these Rules, including:
 - (A) general guidance on the planning of the functional parts of the transmission system (i.e., the generation connections, the demand connections, the sub transmission system and the MITS);
 - (B) background conditions that apply for the MITS and sub transmission system and considerations for background conditions applicable to planning of generation connections and demand connections;
 - (C) consideration of contingency criteria as applicable for planning of each functional part of the transmission system (i.e., the generation connections, the demand connections, the sub transmission system and the MITS);
 - (2) the application of the power system performance standards set out in clause 2.2 of these Rules for planning purposes.
- (k) The Network Service Provider must develop and consult, as needed, with AEMO the generation dispatch used in planning timescales, including with consideration of the relevant sections of the guideline (the Transmission Planning Guideline) developed by the Network Service Provider in accordance with clause 2.5.2(j) of these Rules.
- (l) Any short term equipment ratings or contingency plans and actions that are used by the Network Service Provider to maintain compliance with the criteria detailed in the transmission system planning criteria must be maintained up to date, functional and able to be delivered within the required operational timescales.

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2.5.3 Generation connection planning criteria

This section presents the planning criteria applicable to the connection of one or more Generators to the SWIS. The criteria in this section also applies to Users connected to the transmission system with embedded generation.

2.5.3.1 Limits to power infeed loss risk

- (a) The loss of power infeed resulting from a credible contingency on the transmission system shall be calculated as follows:
 - (1) the sum of the capacities of the generating units disconnected from the power system by the credible contingency, plus
 - (2) the planned import from any external systems disconnected from the power system by the same event, less

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

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(3) the forecast minimum demand disconnected from the power system by the same event but excluding:

(A) any demand that may be automatically tripped for frequency control purposes on the power system; and

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(B) the demand of the largest single User within the group.

(b) The infeed loss risk limit is the maximum allowable loss of power infeed, to remain within the Frequency Operating Standard as defined in the WEM Rules. Subject to clause 2.5.3.1(c), for the purposes of transmission system design and planning, the maximum infeed loss risk limit is 400 MW.

(c) Where a proposed connection or network augmentation results in a loss of power infeed greater than 400 MW, the higher loss of power infeed must be analysed and approved by the Network Service Provider in consultation with AEMO.

(d) Generation connections shall be planned such that, starting with an intact system during the planned outage of any single section of the Network Service Provider's busbar, no reduction of generation capacity greater than 150 MW shall occur.

(e) Generation connections shall be planned such that, starting with an intact system following a credible contingency of:

(1) any single transmission circuit (including those that result in the associated tripping of any other transmission circuits as part of a designed protection scheme), single generation circuit, single section of busbar, the loss of power infeed shall not exceed the infeed loss risk limit;

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(2) any single busbar coupler circuit breaker or busbar section circuit breaker the loss of power infeed shall not exceed the infeed loss risk limit;

(3) any single transmission circuit or single section of busbar during the planned outage of any other single transmission circuit or single section of busbar, the loss of power infeed shall not exceed the infeed loss risk limit; and

(4) any single busbar coupler circuit breaker, or busbar section circuit breaker during the planned outage of any transmission circuit, single section of busbar, the loss of power infeed shall not exceed the infeed loss risk limit.

2.5.3.2 Background conditions

(a) The connection of a Generator shall meet the criteria set out in clause 2.5.3.1 under the following background conditions:

(1) the active power output of the Generator shall be set equal to its rated maximum active power. For the purpose of power system stability studies, the active power output level and power factor should be set to the level that provides the lowest level of damping for oscillations;

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- (2) the reactive power output of the Generator shall be set to the full leading or lagging output that corresponds to an active power output equal to its rated maximum active power. For the purpose of assessment of power system stability and voltage control issues, the reactive power output should be set to the level that may reasonably be expected under the conditions described in clause 2.5.3.2(a)(3);
- (3) conditions on the transmission system shall be set to those reasonably expected to arise in the course of a year of operation. Such conditions shall include forecast demand assumptions, generation dispatch and planned outage patterns.

2.5.3.3 Pre-fault criteria with an intact system or local system outage

- (a) The transmission capacity for a Generator connection shall be planned such that for the background condition of an intact system or local system outage there must be no:
 - (1) equipment loadings exceeding pre-fault ratings;
 - (2) unacceptable voltages conditions; or
 - (3) system instability.

2.5.3.4 Post-fault criteria with intact system

- (a) Transmission capacity for a generation connection shall be planned such that for the background conditions described in clause 2.5.3.2(a) and following the credible contingency of a fault outage on the transmission system of:
 - (1) a single transmission circuit;
 - (2) a single zone substation transformer;
 - (3) a single generation circuit;
 - (4) a single generating unit (or multiple generating units sharing a common circuit breaker or that would be disconnected via a single outage);
 - (5) a reactive equipment; or
 - (6) a section of busbar;

there must be no:

 - (7) loss of demand except as permitted by the Demand connection planning criteria detailed in clause 2.5.4;
 - (8) unacceptable overloading of any transmission equipment;
 - (9) unacceptable voltage conditions; or
 - (10) system instability.

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2.5.4 Demand connection planning criteria

This section presents the planning criteria for the connection of *demand groups* to the *transmission system*. The provisions are intended to prescribe the required level of *power system security* and *transmission network adequacy* to be delivered by the *Network Service Provider*.

2.5.4.1 Demand connection capacity requirements

Note:

The *group demand* applicable for the assessment of demand connection capacity requirements is dependent on the nature of the associated connections.

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- (a) Where the *demand group* includes only demand, the *group demand* for future years is equal to the *Network Service Provider's* estimated demand for the group after considering demand diversity including during *planned outage* conditions and following *fault outages* affecting the *demand group*.
- (b) Where the *demand group* includes both demand and *generation*, the *group demand* for future years is equal to:
 - (1) the *Network Service Provider's* estimated demand for the group after considering demand diversity and taking into account the expected operation of *non-market generation* within the *demand group* including during *planned outage* conditions and following *fault outages* affecting the *demand group*; plus
 - (2) the output of any *market generation* within the *demand group*.

2.5.4.2 Background conditions

- (a) The *transmission capacity* for the connection of a *demand group* must meet the criteria set out in clauses 2.5.4.3, 2.5.4.4, 2.5.4.5 and 2.5.4.6 under the following background conditions:
 - (1) when there are no *planned outages*, the demand shall be set equal to *group demand*;
 - (2) when there is a *planned outage* affecting the *demand group*, the demand shall be set equal to *maintenance period demand*; and
 - (3) any *transfer capacity* identified by the *Network Service Provider* shall be represented taking account of any restrictions on the timescales in which the *transfer capacity* applies. Any *transfer capacity* identified by the *Network Service Provider* for use in *planning timescales* must be reflective of that which could practically be used in *operational timescales*.
- (b) When planning an *outage* affecting a *demand group* >250 MVA the *Network Service Provider* may assume *generating units* can be rescheduled in accordance with the *WEM Rules* to mitigate the impact of any subsequent *unplanned outage* or *fault outage*.

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2.5.4.3 Pre-fault criteria with *intact system*

(a) The *transmission capacity* for the connection of a *demand group* must be planned such that, for the background conditions described in clause 2.5.4.2, under *intact system* conditions there must be no:

- (1) equipment loadings exceeding the *pre-fault rating*;
- (2) unacceptable voltage conditions; or
- (3) system instability.

2.5.4.4 Post-fault criteria with *intact system*

(a) The *transmission capacity* for the connection of a *demand group* shall be planned such that for the background conditions described in clause 2.5.4.2 and following the *credible contingency* of a *fault outage* of:

- (1) a single *transmission circuit*;
- (2) a single *zone substation transformer*;
- (3) a single *generation circuit*;
- (4) a single *generating unit* (or multiple *generating units* sharing a common circuit breaker or that would be disconnected via a single *outage*);
- (5) a single *reactive equipment*; or
- (6) a single section of *busbar*;

there must be no:

- (7) loss of demand except as specified in Table 2-10;
- (8) unacceptable overloading of any *transmission equipment*;
- (9) unacceptable voltage conditions; or
- (10) system instability.

2.5.4.5 Pre-fault criteria with *local system outage*

(a) The *transmission capacity* for the connection of a *demand group* shall also be planned such that for the background conditions described in clause 2.5.4.2 during the *planned outage* and prior to any *fault outage* occurring, there must be no:

- (1) equipment loadings exceeding *pre-fault ratings*;
- (2) unacceptable voltage conditions;
- (3) system instability.

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2.5.4.6 Post-fault criteria with local system outage

(a) The transmission capacity for the connection of a demand group shall also be planned such that for the background conditions described in clause 2.5.4.2 and the initial conditions of a planned outage of:

- (1) a single transmission circuit;
- (2) a single zone substation transformer;
- (3) a single generation circuit;
- (4) a single generating unit (or multiple generating units sharing a common circuit breaker or that would be disconnected via a single outage);
- (5) a single reactive equipment;
- (6) a single section of busbar; or
- (7) a single circuit breaker.

for the credible contingency of a fault outage of:

- (8) a single transmission circuit;
- (9) a single zone substation transformer;
- (10) a single generation circuit;
- (11) a single generating unit (or multiple generating units sharing a common circuit breaker or that would be disconnected via a single outage);
- (12) a reactive equipment; or
- (13) a single section of busbar;

there must be no:

- (14) loss of demand except as specified in Table 2-10;
- (15) unacceptable overloading of any transmission equipment;
- (16) unacceptable voltage conditions; or
- (17) system instability.

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operational restrictions have been agreed between the Network Service Provider and a User as per clause 3.1(b).
Following the loss of the transmission element, the power system must continue to operate in accordance with the power system performance standards specified in clause 2.2.
Notwithstanding the requirements clauses 2.5.2.2(b) and 2.5.2.2(c), where the failed transmission element is a zone substation supply

Deleted: , supply may be lost for a brief switching period while loads are transferred to un-faulted supply transformers by means of distribution system switching. The Network Service Provider must maintain sufficient power transfer capacity to allow supply to all Consumers to be restored following switching.

Note:

For clarity, clauses 2.5.4.6(a)(14), 2.5.4.6(a)(16), and 2.5.4.6(a)(17) can be achieved through several means such as pre-fault switching to achieve network reconfiguration, use of automated systems or network reinforcement. Any systems which result in the disconnection of demand must ensure the limits set out in Table 2-10 are not exceeded.

Where non-network reinforcement solutions are adopted, these must be documented and appropriately implemented including investment in associated plant, equipment and control schemes as required.

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(b) The transmission capacity for the connection of a demand group shall also be planned such that for the background conditions described in clause 2.5.4.2 and the initial conditions of:

(1) the single unplanned outage or fault outage of a transmission circuit or zone substation transformer for the Perth CBD

for the credible contingency of:

(2) a single fault outage of a transmission circuit or zone substation transformer for the Perth CBD

there must be no:

(3) loss of demand except as specified in Table 2-10;

(4) unacceptable overloading of any transmission equipment;

(5) unacceptable voltage conditions; or

(6) system instability.

Note:

For clarity, clauses 2.5.4.6(b)(3), 2.5.4.6(b)(5) and 2.5.4.6(b)(6) can be achieved through several means such as pre-fault switching to achieve network reconfiguration, use of automated systems or network reinforcement. Any systems which result in the disconnection of demand must ensure the limits set out in Table 2-10 are not exceeded.

Where non-network reinforcement solutions are adopted, these must be documented and appropriately implemented including investment in associated plant, equipment and control schemes as required.

2.5.4.7 Permitted demand loss following specified credible contingencies

(a) In planning the transmission capacity for the connection of a demand group, the permitted loss of demand and associated duration of that demand loss for considered credible contingencies are set out in Table 2-10.

(b) Following the coincident occurrence of two unplanned outages or fault outages affecting a demand group excluding the Perth CBD area, group demand can be lost for the duration of the associated repair time.

Note:

A demand connection is deemed adequate if the demand loss set out in the table is not exceeded for the specified credible contingencies.

The power system security requirements are set out in clauses 2.5.4.3, 2.5.4.4, 2.5.4.5 and 2.5.4.6 of these Rules. These requirements must also be met.

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The N-1-1 Criterion applies to those sub-networks of the transmission system where the occurrence of a credible contingency during planned maintenance of another transmission element would otherwise result in the loss of supply to a large number of Consumers. Sub-networks of the transmission system that are designed to the N-1-1 criterion include: ¶
 all 330 kV lines, substations and power stations;¶
 all 132 kV terminal stations in the Perth metropolitan area, and Muja power station 132 kV substation;¶
 all 132 kV transmission lines that supply a sub-system of the transmission system comprising more than 5 zone substations with total peak load exceeding 400 MVA; and¶
 all power stations whose total rated export to the transmission system exceeds 600 MW. ¶
 The range of operating conditions that are allowed for when planning a part of the transmission system to meet the N-1-1 criterion is set out in Table 2.9. ¶

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Table 2.10 Permitted loss of demand following specified credible contingencies

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Area	Loss of demand	Considered credible contingency	With the initial conditions of:		
			Intact system	Planned local system outage	Unplanned local system outage ³
the permitted loss of demand for the next credible contingency is:					
Rural	<10 MVA	zone substation transformer	group demand for the repair time	maintenance period demand for the repair time	group demand for the repair time
	≥10 MVA & <60 MVA	zone substation transformer	group demand for the remote switching time	maintenance period demand for the emergency return to service time	group demand for the repair time
	<20 MVA	transmission circuit	group demand for the repair time	maintenance period demand for the repair time	group demand for the repair time
	≥20 MVA & <90 MVA	transmission circuit, generator circuit or reactive equipment	None ¹	maintenance period demand for the emergency return to service time	group demand for the repair time
	≥90 MVA & <250 MVA	transmission circuit, generator circuit, reactive equipment or busbar	None	maintenance period demand for the emergency return to service time	group demand for the repair time
Urban	<60 MVA	zone substation transformer	group demand for the remote switching time	maintenance period demand for the emergency return to service time	group demand for the repair time
	<90 MVA	transmission circuit, generator circuit or reactive equipment	None	maintenance period demand for the emergency return to service time	group demand for the repair time
	≥90 MVA & <250 MVA	transmission circuit, generator circuit, reactive equipment or busbar	None	maintenance period demand for the emergency return to service time	group demand for the repair time
Perth CBD	<60 MVA	zone substation transformer	group demand for 30 seconds	maintenance period demand for 2 hours	group demand for 2 hours ³
	<90 MVA	transmission circuit, generator circuit or reactive equipment	None ²	maintenance period demand for 2 hours	group demand for 2 hours ³
	≥90 MVA & <250 MVA	transmission circuit, generator circuit, reactive equipment or busbar	None ²	maintenance period demand for 2 hours	group demand for 2 hours ³
All areas	≥250 MVA	transmission circuit, generator circuit, reactive equipment or busbar	None	None	group demand for the repair time

Notes:

- (1) < Remote switching time may be permitted for up to 60 MVA subject to economic justification consistent with guidance in Attachment 13.
- (2) <60 MVA group demand can be lost for <30 seconds if contingency involves zone substation transformer
- (3) For the Perth CBD area, the initial conditions are an unplanned local system outage or a fault outage.

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

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2.5.5 Main Interconnected Transmission System and sub transmission system planning criteria

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This section describes the planning criteria for the *Main Interconnected Transmission system (MITS) and sub transmission system*.

2.5.5.1 Background conditions

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(a) The background conditions for planning the *MITS and sub transmission system* are described in the guideline (the *Transmission Planning Guideline*) developed by the *Network Service Provider* in accordance with clause 2.5.2(j) of these Rules.

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(b) The *transmission capacity* of the *MITS and sub transmission system* shall be planned to withstand the coincident *planned* and *fault outages* of the *transmission elements* specified in clause 2.5.5.5 at *group demand* up to, but not exceeding, the applicable *maintenance period demand*.

Deleted: Maintenance Outages and Contingencies

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2.5.5.2 Pre-fault criteria with intact system

(a) The *transmission capacity* of the *MITS and sub transmission system* shall be planned such that, for the background conditions specified in clause 2.5.5.1, prior to any *fault outage* there must be no:

- (1) equipment loadings exceeding the *pre-fault rating*;
- (2) unacceptable *voltage conditions*; or
- (3) *system instability*.

2.5.5.3 Post-fault criteria with intact system

(a) The *transmission capacity* of the *MITS and sub transmission system* shall also be planned such that for the background conditions described in clause 2.5.5.1 and for the *credible contingency* of a *fault outage* of any of the following:

- (1) a single *transmission circuit*;
- (2) a single *reactive equipment*;
- (3) a single *generation circuit*;
- (4) a single *generating unit* (or multiple *generating units* sharing a common circuit breaker or that would be disconnected via a single *outage*);
- (5) a single section of *busbar*,

there must be no:

- (6) *loss of demand capacity* except as permitted by the Demand connection planning criteria detailed in clause 2.5.4;
- (7) unacceptable *overloading* of any *transmission equipment*;

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

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(8) unacceptable voltage conditions; or

(9) system instability.

(b) The transmission capacity of the MITS shall be planned such that if there is a single circuit breaker failure resulting from a single phase to earth fault provided the system demand is less than 80% of expected transmission system peak load there must be no:

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(1) unacceptable overloading of any transmission equipment;

(2) unacceptable voltage conditions; or

(3) system instability.

2.5.5.4 Pre-fault criteria with local system outage

(a) During the planned outage and prior to any fault outage occurring, there must be no:

(1) equipment loadings exceeding the pre-fault rating;

(2) unacceptable voltage conditions; or

(3) system instability.

2.5.5.5 Post-fault criteria with local system outage

(a) The transmission capacity of the MITS and sub transmission system shall be planned such that for the background conditions described in clause 2.5.5.1 with the initial conditions of a planned outage of:

(1) a single transmission circuit;

(2) a single reactive equipment;

(3) a single generation circuit;

(4) a single circuit breaker;

(5) a single generating unit (or multiple generating units sharing a common circuit breaker or that would be disconnected via a single outage); or

(6) a single section of busbar.

for the credible contingency of a fault outage of:

(7) a single transmission circuit;

(8) a single reactive equipment;

(9) a single generation circuit;

(10) a single generating unit (or multiple generating units sharing a common circuit breaker or that would be disconnected via a single outage); or

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

(11) a single section of busbar;

there must be no:

(12) loss of demand except as permitted by the Demand connection planning criteria detailed in section 2.5.4);

(13) unacceptable overloading of any transmission equipment;

(14) unacceptable voltage conditions; or

(15) system instability.

Note:

For clarity, clauses 2.5.5.5(a)(13), 2.5.5.5(a)(14) and 2.5.5.5(a)(15) can be achieved through several means such as pre-fault switching to achieve network reconfiguration, use of automated systems or network reinforcement. Any systems which automatically disconnect demand to comply with the requirements of 2.5.5.3 and 2.5.5.5 must ensure the limits set out in Table 2-10 are not exceeded.

Where non-network reinforcement solutions are adopted, these must be documented and appropriately implemented including investment in associated plant, equipment and control schemes as required.

- (b) In determining whether the requirements described above have been met, the Network Service Provider may assume that, during the planned outage, generation has been rescheduled in accordance with the WEM Rules to the extent possible to mitigate the effect of a subsequent fault outage.

2.5.5.6 Other MITS and sub transmission system requirements

(a) Under the System Security Background conditions (set out in the guideline (the Transmission Planning Guideline) developed by the Network Service Provider in accordance with clause 2.5.2(j) of these Rules), the criteria in clauses 2.5.5.2 to 2.5.5.5 must be met.

(b) Under the System Economy Background conditions (set out in the guideline (the Transmission Planning Guideline) developed by the Network Service Provider in accordance with clause 2.5.2(j) of these Rules), the criteria in clauses 2.5.5.2 to 2.5.5.5 must be met when there is sufficient economic justification.

(c) When considering investment in accordance with clauses 1.1.1.1(a) and 2.5.5.6(b) the Network Service Provider should consider network and non-network solutions except where operational measures, including constraints, suffice to meet the criteria.

(d) Where operational measures, including constraints, are used in accordance with clause 2.5.5.6(c):

(1) maintenance access for each transmission circuit must be able to be achieved; and

(2) the operational measures must be economically justified by the Network Service Provider.

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Circuit Breaker Failure ¶

If a circuit breaker failure occurs and, as a result, a single phase to earth fault within a transmission system sub-network designed to the N-1-1 criterion is not cleared by a main protection scheme, the power system must return to a state that meets the steady state performance standards specified in clause 2.2.2 without generation rescheduling, provided that the power transfer at the time of the fault is no greater than 80% of the expected transmission system peak load and that, prior to the event, all transmission system equipment is in scheme. ¶

Perth CBD Criterion¶

The Perth CBD criterion applies to those sub-networks of the transmission system that transfer power to the Perth CBD and zone substations and the transmission lines that terminate in those zone substations that supply Perth CBD.¶

Following any outage within a sub-network to which the Perth CBD criterion applies involving:¶

one or two transmission lines;¶

one or two supply transformers; or¶

one transmission line and one supply transformer,¶

and irrespective of whether any single transmission element outage is planned or unplanned, there must be sufficient power transfer capacity in the transmission system to maintain supply to all Consumers within the Perth CBD without the need to reschedule generation.¶

For an unplanned outage of a single supply transformer, there may be a supply interruption to some Consumers of up to 30 seconds to allow for the automatic transfer of the affected loads to other supply transformers within the same substation or to other substations using capacity that is kept available for this purpose.¶

For unplanned outages of two transmission elements in accordance with clause 2.5.3(b), there may be a supply interruption to some Consumers of up to 2 hours to allow for the transfer of the affected loads to other supply transformers within the same substation or to other

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Relationship between 1% Risk criterion and NCR criterion is explained below:¶

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

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(e) For potential MITS and sub transmission system augmentations identified following assessment using the System Economy Background conditions (set out in the guideline (the Transmission Planning Guideline) developed by the Network Service Provider in accordance with clause 2.5.2(j) of these Rules), the Network Service Provider must use data and assumptions in the economic justification that align with those used in the Whole of System Plan published in accordance with section 4.5A of the WEM Rules.

2.5.6 Fault limits

The calculated maximum fault level at any point in the transmission system must not exceed 95% of the equipment fault rating at that point.

2.5.7 Maximum fault currents

The maximum fault current at the connection point of a User connected to the transmission system shall be as specified in the relevant connection agreement.

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2.6 DISTRIBUTION SYSTEM PLANNING CRITERIA

2.6.1 Application

Section 2.6 sets out the *distribution system planning criteria*. The *Network Service Provider* must design the *distribution system* in accordance with the applicable *distribution system planning criteria* described below.

2.6.2 High voltage distribution system

2.6.2.1 Application of the N-0 criterion

- (a) The *Network Service Provider* may, unless *good electricity industry practice* dictates otherwise, design and operate the *distribution system* to the N-0 criterion.
- (b) The *Network Service Provider* may negotiate an enhanced security of *supply* with *Users* requiring a high level of *supply* reliability. Details of the agreed enhanced level of security of *supply* must be included in the *connection agreement*. The *Network Service Provider* is under no obligation to provide a *User* with an enhanced level of security and *Users* should note that provision of an enhanced level of security through connection to the *transmission or distribution system* is often neither economic nor practical. Hence, *Users* requiring an enhanced level of security of *supply* may need to make alternative arrangements such as the provision of on-site standby *generation*.

2.6.2.2 Distribution feeders in the Perth CBD

Distribution feeders in the *Perth CBD* and those connected to *zone substations* within the *Perth CBD* must be designed so that in the event of an unplanned loss of *supply* due to the failure of equipment on a *high voltage distribution system*, the *Network Service Provider* can use remotely controlled switching to restore *supply* to those sections of the *distribution feeder* not directly affected by the fault.

2.6.2.3 Urban distribution feeders

- (a) Existing *urban distribution feeders*
 Urban *distribution feeders* in existence at the *Rules commencement date* must be designed so that, in the event of an unplanned single feeder *outage* due to an equipment failure within the *zone substation* or a failure of the exit cable, the *load* of that feeder can be transferred to other *distribution feeders* by manual reconfiguration.

Note:
 For existing feeders, due to historical *substation* and feeder loading practices, this design requirement may not currently be achieved at 100% *peak load*. In this event some *load shedding* may be necessary at times of high *load* after reconfiguration of the *distribution system* following the *outage* of a single *distribution feeder*. However, in the long term, future network reinforcements will allow for 100% of *peak load* to be transferred, thereby avoiding the need for such *load shedding*.

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 Following the loss of a supply transformer from a 1% Risk zone substation the Network Service Provider must use its best efforts to minimise load shedding by transferring load to other zone substations by utilising available spare capacity.¶

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 No zone substation may be classified an NCR substation unless a rapid response spare transformer is available to temporarily replace the failed supply transformer within a target period of 12 hours.¶
 Following the loss of a supply transformer from an NCR classified zone substation, the Network Service Provider must use its best efforts to minimise load shedding by transferring load to other supply transformers or zone substations by utilising available spare capacity.¶
 Following the deployment of the rapid response spare transformer, the Network Service Provider must install a suitable spare transformer or procure a new transformer to replace the failed transformer permanently and release the rapid response spare transformer to cater for future contingencies...

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

- (b) Urban **distribution feeders constructed after the Rules commencement date**
- (1) Where practical, any new urban *distribution feeder* must be split into two radial spurs at the end of the *zone substation* exit cable; and
 - (2) the *distribution feeder* must be designed so that, if an unplanned single feeder *outage* occurs due to an equipment failure within the *zone substation* or a failure of the exit cable, the *load* on the faulted feeder can be transferred to other feeders **in accordance** with the following provisions:
 - (A) no other *distribution feeder* will pick up more than 50% of the *peak load* from the faulted *distribution feeder* unless capacity has been specifically reserved to provide back-up;
 - (B) the *distribution feeder(s)* picking up the *load* can be from another *zone substation*; and
 - (C) any new underground *distribution feeder*, or portion of a new underground *distribution feeder* that has an installed *transformer* capacity of 1 MVA or more, must be designed so that, as soon as adjacent developments permit, an alternative source of *supply* that is normally open, can be closed to provide *supply*, if a fault occurs on the normal *supply*.

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2.6.2.4 Radial **distribution feeder loads in the Perth metropolitan area**

For all *distribution feeders* within the Perth metropolitan area, the *Network Service Provider* must limit the number of residential **Users who consumes electricity supplied through a connection point** in a *switchable feeder section* to 860, if the *switchable feeder section* is not able to be energised through a back-up normally open interconnection.

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2.6.2.5 Rural **distribution feeders**

Where technically and economically feasible, the *Network Service Provider* must provide normally open interconnections between adjacent rural *distribution feeders*.

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2.6.3 Low **voltage distribution system**

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2.6.3.1 General

- (a) The *Network Service Provider* may design the radial *low voltage distribution systems* to the N-0 criterion. However, where technically and commercially feasible, interconnection between *low voltage* feeders may be provided.
- (b) For underground residential subdivisions, the *Network Service Provider* must ensure that all *low voltage* circuits have a switching point for every 16 *connection points*.

2.6.3.2 Pole to **pillar connection points mandatory**

All new *low voltage connection points* and service mains, and upgrades to existing overhead service mains due to capacity increases, must be underground, even if the service mains are to be connected to an overhead *distribution line*.

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

2.6.4 **Fault limits**

The calculated maximum fault level at any point in the *distribution system* must not exceed 95% of the equipment fault rating at that point.

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2.6.5 **Maximum fault currents**

(a) The *Network Service Provider* must design and construct the *distribution system* so that the potential *maximum fault currents* do not exceed the following values:

- (1) 415 V networks 31.5 kA where supplied from one *transformer*; or
- (2) 63 kA where supplied from two *transformers* in parallel, except where a higher *maximum fault current* is specified in a *User's connection agreement*.
- (3) 6.6 kV networks 21.9 kA
- (4) 11 kV networks 25 kA
- (5) 22 kV networks 16 kA
- (6) 33 kV networks 13.1 kA

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Moved up [13]: The *maximum fault current* at the *connection point* of a *User* connected to the *transmission system* shall be as specified in the relevant *connection agreement*.

(b) Equipment may be installed with a lower *fault current rating* in accordance with applicable requirements of the *Electricity (Network Safety) Regulations 2015* where the fault level is unlikely to exceed the lower rating for a *credible contingency*.

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2.6.6 **Distribution design criteria**

- (a) All *distribution systems* must be designed to *supply* the *maximum reasonably foreseeable load* anticipated for the area served.
- (b) *Distribution systems* must be designed to minimise the cost of providing additional *distribution system* capacity should electricity consumption patterns change.
- (c) *High voltage* switchgear and *distribution transformers* should be located close to the centre of the *loads* to be supplied.
- (d) The *Network Service Provider* may remotely monitor and/or control *high voltage* switchgear where this can be shown to be the most cost efficient approach, *including where this assists* meeting the reliability targets set out in the *access arrangement*.
- (e) *High voltage* switchgear that is not remotely monitored must be fitted with local fault passage indication.

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

(f) Ground mounted distribution transformers rated above 300 kVA must provide:

- (1) local indication of actual and peak load;
- (2) remote monitoring of (signed) active power (kW) and reactive power (kvar), voltage and current. Additional parameters may be provided for the purpose of maintaining compliance of the distribution system with these Rules.

Note:
 Clause 2.6.6(f)(2) may be achieved through the use of the equipment that allows for remote monitoring on the distribution transformer or alternative equipment installed elsewhere in the network that achieves the same level of remote monitoring for required parameters.

(g) The Network Service Provider may install equipment that enables remote monitoring on existing distribution transformers for the purpose of maintaining compliance of the distribution system with these Rules.

Note:
 Examples where clause 2.6.6(g) may be applied include improving network hosting capacity for distributed energy resources or electric vehicles, dynamic network management (including bi-directional flow) or addressing volatility in User behaviour.

2.7 TRANSMISSION AND DISTRIBUTION SYSTEM DESIGN AND CONSTRUCTION STANDARDS

When designing and constructing the transmission and distribution systems, the Network Service Provider must comply with these Rules, the Access Code and the Electricity (Network Safety) Regulations 2015.

To the extent reasonable and practicable, the Network Service Provider should follow any relevant Australian Standards, International Electricity Commission (IEC) Standards, and Electricity Networks Association Guides.

2.8 DISTRIBUTION CONDUCTOR OR CABLE SELECTION

Extensions and reinforcements to the distribution system must be designed and constructed in accordance with a distribution system concept plan for the area. The installation must conform to the concept plan and use conductors or cables that are:

- (a) *configured with the objective of minimising the lifetime cost to the community; and*
- (b) *of a standard carrier size that is equal to or greater than that required for the reasonably foreseeable load.*

2.9 TRANSMISSION AND DISTRIBUTION SYSTEM PROTECTION

2.9.1 General requirements

- (a) *All primary equipment on the transmission and distribution system must be protected so that if an equipment fault occurs, the faulted equipment item is automatically removed from service by the operation of circuit breakers or fuses. Protection systems must be designed and their settings coordinated so that, if there is a fault, unnecessary equipment damage is avoided and any reduction in power transfer capability or in the level of service provided to Users is minimised.*

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

- (b) Consistent with the requirement of clause 2.9.1(a), *protection systems* must remove faulted equipment from service in a timely manner and ensure that, where practical, those parts of the *transmission and distribution system* not directly affected by a fault remain in service.
- (c) *Protection systems* must be designed, installed and maintained in accordance with *good electricity industry practice*. In particular, the *Network Service Provider* must ensure that all new *protection apparatus* complies with IEC Standard 60255 and that all new *current transformers* and *voltage transformers* comply with [JEC Standard 61869](#).

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2.9.2 Duplication of [protection](#)

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(a) *Transmission system*

- (1) *Primary equipment* operating at *transmission system voltages* must be protected by a *main protection system* that must remove from service only those items of *primary equipment* directly affected by a fault. The *main protection system* must comprise *two fully independent protection schemes*. One of the independent *protection schemes* must include earth fault *protection*.
- (2) *Primary equipment* operating at *transmission system voltages* must also be protected by a *back-up protection system* in addition to the *main protection system*. The *back-up protection system* must isolate the faulted *primary equipment* if a *small zone fault* occurs, or a *circuit breaker failure* condition occurs. For *primary equipment* operating at nominal voltages of 220 kV and above the *back-up protection system* must comprise *two fully independent protection schemes* that must discriminate with other *protection schemes*. For *primary equipment* operating at nominal voltages of less than [220 kV](#) the *back-up protection system* must incorporate at least one *protection scheme* to protect against *small zone faults* or a *circuit breaker failure*. For *protection* against *small zone faults* there must also be a second *protection scheme* and, where this is co-located with the first *protection scheme*, together they must comprise *two fully independent protection schemes*.
- (3) The design of the *main protection system* must make it possible to test and maintain either *protection scheme* without interfering with the other.
- (4) *Primary equipment* operating at a *high voltage* that is below a *transmission system voltage* must be protected by *two fully independent protection systems* in accordance with the requirements of clause 2.9.2(b)(1).

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(b) *Distribution system*

- (1) [Other than primary equipment forming part of the distribution system and normally protected by fuses, each](#) item of *primary equipment* forming part of the *distribution system* must be protected by two independent *protection systems*. One of the independent *protection systems* must be a *main protection system* that must remove from service only the faulted item of *primary equipment*. The other independent *protection system* may be a *back-up protection system*.

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

(2) Notwithstanding the requirements of clause 2.9.2(b)(1), where a part of the *distribution system* may potentially form a separate island the *protection system* that provides *protection* against islanding must comprise *two fully independent protection schemes* and comply with the requirements of clause 2.9.2(a)(3).

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2.9.3 Availability of protection systems

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(a) Subject to clauses 2.9.3(b) and 2.9.3(c), all protection schemes, including any back-up or *circuit breaker failure protection scheme*, forming part of a *protection system* protecting part of the *transmission or distribution system* must be kept operational at all times, except that one *protection scheme* forming part of a *protection system* can be taken out of service for period of up to 48 hours.

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(b) Should a *protection scheme* forming part of the *main or back-up protection system* protecting a part of the *transmission system* be out of service for longer than 48 hours, the *Network Service Provider* must remove the protected part of the *transmission system* from service, except:

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(1) when instructed otherwise by AEMO; or

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(2) if undertaking a *planned outage of a protection scheme*, after conducting a formal risk assessment and putting in place an acceptable risk mitigation plan approved by AEMO.

(c) Should either of the *two protection schemes* protecting a part of the *distribution system* be out of service for longer than 48 hours, the *Network Service Provider* must remove the protected part of the *distribution system* from service, except:

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(1) when the part of the *distribution system* must remain in service to maintain *power system stability*; or

(2) after conducting a formal risk assessment and putting in place an acceptable risk mitigation plan.

2.9.4 Maximum total fault clearance times

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(a) This clause 2.9.4 applies to zero impedance short circuit faults of any type on *primary equipment* at nominal system voltage. Where *critical fault clearance times* exist, these times may be lower and take precedence over the times stated in this clause 2.9.4. *Critical fault clearance time* requirements are set out in clause 2.9.5.

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(b) For *primary equipment* operating at *transmission system voltages* the maximum *total fault clearance times* in Table 2-11 and Table 2-12 apply to the nominal voltage of the circuit breaker that clears a particular fault contribution for both *minimum system conditions* and *maximum system conditions*. For *primary equipment* operating at *distribution system voltages* the maximum *total fault clearance times* specified for 33 kV and below may be applied to all circuit breakers required to clear a fault for *maximum system conditions*, irrespective of the nominal voltage of a circuit breaker.

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

- (c) For primary equipment operating at a nominal voltage of 220 kV and above:
- (1) operation of either protection scheme of the main protection system must achieve a total fault clearance time no greater than the "No CB Fail" time given in Table 2-11; and
 - (2) operation of either protection scheme of the back-up protection system must achieve a total fault clearance time no greater than the "CB Fail" time given in Table 2-11.
- (d) For primary equipment operating at 132 kV and 66 kV:
- (1) one of the protection schemes of the main protection system must operate to achieve a total fault clearance time no greater than the "No CB Fail" time given in Table 2-11. The other protection scheme of the main protection system must operate to achieve a total fault clearance time no greater than the "No CB Fail" time in Table 2-12. The back-up protection system must achieve a total fault clearance time no greater than the "CB Fail" time in Table 2-11, except that the second protection scheme that protects against small zone faults must achieve a total fault clearance time no greater than 400 msec;
 - (2) on 132 kV lines longer than 40 km, all main and back-up protection schemes must operate to achieve the relevant maximum total fault clearance time given in Table 2-12; and
 - (3) on 66 kV lines longer than 40 km, one protection scheme of the main protection system must operate to achieve the total fault clearance times specified for 132 kV in Table 2-12 (rather than the times specified in Table 2-11). The other protection scheme of the main protection system must operate to achieve the maximum total fault clearance times specified for 66 kV in Table 2-12.
- (e) For a small zone fault coupled with a circuit breaker failure, maximum total fault clearance times are not defined.
- (f) In Table 2-11 and Table 2-12, for voltages of 66 kV and above, the term "local end" refers to the circuit breaker(s) of a protection system where the fault is located:
- (1) within the same substation as the circuit breaker;
 - (2) for a transmission line between two substations, at or within 50% of the line impedance nearest to the substation containing the circuit breaker, provided that the line is terminated at that substation;
 - (3) for a transmission line between more than two substations, on the same line section as the substation containing the circuit breaker, provided that the line is terminated at that substation.

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

- (g) In Table 2-11 and Table 2-12, for voltages of 66 kV and above, the term "remote end" refers to all circuit breakers required to clear a fault, apart from those specified in clause 2.9.4(f).

Note:
Where one or more circuit breakers required to clear a fault are located in a different *substation* from that at which a line is terminated, situations may arise where all circuit breakers required to clear a fault may operate within the remote end *total fault clearance time*.

- (h) In Table 2-11, for primary equipment operating at nominal voltages of 33 kV and below, the term "local end" refers only to faults located within the *substation* in which a circuit breaker is located.
- (i) The term "existing equipment" refers to equipment in service at the *Rules commencement date*.

- (j) Notwithstanding the requirements of clause 2.9.4, where weak infeed fault conditions result from the connection of a generating system:

(1) where the risk of undetected islanding of a part of the *transmission or distribution system* and a *Generator's facility* is deemed significant by the *Network Service Provider*, the following applies:

- (A) the total fault clearance time of one of the *protection schemes* shall meet the remote end *total fault clearance time* of Table 2-12; and
- (B) the total fault clearance time of the other *protection scheme* shall be as deemed necessary by the *Network Service Provider* to prevent damage to the *transmission or distribution system* and to meet *power system stability* requirements;

(2) where the risk of undetected islanding of a part of the *transmission or distribution system* and a *Generator's facility* is deemed not significant by the *Network Service Provider*, the following applies:

- (A) the total fault clearance time of the two *protection schemes* shall be as deemed necessary by the *Network Service Provider* to prevent damage to the *transmission or distribution system* and to meet *power system stability* requirements.

- (k) Notwithstanding the requirements of clause 2.9.4, where weak infeed conditions result from the connection of generating system coupled with a circuit breaker failure, maximum total fault clearance times are not defined.

Note:
The assessment for weak infeed fault conditions resulting from the connection of generating units shall not go beyond the *transmission line* remote end isolator, which is deemed the accepted practicable point of assessment.
In determining the requirements for clause 2.9.4(j) and 2.9.4(k), the *Network Service Provider* should consider the requirements for *Generator protection* as defined in section 3.5 of these Rules.

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Table 2-11 Maximum total fault clearance times (msec)

		Existing equipment no CB fail	Existing equipment CB fail	New equipment no CB fail	New equipment CB fail
220 kV and above	Local end	120	370	100	270
	Remote end	180	420	140	315
66 kV and 132 kV	Local end	150	400	115	310
	Remote end	200	450	160	355
33 kV and below	Local end	1160	1500	1160	1500
	Remote end	Not defined	Not defined	Not defined	Not defined

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Table 2-12 Alternative maximum total fault clearance times (msec) for 132 kV and 66 kV lines

		Existing equipment no CB fail	Existing equipment CB fail	New equipment no CB fail	New equipment CB fail
132 kV	Local end	150	400	115	310
	Remote end	400	650	400	565
66 kV	Local end	1000	Not defined	115	310
	Remote end	Not defined	Not defined	400	565

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2.9.5 Critical fault clearance times

- (a) Notwithstanding the requirements of clause 2.9.4, where necessary to ensure that the power system complies with the performance standards specified in clause 2.2, the Network Service Provider may designate a part of the transmission or distribution system as subject to a critical fault clearance time. The critical fault clearance time may be lower than the standard maximum total fault clearance time set out in Table 2-11. The network configurations to which the critical fault clearance time applies shall be specified by the Network Service Provider.
- (b) All primary equipment that is subject to a critical fault clearance time must be protected by a main protection system that meets all relevant requirements of clause 2.9.2. Both protection schemes of the main protection system must operate within a time no greater than the critical fault clearance time specified by the Network Service Provider.

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CHAPTER 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

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2.9.6 Protection sensitivity

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- (a) Protection schemes must be sufficiently sensitive to detect fault currents in the *primary equipment* taking into account the errors in *protection apparatus* and *primary equipment* parameters under the system conditions in this clause 2.9.6.
- (b) For *minimum system conditions* and *maximum system conditions*, all *protection schemes* must detect and discriminate for all *primary equipment* faults within their intended normal operating zones.
- (c) For *abnormal equipment conditions* involving two *primary equipment* outages, all *primary equipment* faults must be detected by one *protection* scheme and cleared by a *protection* system. Back-up *protection* systems may be relied on for this purpose. *Fault clearance times* are not defined under these conditions.

2.9.7 Trip supply supervision requirements

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- (a) Where loss of power *supply* to its secondary circuits would result in *protection scheme* performance being reduced, all *protection scheme* secondary circuits must have *trip supply supervision*.

2.9.8 Trip circuit supervision requirements

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- (a) All *protection scheme* secondary circuits that include a circuit breaker trip coil have *trip circuit supervision*, which must monitor the trip coil when the circuit breaker is in both the open and closed position and alarm for an unhealthy condition.

2.9.9 Protection flagging and indication

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- (a) All protective devices supplied to satisfy the *protection* requirements must contain such indicating, flagging and event recording that is sufficient to enable the determination, after the fact, of which devices caused a particular trip.
- (b) Any failure of the tripping supplies, *protection apparatus* and circuit breaker trip coils must be alarmed and the *Network Service Provider* must put in place operating procedures to enable prompt action to be taken to remedy such failures.

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3. TECHNICAL REQUIREMENTS OF USER FACILITIES

3.1 INTRODUCTION

(a) This [Chapter 3](#) sets out details of the technical requirements [that Users must satisfy](#) as a condition of [connection](#) of any equipment to the [transmission and distribution systems](#) (including [loads, generating systems and electricity storage facilities](#)), except where granted an exemption by the [Network Service Provider](#) in accordance with sections 12.33 to 12.39 or the [Authority](#) in accordance with sections 12.40 to 12.49 of the [Access Code](#).

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(b) [This Chapter 3](#) assumes the times a [User's facility](#) may operate will not be restricted, except in accordance with these [Rules and other relevant laws](#). Additional operating restrictions may be agreed by a [Network Services Provider](#) and a [User](#). In such circumstances, the [Network Services Provider](#) may impose requirements over and above those shown in this [Chapter 3](#) to ensure that the [User's facility](#) only operates in accordance with the agreed restrictions. The additional operating restrictions and any additional requirements must be specified in the relevant [connection agreement or User operating protocol](#).

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(c) The [objective](#) of this [Chapter 3](#) is to facilitate maintenance of the [power system](#) performance standards specified in section 2.2, so that other [Users](#) are not adversely affected and that personnel and equipment safety are not put at risk following, or as a result of, the [connection](#) of a [User's](#) equipment.

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Note:

The scope of these [Rules](#) does not include the technical requirements for the provision of [services](#) either in accordance with the relevant provisions of the [WEM Rules](#) or under a commercial arrangement with the [Network Services Provider](#). [Users](#) who provide [those](#) services may be required to comply with technical requirements over and above those specified in this [Chapter 3](#). These additional requirements will be specified in the relevant [services contract](#).

(d) [All Users, including transmission connected market generators, must comply with the requirements specified in section 3.2. Additional requirements specified in sections 3.3 to 3.8 may apply depending on the type of equipment within the User's facility, the equipment's rated capacity and connection arrangement.](#)

(1) [Table 3-1 lists the sections that specify the technical requirements for transmission connected User facilities.](#)

(2) [Table 3-2 lists the sections that specify the technical requirements for distribution connected User facilities.](#)

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Note:

[Transmission connected market Generators may have generator performance standards developed through the process defined in the WEM Rules. These Generators do not need to negotiate generator performance standards through the process outlined in these Rules if they have agreed generator performance standards via the WEM Rule process. However, they must comply with all other technical requirements in these Rules.](#)

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Table 3-1 Technical requirements for User facilities connected to the transmission system

Equipment	Operating mode	Rated capacity ⁽¹⁾	Applicable sections of these Rules
<i>load</i>	-	All	sections 3.1, 3.2, 3.4 and 3.5
<i>electricity storage</i>	consuming active power (i.e., charging)		
<i>electricity storage</i>	discharging active power	> 5 MVA	sections 3.1, 3.2, 3.3 and 3.5
		≤ 5 MVA	sections 3.1, 3.2, 3.5 and 3.6
<i>generating system</i>	-	> 5 MVA	sections 3.1, 3.2, 3.3 and 3.5
		≤ 5 MVA	sections 3.1, 3.2, 3.5 and 3.6

(1) For generating systems or electricity storage the rated capacity is the total capacity of all generating units or storage devices that generate or discharge apparent power in parallel with the power system at a common connection point. For load or electricity storage consuming active power, the rated capacity is the total capacity of all load or storage devices that consume apparent power in parallel with the power system at a common connection point.

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Table 3-2 Technical requirements for User facilities connected to the distribution system

Equipment	Operating mode	Rated capacity	Applicable sections of these Rules
<i>load</i>	-	All	sections 3.1, 3.2, 3.4 and 3.5
<i>electricity storage</i>	consuming active power (i.e., charging)		
<i>generating system</i>	-	> 5 MVA, HV connected	sections 3.1, 3.2, 3.3, and 3.5
<i>electricity storage</i>	discharging active power	≤ 5 MVA, HV connected	sections 3.1, 3.2, 3.5, and 3.6
<i>generating system</i>	-		
<i>electricity storage</i>	discharging active power	LV connected, non-standard connection service	sections 3.1, 3.2, 3.5 and 3.7
<i>generating system</i>	-		
<i>electricity storage</i>	discharging active power	LV connected, standard connection service	sections 3.1, 3.2, 3.5 and 3.8

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(e) The mode of operation of a *generating unit* may be characterised as one of the following modes:

- (1) being in continuous parallel operation with the *transmission or distribution system*, and either exporting electricity to the *transmission or distribution system* or not exporting electricity to it;
- (2) being in occasional parallel operation with the *transmission or distribution system*, and either exporting electricity to the *transmission or distribution system* or not exporting electricity to it, including *generating units* participating in peak lopping and system *peak load* management for up to 200 hours per year;
- (3) being in short term test parallel operation with the *transmission or distribution system*, and either exporting electricity to the *transmission or distribution system* or not exporting electricity to it, and having a maximum duration of parallel operation 2 hours per event and 24 hours per year; or
- (4) bumpless (make before break) transfer operation, being:
 - (A) operation in rapid transfer mode where, when *load* is transferred between the *generating unit* and the *transmission or distribution system* or vice versa, the *generating unit* is synchronised for a maximum of one second per event; or
 - (B) operation in gradual transfer mode where, when *load* is transferred between the *generating unit* and the *transmission or distribution system* or vice versa, the *generating unit* is synchronised for a maximum of 60 seconds per event.

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3.2 REQUIREMENTS FOR ALL USERS

3.2.1 Power system performance standards

(a) A *User* must ensure that each of its *facilities* connected to the *transmission or distribution system* is capable of operation while the *power system* is operating within the parameters of the *power system* performance standards set out in clause 2.2.

Note:

The overvoltage envelope specified in [Figure 2-2](#), [Figure 2-3](#) and [Figure 2-4](#) provides for the level of transient overvoltage excursions expected on the periphery of the *transmission and distribution system*. *Users* proposing to connect equipment that is intolerant of high *connection point voltage* may request the *Network Service Provider* to undertake a study to determine the maximum potential overvoltage at the proposed *connection point*. The cost of such a study will be the responsibility of the *User* requesting it.

(b) Flicker

A *User* must maintain its contributions to flicker at the *connection point* below the limits allocated by the *Network Service Provider* under clause 2.3.1.

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(c) Harmonics

- (1) A User must comply with any harmonic emission limits allocated by the Network Service Provider in accordance with clause 2.3.2(a).
- (2) Where no harmonic injection limit has been allocated in accordance with clause 2.3.2(a), a User must ensure that the injection of harmonics or interharmonics from its equipment or facilities into the transmission or distribution systems does not cause the maximum system harmonic voltage levels set out in Table 2-6 and Table 2-7 to be exceeded at the connection point.

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(d) Negative Phase Sequence Voltage

- (1) A User connected to all three phases must balance the current drawn in each phase at its connection point so as to achieve 10-minute average levels of negative sequence voltage at the connection point that are equal to or less than the values set out in Table 2-8.
- (2) A User directly connected to the transmission system must be connected to all three phases.

(e) Electromagnetic Interference

A User must ensure that the electromagnetic interference caused by its equipment does not exceed the limits set out in Tables 1 and 2 of AS 2344 (2016).

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(f) Fault Levels

- (1) A User connected to the transmission system shall not install or connect equipment at the connection point that is rated for a maximum fault current lower than that specified in the connection agreement in accordance with clause 2.5.7.
- (2) A User connected to the distribution system, who is not a small use customer, must not install equipment at the connection point that is rated for a maximum fault current lower than that specified in clause 2.6.5(a) unless a lower maximum fault current is agreed with the Network Service Provider and specified in the connection agreement.
- (3) Small use customers connected to the distribution system may install equipment with a lower fault rating than the maximum fault current specified in clause 2.6.5(a)(1) in accordance with the applicable requirements of the WA Electrical Requirements.

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Note:

Where a User's equipment increases the fault levels in the transmission system, responsibility for the cost of any upgrades to the equipment required as a result of the changed power system conditions will be dealt with by commercial arrangements between the Network Service Provider and the User.

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(4) A Generator must ensure that the maximum fault current contribution from a generating unit or small generating system is not of a magnitude that will allow the total fault current at the connection point to exceed the levels specified in clause 2.5.7 for all transmission system operating conditions or 2.6.5(a) for all distribution system operating conditions.

(5) If the connection or disconnection of a User's generating system causes or is likely to cause excessively high or low fault levels, this must be addressed by measures agreed with the Network Service Provider and recorded in the relevant connection agreement.

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3.2.2 Main switch

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(a) Except as provided in clause 3.3.15, a User must be able to de-energise its own equipment without reliance on the Network Service Provider.

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(b) A User connected to the low voltage distribution system must comply with AS/NZS 3000 with respect to the provision and location of main switch(s).

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3.2.3 User's power quality monitoring equipment

(a) The Network Service Provider may require a User to provide accommodation and connections for the Network Service Provider's power quality monitoring and recording equipment within the User's facilities or at the connection point.

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(b) The User must meet the requirements of the Network Service Provider in respect of the installation of the power quality monitoring and recording equipment and provide access for reading, operating and maintaining this equipment.

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(c) The key inputs that the Network Service Provider may require a User to provide to the Network Service Provider's power quality monitoring and recording equipment include:

(1) three phase voltage and three phase current and, where applicable, neutral voltage and current; and

(2) digital inputs for circuit breaker status and protection operate alarms hardwired directly from the appropriate devices. If direct hardwiring is not possible and if the Network Service Provider agrees, then the User may provide inputs measurable to 1 millisecond resolution and GPS synchronised.

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a set of functional block diagrams, including all transfer functions between feedback signals

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the characteristics of non-linear elements.¶

3.2.4 Modelling data for power system simulation studies

(a) A User must provide to the Network Service Provider modelling information for their facilities as specified in the 'Generator and Load Model Guidelines' produced by the Network Service Provider.

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(b) The Network Service Provider may provide any information it so receives to any User who intends to connect any equipment to the transmission or distribution system for the purposes of enabling that User to undertake any power system simulation studies it

wishes to undertake, subject to that *User* entering into a confidentiality agreement with the *Network Service Provider*, to apply for the benefit of the *Network Service Provider* and any *User* whose information is so provided, in such form as the *Network Service Provider* may require.

Technical matters to be coordinated

A *User* and the *Network Service Provider* must agree upon the following matters for each new or altered connection:

- (a) design at the *connection point*;
- (b) *protection*;
- (c) control characteristics;
- (d) communications, remote controls, indications and alarms;
- (e) insulation co-ordination and lightning *protection*;
- (f) fault levels and *total fault clearance times*;
- (g) switching and isolation *facilities*;
- (h) interlocking arrangements;
- (i) synchronising *facilities*;
- (j) provision of information;
- (k) computer model and *power system* simulation study requirements;
- (l) *load shedding* and islanding schemes;
- (m) any special test requirements, and
- (n) *generator performance standards for large generating systems.*

3.2.6 Register of performance requirements

- (a) The *Network Service Provider* will maintain a ‘*User Performance Register*’ documenting the *generator performance standards for each large generating system developed through the process defined in clause 3.3.4.* The ‘*User Performance Register*’ will also capture the key technical requirements for *large loads*.

Note:
The register required in this clause 3.2.6 is intended to align with, and not duplicate, the *Generator Register* required in the *WEM Rules*.

- (b) The ‘*User Performance Register*’ should include any information considered relevant by the *Network Service Provider* and must record, at a minimum, for each *large generating system for which generator performance standards have been agreed through the process defined in clause 3.3.4*:

- (1) the status of connection;
- (2) details of the *Generator* responsible for the *large generating system*;
- (3) full details of each *generator performance standard for each generating unit or component of the generating system, including tripper events*;
- (4) the *generating system* model provided by the *Generator*; and

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- (5) each compliance monitoring program agreed by the Network Service Provider under clause 4.1.3(b).
- (c) A Generator responsible for a large generating system for which generator performance standards have been agreed through the process defined in clause 3.3.4 must notify the relevant Network Service Provider as soon as reasonably practicable of any changes in respect of the generating system, the generator performance standards, the generating system model, the ownership of the generating system or any other information in respect of the large generating system that would render the information, recorded in the register, being inaccurate or out of date.
- (d) The Network Service Provider must make the register available on request to:
- (1) a User, but only in respect of the information that relates to a large generating system or large load that the User is responsible for;
 - (2) AEMO; and
 - (3) the Authority.

3.2.7 Changes to control and protection settings

- (a) The Network Service Provider may undertake a review of the control and protection system settings within a User's facility to determine whether there is a need for any modification to those settings to improve power system security, power system reliability or the quality of supply to other Users.
- (b) Where the review completed in accordance with clause 3.2.7(a) identifies a need to alter existing settings the User must make any changes requested.

3.2.8 Other installation requirements

- (a) Users connecting to the distribution system must design their facilities to comply with the WA Service and Installation Requirements.

3.3 REQUIREMENTS FOR CONNECTION OF LARGE GENERATING SYSTEMS TO THE TRANSMISSION SYSTEM OR THE HIGH VOLTAGE DISTRIBUTION SYSTEM

3.3.1 Overview

This clause 3.3 addresses the requirements for the connection of *large generating units and large generating systems of aggregate rated capacity greater than 5 MVA to the transmission system or the high voltage distribution system*. This does not apply to the connection of *small generating systems* for which requirements are provided for in clauses 3.5, 3.7 or 3.8.

Note:

This clause 3.3 allows for the *Network Service Provider to consult with AEMO:*

- prior to accepting negotiated *generator performance standards*;
- when deciding whether a *potential relevant generator modification* is to be classified as a *relevant generator modification*; and
- when assessing the sufficiency of *Generator system models*.

3.3.2 General requirements

- (a) A *Generator responsible for a large generating system* must comply at all times with applicable requirements and conditions of *connection for large generating systems* as set out in this clause 3.3.
- (b) A *Generator responsible for a large generating system* must operate *facilities and equipment* in accordance with *directions* given by *AEMO* and the *Network Service Provider* under these *Rules* or under any *written law*.
- (c) A *generating unit* must have equipment characteristics and *control systems*, including the inertia (effective, presented to the *power system*), short-circuit ratio and *power system stabilisers*, sufficient not to cause any reduction of *power transfer capability* because of:
- (1) *transient stability or oscillatory stability*;
 - (2) *unacceptable frequency conditions*; or
 - (3) *unacceptable voltage conditions*,
- relative to the level *necessary to supply the load connected to the power system*.

Note:

The effect of this clause is to prevent *generating units* being permitted to connect to the *transmission or distribution system* if, as a result of the connection of *those generating units*, the *power transfer capability* of the *power system* will be reduced *such that it would impede the ability to supply load*.

- (d) An unplanned trip of a *generating unit* must not cause an increased need for *load shedding* because of:
- (1) *rate of change of frequency*;
 - (2) *magnitude of frequency excursion*;
 - (3) *active power imbalance*;
 - (4) *reactive power imbalance*; or

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- (5) displacement of reactive capability, over and above the level that would apply if the *generating unit* was not *connected*.

Note:
The effect of this clause is to limit the maximum *generating unit* size that is permitted to connect to the *transmission or distribution system* without taking an appropriate action to rectify the potential problem.

- (e) A *Generator* must ensure that its transients do not adversely affect the *Network Service Provider* and other *Users*.
- (f) Unless otherwise specified in these *Rules*, the technical requirements for *generating systems* apply at the *connection point*.
- (g) A *Generator* responsible for a *large generating system connected to the transmission system* must comply at all times with protection requirements specified in clause 3.5.1 and 3.5.2.
- (h) A *Generator* responsible for a *large generating system connected to the high voltage distribution system* must comply at all times with protection requirements specified in clause 3.5.1 and 3.5.3.

3.3.3 Provision of information

- (a) A *Generator* must provide all data reasonably required by the *Network Service Provider* to assess the impact of a *generating unit* on transmission and distribution systems performance and power system security.
- (b) Details of the kinds of data that may be required are included in Attachment 3, Attachment 4, Attachment 5, Attachment 6, Attachment 7 and Attachment 8.

3.3.4 Establishing generator performance standards

3.3.4.1 General Provisions

- (a) A *Generator* seeking to connect a *large generating system* to the *power system* must establish a set of *generator performance standards* that specify the technical performance requirements for the *generating system* either by applying the process defined in this clause 3.3.4 or through the process defined in clause 3A of the *WEM Rules*, unless granted an exemption under clause 3A.3.1 of the *WEM Rules*.

Note:
For clarity, if a large generating system receives an exemption under clause 3A.3.1 of the WEM Rules, they do not need to negotiate generator performance standards under these Rules. However, all other relevant sections of these Rules continue to apply.

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3.3.4.2 Technical Rules process for establishing generator performance standards

- (a) A Generator seeking to connect a large generating system must propose generator performance standards for the generating system addressing each of the technical requirements listed in clause 3.3.7. The Generator must submit the proposed generator performance standards to the Network Service Provider.
- (b) The generator performance standard proposed for each technical requirement must be set to meet the common requirements and either:
- (1) be equal to or better than the ideal generator performance standard; or
 - (2) if a proposed negotiated generator performance standard is submitted:
 - (A) be no less onerous than the minimum generator performance standard;
 - (B) demonstrate any applicable negotiation criteria have been met;
 - (C) meet the requirements of clause 3.3.4.2(e), and
 - (D) if applicable, meet the requirements of clause 3.3.4.2(f).
- (c) The Network Service Provider must not approve a proposed generator performance standard that does not meet or demonstrate the applicable criteria listed in clause 3.3.4.2(b)
- (d) The Network Service Provider must approve a proposed generator performance standard that is equal to or better than the ideal generator performance standard for a technical requirement.
- (e) A proposed negotiated generator performance standard must be as consistent as practicable to the corresponding ideal generator performance standard for that technical requirement, having regard to:
- (1) the need to protect the large generating system from damage;
 - (2) power system conditions at the location of the connection or proposed connection; and
 - (3) the commercial and technical feasibility of complying with the ideal generator performance standard.
- (f) A proposed negotiated generator performance standard may include a trigger event which must address:
- (1) the conditions for determining whether the trigger event has occurred;
 - (2) the party responsible for determining whether the trigger event has occurred;

- (3) the actions required to be taken and any revised *generator performance standards* which must be achieved if the *trigger event* occurs;
 - (4) the maximum timeframe for compliance with any action required to be taken and each revised *generator performance standard* following the *trigger event*;
 - (5) any requirements to provide information and supporting evidence required by the *Network Service Provider* or *AEMO* to demonstrate that, if the *trigger event* occurs, the actions required will occur and will deliver the agreed outcome and level of performance required by any revised *generator performance standard*;
 - (6) any testing requirements to verify compliance with each revised *generator performance standard*; and
 - (7) any requirements necessary to verify that the actions required to be taken have occurred if the *trigger event* occurs.
- (g) If a *registered generator performance standard* includes a *trigger event* and the *trigger event* subsequently occurs, the *Generator* responsible for the *large generating system* must comply with the requirements of the *trigger event*.
- (h) A *trigger event* contained in a *registered generator performance standard* may be modified by written agreement between the *Generator* responsible for the *large generating system* and the *Network Service Provider*.
- (i) If a *Generator* responsible for a *large generating system* submits to the *Network Service Provider* a *proposed negotiated generator performance standard* pursuant to clause 3.3.4.2(b) or clause 3.3.6(a)(1), the *Generator* must provide to the *Network Service Provider*:
- (1) the reasons and supporting evidence demonstrating why the *large generating system* cannot meet the *ideal generator performance standard*; and
 - (2) any information and supporting evidence required by the *Network Service Provider* setting out the reasons why the *proposed negotiated generator performance standard* is appropriate, including:
 - (A) how the *proposed negotiated generator performance standard* meets the applicable criteria listed in clause 3.3.4.2(b); and
 - (B) how the *Generator* has taken into account each of the matters listed in clause 3.3.4.2(e).
- (j) If, following the receipt of a *proposed negotiated generator performance standard* and the information and evidence referred to in clause 3.3.4.2(i), the *Network Service Provider* reasonably considers it will approve the *proposed negotiated generator performance standard*, the *Network Service Provider* should consult with *AEMO* in relation to each *proposed negotiated generator performance standard* for technical requirements that the *Network Service Provider* considers will impact *power system security* or *power system reliability*.

- (k) The Network Service Provider must determine whether to approve or reject each proposed negotiated generator performance standard proposed by the Generator for the large generating system.
- (l) The Network Service Provider must reject a proposed negotiated generator performance standard where:
- (1) in the Network Service Provider's reasonable opinion one or more of the requirements in clause 3.3.4.2(b)(2) are not met;
 - (2) the Network Service Provider has consulted with AEMO and AEMO has recommended that the Network Service Provider reject the proposed negotiated generator performance standard; or
 - (3) in the Network Service Provider's reasonable opinion, the proposed negotiated generator performance standard will adversely affect:
 - (A) power system security;
 - (B) power system reliability;
 - (C) power transfer capability; or
 - (D) the quality of supply of electricity for other Users.
- (m) If the Network Service Provider rejects a proposed negotiated generator performance standard, the Network Service Provider must provide to the Generator responsible for the large generating system:
- (1) written reasons for the rejection;
 - (2) any recommendation provided by AEMO to the Network Service Provider in respect of a suitable alternative generator performance standard for a technical requirement; and
 - (3) if applicable, an alternative proposed negotiated generator performance standard that the Network Service Provider considers meets the requirements of clause 3.3.4.2(b)(2), which may include a trigger event.
- (n) The Generator responsible for the large generating system may, in relation to an alternative proposed negotiated generator performance standard provided by the Network Service Provider in accordance with clause 3.3.4.2(m)(3), either:
- (1) accept the alternative proposed negotiated generator performance standard;
or
 - (2) reject the alternative proposed negotiated generator performance standard;
and
 - (A) propose a different alternative proposed negotiated generator performance standard consistent with the requirements of clause 3.3.4.2(b)(2), which may include a trigger event, in which case the

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process for consideration and approval of proposed generator performance standards in clause 3.3.4 applies; or

(B) elect to adopt the ideal generator performance standard for the relevant technical requirement.

(o) When a proposed generator performance standard is approved in accordance with clause 3.3.4.2(k) or accepted by the Generator under clause 3.3.4.2(n)(1), it must be recorded by the relevant Network Service Provider on the register developed in accordance with clause 3.2.6.

(p) A Generator must verify compliance of its own equipment with the generator performance standards developed through the process defined in this clause 3.3.4.2 by the methods described in clause 4.1.3.

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3.3.5 Potential relevant generator modifications to existing generating systems

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(a) Clauses 3.3.5 and 3.3.6 do not apply when a Generator undertakes a modification to a large generating system that is declared a Relevant Generator Modification in accordance with clause 3A.13.4 of the WEM Rules.

Note:

The purpose of this clause is to clarify that if the large generating system has agreed generator performance standards under the WEM Rules, the provisions related to Relevant Generator Modification under the WEM Rules apply. However, all other relevant sections of these Rules continue to apply.

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(b) A potential relevant generator modification means for the purposes of clauses 3.3.5 and 3.3.6, a modification to a large generating system that:

- (1) has the potential, or may be likely, to materially impact or change any of the characteristics, performance or capacity of the generating system in respect of a technical requirement addressed by clause 3.1(e), 3.3 or 3.5;
- (2) has the potential to alter the capacity of the large generating system in respect of any technical requirement for which the ideal generator performance standard has been amended since the applicable generator performance standard was approved;
- (3) is reasonably considered to require an amendment to the Generator's connection agreement for the generating system; or
- (4) requires submission of a connection application in accordance with the Network Service Provider's policy for access to its network.

(c) A Generator responsible for a large generating system must notify the Network Service Provider prior to undertaking a potential relevant generator modification.

(d) Subject to clause 3.3.5(e) and clause 3.3.5(f), the Network Service Provider may declare a potential relevant generator modification to be a relevant generator modification.

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- (e) Where the Network Service Provider is notified of a potential relevant generator modification to a large generating system in accordance with clause 3.3.5(c), the Network Service Provider may consult with AEMO before making a decision whether or not to declare the potential relevant generator modification a relevant generator modification.
- (f) The Network Service Provider must declare a potential relevant generator modification to be a relevant generator modification where AEMO advises the Network Service Provider that the potential relevant generator modification should be declared a relevant generator modification.
- (g) If the Network Service Provider declares a potential relevant generator modification to be a relevant generator modification, the Network Service Provider must notify the Generator responsible for the generating system.
- (h) If the Network Service Provider does not declare the potential relevant generator modification to be a relevant generator modification, the Generator may undertake the potential relevant generator modification as notified to the Network Service Provider subject to any other requirements or obligations that apply to the Generator under its connection agreement, arrangement for access, the Access Code, the Rules or any applicable law.

3.3.6 Relevant generator modifications to existing generating systems

- (a) If the Network Service Provider declares a potential relevant generator modification to be a relevant generator modification, the Generator responsible for the large generating system must submit:
 - (1) proposed generator performance standards addressing each technical requirement in accordance with clause 3.3.4.2(b) prior to undertaking the relevant generator modification; and
 - (2) a compliance monitoring program in accordance with clause 4.1.3(b), for the large generating system.
- (b) Where a Generator submits proposed generator performance standards, the process for consideration and approval of proposed generator performance standards in clause 3.3.4 applies.
- (c) Where the Network Service Provider has declared a proposed relevant generator modification to be a relevant generator modification, the Network Service Provider may:
 - (1) on and from the date that works in respect of the relevant generator modification is scheduled to be undertaken or commence, revoke the large generating system's approval to operate; or
 - (2) require the large generating system to conduct commissioning tests and, if the Network Service Provider is not satisfied with the results of the commissioning tests, revoke the large generating system's approval to operate, and

- (3) require the Generator to obtain an interim approval to operate (with or without conditions) or an approval to operate, and the process in clause 4.2.2, as relevant, applies.

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3.3.7 Technical requirements addressed by generator performance standards

3.3.7.1 General

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- (a) Clause 3.3.7 lists each of the technical requirements for large generating systems addressed by generator performance standards. An ideal generator performance standard, minimum generator performance standard and any applicable common requirements are defined for each technical requirement.
- (b) Each technical requirement may specify negotiation criteria which must be met if a Generator responsible for a large generating system submits a proposed negotiated generator performance standard.
- (c) If a technical requirement specifies common requirements, these apply whether an ideal generator performance standard or negotiated generator performance standard is intended to apply to a large generating system in respect of a technical requirement.

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3.3.7.2 Active power capability

- (a) Common requirements
- (1) In relation to the application of this technical requirement, the requirements apply at the connection point unless otherwise specified in the relevant clause, or the Network Service Provider determines that the technical requirement must be measured at a different location for the particular generating unit or generating system, in which case the measurement location must be recorded as part of the relevant generator performance standard.
- (b) Ideal generator performance standard
- (1) The ideal generator performance standard is the same as the minimum generator performance standard for active power capability.
- (c) Minimum generator performance standard
- (1) The generator performance standard for active power capability must include temperature dependency data up to and including the maximum temperature, which must include the rated maximum active power, and including ambient temperatures above the maximum temperature after which the active power capability is reduced:
- (A) for the generating system measured at the connection point; and
- (B) for each synchronous generating unit measured at the generating unit terminal.

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CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

- (2) Subject to clause 3.3.7.2(c)(3) and energy source availability, the generating unit or generating system, as applicable, must be capable of maintaining continuous uninterrupted operation while achieving and maintaining the relevant active power output levels at the temperatures specified in clause 3.3.7.2(c)(1).
- (3) Clause 3.3.7.2(c)(2) does not apply to the extent that a temporary reduction in active power has been agreed to by the Network Service Provider in order to achieve the required reactive power capability under maximum ambient temperature conditions as set out in clause 3.3.7.3.
- (4) Unless otherwise directed by the Network Service Provider generating systems and generating units, as applicable, must not exceed the relevant active power levels at the temperatures specified in clause 3.3.7.2(c)(1).

(d) Negotiation criteria

- (1) There are no negotiation criteria for this technical requirement.

3.3.7.3 Reactive power capability

(a) Common requirements

- (1) In relation to the application of this technical requirement, the requirements apply at the connection point unless otherwise specified in the relevant clause, or the Network Service Provider determines that the technical requirement must be measured at a different location for the particular generating unit or generating system, in which case the measurement location must be recorded as part of the relevant generator performance standard. The generator performance standard must include a generator performance chart, including data up to and including the maximum temperature, and including ambient temperatures above the maximum temperature after which the performance is reduced.
- (2) There must be no control system limitation, protection system or other limiting device in operation that would prevent the generating system from providing the reactive power output within the area defined in the generator performance chart.
- (3) Each generating system's connection point must be capable of permitting the dispatch of the full active power and reactive power capability of the generating system.

(b) Ideal generator performance standard

- (1) For all operating conditions, including at temperatures up to and including the maximum temperature, each generating unit within the generating system must be capable of supplying or absorbing reactive power continuously of at least the amount equal to the product of the rated maximum active power output of the generating unit
- (1) at nominal voltage and 0.484 while operating at any level of active power output between its maximum active power output level and its minimum

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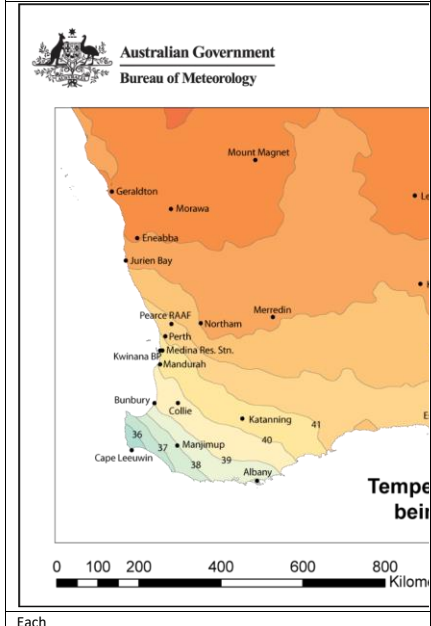
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active power output level as specified in the temperature dependency data under 3.3.7.2, and its rated minimum active power output level.

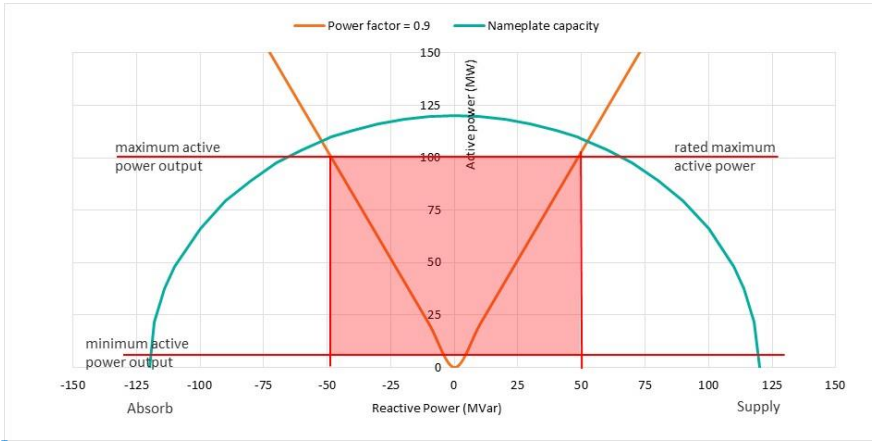


Figure 3-1 Example reactive power capability required to meet ideal generator performance standard

(2) The required levels of reactive power capability must be able to be delivered continuously for voltages at the connection point within the allowable steady state voltage ranges as specified in clause 2.2 of these Rules.

(c) Minimum generator performance standard

(1) Subject to clause 3.3.7.3(c)(3), for all operating conditions, including at temperatures up to and including the maximum temperature, the generating system must be capable of supplying or absorbing reactive power continuously of at least the amount equal to the product of the rated maximum active power output of the generating system and 0.329 while operating at any level of active power output level between its maximum active power output level as specified in the temperature dependency data under 3.3.7.2, and rated minimum active power output level.

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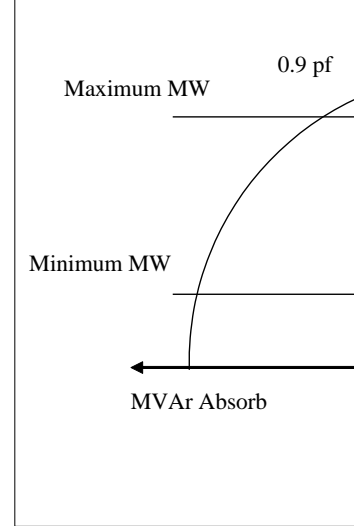
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This clause requires a generator machine, when producing its registered maximum active power output, to be capable of operating at any power factor between 0.8 lagging and 0.9 leading.¶



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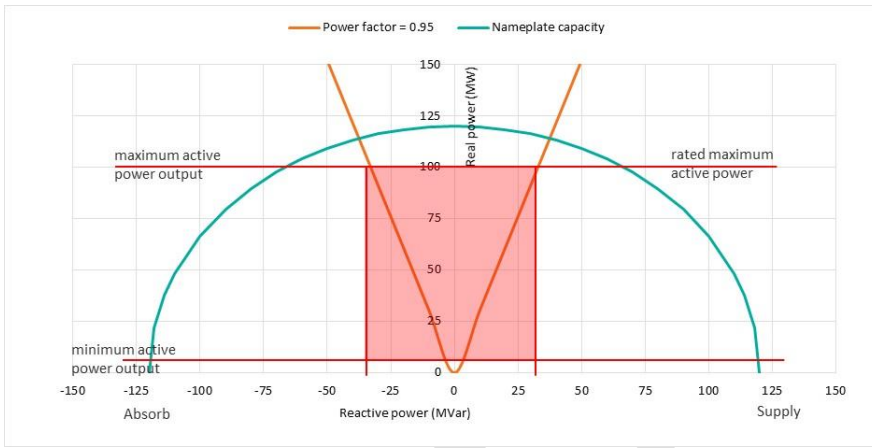


Figure 3-2 Example reactive power capability required to meet the minimum generator performance standard

- (2) The reactive power capability may be varied as shown in Figure 3-3 when the voltage at the connection point varies between 0.9 per unit and 1.1 per unit, where the generating system must be capable of absorbing or supplying reactive power continuously when operating anywhere inside the curve specified in Figure 3-3.

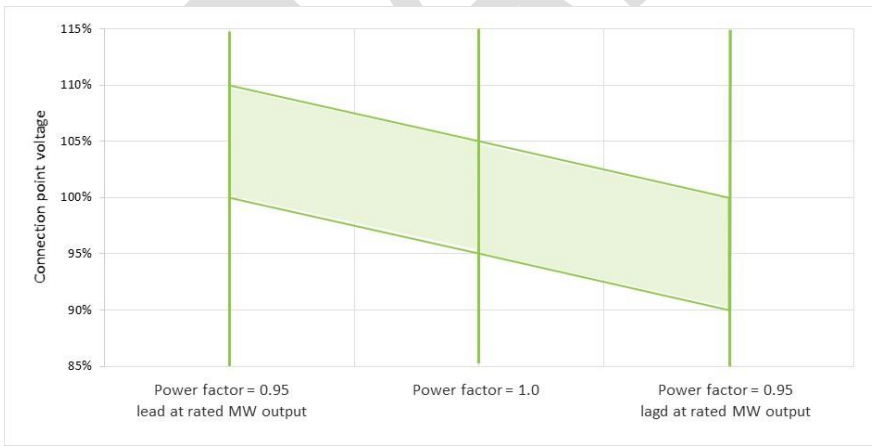


Figure 3-3 Relaxation of reactive power requirement with connection point voltage

- (3) Generating systems containing intermittent generating systems may, with the Network Service Provider's agreement, achieve the reactive power capability specified in clause 3.3.7.3(c)(1) by reducing active power output when the ambient temperature exceeds 25 degrees Celsius in their location, with the conditions forming part of the generator performance standard.

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(d) Negotiation criteria

- (1) There are no negotiation criteria for this technical requirement.

3.3.7.4 Voltage and reactive power control

(a) Common requirements

- (1) In relation to the application of this technical requirement, the requirements apply at the connection point unless otherwise specified in the relevant clause, or the Network Service Provider determines that the technical requirement must be measured at a different location for the particular generating unit or generating system, in which case the measurement location must be recorded as part of the relevant generator performance standard.
- (2) In relation to the application of this technical requirement, unless otherwise specified in the relevant clause, the requirements apply when operating at any active power and reactive power level as permitted or required under these Rules, and at all temperatures up to and including the maximum temperature.

(b) Ideal generator performance standard

- (1) The ideal generator performance standard, as it applies to different generating systems, is specified in Table 3-3.

Table 3-3 Voltage and reactive power control ideal generator performance standard

<u>Type of generating system</u>	<u>Relevant requirement</u>
<u>generating system comprised solely of synchronous generating units.</u>	<u>Clause 3.3.7.4(b)(2) and clause 3.3.7.4(b)(3).</u>
<u>generating system comprised solely of asynchronous generating units.</u>	<u>Clause 3.3.7.4(b)(2) and clause 3.3.7.4(b)(4).</u>
<u>generating system comprised of synchronous generating units and asynchronous generating units.</u>	<u>Clause 3.3.7.4(b)(2) and:</u> <u>(a) for that part of the generating system comprised of synchronous generating units, clause 3.3.7.4(b)(3);</u> <u>(b) for that part of the generating system comprised of asynchronous generating units, clause 3.3.7.4(b)(4).</u>

(2) All generating systems

- (A) The generating system must have equipment capabilities and control systems, including, if necessary, a power system stabiliser, sufficient to ensure that:

- (i) power system oscillations, for the frequencies of oscillation of the generating system against any other generating system or device, are adequately damped;
 - (ii) operation of the generating system does not degrade the damping of any critical mode of oscillation of the power system; and
 - (iii) operation of the generating system does not cause instability (including hunting of tap-changing transformer control systems) that would adversely impact other equipment connected to the power system.
- (B) Control systems on generating systems that control voltage and reactive power must include permanently installed and operational monitoring and recording equipment for key variables including each input and output, and equipment for testing the control systems sufficient to establish their dynamic operational characteristics.
- (C) A generating system must have control systems capable of regulating voltage, reactive power and power factor, with the ability to:
- (i) operate in all control modes; and
 - (ii) switch between control modes, as demonstrated to the reasonable satisfaction of the Network Service Provider. Where a generating system has been commissioned with more than one control mode, a procedure for switching between control modes must be agreed with the Network Service Provider as part of the generator performance standard.
- (D) A generating system must have a voltage control system that:
- (i) regulates voltage to within 0.5% of the target setpoint, where that setpoint may be adjusted to incorporate any voltage droop or reactive current compensation agreed with the Network Service Provider;
 - (ii) regulates voltage in a manner that helps to support network voltages during faults and does not prevent the requirements for voltage performance and stability in the Rules from being achieved;
 - (iii) allows the voltage to be continuously controllable in the range of at least 95% to 105% of the target voltage (as determined by the Network Service Provider), without reliance on a tap-changing transformer and subject to the generator performance standards for reactive power capability with the voltage control location agreed with the Network Service Provider; and

(iv) has limiting devices to ensure that a voltage disturbance does not cause a generating unit to trip at the limits of its operating capability. The generating system must be capable of stable operation for indefinite periods while under the control of any limiter. Limiters must not detract from the performance of any stabilising circuits and must have settings applied which are coordinated with all protection systems.

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(E) Where installed, a power system stabiliser must have:

- (i) two washout filters for each input, with ability to bypass one of them if necessary;
- (ii) sufficient (and not less than two) lead-lag transfer function blocks (or equivalent number of complex poles and zeros) with adjustable gain and time-constants, to compensate fully for the phase lags due to the generating unit;
- (iii) monitoring and recording equipment for key variables including inputs, output and the inputs to the lead-lag transfer function blocks; and
- (iv) equipment to permit testing of the power system stabiliser in isolation from the power system by injection of test signals, sufficient to establish the transfer function of the power system stabiliser.

(F) A reactive power, including a power factor, control system must:

- (i) regulate reactive power or power factor (as applicable) to within:
 - for a generating system operating in reactive power mode, 2% of the rated maximum apparent power of the generating system from the target setpoint; or
 - for a generating system operating in power factor mode, a power factor equivalent to 2% of the rated maximum apparent power of the generating system from the target setpoint; and
- (ii) allow the reactive power or power factor target setpoint to be continuously controllable across the reactive power capability range specified in the relevant generator performance standard.

(G) The structure and parameter settings of all components of the control system, including the voltage regulator, reactive power regulator, power system stabiliser, power amplifiers and all associated limiters, must be approved by the Network Service Provider as part of the generator performance standard.

(H) Each control system must be adequately damped.

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(3) Synchronous generating systems

(A) Each synchronous generating unit must have an excitation control system that:

- (i) is capable of operating the stator continuously at 105% of nominal voltage when operating at the maximum active power output specified in the temperature dependency data provided under 3.3.7.2 for the relevant temperature;
- (ii) has an excitation ceiling voltage of at least:
 - for a static excitation system, 2.3 times; or
 - for other excitation control systems, 1.5 times,the excitation required to achieve generation at the nameplate rating for rated power factor, rated speed and nominal voltage;

Note:
This clause does not align with the equivalent clause in Appendix 12 of the WEM Rules that applies to Transmission Connected Generating Systems. For the generation expected to connect under these Rules, this drafting is more appropriate.

(B) has a power system stabiliser with sufficient flexibility to enable damping performance to be maximised, with the stabilising circuit responsive and adjustable over a frequency range from 0.1 Hz to 2.5 Hz; and

(C) achieves a minimum equivalent gain of 200.

Note:
For both proportional and integral control actions. Note that one per unit excitation voltage is that field voltage required to produce nominal voltage on the air gap line of the generating unit open circuit characteristic (refer IEEE Standard 115-1983 - Test Procedures for Synchronous Machines).

(D) The performance characteristics required for AC exciter, rotating rectifier and static excitation systems are specified in Table 3-4.

Table 3-4 Synchronous generating unit excitation control system performance requirements

<u>Performance item</u>	<u>Units</u>	<u>Static excitation</u>	<u>AC exciter or rotating rectifier</u>	<u>Notes</u>
<u>generating unit field voltage rise time: Time for field voltage to rise from rated field voltage to excitation ceiling voltage following the application of a short duration impulse to the voltage reference.</u>	<u>Second</u>	<u>0.05 maximum</u>	<u>0.5 maximum</u>	<u>1 and 2</u>

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Deleted: nominal voltage and 0.329. Refer to Figure 3.2 for details.

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<u>Settling time with the generating unit unsynchronised following a disturbance equivalent to a 5% voltage step change in the sensed generating unit terminal.</u>	Second	1.5 maximum	2.5 maximum	2
<u>Settling time with the generating unit synchronised following a disturbance equivalent to a 5% voltage step change in the sensed generating unit terminal. It must be met at all operating points within the generating unit capability.</u>	Second	2.5 maximum	5 maximum	2
<u>Settling time following any disturbance which causes an excitation limiter to operate.</u>	Second	5 maximum	5 maximum	2

Notes:

- Rated field voltage is that voltage required to give nominal generating unit terminal voltage when the generating unit is operating at its rated maximum apparent power.
- For rotating rectifier excitation system where the field voltage is not accessible for direct measurement, the main exciter field voltage must comply with this clause.

(E) Where provided, a power system stabiliser must have:

- measurements of rotor speed and active power output of the generating unit as inputs; and
- an output limiter, which is continually adjustable over the range of -10% to +10% of stator voltage.

(4) Asynchronous generating systems

- A generating system, comprised of asynchronous generating units, must have a voltage and reactive power control system that has a power oscillation damping capability with sufficient flexibility to enable damping performance to be maximised, with the stabilising circuit responsive and adjustable over a frequency range from 0.1 Hz to 2.5 Hz. Any power system stabiliser must have measurements of power system frequency and active power output of the generating unit as inputs.
- A generating system, comprised of asynchronous generating units, must have a control system capable of achieving a minimum equivalent gain of 200.
- The performance characteristics required for the voltage and reactive power control systems of all asynchronous generating systems are specified in Table 3-5.

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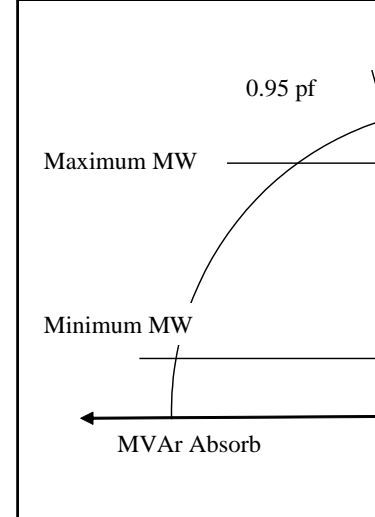


Figure 3.2 Induction generating unit. Minimum reactive capability requirements at connection point shown shaded¶

Each inverter coupled generating unit or converter coupled generating unit, while operating at any level of active power output between its registered maximum and minimum output level, must be capable of supplying reactive power such that at the inverter or converter connection point the lagging power factor is less than or equal to 0.95 and must be capable of absorbing reactive power at a leading power factor less than or equal to 0.95. Refer to Figure 3.3 for details.¶

Where necessary to meet the requirements of these Rules, the Network Service Provider may require an inverter generating unit to be capable of supplying a reactive power output coincident with rated active po...

Deleted: <#>Clause 3.3.3.1(e) is intended to facilitate flexibility in design by assisting proponents to connect generating units that, of themselves, are not capable of meeting the reactive power generation requirements specified in clause 3.3.3.1 through providing for the shortfall to be made up through some other means such as static VAR compensators, static synchronous compensators, inverters, thyristor switched capacitor banks and thyristor switched reactors.¶

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Table 3-5 Asynchronous generating system control system performance requirements

<u>Performance item</u>	<u>Units</u>	<u>Limiting value</u>	<u>Notes</u>
<u>Rise Time</u> : Time for the controlled parameter (<i>voltage or reactive power output</i>) to rise from the initial value to 90% of the change between the initial value and the final value following the application of a 5% step change to the <i>control system</i> reference.	<u>second</u>	<u>1.5 maximum</u>	<u>1 and 3</u>
<u>Settling time</u> of the controlled parameter with the <i>generating system connected to the transmission system</i> following a step change in the <i>control system</i> reference such that it is not large enough to cause saturation of the controlled output parameter. It must be met at all operating points within the <i>generating unit's</i> capability.	<u>second</u>	<u>2.5 maximum</u>	<u>1, 2 and 3</u>
<u>Settling time</u> of the controlled parameter with the <i>generating system connected to the transmission system</i> following any disturbance that is large enough to cause the maximum value of the controlled output parameter to be just exceeded.	<u>second</u>	<u>5 maximum</u>	<u>2 and 3</u>
<p>Notes:</p> <p>1. The step change is 5%, or a lesser value specified by the <i>Network Service Provider</i> such that it is the largest step change that results in the required <i>settling time</i> at the <i>connection point</i>.</p> <p>2. The step change is specified by the <i>Network Service Provider</i> such that it is the largest step change that results in the required <i>settling time</i> at the <i>connection point</i>.</p> <p>3. The step change is to be recorded for future assessment.</p>			

(D) The controlled parameters used to meet the requirements specified in Table 3-5 and measurement of the parameters must be agreed with the *Network Service Provider* as part of the *generator performance standard*.

(c) *Minimum generator performance standard*

(1) The *minimum generator performance standard* for *voltage and reactive power* control as it applies to different *generating systems*, is specified in Table 3-6

Table 3-6 Voltage and reactive power control minimum generator performance standard

<u>Type of generating system</u>	<u>Relevant requirement</u>
<u>generating system comprised solely of synchronous generating units.</u>	<u>Clause 3.3.7.4(c)(2) and clause 3.3.7.4(c)(3)</u>
<u>generating system comprised solely of asynchronous generating units.</u>	<u>Clause 3.3.7.4(c)(2) and clause 3.3.7.4(c)(4).</u>
<u>generating system comprised of synchronous generating units and asynchronous generating units.</u>	<u>Clause 3.3.7.4(c)(2) and:</u> <u>(a) for that part of the generating system comprised of synchronous generating units, clause 3.3.7.4(c)(3);</u> <u>(b) for that part of the generating system comprised of asynchronous generating units, clause 3.3.7.4(c)(4).</u>

(2) All generating systems

(A) A generating system must have equipment capabilities and control systems, including, if necessary, a power system stabiliser, sufficient to ensure that:

- (i) power system oscillations, for the frequencies of oscillation of the generating system against any other generating system or device, are adequately damped;
- (ii) operation of the generating system is adequately damped; and
- (iii) control systems can be sufficiently tested to establish their dynamic operational characteristics.

(B) A generating system must have a control system to regulate:

- (i) voltage; or
- (ii) either of reactive power or power factor, with the agreement of the Network Service Provider.

(C) A voltage control system for a generating system must:

- (i) regulate voltage to within 2% of the target setpoint, where that setpoint may be adjusted to incorporate any voltage droop or reactive current compensation agreed with the Network Service Provider; and
- (ii) allow the voltage target setpoint to be controllable in the range of at least 98% to 102% of the target voltage (as determined by the Network Service Provider) as specified by the Network Service Provider, subject to the reactive power

capability agreed with the Network Service Provider under clause 3.3.7.3.

(D) A generating system's reactive power or power factor control system must:

(i) regulate reactive power or power factor (as applicable) to within:

- for a generating system operating in reactive power mode, 5% of the rated maximum apparent power of the generating system from the target setpoint; or
- for a generating system operating in power factor mode, a power factor equivalent to 5% of the rated maximum apparent power of the generating system from the target setpoint;

(ii) allow the reactive power or power factor target setpoint to be continuously controllable across the reactive power capability defined in the relevant generator performance standard; and

(iii) have limiting devices to ensure that a voltage disturbance does not cause a generating unit to trip at the limits of its operating capability. The generating system must be capable of stable operation for indefinite periods while under the control of any limiter. Limiters must not detract from the performance of any stabilising circuits and must have settings applied, which are coordinated with all protection systems, and must be included as part of the generator performance standard.

(3) Synchronous generating systems

(A) Each synchronous generating unit within the generating system, with an excitation control system required to regulate voltage must:

(i) have excitation ceiling voltage of at least 1.5 times the excitation required to achieve generation at the nameplate rating for rated power factor, rated speed and nominal voltage; and

Note:
This clause does not align with the equivalent clause in Appendix 12 of the WEM Rules that applies to Transmission Connected Generating Systems. For the generation expected to connect under these Rules, this drafting is more appropriate.

(ii) subject to the ceiling voltage requirement, have a settling time of less than 7.5 seconds for a 5% voltage disturbance with the generating unit synchronised, subject to the generating unit operating at a point where such a voltage disturbance would not cause any limiting device to operate.

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Some of these requirements may be relaxed when it is considered that failure to comply would not have a material impact on safety or power system performance. A Generator seeking a relaxation of the requirements must apply for an exemption from the Rules.¶

Immunity to Frequency Excursions: ¶

A generating unit and a power station in which the generating unit is located must be capable of continuous uninterrupted operation within the power system frequency envelope specified in Figure 3.4. Operation for a period of at least 10 seconds is required each time the frequency is below 47.5 Hz. Operation for a period of at least 6 seconds is required each time the frequency is above 52 Hz. Below 47 Hz and above 52.5 Hz, instantaneous disconnection of generating units is permitted.¶

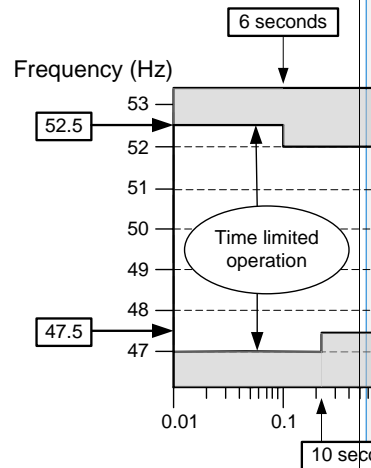


Figure 3.4 Off nominal frequency operation capability requirement for generating units¶

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2. These requirements must be met for all operating conditions, including ambient temperature. Unless operating restrictions have been agreed in accordance with clause 3.1(b) the Network Service Provider may assume the site specific maximum ambient temperature indicated in clause 3.3.3.1(a) when assessing compliance with the requirements of this clause.¶

Deleted: This requirement is intended for undervoltage situations where a generator is potentially exacerbating the problem.¶

Post Fault Voltage Control of a Connection Point: ¶
 Each generating unit

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(4) Asynchronous generating systems

(A) A generating system, comprised of asynchronous generating units, with a voltage control system must have a settling time of less than 7.5 seconds for a 5% voltage disturbance subject to the generating unit being electrically connected to the power system and operating at a point where such a voltage disturbance would not cause any limiting device to operate.

(d) Negotiation criteria

(1) A proposed negotiated generator performance standard must be the highest level that the generating system can reasonably achieve, including by installation of additional dynamic reactive power equipment, and through optimising its control systems.

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3.3.7.5 Active power control

(a) Common requirements

(1) All generating systems must be capable of meeting the dispatch systems requirements defined in the WEM Rules or, where the dispatch system requirements are deemed not relevant by the Network Service Provider, agree alternative arrangements with the Network Service Provider in consultation with AEMO.

(2) Any arrangements put in place as part of the arrangement for access to limit active power output in order to manage constraints on the network must be included as part of the generator performance standard.

(3) Each control system must be adequately damped.

(4) Any relevant disconnection settings must be included as part of the generator performance standard.

(5) Subject to energy source availability and any other agreement by the Network Service Provider, where dispatched by AEMO a generating system must be capable of maintaining its active power output consistent with its last received dispatch level in the event remote monitoring equipment, remote control equipment, or communication equipment are unavailable.

(6) The requirements in this clause 3.3.7.5 do not override any specific active power ramping requirements specified in clause 3.3.7.6 in response to frequency deviations.

(7) In relation to the application of this technical requirement, unless otherwise specified in the relevant clause, the requirements apply when operating at any active power and reactive power level as permitted or required under these Rules, and at all temperatures up to and including the maximum temperature.

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(b) Ideal generator performance standard

- (1) A non-intermittent generating system must have an active power control system capable of:
 - (A) maintaining and changing its active power output in accordance with target setpoints;
 - (B) ramping its active power output linearly from one target setpoint to another; and
 - (C) changing active power generation in response to a change in target setpoint at a rate not less than 5% of its rated maximum active power per minute.
- (2) Subject to energy source availability, an intermittent generating system must be able to change its active power output in accordance with target setpoints, and must not change its active power output at a rate greater than 10 MW per minute or 15% of the rated maximum active power per minute, whichever is the lower or as agreed with the Network Service Provider.

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(c) Minimum generator performance standard

- (1) A non-intermittent generating system must have an active power control system capable of maintaining and changing its active power output in accordance with a target setpoint, and must be capable of changing active power generation at a rate not less than 5% of its rated maximum active power per minute.
- (2) Subject to energy source availability, an intermittent generating system must ensure that any change of active power output in a 5 minute period does not exceed a value agreed with the Network Service Provider.

(d) Negotiation criteria

- (1) There are no negotiation criteria for this technical requirement.

3.3.7.6 Inertia and frequency control

(a) Common requirements

- (1) All control systems must be adequately damped.
- (2) The recorded maximum ramp rate for the generating system must be expressed as the change in active power (measured in MW) achievable across 6 seconds.
- (3) Any relevant disconnection settings must be provided as part of the generator performance standard.
- (4) Control systems on generating systems that control active power must include permanently installed and operational monitoring and recording equipment

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for key variables including each input and output, and equipment for testing the control system sufficient to establish its dynamic operational characteristics.

- (5) After having met the relevant requirements for altering and holding active power output to arrest and correct changes in power system frequency, the generating system, or generating units where relevant, must adhere to relevant requirements of clause 3.3.7.5 when returning to regular active power output.
- (6) Unless otherwise agreed by the Network Service Provider and AEMO, protection or other schemes that disconnect the generating system or elements of the generating system, must not be used in order to meet the requirements of this clause 3.3.7.6.
- (7) A generating system must:
- (A) have an automatic variable active power control characteristic; and
 - (B) where the generating system contains a generating unit with turbine control systems, it must include equipment for both speed and active power control.
- (8) All generating units, or the generating system as applicable, must operate in a mode in which it will automatically alter its active power output to arrest and correct to changes in power system frequency, unless instructed or otherwise approved for testing purposes by the Network Service Provider (in consultation with AEMO).
- (9) The frequency dead band on each generating unit, or the generating system, as applicable, must be no greater than +/-0.025 Hz around 50.0 Hz.
- (10) Unless otherwise stated in this clause 3.3.7.6, the overall required frequency response of each generating unit, or generating system as applicable, must be settable and be capable of:
- (A) automatically achieving an increase in active power output proportional to a change in power system frequency of not less than 5% of the maximum active power specified in the temperature dependency data provided under 3.3.7.2 for each 0.1 Hz reduction in power system frequency from the lower level of frequency dead band, provided the output is above the rated minimum active power; and
 - (B) automatically achieving a reduction in active power output proportional to a change in power system frequency of not less than 5% of the maximum active power specified in the temperature dependency data provided under 3.3.7.2 for each 0.1 Hz increase in power system frequency from the upper level of frequency dead band, provided this does not require operation below the rated minimum active power
- (11) The frequency response capability described in clause 3.3.7.6(a)(10);

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- (A) must not exhibit any step changes in active power as the power system frequency changes, unless otherwise agreed by the Network Service Provider under clause 3.3.7.6(a)(6);
 - (B) must commence responding with a delay no greater than that required to ensure stable operation or to allow for control system latency, as agreed by the Network Service Provider and AEMO;
 - (C) must not increase active power output in response to an increase in power system frequency; and
 - (D) must not decrease active power output in response to a decrease in power system frequency;
 - (12) In relation to the application of this technical requirement, the requirements apply at the connection point unless otherwise specified in the relevant clause, or the Network Service Provider determines that the technical requirement must be measured at a different location for the particular generating unit or generating system, in which case the measurement location must be recorded as part of the relevant generator performance standard.
 - (13) In relation to the application of this technical requirement, unless otherwise specified in the relevant clause, the requirements apply when operating at any active power and reactive power level as permitted or required under these Rules, and at all temperatures up to and including the maximum temperature.
- (b) Ideal generator performance standard
- (1) The ideal generator performance standard requires that control ranges, response times and sustain times are achieved for generating units, or the generating system as applicable, such that, subject to energy source availability:
 - (A) the required frequency response in clause 3.3.7.6(a)(10)(A) can be complied with for any initial output up to the maximum active power specified in the temperature dependency data provided under clause 3.3.7.2 for the relevant temperature;
 - (B) for synchronous generating systems, for any frequency disturbance where the change in power system frequency is sufficient to change the active power of the generating system by at least 5% of its rated maximum active power, the generating unit or generating system achieves at least 90% of the required frequency response specified in clause 3.3.7.6(a)(10) within 6 seconds; and
 - (C) for asynchronous generating systems, for any frequency disturbance where the change in power system frequency is sufficient to change the active power of the generating system by at least 5% of its rated maximum active power, the generating unit or generating system achieves at least 90% of the required frequency response specified in clause 3.3.7.6(a)(10) within 2 seconds;

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- (D) the required frequency response specified in clause 3.3.7.6(a)(10) is sustained for not less than a further 10 seconds beyond the timeframes specified in clause 3.3.7.6(b)(1)(B) and clause 3.3.7.6(b)(1)(C) as applicable, subject to a restoration of power system frequency in which case the active power output must be changed in proportion to the power system frequency in accordance with the required frequency response specified in clause 3.3.7.6(a)(10); and
- (E) each generating unit's or generating system's, as applicable, capability to sustain response beyond the timeframe specified in clause 3.3.7.6(b)(1)(D) must be included as part of the relevant generator performance standard.

(c) Minimum generator performance standard

(1) Subject to energy source availability, a generating system is required to have control ranges and response times for each generating unit, or generating systems as applicable, such that:

- (A) it is able to comply with the required frequency response specified in clause 3.3.7.6(a)(10)(A) for any initial output up to 85% of rated maximum active power output;
- (B) for initial outputs above 85% of rated maximum active power output, each generating unit's or generating system's, as applicable, response capability must be agreed with the Network Service Provider, and included as part of the relevant generator performance standard; and
- (C) for synchronous generating systems, for any frequency disturbance where the change in frequency is sufficient to change the active power of the generating system by at least 5% of its rated maximum active power output, the generating unit or generating system achieves at least 60% of the required frequency response specified in clause 3.3.7.6(a)(10) within 6 seconds, and 90% of the required frequency response specified in clause 3.3.7.6(a)(10) within 15 seconds;
- (D) for asynchronous generating systems, for any frequency disturbance where the change in frequency is sufficient to change the active power of the generating system by at least 5% of its rated maximum active power output, the generating unit or generating system achieves at least 60% of the required frequency response specified in clause 3.3.7.6(a)(10) within 6 seconds, and at least 90% of the required frequency response specified in clause 3.3.7.6(a)(10) within 15 seconds;
- (E) the required frequency response specified in clause 3.3.7.6(a)(10) is sustained for not less than a further 10 seconds beyond the latest timeframe specified in clause 3.3.7.6(c)(1)(C) and clause 3.3.7.6(c)(1)(D) as applicable, subject to a restoration of power

system frequency in which case the active power output must be changed in proportion to the power system frequency in accordance with the required frequency response specified in clause 3.3.7.6(a)(10); and

(F) each generating unit's or generating system's, as applicable, capability to sustain response beyond the timeframe specified in clause 3.3.7.6(c)(1)(E) must be included as part of the relevant generator performance standard.

(d) Negotiation criteria

(1) A negotiated generator performance standard must require that there is no requirement for a generating system to operate with an active power output:

(A) below its rated minimum active power in response to a rise in the power system frequency as measured at the connection point;

(B) above the relevant maximum active power output specified in the temperature dependency data provided under clause 3.3.7.2 for the relevant temperature, in response to a fall in the frequency of the power system as measured at the connection point; or

(C) to deliver a rate of change in output exceeding the specified maximum ramp rate.

(2) An additional source of inertia or frequency control may be included within the generating system. The control system for the additional source of inertia or frequency control must be coordinated with the remainder of the generating system and, together, must meet the performance requirements of the relevant technical requirements.

3.3.7.7 Frequency disturbance ride through

(a) Common requirements

(1) In relation to the application of this technical requirement, the requirements apply at the connection point unless otherwise specified in the relevant clause, or the Network Service Provider determines that the technical requirement must be measured at a different location for the particular generating unit or generating system, in which case the measurement location must be recorded as part of the relevant generator performance standard.

(2) Any relevant disconnection settings must be provided as part of the generator performance standard.

(3) Where the Network Service Provider and AEMO have agreed to a protection, or other scheme, that will disconnect the generating system or elements of the generating system, in order to satisfy the requirements of clause 3.3.7.6, the operation of those schemes based on their agreed parameters will not be taken to be a breach of the requirements of this clause 3.3.7.7.

(4) In relation to the application of this technical requirement, unless otherwise specified in the relevant clause, the requirements apply when operating at any active power and reactive power level as permitted or required under the other technical requirements in section 3.3.7.

(b) Ideal generator performance standard

(1) A generating system must maintain continuous uninterrupted operation where a power system disturbance causes the frequency to:

- (A) reach 52.5 Hz for a period of up to 6 seconds;
- (B) reach 52 Hz for a period of up to 2 minutes;
- (C) reach 51.5 Hz for a period of up to 5 minutes;
- (D) operate between 49.0 Hz to 51.0 Hz continuously;
- (E) reach 47.5 Hz for a period of up to 15 minutes; or
- (F) reach 47.0 Hz for a period of up to 2 minutes,

as shown in Figure 3-4.

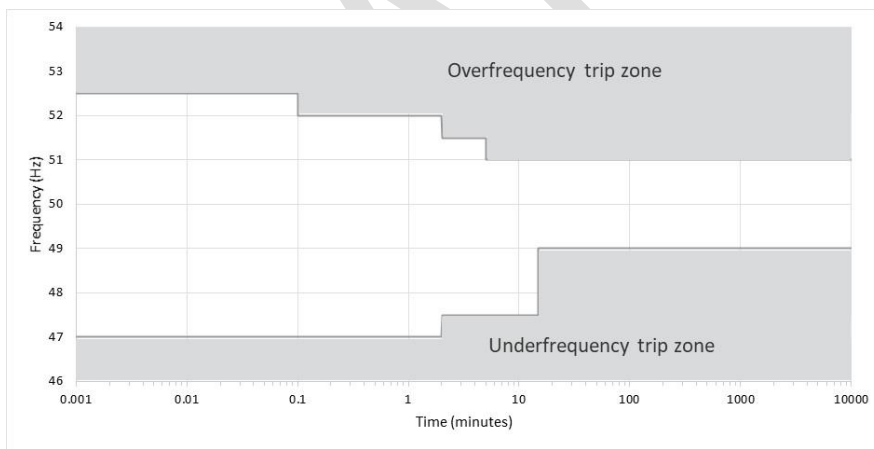


Figure 3-4 Frequency variations that a generating system must ride through to meet the ideal generator performance standard

(2) A generating system must maintain continuous uninterrupted operation where a power system disturbance causes the RoCoF to:

- (A) reach 4 Hz/s over 250 milliseconds during the disturbance; or
- (B) reach 3 Hz/s over one second during the disturbance,

as shown in Figure 3-5.

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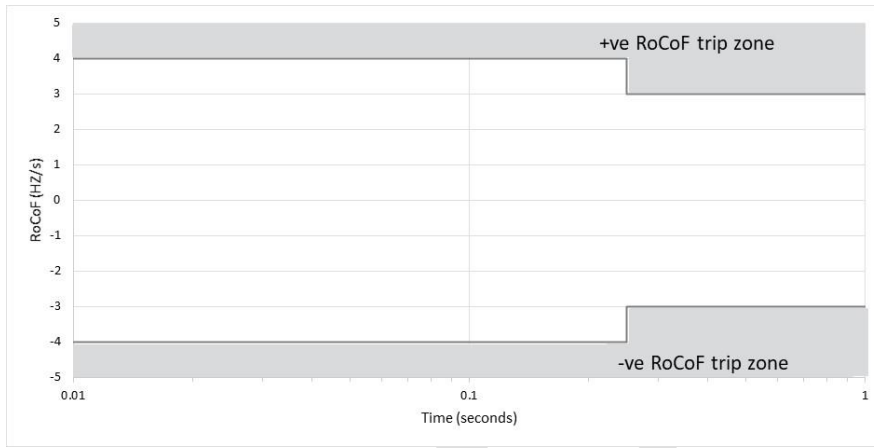


Figure 3-5 RoCoF that a generating system must ride through to meet the ideal generator performance standard

(c) Minimum generator performance standard

(1) A generating system must maintain continuous uninterrupted operation where a power system disturbance causes the frequency to:

- (A) reach 52.0 Hz for a period of up to 2 minutes;
- (B) operate between 49.0 Hz to 51.0 Hz continuously;
- (C) reach 48.0 Hz for a period of at least 15 minutes;
- (D) reach 47.5 Hz for a period of at least 5 minutes; or
- (E) reach 47.0 Hz for a period of at least 10 seconds.

as shown in Figure 3-6.

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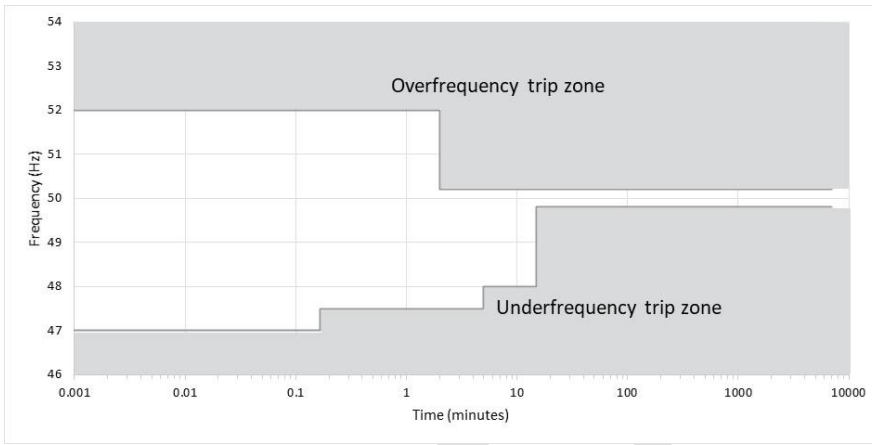


Figure 3-6 *Frequency variations that a generating system must ride through to meet the minimum generator performance standard*

(2) *A generating system must maintain continuous uninterrupted operation where a power system disturbance causes the RoCoF to:*

(A) *reach 2 Hz/s over 250 milliseconds during the disturbance; or*

(B) *reach 1 Hz/s over one second during the disturbance,*

as shown in Figure 3-7.

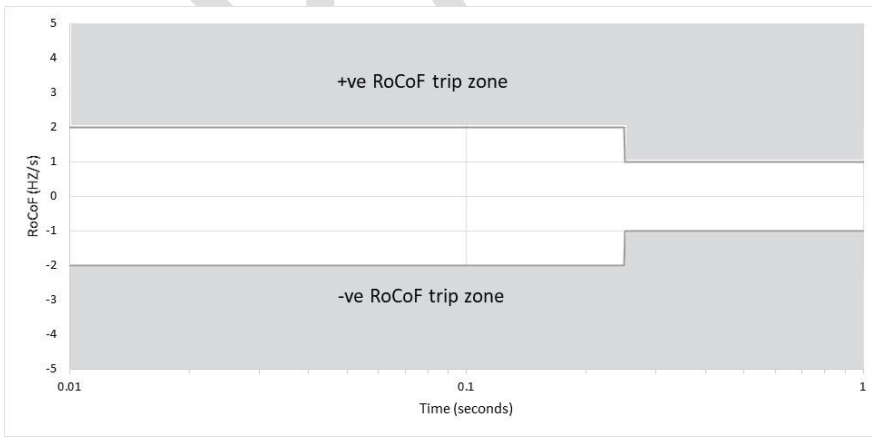


Figure 3-7 *RoCoF that a generating system must ride through to meet the minimum generator performance standard*

(d) *Negotiation criteria*

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- (1) A proposed negotiated generator performance standard for disturbance ride through for a frequency disturbance may be accepted provided the Network Service Provider agrees that the frequency would be unlikely to fall below the lower bound of the single contingency event band specified in the frequency operating standard.

3.3.7.8 Voltage disturbance ride through

(a) Common requirements

- (1) In relation to the application of this technical requirement, the requirements apply at the connection point unless otherwise specified in the relevant clause, or the Network Service Provider determines that the technical requirement must be measured at a different location for the particular generating unit or generating system, in which case the measurement location must be recorded as part of the relevant generator performance standard.
- (2) The generating system and each of its operating generating units is required to remain in continuous uninterrupted operation while the connection point voltage remains within 90% to 110% of nominal voltage for generating systems connected to the transmission system and 85% to 110% of nominal voltage for generating systems connected to the distribution system.
- (3) Any relevant disconnection settings must be provided as part of the generator performance standard.
- (4) In relation to the application of this technical requirement, unless otherwise specified in the relevant clause, the requirements apply when operating at any active power and reactive power level as permitted or required under these Rules.

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(b) Ideal generator performance standard

- (1) A generating system must maintain continuous uninterrupted operation where a power system disturbance causes the voltage to vary within the following ranges:
- (A) voltage does not exceed 130% of nominal voltage for more than 0.02 seconds after T(ov);
- (B) voltage does not exceed 120% of nominal voltage for more than 2.0 seconds after T(ov);
- (C) voltage does not exceed 115% of nominal voltage for more than 20.0 seconds after T(ov);
- (D) voltage does not exceed 110% of nominal voltage for more than 20.0 minutes after T(ov);
- (E) voltage remains at 0% of nominal voltage for no more than 450 milliseconds after T(uv);

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- (F) voltage does not stay below 70% of nominal voltage for more than 450 milliseconds after T(uv);
- (G) voltage does not stay below 80% of nominal voltage for more than 2.0 seconds after T(uv); and
- (H) voltage does not stay below 90% of the nominal transmission voltage or 85% of the nominal distribution voltage for more than 10.0 seconds after T(uv).

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Where:

T(ov) means a point in time when the voltage first varied above 110% of nominal voltage before returning to between 85% and 110% of nominal distribution voltage or between 90% and 110% of nominal transmission voltage; and

T(uv) means a point in time when the voltage first varied below 90% of nominal voltage before returning to between 85% and 110% of nominal distribution voltage or between 90% and 110% of nominal transmission voltage.

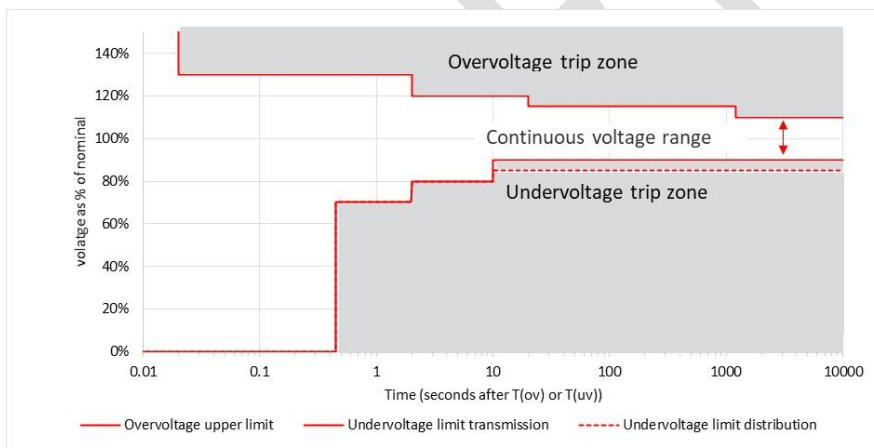


Figure 3-8 Voltage variations that a generating system must ride through to meet the ideal generator performance standard

(c) Minimum generator performance standard

(1) A generating system must maintain continuous uninterrupted operation where a power system disturbance causes the voltage to vary within the following ranges:

- (A) voltage does not exceed 120% of nominal voltage after T(ov);
- (B) voltage does not exceed 115% of nominal voltage for more than 0.1 seconds after T(ov);

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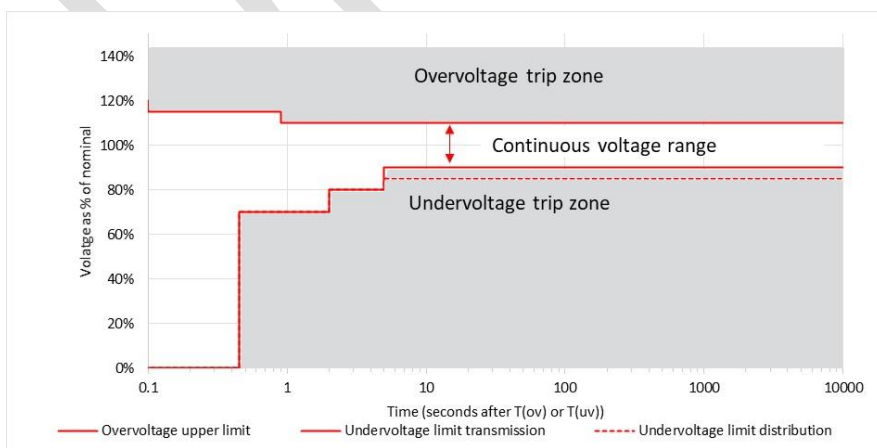
- (C) voltage does not exceed 110% of nominal voltage for more than 0.9 seconds after T(ov);
- (D) voltage remains at 0% of nominal voltage for no more than 450 milliseconds after T(uv) subject to clause 3.3.7.8(c)(2);
- (E) voltage does not stay below 70% of nominal voltage for more than 450 milliseconds after T(uv);
- (F) voltage does not stay below 80% of nominal voltage for more than 2.0 seconds after T(uv); and
- (G) voltage does not stay below 90% of the nominal transmission voltage or 85% of the nominal distribution voltage for more than 5.0 seconds after T(uv).

Where:

T(ov) means a point in time when the voltage first varied above 110% of nominal voltage before returning to between 85% and 110% of nominal distribution voltage or between 90% and 110% of nominal transmission voltage; and

T(uv) means a point in time when the voltage first varied below 90% of nominal voltage before returning to between 85% and 110% of nominal distribution voltage or between 90% and 110% of nominal transmission voltage.

- (2) The duration of the zero percent voltage level may be relaxed through agreement with the Network Service Provider, but shall not be lower than the maximum total fault clearance time with no circuit breaker fail as specified in these Rules.
- (3) Any operational arrangements necessary to ensure the generating system and each of its operating generating units will meet its generator performance standard must be provided as part of the generator performance standard.



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Figure 3-9 Voltage variations that a generating system must ride through to meet the minimum generator performance standard

(d) Negotiation criteria

- (1) There are no negotiation criteria for this technical requirement.

3.3.7.9 Multiple disturbance ride through

Note:

This technical requirement uses the term 'fault' to include a fault of the relevant type having a metallic conducting path.

(a) Common requirements

- (1) The common requirements for disturbance ride through for multiple disturbances as they apply to different generating systems, are specified in Table 3-7.

Table 3-7 Common requirements for disturbance ride through for multiple disturbances

Type of generating system	Relevant requirement
<u>generating system comprised solely of synchronous generating units.</u>	<u>Clause 3.3.7.9(a)(2), clause 3.3.7.9(a)(3), clause 3.3.7.9(a)(4), and clause 3.3.7.9(a)(6)</u>
<u>generating system comprised solely of asynchronous generating units.</u>	<u>Clause 3.3.7.9(a)(2), clause 3.3.7.9(a)(3), clause 3.3.7.9(a)(5), and clause 3.3.7.9(a)(6)</u>
<u>generating system comprised of synchronous generating units and asynchronous generating units.</u>	<u>Clause 3.3.7.9(a)(2), clause 3.3.7.9(a)(3), clause 3.3.7.9(a)(6) and:</u> <u>(a) for that part of the generating system comprised of synchronous generating units, clause 3.3.7.9(a)(4);</u> <u>(b) for that part of the generating system comprised of asynchronous generating units, clause 3.3.7.9(a)(5).</u>

- (2) Any relevant disconnection settings must be provided as part of the generator performance standard.

(3) All generating systems

- (A) The generator performance standard must include any operational arrangements to ensure the generating system, including all operating generating units, will meet their agreed performance levels under abnormal network or generating system conditions.

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- (B) When assessing multiple disturbances, a fault that is re-established following operation of automatic reclose protection scheme shall be counted as a separate disturbance.

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(4) Synchronous generating systems

(A) For a generating system comprised solely of synchronous generating units, the reactive current contribution, must equal or exceed 250% of the maximum continuous current of the generating system. For a synchronous generating unit in any other generating system, the reactive current contribution must equal or exceed 250% of the maximum continuous current of that synchronous generating unit.

(5) Asynchronous generating systems

(A) For a generating system comprised of asynchronous generating units:

- (i) the reactive current contribution must equal or exceed the maximum continuous current of the generating system, including all operating asynchronous generating units;
- (ii) the reactive current contribution and voltage deviation may be measured at a location other than the connection point (including within the relevant generating system) where agreed with the Network Service Provider, in which case the reactive current contribution and voltage deviation will be assessed at that agreed location;
- (iii) the reactive current contribution required may be calculated using phase to phase, phase to ground or sequence components of voltages. The ratio of the negative sequence to positive sequence components of the reactive current contribution must be agreed with the Network Service Provider for the types of disturbances specified in this technical requirement; and
- (iv) the generator performance standard must record all conditions (which may include temperature) considered relevant by the Network Service Provider under which the reactive current response is required.

(6) Measurement location and temperature limitations

(A) In relation to the application of this technical requirement, the requirements apply at the connection point unless otherwise specified in the relevant clause, or the Network Service Provider or AEMO determines that the technical requirement must be measured at a different location for the particular generating unit or generating system, in which case the measurement location must be recorded as part of the relevant generator performance standard.

(B) In relation to the application of this technical requirement, unless otherwise specified in the relevant clause, the requirements apply when operating at any active power and reactive power level as

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permitted or required under the other technical requirements in these Rules, and the User responsible for the generating system must specify any thermal limitations that may limit the output of the generating system or generating unit in relation to this technical requirement

(b) Ideal generator performance standard

(1) The ideal generator performance standard as it applies to different generating systems, is specified in Table 3-8:

Table 3-8: Disturbance ride through for multiple disturbances ideal generator performance standard

<u>Type of generating system</u>	<u>Relevant requirement</u>
<u>generating system comprised solely of synchronous generating units.</u>	<u>Clause 3.3.7.9(b)(2) and clause 3.3.7.9(b)(3).</u>
<u>generating system comprised solely of asynchronous generating units.</u>	<u>Clause 3.3.7.9(b)(2) and clause 3.3.7.9(b)(4).</u>
<u>generating system comprised of synchronous generating units and asynchronous generating units.</u>	<u>Clause 3.3.7.9(b)(2) and:</u> <u>(a) for that part of the generating system comprised of synchronous generating units, clause 3.3.7.9(b)(3);</u> <u>(b) for that part of the generating system comprised of asynchronous generating units, 3.3.7.9(b)(4).</u>

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(2) All generating systems

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(A) A generating system and each of its operating generating units must remain in continuous uninterrupted operation for any disturbances caused by:

- (i) a credible contingency;
- (ii) a three phase fault in a transmission system cleared by all relevant primary protection systems; and
- (iii) a two phase to ground, phase to phase or phase to ground fault in a transmission or distribution system or a three phase fault in a distribution system cleared in:
 - the longest time expected to be taken for a relevant breaker fail protection system to clear the fault; or
 - if a relevant breaker fail protection system is not installed, the greater of 450 milliseconds and the

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longest time expected to be taken for all relevant primary protection systems to clear the fault,

provided that the event is not one that would disconnect the generating unit from the power system by removing network elements from service or as a result of the operation of an existing inter-trip, protection scheme or runback scheme approved by the Network Service Provider.

(B) A generating system and each of its operating generating units must remain in continuous uninterrupted operation for a series of up to 15 disturbances within any 5 minute period.

(3) Synchronous generating systems

(A) Subject to any changed power system conditions or energy source availability beyond the operator of the generating system's reasonable control, a generating system comprised of synchronous generating units, in respect of the faults referred to in clause 3.3.7.9(b)(2)(A), must supply to, or absorb from, the network:

(i) to assist the maintenance of power system voltages during the fault, capacitive reactive current of at least the greater of its pre-disturbance reactive current and 4% of the maximum continuous current of the generating system including all operating synchronous generating units (in the absence of a disturbance) for each 1% reduction (from the level existing just prior to the fault) of connection point voltage or another agreed location in the power system (including within the generating system) during the fault;

(ii) after clearance of the fault, reactive power sufficient to ensure that the connection point voltage or another agreed location in the power system (including within the generating system) is within the range for continuous uninterrupted operation, and

(iii) from 100 milliseconds after clearance of the fault, active power of at least 95% of the level existing just prior to the fault.

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(4) Asynchronous generating systems

(A) Subject to any changed power system conditions or energy source availability beyond the operator of the generation system's reasonable control, a generating system comprised of asynchronous generating units, for the faults referred to in clause 3.3.7.9(b)(2)(A), must have equipment capable of supplying to, or absorbing from, the network:

(i) to assist the maintenance of power system voltages during the fault:

- capacitive reactive current in addition to its pre-disturbance level of at least 4% of the maximum

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continuous current of the generating system including all operating asynchronous generating units (in the absence of a disturbance) for each 1% reduction of voltage at the connection point below the under-voltage range of 85% to 90% of nominal voltage, except where a generating system is directly connected to the power system with no step-up or connection transformer and voltage at the connection point is 5% or lower of nominal voltage; and

- inductive reactive current in addition to its pre-disturbance level of at least 6% of the maximum continuous current of the generating system including all operating asynchronous generating units (in the absence of a disturbance) for each 1% increase of voltage at the connection point the over-voltage range of 110% to 115% of nominal voltage,

during the disturbance and maintained until connection point voltage recovers to between 90% and 110% of nominal voltage, or such other range agreed with the Network Service Provider; and

- (ii) from 100 milliseconds after clearance of the fault, active power of at least 95% of the level existing just prior to the fault.

(B) The under-voltage and over-voltage range referred to in clause 3.3.7.9(b)(4)(A)(i) may be varied with the agreement of the Network Service Provider (provided the magnitude of the range between the upper and lower bounds remains at 5%).

(C) The reactive current response referred to in clause 3.3.7.9(b)(4)(A)(i) must have a rise time of no greater than 40 milliseconds and a settling time of no greater than 70 milliseconds and must be adequately damped.

(D) Subject to a generating system's thermal limitations as specified in clause 3.3.7.8(a)(4) and energy source availability, a generating system must make available at all times:

- (i) sufficient current to maintain rated maximum apparent power of the generating system including all operating generating units (in the absence of a disturbance), for all connection point voltages above 115% (or otherwise, above the agreed over-voltage range); and

Note:

This clause does not align with the equivalent clause in Appendix 12 of the WEM Rules that applies to Transmission Connected Generating Systems. For the generation expected to connect under these Rules, this drafting is more appropriate.

Moved (insertion) [28]

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(ii) the maximum continuous current of the generating system including all operating generating units (in the absence of a disturbance) for all connection point voltages below 85% (or otherwise, below the agreed under-voltage range),

despite the amount of reactive current injected or absorbed during voltage disturbances, except that AEMO and the Network Service Provider may agree limits on active current injection where required to maintain power system security and/or the quality of supply to other equipment connected to the power system.

(c) Minimum generator performance standard

(1) The minimum generator performance standard as it applies to different generating systems, is specified in Table 3-9.

Table 3-9 Disturbance ride through for multiple disturbances minimum generator performance standard

Type of generating system	Relevant requirement
<u>generating system comprised solely of synchronous generating units.</u>	<u>Clause 3.3.7.9(c)(2) and clause 3.3.7.9(c)(3).</u>
<u>generating system comprised solely of asynchronous generating units.</u>	<u>Clause 3.3.7.9(c)(2) and clause 3.3.7.9(c)(4).</u>
<u>generating system comprised of synchronous generating units and asynchronous generating units.</u>	<u>Clause 3.3.7.9(c)(2) and:</u> <u>(a) for that part of the generating system comprised of synchronous generating units, clause 3.3.7.9(c)(3);</u> <u>(b) for that part of the generating system comprised of asynchronous generating units, clause 3.3.7.9(c)(4).</u>

(2) All generating systems

(A) A generating system and each of its operating generating units must remain in continuous uninterrupted operation for any disturbance caused by:

Deleted: if:

(i) a credible contingency; or

Deleted: the generating unit is not disconnected from the

(ii) a single phase to ground, phase to phase or two phase to ground fault or three phase fault in a transmission or distribution system cleared in the longest time expected to be taken for all relevant primary protection systems to clear the fault,

Deleted: due to

Deleted: system

provided that the event is not one that would disconnect the generating unit from the power system by removing network elements from service or as a result of the operation of an inter-

Deleted: ;

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trip, protection scheme or runback scheme approved by the Network Service Provider.

(B) A generating system and each of its operating generating units must remain in continuous uninterrupted operation for a series of up to 6 disturbances within any 5 minute period.

(3) Synchronous generating systems

(A) After clearance of a fault, a generating system comprised of synchronous generating units, in respect of the faults referred to in clause 3.3.7.9(c)(2)(A) must:

- (i) deliver active power to the network, and supply or absorb leading or lagging reactive power, sufficient to ensure that the connection point voltage or another location in the power system (including within the generating system), as specified by the Network Service Provider, is within the range for continuous uninterrupted operation agreed under the relevant generator performance standard; and
- (ii) return to at least 95% of the pre-fault active power output within a period of time agreed by the Network Service Provider.

(4) Asynchronous generating systems

(A) Subject to a generating system's thermal limitations as specified in clause 3.3.7.8(a)(4) and any changed power system conditions or energy source availability beyond the operator of the generating system's reasonable control, a generating system comprised of asynchronous generating units, for the faults referred to in clause 3.3.7.9(c)(2)(A), must have equipment capable of supplying to, or absorbing from, the network:

- (i) to assist the maintenance of power system voltages during the fault:
 - capacitive reactive current in addition to its pre-disturbance level of at least 2% of the maximum continuous current of the generating system including all operating asynchronous generating units (in the absence of a disturbance) for each 1% reduction of voltage at the connection point below a specified threshold level agreed by the Network Service Provider within the under-voltage range of 80% to 90% of nominal voltage, except where:
 - voltage at the connection point is 15% or lower of nominal voltage; or
 - the generating system is directly connected to the power system with no step-up or connection

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Deleted: <#>the active power output returns to the generating unit's pre-fault electric power output within 200 milliseconds after the voltage has returned to between 80% and 110% of nominal voltage. In making this assessment allowances may be made for:
 ¶ any variation in active power output for non-synchronous generating units due to variation in the primary source of energy; and
 ¶ any variation in active power output of synchronous generating units due to any reduction in the power system frequency in accordance with the registered capability of the generating unit.
 ¶ the reactive power control mode in which the generating unit was operating prior to the credible contingency event occurring does not change, unless it is required by clause 3.3.3.3(f).
Sudden Reduction in Active Power Requirement ¶
 A generating unit must be capable of

Deleted: <#>as defined in clause 3.3.3.3(h)

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transformer and voltage at the connection point is 20% or lower of nominal voltage; and

- inductive reactive current in addition to its pre-disturbance level of at least 2% of the maximum continuous current of the generating system including all operating asynchronous generating units (in the absence of a disturbance) for each 1% increase of voltage at the connection point above a specified threshold level agreed by the Network Service Provider within the over-voltage range of 110% to 120% of nominal voltage,

during the disturbance and maintained until the connection point voltage recovers to between 90% and 110% of nominal voltage, or such other range agreed with the Network Service Provider; and

- (ii) returning to at least 95% of the pre-fault active power output, after clearance of the fault, within a period of time agreed by the Network Service Provider.

(B) The under-voltage and over-voltage range referred to in clause 3.3.7.9(c)(4)(A) may be varied with the agreement of the Network Service Provider (provided the magnitude of the range between the upper and lower bounds remains at 10%).

(C) Where the Network Service Provider require the generating system to sustain a response duration of 2 seconds or less, the reactive current response referred to in clause 3.3.7.9(c)(4)(A) must have a rise time of no greater than 40.0 milliseconds and a settling time of no greater than 70.0 milliseconds and must be adequately damped.

(D) Where the Network Service Provider requires the generating system to sustain a response duration of greater than 2 seconds, the reactive current rise time and settling time must be as soon as practicable and must be adequately damped. The rise time and settling time must be provided as part of the generator performance standard.

(d) Negotiation criteria

- (1) A proposed negotiated generator performance standard may be accepted if the connection of the generating system at the proposed performance level would not cause other generating systems or loads to trip as a result of an event, when they would otherwise not have tripped for the same event.

3.3.7.10 Disturbance ride through for partial load rejection

(a) Common requirements

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(1) In relation to the application of this technical requirement, the requirements apply at the *connection point* unless otherwise specified in the relevant clause, or the *Network Service Provider* determines that the technical requirement must be measured at a different location for the particular *generating unit* or *generating system*, in which case the measurement location must be recorded as part of the relevant *generator performance standard*.

(b) In relation to the application of this technical requirement, unless otherwise specified in the relevant clause, the requirements apply when operating at any *active power* and *reactive power* level as permitted or required under the other technical requirements in these Rules, and at all temperatures up to and including the *maximum temperature*.

(c) *Ideal generator performance standard*

(1) A *generating system* and each of its operating *generating units* must be capable of *continuous uninterrupted operation* during and following a sudden reduction in required *active power generation* imposed from the *power system*, provided that the reduction is less than 30% of the *generating system's rated maximum active power* and the required *active power generation* remains above the *generating system's rated minimum active power output level*.

Deleted: generator machine's nameplate rating

Deleted: unit's registered

Deleted: generation capability.

(d) *Minimum generator performance standard*

(1) A *generating system* must be capable of *continuous uninterrupted operation* during and following a sudden reduction in required *active power generation* imposed from the *power system*, provided that the reduction is less than 5% of the *generating system's rated maximum active power* and the required *active power generation* remains above the *generating system's rated minimum active power output level*.

Deleted: <#>Ramping Rates¶

Deleted: scheduled

Deleted: unit, in a thermally stable state,

Deleted: increasing or decreasing

Deleted: in response to a manually or remotely initiated order to change

Deleted: level of generated active

Deleted: at a rate not

Deleted: generator machine's nameplate rating per minute.¶ A power station that is not subject to dispatch by System Management must not increase or decrease its

Moved up [16]: Note:¶

Deleted: at a rate greater than 10MW per minute or 15% of the power station's aggregate nameplate rating per minute, whichever is the greater, except when more rapid changes are necessary due to ...

Deleted: strength of the energy source moving outside the power station's design range.¶

Deleted: This requirement would normally be incorporated into the design of the ...

Deleted: controller

(e) *Negotiation criteria*

(1) There are no *negotiation criteria* for this technical requirement.

3.3.7.11 Disturbance ride through for quality of supply

(a) *Common requirements*

(1) There are no *common requirements* for this technical requirement.

(b) *Ideal generator performance standard*

(1) The *ideal generator performance standard* is the same as the *minimum generator performance standard* for disturbance ride through for *quality of supply*.

(c) *Minimum generator performance standard*

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- (1) A generating system, including each of its operating generating units and reactive equipment, must not disconnect from the power system as a result of voltage fluctuation, harmonic voltage distortion and voltage unbalance conditions at the connection point within the levels specified for flicker, harmonics and negative phase sequence voltage in the Rules.

(d) Negotiation criteria

- (1) There are no negotiation criteria for this technical requirement.

3.3.7.12 Quality of electricity generated

(a) Common requirements

- (1) A generating system, when generating and when not generating, must not produce, at its connection point for generation, voltage imbalance greater than the limits determined by the Network Service Provider as necessary to achieve the requirements specified for negative phase sequence voltage at the connection point in these Rules.

(b) Ideal generator performance standard

- (1) A generating system, when generating and when not generating, must not produce at any of its connection points for generation:

- (A) voltage fluctuation greater than the limits allocated by the Network Service Provider that are no more onerous than the lesser of the acceptance levels determined in accordance with either of the stage 1 or the stage 2 evaluation procedures defined in AS/NZS 61000.3.7 (2001); and
- (B) harmonic voltage distortion greater than emission limits allocated by the Network Service Provider that are no more onerous than the lesser of the acceptance levels determined in accordance with either of the stage 1 or the stage 2 evaluation procedures defined in AS/NZS 61000.3.6 (2001).

(c) Minimum generator performance standard

- (1) A generating system, when generating and when not generating, must not produce at any of its connection points for generation:
- (A) voltage fluctuations greater than limits determined by the Network Service Provider through the negotiation using the stage 3 evaluation procedure defined in AS/NZS 61000.3.7 (2001), with the Generator responsible for the large generating system agreeing to fund any works necessary to mitigate adverse effects from accepting this emission level; and
- (B) harmonic voltage distortion greater than emission limits determined by the Network Service Provider through the

negotiation using the Stage 3 evaluation procedure defined in AS/NZS 61000.3.6 (2001) with the Generator responsible for the generating system agreeing to fund any works necessary to mitigate adverse effects from accepting this emission level.

(d) Negotiation criteria

- (1) A proposed negotiated generator performance standard must not prevent the Network Service Provider meeting each SWIS operating standard or contractual obligations to existing holders of arrangements for access.

3.3.8 Remote monitoring requirements

- (a) The Generator must provide and install remote monitoring equipment to enable the Network Service Provider or AEMO to monitor the performance of a generating unit (including its dynamic performance) remotely, in real time for control, planning or power system security.
- (b) All remote monitoring equipment installed, upgraded, modified or replaced (as applicable) under clause 3.3.8(a) must conform to the 'Generating System Control and Monitoring Guideline' developed by the Network Service Provider in accordance with clause 5.8.1(b) as it applies to remote monitoring equipment and be compatible with the Network Service Provider's and AEMO's SCADA system, including the requirements of the nomenclature standards.
- (c) The remote monitoring equipment must provide for the signals specified in the 'Generating System Control and Monitoring Guideline' and such other information required by the Network Service Provider and AEMO.
- (d) The remote monitoring equipment must be kept available at all times, subject to outages as agreed by the Network Service Provider and, if applicable, AEMO.

3.3.9 Remote control requirements

- (a) The Network Service Provider or AEMO may, for any generating system which may be unattended when connected to the power system, require remote control equipment to be installed in order to enable the Network Service Provider or AEMO to disconnect a generating system from the power system.
- (b) All remote control equipment installed, upgraded, modified or replaced (as applicable) under clause 3.3.9(a) must conform to the 'Generating System Control and Monitoring Guideline' developed by the Network Service Provider in accordance with clause 5.8.1(b) of these Rules as it applies to remote control equipment and be compatible with the Network Service Provider's and AEMO's SCADA system, including the requirements of the nomenclature standards.
- (c) The remote control equipment must be kept available at all times, subject to outages as agreed by AEMO and the Network Service Provider.

3.3.10 Communication equipment requirements

- (a) A Generator responsible for the large generating system must provide and maintain communications paths (with redundancy consistent with the 'Generating System Control and Monitoring Guideline') between the remote monitoring equipment and remote communication equipment installed at any of its generating units to a communications interface at the relevant power station and in a location acceptable to the Network Service Provider. Communications systems between this communications interface and the Network Service Provider's control centre are the responsibility of the Network Service Provider, unless otherwise agreed.

Note:

For connections to the distribution system, the nominated location is in the zone substation from which the distribution feeder to which the User is connected emanates.

- (b) A Generator responsible for the large generating system must provide and maintain a primary speech communication channel by means of which routine and emergency control telephone calls may be established between the operator of the generation system and AEMO or the Network Service Provider, whichever is applicable.
- (c) The primary speech communication channel must meet any requirements specified in the 'Generating System Control and Monitoring Guideline'.
- (d) Where the public switched telephone network is to be used as the primary speech communication channel, a sole-purpose connection must be provided, which must be used only for operational communications.
- (e) The communications paths to any applicable remote monitoring equipment or remote communication equipment must be kept available at all times, subject to outages as agreed by AEMO.
- (f) The primary speech communication channel must be maintained in good working order.

3.3.11 Generation system model

- (a) All modelling data described in the WEM Procedure referred to in clause 3A.4.2 of the WEM Rules must be provided to the Network Service Provider within the timeframes specified in those guidelines, as updated from time to time.
- (b) The modelling data provided must be sufficient to enable the Network Service Provider or AEMO to predict the output of the generation system under all power system conditions.
- (c) The observed performance of the generating system must match the predicted performance of the generating system using the generation system model, as assessed by the Network Service Provider or AEMO.
- (d) The Generator must provide updates to the generation system model in accordance with the 'Generator and Load Model Guidelines', as updated from time to time.

3.3.12 Safe shutdown without external electricity supply

A generating unit must be capable of being safely shut down without an electricity supply being available from the transmission or distribution system at the relevant connection point.

Deleted: SECTION
Deleted: Shutdown
Deleted: External Electricity Supply

3.3.13 Restart following restoration of external electricity supply

- (a) A generating unit must be capable of being restarted and synchronised to the transmission or distribution system without unreasonable delay following restoration of external supply from the transmission or distribution system at the relevant connection point, after being without external supply for 2 hours or less, provided that the generating unit was not disconnected due to an internal fault.

Deleted: Following Restoration
Deleted: External Electricity Supply

Note:

Examples of unreasonable delay in the restart of a generating unit are:

- Delays not inherent in the design of the relevant start-up facilities and which could reasonably have been eliminated by the relevant Generator; and
- The start-up facilities for a new generating unit not being designed to minimise start up time delays for the generating unit following loss of external supplies for 2 hours or less and which could reasonably have been eliminated by the relevant Generator.

Deleted: delays
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- (b) The maximum restart time, agreed by the Generator and the Network Service Provider, must be specified in the relevant connection agreement.

Deleted: Protection of
Deleted: Units from Power System Disturbances

3.3.14 Generating unit transformer

- (a) Transformer impedance:

The maximum permitted impedance of a generating unit transformer is 20% of the Generator's MVA rating.

Deleted: <#>A generating unit may be disconnected automatically from the transmission or distribution system in response to abnormal conditions arising from the behaviour of the power system. However, a generating unit must not be disconnected if the power system conditions at the connection point remain within the envelope described in clause 3.3.3.3 for continuous uninterrupted operation.¶ The abnormal conditions referred to in clause 3.3.3.8(a) include:¶
loss of synchronism;¶
high or low frequency outside the generator off-nominal frequency operation capability requirements specified in Figure 3.4;¶
sustained excessive generating unit stator current that cannot be automatically controlled;¶
high or low stator voltage outside generator machine rating; ¶
voltage to frequency ratio outside generator machine rating;¶
negative phase sequence current outside generator machine rating; and¶
any similar condition agreed between the Generator and the Network Service Provider after consultation with System Management.¶
The actual design and settings of the protection equipment installed in order to disconnect a generating unit in accordance with clause 3.3.3.8(a) must be consistent with power system performance requirements specified in section 2 and must be approved by the Network Service Provider. ¶
Generating Unit

- (b) Vector group:

A generating unit transformer's vector group must be agreed with the Network Service Provider. The vector group must be compatible with the power system at the connection point and preference may be given to vector groups with a zero sequence opening between high voltage and low voltage windings.

Deleted: <#>Transformer Impedance:¶
Deleted: <#>generator's
Deleted: Group
Deleted: Changing

- (c) Tap changing:

A generating unit transformer of a generating unit or wind farm must be capable of on-load tap-changing within the range specified in the relevant connection agreement.

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3.3.15 De-energisation of Generator circuits

3.3.15.1 De-energisation of transmission connected large generating systems

The Network Service Provider's relevant circuit breaker may be used as a point of de-energisation, instead of the main switch specified in clause 3.2.2 provided that the transmission connected Generator meets the following requirements:

- (a) the *Generator* must be able to synchronise any parallel *generating equipment* to the *transmission system* across a circuit breaker owned by the *Generator*;
- (b) the *Generator* must be able to clear a fault on its equipment:
- (1) without adversely affecting any other *User* or potential *User*; and
 - (2) within the *fault clearance times* specified in clause 3.5.2(c);
 - (3) provided that the *substation* where the *Network Service Provider's* relevant circuit breaker is located is in its normal operating configuration.
- (c) if:
- (1) the *Generator* has only one circuit at the *connection point*; and
 - (2) the *Network Service Provider's* relevant circuit breaker is located in a meshed *substation*,
- and if:
- (3) the *Generator's facilities* are continuously manned with personnel capable of resetting a hand-reset *protection relay*; or
 - (4) the *Generator's facilities* have self-resetting relays,
- then the *Generator* may de-energise its equipment by sending a trip signal to the *Network Service Provider's* relevant circuit breaker.
- (d) the *Generator* must own a visible point of isolation between the *Network Service Provider's* relevant circuit breaker and the *Generator's* equipment for each piece of equipment *connected* to the *transmission system*.

Note:

Under the relevant *connection agreement*, the *Network Service Provider* will require the *Generator* to indemnify the *Network Service Provider* from any and all liability for any direct or indirect damage caused to [its equipment or facility](#) as a result of the *Generator's* electing to use any *Network Service Provider's* circuit breaker to clear a fault under clause 3.3.15.1(c).

3.3.15.2 Main switch for distribution connected large generating systems

- (a) Each facility at which one or more generating units in a large generating system is connected to the distribution system must contain one main switch provided by the User for each connection point and one main switch for each generating unit, where a generating unit shares a connection point with other generating units or loads. For larger installations, additional connection points and main switches or a dedicated feeder may be required.
- (b) Switches must be circuit breakers or automatically operated, fault current breaking and making ganged switches. The relevant facility may also contain similarly rated interposed paralleling switches for the purpose of providing alternative synchronised switching operations.

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Deleted: <#>Monitoring and Control Requirements¶
Remote Monitoring¶
 The Network Service Provider or System Management may require a User to:¶
 provide remote monitoring equipment (RME) to enable the Network Service Provider or System Management to monitor performance of a generating unit (including its dynamic performance) remotely where this is necessary in real time for control, planning or security of the power system; and¶
 upgrade, modify or replace any RME already installed in a power station provided that the existing RME is, in the opinion of the Network Service Provider, no longer fit for purpose and notice is given in writing to the relevant Generator accordingly.¶
 Any RME provided, upgraded, modified or replaced (as applicable) under clause 3.3.4.1(a), must conform to an acceptable standard as agreed by the Network Service Provider and must be compatible with the Network Service Provider's and System Management's SCADA system. ¶
 Input information to RME may include the following:¶
 Status Indications¶
 generating unit circuit breaker open/closed (dual point);¶
 remote generation load control on/off;¶
 generating unit operating mode;¶
 turbine control limiting operation; and¶
 connection to the transmission or distribution system; ¶
 Alarms¶
 generating unit circuit breaker / main switch tripped by protection;¶
 prepare to off load; and¶
 protection defective alarms;¶
 Measured Values¶
 transmission system:¶
 gross active power output of each generating unit; ¶
 gross reactive power output of each generating unit; ¶
 net station active power import or export at each connection point; ¶
 net station reactive power import or export at each connection point; ¶
 generating unit stator voltage;¶
 generating unit transformer tap position;¶
 net station output of active energy (impulse);¶
 generating unit remote generation control high limit value;¶
 generating unit remote generation control low limit value; and¶
 generating unit remote generation control rate limit value;¶
 distribution system:¶
 main switch active power import or export; ¶
 main switch reactive power import or export; and ¶
 voltage on the Network Service Provider side of main switch; and¶
 such other input information reasonably required by the Network Service Provider or System Management.¶
Remote control¶
 The Network Service Provider or System Management may, for any generating unit which may be unattended when connected to the transmission or distribution system, require the Generator to: ¶
 provide remote control equipment (RCE) to enable the Network Service Provider or System Management to disconnect a generating unit from the transmission or distribution system; and ¶
 upgrade, modify or replace any RCE already installed in a power station provided that the existing RCE is, in the opinion...

Moved (insertion) [29]

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(c) At each relevant *connection point* there must be a means of visible and lockable isolation and test points accessible to the *Network Service Provider's* operational personnel. This may be a withdrawable switch, a switch with visible contacts, a set of removable links or other approved means. The isolation point must be designed to allow the *Network Service Provider's* operational personnel to fit safety locks on the isolation point.

3.3.16 Power station auxiliary transformers

In cases where a *power station* takes its auxiliary supplies through a *transformer* by means of a separate *connection point*, the *User* must comply with the conditions for *connection of loads* (refer to clause 3.4) in respect of that *connection point*.

3.3.17 Synchronising

(a) For a *transmission connected* *synchronous generating unit* the *Generator* must provide and install *automatic synchronising at the generating unit circuit breakers*.

(b) For a *distribution connected synchronous generating unit* the *Generator* must provide and install *automatic synchronising at the generating unit circuit breakers*.

(c) The *Generator* must provide check synchronising on all *generating unit* circuit breakers and any other circuit breakers, unless interlocked *to the satisfaction of the Network Service Provider*, that are capable of connecting the *User's generating equipment* to the *transmission or distribution system*.

(d) Prior to the initial *synchronisation* of the *generating unit(s)* to the *transmission or distribution system*, the *Generator* and the *Network Service Provider* must agree on written operational procedures for *synchronisation*.

3.3.18 Secure electricity supplies

A *Generator* must provide secure electricity supplies of adequate capacity for the operation of equipment performing metering, communication, monitoring, and *protection* functions for at least 8 hours after the loss of AC supplies to that equipment.

3.3.19 Design requirements for Generator's substations

A *Generator* must comply with the requirements of clause 3.4.8.

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Moved up [20]: Note:¶

Moved up [18]: ¶
Table

Moved up [25]: Limiters must not detract from the performance of any stabilising circuits and must have settings applied which are coordinated with all *protection systems*.

Deleted: The overriding objective of a *generating unit's voltage control system* is to maintain the specified *voltage range* at the *connection point*. ¶

The excitation control system of a *synchronous generating unit* must be capable of: ¶

limiting the *reactive power* absorbed or supplied by the *generating unit* to within *generating unit's* capability for continuous operation given its *load level*; ¶

controlling the *generating unit's* excitation to maintain the short-time average *generating unit stator voltage* below its highest rated level (which must be at least 5% above the nominal *stator voltage*); ¶

maintaining adequate *generating unit* stability under all operating conditions and providing *power system* stabilising action if fitted with a *power system stabiliser*; ¶

providing a 5 second ceiling *excitation voltage* of at least twice the *excitation voltage* required to achieve maximum continuous *reactive power* rating at nominal *voltage* and at nominal *active power* output; and ¶

providing *reactive current* compensation settable for droop or remote point *voltage control*. ¶

Synchronous generating units must be fitted with fast acting excitation control systems in accordance with good electricity industry practice ¶

New non-synchronous generating units must be fitted with fast acting voltage and / or reactive power control systems in accordance with good electricity industry practice, which must be approved by the *Network Service Provider*. ¶

Synchronous generating units with ratings in excess of 30 MW or smaller *generating units* within a *power station* with a total *active power* output capability in excess of 30 MW must incorporate *power system stabiliser* (PSS) circuits which modulate the *generating unit field voltage* ...

Deleted: 3.1 Synchronous generator excitation control system performance requirements¶
Performance Item

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Power station Auxiliary Transformers¶

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Deleted: <#>Computer Model ¶
A *Generator* must provide a software model of each *generating unit* suitable for use in the software package wh ...

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3.4 REQUIREMENTS FOR CONNECTION OF LOADS

3.4.1 Obligations of Users

- (a) For the purposes of section 3.4, references to *User* means a *User* that consumes electricity supplied through a *connection point*.
- (b) Unless clause 3.4.1(e) applies, for facilities associated with the relevant *connection point*, a *User* must comply with the requirements and conditions for *connection of loads*:
- (1) as set out in this section 3.4; and
 - (2) in accordance with any relevant *connection agreement* with the *Network Service Provider*.
- (c) A *User* must operate its *facilities* and equipment in accordance with any and all *directions* given by AEMO or the *Network Service Provider* under these *Rules* or under any *written law*.
- (d) A *User* must comply at all times with *protection* requirements specified in clause 3.5.1 and clause 3.5.5.
- (e) For *connection points* associated with *electricity storage* or *embedded generation*, the *Network Service Provider* may specify alternative requirements to those outlined in section 3.4 of these *Rules* where the *Network Service Provider* considers meeting the section 3.4 requirements would be inconsistent with achieving the other technical requirements that apply under these *Rules*.

Note:

Clause 3.4.1(e) recognises that *electricity storage* and *embedded systems* need to meet *load* requirements when consuming *active power* at the *connection point* and *generation* requirements when discharging *active power* at the *connection point*. In the event the technical requirements result in conflict (e.g. the *power factor*, *load shedding* facilities), the clause gives the *Network Service Provider* discretion to amend the *load* requirements in section 3.4 of these *Rules* but not the other requirements that apply.

3.4.2 Overview

- (a) This clause 3.4 applies to the *connection of facilities and equipment of Users* to the *transmission and distribution systems*. The specific requirements for the *connection of a particular User's facilities and equipment* must be determined by the *Network Service Provider* and will depend on the magnitude and other characteristics of the *User's load*, the *power transfer capacity*, *voltage* and location of the *connection point*, and characteristics of the local *transmission or distribution system* in the vicinity of the *connection point*.
- (b) A *User* must provide equipment capabilities, *protection* and *control systems* that ensure that its *load*:
- (1) does not cause excessive *load* fluctuations, *reactive power* draw or, where applicable, stalling of motor *loads* that would have an adverse impact on other

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CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

Users, AEMO, the Network Service Provider or the performance of the power system; and

(2) does not cause any reduction of inter-regional or intra-regional power transfer capability based on:

(A) frequency stability, or

(B) voltage stability,

by more than its loading level whenever connected relative to the level that would apply if the User were disconnected.

Note:

This requirement is intended to safeguard from transients caused by relatively large Users with a high proportion of motor loads; for example, to safeguard one mining operation from another.

3.4.3 Power frequency variations

A User must ensure that the equipment connected to its connection point is capable of continuous uninterrupted operation (other than when the facility is faulted) if variations in supply frequency of the kind described in clause 1.1.1.1(a) occur.

3.4.4 Power frequency voltage variations

A User must ensure that the equipment connected to its connection point is capable of continuous uninterrupted operation (other than when the facility is faulted) if variations in supply voltage of the kind described in clauses 2.2.2 and 2.2.3 occur.

3.4.5 Provision of information

(a) Before connection to the transmission or distribution system, a User must provide all data relevant to each connection point that is required by the Network Service Provider in order to complete the detailed design and installation of the relevant connection assets, to ensure that there is sufficient power transfer capability in the transmission and distribution systems to supply the User's load and that connection of the User's load will not have an adverse impact on other Users, or on the performance of the power system.

(b) The specific data that must be provided by a User in respect of a particular connection point will depend on characteristics of the User's loads, the power transfer capacity of the connection point as specified in the relevant connection agreement, the voltage and location of the connection point, and characteristics of the local transmission or distribution system in the vicinity of the connection point. Equipment data that may need to be provided includes:

(1) interface protection details including line diagram, grading information, secondary injection and trip test certificate on all circuit breakers;

(2) metering system design details for equipment being provided by the User;

(3) a general arrangement locating all the major loads on the site;

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CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

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- (4) a general arrangement showing all exits and the position of all electrical equipment in *substations* that are directly connected to the *connection point*;
- (5) type test certificates for new switchgear and *transformers*, including measurement *transformers* to be used for metering purposes;
- (6) the proposed methods of earthing cables and other equipment plus a single line earthing diagram;
- (7) equipment and earth grid test certificates from approved test authorities;
- (8) operational procedures;
- (9) details of time-varying, non-sinusoidal and potentially disturbing *loads*;
- (10) SCADA arrangements;
- (11) *load* details including maximum demand profiles;
- (12) a line diagram and service or incoming cable routes and sizes; and
- (13) preferred location of the *connection point*.

Note:

Typically, a small domestic *User* will only be required to provide the data referred to in clauses 3.4.5(b)(12) and clause 3.4.5(b)(13).

- (c) In addition to the requirements in clause 3.4.5(a) and 3.4.5(b), the *User* must provide *load* data reasonably required by the *Network Service Provider*. Details of the kinds of data that may be required are included in Attachment 3 and Attachment 9.

3.4.6 Design standards

- (a) The equipment connected to a *User's connection point* must comply with the relevant *Australian Standards* as applicable at the time of first installation of the equipment, the Electricity (Network Safety) Regulations 2015, *good electricity industry practice* and these *Rules* and it must be capable of withstanding the power *frequency voltages* and impulse levels specified by the *Network Service Provider*.
- (b) The circuit breakers, fuses and other equipment provided to isolate a *User's facilities* from the *transmission and distribution system* in the event of a fault must be capable of breaking, without damage or restrike, the fault currents specified by the *Network Service Provider* for the relevant *connection point*.
- (c) The equipment ratings connected to a *User's connection point* must coordinate with the equipment installed on the *power system*.

3.4.7 Power factor requirements

- (a) *Power factor* ranges to be met by *loads* connected to the *transmission system* and *loads* connected to the *distribution system* that are rated 1 MVA or more are shown in Table 3-10.

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Table 3-10 Power factor requirements for loads

Permissible Range	
Supply voltage (nominal)	Power factor range (half-hour average, unless otherwise specified by the Network Service Provider)
220 kV / 330 kV	0.96 lagging to unity (var absorption)
66 kV / 132 kV	0.95 lagging to unity (var absorption)
<66 kV	0.90 lagging (var absorption) to 0.9 leading (var supply)

- (b) The power factor range to be met by loads of less than 1 MVA connected to the distribution system is 0.8 lagging to 0.8 leading. Where necessary to ensure the satisfactory operation of the distribution system, a different power factor range may be specified in the relevant connection agreement.
- (c) The Network Service Provider after consulting with AEMO may permit a lower lagging or leading power factor where this will not reduce power system security, quality of supply, or require a higher lagging or leading power factor to achieve the power transfers required by the load.
- (d) A shunt capacitor installed to comply with power factor requirements must comply with the Network Service Provider's requirements to ensure that the design does not severely attenuate audio frequency signals used for load control or operations.
- (e) A static var compensator system installed for either power factor or quality of supply requirements must have a control system that does not interfere with other control functions on the transmission and distribution system. Adequate filtering facilities must be provided if necessary to absorb any excessive harmonic currents.

3.4.8 Design requirements for Users' substations

Equipment in or for any User's substation that is connected directly to a connection point must comply with the following requirements:

- (a) safety provisions that comply with the requirements of the Network Service Provider must be incorporated into the substation facilities;
- (b) where required by the Network Service Provider, interfaces and accommodation must be provided by the User for metering, communication, remote monitoring and protection equipment to be installed in the substation by the Network Service Provider;
- (c) the substation must be capable of continuous uninterrupted operation within the system performance standards specified in Chapter 2;
- (d) the transformer vector group must be agreed with the Network Service Provider. The vector group must be compatible with the power system at the connection point and preference given to vector groups with a zero sequence opening between high voltage and low voltage windings;
- (e) earthing of primary equipment in the substation must be in accordance with the WA Electrical Requirements and AS/NZS 2067 for high voltage equipment or AS/NZS 3000 for low voltage equipment. The earthing system must satisfy these requirements without any

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CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

reliance on the *Network Service Provider's* equipment. Where it is not possible to design a compliant earthing system within the boundaries of a *User's* plant, the *Network Service Provider* must provide a *User* access to its easement for the installation of earthing conductors and stakes where it is practical to do so and provided that this is not precluded by any legal requirement;

- (f) *synchronisation facilities* or reclose blocking must be provided if *generating units* are connected through the *substation*; and
- (g) insulation levels of equipment in the *substation* must coordinate with the insulation levels of the *transmission and distribution system* to which the *substation* is connected without degrading the design performance of the *transmission and distribution system*.

3.4.9 Load shedding facilities

3.4.9.1 General

- (a) *Users* must provide automatic *load shedding* facilities where required by the *Network Service Provider* in accordance with clause 2.4(b).
- (b) *Load shedding facilities provided by a User that respond to under frequency events must be designed to achieve a reduction in active power import at the connection point.*
- (c) *Where load shedding facilities provided by a User that respond to under frequency events includes generation the User must remain compliant with any applicable export limits.*

Note:
Consistent with the definition for *electricity storage* provided in the Attachment 1 of these Rules, *generation* in this clause refers to both *generation from a generating unit and electricity storage when discharging active power.*

3.4.9.2 Installation and testing of load shedding facilities

A *User* that controls a *load* subject to *load shedding* in accordance with clause 2.4(b) must:

- (a) provide, install, operate and maintain equipment for *load shedding*;
- (b) co-operate with the *Network Service Provider* in conducting periodic functional testing of the *load shedding* equipment, which must not require *load* to be disconnected;
- (c) apply *underfrequency* settings to relays as determined by the *Network Service Provider*; and
- (d) apply *undervoltage* settings to relays as determined by the *Network Service Provider*.

3.4.10 Monitoring and control requirements

3.4.10.1 Remote monitoring

- (a) The *Network Service Provider* may require large *transmission and distribution system* connected *Users* to:

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CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

- (1) provide *remote monitoring equipment (RME)* to enable AEMO or the *Network Service Provider* to monitor the status and indications of the *load* remotely where this is necessary in real time for management, control, planning or *power system security*; and
 - (2) upgrade, modify or replace any *RME* already installed in a User's substation where the existing *RME* is, in the opinion of the *Network Service Provider*, no longer fit for purpose and notice is given in writing to the relevant User.
- (b) An *RME* provided, upgraded, modified or replaced (as applicable) in accordance with clause 3.4.10.1(a) must:
- (1) be compatible with the Network Service Provider's SCADA system, including nomenclature standards; and
 - (2) conform with at least the minimum standard agreed by the Network Service Provider.
- (c) Input information to *RME* may include the following:
- (1) status indications
 - (A) relevant circuit breakers open/closed (dual point) within the equipment;
 - (B) relevant isolators within the equipment;
 - (C) connection to the *transmission or distribution system*; and
 - (D) relevant earth switches;
 - (2) alarms
 - (A) *protection* operation;
 - (B) *protection* fail;
 - (C) battery fail - AC and DC;
 - (D) *trip circuit supervision*; and
 - (E) *trip supply supervision*;
 - (3) measured values
 - (A) *active power load*;
 - (B) *reactive power load*;
 - (C) *load current*; and
 - (D) relevant *voltages* throughout the equipment, including *voltage* on the *Network Service Provider* side of main switch.

3.4.10.2 Network Service Provider's communications equipment

Where *remote monitoring equipment* is installed in accordance with clause 3.4.10.1, the *User* must provide communications paths (with appropriate redundancy) between the *remote monitoring equipment* and a communications interface in a location reasonably acceptable to the *Network*

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Service Provider. Communications systems between this communications interface and the relevant control centre are the responsibility of the *Network Service Provider* unless otherwise agreed.

3.4.11 Secure electricity supplies

All *Users* must provide secure electricity supplies of adequate capacity for the operation of equipment performing metering, communication, monitoring, and *protection* functions for at least 8 hours after the loss of AC supplies to that equipment.

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3.5 USER'S PROTECTION REQUIREMENTS

3.5.1 Overview

- (a) The requirements of this clause 3.5 apply only to a User's protection system that is necessary to maintain *power system security*. The extent of a User's equipment that conform to the requirements of this clause 3.5 will vary from installation to installation, dependent on the specific requirements in clause 3.5. Consequently, each installation should be assessed individually by the *Network Service Provider*. Information that may be required by the *Network Service Provider* to complete this assessment is specified in Attachment 5, Protection systems installed solely to cover risks associated with a User's equipment are at the User's discretion.
- (b) The requirement for *protection systems* in respect of any User's equipment that forms an integral part of the *transmission or distribution system* (as seen from the *transmission or distribution system*) is the same as would apply under clause 2.9 if that equipment were the *Network Service Provider's* equipment. For the purposes of this clause 3.5.1(b) a User's equipment forms an integral part of the *transmission and distribution system* when the *connection asset* (such as a circuit breaker) that is used to *disconnect* a User's equipment from the *transmission or distribution system* is owned by a User.
- (c) All User's equipment *connected* to the *transmission or distribution system* must be protected by *protection systems* or devices that automatically *disconnect* any faulty circuit from the *transmission or distribution system*.
- (d) A User and the *Network Service Provider* must cooperate in the design and implementation of *protection systems*, including with regard to:
 - (1) the functionality of any protection system required as a condition of the User's connection to the transmission or distribution system;
 - (2) the use of *current transformer* and *voltage transformer* secondary circuits (or equivalent) of one party by the *protection system* of the other;
 - (3) tripping of one party's circuit breakers by a *protection system* of the other party; and
 - (4) co-ordination of *protection system* settings to ensure inter-operation.

Note:
Any reliance on the *Network Service Provider's protection system* to protect an item of User's equipment, and vice versa, including the use of *current transformers and voltage transformers* (or equivalent) and the tripping of circuit breakers, must be included in the relevant *connection agreement*.

- (e) A User's protection systems must be located on the relevant User's equipment and must discriminate between the *Network Service Provider's protection systems* and that of other Users.
- (f) Except in an emergency, a User with equipment *connected* directly to the *transmission system* must notify the *Network Service Provider* at least 5 *business days* prior to taking

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out of service all or part of a *protection system* of any equipment operating at a nominal voltage of 66 kV or greater.

- (g) The installation and use of *automatic reclose equipment* in a *User's facility* is permitted only with the prior written agreement of the *Network Service Provider*.
- (h) A *User* must not adjust *their protection settings or otherwise modify its protection systems, including replacing associated primary or secondary equipment*, without the *Network Service Provider's approval*.

3.5.2 Protection requirements for transmission connected generating systems

- (a) Subject to clause 3.5.2(b), a Generator responsible for a generating system connected to the transmission system must satisfy the protection requirements specified in this clause 3.5.2.
- (b) A Generator, responsible for a generating system that has an aggregate rated capacity of less than or equal to 1 MVA, is comprised solely of inverter connected generating units, and is connected to the transmission system must satisfy the protection requirements specified in this clause 3.5.3.
- (c) The main protection system for a generating unit must incorporate two fully independent protection schemes, each discriminating with the transmission system. Where a critical fault clearance time exists, each protection scheme must be capable of operating to achieve the critical fault clearance time. Where there is no critical fault clearance time both independent protection schemes must meet the relevant maximum total fault clearance times specified in clause 2.9.4.
- (d) The design of the *two fully independent protection schemes* must make it possible to test and maintain either *protection scheme* without interfering with the other.
- (e) The *Generator's protection system* and other controls must achieve the following functions:
 - (1) disconnection of the *Generator's generation* from the *transmission systems* if any of the *protection schemes* required by clause 3.5.2(c) operate;
 - (2) anti-islanding protection to ensure the generating system is prevented from supplying an isolated portion of the power system when it is not secure to do so consistent with the guideline developed by the Network Service Provider in accordance with clause 3.5.2(g) with that protection only enabled by the Generator when AEMO or the Network Service Provider instructs;
 - (3) prevention of the *Generator's generating unit* from energising de-energised *Network Service Provider* equipment, or energising and supplying an otherwise isolated portion of the *transmission system* except where a *Generator* is contracted under the *WEM Rules* to provide a black start service and is directed to provide this service by *AEMO*;
 - (4) adequate *protection* of the *Generator's equipment* without reliance on back up from the *Network Service Provider's protection apparatus* except as agreed with the *Network Service Provider* in accordance with clause 3.3.15 or 3.5.1(d);

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CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

(5) detection of a failure of a *Generator's* circuit breaker to clear a fault due to either mechanical or electrical failure. If such a failure is detected, the *Generator's protection system* must send a trip signal to an alternative circuit breaker, which may be provided by the *Network Service Provider* in accordance with clause 3.5.1(d), in order to clear the fault; and

(6) disconnection of the *generating system* during abnormal conditions in the *power system* that would threaten the stability of the *generating system*, or risk damage to the *generating system*. The settings of these *protection schemes* must deliver the required performance for disturbance ride through specified in clause 3.3.7.7, clause 3.3.7.8 and clause 3.3.7.9.

(f) A *Generator* must install check synchronising interlocks on all of their circuit breakers that are capable of out-of-synchronism closure, unless otherwise interlocked to the satisfaction of the *Network Service Provider*.

(g) The *Network Service Provider* must develop a guideline detailing the performance requirements for anti-islanding systems for large generating systems connected to the transmission system.

3.5.3 Protection requirements for *distribution connected generating systems*

3.5.3.1 Application

(a) A *Generator* responsible for a *generating system* connected to the *distribution system* other than via a *standard connection service*, must satisfy the protection requirements specified in this clause 3.5.3.

(b) The protection requirements for a *generating system* connected to the *low voltage distribution system* via a *standard connection service* are specified in clause 3.5.4.

3.5.3.2 General

(a) Subject to clause 3.5.3.2(b), a *Generator* must provide, as a minimum, the protection functions specified in this clause 3.5.3.2. Protection functions should respond to quantities measured at the connection point.

(b) For a *generating system* with an aggregate rated capacity less than or equal to 1 MVA and comprised of *inverter connected generating units*, the *Network Service Provider* may accept protection functions that respond to quantities measured at other locations within the *User's facility* provided these protection arrangements:

(1) are consistent with any guidelines developed by the *Network Service Provider*; and

(2) do not reduce the ability to maintain power system security.

(c) A *Generator's* proposed protection system and settings must be approved by the *Network Service Provider*, who must assess their likely effect on the *distribution system* and may specify modified or additional requirements to ensure that the performance standards specified in clause 2.2 are met, the power transfer capability of the *distribution system* is not reduced and the quality of supply to other *Users* is maintained. Information that may

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be required by the *Network Service Provider* prior to giving approval is specified in Attachment 5 and Attachment 10.

(d) A *Generator's protection system* must clear internal plant faults and coordinate with the *Network Service Provider's protection system*.

(e) The design of a *Generator's protection system* must ensure that failure of any *protection device* cannot result in the *distribution system* being placed in an unsafe operating mode or lead to a disturbance or safety risk to the *Network Service Provider* or to other *Users*.

Note:

This may be achieved by providing back-up *protection schemes* (including *protection functions* implemented in AS/NZS 4777.2 compliant *inverters*) or designing the *protection system* to be fail-safe e.g., to trip on failure.

(f) All dedicated *protection apparatus* must comply with the IEC 60255 series of standards. Integrated control and *protection apparatus* may be used provided that it can be demonstrated that the *protection functions* are functionally independent of the control functions, i.e. failure or mal-operation of the control features will not impair operation of the *protection system*.

(g) All *power stations* must provide under and over *voltage*, under and over *frequency* and overcurrent *protection schemes* in accordance with the equipment rating.

(h) All *power stations* must provide earth fault *protection* for earth faults on the *distribution system*.

Note:

The earth fault *protection scheme* may be earth fault or neutral *voltage* displacement (depending on the earthing system arrangement). For *generating systems* with an aggregate rated capacity of less than or equal to 1 MVA and connected via *inverters*, the earth fault *protection* may be integrated within an anti-islanding scheme.

(i) All *power stations* must provide *protection* against abnormal *distribution system* conditions that would threaten the stability of the *generating system*, or risk damage to the *generating system*. The settings of these *protection schemes* must deliver the required performance for disturbance ride through specified in clauses 3.3.7.7, 3.3.7.8 and 3.3.7.9.

(j) All *power stations* that have an export limit shall have directional (export) power or directional current limits set appropriate to the export limit. For *inverter connected generators* that conform with AS/NZS 4777.2, in certain circumstances, the export limit control set to the appropriate export limit may be used in place of an external protection relay. The *Network Service Provider* must advise the *Generator* of the conditions to be satisfied for the *Network Service Provider* to accept the export limit control in the *inverters*.

(k) All *power stations* must have loss of AC and DC auxiliary *supply protection*, which must immediately trip all switches that depend on that *supply* for operation of their *protection*, except where the auxiliary *supply* is duplicated in which case the failure may be alarmed in accordance with clause 3.5.3.6.

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(l) Where synchronisation is time limited, the power station must be disconnected by an independent timer.

(m) Generating units that are only operated in parallel with the distribution system during rapid bumpless transfer must be protected by an independent timer that will disconnect the generating unit from the distribution system if the bumpless transfer is not successfully completed. Automatic transfer switches must comply with AS 60947.6.2 (2004). For the avoidance of doubt generating units that are only operated in parallel with the distribution system during rapid bumpless transfer need not comply with subclauses (g) to (l) of this clause 3.5.3.2.

Note:

The above exemption from subclauses (g) to (l) of clause 3.5.3.2 recognises that the rapid bumpless transfer will be completed or the generating unit will be disconnected by the disconnection timer before other protection schemes operate. Protection of the generating unit when it is not operating in parallel with the distribution system is at the discretion of the Generator.

3.5.3.3 Pole slipping

Where it is determined that the disturbance resulting from loss of synchronism is likely to exceed that permitted in clause 2.2, the Generator must install a pole slipping protection scheme.

3.5.3.4 Islanding protection

(a) A power station must not supply power into any part of the distribution system that is disconnected from the power system.

Note:

This protection against loss of external supply (loss of mains) may be rate of change of frequency (RoCoF), voltage vector shift, directional (export) power or directional over current or any other method, approved by the Network Service Provider, that can detect a balanced load condition in an islanded state.

(b) For parallel operation (which excludes rapid or gradual bumpless transfer) under all operating modes, islanding protection schemes of two different functional types must be provided to prevent a generating unit energising a part of the distribution system that has become isolated from the remainder of the transmission or distribution system.

(c) A Generator responsible for a small generating system with an aggregate rated capacity of less than or equal to 1 MVA and inverter connected, may propose meeting requirements specified in clause 3.5.3.4(b) through the combination of one IEC 60255 compliant external Generator protection relay and protection functions implemented in AS/NZS 4777.2 compliant inverters that connect the generating system. The Network Service Provider may accept such arrangements as satisfying the requirements of clause 3.5.3.4(b) provided it is satisfied that the proposed arrangements are sufficient to maintain power system security.

(d) For generating systems that have an aggregate rated capacity of less than or equal to 1 MVA and connected to the low voltage distribution system via inverters, the Network Service Provider may accept that the islanding protection incorporated within inverters provides sufficient islanding protection to ensure that the small generating system will not

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supply power into any part of the distribution system that is disconnected from the power system. The Network Service Provider must advise the Generator of the conditions that need to be satisfied for the Network Service Provider to accept the islanding protection incorporated in the inverters is acceptable. If the Network Service Provider is not satisfied that the required conditions have been met, the Generator must install islanding protection meeting the requirement specified in clause 3.5.3.4(c).

- (e) For power stations rated above 1 MVA, there must not be a common failure mode between each functional type of islanding protection scheme. This requirement may be applied to power stations rated below 1 MVA in situations where it is possible for the power station to support a sustained island on a part of the high voltage distribution system.

Note:
For clarity, functional types of islanding protection may share the same voltage and current transformers but must be connected to different secondary windings.

- (f) Where there is no export of power into the distribution system and the aggregate rating of the power station is less than 150 kVA, islanding protection schemes can be in the form of a directional power function that will operate for power export. Directional overcurrent relays may also be used for this purpose.

- (g) Generating units designed for gradual bumpless transfer must be protected with at least one functional type of loss of mains protection scheme.

- (h) Islanding protection must operate within 2 seconds to ensure disconnection before the first distribution system reclosing attempt (typically 5 seconds). Relay settings are to be agreed with the Network Service Provider.

Note:
It should be assumed that the Network Service Provider will always attempt to auto-reclose to restore supply following transient faults.

3.5.3.5 Intertripping

In cases where, in the opinion of the Network Service Provider, the risk of undetected islanding of part of the distribution system and the Generator's facility remains significant, the Network Service Provider may also require the installation of an intertripping link between the Generator's main switch(es) and the feeder circuit breaker(s) in the zone substation or other upstream protection device nominated by the Network Service Provider.

3.5.3.6 Failure of generator's protection equipment

Any failure of the Generator's protection apparatus must automatically trip the generating unit's main switch except, where the affected protection apparatus forms part of a protection system comprised of two fully independent protection schemes, the failure may instead be alarmed within the Generator's facility provided that operating procedures are in place to ensure that prompt action is taken to remedy such failures.

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3.5.4 Protection requirements for small generating systems connected via a standard connection service

- (a) The *protection* requirements specified in this clause 3.5.4, must be satisfied by *Generators* responsible for *small generating systems connected to the low voltage distribution system via a standard connection service*.
- (b) An *inverter energy system connected to the distribution system* must be approved by the *Network Service Provider* and the *User* must meet the following requirements:
 - (1) the *User* must provide the information required by the *Network Service Provider* prior to approval being given;
 - (2) the *User* must maintain the integrity of the *protection and control systems of the inverter energy system* so that they comply with the requirements of these *Rules, AS/NZS 4777 series and the connection agreement* at all times;
 - (3) the *User* must configure *inverter control and protection settings* as specified in the *connection agreement*; and
 - (4) the *User* must provide evidence to demonstrate to the satisfaction of the *Network Service Provider* that the setting specified in the *connection agreement* have been implemented.

3.5.5 Protection requirements for loads

- (a) A *User* must provide a *main protection system* to disconnect from the *power system* any faulted element within its *protection zone* within the *maximum total fault clearance time* agreed with the *Network Service Provider* and specified in the relevant *connection agreement*. For equipment supplied from *connection points* with a nominal voltage of 33 kV or greater, the *maximum total fault clearance times* are the relevant times specified in clause 2.9.4 unless a *critical fault clearance time* applies in accordance with clause 2.9.5, in which case the required *maximum total fault clearance time* is the *critical fault clearance time*.
- (b) If the *User's connection point* has a nominal voltage of 66 kV or greater, the *main protection system* must:
 - (1) have sufficient redundancy to ensure that a faulted element is *disconnected* from the *power system* within the applicable *fault clearance time* as determined in accordance with clause 3.5.5(a) with any single *protection element* (including any communications *facility* upon which the *protection system* depends) out of service;
 - (2) provide a *circuit breaker failure protection scheme* to clear faults that are not cleared by the circuit breakers controlled by the primary *protection system* within the applicable *fault clearance time* as determined in accordance with clause 3.5.5(a). If a circuit breaker fails, the *User's protection system* may send a trip signal to a circuit breaker provided by the *Network Service Provider* in accordance with clause 3.5.1(d), in order to clear the fault.

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- (c) [A User whose facilities are connected to the high voltage distribution system may be required to provide a sensitive earth fault protection scheme that complies with the IEC 60255 series of standards.](#)

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3.6 REQUIREMENTS FOR CONNECTION OF SMALL GENERATING SYSTEMS TO THE TRANSMISSION OR HIGH VOLTAGE DISTRIBUTION SYSTEM

3.6.1 Overview

- (a) This clause 3.6 addresses the requirements for the connection of *small generating systems* (i.e., *generating systems* of aggregate rated capacity *less than or equal to 5 MVA*) to the *transmission system* or the *high voltage distribution system*. This does not apply to the connection of *small generating systems* to the *low voltage distribution system* (in which case either clause 3.7 or 3.8 applies).
- (b) A *Generator* responsible for a *small generating system connected to the transmission system* must comply at all times with *protection* requirements specified in clauses 3.5.1 and 3.5.2.
- (c) A *Generator* responsible for a *small generating system connected to the high voltage distribution system* must comply at all times with *protection* requirements specified in clauses 3.5.1 and 3.5.3.

3.6.2 Categorisation of facilities

- (a) This clause 3.6 covers *generating units* of all types, whether using renewable or non-renewable energy sources.
- (b) Unless otherwise specified, technical requirements for *generating units* shall apply at the *connection point*, rather than at the *generating unit* terminals.
- (c) In this clause 3.6, *connection points* for *small generating systems* are characterised as:
 - (1) *transmission connected*: 3 phase, 66 kV, 132 kV, 220 kV or 330 kV; or
 - (2) *high voltage distribution connected*: 3 phase, 6.6 kV, 11 kV, 22 kV or 33 kV.

3.6.3 Information to be provided by the Generator

- (a) A *Generator* must provide to the *Network Service Provider* information in relation to the *design, construction, operation and configuration of the small generating system* as is reasonably required to ensure that the operation and performance standards of the *power system*, or other *Users*, are not adversely affected by the operation of the *small generating system*. Details of the kinds of information that may be required are included in Attachment 10. Where considered necessary by the *Network Service Provider* additional information of the kind included in Attachment 3 may be required and shall be provided by the *Generator*.
- (b) In order to allow the *Network Service Provider* to assess the impact of the *generating system* on the operation and performance of the *power system* or on other *Users*, a *Generator* must provide data on:
 - (1) *power station and generating unit aggregate active power and reactive power*;

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Deleted: up to 10 MW (small power stations) to the distribution system where such generating units are not subject

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The issues addressed by this clause 3.6 are:¶

the possibility that generating units embedded in distribution systems may affect the quality of supply to other Users, cause reverse power transfer, use up

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CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

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- (2) flicker coefficients and harmonic profile of the equipment. Data on power quality characteristics, including flicker and harmonics, in accordance with IEC 61400-21 must be provided for all wind turbines. Similar data may also be required for other inverter connected generating systems such as solar farms;
- (3) Net import / export data must be provided in the form of:
 - (A) a typical 24 hour power curve measured at 15 minute intervals (or better if available); and
 - (B) details of the maximum kVA output over a 60 second interval, or such other form as specified in the relevant connection agreement.
- (4) When requested by the Network Service Provider, a Generator must provide details of the proposed operation of the equipment during start-up, shut-down, normal daily operation, intermittent fuel or wind variations and under fault or emergency conditions.

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3.6.4 Safety and contribution to power system reliability

- (a) The requirements imposed on a Generator by this clause 3.6 are intended to provide minimum safety and reliability standards to protect the power system and other User's equipment. Safety, power system reliability and the quality of supply to other Users are paramount and access applications must be evaluated accordingly.
- (b) A Generator shall not cause the power system performance to degrade below minimum safety and reliability standards for the power system or below minimum requirements that affect the quality of supply for other Users. In addition to meeting clause 3.6, the Generator must design and operate its facilities in accordance with applicable standards and regulations, good electricity industry practice and the manufacturers' recommendations.
- (c) Where it is apparent that the operation of equipment installed in accordance with the requirements of this clause 3.6 may nevertheless have an adverse impact on the operation, safety or performance of the power system, or on the quality of supply to other Users, the Network Service Provider must consult with the Generator to reach an agreement on an acceptable solution. As a consequence, the Network Service Provider may require the Generator to test or modify its relevant equipment.
- (d) Unless otherwise agreed in the relevant connection agreement, the Network Service Provider may require a Generator not to operate equipment in abnormal power system operating conditions.

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3.6.5 Technical requirements

- (a) All small generating systems with aggregate rated capacity greater than 150 kVA must achieve the common requirements and minimum generator performance standards specified in the following clauses:
 - (1) 3.3.7.3 - reactive power capability

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- (2) [3.3.7.4 - voltage and reactive power control](#)
- (3) [3.3.7.5 - active power control](#)
- (4) [3.3.7.6 - inertia and frequency control](#)
- (5) [3.3.7.7 - frequency disturbance ride through](#)
- (6) [3.3.7.8 - voltage disturbance ride through](#)
- (7) [3.3.7.9 - multiple disturbance ride through](#)
- (8) [3.3.7.10 - disturbance ride through for partial load rejection](#)
- (9) [3.3.7.11 - disturbance ride through for quality of supply](#)
- (10) [3.3.7.12 - quality of electricity generated](#)

(b) [All small generating systems with aggregate rated capacity less than or equal to 150 kVA must achieve the common requirements and minimum generator performance standards specified in the following clauses:](#)

- (1) [3.3.7.3 - reactive power capability](#)
- (2) [3.3.7.4 - voltage and reactive power control except:](#)
 - (A) [The Network Service Provider may approve the relaxation of performance requirements for voltage, power factor and reactive power control systems specified in clause 3.3.7.4\(c\) provided that would not result in the generating system operating in a manner that causes the voltage at the connection point to exceed the limits specified in clause 2.2.2 or 2.2.3.](#)
- (3) [3.3.7.6 - inertia and frequency control](#)
- (4) [3.3.7.7 - frequency disturbance ride through](#)
- (5) [3.3.7.8 - voltage disturbance ride through except:](#)
 - (A) [The voltage disturbance ride through requirements in clause Error! Reference source not found. are relaxed to the voltage limits specified in AS/NZS 4777.2](#)
- (6) [3.3.7.9 - multiple disturbance ride through except:](#)
 - (A) [The multiple disturbance ride through requirements in clause Error! Reference source not found. are relaxed to align with the limits specified in AS/NZS 4777.2](#)
- (7) [3.3.7.12 - quality of electricity generated](#)

Note:
There is no requirement for the Network Service Provider to involve AEMO in setting the technical performance required to meet the minimum performance standards specified in clause 3.6.5(a) and

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3.6.5(b)

3.6.6 [Connection and operation](#)

3.6.6.1 [Generators' substations](#)

[Generators' substations](#) through which [generating units](#) are connected to the [transmission or distribution system](#) must comply with the requirements of [clause 3.4.8](#).

3.6.6.2 [Main switch](#)

- (a) [Each facility at which one or more generating units in a small generating system is connected to the transmission or distribution system must contain one main switch provided by the User for each connection point and one generator main switch for each generating unit, where a generating unit shares a connection point with other generating units or loads. For larger installations, additional connection points and main switches or a dedicated feeder may be required.](#)
- (b) [Switches must be circuit breakers or automatically operated, fault current breaking and making ganged switches. The relevant facility may also contain similarly rated interposed paralleling switches for the purpose of providing alternative synchronised switching operations.](#)
- (c) [At each relevant connection point there must be a means of visible and lockable isolation and test points accessible to the Network Service Provider's operational personnel. This may be a withdrawable switch, a switch with visible contacts, a set of removable links or other approved means. The isolation point must be designed to allow the Network Service Provider's operational personnel to fit safety locks on the isolation point.](#)

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3.6.6.3 [Synchronising](#)

- (a) [For a synchronous generating unit in a small generating system, a Generator must provide automatic synchronising equipment at each generating unit circuit breaker.](#)
- (b) [Check synchronising must be provided on all generating unit circuit breakers and any other switching devices that are capable of connecting the User's generating equipment to the transmission or distribution system unless otherwise interlocked to the satisfaction of the Network Service Provider.](#)
- (c) [Prior to the initial synchronisation of the generating unit\(s\) to the transmission or distribution system, the Generator and the Network Service Provider must agree on written operational procedures for synchronisation.](#)

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3.6.6.4 [Safe shutdown without external supply](#)

[A generating unit](#) must be capable of being safely shut down without [electricity supply](#) being available from the [transmission or distribution system](#).

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3.6.6.5 Export limit control

- (a) To ensure the safe, reliable and secure operation of the *power system* the *Network Service Provider* may specify an export limit for a *generating system* that is less than the rated capacity of the *generating system*.
- (b) The *Generator* must control the *active power* produced by a *generating system* such that the *active power* injected into the *power system* at the *connection point* does not exceed any export limit specified by the *Network Service Provider*.

3.6.7 Power quality and voltage change

- (a) A *Generator* connecting a *small generating system* to the *power system*, must provide information to enable assessment of whether the performance standards specified in clause 2.2 can continue to be met following the connection.
- (b) The *voltage step change* at the *connection point* for *connection and disconnection* must comply with the requirements of clauses 2.2.2 and 2.2.3, as applicable.

Note:

These requirements may be achieved by synchronising individual *generating units* at intervals of at least two minutes.

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3.6.8 Remote monitoring, control and communications

- (a) For each *generating system* with aggregate rated capacity exceeding 1 MVA, the *Generator* must provide for:
 - (1) tripping of the *generating unit* remotely from the *Network Service Provider's control centre*;
 - (2) an interlock operated from the *Network Service Provider's control centre*; and
 - (3) remote monitoring at the *Network Service Provider's control centre* of (signed) MW, Mvar and voltage and applicable setpoints for voltage, power factor or reactive power controller provided to satisfy the requirements in clause 3.6.5.
- (b) For *generating systems* with aggregate rated capacity less than or equal to 1 MVA monitoring may not be required. However, where concerns for *power system security, safety or power system reliability* arise that are not adequately addressed by automatic protection systems and interlocks, the *Network Services Provider* may require the *Generator* to provide remote monitoring and remote control of some functions in accordance with clause 3.6.8(a).
- (c) For *generating systems* that are required to implement remote monitoring and control under clause 3.6.8(a) or 3.6.8(b), the *Generator* must provide a continuous communication link to the *Network Service Provider's control centre*.

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- (d) A Generator must have available at all times a telephone link or other communication channel to enable voice communications between a small generating system and the Network Service Provider's control centre.

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3.6.9 Commissioning and testing

3.6.9.1 Commissioning

The Generator must comply with the testing and commissioning requirements for generating units connected to the transmission or distribution system specified in Attachment 12.

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3.6.9.2 Re-confirmation of correct operation

- (a) The Network Service Provider may inspect the generating system from time to time to confirm continued compliance with the requirements in these Rules.
- (b) In the event that the Network Service Provider considers that the generating system does not meet the requirements of clause 3.5.1, 3.5.3 or 3.6, it may:
- (1) request information on the settings for the generating system from the User or Generator;
 - (2) require testing or setting changes on the generating system; or
 - (3) disconnect the generating system.
- (c) The User or Generator must conduct testing, implement setting changes, or disconnect the generating system if requested by the Network Service Provider in accordance with clause 3.6.9.2(b).

3.6.10 Technical matters to be coordinated

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- (a) The Generator and the Network Service Provider must agree upon the following matters in respect of each new or altered connection:
- (1) design at connection point;
 - (2) physical layout adjacent to connection point;
 - (3) back-up (alternative) supply arrangements;
 - (4) protection and back-up;
 - (5) control characteristics;
 - (6) communications, metered quantities and alarms;
 - (7) insulation co-ordination and lightning protection;
 - (8) fault levels and fault clearing times;
 - (9) switching and isolation facilities;
 - (10) interlocking arrangements;

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CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

- (11) synchronising facilities;
- (12) under frequency load shedding and islanding schemes; and
- (13) any special test requirements.

(b) As an alternative to distribution system augmentation, the Network Service Provider may require a Generator to provide additional control and protection schemes to ensure that operating limits and agreed import and export limits are not exceeded.

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3.7 REQUIREMENTS FOR CONNECTION OF SMALL GENERATING SYSTEMS TO THE LOW VOLTAGE DISTRIBUTION SYSTEM

3.7.1 Overview

- (a) This clause 3.7 addresses the particular requirements for the connection of *small generating systems* (i.e., *generating systems* of aggregate rated capacity less than or equal to 5 MVA) to the *low voltage distribution system*. This clause does not apply to the connection of *inverter energy systems* via a *standard connection service* to the *low voltage distribution system* (in which case clause 3.8 applies).
- (b) A *Generator* responsible for a *small generating system* connected to the *low voltage distribution system*, other than via a *standard connection service*, must comply at all times with protection requirements specified in clause 3.5.1 and clause 3.5.3.

3.7.2 Categorisation of facilities

- (a) This clause 3.7 covers *generating units* of all types, whether using renewable or non-renewable *energy sources*.
- (b) Unless otherwise specified, technical requirements for *generating units* shall apply at the *connection point*, rather than at the *generating unit* terminals.
- (c) Where a *small generating system* is the only *facility* connected to a *low voltage* network the *Generator* may choose to have the *power station* assessed for compliance as if the *power station* was *high voltage* connected. Prior to another *User* subsequently connecting to the same *low voltage* network the *Network Service Provider* must reassess the *power station* for compliance with the requirements for *low voltage* connected *power stations* and the *Generator* must rectify any non-compliance identified in the reassessment.
- (d) This clause 3.7 differentiates the requirements applicable to *inverter connected generating systems* with AS/NZS 4777.2 compliant *inverters* from those applicable to *other generating systems*.

3.7.3 Information to be provided by the Generator

- (a) A *Generator* for a *small generating system* must provide to the *Network Service Provider* information in relation to the design, construction, operation and configuration of that *small generating system* as is reasonably required to ensure that the operation and performance standards of the *power system*, or other *Users*, are not adversely affected by the operation of the *small generating system*. Details of the kinds of information that may be required are included in Attachment 10. Where considered necessary by the *Network Service Provider* additional information of the kind included in Attachment 3 may be required and shall be provided by the *Generator*.

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being in continuous parallel operation

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being in occasional parallel operation with the *distribution system*, and either exporting electricity to the *distribution system* or not exporting electricity to it, including

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bumpless (make before break) transfer operation, being:¶

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being in short term test parallel operation with the *distribution system*, and either exporting electricity to the

Deleted: <#>operation in rapid transfer mode where, when load is transferred between the *generating unit* and the *distribution system* or vice versa, the *generating unit* is synchronised for a maximum of one second per event; or¶
operation in gradual transfer mode where, when load is transferred between the *generating unit* and the *distribution system* or vice versa, the *generating unit* is synchronised for a maximum of 60 seconds per event

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CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

- (b) In order to allow the Network Service Provider to assess the impact of the generating system on the operation and performance of the power system or on other Users, a Generator must provide data on:
- (1) power station and generating unit aggregate active power and reactive power;
 - (2) flicker coefficients and harmonic profile of the equipment. Data on power quality characteristics, including flicker and harmonics, in accordance with IEC 61400-21 must be provided for all wind turbines. Similar data may also be required for other inverter connected generating systems such as solar farms;
 - (3) net import / export data must be provided in the form of:
 - (A) a typical 24 hour power curve measured at 15 minute intervals (or better if available); and
 - (B) details of the maximum kVA output over a 60 second interval.or such other form as specified in the relevant connection agreement.
 - (4) When requested by the Network Service Provider, a Generator must provide details of the proposed operation of the equipment during start-up, shut-down, normal daily operation, intermittent fuel or wind variations and under fault or emergency conditions.

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 a typical 24 hour power curve measured at 15 minute intervals (or better if available); and
 details of the maximum kVA output over a 60 second interval,
 or such other form as specified in the relevant connection agreement.
 When requested by the Network Service Provider, a Generator must provide details of the proposed operation of the equipment during start-up, shut

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3.7.4 Safety and contribution to power system reliability

- (a) The requirements imposed on a Generator by this clause 3.7 are intended to provide minimum safety and reliability standards to protect the power system and other User's equipment. Safety, power system reliability and the quality of supply to other Users are paramount and access applications must be evaluated accordingly.
- (b) A Generator shall not cause the power system performance to degrade below minimum safety and reliability standards for the power system or below minimum requirements that affect the quality of supply for other Users. In addition to meeting clause 3.7, the Generator must design and operate its facilities in accordance with applicable standards and regulations, good electricity industry practice and the manufacturers' recommendations.
- (c) Where it is apparent that the operation of equipment installed in accordance with the requirements of this clause 3.7 may nevertheless have an adverse impact on the operation, safety or performance of the power system, or on the quality of supply to other Users, the Network Service Provider must consult with the User to reach an agreement on an acceptable solution. As a consequence, the Network Service Provider may require the Generator to test or modify its relevant equipment.
- (d) Unless otherwise agreed in the relevant connection agreement, the Network Service Provider may require a Generator not to operate equipment in abnormal power system operating conditions.

Deleted: <#>For generating units in a small power station of aggregate rating 5 MW and above, the Network Service Provider must assess the need for dynamic simulation studies and may require the Generator to provide a computer model in accordance with the requirements of clause 3.3.9.

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 Unless otherwise agreed in the relevant connection agreement, the Network Service Provider may require a Generator not to operate equipment in abnormal

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3.7.5 Technical requirements

(a) All small generating systems connected to the low voltage distribution system via inverters must:

- (1) use only inverters that comply with AS/NZS 4777.2, and
- (2) implement control modes and control settings specified by the Network Service Provider.

(b) All non-inverter connected small generating systems with aggregate rated capacity greater than 150 kVA connected to the low voltage distribution system must achieve the common requirements and minimum generator performance standards specified in the following clauses:

- (1) 3.3.7.3 - reactive power capability
- (2) 3.3.7.4 - voltage and reactive power control
- (3) 3.3.7.5 - active power control
- (4) 3.3.7.6 - inertia and frequency control
- (5) 3.3.7.7 - frequency disturbance ride through
- (6) 3.3.7.8 - voltage disturbance ride through, except the clause 3.3.7.8(c)(1) is replaced with the following:

(A) A generating system must maintain continuous uninterrupted operation where a power system disturbance causes the phase to phase voltage (for balanced 3 phase network) to vary within the following ranges:

- (i) voltage does not exceed 480 V after T(ov);
- (ii) voltage does not exceed 460 V for more than 0.1 seconds after T(ov);
- (iii) voltage does not exceed 440 V for more than 0.9 seconds after T(ov);
- (iv) voltage remains at 400 V for no more than 450 milliseconds after T(uv) subject to clause 3.3.7.8(c)(2);
- (v) voltage does not stay below 280 V for more than 450 milliseconds after T(uv); and
- (vi) voltage does not stay below 320 V for more than 2.0 seconds after T(uv); and
- (vii) voltage does not stay below 340 V for more than 5.0 seconds after T(uv).

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Where:

T(ov) means a point in time when the voltage first varied above 440 V before returning to between 340 V and 440 V; and

T(uv) means a point in time when the voltage first varied below 340 V before returning to between 340 V and 440 V.

- (7) 3.3.7.9 - multiple disturbance ride through
- (8) 3.3.7.10 - disturbance ride through for partial load rejection
- (9) 3.3.7.11 - disturbance ride through for quality of supply
- (10) 3.3.7.12 - quality of electricity generated

(c) All non-inverter connected small generating systems with aggregate rated capacity less than or equal to 150 kVA connected to the low voltage distribution system must achieve the common requirements and minimum generator performance standards specified in the following clauses:

- (1) 3.3.7.3 - reactive power capability
- (2) 3.3.7.4 - voltage and reactive power control except:

(A) The Network Service Provider may approve the relaxation of performance requirements for voltage, power factor and reactive power control systems specified in clause 3.3.7.4(c) provided that would not result in the generating system operating in a manner that causes the voltage at the connection point to exceed the limits specified in clause 2.2.3.

- (3) 3.3.7.6 - inertia and frequency control
- (4) 3.3.7.7 - frequency disturbance ride through
- (5) 3.3.7.8 - voltage disturbance ride through except:

(A) The voltage disturbance ride through requirements in clause Error! Reference source not found. are relaxed to the voltage limits specified in AS/NZS 4777.2

- (6) 3.3.7.9 - multiple disturbance ride through except:

(A) The multiple disturbance ride through requirements in clause Error! Reference source not found. are relaxed to align with the limits specified in AS/NZS 4777.2

- (7) 3.3.7.12 - quality of electricity generated.

Note:
There is no requirement for the Network Service Provider to involve AEMO in setting the technical performance required to meet the minimum performance standards specified in clause 3.7.5(b) and 3.7.5(c)

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Deleted: ensure that the maximum fault current contribution from a generating unit or small power station is not of a magnitude

Deleted: will allow the total fault current

Deleted: levels

Deleted: 2.5.8(b) for all distribution system operating conditions.

Deleted: <#>Requirements of clause 3.3 applicable to small power stations¶
 Table 3.4 lists specific provisions of clause 3.3 that apply to small power stations in addition to the requirements of this clause 3.6.¶
 Table 3.4 Specific paragraphs of clause 3.3 applicable to distribution-connected generating units rated up to 10 MW¶
 Clause ...

Deleted: 126¶

3.7.6 Connection and operation

3.7.6.1 Main switch

- (a) Each facility at which one or more generating units in a small generating system is connected to the low voltage distribution system must comply with the main switch requirements in clause 3.2.2.
- (b) At each relevant connection point there must be a means of visible and lockable isolation and test points accessible to the Network Service Provider's operational personnel.

3.7.6.2 Synchronising

- (a) For a synchronous generating unit in a small generating system, a Generator must provide automatic synchronising equipment at each generating unit circuit breaker.
- (b) Check synchronising must be provided on all generating unit circuit breakers and any other switching devices that are capable of connecting the User's or Generator's generating equipment to the distribution system unless otherwise interlocked to the satisfaction of the Network Service Provider.
- (c) Prior to the initial synchronisation of the generating unit(s) to the distribution system, the User or Generator and the Network Service Provider must agree on written operational procedures for synchronisation.

3.7.6.3 Safe shutdown without external supply

A generating unit must be capable of being safely shut down without electricity supply being available from the distribution system.

3.7.6.4 Export limit control

- (a) The Network Service Provider may specify an export limit for a generating system that is less than the rated capacity of the generating system.
- (b) The User or Generator must control the active power produced by a generating system such that the active power injected into the power system at the connection point does not exceed any export limit specified by the Network Service Provider.
- (c) The Network Service Provider may request information from a User or a Generator on any export limit control implemented in accordance with this clause and may request subsequent changes if the export limit control is considered inadequate.
- (d) The User or Generator must provide information and implement any changes required in response to the Network Service Provider's request made under clause 3.7.6.4(c).

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Deleted: Operation

Deleted: <#>Generators' Substations ¶
Generators' substations through which

Deleted: units are

Deleted: of

Deleted: 3.4.8.

Moved (insertion) [48]

Moved up [29]: <#> is connected to the distribution system must contain one main switch provided by the User for each connection point and one main switch for each generating unit, where a generating unit shares a connection point with other generating units or loads. For larger installations, additional connection points and main switches or a dedicated feeder may be required.¶

Moved up [42]: <#> The relevant facility may also contain similarly rated interposed paralleling switches for the purpose of providing alternative synchronised switching operations.¶ At each relevant connection point there must be a means of visible and lockable isolation and test points accessible to the Network Service Provider's operational personnel. This may be a withdrawable switch, a switch with visible contacts, a set of removable links or other approved means.

Moved up [22]: <#>Note:¶

Moved up [43]: <#>Synchronising

Deleted: <#>Main Switch¶

Each facility at which a

Deleted: <#>power station

Deleted: <#>Switches must be automatically operated, fault current breaking and making, ganged switches or circuit breakers.

Deleted: <#>It must be possible for the Network Service Provider's operational personnel to fit safety locks on the isolation point.¶

Deleted: <#>Low voltage generating units with moulded case circuit breakers and fault limiting fuses with removable links are acceptable for isolation points in accordance with subclause 3.6.7.2(c).¶

Deleted: <#> ¶

For a synchronous generating unit in a small power station

Deleted: User's

Deleted: Shutdown

Deleted: External Supply

Deleted: 127¶

Deleted: SECTION

3.7.6.5 Generation limit control

(a) Where the *generating system* includes multiple energy source types, the *Network Service Provider* may specify *generation limit control* that is less than the total rated *generating system capacity*.

(b) The *User or Generator* must implement a *generation limit* that prevents the *apparent power* produced by the *small generating system* exceeding any limit specified by the *Network Service Provider*.

Note:
Multiple energy source types may include battery energy storage and a combination of other energy sources.

(c) The *Network Service Provider* may request information from the *User or Generator* on any *generation limit control* implemented in accordance with this clause and may request subsequent *changes* if the *generation limit control* is considered inadequate.

(d) The *User or Generator* must provide information and implement any *changes* required in response to the *Network Service Provider's* request made under clause 3.7.6.5(c).

3.7.7 Power quality and voltage change

(a) A *Generator* connecting a *small generating system* to the *power system*, must provide information to enable assessment of whether the performance standards specified in clause 2.2 can continue to be met following the connection.

(b) The *voltage step change* at the *connection point* for connection and disconnection must comply with the requirements of clause 2.2.3. On *low voltage* feeders, *voltage* changes up to 5% may be allowed in some circumstances with the approval of the *Network Service Provider*.

Note:
The requirements of clause 1.1.1.1(a) may be achieved by synchronising individual *generating units* at intervals of at least two minutes.

3.7.8 Remote monitoring, control and communications

(a) For a *generating system* connecting to the *low voltage distribution system* via a connection service other than a *standard connection service*, the *User or Generator* must:

- (1) comply with the requirements of clause 3.6.8, and
- (2) the *Network Service Provider* may specify additional requirements for the *User or Generator* to enable remote monitoring and control of the *generating system*.

(b) Where additional requirements are specified under clause 3.7.8(a)(2) the *User or Generator* must implement them.

Deleted: Quality

Deleted: Voltage Change

Deleted: must ensure that

Deleted: of

Deleted: 2.2

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Deleted: when a small power station is connected by it to the distribution system

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Moved up [44]: ¶

Note:¶
These requirements may be achieved by synchronising individual *generating units* at intervals of at least two minutes. ¶

Deleted: 2.2.2.

Moved (insertion) [49]

Deleted: steady state voltage rise

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Deleted: point resulting from export of power to the distribution system

Deleted: not cause the *voltage* limits specified in clause 2.2 to be exceeded and, unless otherwise agreed

Deleted: , must not exceed 2%.

Moved up [49]: Note:¶

Deleted: The 2% limit on the *voltage* rise

Deleted: in this

Deleted: 3.6.8 (c) may be waived if

Deleted: is contracted by the

Deleted: 128¶

CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

(c) The Network Service Provider may request information from a User or a Generator on any remote monitoring and control implemented in accordance with this clause and may request subsequent changes if the remote monitoring and control is considered inadequate.

(d) The User or Generator must provide information and implement any changes required in response to the Network Service Provider's request made under clause 3.7.8(c).

3.7.9 Commissioning and testing

3.7.9.1 Commissioning

The User or Generator must comply with the testing and commissioning requirements for generating units connected to the distribution system specified in Attachment 12.

3.7.9.2 Re-confirmation of correct operation

(a) The Network Service Provider may inspect the generating system from time to time to confirm continued compliance with the requirements in these Rules.

(b) In the event that the Network Service Provider considers that the generating system does not meet the requirements of clause 3.5.1, 3.5.3 or 3.7, it may:

- (1) request information on the settings for the generating system from the User or Generator;
- (2) require testing or setting changes on the generating system;
- (3) disconnect the generating system.

(c) The User or Generator must conduct testing, implement setting changes, or disconnect the generating system if requested by the Network Service Provider in accordance with clause 3.7.9.2(b).

3.7.10 Technical matters to be coordinated

(a) The User or Generator and the Network Service Provider must agree on the following matters in respect of each new or altered connection:

- (1) design at connection point;
- (2) physical layout adjacent to connection point;
- (3) alternative supply arrangements;
- (4) protection and back-up protection systems;
- (5) control characteristics;
- (6) communications, metered quantities and alarms;
- (7) insulation co-ordination and lightning protection;
- (8) fault levels and fault clearing times;

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Deleted: for the provision of voltage

Deleted: services. Such a waiver is most likely to be necessary at fringe of grid locations.

Moved up [24]: General

Moved up [45]: tripping of the generating unit remotely from the Network Service Provider's control centre;¶

Deleted: When operating unsynchronised, a synchronous generating unit in a small power station must generate a constant voltage level with balanced phase voltages and harmonic voltage distortion equal to or less than permitted in accordance with either Australian Standard AS 1359 (1997) "

Deleted: Requirements for Rotating Electrical Machines;¶

Deleted: more to the distribution system the

Deleted: for:¶

Deleted: a close-enable interlock operated from the ¶

Deleted: ¶

Deleted: ¶ However, where concerns for safety and ¶

Moved up [31]: General¶

Moved up [33]: A Generator's protection system must

Moved up [26]: Note:¶

Deleted: provide remote monitoring and remote control ¶

Deleted: A Generator must provide, as a minimum, the ¶

Deleted: ¶

Deleted: This may be achieved by providing back-up ¶

Moved up [34]: protection apparatus must comply with

Deleted: failure or mal-operation of the control features ¶

Deleted: and over frequency and overcurrent protection ¶

Moved up [10]: <#>Note:¶

Moved up [35]: <#>The earth fault protection scheme

Moved up [36]: <#>Generating units that are only

Moved up [11]: <#>Note:¶

Moved up [28]: <#>Note:¶

Moved up [37]: <#> This requirement may be applied to

Moved up [38]: <#>Directional overcurrent relays may

Moved up [39]: <#>Note:¶

Deleted: <#>All small power stations must provide earth ¶

Deleted: <#>¶

Deleted: <#>For the avoidance of doubt generating units ¶

Deleted: <#>The above exemption from subclauses (f) to ¶

Deleted: <#>This protection against loss of external supply ¶

Deleted: <#>Except as provided in clause 3.6.10.3(c) wh ¶

Deleted: <#>¶

Deleted: <#>Failure of Generator's Protection equipme ¶

Deleted: <#>Testing

Deleted: Attachment 12.

Moved up [47]: <#>Technical matters to be coordinated ¶

Deleted: 129¶

CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

(9) switching and isolation facilities;

(10) interlocking arrangements;

(11) synchronising facilities;

(12) under frequency load shedding and islanding schemes; and

(13) any special test requirements.

(b) The Network Service Provider may provide a User or Generator with additional protection or control for their small generating system as an alternative to distribution system augmentation.

(c) Where additional protection or control is required under clause 3.7.10(b), the User or Generator must comply with agreed functions and operating limits (including import and export limits).

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Deleted: are not exceeded.

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DRAFT

3.8 REQUIREMENTS FOR CONNECTION OF INVERTER ENERGY SYSTEMS CONNECTED TO THE LOW VOLTAGE DISTRIBUTION SYSTEM VIA A STANDARD CONNECTION SERVICE

3.8.1 Overview

- (a) This clause 3.8 addresses the particular requirements for the connection of *inverter energy systems* to the *Network Service Provider's low voltage distribution system* that can be connected via a *standard connection service*.
- (b) Where the *inverter energy system* requires a connection service other than a *standard connection service*, the requirements of clause 3.7 apply.
- (c) Nothing in this clause 3.8 obliges the *Network Service Provider* to approve the connection of an *inverter energy system* to the *low voltage distribution system* if it considers that the *power system* performance standards specified in clause 2.2 will not be met as a consequence of the operation of the *inverter energy systems*.
- (d) All *inverter energy systems* connected via a *standard connection service* to the *low voltage distribution network* must comply with AS/NZS 4777 series and must achieve the additional requirements specified in this clause 3.8.
- (e) An *inverter energy system* connected via a *standard connection service* to the *low voltage distribution network* must comply at all times with *protection requirements* specified in clause 3.5.1 and clause 3.5.4.

3.8.2 Energy system capacity, imbalance and assessment

- (a) It is the responsibility of the *Network Service Provider* to carry out a connection assessment for the following *inverter energy systems* connected via *standard connection services* to confirm that the *power system* performance standards specified in clause 2.2 will be met when the *inverter energy system* is operating at its full rated capacity:
 - (1) single phase *inverter* connections rated greater than 5 kVA,
 - (2) three phase *inverter* connections with more than 2.5 kVA imbalance on three phase connection services between any two phases, and
 - (3) connections that are beyond any other maximum threshold determined by the *Network Service Provider*.

Note:
For *inverter energy systems* connecting at levels below the thresholds in this clause, assessment is not necessarily required. However, the *Network Service Provider* can use discretion under clause 3.8.2(b) if it considers assessment is necessary.

- (b) The *Network Service Provider* may carry out the assessment of connections below the thresholds in clause 3.8.2(a) if it deems necessary.
- (c) The *inverter energy system* must not cause a voltage rise across the service leads that exceeds 1% of the connection voltage.

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Deleted: INVERTERS

Deleted: <#>Scope¶

Deleted: 3.7

Deleted: inverters. It covers installations rated up to 10 kVA single phase and 30 kVA three phase. For similarly rated non-

Deleted: connected

Deleted: systems

Deleted: 3.6

Deleted: 3.7

Deleted: 2.2

Deleted: system

Deleted: Note:¶
The scope of this clause 3.7 is limited to technical conditions of connection. The *Network Service Provider* is not able to enter an *energy buyback* agreement directly. A *User* wishing to enter into such an agreement must apply to a participating retailer. It should also be noted that whereas this clause 3.7 covers *connection* issues for *generators* up to 30 kVA, the maximum *generator* capacity for which a retailer may be prepared to enter into an *energy buyback* agreement may be less than this amount.¶

Energy System Capacity, Imbalance and Assessment¶

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Deleted: 2.2

Deleted:

Deleted: Single

Deleted: PV

Deleted: and

Deleted: 415 V

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Deleted: Notwithstanding clause 3.7.2(a), the

Deleted: these

Deleted: The

Deleted: must not exceed

Moved up [15]: Note:

Deleted: rated volts. ¶

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Typical remedial measures include upgrade of the service leads and/or splitting the *generation* across all three phases, where applicable....

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3.8.3 Relevant standards

- (a) A User must only use inverters that have a type-test report or type-test certificate from an independent and recognised certification body showing compliance of the inverter with AS/NZS 4777.2. Evidence of this must be supplied to the Network Service Provider on request.
- (b) Inverter energy systems must be designed, installed and commissioned in accordance with relevant Australian Standards and good electricity industry practice.
- (c) Only inverter energy systems that have been assessed and approved by the Network Service Provider shall be installed.

3.8.4 Safety

3.8.4.1 General

- (a) Installations must comply with all statutory requirements and the relevant Australian Standards, including AS/NZS 3000, AS/NZS 5033 and AS/NZS 4777 series.
- (b) All electrical installation, commissioning and maintenance work wherever required must be carried out by an electrical contractor licensed under the Electricity (Licensing) Regulations, 1991.
- (c) Any changes to any parameter on an installed inverter energy system must be approved by the Network Service Provider.

3.8.4.2 Security of operational settings

- (a) Where operational settings are applied via a keypad or switches, adequate security must be employed to prevent tampering, inadvertent or unauthorised changes to these settings. A suitable lock or password system must be used. The Network Service Provider must approve changes to settings prior to implementation.
- (b) The Network Service Provider may require the User to demonstrate that the operational settings implemented in the inverter energy system are those approved by the Network Service Provider.
- (c) The User or the Generator must provide the Network Service Provider with evidence of inspected settings in response to any request made in accordance with clause 3.8.4.21.1.1.1(a).

3.8.5 Connection and operation

3.8.5.1 Main switch

- (a) All inverter energy systems connected to the low voltage distribution system via a standard connection service must comply with the main switch requirements in clause 3.2.2.

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Deleted: <#>The installation of primary inverter energy systems must comply with the relevant Australian Standards and international standards.¶ Inverter systems must satisfy the requirements of Australian Standard AS/NZS 4777 "Grid connection of energy systems via...

Deleted: <#>" as published and revised. ¶ The term 'inverter energy system' in these Rules has the same meaning as in AS/NZS 4777.¶ A

Deleted: <#>test

Deleted: <#>plant

Deleted: <#>.

Deleted: and relevant Australian Standards

Deleted: <#>Should it be necessary to change any parameter of the equipment as installed and contracted, approval must be sought from Network Service Provider. Subsequently, the Network Service Provider will determine whether a revised application is required.¶ **Metering Installation¶** The User must make provision for an import/export meter, as

Deleted: <#>.

Deleted: the relevant Australian Standards and

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Deleted: the WA Electrical Requirements

Deleted: <#>Labelling of switches¶ The User's installation must display warning labels in accordance with the WA Electrical Requirements. These labels must be maintained in good order. ¶

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Deleted: <#>Circuit Arrangements ¶ **Schematic diagram¶** A durable single sided schematic-wiring diagram of the installation showing all equipment and switches must be affixed on the site adjacent to

Moved up [27]: <#>¶

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Deleted: <#>switches must be suitably rated for the requ...

Deleted: <#>via an inverter to the network. The modes of ...

Deleted: <#> and meet the requirements of relevant ...

Moved up [48]: Synchronising¶

Deleted: information required by the Network Service ...

Deleted: Connection to the distribution system must be ...

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Deleted: <#>Voltage limits¶

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Deleted: system must remain

Deleted: for voltage variations within the limits of Table ...

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- (b) At each relevant connection point there must be a means of visible and lockable isolation and test points accessible to the Network Service Provider's operational personnel.

3.8.5.2 Export limit control

- (a) To ensure the safe, reliable and secure operation of the power system the Network Service Provider
- (a) may specify an export limit for an inverter energy system that is less than the inverter energy system rated capacity.
- (b) The User or Generator must control the active power produced by an inverter energy system such that the active power injected into the low voltage distribution system at the connection point does not exceed any export limit specified by the Network Service Provider.
- (c) The Network Service Provider may request information from a User or a Generator on any export limit control implemented in accordance with this clause and may request subsequent changes if the export limit control is considered inadequate.
- (d) The User or Generator must provide information and implement any changes required in response to the Network Service Provider's request made under clause 3.8.5.2(c).

3.8.5.3 Generation limit control

- (a) Where the inverter energy system includes multiple energy source types, the Network Service Provider may specify generation limit control that is less than the total rated inverter energy system capacity.
- (b) The User or Generator must implement a generation limit that prevents the apparent power produced by the inverter energy system exceeding any limit specified by the Network Service Provider.

Note:

Multiple energy source types may include battery energy storage and a combination of other energy sources.

- (c) The Network Service Provider may request information from a User or a Generator on any export limit control implemented in accordance with this clause and may request subsequent changes if the export limit control is considered inadequate.
- (d) The User or Generator must provide information and implement any changes required in response to the Network Service Provider's request made under clause 3.7.8(c).

3.8.6 Remote monitoring, control and communications

- (a) The Network Service Provider may specify requirements for the User or Generator to enable remote monitoring and control of an inverter energy system.

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Deleted: <#>must remain connected for frequency variations between 47.5 Hz and 52 Hz unless otherwise agreed with ...

Deleted: 133¶

- (b) ~~Where additional requirements are specified under clause 3.8.6(a) the User or Generator must implement them.~~
- (c) ~~The Network Service Provider may request information on any remote monitoring and control implemented in accordance with this clause and may request subsequent changes if the remote monitoring and control is considered inadequate.~~
- (d) ~~The User or Generator must provide information and implement any changes required in response to the Network Service Provider's request made under clause 3.8.6(c).~~

3.8.7 Commissioning and testing

3.8.7.1 Exclusion of clause 4.1.3 and 4.2

- (a) ~~The requirements for commissioning and testing of inverter energy systems connected to the low voltage distribution system via a standard connection service defined in this clause 3.8.6(c) take precedence over requirements defined in clause 4.2.~~
- (b) ~~Clause 4.1.3 does not apply to inverter energy system covered by clause 3.8.~~

3.8.7.2 Commissioning

- (a) Commissioning may occur only after the installation of the metering equipment.
- (b) In commissioning equipment installed under this clause 3.8, a User or Generator must comply with the commissioning requirement specified in AS/NZS 4777.1.
- (c) Subsequent modifications to the inverter installation must be submitted to the Network Service Provider for approval.

3.8.7.3 Re-confirmation of correct operation

- (a) ~~The Network Service Provider may elect to inspect an inverter energy system from time to time to ensure continued compliance with the requirements in these Rules.~~
- (b) ~~In the event that the Network Service Provider considers that the inverter energy system does not meet the requirements of clause 3.5.1, 3.5.4 or 3.8, it may:~~
 - (1) ~~request information on the settings for the inverter energy system from the User or Generator;~~
 - (2) ~~require testing or setting changes on the inverter energy system; or~~
 - (3) ~~disconnect the inverter energy system.~~
- (c) ~~The User or Generator must conduct testing, implement setting changes, or disconnect the inverter energy system if requested by the Network Service Provider in accordance with clause 3.8.7.3(b).~~

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Deleted: Testing

Deleted: Where it applies, this clause 3.7.8 applies to the exclusion of clause 4.2.¶

Deleted: 3.7

Deleted: verify that:¶
The approved schematic has been checked and accurately reflects the installed electrical system.¶
All required switches present and operate correctly as per the approved schematic.¶
Signage and labelling

Deleted: WA Electrical Requirements.¶
The installation is correct and fit for purpose. ¶
Operational settings are secure as

Deleted: .¶
The islanding protection operates correctly and disconnects the Inverter energy system from the network within 2 seconds.¶
The delay

Deleted: reconnection following restoration of normal supply is greater than ...

Deleted: minute

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Deleted: generating equipment

Deleted: <#>To avoid doubt, clause 4.1.3 does not apply to generators covered by clause 3.7. ¶
Signage¶
The User must provide signage as per the WA Electrical Requirements.¶
¶

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4. INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

4.1 INSPECTION AND TESTING

4.1.1 Right of entry and inspection

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(a) The Network Service Provider or AEMO (in this clause 4.1.1 the "inspecting party") may, in accordance with this clause 4.1.1, enter and inspect any *facility* of the *Network Service Provider* or any *User* whose equipment is *connected* directly to the *transmission system* and who is bound by these *Rules* (in this clause 4.1.1 the "*facility owner*") and the operation and maintenance of that *facility* in order to:

Deleted: The *Network Service Provider*, *System Management* or any *User* whose *equipment* is *connected* directly to the *transmission system* and who is bound by these *Rules* (a reference to any of whom, for the purposes of this clause 4.1.1, includes its *representatives*)

- (1) assess compliance by the *facility owner* with its obligations under the *Access Code* or these *Rules*, or any relevant *connection agreement*;
- (2) investigate any operating incident in accordance with clause 5.4.4.3;
- (3) investigate any potential threat by that *facility* to *power system security*; or
- (4) conduct any periodic familiarisation or training associated with the operational requirements of the *facility*.

(b) If an inspecting party wishes to inspect a *facility* under clause 4.1.1(a), the inspecting party must give the *facility owner* at least:

- (1) 2 *business days*' notice or as otherwise agreed by the parties, or
- (2) 10 *business days*' notice for a non-urgent issue,

in writing of its intention to carry out an inspection.

(c) In the case of an emergency condition affecting the *transmission or distribution system* that the *Network Service Provider* or AEMO reasonably considers requires access to a *facility*, prior notice to the *facility owner* is not required. However, the *Network Service Provider* or AEMO, as applicable, must notify the *facility owner* as soon as practicable of the nature and extent of the activities it proposes to undertake, or which it has undertaken, at the *facility*.

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(d) A notice given by an inspecting party under clause 4.1.1(b) must include the following information:

- (1) the name of the inspecting party's *representative* who will be conducting the inspection;
- (2) the time when the inspection will commence and the expected time when the inspection will conclude; and
- (3) the relevant reasons for the inspection.

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

- (e) An inspecting party must not carry out an inspection under this clause 4.1.1 within ~~6 months~~ of any previous inspection by it, except for the purpose of verifying the performance of corrective action claimed to have been carried out in respect of a non-conformance observed and documented on the previous inspection or for the purpose of investigating an operating incident in accordance with clause ~~5.4.4.3~~.
- (f) At any time when the *representative* of an inspecting party is in a *facility owner's facility*, that *representative* must:
- (1) not cause any damage to the *facility*;
 - (2) interfere with the operation of the *facility* only to the extent reasonably necessary and as approved by the *facility* owner (such approval not to be unreasonably withheld or delayed);
 - (3) observe "permit to test" access to site and clearance protocols applicable to the *facility*, provided that these are not used by the *facility* owner or any contractor or agent of the *facility* owner solely to delay the granting of access to the *facility* or its inspection;
 - (4) observe the requirements in relation to occupational health and safety and industrial relations matters which are of general application to all invitees entering on or into the *facility*, provided that these requirements are not used by the *facility* owner or any contractor or agent of the *facility* owner solely to delay the granting of access to the *facility*; and
 - (5) not ask any question other than as may be reasonably necessary for the purpose of such inspection, nor give any direction or instruction to any person involved in the operation or maintenance of the *facility* other than in accordance with these *Rules* or, where the inspecting party and the *facility* owner are parties to a *connection agreement*, that *connection agreement*.
- (g) Any *representative* of an inspecting party conducting an inspection under this clause 4.1.1 must be appropriately qualified and experienced to perform the relevant inspection. If so requested by the *facility* owner, the inspecting party must procure that its *representative* (if not a direct employee of the inspecting party) enters into a confidentiality undertaking in favour of the *facility* owner in a form reasonably acceptable to the *facility* owner prior to seeking access to the relevant *facility*.
- (h) An inspection under this clause 4.1.1 must not take longer than one day unless the inspecting party seeks approval from the *facility* owner for an extension of time (which approval must not be unreasonably withheld or delayed).
- (i) Any equipment or goods installed or left on land or in premises of a *facility* owner after an inspection conducted under this clause 4.1.1 do not become the property of the *facility* owner (notwithstanding that they may be annexed or affixed to the land on which the *facility* is situated).

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- (j) In respect of any equipment or goods left by an inspecting party on land or in premises of a *facility owner* during or after an inspection, the *facility owner* must, and must procure that any person who owns or occupies the land on which the *facility* is situated or any part thereof does:
- (1) take reasonable steps to ensure the security of any such equipment;
 - (2) not use any such equipment or goods for a purpose other than as contemplated in these *Rules* without the prior written approval of the inspecting party;
 - (3) allow the inspecting party to remove any such equipment or goods in whole or in part at a time agreed with the *facility owner*, which agreement must not be unreasonably withheld or delayed; and
 - (4) not create or cause to be created any mortgage, charge or lien over any such equipment or goods.

4.1.2 Right of testing

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- (a) If the *Network Service Provider* or any *User* whose equipment is *connected* directly to the *transmission system* under a *connection agreement* (in this clause 4.1.2 the "requesting party") believes that equipment owned or operated by, or on behalf of, the other party to the *connection agreement* (in this clause 4.1.2 the "equipment owner") may not comply with the *Access Code*, these *Rules* or the *connection agreement*, the requesting party may require testing by the equipment owner of the relevant equipment by giving notice in writing to the equipment owner accordingly.
- (b) If a notice is given under clause 4.1.2(a), the relevant test must be conducted at a reasonable time mutually agreed by the requesting party and the equipment owner and, where the test may have an impact on *power system security, AEMO* or the *Network Service Provider* as the case requires. Such agreement must not be unreasonably withheld or delayed.
- (c) An equipment owner who receives a notice under clause 4.1.2(a) must co-operate in relation to conducting the tests requested by that notice.
- (d) Tests conducted in respect of a *connection point* under this clause 4.1.2 must be conducted using test procedures agreed between the *Network Service Provider*, the relevant *Users* and, where appropriate, *AEMO*, which agreement must not be unreasonably withheld or delayed.
- (e) Tests under this clause 4.1.2 must be conducted or supervised only by persons with the relevant skills and experience in the commissioning or testing of power system primary equipment and secondary equipment.

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

- (f) A requesting party may appoint a *representative* to witness the test requested by it under this clause 4.1.2 and the equipment owner must permit a *representative* so appointed to be present while the test is being conducted.
- (g) Subject to clause 4.1.2(h), an equipment owner who conducts a test must submit a report to the requesting party and, where the test was one that could have had an impact on *power system, security, AEMO* or the *Network Service Provider* as the case requires, within a reasonable period after the completion of the test. The report must outline relevant details of the tests conducted, including, but not limited to, the results of those tests.
- (h) The *Network Service Provider* may attach test equipment or *monitoring* equipment to equipment owned by a *User* or require a *User* to attach such test equipment or *monitoring* equipment, subject to the provisions of clause 4.1.1 regarding entry and inspection. The data from any such test equipment or *monitoring* equipment must be read and recorded by the equipment owner.
- (i) In carrying out monitoring under clause 4.1.2(h), the *Network Service Provider* must not cause the performance of the monitored equipment to be constrained in any way.
- (j) If a test under this clause 4.1.2 or monitoring under clause 4.1.2(h) demonstrates that equipment does not comply with the *Access Code*, these *Rules* or the relevant *connection agreement*, then the equipment owner must:
 - (1) promptly notify the requesting party of that fact;
 - (2) promptly advise the requesting party of the remedial steps it proposes to take and the timetable for such remedial work;
 - (3) diligently undertake such remedial work and report at *monthly* intervals to the requesting party on progress in implementing the remedial action; and
 - (4) conduct further tests or monitoring on completion of the remedial work to confirm compliance with the relevant requirement.

4.1.3 Tests to demonstrate compliance with connection requirements for generators

A Generator who has developed a set of Generator Performance Standards and a GPS Monitoring Plan by applying the process defined in clause 3A of the WEM Rules must adhere to the compliance framework in the WEM Rules. The arrangements defined in clause 4.1.3 apply to all other Generators.

- (a) (1) A *Generator* must provide evidence to the *Network Service Provider* that each of its *generating units* complies with the technical requirements of Chapter 3, as applicable, and the relevant *connection agreement* prior to commencing commercial operation. In addition, each *Generator* must cooperate with the *Network Service Provider* and, if necessary, AEMO in carrying out *power system* tests prior to commercial operation in order to verify the performance of each *generating unit*, and provide information

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and data necessary for computer model validation. The test requirements for *synchronous generating units* are detailed in Table A11.1 of Attachment 11. The *Network Service Provider* must specify test requirements for *asynchronous generation*. If tests reveal that the computer model provided by the Generator in accordance with clause 3.3.11 requires amendment, the Generator must provide an update to the generation system model in accordance with the generation system model procedure developed by the Network Service Provider.

(2) Special tests may be specified by the *Network Service Provider* or *AEMO* where reasonably necessary to confirm that the performance standards of the *power system*, *power system security* and the quality of service to other *Users* will not be adversely affected by the connection or operation of a *Generator's* equipment. The requirement for such tests must be determined on a case by case basis and the relevant *Generator* must be advised accordingly. Examples of these special tests are listed in Table A11.2 of Attachment 11. Where testing is not practicable in any particular case, the *Network Service Provider* may require the *Generator* to install recording equipment at appropriate locations in order to monitor equipment performance.

(3) A Generator may be required to undertake compliance tests as described in clause 4.1.3(a) following any relevant generator modification or triggered event.

(4) These compliance tests must only be performed after the machines have been tested and certified by a chartered professional engineer with National Engineering Register standing qualified in a relevant discipline, unless otherwise agreed, and after the machine's turbine controls, AVR, excitation limiters, power system stabiliser, and associated *protection* functions have been calibrated and tuned for commercial operation to ensure stable operation both on-line and off-line. All final settings of the AVR, PSS and excitation limiters must be indicated on control transfer block diagrams and made available to the *Network Service Provider* before the tests.

(5) All compliance tests under this clause 4.1.3 must be carried out under the supervision of personnel experienced in the commissioning or testing of power system primary equipment and secondary equipment.

(6) A *Generator* must forward test procedures for undertaking the compliance tests required in respect of its equipment, including details of the recorders and measurement equipment to be used in the tests, to the *Network Service Provider* for approval 30 *business days* before the tests or as otherwise agreed. The *Generator* must provide all necessary recorders and other measurement equipment for the tests.

(7) A *Generator* must also coordinate the compliance tests in respect of its equipment and liaise with all parties involved, including the *Network Service Provider* and *AEMO*. The *Network Service Provider* or *AEMO* may

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witness the tests and must be given access to the site for this purpose, but responsibility for carrying out the tests remains with the *Generator*.

- (8) All test results and associated relevant information including final transfer function block diagrams and settings of automatic *voltage* regulator, *power* system stabiliser, under excitation limiter and over excitation limiter must be forwarded to the *Network Service Provider* within 10 *business days* after the completion of the test.

- (b) A *Generator* must negotiate in good faith with the *Network Service Provider* and agree on a compliance monitoring program, following commissioning, for each of its *generating units* to confirm ongoing compliance with the applicable technical requirements of clause 3.3, as applicable, and the relevant *connection agreement*. The negotiations must consider the use of high speed data recorders and similar non-invasive methods for verifying the equipment performance to the extent that such non-invasive methods are practicable.

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- (1) When developing the compliance monitoring program, the *Generator* and the *Network Service Provider* should be guided by the GPS Monitoring Plan template developed by AEMO under the *WEM Rules*. The monitoring program should define:

(A) how the *Generator* will monitor performance against the applicable technical requirements including any testing and verification requirements;

(B) the record keeping obligations relating to monitoring compliance with technical requirements the *Generator* must comply with; and

(C) the information and data provision obligations the *Generator* must comply with when requested by the *Network Service Provider*, including the form and timeframes by which that information and data must be provided.

- (2) The *Generator* must review and amend the compliance monitoring program following any relevant *generator modification* to the *generating system* or revision of any of the technical requirements applicable to the *generating system*.

- (3) The *Generator* must review and amend the compliance monitoring program following any revision to the GPS Monitoring Plan template developed by AEMO under the *WEM Rules*.

- (4) Before agreeing to a monitoring program the *Network Service Provider* may consult with AEMO.

- (5) The *Network Service Provider* must include the compliance test results, the agreed compliance monitoring program and any results obtained through the execution of the compliance monitoring program in the register of performance requirements defined in clause 3.2.6.

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

- (c) If compliance testing or monitoring of in-service performance demonstrates that a generating system is not complying with one or more technical requirements of clause 3.3 and the relevant connection agreement then the Generator must:
- (1) promptly notify the Network Service Provider of that fact;
 - (2) promptly advise the Network Service Provider of the proposed rectification plan containing the remedial steps it proposes to take and the timetable for such remedial work to address the non compliance;
 - (3) diligently undertake such remedial work defined in the approved rectification plan and report at monthly intervals to the Network Service Provider on progress in implementing the remedial action; and
 - (4) conduct further tests or monitoring on completion of the remedial work to confirm compliance with the relevant technical requirement.

(d) The Network Service Provider must consult with AEMO on any power system security implications prior to approving any proposed rectification plan.

(e) The Network Service Provider must use best endeavours to respond to the Generator within 10 business days of receipt of the proposed rectification plan and either:

- (1) approve the proposed rectification plan;
- (2) reject the proposed rectification plan providing reasons for the rejection, including, if applicable, any reasons provided by AEMO;
- (3) seek further information needed to assess the suitability of the proposed rectification plan; or
- (4) propose an alternative rectification plan the Network Service Provider considers would be acceptable.

(f) If a Generator reasonably considers it is unable to meet or comply with the requirements of an approved rectification plan it must notify the Network Service Provider as soon as reasonably practicable and may propose an amendment to the approved rectification plan.

(g) Where a Generator considers that compliance with an approved rectification plan will pose a credible safety risk or threaten power system security or power system reliability, it must immediately notify the Network Service Provider and:

- (1) provide details of the actions required by the rectification plan that pose the safety risk or threat to power system security or power system reliability; and
- (2) propose amendments to the rectification plan to address the safety risk or threat to power system security or power system reliability.

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- (h) While amendments are being developed in accordance with clause 4.1.3(g), the Generator is only required to comply with the requirements of the approved rectification plan that do not pose a safety risk or threat to power system security or power system reliability unless the Network Service Provider advises that the Generator can suspend compliance while the proposed amendment is developed and considered.
- (i) If a Generator proposes an amendment to an approved rectification plan, the Network Service Provider may:
- (1) approve the proposed amendment to the rectification plan; or
 - (2) reject the proposed amendment to the rectification plan and, at the Network Service Provider's discretion, propose an alternative amendment to the rectification plan if it considers a suitable alternative is available, which must be accepted or rejected by the Generator within 5 business days or such longer period agreed by the Network Service Provider.
- (j) Before approving a proposed amendment to a rectification plan, the Network Service Provider should consult with AEMO on any power system security implications.
- (k) If the Network Service Provider reasonably considers a Generator has not complied, or is not complying, with the requirements of an approved rectification plan and any approved amendments, the Network Service Provider may after consulting with AEMO on any power system security implications take action to address the risk posed by the continued non-compliance. Action may include:
- (1) issuing a written notice to the Generator advising that the Network Service Provider considers that the Generator has not complied with the requirement of the approved rectification plan and any approved amendments and seeking an explanation from the Generator within a reasonable time not less than 5 business days;
 - (2) depending on the explanation received, cancelling an approved rectification plan and requiring a modified plan be developed; and
 - (3) directing the Generator in accordance with Clause 5.3.3(d) to restrict the operation of the generating system to manage the risk posed by the non-compliance.
- (l) If the Network Service Provider or, where relevant, AEMO reasonably believes that a generating unit is not complying with one or more technical requirements of Chapter 3 or the relevant connection agreement, the Network Service Provider or AEMO may require the Generator to conduct tests within an agreed time to demonstrate that the relevant generating unit complies with those technical requirements and if the tests provide evidence that the relevant generating unit continues to comply with the technical requirement(s), whichever of the Network Service Provider or AEMO that requested the tests must reimburse the Generator for the reasonable expenses incurred as a direct result of conducting the tests.

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

- (m) If the *Network Service Provider* or, where relevant, *AEMO*:
- (1) has reason to believe that a *generating unit* does not comply with one or more of the requirements of [Chapter 3](#);
 - (2) has reason to believe that a *generating unit* does not comply with the requirements for *protection schemes* set out in clause 2.9, as those requirements apply to the *Generator* under clause [3.5](#); or
 - (3) either:
 - (A) does not have evidence demonstrating that a *generating unit* complies with the technical requirements set out in [Chapter 3](#); or
 - (B) holds the opinion that there is, or could be, a threat to the *power system security* or *power system stability*,
- the *Network Service Provider* or, where relevant, *AEMO*, may direct the relevant *Generator* to operate the relevant *generating unit* at a particular *generated output* or in a particular mode of operation until the relevant *Generator* submits evidence reasonably satisfactory to the *Network Service Provider* or, where relevant, *AEMO*, that the *generating unit* is complying with the relevant technical requirement. If such a *direction* is given orally, the *direction*, and the reasons for it, must be confirmed in writing to the *Generator* as soon as practicable after the *direction* is given.
- (n) If:
- (1) the *Network Service Provider* or, where relevant, *AEMO*, gives a *direction* to a *Generator* under clause 4.1.3(m) and the *Generator* neglects or fails to comply with that *direction*; or
 - (2) the *Network Service Provider* or, where relevant, *AEMO*, endeavours to communicate with a *Generator* for the purpose of giving a *direction* to a *Generator* under clause 4.1.3(m) but is unable to do so within a time which is reasonable, having regard to circumstances giving rise to the need for the *direction*,
- then the *Network Service Provider* or *AEMO*, as the case requires, may take such measures as are available to it (including, in the case of *AEMO*, issuing an appropriate *direction* to the *Network Service Provider* to take measures) to cause the relevant *generating unit* to be operated at the required *generated output* or in the required mode, or *disconnect* the *generating unit* from the *power system*.
- (o) A *direction* under clause 4.1.3(m) must be recorded by the *Network Service Provider* or *AEMO*, as applicable.
- (p) From the *Rules commencement date*, each *Generator* must maintain records and retain them for a minimum of 7 years (from the date of creation of each record) for each of its *generating units* and *power stations* setting out details of the results of all technical

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performance and monitoring conducted under this clause 4.1.3 and make these records available to the *Network Service Provider* or [AEMO](#) on request.

4.1.4 Routine testing of protection equipment

(a) A *User* must cooperate with the *Network Service Provider* to test the operation of equipment forming part of a *protection scheme* relating to a *connection point* at which that *User* is connected to a *transmission or distribution system* and the *User* must conduct these tests:

- (1) prior to the equipment at the relevant *connection point* being placed in service; and
- (2) at intervals specified in the *connection agreement* or in accordance with an asset management plan agreed between the *Network Service Provider* and the *User*.

(b) A *User* must, on request from the *Network Service Provider*, demonstrate to the *Network Service Provider's* satisfaction the correct calibration and operation of the *User's protection* at the *User's connection point*.

(c) The *Network Service Provider* and, where applicable, a *User*, must institute and maintain a compliance program to ensure that each of its *facilities* of the following types, to the extent that the proper operation of any such *facility* may affect *power system security* and the ability of the *power system* to meet the performance standards specified in clause 2.2, operates reliably and in accordance with its relevant performance requirements specified in [Chapter 2](#):

- (1) *protection systems*;
- (2) *control systems* for maintaining or enhancing *power system stability*;
- (3) *control systems* for controlling *voltage or reactive power*; and
- (4) *control systems* for *load shedding*.

(d) A compliance program under clause 4.1.4(c) must:

- (1) include monitoring of the performance of the *facilities*;
- (2) to the extent reasonably necessary, include provision for periodic testing of the performance of those *facilities* upon which *power system security* depends;
- (3) provide reasonable assurance of ongoing compliance of the *power system* with the performance standards specified in clause 2.2; and
- (4) be in accordance with *good electricity industry practice*.

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

- (e) The *Network Service Provider* and, where applicable, a *User*, must notify [AEMO](#) immediately if it reasonably believes that a *facility* of the type listed in clause 4.1.4(c), and forming part of a registered *facility*, does not comply with, or is unlikely to comply with, relevant performance requirements specified in [Chapter 2](#).

4.1.5 Testing by Users of their own [equipment requiring changes to agreed operation](#)

- (a) If a *User* proposes to conduct a test on equipment related to a *connection point* and that test requires a *change* to the operation of that equipment as specified in the relevant *connection agreement*, or if the *User* reasonably believes that the test might have an impact on the operation or performance of the *power system*, the *User* must give notice in writing to the *Network Service Provider* at least 15 *business days* in advance of the test, except in an emergency.
- (b) The notice to be provided under clause 4.1.5(a) must include:
- (1) the nature of the proposed test;
 - (2) the estimated start and finish time for the proposed test;
 - (3) the identity of the equipment to be tested;
 - (4) the *power system* conditions required for the conduct of the proposed test;
 - (5) details of any potential adverse consequences of the proposed test on the equipment to be tested;
 - (6) details of any potential adverse consequences of the proposed test on the *power system*; and
 - (7) the name of the person responsible for the coordination of the proposed test on behalf of the *User*.
- (c) The *Network Service Provider* must review the proposed test to determine whether the test:
- (1) could adversely affect the normal operation of the *power system*;
 - (2) could cause a threat to *power system security*;
 - (3) requires the *power system* to be operated in a particular way which differs from the way in which the *power system* is normally operated;
 - (4) could affect the normal metering of *energy* at a *connection point*;
 - (5) could threaten public safety; or
 - (6) could damage equipment at the *connection point*.

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

- (d) If, in the *Network Service Provider's* opinion, a test could threaten public safety, damage or threaten to damage equipment or adversely affect the operation, performance or *power system security*, the *Network Service Provider* may direct that the proposed test procedure be modified or that the test not be conducted at the time proposed. Where appropriate, the *Network Service Provider* must consult with *AEMO* in determining the nature of any modified test procedure or the appropriate time for the test to be conducted.
- (e) The *Network Service Provider* must advise any other *Users* who will be adversely affected by a proposed test and consider any requirements of those *Users* when approving the proposed test.
- (f) The *User* who conducts a test under this clause 4.1.5 must ensure that the person responsible for the coordination of the test promptly advises the *Network Service Provider* and, where appropriate, *AEMO*, when the test is complete.
- (g) If the *Network Service Provider* approves a proposed test, the *Network Service Provider* and, where appropriate, *AEMO* must ensure that *power system* conditions reasonably required for that test are provided as close as is reasonably practicable to the proposed start time of the test and continue for the proposed duration of the test.
- (h) Within a reasonable period after any such test has been conducted, the *User* who has conducted a test under this clause 4.1.5 must provide the *Network Service Provider* and, where appropriate, *AEMO*, with a report in relation to that test, including test results where appropriate.
- (i) Any tests completed under this clause 4.1.5 must be carried out under the supervision of personnel experienced in the commissioning or testing of power system primary equipment and secondary equipment.

4.1.6 Tests of generating units requiring changes to agreed operation

- (a) The *Network Service Provider* may, at intervals of not less than 12 months per *generating unit*, by notice to the relevant *Generator* accordingly, require the testing of any *generating unit* connected to the *transmission or distribution system* in order to determine analytic parameters for modelling purposes or to assess the performance of the relevant *generating unit*.
- (b) The *Network Service Provider* must, in consultation with the *Generator*, propose a date and time for the tests but, if the *Network Service Provider* and the *Generator* are unable to agree on a date and time for the tests, they must be conducted on the date and at the time nominated by the *Network Service Provider*, provided that:
 - (1) the tests must not be scheduled for a date earlier than 15 *business days* after notice is given by the *Network Service Provider* under clause 4.1.6(a);
 - (2) the *Network Service Provider* must ensure that the tests are conducted at the next scheduled *outage* of the relevant *generating unit* or at some other

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time which will minimise the departure from the *commitment* and *dispatch* that is anticipated to take place at that time; and

- (3) in any event, the tests must be conducted no later than 9 *months* after notice is given by the *Network Service Provider* under clause 4.1.6(a).
- (c) A *Generator* must provide any reasonable assistance requested by the *Network Service Provider* in relation to the conduct of the tests.
- (d) Tests conducted under clause 4.1.6 must be conducted in accordance with test procedures agreed between the *Network Service Provider* and the relevant *Generator*. A *Generator* must not unreasonably withhold its agreement to test procedures proposed for this purpose by the *Network Service Provider*.

(e) For *Generators* that have an obligation to provide a computer model in accordance with clause 3.3.11, the *Network Service Provider* must provide to a *Generator* test results and any analysis that indicates a need to revise that model, and the *Generator* must provide an update to the *generation system model* in accordance with the *generation system model procedure* developed by the *Network Service Provider*.

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(f) For *Generators* for which clause 4.1.6(e) does not apply, the *Network Service Provider* must provide to a *Generator* such details of the analytic parameters of the model derived from the tests referred to in clause 4.1.6 for any of that *Generator's* *generating units* as may reasonably be requested by the *Generator*.

4.1.7 Power system tests

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- (a) Tests conducted for the purpose of either verifying the magnitude of the *power transfer capability* of the *transmission or distribution system* or investigating *power system* performance must be coordinated and approved by the *Network Service Provider*.
- (b) The tests described in clause 4.1.7(a) must be conducted, if considered necessary by the *Network Service Provider* or AEMO, whenever:
 - (1) a new *generating unit or facility* or a *transmission or distribution system* development is commissioned that is calculated or anticipated to alter substantially the *power transfer capability* through the *transmission or distribution system*;
 - (2) setting *changes* are made to any *turbine control system* and *excitation control system*, including *power system* stabilisers; or
 - (3) they are required to verify the performance of the *power system* or to validate computer models.

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

- (c) Tests as described in clause 4.1.7(a) may be requested by **AEMO** or by a *User*. In either case, the *Network Service Provider* must conduct the tests unless it reasonably considers that the grounds for requesting the test are unreasonable.
- (d) If the *Network Service Provider* is satisfied that tests as described in clause 4.1.7(a) are necessary, it must develop a proposed test procedure describing how the tests will be undertaken and identify any potential impacts on *Users* during the tests. The test procedure should be finalised through consultation with affected *Users* and **AEMO** and published by the *Network Service Provider* at least 2 months before the start of any test.
- (e) The *Network Service Provider* must notify all *Users* who could reasonably be expected to be affected by the proposed test at least 15 *business days* before any test under this clause 4.1.7 may proceed and consider any requirements of those *Users* when approving the proposed test.
- (f) Operational conditions for each test must be arranged by the *Network Service Provider* in consultation, where relevant, with **AEMO**, and the test procedures must be coordinated by an officer nominated by the *Network Service Provider* who has authority to stop the test or any part of it or vary the procedure within pre-approved guidelines if it considers any of these actions to be reasonably necessary.
- (g) A *User* must cooperate with the *Network Service Provider* when required in planning and conducting *transmission and distribution system* tests as described in clause 4.1.7(a).
- (h) The *Network Service Provider*, following consultation where appropriate with **AEMO**, may direct the operation of *generating units* by *Users* during *power system* tests and, where necessary, the disconnection of *generating units* from the *transmission and distribution systems*, if this is necessary to achieve operational conditions on the *transmission and distribution systems* which are reasonably required to achieve valid test results.
- (i) The *Network Service Provider* must plan the timing of tests so that the variation from *commitment* and *dispatch* that would otherwise occur is minimised and the duration of the tests is as short as possible consistent with test requirements and *power system security*.
- (j) If a test conducted in accordance with this clause 4.1.7 identifies the need to revise computer models for *generating systems*:
 - (1) For *Generators* that have an obligation to provide a computer model in accordance with clause 3.3.11, the *Network Service Provider* must provide to a *Generator* test results and any analysis that indicates a need to revise that model, and the *Generator* must provide an update to the *generation system model* in accordance with the *generation system model procedure* developed by the *Network Service Provider*.

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- (2) For generating systems for which clause 4.1.7(j)(1) does not apply, the Network Service Provider must develop appropriate model revisions and provide revised models to the Generator if requested to do so.

4.1.8 Provision of information

- (a) The Network Service Provider may request information from Users to validate the capacity and technical specification of equipment connected within the User's facility. The information that can be requested is limited to:

- (1) information required to assess the impact of a User's facility on power system security, power system reliability or the quality of supply to other Users, and
- (2) information required to assess the ability of the facility to meet the technical requirements specified in a generator performance standard or connection agreement.

- (b) Information gathered by the Network Service Provider under this clause may be shared with AEMO.

- (c) The User must use reasonable endeavours to provide the information requested by the Network Service Provider under this clause 4.1.8.

4.2 COMMISSIONING OF USER'S EQUIPMENT

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4.2.1 Requirement to inspect and test equipment

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- (a) A User must ensure that new or replacement equipment is inspected and tested to demonstrate that it complies with relevant *Australian Standards*, relevant international standards, these *Rules*, the *Access Code* and any relevant *connection agreement* and *good electricity industry practice* prior to being connected to a *transmission or distribution system*.

- (b) If a User installs or replaces equipment at a *connection point*, the *Network Service Provider* is entitled to witness the inspections and tests described in clause 4.2.1(a).

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4.2.2 Co-ordination during commissioning

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- (a) A User seeking to connect equipment to a *transmission or distribution system* must cooperate with the *Network Service Provider* to develop procedures to ensure that the commissioning of the *connection and connected facility* is carried out in a manner that:

- (1) does not adversely affect other *Users* or affect *power system security or quality of supply to other Users* of the *power system*; and
- (2) minimises the threat of damage to the *Network Service Provider's* or any other *User's* equipment.

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

(b) A User may request the Network Service Provider schedule commissioning and tests (including the relevant exchange of correspondence) at particular times that suit the project completion dates. *The Network Service Provider* must make all reasonable efforts to accommodate such a request.

(c) A User must not connect equipment to the network without the approval of the *Network Service Provider* who must not approve such connection before the User's installation has been certified for compliance with these *Rules* and the *WA Electrical Requirements*. However, this clause 4.2.2(c) does not apply if clause 3.8 applies.

(d) Clauses 4.2.2(e) through 4.2.2(m) apply to Generators that operate large generating systems that are not transmission connected market generators.

Note:
The intention of this clause is to exclude subsequent clauses from applying to large generating systems that are covered by equivalent clauses in the WEM Rules.

(e) A Generator must not generate electricity unless it is doing so in accordance with a commissioning procedure agreed with the Network Service Provider, has a valid interim approval to operate (with or without conditions) or an approval to operate.

(f) The Network Service Provider may only issue an interim approval to operate without conditions to a Generator where the Network Service Provider and AEMO consider the relevant large generating system has not demonstrated any non-compliance based on observed performance with the applicable registered generator performance standard and there are no observed risks to power system security or power system reliability.

(g) Subject to clause 4.2.2(h), the Network Service Provider may, in its discretion and after consulting with AEMO:

- (1) issue an interim approval to operate with conditions to a Generator; or
- (2) place conditions on an interim approval to operate issued pursuant to clause 4.2.2(f).

(h) The Network Service Provider may only issue and place conditions on an interim approval to operate pursuant to clause 4.2.2(g) if after consulting with AEMO the Network Service Provider:

- (1) either:
 - (A) does not consider the large generating system is demonstrating compliance based on observed performance with the applicable registered generator performance standards; or
 - (B) considers that conditions are required to mitigate any observed risks to power system security or power system reliability; and

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- (2) considers the *large generating system* is reasonably likely to resolve the performance issue and be compliant with the applicable *registered generator performance standards* in the future.
- (i) Prior to being issued an *approval to operate*, if a *large generating system* is not meeting the applicable *registered generator performance standards*, the *Generator* responsible for the *large generating system* must:
- (1) immediately notify the *Network Service Provider* and provide details of the non-compliance; and
- (2) either:
- (A) make any modification required to comply with the conditions and meet the applicable *registered generator performance standards* within the timeframe specified by the *Network Service Provider* or, if a *rectification plan* is required pursuant to clause 4.1.3(c), within the timeframe specified in the approved *rectification plan*; or
- (B) as soon as practicable request to renegotiate any applicable *registered generator performance standards* it is unable to meet in which case clause 4.2.2(k) applies.
- (j) Where the *Network Service Provider* is notified pursuant to clause 4.2.2(i)(1), the *Network Service Provider* must advise AEMO as soon as reasonably practicable. The *Network Service Provider* may require the *Generator* to submit a *rectification plan* for approval in accordance with clause 4.1.3(c).
- (k) The *Network Service Provider* may, in its discretion and with the approval of AEMO, agree to a request made pursuant to clause 4.2.2(i)(2)(B) to renegotiate a *registered generator performance standard* for a *generating system* where the *Network Service Provider* and AEMO agree the *Generator* will be able to meet and comply with an *alternative generator performance standard* that meets the applicable criteria listed in clause 3.3.4.2(b), in which case the process for consideration and approval of *proposed generator performance standards* in clause 3.3.4 applies.
- (l) If the *Network Service Provider* refuses a request made pursuant to clause 4.2.2(i)(2)(B) to renegotiate a *registered generator performance standard* for a *large generating system* or an *alternative generator performance standard* cannot be agreed between the *Network Service Provider*, AEMO and the *Generator*, the *Generator* must comply with the applicable *registered generator performance standards* previously approved as recorded in the *register of performance requirements* within the timeframe specified by the *Network Service Provider*.
- (m) The *Network Service Provider* may revoke an *interim approval to operate* issued pursuant to clause 4.2.2(f) or clause 4.2.2(g), where the *Network Service Provider* reasonably considers that:

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(1) the performance of the large generating system differs from the applicable registered generator performance standards; or

(2) the conditions placed on an interim approval to operate have not been met or complied with,

and the Generator responsible for the large generating system has not complied with the requirement in clause 4.2.2(i)(2).

(n) The Network Service Provider may consult with AEMO prior to making a decision under clause 4.2.2(m)

(o) The Network Service Provider must, after consulting with AEMO, issue an approval to operate to a Generator responsible for a large generating system where:

(1) a compliance program for the large generating system has been agreed with the Network Service Provider under clause 4.1.3(b) and the Network Service Provider has included it in the register of performance requirements;

(2) the operational performance of the large generating system is considered satisfactory to the Network Service Provider and AEMO; and

(3) the Network Service Provider considers the Generator responsible for the large generating system has met the requirements of, and indicated compliance with, the applicable registered generator performance standards.

4.2.3 Control and protection settings for equipment

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(a) Not less than 65 *business days* (or as otherwise agreed between the *User* and the *Network Service Provider*) prior to the proposed commencement of commissioning by a *User* of any new or replacement equipment that could reasonably be expected to alter materially the performance of the *power system*, the *User* must submit to the *Network Service Provider* sufficient design information including proposed parameter settings to allow critical assessment including analytical modelling of the effect of the new or replacement equipment on the performance of the *power system*.

(b) The *Network Service Provider* must:

(1) consult with other *Users* and AEMO as appropriate; and

(2) within 20 *business days* of receipt of the design information under clause 4.2.3(a), notify the *User* of any comments on the proposed parameter settings for the new or replacement equipment.

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(c) If the *Network Service Provider's* comments include alternative parameter settings for the new or replacement equipment, then the *User* must notify the *Network Service*

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Provider within 10 *business days* that it either accepts or disagrees with the alternative parameter settings suggested by the *Network Service Provider*.

- (d) The *Network Service Provider* and the *User* must negotiate parameter settings that are acceptable to them both and if there is any unresolved disagreement between them, the matter must be determined by means of the disputes procedure provided for in clause 1.7.
- (e) The *User* and the *Network Service Provider* must co-operate with each other to ensure that adequate grading of *protection* is achieved so that faults within the *User's facility* are cleared without adverse effects on the *power system*.

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4.2.4 Commissioning program

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- (a) Not less than 65 *business days* (or as otherwise agreed between the *User* and the *Network Service Provider*) prior to the proposed commencement of commissioning by a *User* of any new or replacement equipment that could reasonably be expected to alter materially the performance of the *power system*, the *User* must advise the *Network Service Provider* in writing of the commissioning program including test procedures and proposed test equipment to be used in the commissioning.
- (b) The *Network Service Provider* must, within 20 *business days* of receipt of such advice under clause 4.2.4(a), notify the *User* either that it:
 - (1) agrees with the proposed commissioning program and test procedures; or
 - (2) requires changes in the interest of maintaining *power system security, safety or quality of supply*.
- (c) If the *Network Service Provider* requires *changes*, then the *Network Service Provider* and the *User* must co-operate to reach agreement and finalise the commissioning program within a reasonable period.
- (d) A *User* must not commence the commissioning until the commissioning program has been finalised and the *Network Service Provider* must not unreasonably delay finalising a commissioning program.

4.2.5 Commissioning tests

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- (a) The *Network Service Provider* and AEMO have the right to witness commissioning tests relating to new or replacement equipment, including *remote monitoring equipment, protection* and control and data acquisition equipment, that could reasonably be expected to alter materially the performance of the *power system* or the accurate metering of *energy* or be required for the real time operation of the *power system*.
- (b) Prior to *connection* to the *transmission or distribution system* of new or replacement equipment covered by clause 4.2.5(a), a *User* must provide to the *Network Service*

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

Provider a signed written statement to certify that the inspection and tests required under clause 4.2.1(a) have been completed and that the equipment is ready to be *connected* and *energised*. The statement must be certified by a chartered professional engineer with National Engineering Register standing qualified in a relevant discipline.

(c) The *Network Service Provider* must, within a reasonable period of receiving advice of commissioning tests of a *User's* new or replacement equipment under this clause 4.2.5, advise the *User* whether or not it:

- (1) wishes to witness the commissioning tests; and
- (2) agrees with the proposed commissioning times.

(d) A *User* whose new or replacement equipment is tested under this clause 4.2.5 must, as soon as practicable after the completion of the relevant tests, submit to the *Network Service Provider* the commissioning test results demonstrating that a new or replacement item of equipment complies with these *Rules* or the relevant *connection agreement* or both to the satisfaction of the *Network Service Provider*.

(e) If the commissioning tests conducted under this clause 4.2.5 in relation to a *User's* new or replacement item of equipment demonstrate non-compliance with one or more requirements of these *Rules* or the relevant *connection agreement*, then the *User* must promptly meet with the *Network Service Provider* to agree on a process aimed at achieving compliance with the relevant item in these *Rules*.

(f) The *Network Service Provider* may direct that the commissioning and subsequent *connection* of a *User's* equipment must not proceed if the relevant equipment does not meet the technical requirements specified in clause 4.2.

(g) All commissioning tests under this clause 4.2.5 must be carried out under the supervision of personnel experienced in the commissioning of *power system primary equipment* and *secondary equipment*.

(h) The *Network Service Provider* must include the commissioning test results in the register of performance requirements defined in clause 3.2.6.

4.2.6 Coordination of protection settings

(a) A *User* must ensure that its *protection settings* coordinate with the existing *protection settings* of the *transmission and distribution system*. Where this is not possible, the *User* may propose revised *protection settings*, for the *transmission and distribution system* to the *Network Services Provider*. In extreme situations it may be necessary for a *User* to propose a commercial arrangement to the *Network Service Provider* to modify the *transmission or distribution system protection*. The *Network Service Provider* must consider all such proposals, but it must not approve a *User's* *protection system* until *protection* coordination problems have been resolved. In some situations, the *User* may be required to revise the *Network Service Provider* settings or upgrade the *Network Service Provider's* or other *Users'* equipment, or both.

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

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- (b) If a *User* seeks approval from the *Network Service Provider* to apply or *change* a control or *protection system* setting, this approval must not be withheld unless the *Network Service Provider* reasonably determines that the changed setting would cause the *User* not to comply with the requirements of [Chapter 3](#) of these *Rules*, or the *power system* not to comply with the performance standards specified in clause 2.2, or the *Network Service Provider* or some other *User* not to comply with their own *protection* requirements specified in the respective clauses 2.9 and 3.5, or the *power transfer capability* of the *transmission or distribution system* to be reduced.
- (c) If the *Network Service Provider* reasonably determines that a setting of a *User's control system* or *protection system* needs to *change* in order for the *User* to comply with the requirements of [Chapter 3](#) of these *Rules*, or for the *power system* to meet the performance standards specified in clause 2.2 or so as not to cause the *Network Service Provider* or some other *User* to fail to comply with its own *protection* requirements specified in clause 2.9 or 3.5, as applicable, or for the *power transfer capability* of the *transmission or distribution system* to be restored, the *Network Service Provider* must consult with the *User* and may direct in writing that a setting be applied in accordance with the determination.
- (d) The *Network Service Provider* may require a test in accordance with clause 4.1.3 to verify the performance of the *User's* equipment with any new setting.

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4.2.7 Approval of [proposed protection](#)

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- (a) A *User* must not allow its plant to take *supply* of electricity from the *power system* without prior approval of the *Network Service Provider*.
- (b) A *User* must not *change* the approved *protection* design or settings without prior written approval of the *Network Service Provider*.

4.3 DISCONNECTION AND RECONNECTION

4.3.1 General

- (a) If the *Network Service Provider*, in its opinion, needs to interrupt *supply* to any *User* of the *transmission system* for reasons of safety to the public, the *Network Service Provider's* personnel, any *Users'* equipment or the *Network Service Provider's* equipment, the *Network Service Provider* must (time permitting) consult with the relevant *User* prior to executing that interruption. Such consultations are generally impracticable at the *distribution system* level, because of the large number of *Users* involved, and hence are not required in relation to interruptions to *supply* to *Users* on the *distribution system*.
- (b) The *Network Service Provider* may *disconnect Users* if the *transmission or distribution system* is operating outside the permissible limits.

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

4.3.2 Voluntary disconnection

- (a) Unless agreed otherwise and specified in a *connection agreement*, a *User* must give to the *Network Service Provider* notice in writing of its intention to *disconnect a facility* permanently from a *connection point*.
- (b) A *User* is entitled, subject to the terms of the relevant *connection agreement*, to require voluntary permanent disconnection of its equipment from the *power system*, in which case appropriate operating procedures necessary to ensure that the disconnection will not threaten *power system security* must be implemented in accordance with clause 1.1.1.

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4.3.3 Disconnection procedures

- (a) If a *User's facility* is to be *disconnected* permanently from the *power system*, whether in accordance with clause 4.3.2 or otherwise, the *Network Service Provider* and the *User* must, prior to such disconnection occurring, follow agreed procedures for disconnection.
- (b) The *Network Service Provider* must notify other *Users* if it reasonably believes that their rights under a *connection agreement* will be adversely affected by the implementation of the procedures for disconnection agreed under clause 4.3.3(a). The *Network Service Provider* and the *User* and, where applicable, other affected *Users* must negotiate any amendments to the procedures for disconnection or the relevant *connection agreements* that may be required.
- (c) Any disconnection procedures agreed to or determined under clause 4.3.3(a) must be followed by the *Network Service Provider* and all relevant *Users*.

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4.3.4 Involuntary disconnection

- (a) The *Network Service Provider* or *AEMO* may *disconnect a User's facilities* from the *transmission or distribution system* or otherwise curtail the provision of services in respect of a *connection point*:
 - (1) in the case of the *Network Service Provider*, where directed to do so by *AEMO* in the exercise or purported exercise of a power under the *WEM Rules*;
 - (2) in accordance with clause 4.1.3(n);
 - (3) in accordance with clause 4.3.5;
 - (4) during an emergency in accordance with clause 4.3.6;
 - (5) for safety reasons where the *Network Service Provider* considers that the connection of the *User's facilities* may create a serious hazard to people or property;

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

- (6) in accordance with the provisions of any written law; or
- (7) in accordance with any connection agreement relating to the connection point.

Note:

Disconnection in accordance with clause 4.3.4(a)(5) could occur, for example, if the *Network Service Provider* becomes aware that a *User's* earthing arrangements have been *changed* to the extent that they may no longer meet the requirements of clause 3.4.8(e).

- (b) In all cases of *disconnection* by the *Network Service Provider* during an emergency in accordance with clause 4.3.6 the *Network Service Provider* must provide a report to the *User* advising of the circumstances requiring such action.

4.3.5 Curtailment to undertake works

- (a) The *Network Service Provider* may, in accordance with *good electricity industry practice*, disconnect a *User's* facilities from the *transmission or distribution system* or otherwise curtail the provision of services in respect of a *connection point* (collectively in this clause 4.3.5 a "curtailment"):
 - (1) to carry out planned *augmentation* or maintenance to the *transmission or distribution system*; or
 - (2) to carry out unplanned maintenance to the *transmission or distribution system* where the *Network Service Provider* considers it necessary to do so to avoid injury to any person or material damage to any property or the environment; or
 - (3) if there is a breakdown of, or damage to, the *transmission or distribution system* that affects the *Network Service Provider's* ability to provide services at that *connection point*; or
 - (4) if an event:
 - (A) that is outside the reasonable control of the *Network Service Provider*; and
 - (B) whose effect on the assets of the *Network Service Provider* or the property of any person cannot, by employing *good electricity industry practice*, be prevented,
 is imminent, with the result that safety requirements or the need to protect the assets of the *Network Service Provider* or any other property so require; or
 - (5) to the extent necessary for the *Network Service Provider* to comply with a *written law*.
- (b) The *Network Service Provider* must keep the extent and duration of any curtailment under clause 4.3.5(a) to the minimum reasonably required in accordance with *good electricity industry practice*.
- (c) The *Network Service Provider* must notify each *User* of the *transmission system* who will or may be adversely affected by any proposed curtailment under clause 4.3.5(a) of

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CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

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that proposed curtailment as soon as practicable. Where it is not reasonably practicable to notify a *User* prior to the commencement of the curtailment, the *Network Service Provider* must do so as soon as reasonably practicable after its commencement.

- (d) If the *Network Service Provider* notifies a *User* of a curtailment in accordance with clause 4.3.5(c) in respect of a *connection point*, the *User* (acting reasonably and prudently) must comply with any requirements set out in the notice concerning the curtailment.

4.3.6 Disconnection during an emergency

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Where the *Network Service Provider* or *AEMO* is of the opinion that it must *disconnect* a *User's facilities* during an emergency under these *Rules* or otherwise, then the *Network Service Provider* or *AEMO*, as applicable, may:

- (a) request the relevant *User* to reduce the *power transfer* at the proposed point of disconnection to zero in an orderly manner and then *disconnect* the *User's facility* by automatic or manual means; or
- (b) immediately *disconnect* the *User's facilities* by automatic or manual means where, in the opinion of the *Network Service Provider* or *AEMO*, as applicable, it is not appropriate to follow the procedure set out in clause 4.3.6(a) because action is urgently required as a result of a threat to safety of persons, hazard to equipment or a threat to *power system security*.

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4.3.7 Obligation to reconnect

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The *Network Service Provider* must reconnect a *User's facilities* to a *transmission or distribution system* as soon as practicable:

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- (a) in the case of the *Network Service Provider*, where directed to do so by *AEMO* in the exercise or purported exercise of a power under the *WEM Rules*;
- (b) if the breach of the *Access Code*, these *Rules* or a *connection agreement* giving rise to the disconnection has been remedied; or
- (c) if the *User* has taken all necessary steps to prevent the re-occurrence of the relevant breach and has delivered binding undertakings to the *Network Service Provider* or *AEMO*, as applicable, that the breach will not re-occur.

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5. TRANSMISSION AND DISTRIBUTION SYSTEM OPERATION AND COORDINATION

5.1 APPLICATION

This [Chapter 5](#) applies to the operation and coordination of the *Network Service Provider's* and *Users' facilities* to the extent not covered under the [WEM Rules](#). For Market [Participants](#) (as defined under the [WEM Rules](#)) the rules that apply for *power system* operation and coordination are those found within the [WEM Rules](#).

[Chapter 5 does not explicitly define the requirements for operational coordination between the Network Service Provider and AEMO as those requirements are described in the WEM Rules and associated procedures.](#)

Note:

[In this chapter, references to AEMO's direct control refer to the sections of the transmission system where AEMO is responsible for power system security and power system reliability.](#)

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5.2 INTRODUCTION

5.2.1 Purpose and Scope of [Chapter 5](#)

(a) This [Chapter 5](#), which applies to, and defines obligations for, the *Network Service Provider* and all *Users*, has the following aims:

- (1) to establish processes and arrangements to enable the *Network Service Provider* to plan and conduct operations within the *power system*;
- (2) to establish arrangements for the actual *dispatch* of *generating units* and *loads* by *Users*, [and](#)
- (3) [to define operational criteria that the Network Service Provider endeavours to meet when planning and operating the power system.](#)

(b) [The Network Service Provider's operational obligations and responsibilities are classified as Transmission Network Operator or Distribution Network Operator obligations and responsibilities.](#)

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5.3 POWER SYSTEM OPERATION CO-ORDINATION RESPONSIBILITIES AND OBLIGATIONS

5.3.1 Responsibilities of the [Transmission Network Operator](#)

(a) [The Transmission Network Operator's responsibilities for the operation and co-ordination of the transmission system are to:](#)

- (1) take steps to coordinate switching procedures and arrangements in accordance with *good electricity industry practice* in order to avoid damage to equipment, to ensure the safety of the *power system*, [and maintain power system reliability, transmission network adequacy and power system security](#);

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- (2) operate all equipment under its control or co-ordination within the appropriate operational or emergency limits which are either established by the *Network Service Provider* or advised by the respective *Users*;
 - (3) assess the impacts of any technical and operational limitations of all plant and equipment *connected to the transmission system* on the operation of the *power system*;
 - (4) subject to clause 5.3.1(a)(7):
 - (A) disconnect *Users'* equipment, or
 - (B) require a *User* to operate its equipment,
 as necessary to maintain and restore secure and reliable operation of the *power system*;
 - (5) coordinate and direct any rotation of *supply* interruptions in the event of a major *supply* shortfall or disruption;
 - (6) investigate and review all major *transmission system* and *power system* operational incidents and to initiate action plans to manage any abnormal situations or significant deficiencies that could reasonably threaten safe and reliable operation of the *transmission system*. Such situations or deficiencies include:
 - (A) *power system* frequencies outside those specified in the *frequency operating standards* specified in the *WEM Rules* and investigation or review is required to support an *AEMO* investigation under the *WEM Rules*;
 - (B) *power system voltages* outside those specified in clause 2.2.2;
 - (C) actual or potential lack of *power system stability*;
 - (D) unplanned or unexpected operation of *power system* equipment;
 - (7) operate those parts of the *transmission system* that are not under the control of *AEMO* so as to ensure that the *power system* performance standards as specified in clause 2.2 are met; and
 - (8) operate the *transmission system* in accordance with the operational criteria specified in clause 5.4.1.
- (b) The operational activities performed by the *Transmission Network Operator* must be coordinated with *AEMO* following the processes defined in the *WEM Rules* and further informed by the relevant operating protocol established in accordance with clause 3.1A of the *WEM Rules*.

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5.3.2 Responsibilities of the Distribution Network Operator

(a) The Distribution Network Operator's responsibilities for the operation and co-ordination of the distribution system are to:

- (1) take steps to coordinate switching procedures and arrangements in accordance with good electricity industry practice in order to avoid damage to equipment, to ensure the safety of the power system, and maintain power system reliability, transmission network adequacy and power system security;
- (2) operate all equipment under its control or co-ordination within the appropriate operational or emergency limits which are either established by the Network Service Provider or advised by the respective Users;
- (3) assess the impacts of any technical and operational limitations of all plant and equipment connected to the distribution system on the operation of the power system;
- (4) subject to clause 5.3.2(a)(7):
 - (A) disconnect Users' equipment; or
 - (B) require a User to operate its equipment,

as necessary to maintain and restore secure and reliable operation of the power system;

- (5) coordinate and direct any rotation of supply interruptions in the event of a major supply shortfall or disruption;
- (6) investigate and review all major distribution system and power system operational incidents and to initiate action plans to manage any abnormal situations or significant deficiencies that could reasonably threaten safe and reliable operation of the distribution system. Such situations or deficiencies include:
 - (A) power system frequencies outside those specified in the frequency operating standards specified in the WEM Rules and investigation or review is required to support an AEMO investigation under the WEM Rules;
 - (B) power system voltages outside those specified in clause 2.2.3;
 - (C) actual or potential lack of power system stability;
 - (D) unplanned or unexpected operation of power system equipment;

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(7) operate those parts of the *distribution system* that are not under the control of *AEMO* so as to ensure that the *power system* performance standards as specified in clause 2.2 are met; and

(b) the operational activities impacting *power system security* performed by the *Distribution Network Operator* must be coordinated with *AEMO* as informed by the relevant operating protocol established in accordance with clause 3.1A of the *WEM Rules*.

5.3.3 **User obligations**

(a) A *User* must ensure that only appropriately qualified and competent persons operate equipment that is directly connected to the *transmission or distribution system* through a *connection point*.

(b) A *User* must co-operate with any review of operating incidents undertaken by the *Transmission Network Operator* under clause 5.4.4.3, or the *Distribution Network Operator* under clause 5.5.3.3.

(c) A *User* must co-operate with and assist the *Transmission Network Operator and the Distribution Network Operator* in the proper discharge of the *transmission or distribution system* operation and co-ordination responsibilities.

(d) A *User* must operate its *facilities* and equipment in accordance with any *direction* given by the *Transmission Network Operator, Distribution Network Operator* or *AEMO*.

(e) A *User* must notify *AEMO* or, where appropriate, the *Transmission Network Operator or Distribution Network Operator*, prior to a *generating unit* being operated in a mode (e.g. "turbine-follow" mode) where the *generating unit* will be unable to respond in accordance with the *technical requirements specified in* clause 3.3.7.6.

(f) Except in an emergency, a *User* must notify the *Transmission Network Operator* at least 5 *business days* prior to taking a *protection of transmission element* out of service in accordance with *availability requirements specified in* clause 2.9.3.

(g) Except in an emergency, a *User* must notify the *Distribution Network Operator* at least 5 *business days* prior to taking a *protection of distribution element* out of service if this *protection* is required to meet a *critical fault clearance time* in accordance with *availability requirements specified in* clause 2.9.3.

(h) A *User* must operate their *facilities* in accordance with any relevant *User Operating Protocol* negotiated with the *Network Service Provider* in accordance with clause 5.7.2.

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 The *Network Service Provider* must, in accordance with the *Access Code* (including through the provision of appropriate information to *Users* to the extent permitted by law and under these *Rules*), to fulfil its *transmission system* or the *distribution system* operation and co-ordination responsibilities in accordance with the appropriate *power system operating procedures* and *good electricity industry practice*.
 The *Network Service Provider* must make accessible to *Users* such information as:
 the *Network Service Provider* considers appropriate; and
 the *Network Service Provider* is permitted to disclose, in order to assist *Users* to make appropriate market decisions related to open access to the *Network Service Provider's transmission and distribution systems* and, in doing so, the *Network Service Provider* must ensure that such information is available to those *Users* who request the information on a non-discriminatory basis.
 The *Network Service Provider* must

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5.4 TRANSMISSION NETWORK OPERATOR DETAILED OBLIGATIONS

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5.4.1 Operational criteria for the transmission system

5.4.1.1 General

(a) The Transmission *Network Operator* must:

- (1) operate the *transmission network* in accordance with the *power system security* requirements specified in clauses 5.3.1(b) and 5.4.1.2;
- (2) in accordance with the *WEM Rules*, follow *directions* issued by *AEMO* to maintain *power system security* or *power system reliability*.

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5.4.1.2 Power system security requirements

(a) The *transmission system* shall be operated under *prevailing system conditions* with no:

- (1) equipment loadings exceeding *pre-fault ratings* or *unacceptable overloading*;
- (2) *unacceptable voltage conditions*, or
- (3) *system instability*;

(b) Subject to clause 5.4.1.2(a), the *transmission system* shall be operated such that for the *credible contingency* of a *fault outage* on the *transmission system* of any of the following:

- (1) a single *transmission circuit*;
- (2) a *zone substation transformer*;
- (3) a *reactive equipment*;
- (4) a single *generation circuit*;
- (5) a single *generating unit* (or several *generating units* sharing a common *circuit breaker*).

there must be no:

- (6) *loss of demand* except as specified in *Table 2-10*;
- (7) *unacceptable overloading* of any *transmission equipment*;
- (8) *unacceptable voltage conditions*; or
- (9) *system instability*.

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(c) Subject to clause 5.4.1.2(a), the transmission system shall also be operated such that for any other contingency deemed credible by AEMO in operational timescales, there must be no:

- (1) unacceptable overloading of any transmission equipment;
- (2) unacceptable voltage conditions; or
- (3) system instability.

(d) Where the Network Service Provider identifies a compliance violation with the requirements under clauses 5.4.1.2(a), 5.4.1.2(b), and 5.4.1.2(c), then they must, in consultation with AEMO, alter the prevailing system conditions within its control capability as soon as practicable to bring the power system back into compliance with these clauses.

Note:

For clarity, the above clauses are not intended to alter the obligation on the Network Service Provider to take all practical steps to minimise load loss during operation. AEMO is responsible for managing essential system services in accordance with the WEM Rules. Any shortfalls in essential system services will be managed by AEMO.

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5.4.2 Transmission system voltage control

(a) The Transmission Network Operator must monitor the adequacy of the capacity to produce or absorb reactive power to control the transmission system voltages within the operational voltage envelope specified by AEMO.

(b) The Transmission Network Operator must monitor voltages on the transmission system and implement operational arrangements to maintain voltages within the operational voltage envelope specified by AEMO and the voltage limits specified in clause 2.2.

(c) Operational arrangements implemented to control voltage may include any combination of the following:

- (1) operating transmission equipment;
- (2) requiring Users to operate their facilities to provide a level of voltage support consistent with the relevant technical requirements documented in the connection agreement or the 'User Performance Register' defined in clause 3.2.6; or
- (3) utilising additional services procured through contractual arrangements with Users.

5.4.3 Partial outage of transmission system protection systems

(a) Where there is an outage of one protection scheme of a transmission element, the Transmission Network Operator must determine, and where appropriate advise AEMO

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of, the most appropriate action to take to deal with that outage. Depending on the circumstances, the determination may be:

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- (1) to leave the *transmission element* in service for a limited duration;
 - (2) to take the *transmission element* out of service immediately;
 - (3) to install or direct the installation of a temporary *protection scheme*;
 - (4) to accept a degraded performance from the *protection system*, with additional operational measures or other temporary measures to minimise power system impact where deemed necessary; or
 - (5) to operate the *transmission element* at a lower capacity.
- (b) If there is an outage of both protections on a *transmission element* and the *Transmission Network Operator* determines that to leave the *transmission element* in service presents an unacceptable risk to power system security, the *Transmission Network Operator* must take the *transmission element* out of service as soon as practicable and advise *AEMO* and any affected *Users* immediately this action is undertaken.
- (c) The *Transmission Network Operator* must abide by any relevant instruction given to it by *AEMO* in accordance with the *WEM Rules*.
- (d) When assessing the impact of *transmission equipment protection outages* in accordance with this clause 5.4.3, the *Transmission Network Operator* must consider the availability requirements specified in the *transmission protection* requirements in clause 2.9.3.

5.4.4 Transmission system operation and co-ordination

5.4.4.1 Response to User's advice

If the *Transmission Network Operator* considers the circumstances advised to it under clause 5.6.2.1(a) to be a threat to power system security, the *Transmission Network Operator*, in consultation as necessary with *AEMO*, may direct that the equipment protected or operated by the relevant *protection* or *control system* be taken out of operation or operated in such manner as the *Transmission Network Operator* requires.

5.4.4.2 Managing electricity supply shortfall events

Note:

It is the responsibility of *AEMO* under the *WEM Rules* to manage *supply* shortfall events arising from a shortage of *generation* or from multiple *contingency events* on those parts of the *transmission system* under its direct control. However, *supply* shortfall events may also occur as a result of *contingency events* arising within those parts of the *transmission and distribution systems* under the control of the *Network Service Provider*. In addition, the *Transmission Network Operator* may be required to manage the rotation of *supply* interruptions in accordance with clause 5.3.1(a)(5).

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- (a) If, at any time, there are insufficient transmission or distribution system supply options available to supply total load in a region securely, then the Transmission Network Operator may undertake any one or more of the following:
- (1) recall of a transmission equipment outage where the item of transmission equipment is not under the direct control of AEMO;
 - (2) disconnect one or more load connection points as:
 - (A) the Transmission Network Operator considers necessary in accordance with procedures under the WEM Rules; or
 - (B) directed by AEMO in accordance with the demand control measures in the WEM Rules; or
 - (3) direct a User to take such steps as are reasonable to reduce its load immediately. Any temporary load reduction must be such that preference in supply is given, where necessary, to domestic consumers, then commercial consumers and finally industrial consumers.
- (b) If there is a major supply shortfall, the Transmission Network Operator must implement, to the extent practicable, load shedding across interconnected regions in accordance with any relevant provisions under the WEM Rules.

5.4.4.3 Review of operating incidents

- (a) The Transmission Network Operator may conduct reviews of significant operating incidents or deviations from normal operating conditions in order to assess the adequacy of the provision and response of facilities or services, and must do so if directed by AEMO.
- (b) For cases where the Transmission Network Operator has disconnected a transmission system User, a report must be provided by the Transmission Network Operator to the User detailing the circumstances that required the Transmission Network Operator to take that action.
- (c) The Transmission Network Operator must provide to a User available information or reports, as is reasonable, relating to the performance of that User's equipment during power system incidents or operating condition deviations following a User's request.

5.4.5 Transmission system operations and maintenance planning

- (a) The Transmission Network Operator must develop an outage assessment guideline to guide a consistent application of the risk-based outage assessment process.
- (b) The Transmission Network Operator must assess the potential impact of proposed outages of transmission equipment using the risk-based assessment process described in the outage assessment guideline.

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 The limits of operation of the transmission system must be translated by the Network Service Provider into key location operational voltage settings or limits, transmission line capacity limits, reactive power production (or absorption) capacity or other appropriate limits to enable their use by the System Management and, where appropriate, the Network Service Provider in the maintenance of power system security.¶
 The Network Service Provider must design and construct the transmission and distribution system such that voltage nominations at all connection points can be maintained in accordance with the technical requirements specified in section 2.¶
 In order to meet the requirements of clause 5.4.1(d), the Network Service Provider must arrange the provision of reactive power facilities and power system voltage stabilising facilities through:¶
 contractual arrangements for ancillary services with appropriate Users;¶
 obligations on the part of Users under relevant connection agreements; and¶
 provision of such facilities by the Network Service Provider.¶
 Reactive power facilities arranged under clause 5.4.1(e) may include

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 synchronous condensers (compensators);¶
 static VAR compensators (SVC);¶
 static synchronous compensators (STATCOM);¶
 shunt capacitors;¶
 shunt reactors; and¶
 series capacitors.¶
Reactive Power Reserve Requirements¶
 The Network Service Provider must ensure that sufficient reactive power reserve is available at all times to maintain or restore the power system to a normal operating state after the most critical contingency event as determined by previous analysis or by periodic contingency analysis by the Network Service Provider.¶
Audit and Testing¶
 The Network Service Provider must arrange, coordinate and supervise...

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- (c) The risk-based *outage* assessment process should ensure that the timing of *outages* of transmission equipment and arrangements implemented to facilitate those *outages*:
 - (1) are consistent with the *transmission system planning criteria* defined in section 2.5;
 - (2) enable the operational criteria defined in section 5.4.1 to be achieved; and
 - (3) appropriately balance the measures necessary to facilitate taking the *outage* against any risks to safety, security and the reliability of the transmission system from using those measures.
- (d) Where required by the *WEM Rules*, the *Transmission Network Operator* must submit transmission equipment *outage* requests to *AEMO* for approval.
- (e) When undertaking approved *outages* of transmission equipment, any relevant *User* arrangements made in accordance with clause 3.1(b) must be considered by the *Transmission Network Operator*.

5.5 DISTRIBUTION NETWORK OPERATOR DETAILED OBLIGATIONS

5.5.1 Operational criteria for the *distribution system*

- (a) The *Distribution Network Operator* must:
 - (1) operate those parts of the *distribution system* not under the control of *AEMO* to meet the requirements in clauses 5.3.2(b) and 5.3.2(a)(7); and
 - (2) in accordance with the *WEM Rules*, follow *directions* issued by *AEMO* to maintain *power system security* or *power system reliability*.

5.5.2 *Distribution System voltage control*

- (a) The *Distribution Network Operator* must determine the adequacy of the capacity to produce or absorb *reactive power* to control the *distribution system voltages*.
- (b) The *Distribution Network Operator* must monitor *voltages* on the *distribution system* and implement operational arrangements to maintain *voltages* within the *voltage limits* specified in clause 2.2.
- (c) Operational arrangements implemented to control *voltage* may include any combination of the following:
 - (1) Operating *distribution system* equipment;
 - (2) requiring *Users* to operate their *facilities* to provide a level of *voltage* support consistent with the relevant technical requirements documented

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in the *connection agreement* or the ‘User Performance Register’ defined in clause 3.2.6; or

- (3) utilising additional services procured through contractual arrangements with Users.

5.5.3 *Distribution system operation and co-ordination*

5.5.3.1 *Response to User’s advice*

If the *Distribution Network Operator* considers the circumstances advised to it under clause 5.6.2.1(a) to be a threat to *power system security*, the *Distribution Network Operator*, in consultation where necessary with *AEMO*, may *direct* that the equipment protected or operated by the relevant *protection* or *control system* be taken out of operation or operated in such manner as the *Distribution Network Operator* requires.

5.5.3.2 *Managing electricity supply shortfall events*

Note:

It is the responsibility of *AEMO* under the *WEM Rules* to manage *supply* shortfall events arising from a shortage of *generation* or from multiple *contingency events* on those parts of the *transmission system* under its direct control. However, *supply* shortfall events may also occur as a result of *contingency events* arising within those parts of the *transmission and distribution systems* under the control of the *Network Service Provider*. In addition, the *Distribution Network Operator* may be required to manage the rotation of *supply interruptions* in accordance with clause 5.3.2(a)(5).

- (a) If, at any time, there are insufficient *distribution supply* options available to *supply* total *load* securely, then the *Distribution Network Operator* may undertake any one or more of the following:

- (1) recall of a *distribution equipment outage*;
 (2) disconnect one or more *load connection points* as:
 (A) the *Distribution Network Operator* considers necessary; or
 (B) directed by *AEMO* in accordance with the demand control measures in the *WEM Rules*; or
 (3) *direct* a *User* to take such steps as are reasonable to reduce its *load* immediately. Any temporary *load* reduction must be such that preference in *supply* is given, where necessary, to domestic consumers, then commercial consumers and finally industrial consumers.

- (b) If there is a major *supply* shortfall, the *Distribution Network Operator* must implement, to the extent practicable, *load shedding* in accordance with any relevant provisions under the *WEM Rules*.

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5.5.3.3 Review of operating incidents

- (a) The Distribution Network Operator may conduct reviews of significant operating incidents or deviations from normal operating conditions in order to assess the adequacy of the provision and response of facilities or services, and must do so if directed by AEMO.
- (b) Unless specifically included in the connection agreement, there is no requirement for the Distribution Network Operator to provide a report to a distribution system User that is disconnected by the Distribution Network Operator or AEMO. Where such a report is required, it must detail the circumstances that required the Distribution Network Operator or AEMO to disconnect the User.
- (c) The Distribution Network Operator must provide to a User available information or reports, as is reasonable, relating to the performance of that User's equipment during power system incidents or operating condition deviations following a User's request.

5.5.4 Distribution system operations and maintenance planning

- (a) The Distribution Network Operator must assess the potential impact of proposed outages of distribution equipment.
- (b) Where required by the WEM Rules, the Distribution Network Operator must submit distribution equipment outage requests to AEMO for approval.
- (c) When undertaking approved outages of distribution equipment, any relevant User arrangements made in accordance with clause 3.1(b) must be considered by the Distribution Network Operator.

5.6 USER DETAILED OBLIGATIONS

5.6.1 Partial outage of transmission system protection systems

A User must act consistently with determinations made by the Network Service Provider under clause 5.4.3.

5.6.2 Power system operation and co-ordination

5.6.2.1 User's advice

- (a) A User must promptly advise the Network Service Provider if the User becomes aware of any circumstance, including any defect in, or mal-operation of, any protection or control system, which could be expected to adversely affect the secure operation of the power system.
- (b) A User must comply with a direction given by the Transmission Network Operator under clause 5.4.4.1 or the Distribution Network Operator under clause 5.5.3.1.

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5.6.2.2 Managing electricity supply shortfall events

A User must comply with a direction given under clause 5.4.4.2(a)(3) or clause 5.5.3.2(a)(3).

5.6.2.3 Review of operating incidents

(a) A User must co-operate in any review of operating incidents conducted by the Network Service Provider (including by making available relevant records and information) under clause 5.4.4.3 or clause 5.5.3.3.

(b) A User must provide to the Network Service Provider such information relating to the performance of its equipment during and after particular power system incidents or operating condition deviations as the Network Service Provider reasonably requires for the purposes of analysing or reporting on those power system incidents or operating condition deviations.

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5.6.3 Operations and maintenance planning

Note:

This clause is not intended to apply to Users who are registered as Rule Participants under Section 2 of the WEM Rules. Outage planning for Rule Participants is undertaken by AEMO in accordance with clauses 3.18 to 3.21 of the WEM Rules.

In accordance with clause A3.56 of the Access Code, for coordination purposes, operation, maintenance and extension planning and co-ordination must be performed as follows:

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(a) on or before 1 July and 1 January each year, a User, where so requested by the Network Service Provider, must provide to the Network Service Provider:

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(1) a maintenance schedule in respect of the equipment and equipment connected at each of its connection points for the following financial year; and

(2) a non-binding indicative planned maintenance plan in respect of the equipment and equipment connected at each of its connection points for each of the 2 financial years following the financial year to which the maintenance schedule provided under clause 5.6.3(a)(1) relates.

(b) A User must provide the Network Service Provider with any information that the Network Service Provider requests concerning maintenance of equipment and equipment connected at the User's connection points.

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(c) A User must ensure that a maintenance schedule provided by the User under clause 5.6.3(a)(1) is complied with, unless otherwise agreed with the Network Service Provider.

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- (d) Both a maintenance schedule and a maintenance plan must:
- (1) specify the dates and duration of *planned outages* for the relevant equipment which may have an impact on the *transmission system*;
 - (2) specify the work to be carried out during each such an *outage*;
 - (3) be in writing in substantially the form requested by the *Network Service Provider*; and
 - (4) be consistent with *good electricity industry practice*.
- (e) If a *User* becomes aware that a maintenance schedule provided by the *User* under clause 5.6.3(a)(1) in respect of one of its *connection points* will not be complied with, then the *User* must promptly notify the *Network Service Provider*.

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5.7 POWER SYSTEM OPERATING PROCEDURES, PROTOCOLS, AUDITS AND INFORMATION

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5.7.1 Operation of *User's* equipment

- (a) A *User* must observe the requirements of the relevant *power system operating procedures*.
- (b) A *User* must operate its equipment interfacing with the *transmission or distribution system* in accordance with the requirements of the *Access Code*, these *Rules*, any applicable *connection agreement*, *User Operating Protocol*, and the *Network Service Provider's* electrical safety instructions and procedures.
- (c) The *Network Service Provider* may direct a *User* to place *reactive power facilities* belonging to, or controlled by, that *User* into or out of service for the purposes of maintaining *power system* performance standards specified in clause 2.2. A *User* must comply with any such *direction*.

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5.7.2 Operating protocols

- (a) If required by the *Network Service Provider*, a *User* must cooperate with the *Network Service Provider* to develop a *User Operating Protocol* that captures operational arrangements for their *facility*.
- (b) *User Operating Protocols* should be consistent with the template developed by the *Network Service Provider*.
- (c) A *User* must negotiate any revisions to relevant *User Operating Protocols* to ensure the protocol continues to accurately record operating arrangements relevant to their *facility*.

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5.7.3 Power system fault levels

- (a) The *Network Service Provider* must determine the maximum prospective fault levels at all *transmission system busbars* and all *zone substation supply busbars*. This determination must consider all credible *transmission system* operating configurations and all credible *generation* patterns, but need not consider short term switching arrangements that result in, for example, the temporary paralleling of *transformers* to maintain continuity of *supply*.
- (b) The fault levels determined under clause 5.7.3(a) must be publicly available. In addition, the *Network Service Provider* must ensure that there is available to a *User*, on request, such other information as will allow the *User* to determine the maximum fault level at any of the *User's connection points*.

5.7.4 Protection audit and testing

The *Network Service Provider* must coordinate such inspections and tests as the *Network Service Provider* thinks appropriate to ensure that the *protection* of the *transmission and distribution system* is adequate to protect against damage to *equipment* and facilitate safe and secure operation of the power system. Such tests must be performed according to the requirements of clause 4.1.

5.7.5 Audit and testing of reactive power control equipment

The *Network Service Provider* must arrange, coordinate and supervise the conduct of appropriate tests to assess the availability and adequacy of the provision of reactive power devices to control and maintain power system voltages.

5.7.6 Audit and testing of power system stability systems

The *Network Service Provider* must arrange, coordinate and supervise the conduct of such inspections and tests as it deems appropriate to assess the availability and adequacy of the devices installed to maintain *power system stability*.

5.8 POWER SYSTEM OPERATION SUPPORT

5.8.1 Remote control and monitoring devices

- (a) All remote control, operational metering and monitoring devices and local circuits as described in Chapter 3 must be installed, operated and maintained by a *User* in accordance with the standards and protocols determined and advised by the *Network Service Provider* or AEMO.
- (b) The Network Service Provider must publish a 'Generating System Control and Monitoring Guideline', describing the signals that a User may need to monitor and make available to the Network Service Provider or AEMO. In developing the guideline, the Network Service Provider must consider the procedure developed in accordance with clause 2.35.4 of the WEM Rules.

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5.8.2 Power system operational communication facilities

(a) Users must advise the *Network Service Provider* of its requirements for the giving and receiving of *operational communications* in relation to each of its *facilities* and ensure these are kept up to date. The requirements that must be forwarded to the *Network Service Provider* include:

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- (1) the title of contact position;
- (2) the telephone numbers of that position;
- (3) the telephone numbers of other available communication systems in relation to the relevant *facility*;
- (4) a facsimile number for the relevant *facility*; and
- (5) an electronic mail address for the relevant *facility*.

(b) A *User* must maintain the speech communication channel installed in accordance with clause 3.3.10(c) or clause 3.6.8(d) in good repair and must investigate any fault within 4 hours, or as otherwise agreed with the *Network Service Provider*, of that fault being identified and must repair or procure the repair of faults promptly.

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(c) Where required by *AEMO* or the *Network Service Provider* a *User* must establish and maintain a form of electronic mail *facility* as approved by the *Network Service Provider* for communication purposes.

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(d) The *Network Service Provider* must, where necessary for the operation of the *transmission and distribution system*, advise *Users* of nominated persons for the purposes of giving or receiving *operational communications* and ensure this is kept up to date.

(e) Contact details to be provided by the *Network Service Provider* in accordance with clause 5.8.2(d) include position, telephone numbers, a facsimile number and an electronic mail address.

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5.8.3 Authority of nominated operational contacts

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The *Network Service Provider* and a *User* are each entitled to rely upon any communications given by or to a contact designated under clause 5.8.2 as having been given by or to the *User* or the *Network Service Provider*, as the case requires.

5.8.4 Records of power system operational communication

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(a) The *Network Service Provider* and *Users* must log each telephone *operational communication* in the form of entries in a log book which provides a permanent record as soon as practicable after making or receiving the *operational communication*.

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- (b) In addition to the log book entry required under clause 5.8.4(a), the *Network Service Provider* must make a voice recording of each telephone *operational communication*. The *Network Service Provider* must ensure that when a telephone conversation is being recorded under this clause 5.8.4(b), the persons having the conversation receive an audible indication that the conversation is being recorded in accordance with relevant statutory requirements.
- (c) Records of *operational communications* must include the time and content of each communication and must identify the parties to each communication.
- (d) The *Network Service Provider* and *Users* must retain all *operational communications* records including voice recordings for a minimum of 7 years.
- (e) If there is a dispute involving an *operational communication*, the voice recordings of that *operational communication* maintained by, or on behalf of, the *Network Service Provider* will constitute prima facie evidence of the contents of the *operational communication*.

5.9 NOMENCLATURE STANDARDS

- (a) A *User* must use the *nomenclature standards* for transmission and distribution equipment and apparatus as determined by the *Network Service Provider*, and use the specified nomenclature in any *operational communications* with the *Network Service Provider*.
- (b) A *User* must ensure that name plates on its equipment relevant to operations at any point within the *power system* conform to the specified nomenclature standards and are maintained to ensure easy and accurate identification of equipment.
- (c) A *User* must ensure that technical drawings and documentation provided to the *Network Service Provider* comply with the specified nomenclature standards.
- (d) The *Network Service Provider* may, by notice in writing, require a *User* to *change* the existing numbering or nomenclature of *transmission* and *distribution* equipment and apparatus of the *User* for purposes of uniformity.

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ATTACHMENT 1 GLOSSARY

In these Rules, [unless a contrary intention appears](#):

- (a) a word or phrase set out in column 1 of the table below has the meaning set out opposite that word or phrase in column 2 of that table; and
- (b) a word or phrase defined in the Act or the Access Code has the meaning given in that Act or that Code (as the case requires), unless redefined in the table below.

abnormal equipment conditions	<p>Are, for the purpose of clause 2.9, those conditions that prevail at a particular location in the <i>power system</i> when the following circumstances exist:</p> <ul style="list-style-type: none"> (a) the number of <i>generating units connected</i> to the <i>power system</i> is the least number normally <i>connected</i> at times of minimum <i>generation</i>; (b) there is one worst case <i>generating unit outage</i>; and (c) there are either: <ul style="list-style-type: none"> (1) no more than two <i>primary equipment outages</i>; or (2) no more than one <i>primary equipment outage</i> and no more than one <i>secondary equipment outage</i>. <p>Where the <i>primary equipment outage(s)</i> are those which, in combination with the other circumstances of the kind listed in paragraphs (a) to (c) of this definition then existing, lead to the lowest fault current at the particular location, or to the maximum reduction in <i>sensitivity</i> of the remaining secondary system for the fault type under consideration, or to both.</p>
Access	<p>The meaning given in the Access Code.</p> <p>[Note: The definition in Unofficial Consolidated version of the Access Code, 30 July 2021, was: “access”, in relation to services, has the meaning corresponding with the meaning that it has when used in that context in the Competition and Consumer Act 2010 of the Commonwealth.]</p>
access application	<p>The meaning given in the Access Code.</p> <p>[Note: The definition in Unofficial Consolidated version of the Access Code, 30 July 2021, was: “access application” means—</p> <ul style="list-style-type: none"> (a) an application lodged with a service provider under an access arrangement to establish or modify an access contract or to modify any other contract for services; and (b) a prior application and a transitioned application. <p>and includes any additional information provided by the applicant in relation to the application.]</p>
access arrangement	<p>The meaning given in the Access Code.</p> <p>[Note: The definition in Unofficial Consolidated version of the Access Code, 30 July 2021, was: “access arrangement” means an arrangement for access to a covered network that has been approved by the Authority under this Code.]</p>
Access Code	<p>The Electricity Networks Access Code 2004 (WA)</p>

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 1 – GLOSSARY

access contract	<p>The meaning <u>given</u> in the <i>Access Code</i>.</p> <p>[Note: The definition in Unofficial Consolidated version of the <i>Access Code</i>, 30 July 2021, was: <u>“access contract” has the same meaning as ‘access agreement’ does in Part 8 of the Act, and under section 13.4(d) includes a deemed access contract.</u>]</p>
Act	The Electricity Industry Act 2004 (WA).
active energy	A measure of electrical energy flow, being the time integral of the product of <i>voltage</i> and the in-phase component of current flow across a <i>connection point</i> , expressed in watt hours (Wh) and multiples thereof.
active power	<p>The rate at which <i>active energy</i> is transferred.</p> <p>[Note: This definition is used in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i> dated 22 July 2023.]</p>
active power capability	The maximum rate at which <i>active energy</i> may be transferred from a <i>generating unit</i> to a <i>connection point</i> as specified in the relevant <i>connection agreement</i> .
adequately damped	<p><u>A system oscillation that complies with the requirements of clause 2.2.9(b) of these Rules is adequately damped.</u></p> <p>[Note: This definition is used in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i> dated 22 July 2023.]</p>
AEMO or Australian Energy Market Operator	<p>The same meaning as “AEMO” or “Australian Energy Market Operator” in the <i>Access Code</i>.</p> <p>[Note: The definition in Unofficial Consolidated version of the <i>Access Code</i>, 30 July 2021, was: <u>“AEMO” or “Australian Energy Market Operator” means the Australian Energy Market Operator Limited (ACN 072 010 327).</u>]</p>
agreed capability	In relation to a <i>connection point</i> , the capability to receive or send out <i>active power</i> and <i>reactive power</i> for that <i>connection point</i> determined in accordance with the relevant <i>connection agreement</i> .
apparent power	<p>The positive square root of the sum of the squares of the <i>active power</i> and the <i>reactive power</i>.</p> <p>[Note: This definition is used in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i> dated 22 July 2023.]</p>
applicant	<p>The meaning given in the <i>Access Code</i>.</p> <p>[Note: The definition in Unofficial Consolidated version of the <i>Access Code</i>, 30 July 2021, was: <u>“applicant” means—</u></p> <p>(a) <u>a person (who may be a user) who has lodged an access application under the access arrangement for a covered network to establish or modify a contract for services, and includes a prospective applicant; and</u></p> <p>(b) <u>a prior applicant.</u>]</p>
approval to operate	<u>The notification issued by the Network Service Provider granting final approval to a User to operate.</u>
asynchronous generating system	<p><u>A generating system comprised of asynchronous generating units.</u></p> <p>[Note: This definition aligns with the definition in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i>, dated 22 July 2023.]</p>

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<u>asynchronous generating unit</u>	<u>A generating unit that is not a synchronous generating unit.</u>
augment, augmentation	The meaning given in the <i>Access Code</i> . [Note: The definition in Unofficial Consolidated version of the <i>Access Code</i> , 30 July 2021, was: <u>“augmentation”</u> , in relation to a <i>covered network</i> , means an increase in the capability of the <i>covered network</i> to provide <i>covered services</i> .]
Australian Standard (AS)	The edition of a standard publication by Standards Australia (Standards Association of Australia) as at the date specified in the relevant clause or, where no date is specified, the most recent edition.
Authority	Means the Economic Regulation Authority established under the <i>Economic Regulation Authority Act 2003</i> (WA).
automatic reclose equipment	In relation to a <i>transmission line</i> , the equipment which automatically recloses the relevant line's circuit breaker(s) following their opening as a result of the detection of a fault in the <i>transmission line</i> .
back-up protection system	A <i>protection system</i> intended to supplement the <i>main protection system</i> in case the latter does not operate correctly, or to deal with faults in those parts of the <i>power system</i> that are not readily included in the operating zone of the <i>main protection system</i> . A <i>back-up protection system</i> may use the same circuit breakers as a <i>main protection system</i> and a <i>protection scheme</i> forming part of a <u>back-up protection system</u> may be incorporated in the same <i>protection apparatus</i> as the <i>protection schemes</i> comprising the <i>main protection system</i> .
black start-up equipment	The equipment required to provide a <i>generating unit</i> with the ability to start and synchronise without using electricity <i>supplied</i> from the <i>power system</i> .
busbar	A <u>point of connection between two or more circuits</u> in a <i>substation</i> .
business day	The meaning given in the <i>Access Code</i> . [Note: The definition in Unofficial Consolidated version of the <i>Access Code</i> , 30 July 2021, was: <u>“business day”</u> means a day that is not a Saturday, Sunday or public holiday throughout Western Australia.]
capacitor bank	A type of electrical equipment used to <i>generate reactive power</i> and therefore support <i>voltage</i> levels on <i>transmission lines</i> or <i>distribution lines</i> .
<u>Cascading outage</u>	The occurrence of an uncontrollable succession of <i>outages</i> , each of which is initiated by conditions (e.g., instability or overloading) arising or made worse as a result of the event preceding it.
change	Includes amendment, alteration, addition or deletion.
<u>Circuit breaker failure</u>	A circuit breaker will be deemed to have failed if, having received a trip signal from a <i>protection scheme</i> , it fails to interrupt fault current within its design operating time.
<u>Commitment</u>	The commencement of the process of starting up and synchronising a <i>generating unit</i> to the <i>power system</i> .

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<u>Common requirements</u>	<u>In respect of each technical requirement specified in clause 3.3.7, those requirements that are common to both the <i>ideal generator performance standard</i> and <i>minimum generator performance standard</i></u>
connected	The state of physical linkage to or through the <i>transmission or distribution system</i> , by direct or indirect connection, so as to have an impact on <i>power system security, reliability and quality of supply</i> .
<u>Connection agreement</u>	An agreement or other arrangement between the <i>Network Service Provider</i> and a <i>User</i> , which may form part of or include an <i>access contract</i> , that specifies the technical requirements that apply in relation to the connection of a <i>User's</i> equipment to the <i>transmission or distribution system</i> . <u>An Electricity Transfer Access Contract (ETAC) is an example of a <i>connection agreement</i>.</u>
<u>Connection asset</u>	For a <i>connection point</i> , means all of the network assets that are used only in order to transfer electricity to or from the <i>connection point</i> .
<u>Connection point</u>	A point on the network where the <i>Network Service Provider's</i> primary equipment (excluding metering assets) is <i>connected to primary equipment</i> owned by a <i>User</i> .
constraint	<u>The meaning given in the <i>WEM Rules</i>.</u> <u>[Note: The definition in Chapter 11 of the consolidated companion version of the <i>WEM Rules</i>, dated 22 July 2023, was:</u> <u>Constraint: Means:</u> <u>(a) a <i>Network Constraint</i>; and</u> <u>(b) a limitation <u>or requirement affecting</u> the capability of a <i>Load</i> or <i>Energy Producing System</i> such that it would represent a risk to <i>Power System Security</i> or <i>Power System Reliability</i> if the limitation <u>or requirement</u> was removed.]</u>
contingency event	An event affecting the <i>power system</i> that the <i>Network Service Provider</i> expects would be likely to involve the failure or removal from operational service of a <i>generating unit</i> , a <i>load</i> , <i>transmission element</i> or <i>distribution element</i> .

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<p><u>continuous uninterrupted operation</u></p>	<p><u>In respect of a generating system or operating generating unit connected to the transmission or distribution system and operating immediately prior to a power system disturbance:</u></p> <p>(a) <u>not disconnecting from the power system except in accordance with its generator performance standards;</u></p> <p>(b) <u>during the disturbance contributing active and reactive current as required by its generator performance standards;</u></p> <p>(c) <u>after clearance of any electrical fault that caused the disturbance, only substantially varying its active power and reactive power as required or permitted by its generator performance standards; and</u></p> <p>(d) <u>not exacerbating or prolonging the disturbance or causing a subsequent disturbance for other connected plant, except as required or permitted by its generator performance standards,</u></p> <p><u>with all essential auxiliary and reactive plant remaining in service.</u></p> <p><u>[Note: This definition aligns with the definition given in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u></p>
<p><u>control centre</u></p>	<p><u>A facility used by AFMO or the Network Service Provider for directing the minute to minute operation of the power system.</u></p>
<p><u>control system</u></p>	<p><u>The means of monitoring and controlling the operation of the power system or equipment including generating units connected to a transmission or distribution system.</u></p> <p><u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u></p>
<p><u>controllable</u></p>	<p><u>Means that voltages at all major busbars in the transmission and distribution system must be able to be maintained continuously at the target level notwithstanding variations in load or that some reactive sources may have reached their output limits in the post-fault steady state.</u></p>
<p><u>Co-ordinator of Energy</u></p>	<p>The same meaning as <u>“Coordinator”</u> in <u>the Access Code.</u></p> <p><u>[Note: The definition in Unofficial Consolidated version of the Access Code, 30 July 2021, was:</u></p> <p><u>“Coordinator” means the Coordinator of Energy referred to in section 4 of the Energy Coordination Act 1994.]</u></p>
<p><u>credible contingency</u></p>	<p><u>A contingency that is considered for the purposes of assessing power system security and that must not result in the remaining power system being in breach of the stated planning or operational criteria outlined in these Rules.</u></p> <p><u>Credible contingencies are individually specified throughout Chapter 2 and Chapter 5 of these Rules.</u></p> <p><u>A credible contingency is initiated by a credible fault event or the sudden disconnection of a system component e.g., a transmission line or a generating unit.</u></p> <p><u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u></p>

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<p>credible <u>fault event</u></p>	<p><u>Means any of the following fault events that initiate a credible contingency:</u></p> <p>(a) for voltages at <u>66kV</u> or below, three phase to earth fault cleared by disconnection of the faulted component, with the fastest <i>main protection scheme</i> out of service;</p> <p>(b) for voltages above 66kV, <u>either</u>:</p> <p>(1) a two-phase to earth fault cleared by disconnection of the faulted component, with the fastest <i>main protection scheme</i> out of service; or</p> <p>(2) a three-phase to earth fault cleared by disconnection of the faulted component, with the fastest <i>main protection scheme</i> out of service. This criterion is to be applied only to <i>transmission elements</i> where the <i>Network Service Provider</i> can demonstrate that the design type, environmental conditions, historic performance or operational parameters results in a material increase in the likelihood of a three-phase to earth fault occurring;</p> <p>(c) a single-phase to earth fault cleared by the <i>disconnection</i> of the faulted component, with the fastest <i>main protection scheme</i> out of service;</p> <p>(d) a single-phase to earth fault cleared after unsuccessful high-speed single-phase auto-reclosure onto a persistent fault; <u>or</u></p> <p>(e) a single-phase to earth <i>small zone fault</i> or a single-phase to earth fault followed by a <i>circuit breaker failure</i>, in either case cleared by the operation of the fastest available <i>protection scheme</i>.</p>
<p>critical fault clearance time</p>	<p>The maximum <i>total fault clearance time</i> that the <i>power system</i> can withstand without one or both of the following conditions arising:</p> <p>(a) instability;</p> <p>(b) unacceptable disturbance of <i>power system voltage or frequency</i>.</p> <p>[Note: This definition is used in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i> dated 22 July 2023]</p>
<p>current rating</p>	<p>The maximum current that may be permitted to flow (under defined conditions) through a <i>transmission line</i> or <i>distribution line</i> or other item of equipment that forms part of a <i>power system</i>.</p>
<p>current transformer (CT)</p>	<p>A <i>transformer</i> for use with meters or <i>protection devices</i> or both in which the current in the secondary winding is, within prescribed error limits, proportional to and in phase with the current in the primary winding.</p>
<p>customer</p>	<p>The meaning given in the <i>Access Code</i>.</p> <p>[Note: The definition in Unofficial Consolidated version of the <i>Access Code</i>, 30 July 2021, was: "<i>customer</i>" means a:</p> <p>(a) <i>user</i>, or</p> <p>(b) <i>end-user customer in the end-use customer's capacity as indirect customer for covered services</i>.]</p>

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a sudden *disconnection* of a system component, e.g. a *transmission line* or a *generation unit*.

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damping ratio	A standard mathematical parameter that characterises the shape of a damped sine wave.
decommission	The act of causing a <i>generating unit</i> to cease generating indefinitely and <i>disconnecting</i> it from a <i>transmission or distribution system</i> .
demand group	A site or group of sites that collectively take power from the remainder of the transmission system.
direction	A requirement issued by the <i>Network Service Provider</i> or AEMO to any <i>User</i> requiring the <i>User</i> to do any act or thing which the <i>Network Service Provider</i> or AEMO considers necessary to maintain or re-establish <i>power system security</i> or to maintain or re-establish the <i>power system</i> in a reliable operating state in accordance with these <i>Rules</i> .
disconnect	The operation of switching equipment or other action so as to prevent the flow of electricity at a <i>connection point</i> .
dispatch	The act of the <i>Network Service Provider</i> or AEMO in committing to service all or part of the <i>generation</i> available from a <i>generating unit</i> , permitting a particular level of active power consumption by a load or requiring a load or generating system to operate with a particular control mode enabled.
dispatch systems requirements	The meaning given in the WEM Rules. [Note: The definition in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i> , dated 22 July 2023, was: Dispatch Systems Requirements: Means the requirements described in section 2.35.1
distribution	The functions performed by a <i>distribution system</i> , including conveying, transferring or permitting the passage of electricity.
distribution element	A single identifiable major component of a distribution system.
distribution feeder	In the power system, a high voltage radial circuit forming part of the distribution system that is supplied from a zone substation.
Distribution Network Operator	The Network Service Provider personnel, systems and infrastructure that perform operational roles and responsibilities that provide for the safe, secure and reliable operation of the distribution system.
distribution system	Any apparatus, equipment, plant or buildings used, or to be used, for, or in connection with, the transportation of electricity at nominal <i>voltages</i> of less than 66 kV and which form part of the <i>South West Interconnected Network</i> .
dynamic performance	The response and behaviour of networks and <i>facilities</i> that are <i>connected</i> to the networks when the normal operation of the <i>power system</i> is disturbed.

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<u>electricity storage</u>	<p><u>A device consisting of 'storage works' as defined in the Act but does not include non-dispatchable active power energy storage equipment such as a synchronous compensator or flywheel.</u></p> <p><u>When discharging active power, electricity storage facilities are considered as generation and must meet the relevant clauses of the Rules. When consuming active power, electricity storage facilities are considered as load and must meet the relevant clauses of the Rules.</u></p> <p><u>[Note: The definition in the Act as of the version that came into affect on 7 April 2020 was: storage works means any wires, apparatus, equipment, plant or buildings used, or to be used, for, or in connection with, or to control, a storage activity]</u></p> <p><u>[Note: This definition aligns with the definition in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023 except that it references the Act definition and provides further clarity required in the context of these Rules.]</u></p>
<u>embedded system</u>	<u>Means a network connected at a connection point on the SWIS that is owned, controlled or operated by a person who is not the Network Service Provider or AEMO.</u>
<u>emergency conditions</u>	<u>For the power system, the operating conditions applying after a significant transmission element has been removed from service other than in a planned manner.</u>
<u>emergency return to service</u>	<u>The pre-agreed time to recall a planned outage following an unplanned event.</u>
<u>EMT</u>	<u>Electromagnetic transient.</u>
<u>energisation</u>	The act or process of operating switching equipment or starting up <u>a generating unit</u> , which results in there being a non-zero voltage beyond a connection point or part of the transmission system or the distribution system.
<u>energy</u>	Active energy or reactive energy, or both.
<u>essential services</u>	Essential services include, but are not necessarily limited to, services such as hospitals and railways where the maintenance of a supply of electricity is necessary for the maintenance of public health, order and safety.
<u>essential system services</u>	<p><u>The meaning given in the WEM Rules.</u></p> <p><u>[Note: The definition in Chapter 11 of the consolidated companion version of the WEM Rules, dated 22 July 2023, was:</u></p> <p><u>Essential System Services: A service, including each service described in section 3.9, that is required to maintain Power System Security and Power System Reliability, facilitate orderly trading in electricity and ensure that electricity supplies are of an acceptable quality.]</u></p>
<u>excitation control system</u>	<p>In relation to a <i>generating unit</i>, the automatic control system that provides the field excitation for the <i>generating unit</i> (including excitation limiting devices and any power system stabiliser).</p> <p><u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u></p>
<u>extension</u>	An <i>augmentation</i> that requires the connection of a power line or <i>facility</i> to the transmission or distribution system.

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<u>Equipment</u>	<p>A device used in generating, transmitting or utilising electrical energy, making available electric power, or communicating information that supports the management of power flow.</p> <p>[Note: This definition is used in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i> dated 22 July 2023 but is no longer used as a defined term in these <i>Rules</i>. The definition is retained here to enable use of the term in <i>WEM Rules</i> application only.]</p>
facility	<p>An installation comprising equipment and associated apparatus, buildings and necessary associated supporting resources used for or in connection with <i>generating</i>, conveying, transferring, or consuming electricity, and includes:</p> <p>(a) a <i>power station or generating system</i>;</p> <p>(b) a <i>substation</i>;</p> <p>(c) equipment by which electricity is consumed;</p> <p>(d) <i>electricity storage</i>; and</p> <p>(e) a <i>control centre</i>.</p>
<u>Fault clearance time</u>	The time interval between the occurrence of a fault and the fault clearance.
<u>Fault outage</u>	An outage of one or more items of equipment or generation initiated by automatic action unplanned at that time, which may or may not involve the passage of fault current.
<u>Financial year</u>	A period of 12 months commencing on 1 July.
<u>Frequency</u>	For alternating current electricity, the number of cycles occurring in each second, measured in Hz.
<u>Frequency dead band</u>	The range through which power system frequency can vary without the frequency control system initiating an active power response.
<u>Frequency operating standards</u>	The standards that specify the frequency levels for the operation of the power system set out in clause 1.1.1.1(a).
frequency stability	The ability of a power system to attain a steady frequency following a severe system disturbance that has resulted in a severe imbalance between generation and load. Instability that may result occurs in the form of sustained frequency swings leading to tripping of generating units or loads or both.
<u>Frequent operational switching</u>	<p>Operation of plant and equipment which is undertaken regularly on the transmission or distribution system.</p> <p>For the avoidance of doubt frequent operational switching comprises manual and automatic initiation of switching actions including, but not limited to, transformer tap changing, capacitor/reactor switching, switching of circuits for voltage control or safe access, etc.</p>
generated	In relation to a generating unit, the amount of electricity produced by the generating unit as measured at its terminals.
<u>Generating equipment</u>	In relation to a connection point, includes all equipment involved in generating electrical energy transferred at that connection point.

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<u>Generating system</u>	A system comprising one or more <i>generating units</i> . [Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]
generating unit	The equipment used to generate electricity and all the related equipment essential to its functioning as a single entity. [Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]
generation	The production of electric power by converting another form of <i>energy</i> into electricity in a <i>generating unit</i> . [Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]
<u>generation circuit</u>	The sole electrical connection between one or more <i>generating units</i> and the <i>transmission system</i> . It is a radial circuit that, if removed, would disconnect the <i>generation</i> from the <i>transmission system</i> .
Generator	Any person (including a <i>User</i> or the <i>Network Service Provider</i>) who owns, controls or operates a <i>generating system</i> that supplies or is capable of supplying electricity to, or who otherwise supplies electricity, to the <i>transmission system</i> or <i>distribution system</i> .
<u>Generator performance chart</u>	The meaning given in the WEM Rules. [The definition in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023, was: Generator Performance Chart: Means a chart defining the capability of a Generating System or Generating Unit to produce Active Power while producing or consuming Reactive Power. The capability is provided for specified ambient conditions and voltage levels at the Measurement Location based on a template provided by the Network Operator. The chart shows the Reactive Power capability continuously achievable while in operation, subject to energy source availability, for a given level of Active Power output for a range of ambient temperatures, while not exceeding limits necessary to prevent damage to Equipment and ensure compliance with other Technical Requirements.]
<u>generator performance standard</u>	A standard of performance which a <i>Generator</i> must achieve and establish through the process described in clause 3.3.4 of these Rules. The <i>generator performance standards</i> for a large <i>generating system</i> must address each of the technical requirements in clause 3.3.7 of these Rules. [Note: This definition aligns with the equivalent definition in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]
good electricity industry practice	The meaning given in the Access Code. [Note: The definition in Unofficial Consolidated version of the Access Code, 30 July 2021, was: “good electricity industry practice” means the exercise of that degree of skill, diligence, prudence and foresight that a skilled and experienced person would reasonably and ordinarily exercise under comparable conditions and circumstances consistent with applicable written laws and statutory instruments and applicable recognised codes, standards and guidelines.]
gradual bumpless transfer	The make-before-break transfer of a <i>load</i> between the <i>distribution system</i> and an islanded <i>generating unit</i> (or vice versa) where the time for which the <i>generating unit</i> is operated in parallel with the <i>distribution system</i> is limited to less than 60 seconds.

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 1 – GLOSSARY

<u>group demand</u>	<u>The forecast maximum demand for a single demand group taking demand from the transmission system in accordance with the requirements of these Rules.</u>
<u>halving time</u>	The elapsed time required for the magnitude of a damped sine wave to reach half its initial value.
<u>high voltage (HV)</u>	Any nominal voltage above 1 kV. <u>Note: MV is a subset of HV.</u>
<u>ideal generator performance standard</u>	<u>A Generator that meets the ideal performance standard for a particular technical requirement will not be refused connection to the network because of that technical requirement. The ideal generator performance standard for each technical requirement is defined in clause 3.3.7 of these Rules.</u> <u>[Note: This definition aligns with the equivalent definition in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u>
<u>induction generating unit</u>	An alternating current <i>generating unit</i> whose rotor currents are produced by induction from its stator windings and, when driven above synchronous speed by an external source of mechanical power, converts mechanical power to electric power by means of a conventional induction machine.
<u>infeed loss risk limit</u>	<u>The meaning given in clause 2.5.3.1(b) of these Rules.</u>
<u>infrequent operational switching</u>	<u>Operation of plant and equipment associated with rare or infrequent events. Infrequent operational switching comprises manual and automatic initiation of switching actions including, but not limited to, isolation of circuits for maintenance and subsequent re-energisation, operation of intertrip schemes consequent upon a credible contingency, etc.</u>
<u>intact system</u>	<u>The transmission system with no planned outages and no unplanned outages.</u>
<u>interconnection</u>	A transmission line or group of transmission lines that connects the transmission systems in adjacent regions.
<u>interim approval to operate</u>	<u>The notification issued by the Network Service Provider, which may or may not be subject to and contain conditions, granting interim approval to a User to operate.</u>
<u>intermittent generating system</u>	<u>Any generating system whose output is not reasonably controllable by the Network Service Provider or AFMO, and whose output is dependent on a fuel resource that cannot be directly stored or stockpiled and whose availability is difficult to predict.</u> <u>[Note: This definition aligns with the definition in Chapter 11 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u>
<u>inverter</u>	<u>A device that uses semiconductor devices to transfer power between a DC source or load and an AC source or load.</u> <u>Inverters include AC to AC convertors transferring power between non-grid energy sources and an AC source or load that use semiconductor devices.</u>
<u>inverter energy system</u>	<u>A system comprising one or more inverters together with one or more energy sources (which may include electricity storage), and controls, which comply with the requirements of AS/NZS 4777 series.</u>

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large disturbance	<p>A disturbance sufficiently large or severe as to prevent the linearization of system equations for the purposes of analysis. The resulting system response involves large excursions of system variables from their pre-disturbance values, and is influenced by non-linear power-angle relationship and other non-linearity effects in <i>power systems</i>.</p> <p><i>Large disturbance</i> is typically caused by a short circuit on a nearby <i>power system</i> component (for example, <i>transmission line</i>, <i>transformer</i>, etc.).</p>
large generating system	<u>A generating system with a total rated capacity exceeding 5 MVA.</u>
large load	<u>A load connection point that is rated to consume more than 5 MVA of power from the transmission or distribution system.</u>
load	<p>Either:</p> <p>(a) a <i>connection point</i> at which electric power is made available to a person; or</p> <p>(b) the amount of electric <i>power transfer</i> at a defined instant at a specified point on the <i>transmission or distribution system</i></p> <p>as the case requires.</p>
load shedding	Reducing or disconnecting <i>load</i> from the <i>power system</i> .
local system outage	<p><u>For a demand group, a planned outage or unplanned outage local to the demand group that has a direct effect on the supply capacity to that demand group.</u></p> <p><u>For generation connections, a planned outage local to the generation that has a direct effect on the generation connection.</u></p>
loss of demand	<u>The reduction in the demand supplied by the transmission system to one or more demand groups.</u>
loss of power infeed	<u>The meaning given in clause 2.5.3.1(a) of these Rules.</u>
low voltage (LV)	Any nominal <i>voltage</i> of 1 kV and below.
Main Interconnected Transmission system or MITS	<u>In the context of the SWIS, the meaning given in clause 2.5.2(b) of these Rules.</u>
main protection scheme	A <i>protection scheme</i> that has the primary purpose of disconnecting specific equipment from the <i>transmission and distribution system</i> in the event of a fault occurring within that equipment.
main protection system	A <i>protection system</i> that has the primary purpose of disconnecting specific equipment from the <i>transmission and distribution system</i> in the event of a fault occurring within that equipment.
maintenance conditions	The operating conditions that exist when a significant element of the <i>transmission system</i> or the <i>distribution system</i> has been taken out of service in a planned manner so that maintenance can be carried out safely.

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 1 – GLOSSARY

<u>maintenance period demand</u>	<p>The expected maximum demand for a <i>demand group</i> during the maintenance period.</p> <p>Where better data is unavailable, this should be taken as 80% of the forecast <i>group demand</i>.</p>
<u>major augmentation</u>	<p>The meaning given in the <i>Access Code</i>.</p> <p>[Note: The definition in Unofficial Consolidated version of the <i>Access Code</i>, 30 July 2021, was: "major augmentation" means an <i>augmentation</i> for which the <i>new facilities investment</i> for the <i>shared assets</i>:</p> <p>(a) exceeds \$10 million (CPI adjusted), where the <i>network assets</i> comprising the <i>augmentation</i> are, or are to be, part of a <i>distribution system</i>; and</p> <p>(b) exceeds \$30 million (CPI adjusted), where the <i>network assets</i> comprising the <i>augmentation</i> are, or are to be, part of:</p> <p>(i) a <i>transmission system</i>; or</p> <p>(ii) both a <i>distribution system</i> and a <i>transmission system</i>.]</p>
<u>market generation</u>	<p>The <i>generation</i> produced from a <i>generating unit</i> or <i>generating system</i> operated by a <i>market generator</i>.</p>
<u>market generator</u>	<p>A <i>User</i> who is registered as a <i>Market Generator</i> in accordance with the <i>WEM Rules</i>.</p>
<u>maximum continuous current</u>	<p>The maximum current capable of being injected continuously in accordance with the relevant <i>Australian Standard</i> or <i>ISO Standard</i> for <i>synchronous generating units</i> and <i>asynchronous generating units</i> at the <i>measurement location</i> by the <i>generating system</i> or <i>generating units</i>, as applicable, in order to support maintaining voltage on the <i>SWIS</i> during a disturbance, without causing damage to, or maloperation of, equipment in the <i>generating system</i>. The details regarding which relevant <i>Australian Standard</i> or <i>ISO Standard</i> applies is documented in the guidelines published by the <i>Network Service Provider</i> under clause 3A.4.4 of the <i>WEM Rules</i>.</p> <p>[Note: This aligns with the definition given in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i> dated 22 July 2023.]</p>
<u>maximum fault current</u>	<p>The current that will flow to a fault on an item of equipment when <i>maximum system conditions</i> prevail.</p>
<u>maximum reasonably foreseeable load</u>	<p>Determined by estimating the <i>peak load</i> of the area after it has been fully developed, taking into account restrictions on land use, assuming future electricity consumption patterns and impacts from climate change and emerging technologies.</p>
<u>maximum system conditions</u>	<p>For any particular location in the <i>power system</i>, those conditions that prevail when the maximum number of <i>generating units</i> that are normally connected at times of maximum <i>generation</i> are so connected.</p>
<u>maximum temperature</u>	<p>The maximum ambient temperature specified by the <i>Network Service Provider</i> in consultation with the <i>AEMO</i>, based on an assessment of the physical location of the <i>generating system</i>.</p> <p>[Note: This definition aligns with the definition given in the companion <i>WEM Rules</i> dated 22 July 2023.]</p>

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 1 – GLOSSARY

<u>measurement location</u>	<p>The meaning given in the WEM Rules.</p> <p>[The definition in Appendix 12 of the consolidated companion version of the WEM Rules, dated 22 July 2023, was:</p> <p>Measurement location: The Connection Point, or another measurement location agreed by AEMO and the Network Operator, as specified for the relevant Technical Requirement.]</p>
<u>medium voltage (MV)</u>	<p>Any nominal voltage above 1 kV and below 35 kV.</p> <p>[Note: MV is a subset of HV.]</p>
<u>minimum fault current</u>	<p>The current that will flow to a fault on an item of equipment when <i>minimum system conditions</i> prevail.</p>
<u>minimum generator performance standard</u>	<p>A Generator that does not meet the minimum generator performance standard for a technical requirement will not be allowed to connect because of that technical requirement. The minimum generator performance standard for each technical requirement is defined in clause 3.3.7 of these Rules.</p> <p>[Note: This definition does not align with the definition given in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023]</p>
<u>minimum system conditions</u>	<p>For any particular location in the <i>power system</i>, those conditions that prevail when:</p> <p>(a) the least number of <i>generating units</i> normally connected at times of minimum generation are so connected; and</p> <p>(b) there is one <i>primary equipment outage</i>.</p> <p>The <i>primary equipment outage</i> is taken to be that which, in combination with the minimum generation, leads to the lowest fault current at the particular location for the fault type under consideration.</p>
<u>monitoring equipment</u>	<p>The testing instruments and devices used to record the performance of equipment for comparison with expected performance.</p>
<u>month</u>	<p>The meaning given to it in section 62 of the <i>Interpretation Act 1984</i> (WA).</p>
<u>nameplate rating</u>	<p>The maximum continuous output or consumption specified either in units of <i>active power</i> (watts) or <i>apparent power</i> (volt-amperes) of an item of equipment as specified by the manufacturer.</p> <p>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</p>
<u>negotiated generator performance standard</u>	<p>A performance standard for a particular technical requirement that has been determined via the process in clause 3.3.4 of these Rules.</p>
<u>negotiation criteria</u>	<p>The criteria that must be met in respect of each technical requirement in clause 3.3.7 of these Rules if a Generator submits a proposed negotiated generator performance standard.</p>
<u>Network Service Provider</u>	<p>The meaning given to it in clause 1.3(a) of these Rules.</p>
<u>new capacity</u>	<p>Any increase in electricity <i>generation, transmission or distribution</i> capacity which would arise from enhancement to or expansion of the electricity <i>generation, transmission system or distribution system</i>.</p>

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nomenclature standards	The standards approved by the <i>Network Service Provider</i> relating to numbering, terminology and abbreviations used for information transfer between <i>Users</i> as provided for in clause 5.9 <u>of these Rules</u> . [Note: This definition is used in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i> dated 22 July 2023.]
<u>non-co-optimised essential system service (NCESS)</u>	The meaning given in the <i>WEM Rules</i> . [Note: The definition in Chapter 11 of the consolidated companion version of the <i>WEM Rules</i> , dated 22 July 2023, was: Non-Co-optimised Essential System Service: An Essential System Service procured under section 3.11B.]
<u>non-intermittent generating system</u>	<u>A generating system that is not an intermittent generating system, including, without limitation, thermal generators fuelled by coal, natural gas, or distillate</u> [Note: This definition aligns with the definition in Chapter 11 of the consolidated companion version of the <i>WEM Rules</i> dated 22 July 2023.]
<u>non-market generation</u>	<u>The generation produced from generating unit or generating system operated by a non-market generator.</u>
<u>non-market generator</u>	<u>A generator that is not a market generator.</u>
<u>non-scheduled generating system</u>	<u>A generating system that is not dispatched by AEMO.</u>
operational communication	A communication concerning the arrangements for, or actual operation of, the <i>power system</i> in accordance with the <i>Rules</i> .
<u>operational timescales</u>	<u>The timescales under which decisions are made regarding the efficient operation of the existing power system to ensure compliance with Chapter 5 of these Rules and the WEM Rules.</u> <u>This includes decisions regarding outage planning, the co-ordination of network and generation outages, operational switching, the adjustment of control settings, the operation of plant and equipment, and utilisation of contracted services.</u> <u>Operational timescales typically cover the period from real time to 1 year ahead and may, in some circumstances, cover longer forward looking periods.</u>
operator	The person or organisation responsible for the provision of service in real time.
outage	Any planned or unplanned full or partial unavailability of equipment.
peak load	Maximum <i>load</i> .
<u>Perth CBD</u>	The geographical area in the City of Perth bound by Hill Street (East), Havelock Street (West), Wellington Street (North) and Riverside Drive and Kings Park Road (South).
<u>planned outage</u>	<u>An outage of one or more items of equipment and/or generation initiated by manually instructed action that has been subject to an outage process managed by the Network Service Provider or AEMO.</u> [Note: This term is analogous to a scheduled outage under the <i>WEM Rules</i> .]

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<i>planning timescales</i>	<p>The timescales under which decisions are made regarding investments that provide the <i>power system</i> capability necessary to deliver an efficient, secure, adequate and reliable system and enable the <i>power system</i> to meet the criteria defined in Chapter 2 of these Rules.</p> <p>Planning timescales typically cover the period 1 year ahead to 10 years ahead.</p>
<i>point of common coupling</i>	<p>The point on the network where <i>connection assets</i> associated with a <i>connection point</i> are connected to primary network assets that are shared with other <i>Users</i>.</p>
<i>potential relevant generator modification</i>	<p>The meaning given in clause 3.3.5 of these Rules.</p>
<i>power factor</i>	<p>The ratio of the <i>active power</i> to the <i>apparent power</i> at a point.</p> <p>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</p>
<i>power station</i>	<p>The one or more <i>generating units</i> at a particular location and the apparatus, equipment, buildings and necessary associated supporting resources for those <i>generating units</i>, including <i>black start-up</i> equipment, <i>step-up transformers</i>, <i>substations</i> and the <i>power station control centre</i>.</p> <p>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</p>
<i>power system</i>	<p>The electric <i>power system</i> constituted by the <i>South West Interconnected Network</i> and its <i>connected generation</i> and <i>loads</i>, operated as an integrated system.</p>
<i>power system operating procedures</i>	<p>The procedures to be followed by <i>Users</i> in carrying out operations and maintenance activities on or in relation to <i>primary equipment</i> and <i>secondary equipment</i> connected to or forming part of the <i>power system</i> or <i>connection points</i>, as described in clause 5.7.1 of these Rules.</p>
<i>power system reliability</i>	<p>The meaning given in the WEM Rules.</p> <p>[Note: The definition in Chapter 11 of the consolidated companion version of the WEM Rules, dated 22 July 2023, was:</p> <p>Power System Reliability: Means the safe scheduling, operation and control of the <i>SWIS</i> in accordance with the <i>Power System Reliability Principles</i>.]</p>
<i>power system security</i>	<p>The meaning given in the WEM Rules.</p> <p>[Note: The definition in Chapter 11 of the consolidated companion version of the WEM Rules, dated 22 July 2023, was:</p> <p>Power System Security: Means the safe scheduling, operation and control of the <i>SWIS</i> in accordance with the <i>Power System Security Principles</i>.]</p>
<i>power system stability</i>	<p>The ability of the power system, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical disturbance, with most system variables bounded so that practically the entire system remains intact.</p>
<i>power transfer</i>	<p>The instantaneous rate at which <i>active energy</i> is transferred between <i>connection points</i>.</p>

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 1 – GLOSSARY

power transfer capability	The maximum permitted <i>power transfer</i> through a <i>transmission</i> or <i>distribution system</i> or part thereof.
<u>pre-disturbance steady state voltage limits</u>	<u>The voltage limits for use in planning timescales for circumstances before a fault, as detailed in clause 2.2.2 of these Rules.</u>
<u>pre-fault rating</u>	<u>The specified pre-fault continuous capability of transmission equipment with consideration for the specific conditions (e.g., ambient/seasonal temperature), time-dependent loading cycles of equipment and any additional relevant procedures.</u> <u>In operational timeframes, dynamic ratings may also be used where available.</u>
<u>prevailing system conditions</u>	<u>The conditions on the transmission system prevailing at any given time. These conditions normally include planned outages, unplanned outages and may include fault outages.</u>
primary equipment	Refers to apparatus <u>that</u> conducts <i>power system load</i> or conveys <i>power system voltage</i> . <u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u>
<u>priority project</u>	<u>The meaning given in the Access Code.</u> <u>[Note: The definition in Unofficial Consolidated version of the Access Code, 30 July 2021, was: "priority project" means a project specified as a priority project in a whole of system plan.]</u>
<u>proposed generator performance standard</u>	<u>A generator performance standard proposed to apply to a larger generating system that has not been approved and registered in accordance with the process in clause 3.3.4.</u>
<u>proposed negotiated generator performance standard</u>	<u>A proposed generator performance standard that is not an ideal generator performance standard but is no less than the minimum generator performance standard.</u>
protection	The detection, limiting and removal of the effects of <i>primary equipment</i> faults from the <i>power system</i> ; or the apparatus, device or system required to achieve this function.
protection apparatus	Includes all relays, meters, power circuit breakers, synchronisers and other control devices necessary for the proper and safe operation of the <i>power system</i> .
protection scheme	An arrangement of <i>secondary equipment</i> designed to protect <i>primary equipment</i> from damage by detecting a fault condition and sending a signal to disconnect the <i>primary equipment</i> from the <i>transmission</i> or <i>distribution system</i> . <u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 1 February 2023.]</u>

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 1 – GLOSSARY

protection system	<p>A system designed to <i>disconnect</i> faulted <i>primary equipment</i> from the <i>transmission or distribution system</i>, <u>that</u> includes one or more <i>protection schemes</i> and which also includes the <i>primary equipment</i> used to effect the disconnection.</p> <p><u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 1 February 2023.]</u></p>
quality of supply	<p>With respect to electricity, technical attributes to a standard set out in clause <u>2.2 of these Rules</u>, unless otherwise stated in these <i>Rules</i> or the relevant <i>connection agreement</i>.</p>
rapid bumpless transfer	<p>The make-before-break transfer of a <i>load</i> between <i>the distribution system</i> and an islanded <i>generating unit</i> (or vice versa) where the time for which the <i>generating unit</i> is operated in parallel with the <i>distribution system</i> is limited to less than 1 second.</p>
rate of change of frequency (RoCoF)	<p><u>The rate of change of frequency, expressed in Hertz per second.</u></p>
rated maximum active power	<p><u>The meaning given in the WEM Rules.</u></p> <p><u>[Note: The definition in Appendix 12 of the consolidated companion of the WEM Rules, dated 22 July 2023, was:</u></p> <p>Rated Maximum Active Power: <u>The maximum Active Power level that a Generating Unit or Generating System, as applicable, can continuously deliver at the Measurement Location, subject to energy source availability, in accordance with the requirements of Part A12.2 when the ambient temperature is at the Maximum Temperature, as specified in the Temperature Dependency Data.]</u></p>
rated maximum apparent power	<p><u>The meaning given in the WEM Rules.</u></p> <p><u>[Note: The definition in Appendix 12 of the consolidated companion version of the WEM Rules, dated 22 July 2023, was:</u></p> <p>Rated Maximum Apparent Power: <u>The maximum Apparent Power level that a Generating Unit or Generating System, as applicable, can continuously deliver at the Measurement Location, subject to energy source availability, when operating at the extent of the Generator Performance Chart provided under Part A12.3 and the ambient temperature is at the Maximum Temperature.]</u></p>
rated minimum active power	<p><u>The meaning given in the WEM Rules.</u></p> <p><u>[Note: The definition in Appendix 12 of the consolidated companion version of the WEM Rules, dated 22 July 2023, was:</u></p> <p>Rated Minimum Active Power: <u>Means</u></p> <p>(a) <u>in relation to a Generating Unit, the minimum amount of Active Power that the Generating Unit can continuously deliver, subject to energy source availability, while maintaining stable operation at the Measurement Location; and</u></p> <p>(b) <u>in relation to a Generating System, the combined minimum amount of Active Power that its in-service Generating Units can continuously deliver, subject to energy source availability, at the Measurement Location while maintaining stable operation.]</u></p>
reactive energy	<p>A measure, in <u>var</u> hours (<u>varh</u>), of the alternating exchange of stored energy in inductors and capacitors, which is the time-integral of the product of <i>voltage</i> and the out-of-phase component of current flow across a <i>connection point</i>.</p>

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reactive equipment	<p><u>Equipment</u> which is normally provided specifically to be capable of providing or absorbing <i>reactive power</i>.</p> <p><u>Examples of equipment include <i>synchronous generating unit voltage controls usually associated with tap-changing transformers; or generating unit AVR set point control (rotor current adjustment), synchronous condensers (compensators), static var compensators (SVC), static synchronous compensators (STATCOM), shunt capacitors, shunt reactors; and series capacitors, etc.</i></u></p>
reactive power	<p>The rate at which <i>reactive energy</i> is transferred, measured in <u>var</u>.</p> <p><i>Reactive power</i> is a necessary component of alternating current electricity which is separate from <i>active power</i> and is predominantly consumed in the creation of magnetic fields in motors and <i>transformers</i> and produced by equipment such as:</p> <ul style="list-style-type: none"> (a) alternating current <i>generating units</i>; (b) capacitors, including the capacitive effect of parallel <i>transmission wires</i>; (c) <i>synchronous condensers</i>. <p><i>Reactive power</i> is obtained from a combination of static and dynamic sources. Static sources include, for example, <i>reactors</i> and <i>capacitor banks</i>, and the charging current of <i>transmission lines</i>. Dynamic sources include, for example, synchronous machines, operating as <i>generating units</i> or <i>synchronous compensators</i>, <i>static synchronous compensators</i>, and static <u>var compensators</u>.</p> <p><u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u></p>
reactive power capability	<p>The maximum rate at which <i>reactive energy</i> may be transferred from a <i>generating unit</i> to a <i>connection point</i> as specified in the relevant <i>connection agreement</i>.</p> <p><u>[Note: This definition is different from the definition in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u></p>
reactive power reserve	<p>Unutilised sources of <i>reactive power</i> arranged to be available to cater for the possibility of the unavailability of another source of <i>reactive power</i> or increased requirements for <i>reactive power</i>.</p>
reactor	<p>A device, similar to a <i>transformer</i>, arranged to be <i>connected</i> into the <i>transmission or distribution system</i> during periods of low demand or low <i>reactive power</i> demand to counteract the natural capacitive effects of long <i>transmission lines</i> in generating excess <i>reactive power</i> and so correct any <i>transmission voltage</i> effects during these periods.</p>
rectification plan	<p><u>A plan to address non-compliance with technical performance requirements proposed by a <i>Generator</i> and approved by the <i>Network Service Provider</i> in accordance with clause 4.1.3.</u></p>

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region	An area determined by the <i>Network Service Provider</i> to be a <i>region</i> , being an area served by a particular part of the <i>transmission system</i> containing one or more: (a) concentrated areas of <i>load</i> or <i>loads</i> with a significant combined consumption capability; or (b) concentrated areas containing one or more <i>generating units</i> with significant combined generating capability, or both.
<u>registered generator performance standard</u>	<u>Each generator performance standard in respect of a technical requirement applying to a large generating system that has been approved and registered in accordance with the process in clause 3.3.4 of these Rules.</u>
<u>relevant generator modification</u>	<u>A potential relevant generator modification that the Network Service Provider declares to be a relevant generator modification.</u>
<u>remote communication equipment</u>	<u>Equipment installed to enable the Network Service Provider to communicate with a User's equipment.</u> <u>[Note: This definition is used in Appendix 12 of the consolidated companion version of WEM Rules dated 22 July 2023 but there is no definition given in the WEM Rules.]</u>
remote control equipment (RCE)	Equipment installed to enable the <i>Network Service Provider</i> to control a <i>generating unit</i> circuit breaker or other circuit breaker remotely. <u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u>
remote monitoring equipment (RME)	Equipment installed to enable the monitoring of other equipment from a <i>remote control centre</i> , and includes a <i>remote terminal unit (RTU)</i> . <u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u>
<u>remote switching time</u>	<u>The time it would typically take to carry out remote switching from the Network Service Provider's control centre.</u>
<u>remote terminal unit (RTU)</u>	<u>A remote terminal unit installed within a substation to enable monitoring and control of equipment from a remote control centre.</u>
representative	In relation to a person, any employee, agent or consultant of: (a) that person; (b) a related body corporate of that person; or (c) a third party contractor to that person.
reserve	The <i>active power</i> and <i>reactive power</i> available to the <i>power system</i> at a nominated time but not currently utilised.
<u>restart plan</u>	<u>Operational plan for restarting the power system following a system shutdown developed by AEMO in accordance with the WEM Rules.</u>
<u>revision</u>	<u>The revision to the Rules following an amendment under sections 12.50 - 12.54A, or a review under section 12.56, of the Access Code and approval by the Authority.</u>

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<u>rise time</u>	<p><u>The meaning given in the WEM Rules.</u></p> <p>[Note: The definition in Appendix 12 of the consolidated companion version of the WEM Rules, dated 22 July 2023, was:</p> <p>Rise Time: In relation to a control system, means the time taken for an output quantity to rise from its initial value to 90% of the final value induced by a step change of an input quantity, including in response to a disturbance as required under section A12.9.]</p>
Rules	These Rules, also called the “Technical Rules”, prepared by the Network Service Provider under Chapter 12 of the Access Code.
Rules commencement date	The date given in clause 1.4 of these Rules.
SCADA system	Supervisory control and data acquisition equipment which enables AEMO or the Network Service Provider to monitor continuously and remotely, and to a limited extent control, the import or export of electricity from or to the power system.
<u>Scheduled generating system</u>	A generating system that is dispatched by AEMO.
<u>Secondary equipment</u>	Equipment within a facility or the electricity transmission or distribution system which does not carry the energy being transferred, but which is required for control, protection or operation of other equipment that does carry such energy.
<u>Sensitivity</u>	In relation to protection schemes, means the ability to detect faults.
<u>Service provider</u>	<p><u>The meaning given in the Access Code.</u></p> <p>[Note: The definition in Unofficial Consolidated version of the Access Code, 30 July 2021, was: “service provider”, in relation to a network, means a person who owns or operates the network.]</p>
<u>settling time</u>	<p>In relation to a control system, means the time measured from initiation of a step change in an input quantity to the time when the magnitude of error between the output quantity and its final settling value remains less than 10% of:</p> <p>(a) if the sustained change in the quantity is less than half of the maximum change in that output quantity, half of the maximum change induced in that output quantity; or otherwise</p> <p>(b) the sustained change induced in that output quantity.</p>
<u>short circuit ratio</u>	The synchronous three phase fault level in MVA at the connection point divided by the rated output of the generating unit or generating system (expressed in MW or MVA, at the Network Service Provider's discretion).
shunt capacitor	A type of equipment connected to a transmission or distribution system to generate reactive power.
shunt reactor	A type of equipment connected to a transmission or distribution system to absorb reactive power.

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small disturbance	<p>A disturbance sufficiently small to permit the linearization of system equations for the purposes of analysis. The resulting system response involves small excursions of system variables from their pre-disturbance values.</p> <p><i>Small disturbances</i> may be caused by routine switching (for example, line or capacitor), <i>transformer tap changes</i>, <i>generating unit AVR set point changes</i>, changes in the <i>connected load</i>, etc.</p>
small generating system	A <u>generating system with a total rated capacity less than or equal to 5 MVA.</u>
small use customer	A <u>User who</u> consumes less than 160 MWh of electricity per annum.
small zone fault	A fault which occurs on an area of equipment that is within the zone of detection of a <i>protection scheme</i> , but for which not all contributions to the fault will be cleared by the circuit breaker(s) tripped by that <i>protection scheme</i> . For example, a fault in the area of equipment between a <i>current transformer</i> and a circuit breaker, fed from the <i>current transformer</i> side, may be a <i>small zone fault</i> .
South West Interconnected Network (SWIN)	The <u>network parts of the SWIS.</u>
South West interconnected system (SWIS)	<p>The <u>meaning given in the Act.</u></p> <p>[Note: The definition in the Act as of the version that came into affect on 7 April 2020 was: <u>South West interconnected system means the interconnected transmission and distribution systems, generating works and associated works —</u></p> <p>(a) <u>located in the South West of the State and extending generally between Kalbarri, Albany and Kalgoorlie; and</u></p> <p>(b) <u>into which electricity is supplied by —</u></p> <p>(i) <u>one or more of the electricity generation plants at Kwinana, Muja, Collie and Pinjar; or</u></p> <p>(ii) <u>any prescribed electricity generation plant]</u></p>
spare capacity	Any portion of firm capacity or non-firm capacity not committed to existing <i>Users</i> .
standard connection service	The <u>same meaning as “standard connection service (supply) Western Power”</u> in the <u>WA Service and Installation Requirements.</u>
static excitation system	<p>An <i>excitation control system</i> in which the power to the rotor of a <i>synchronous generating unit</i> is transmitted through high power solid-state electronic devices.</p> <p>[Note: This definition is used in Appendix 12 of the consolidated companion version of the <u>WEM Rules dated 22 July 2023.</u>]</p>
static synchronous compensator (STATCOM)	A device provided on a <i>transmission or distribution system</i> specifically to provide the ability to generate and absorb <i>reactive power</i> and to respond automatically and rapidly to <i>voltage</i> fluctuations or <i>voltage</i> instability arising from a disturbance or disruption on the <i>transmission or distribution system</i> .

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<u>static var compensator (SVC)</u>	<u>A device provided on a transmission or distribution system specifically to provide the ability to generate and absorb reactive power and to respond automatically and rapidly to voltage fluctuations or voltage instability arising from a disturbance or disruption on the transmission or distribution system.</u>
<u>steady state voltage</u>	<u>The voltage measured in the absence of any contingency event or following a contingency event once sufficient time has passed for automatic voltage control devices to have operated (such as on load transformer tap adjustment or automatic switching of reactive equipment).</u>
<u>sub transmission system</u>	<u>In the context of the SWIS, the meaning given in clause 2.5.2(c) of these Rules.</u>
substation	A facility at which lines are switched for operational purposes, and which may include one or more transformers so that some connected lines operate at different nominal voltages to others.
<u>sub-synchronous oscillations</u>	<u>Power system oscillations at frequencies that are less than the power frequency. They arise from modes of oscillation associated with interactions between certain elements on the transmission system such as generating unit rotor circuits, shaft systems, series compensated lines, excitation control systems and power system stabilisers.</u>
supply	The delivery of electricity as defined in the Act.
<u>switchable feeder section</u>	<u>A section of a high voltage distribution feeder that can be switched into or out of service by means of manual or remote switching.</u>
synchronisation	The act of synchronising a generating unit to the power system.
synchronism	A condition in which all machines of the synchronous type (generating units and motors) that are connected to a transmission or distribution system rotate at the same average speed, resulting in controlled sharing of the transfer of power. Loss of synchronism causes uncontrolled transfers of power between machine groups, causing severe and widespread disturbances of supply to Users, disconnection of transmission lines, possible damage to synchronous machines and system shutdown. <u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u>
synchronous condenser or synchronous compensator	An item of equipment, similar in construction to a generating unit of the synchronous generating unit category, which operates at the equivalent speed of the frequency of the power system, provided specifically to generate or absorb reactive power through the adjustment of rotor current.
<u>synchronous generating unit</u>	<u>The alternating current generating units that operate at the equivalent speed of the frequency of the power system in its normal operating condition.</u> <u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u>
<u>synchronous generating system</u>	<u>A generating system comprised of synchronous generating units.</u> <u>[Note: This definition aligns with the definition given in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u>

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synchronous generating unit voltage control	The automatic <i>voltage control</i> system of a <i>generating unit</i> of the <i>synchronous generating unit</i> category which <i>changes</i> the output <i>voltage</i> of the <i>generating unit</i> through the adjustment of the <i>generating unit</i> rotor current and effectively <i>changes</i> the <i>reactive power</i> output from that <i>generating unit</i> .
system instability	<p>This constitutes:</p> <p>(a) <i>Inadequate transient stability</i> – where the <i>requirements</i> of <i>clause 2.2.8</i> of <i>these Rules</i> are not met</p> <p>(b) <i>Inadequate power system damping</i> – where the <i>requirements</i> of <i>clause 2.2.9</i> of <i>these Rules</i> are not met.</p> <p>(c) <i>Unacceptable sub-synchronous oscillations</i> where the <i>relevant modes of oscillation</i> are <i>negative</i> or there is <i>insufficient net damping</i> such that the <i>requirements</i> in <i>clause 2.2.9</i> of <i>these Rules</i> are not met.</p>
system strength	<p>The meaning given in the <i>WEM Rules</i>.</p> <p>[Note: The definition in Chapter 11 of the consolidated companion version of the <i>WEM Rules</i>, dated 22 July 2023, was:</p> <p>System Strength: Is a measure of how resilient the voltage waveform is to disturbances such as those caused by a sudden change in load or an Energy Producing System, the switching of a Network element, tapping of transformers and other types of faults.]</p>
system strength requirements	<p>The meaning given in the <i>WEM Rules</i>.</p> <p>[Note: The definition in Chapter 11 of the consolidated companion version of the <i>WEM Rules</i>, dated 22 July 2023, was:</p> <p>System Strength Requirements: Means, the requirements identified to maintain sufficient System Strength on the SWIS, as determined by the processes specified in the WEM Procedure referred to in clause 3.2.7.]</p>
tap-changing transformer	<p>A <i>transformer</i> with the capability to allow internal adjustment of output <i>voltages</i> which can be automatically or manually initiated while on-line and which is used as a major component in the control of the <i>voltage</i> of the <i>transmission and distribution systems</i> in conjunction with the operation of <i>reactive</i> equipment. The <i>connection point</i> of a <i>generating unit</i> may have an associated <i>tap-changing transformer</i>, usually provided by the <i>Generator</i>.</p> <p>[Note: This definition is used in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i> dated 22 July 2023.]</p>
target setpoint	<p>The meaning given in the <i>WEM Rules</i>.</p> <p>[Note: The definition in Appendix 12 of the consolidated companion version of the <i>WEM Rules</i>, dated 22 July 2023, was:</p> <p>Target Setpoint: Means a value specifying a desired operating level for the <i>Generating Unit</i> or <i>Generating System</i>, as applicable, at the relevant location. For example, a desired <i>Active Power</i>, <i>Reactive Power</i> or <i>Power Factor</i>.]</p>
technical envelope	The limits described in the <i>WEM Rules</i> .
technical requirement	<p>Each <i>technical requirement</i> for a <i>generating system</i> specified in <i>section 3.3.7</i> of <i>these Rules</i>.</p> <p>[Note: This definition is different from the equivalent definition in Chapter 11 of the consolidated companion version of the <i>WEM Rules</i> dated 22 July 2023.]</p>

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<u>temperature dependency data</u>	<p><u>The meaning given in the WEM Rules.</u></p> <p><u>[Note: The definition in Appendix 12 of the consolidated companion version of the WEM Rules, dated 22 July 2023, was:</u></p> <p><u>Temperature Dependency Data: Means a set of data defining the maximum achievable Active Power of a Generating System or Generating Unit at a particular temperature at the Measurement Location. The data will be provided based on a template provided by the Network Operator. The data shows the Active Power capability achievable for a range of ambient temperatures while meeting all other Technical Requirements.]</u></p>
terminal station	<p>A <i>substation</i> that transforms electricity between two <i>transmission system voltages</i> and <u>that</u> supplies electricity to <i>zone substations</i> but <u>that</u> does not supply electricity to the <i>distribution system</i>.</p>
total fault clearance time	<p>The time from fault inception to the time of complete fault interruption by a circuit breaker or circuit breakers. This is to be taken, as a minimum, to be equal to 10 milliseconds plus the circuit breaker maximum break time plus the maximum <i>protection</i> operating time.</p> <p><u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u></p>
<u>transfer capacity</u>	<p><u>System capacity from adjacent demand groups that can be made available within the times stated in Table 2-10.</u></p>
transformer	<p>A piece of equipment that reduces or increases the <i>voltage</i> of alternating current.</p> <p><u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u></p>
transformer tap position	<p>Where a tap changer is fitted to a <i>transformer</i>, each tap position represents a <i>change</i> in <i>voltage</i> ratio of the <i>transformer</i> which can be manually or automatically adjusted to <i>change</i> the <i>transformer</i> output <i>voltage</i>. The tap position is used as a reference for the output <i>voltage</i> of the <i>transformer</i>.</p>
transmission	<p>The functions performed by a <i>transmission system</i>, including conveying, transferring or permitting the passage of electricity.</p>
transmission and distribution systems	<p>The <i>Network Service Provider's transmission system</i> and <i>distribution system</i> collectively.</p>
<u>transmission capacity</u>	<p><u>The ability of the transmission system to transmit electricity. It does not include any ability resulting from operational measures.</u></p>
<u>transmission circuit</u>	<p><u>Part of the transmission system between two or more circuit breakers, which may include overhead lines, underground cables, and bus tie transformers but excludes busbars and generation circuits.</u></p>
<u>transmission connected market generators</u>	<p><u>A User who is registered as a Market Generator in accordance with the WEM Rules and is responsible for a generating system that is connected to the transmission system.</u></p>

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transmission element	A single identifiable major component of a <i>transmission system</i> involving: (a) an individual <i>transmission circuit</i> or a phase of that circuit; <u>or</u> (b) a major item of <i>transmission</i> equipment necessary for the functioning of a particular <i>transmission circuit</i> or <i>connection point</i> (such as a <i>transformer</i> or a circuit breaker).
transmission equipment	The equipment associated with the function or operation of a <i>transmission circuit</i> or <i>substation</i> , which may include <i>transformers</i> , circuit breakers, <i>busbar</i> , <i>reactive equipment</i> , <i>monitoring equipment</i> and control equipment.
transmission line	A power line that is part of a <i>transmission system</i> .
transmission network adequacy	<u>The ability of the <i>transmission network</i> to maintain transfer of electricity in compliance with section 2.5 of these Rules. When these conditions are met, the <i>transmission network</i> is deemed adequate.</u>
Transmission Network Operator	<u>The <i>Network Service Provider</i> personnel, systems and infrastructure that perform operational roles and responsibilities that provide for the safe, secure and reliable operation of the <i>transmission system</i>.</u>
transmission or distribution system	Either the <i>Network Service Provider's</i> <i>transmission system</i> or <i>distribution system</i> .
transmission system	Any apparatus, equipment, plant or buildings used, or to be used, for, or in connection with, the transportation of electricity at nominal voltages of 66 kV or higher, and which forms part of the <i>South West Interconnected Network</i> . For the avoidance of doubt the <i>transmission system</i> includes equipment such as static <i>reactive power</i> compensators, which <u>are</u> operated at <i>voltages</i> below 66 kV, provided that the primary purpose of this equipment is to support the transportation of <i>electricity</i> at <i>voltages</i> of 66 kV or higher. <u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u>
transmission system planning criteria	The criteria <u>set out in section 2.5 of these Rules in accordance with the requirement</u> under section A6.1(m) of the <i>Access Code</i> .
trigger event	<u>One or more circumstances specified in a <i>negotiated generator performance standard</i>, the occurrence of which requires a <i>Generator</i> responsible a <i>large generating system</i> to undertake required actions to achieve an agreed outcome and or achieve an agreed higher level of performance than the existing <i>registered generator performance standard</i> applicable in respect of one or more technical requirements.</u>
trip circuit supervision	A function incorporated within a <i>protection scheme</i> that results in alarming for the loss of integrity of the <i>protection scheme's</i> trip circuit. <i>Trip circuit supervision</i> supervises a <i>protection scheme's</i> trip supply together with the integrity of associated wiring, cabling and circuit breaker trip coil.
trip supply supervision	A function incorporated within a <i>protection scheme</i> that results in alarming for loss of trip supply.

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turbine control system	<p>The automatic control system <u>that</u> regulates the speed and power output of a <i>generating unit</i> through the control of the rate of entry into the <i>generating unit</i> of the primary energy input (for example, steam, gas or water).</p> <p><u>[Note: This definition is used in Appendix 12 of the consolidated companion version of the WEM Rules dated 22 July 2023.]</u></p>
two fully independent protection schemes	<p><i>Protection schemes</i> having differing principles of operation and which, in combination, provide dependable detection of faults on the protected <i>primary equipment</i> and operate within a specified time, despite any single failure to operate of the <i>secondary equipment</i>.</p> <p>To achieve this, complete <i>secondary equipment</i> redundancy is required, including <i>current transformer</i> and <i>voltage transformer</i> secondaries, auxiliary supplies, signalling systems, cabling, wiring, and circuit breaker trip coils. Auxiliary supplies include DC supplies for <i>protection</i> purposes. Therefore, to satisfy the redundancy requirements, each <i>protection scheme</i> would need to have its own independent battery and battery charger system supplying all that <i>protection scheme's</i> trip functions.</p> <p>In addition, the relays of each <i>protection scheme</i> must be grouped in separate physical locations (which need not be in different panels). Furthermore, the two <i>protection schemes</i> must either use different methods of operation or, alternatively, have been designed and manufactured by different organisations.</p>
<u>UFLS Specification Document</u>	<u>The document developed in accordance with clause 3.6.6 of the WEM Rules.</u>
<u>unacceptable frequency conditions</u>	<u>The conditions where the system frequency falls outside of the limits specified in the WEM Rules.</u>
<u>unacceptable overloading</u>	<p><u>The overloading of any primary equipment beyond its specified time-related capability, with consideration for specific conditions (e.g., ambient/seasonal temperature), pre-fault loading, time-dependent loading cycles of equipment and any additional relevant procedures.</u></p> <p><u>In operational timeframes, dynamic ratings may also be used where available.</u></p>
<u>unacceptable voltage conditions</u>	<u>The conditions where voltage falls outside of the limits specified in clause 2.2.2 or 2.2.3 of these Rules.</u>
<u>unplanned outage</u>	<u>An outage of one or more items of equipment, which may include User or Network Service Provider equipment, initiated by manually instructed action that has not been subject to an outage process managed by the Network Service Provider or AEMO.</u>
User	<u>The meaning given in clause 1.3(b)(3) of these Rules.</u>
<u>User operating protocol</u>	<u>A document that captures the operational arrangements between a User and the Network Service Provider.</u>
voltage	The electronic force or electric potential between two points that gives rise to the flow of electricity.

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voltage stability	<p>The ability of a <i>power system</i> to attain steady <i>voltages</i> at all <i>busbars</i> after being subjected to a disturbance from a given operating condition. Instability that may result occurs in the form of a progressive fall or rise of <i>voltages</i> at some <i>busbars</i>.</p> <p>Possible outcomes of <i>voltage</i> instability are loss of <i>load</i> in an area, or the tripping of <i>transmission lines</i> and other elements, including <i>generating units</i>, by their protective systems leading to <i>cascading outages</i>.</p>
voltage step change	<p><u>The difference in <i>voltage</i> between that immediately before a <i>contingency event</i> or operational switching and that at the end of the transient time phase after the event. Measured as the differences between:</u></p> <p>(a) <u>the post-event <i>voltage</i> appearing once the transient response has subsided but prior to control actions taken to restore <i>voltage</i> such as adjustment of <i>transformer tap position</i> via on-load tap changers, and</u></p> <p>(b) <u>the pre-event <i>voltage</i> measures just prior to the event occurring.</u></p>
voltage transformer (VT)	A <i>transformer</i> for use with meters and/or <i>protection</i> devices in which the <i>voltage</i> across the secondary terminals is, within prescribed error limits, proportional to and in phase with the <i>voltage</i> across the primary terminals.
WA Electrical Requirements	The WA Electrical Requirements issued under Regulation 49 of the <i>Electricity (Licensing) Regulations 1991 (WA)</i> .
WA Service and Installation Requirements	<u>The Western Australia Service and Installation Requirements as published by Western Power and Horizon Power.</u>
weak infeed fault conditions	Occur when a <i>generating unit</i> <u>connected to the <i>distribution system</i></u> supplies a fault current <u>that</u> is significantly below normal <i>load</i> current of the installed <i>transmission protection scheme</i> .
WEM Rules	<u>The Wholesale Electricity Market Rules established under the <i>Electricity Industry (Wholesale Electricity Market) Regulations 2004 (WA)</i>.</u>
Wholesale Electricity Market (WEM)	<p>The meaning given in the <i>WEM Rules</i>.</p> <p>[Note: The definition in Chapter 11 of the consolidated companion version of the <i>WEM Rules</i>, dated 22 July 2023, was:</p> <p><u>Wholesale Electricity Market: The market established under section 122 of the <i>Electricity Industry Act</i>.]</u></p>
wind farm	A <i>power station</i> consisting of one or more wind powered <i>generating units</i> .
written law	The meaning given to it in section 5 of the <i>Interpretation Act 1984 (WA)</i> .
zone substation	A <i>substation</i> that transforms electricity from a <i>transmission system voltage</i> to a <i>distribution system voltage</i> .

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ATTACHMENT 2 INTERPRETATION

In these *Rules*, headings and captions are for convenience only and do not affect interpretation and, unless the contrary intention appears from the context, and subject to the *Act* and the *Access Code*, these *Rules* must be interpreted in accordance with the following rules of interpretation:

- (a) a reference in these *Rules* to a contract or another instrument includes a reference to any amendment, variation or replacement of it save for a reference to an *Australian Standard* that explicitly states a date or year of publication;
- (b) a reference to a person includes a reference to the person's executors, administrators, successors, substitutes (including persons taking by novation) and assigns;
- (c) references to time are to Western Standard Time, being the time at the 120th meridian of longitude east of Greenwich in England, or Coordinated Universal Time, as required by the *National Measurement Act 1960* (Cth);
- (d) any calculation must be performed to the accuracy, in terms of a number of decimal places, determined by the *Network Service Provider* in respect of all *Users*;
- (e) where any word or phrase is given a defined meaning, any part of speech or other grammatical form of that word or phrase has a corresponding meaning;
- (f) the word "including" means "including, but without limiting the generality of the foregoing" and other forms of the verb "to include" are to be construed accordingly;
- (g) a connection point is a User's connection point or a connection point of a User if it is the subject of a connection agreement between the User and the Network Service Provider;
- (h) a reference to a half hour is a reference to a 30 minute period ending on the hour or on the half hour and, when identified by a time, means the 30 minute period ending at that time; and
- (i) measurements of physical quantities are in Australian legal units of measurement within the meaning of the *National Measurement Act 1960* (Cth).

ATTACHMENT 3 SCHEDULES OF TECHNICAL DETAILS IN SUPPORT OF CONNECTION APPLICATIONS

A3.1. Various sections of the [Rules](#) require that *Users* submit technical data to the *Network Service Provider*. [This Attachment 3](#) summarises schedules [listing](#) the typical range of data [that](#) may be required and explains the terminology. Data additional to those listed in the schedules may be required. The actual data required will be advised by the *Network Service Provider* at the time of assessment of a *transmission or distribution system access application*, and will form part of the technical specification in the *access contract or connection agreement*.

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A3.2. Data is [categorised](#) according to the stage at which it is available in the build-up of data during the process of forming a connection or obtaining *access* to a *transmission or distribution system*, with data acquired at each stage being carried forward, or enhanced in subsequent stages, e.g. testing.

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Preliminary system planning data

This is data required for submission with the *access application* or connection application, to allow the *Network Service Provider* to prepare an offer of terms for a *connection agreement* and to assess the requirement for, and effect of, *transmission and distribution system augmentation or extension* options. Such data is normally limited to the items denoted as Standard Planning Data [\(S\)](#) in the technical data schedules in [Attachment 4](#) to [Attachment 10](#).

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The *Network Service Provider* may, in cases where there is doubt as to the viability of a proposal, require the submission of other data before making an *access offer* to connect or to amend an *access contract or connection agreement*.

Registered system planning data

This is the class of data [that](#) will be included in the *access contract or connection agreement* signed by both parties. It consists of the preliminary system planning data plus those items denoted in the attached schedules as Detailed Planning Data (D). The latter must be submitted by the *User* in time for inclusion in the *access contract or connection agreement*.

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Registered [Data](#)

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Registered Data [\(R\)](#) consists of data validated and augmented prior to actual connection [and](#) provision of access from manufacturers' data, detailed design calculations, works or site tests etc.(R1); and data derived from on-system testing after connection (R2).

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All of the data will, from this stage, be categorised and referred to as Registered Data; but for convenience the schedules omit placing [additional category identifiers against](#) items [that](#) are expected to already be valid at an earlier stage.

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A3.3. Data will be subject to review at reasonable intervals to ensure its continued accuracy and relevance. The *Network Service Provider* must initiate this review. [Subject to complying with obligations in Chapters 3 and 4 requiring the User to gain approval for setting changes from the Network Service Provider, a User may change any data item at any time, Revised data must be submitted to the Network Service Provider, together with authentication documents and supporting reports.](#)

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A3.4. [Attachment 4](#) to [Attachment 12](#), cover the following data areas:

- (a) [Attachment 4 – LARGE GENERATING SYSTEM DESIGN DATA](#). This comprises large *generating systems* fixed design parameters.

- (b) Attachment 5 – SUBMISSION REQUIREMENTS FOR ELECTRICAL PLANT PROTECTION. This comprises design and setting data for protection systems that must coordinate or interface with the protection systems for the transmission and distribution system or that could impact the operation of the transmission and distribution system.
- (c) Attachment 6 – LARGE GENERATING UNIT OR GENERATING SYSTEM SETTING DATA. This comprises settings which can be varied by agreement or by direction of the Network Service Provider.
- (d) Attachment 7 – TRANSMISSION SYSTEM AND EQUIPMENT TECHNICAL DATA OF EQUIPMENT AT OR NEAR CONNECTION POINT. This comprises fixed electrical parameters.
- (e) Attachment 8 – TRANSMISSION SYSTEM EQUIPMENT AND APPARATUS SETTING DATA. This comprises settings which can be varied by agreement or by direction of the Network Service Provider.
- (f) Attachment 9 – LOAD CHARACTERISTICS AT CONNECTION POINT. This comprises the estimated parameters of load groups in respect of, for example, harmonic content and response to frequency and voltage variations.
- (g) Attachment 10 – SMALL GENERATING SYSTEM DESIGN AND SETTING DATA (RATED CAPACITY ≤ 5 MVA EXCLUDING INVERTER ENERGY SYSTEMS CONNECTED TO THE LOW VOLTAGE DISTRIBUTION SYSTEM VIA A STANDARD CONNECTION SERVICE). This comprises a reduced set of design parameters that the Network Services Provider may require for small power stations covered by clause 3.6 and 3.7 of the Rules.
- (h) Attachment 11 – TEST SCHEDULE FOR SPECIFIC PERFORMANCE VERIFICATION AND MODEL VALIDATION. This comprises a schedule of commissioning and performance tests that the Network Service Provider may require for large generating units covered by clause 3.3 and specified in Chapter 4 of the Rules.
- (i) Attachment 12 – TESTING AND COMMISSIONING OF SMALL POWER STATIONS CONNECTED TO THE DISTRIBUTION SYSTEM. This comprises a schedule of commissioning and performance tests that the Network Service Provider may require for small power stations covered by clause 3.6 and 3.7 of the Rules.

A3.5. A Generator that connects a large generating unit that is not a synchronous generating unit must be given exemption from complying with those parts of schedules in Attachment 4 and Attachment 6 that are determined by the Network Service Provider to be not relevant to such generating units, but must provide the information required by those parts of the schedules in Attachments 5, 7, 8 and 9 that are relevant to such generating units, as determined by the Network Service Provider. For asynchronous generating units, additional data may be requested by the Network Service Provider.

Codes:

S = Standard Planning Data

D = Detailed Planning Data

R = Registered Data (R1 pre-connection, R2 post-connection)

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ATTACHMENT 4 LARGE GENERATING SYSTEM DESIGN DATA'

Symbol	Data Description	Units	Data Category
	Power station technical data:		
	Connection point to <u>transmission</u> system,	Text, diagram	S, D
	Nominal voltage at connection point to <u>transmission</u> system	kV	S
	Total Power Station Sent Out Capacity	MW (sent out)	S, D, R2
	At connection point:		
<u>MSCR</u>	<p><u>Minimum Short Circuit Ratio:</u></p> <p>The lowest short circuit ratio at the connection point for which the generating system, including its control systems: (i) will be commissioned to maintain stable operation; and (ii) has the design capability to maintain stable operation.</p> <p>For the purposes of the above, "short circuit ratio" is the synchronous three phase fault level (expressed in MVA) at the connection point divided by the rated output of the generating system (expressed in MW or MVA) at the Network Service Provider's discretion.</p>	<u>Numeric ratio</u>	<u>S, D, R1</u>
	Maximum 3 phase short circuit infeed calculated by method of AS 3851 (1991) (Amendment 1-1992):		
	Symmetrical	kA	S, D
	Asymmetrical	kA	D
	Minimum zero sequence impedance	(a+jb) ohms	D
	Minimum negative sequence impedance	(a+jb) ohms	D

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Symbol	Data Description	Units	Data Category
	<u>Controllers responding to frequency deviations</u> <u>(e.g. generating unit turbine controller, generating unit or generating system load controller)</u>		
	<u>Make</u>	<u>Text</u>	<u>S, D</u>
	<u>Model</u>	<u>Text</u>	<u>S, D</u>
	<u>General description of turbine control system or other control systems that adjusts active power generated to correct power system frequency deviations (including block diagram transfer function & parameters)</u>	<u>Text, diagram</u>	<u>S, D</u>
	<u>Maximum Droop</u>	<u>%</u>	<u>S, D, R1</u>
	<u>Normal Droop</u>	<u>%</u>	<u>D, R1</u>
	<u>Minimum Droop</u>	<u>%</u>	<u>D, R1</u>
	<u>Maximum Frequency Dead band</u>	<u>Hz</u>	<u>D, R1</u>
	<u>Normal Frequency Dead band</u>	<u>Hz</u>	<u>D, R1</u>
	<u>Minimum Frequency Dead band</u>	<u>Hz</u>	<u>D, R1</u>
	<u>MW Dead band</u>	<u>MW</u>	<u>D, R1</u>
	<u>Generating unit or generating system response capability:</u>		
	<u>Sustained response to frequency change</u>	<u>MW/Hz</u>	<u>D, R2</u>
	<u>Non-sustained response to frequency change</u>	<u>MW/Hz</u>	<u>D, R2</u>
	<u>Load Rejection Capability</u>	<u>MW</u>	<u>S, D, R2</u>
	<u>Individual synchronous generating unit data:</u>		
	<u>Make</u>		
	<u>Model</u>		
MBASE	<u>Rated MVA</u>	<u>MVA</u>	<u>S, D, R1</u>
PSO	<u>Rated MW (Sent Out)</u>	<u>MW (sent out)</u>	<u>S, D, R1</u>
PMAX	<u>Rated MW (generated)</u>	<u>MW (Gen)</u>	<u>D</u>

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Symbol	Data Description	Units	Data Category
VT	Nominal Terminal Voltage	kV	D, R1
PAUX	Auxiliary load at PMAX	MW	S, D, R2
Qmax	Rated Reactive Output at PMAX	Mvar (sent out)	S, D, R1
PMIN	Minimum Load (ML)	MW (sent out)	S, D, R2
H	Inertia Constant for all rotating masses connected to the generating unit shaft (for example, generating unit, turbine, etc.)	MWs/rated MVA	S, D, R1
Hg	Generating unit Inertia Constant (applicable to synchronous condenser mode of operation)	MWs/rated MVA	S, D, R1
GSCR	Short Circuit Ratio		D, R1
ISTATOR	Rated Stator Current	A	D, R1
IROTOR	Rated Rotor Current at rated MVA and Power factor, rated terminal volts and rated speed	A	D, R1
VROTOR	Rotor Voltage at which IROTOR is achieved	V	D, R1
VCEIL	Rotor Voltage capable of being supplied for five seconds at rated speed during field forcing	V	D, R1
ZN	Neutral Earthing Impedance	(a+jb)%* * MVA base must be clearly stated.	
	Generating unit resistance:		
RA	Stator Resistance	% on MBASE	S, D, R1, R2
RF	Rotor resistance at 20°C	ohms	D, R1
	Generating unit sequence impedances (saturated):		
Z0	Zero Sequence Impedance	(a+jb)% on MBASE	D, R1
Z2	Negative Sequence Impedance	(a+jb)% on MBASE	D, R1
	Generating unit reactances (saturated):		
XD'(sat)	Direct Axis Transient Reactance	% on MBASE	D, R1

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 4 – LARGE GENERATING SYSTEM DESIGN DATA

XD"(sat)	Direct Axis Sub-Transient Reactance	% on MBASE	D, R1
	Generating unit reactances (unsaturated):		
XD	Direct Axis Synchronous Reactance	% on MBASE	S, D, R1, R2
XD'	Direct Axis Transient Reactance	% on MBASE	S, D, R1, R2
XD''	Direct Axis Sub-Transient Reactance	% on MBASE	S, D, R1, R2
XQ	Quadrature Axis Synch Reactance	% on MBASE	D, R1, R2
XQ'	Quadrature Axis Transient Reactance	% on MBASE	D, R1, R2
XQ''	Quadrature Axis Sub-Transient Reactance	% on MBASE	D, R1, R2
XL	Stator Leakage Reactance	% on MBASE	D, R1, R2
XO	Zero Sequence Reactance	% on MBASE	D, R1
X2	Negative Sequence Reactance	% on MBASE	D, R1
XP	Potier Reactance	% on MBASE	D, R1
	Generating unit time constants (unsaturated):		
TDO'	Direct Axis Open Circuit Transient	Seconds	S, D, R1, R2
TDO''	Direct Axis Open Circuit Sub-Transient	Seconds	S, D, R1, R2
TKD	Direct Axis Damper Leakage	Seconds	D, R1, R2
TQO'	Quadrature Axis Open Circuit Transient	Seconds	D, R1, R2
TA	Armature Time Constant	Seconds	D, R1, R2
TQO''	Quadrature Axis Open Circuit Sub-Transient	Seconds	D, R1, R2
	Charts:		
GCD	Generator performance chart	Graphical data	D, R1, R2
GOCC	Open Circuit Characteristic	Graphical data	R1
GSCC	Short Circuit Characteristic	Graphical data	R1
GZPC	Zero power factor curve	Graphical data	R1
	V curves	Graphical data	R1
GOTC	MW, Mvar outputs versus temperature chart	Graphical data	D, R1, R2

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 4 – LARGE GENERATING **SYSTEM** DESIGN DATA

Generating unit transformer:			
GTW	Number of windings	Text	S, D
GTRn	Rated MVA of each winding	MVA	S, D, R1
GTRn	Principal tap rated <i>voltages</i>	kV/kV	S, D, R1
GTZ1n	Positive Sequence Impedances (each wdg)	(a + jb) % on 100 MVA base	S, D, R1
GTZ2n	Negative Sequence Impedances (each wdg)	(a + jb) % on 100 MVA base	S, D, R1
GTZOn	Zero Sequence Impedances (each wdg)	(a + jb) % on 100 MVA base	S, D, R1
	Tapped Winding	Text, diagram	S, D, R1
GTAPR	Tap Change Range	kV - kV	S, D
GTAPS	Tap Change Step Size	%	D
	Tap Changer Type, On/Off <i>load</i>	On/Off	D
	Tap Change Cycle Time	Seconds	D
GTVG	Vector Group	Diagram	S, D
	Earthing Arrangement	Text, diagram	S, D
	Saturation curve	Diagram	R1
Generating unit reactive capability (at machine terminals):			
	Lagging <i>Reactive power</i> at PMAX	Mvar export	S, D, R2
	Lagging <i>Reactive power</i> at ML	Mvar export	S, D, R2
	Lagging Reactive Short Time	Mvar	D, R1, R2
	capability at rated MW, terminal	(for time)	
	Voltage and speed		
	Leading <i>Reactive power</i> at rated MW	Mvar import	S, D, R2
Generating unit excitation control system:			
	Make		
	Model		

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	General description of <i>excitation control system</i> (including block diagram transfer function & parameters)	Text, diagram	S, D
	Rated Field <i>Voltage</i> at rated MVA and <i>Power factor</i> and rated terminal volts and speed	V	S, D, R1
	Maximum Field <i>Voltage</i>	V	S, D, R1
	Minimum Field <i>Voltage</i>	V	D, R1
	Maximum rate of change of Field <i>Voltage</i>	Rising V/s	D, R1
	Maximum rate of change of Field <i>Voltage</i>	Falling V/s	D, R1
	<i>Generating unit</i> and exciter Saturation		
	Characteristics 50 - 120% V	Diagram	D, R1
	Dynamic Characteristics of Over	Text	
	Excitation Limiter (drawn on capability <i>generating unit</i> diagram)	Block diagram	D, R2
	Dynamic Characteristics of Under	Text	
	Excitation Limiter (drawn on capability <i>generating unit</i> diagram)	Block diagram	D, R2
	Mechanical shaft model:		
	(Multiple-stage steam turbine <i>generating units</i> only)		
	Dynamic model of turbine/ <i>generating unit</i> shaft system in lumped element form showing component inertias, damping and shaft stiffness.	Diagram	D
	Natural damping of shaft torsional oscillation modes (for each mode)		
	- Modal <i>frequency</i>	Hz	D
	- Logarithmic decrement	Nepers/Sec	D
	Steam Turbine Data:		
	(Multiple-stage steam turbines only)		

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Generating unit turbine / load controller (governor):

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	Fraction of power produced by each stage:		
	Symbols KHP KIP KLP1 KLP2	Per unit of Pmax	D
	Stage and reheat time constants:		
	Symbols THP TRH TIP TLP1 TLP2	Seconds	D
	Turbine <i>frequency</i> tolerance curve	Diagram	S, D, R1
	Gas turbine data		
HRSG	Waste heat recovery boiler time constant (where applicable e.g. for co-generation equipment)	Seconds	D
	MW output versus turbine speed (47-52 Hz)	Diagram	D, R1, R2
	Type of turbine (heavy industrial, aero derivative etc.)	Text	S
	Number of shafts		S, D
	Gearbox Ratio		D
	Fuel type (gas, liquid)	Text	S, D
	Base <i>load</i> MW vs temperature	Diagram	D
	<i>Peak load</i> MW vs temperature	Diagram	D
	Rated exhaust temperature	°C	S, D
	Controlled exhaust temperature	°C	S, D, R1
	Turbine <i>frequency</i> tolerance capability	Diagram	D
	Turbine compressor surge map	Diagram	D
	Hydraulic turbine data		
	Required data will be advised by the <i>Network Service Provider</i>		

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 4 – LARGE GENERATING ~~SYSTEM~~ DESIGN DATA

Wind farm/wind turbine data¹			
	A typical 24 hour power curve measured at 15-minute intervals or better if available;		S, D, R1
	maximum kVA output over a 60 second interval		S, D, R1
Data on power quality characteristics for wind Generators (including flicker and harmonics) as specified in IEC 61400-21.			
	Long-term flicker factor for <i>generating unit</i>		S, D, R1
	Long term flicker factor for <i>wind farm</i>		S, D, R1
	Maximum output over a 60 second interval	kVA	S, D, R1
	Harmonics current spectra	A	S, D, R1
	Power curve MW vs. wind speed	Diagram	D
	Spatial Arrangement of <i>wind farm</i>	Diagram	D
	Startup profile MW, Mvar vs time for individual Wind Turbine Unit and <i>Wind farm</i> Total	Diagram	D
	Low Wind Shutdown profile MW, Mvar vs time for individual Wind Turbine Unit and <i>Wind farm</i> Total	Diagram	D
	MW, Mvar vs time profiles for individual Wind Turbine Unit under normal ramp up and ramp down conditions.	Diagram	D
	High Wind Shutdown profile MW, Mvar vs time for individual Wind Turbine Unit and <i>Wind farm</i> Total	Diagram	D
Induction generating unit data			
	Make		
	Model		
	Type (squirrel cage, wound rotor, doubly fed)		
MBASE	Rated MVA	MVA	S, D, R1
PSO	Rated MW (Sent out)	MW	S, D, R1
PMAX	Rated MW (<i>generated</i>)	MW	D

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 4 – LARGE GENERATING SYSTEM DESIGN DATA

VT	Nominal Terminal Voltage	kV	S,D,R1
	Synchronous Speed	rpm	S,D,R1
	Rated Speed	rpm	S,D,R1
	Maximum Speed	rpm	S,D,R1
	Rated Frequency	Hz	S,D,R1
Qmax	Reactive consumption at PMAX	Mvar import	S,D,R1
	Curves showing torque, power factor, efficiency, stator current, MW output versus slip (+ and -).	Graphical data	D,R1,R2
	Number of capacitor banks and Mvar size at rated voltage for each capacitor bank (if used).	Text	S
	Control philosophy used for var /voltage control.	Text	S
H	Combined inertia constant for all rotating masses connected to the generating unit shaft (for example, generating unit, turbine, gearbox, etc.) calculated at the synchronous speed	MW-sec/MVA	S,D,R1
	Resistance		
Rs	Stator resistance	% on MBASE	D,R1
Rs	Stator resistance versus slip curve, or two extreme values for zero (nominal) and unity (negative) slip	Graphical data or % on MBASE	D,R1
	Reactances (saturated)		
X'	Transient reactance	% on MBASE	D,R1
X''	Subtransient reactance	% on MBASE	D,R1
	Reactances (unsaturated)		
X	Sum of magnetising and primary winding leakage reactance.	% on MBASE	D,R1
X'	Transient reactance	% on MBASE	D,R1
X''	Subtransient reactance	% on MBASE	D,R1
Xl	Primary winding leakage reactance	% on MBASE	D,R1

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Time constants (unsaturated)			
T'	Transient	sec	S, D, R1, R2
T''	Subtransient	sec	S, D, R1, R2
Ta	Armature	sec	S, D, R1, R2
To'	Open circuit transient	sec	S, D, R1, R2
To''	Open circuit subtransient	sec	S, D, R1, R2
Converter data			
Control: <i>transmission system</i> commutated or self commutated			
Additional data may be required by the <i>Network Service Provider</i>			
Doubly fed induction <i>generating unit</i> data			
Required data will be advised by the <i>Network Service Provider</i>			
<u>Inverter connected generating systems</u>²			
	<u>Generating System Identifier</u> ³	text	S
	<u>Make</u>	text	D
	<u>Model</u>	text	D
	<u>Maximum apparent power output over a 60 s interval</u> ⁴	MVA	S, D, R1
	<u>Maximum fault current contribution</u> ⁴	kA rms symmetrical	S, D, R1
	<u>Control modes (voltage, reactive power, power factor)</u> ⁴	Text	S, D, R1
<u>Attachments</u>			
	<u>Control system block diagram including limiters and parameters for voltage, reactive power, power factor controls</u>	Graphical Data	S, D, R1
	<u>Block diagram including limiters and parameters for power oscillation damper</u>	Graphical Data	S, D, R1
	<u>Reactive capability curve</u>	Graphical Data	S, D, R1

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 4 – LARGE GENERATING SYSTEM DESIGN DATA

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	Data on power quality characteristics including flicker and harmonics similar to that specified in IEC 61400-21.		
	Long-term flicker factor for Generator	-	S, D, R2
	Long term flicker factor for wind farm	-	S, D, R2
	Harmonics current spectra	-	S, D, R2
	The Network Service Provider may specify additional data for inverter energy systems		

Notes:

- 1: [Where applicable and unless requested otherwise, the data shall be provided at the site specific maximum ambient temperature.](#)
- 2: [A separate data sheet is required for each generating unit within the generating system.](#)
- 3: [Where there is more than one generating unit, the identifier should be the same as used on the single line diagram.](#)
- 4: [Aggregate capability for the entire generating system](#)

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ATTACHMENT 5 SUBMISSION REQUIREMENTS FOR ELECTRICAL PLANT PROTECTION

Protection data submission timelines:		
D	Within 3 months of signing of the connection agreement, or as agreed otherwise in the connection agreement.	
R1	At least 3 months prior to commencement of protection equipment commissioning, or as agreed otherwise in the connection agreement.	
R2	Within 3 weeks of the completion of protection equipment commissioning, or as agreed otherwise in the connection agreement.	
Data Description		Data Category
Protection Design Philosophy:		
Documentation explaining the general protection philosophy, including:		D, R1 and R2
	- Present and design minimum and maximum fault levels.	
	- Present and design minimum and maximum fault contributions to the network from the User, at the connection point.	
	- Details of required critical fault clearance times, and which protections will be employed to meet these times.	
	- Local <u>Back-up</u> (circuit breaker fail) philosophy.	
	- Special scheme philosophy (for example, islanding or load shedding schemes).	
	- Protection number 1 philosophy	
	- Protection number 2 philosophy	
Power single line diagram, down to and including the low voltage (greater than 50V AC) bus(s), including:		D, R1 and R2
	- Voltage levels,	
	- Transformer ratings, winding configurations and earthing connections	
	- <u>Generating unit</u> ratings and earthing connections	
	- Operating status of switching devices	
	- Earthing configuration	

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TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

ATTACHMENT 5 – SUBMISSION REQUIREMENTS FOR ELECTRICAL PLANT PROTECTION LARGE GENERATING SYSTEM DESIGN DATA

- Primary plant interlocks	
Details of <i>protection</i> interfaces between the network and the <i>User</i>	D, R1 and R2
<i>Protection</i> single line diagram, down to and including the <i>low voltage</i> (greater than 50V AC) bus(s), including:	R1 and R2
- <i>Current transformer</i> locations, rated primary and secondary current, rated short-time thermal current, rated output, accuracy class and designation.	
- <i>Voltage transformer</i> locations, winding connections, rated primary and secondary <i>voltages</i> , rated output and accuracy class.	
- Relay make and model number	
- Relay functions employed	
- Primary plant mechanical <i>protections</i>	
- Trip details (diagrammatic or by trip matrix)	
Impedance diagram of the system, showing, for each item of primary plant, details of the positive, negative and zero sequence series and shunt impedances, including mutual coupling between physically adjacent elements. Impedances to be in per unit, referred to a 100MVA base.	R1 and R2
Final submission (R2) to include tested values of <i>generating unit</i> and <i>transformer</i> impedances (for example, from manufacturer's test certificates)	
Tripping and control power <i>supply</i> (e.g. DC system) single line diagram.	R1 and R2
Power flow details at <u>the connection point</u> as per the data requested in Attachment 5.	R1 and R2
<i>HV</i> circuit breaker details, including:	R1 and R2
- A control and <i>protection</i> schematic diagram of the circuit breaker(s) at the <i>User</i> connection to the network	
- Type, rated current and rated fault MVA or rated breaking current of all <i>HV</i> circuit breakers	
<i>HV</i> switch fuse details, including:	R1 and R2
- Rated current of fuse	
- Rated breaking current of fuse	
- Type of fuse	

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- Current-time characteristic curves	
Protection Settings Design Philosophy:	
Documentation explaining the general <i>protection</i> settings philosophy	R1 and R2
Calculated <i>critical fault clearance times</i>	R1 and R2
<i>Protection</i> function settings to be employed and reasons for selecting these settings. Diagrams to be submitted where applicable.	R1 and R2
Overcurrent grading curves for phase faults.	R1 and R2
Overcurrent grading curves for earth faults	R1 and R2

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ATTACHMENT 6 LARGE GENERATING UNIT OR GENERATING SYSTEM SETTING DATA

Data Description Category	Units	Data
---------------------------	-------	------

Protection Data:

Settings of the following *protections*:

Loss of field	Text	D
Under excitation	Text, diagram	D
Over excitation	Text, diagram	D
Differential	Text	D
Under <i>frequency</i>	Text	D
Over <i>frequency</i>	Text	D
Negative sequence component	Text	D
Stator overvoltage	Text	D
Stator overcurrent	Text	D
Rotor overcurrent	Text	D
Reverse power	Text	D

Control Data:

Details of *excitation control system* incorporating, where applicable, individual elements for *power system stabiliser*, under excitation limiter and over excitation limiter described in block diagram form showing transfer functions of individual elements, parameters and measurement units (preferably in IEEE format, but suitable for use in the software package nominated by the *Network Service Provider*. Currently, that package is DigSilent). The source code of the model must also be provided, in accordance with clause 3.3.11.

Text, diagram D, R1, R2

Settings of the following controls:

Details of the *turbine control system* described in block diagram form showing transfer functions of individual elements and measurement units (preferably in IEEE format, but suitable for use in the software package nominated by the *Network Service Provider*. Currently, that package is DigSilent). The source code of the model must also be provided, in accordance with clause 3.3.11.

Text, diagram D, R1, R2

Stator current limiter (if fitted)	Text, diagram	D
Manual restrictive limiter (if fitted)	Text	D
Load drop compensation/ <u>var</u> sharing (if fitted)	Text, function	D
V/f limiter (if fitted)	Text, diagram	D

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ATTACHMENT 7 TRANSMISSION SYSTEM AND EQUIPMENT TECHNICAL DATA OF EQUIPMENT AT OR NEAR CONNECTION POINT

Data Description Category	Units	Data
Voltage rating		
Nominal voltage	kV	S, D
Highest voltage	kV	D
Insulation co-ordination		
Rated lightning impulse withstand voltage	kVp	D
Rated short duration power frequency withstand voltage	kV	D
Rated currents		
Circuit maximum current	kA	S, D
Rated Short Time Withstand Current	kA for seconds	D
Ambient conditions under which above current applies	Text	S, D
Earthing		
System Earthing Method	Text	S, D
Earth grid rated current	kA for seconds	D
Insulation Pollution Performance		
Minimum total creepage	mm	D
Pollution level	Level of IEC 815	D
Controls		
Remote control and data transmission arrangements	Text	D

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Transmission system configuration

Operation Diagrams showing the electrical circuits of the existing and proposed main facilities within the User's ownership including busbar arrangements, phasing arrangements, earthing arrangements, switching facilities and operating voltages.

Single line Diagrams S, D, R1

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Transmission system impedances

For each item of equipment (including lines): details of the positive, negative and zero sequence series and shunt impedances, including mutual coupling between physically adjacent elements.

% on 100 MVA base S, D, R1

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Short circuit infeed to the transmission system

Maximum *Generating unit* 3-phase short circuit infeed including infeeds from *generating units connected* to the User's system, calculated by method of AS 3851 (1991)(Amndt 1-1992).

kA symmetrical S, D, R1

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The total infeed at the instant of fault (including contribution of induction motors).

kA D, R1

Minimum zero sequence impedance of User's transmission system at connection point.

% on 100 MVA base D, R1

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Minimum negative sequence impedance of User's transmission system at connection point.

% on 100 MVA base D, R1

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Load transfer capability:

Where a *load*, or group of *loads*, may be fed from alternative *connection points*:

Load normally taken from *connection point X*

MW D, R1

Load normally taken from *connection point Y*

MW D, R1

Arrangements for transfer under planned or fault *outage* conditions

Text D

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Circuits connecting embedded generating units to the transmission system:

For all *generating units*, all connecting lines/cables, *transformers* etc.

Series Resistance (+ve, -ve & zero seq.) % on 100 MVA base D, R

Series Reactance (+ve, -ve & zero seq.) % on 100 MVA base D, R

Shunt Susceptance (+ve, -ve & zero seq.) % on 100 MVA base D, R

Normal and short-time emergency ratings MVA D, R

Technical Details of *generating units* as per schedules S1, S2

Transformers at connection points:

Saturation curve Diagram R

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ATTACHMENT 8 TRANSMISSION SYSTEM EQUIPMENT AND APPARATUS SETTING DATA

Description Category	Units	Data
Protection data for protection relevant to		
Connection point:		
Reach of all <i>protections</i> on <i>transmission lines</i> , or cables _____	ohms or % on 100 MVA base	S, D
Number of <i>protections</i> on each item	Text	S, D
Total fault clearing times for near and remote faults	ms	S, D, R1
Line reclosure sequence details _____	Text	S, D, R1
Tap change control data:		
Time delay settings of all <i>transformer tap changers</i> .	Seconds	D, R1
Reactive compensation (including filter banks):		
Location and rating of individual <i>shunt reactors</i>	Mvar	D, R1
Location and rating of individual <i>shunt capacitor banks</i>	Mvar	D, R1
<i>Capacitor bank</i> capacitance _____	microfarads	D
Inductance of switching <i>reactor</i> (if fitted) _____	millihenries	D
Resistance of capacitor plus <i>reactor</i>	Ohms	D
Details of special controls (e.g. Point-on-wave switching)	Text	D
For each <i>shunt reactor</i> or <i>capacitor bank</i> (including filter banks):		
Method of switching _____	Text	S
Details of automatic control logic such that operating characteristics can be determined _____	Text	D, R1

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Description Category	Units	Data
FACTS Installation:		
Data sufficient to enable static and dynamic performance of the installation to be modelled	Text, diagrams control settings	S, D, R1
Under frequency load shedding scheme:		
Relay settings (<i>frequency and time</i>)	Hz, seconds	S, D
Islanding scheme:		
Triggering signal (e.g. <i>voltage, frequency</i>)	Text	S, D
Relay settings	Control settings	S, D

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ATTACHMENT 9 LOAD CHARACTERISTICS AT CONNECTION POINT

Description Category	Units	Data
For all Types of Load		
Type of <i>Load</i> e.g. controlled rectifiers or large motor drives	Text	S
Rated capacity	MW, MVA	S
<i>Voltage</i> level	kV	S
Rated current	A	S
<i>Power factor</i> range during normal operation	Text/diagram	S
DC injection levels (for each phase)	A	S
For Fluctuating Loads		
Cyclic variation of <i>active power</i> over period	Graph MW/time	S
Cyclic variation of <i>reactive power</i> over period	Graph <u>Mvar</u> /time	S
Maximum rate of change of <i>active power</i>	MW/s	S
Maximum rate of change of <i>reactive power</i>	<u>Mvar</u> /s	S
Shortest Repetitive time interval between fluctuations in <i>active power</i> and <i>reactive power</i> reviewed annually	s	S
Largest step change in <i>active power</i>	MW	S
Largest step change in <i>reactive power</i>	<u>Mvar</u>	S
For commutating power electronic load:		
No. of pulses	Text	S
Maximum <i>voltage</i> notch	%	S
Harmonic current distortion (up to the 50th harmonic)	A or %	S

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For inverter connected large loads

minimum short circuit ratio (MSCR)

The lowest short circuit ratio at the connection point for which the load, including its control systems: (i) will be commissioned to maintain stable operation; and (ii) has the design capability to maintain stable operation.

numeric ratio

S, D, R1

For the purposes of the above, "short circuit ratio" is the synchronous three phase fault level (expressed in MVA) at the connection point divided by the rated consumption of the load (expressed in MW or MVA) at the Network Service Provider's discretion.

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DISTRIBUTION SYSTEM CONNECTED GENERATORS UP TO 10 MW (EXCEPT INVERTOR-CONNECTED GENERATORS UP TO 30 KVA)¶

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ATTACHMENT 10 SMALL GENERATING SYSTEM DESIGN AND SETTING DATA (RATED CAPACITY ≤ 5 MVA EXCLUDING INVERTER ENERGY SYSTEMS CONNECTED TO THE LOW VOLTAGE DISTRIBUTION SYSTEM VIA A STANDARD CONNECTION SERVICE)

Power Station	Data Category
Address	S, R1
Description of <i>power station</i> , for example, is it a green or brownfield site, is there a process steam or heat requirement, any other relevant information	S
Site-specific issues which may affect access to site or design, e.g. other construction onsite, mine site, environmental issues, soil conditions	S, D
Number of <i>generating units</i> and ratings (kW)	S, D, R1
Type: e.g. synchronous, induction	S, D, R1
Manufacturer:	D
Connected to the network via: e.g. <i>inverter, transformer, u/g cable</i> etc.	S
Prime mover types: e.g. reciprocating, turbine, hydraulic, photovoltaic, other	S
Manufacturer	D
Energy source: e.g. natural gas, landfill gas, distillate, wind, solar, other	S
Total <i>power station</i> total capacity (kW)	S, D, R1
<i>Power station</i> export capacity (kVA)	S, D, R1
Forecast annual <i>energy generation</i> (kWh)	S, D
Normal mode of operation as per clause 3.1(e) i.e. (a) continuous parallel operation (b) occasional parallel operation (c) short term test parallel operation (d) bumpless transfer, ((1) rapid (2) gradual)	S
Purpose: e.g. power sales, peak lopping, demand management, exercising, emergency back up	S

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Associated Facility Load	
Expected <i>peak load</i> at facility (kW)	S, D, R1
Forecast annual <i>energy</i> consumption (kWh)	S
Construction <i>supply</i> required?	S
Max construction power	S
Required connection date	S
Required full operation date	S
Expected life	S
Additional Information Required	
(1) proposed arrangement & site layout of the <i>power station</i> including prime movers, generating units , <i>transformers</i> , synchronising circuit breakers and lockable <i>disconnect</i> device. Each component should be identified so that the plan can be cross-referenced to the data provided.	S, D
(2) single line diagram & earthing configuration	S, D, R2
(3) details of generating unit or generating system maximum kVA output over 60 second interval	S, D, R2
(4) a typical 24 hour <i>load</i> power curve measured at 15 minute intervals or less	S, D, R2
(5) calculation of expected maximum symmetrical 3 phase fault current contribution	S, D,
(6) Data on power quality characteristics for <i>wind farms</i> (including flicker and harmonics) as specified in IEC 61400-21 . Similar data may also be required for other inverter connected generating systems such as solar farms.	S, D, R2
(7) where required by the Network Service Provider , aggregate data required for performing stability studies undertaken in accordance with clause 2.3.5.2 and 2.3.6 and results of preliminary studies (if available)	D

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Transformers¹		
Item	Unit	Data Category
Identifier ²		
Number of windings	Number	S
Rated MVA of each winding	MVA	S, D
Principal tap rated <i>voltages</i>	kV/kV	S
Positive sequence impedances (each wdg) ³	(a+jb)%	D, R1
Negative sequence impedances (each wdg) ³	(a+jb)%	D, R1
Zero sequence impedances (each wdg) ³	(a+jb)%	D, R1
Tapped winding	Text or diagram	S
Tap change range	kV-kV	D
Tap change step size	%	D
Number of taps	Number	D
Tap changer type, on/off <i>load</i>	On/Off	S
Tap change cycle time	S	D
Vector group	Text or diagram	S
Attachments required		
Earthing arrangement		S, D

Notes:

- 1: A separate data sheet is required for each *transformer*.
- 2: Where there is more than one *transformer*, the identifier should be the same as used on the single line diagram.
- 3: Base quantities must be clearly stated.

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Synchronous generating systems¹

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Item	Unit	Data Category
Identifier ²		
Make	Text	D
Model	Text	D
Rated kVA	kVA	S, D, R1
Nominal terminal <i>voltage</i>	kV	D
Number of pole-pairs	No	
Speed	rpm	
Rated kW (sent out)	kW (sent out)	S, D, R1
Minimum <i>load</i> (ML)	kW (sent out)	D, R1
Inertia constant (H) for <u>generating system</u> only	kW-sec/rated kVA	D, R1
Inertia constant (H) for all rotating masses <i>connected</i> to the <u>generating unit</u> shaft (for example, <u>turbine</u> , etc.). Include gearbox (if any)	kW-sec/rated kVA	D, R1
<i>Short circuit ratio</i>		D, R1
Neutral earthing impedance ³	(a+jb)%	D, R1
Sequence Impedances (saturated)		
Zero sequence impedance ³	(a+jb)%	D, R1
Negative sequence impedance ³	(a+jb)%	D, R1
Reactances (saturated)		
Direct axis transient reactance ³	%	D, R1
Direct axis sub-transient reactance ³	%	D, R1
Reactive capability (at machine terminals)		
Maximum lagging (overexcited) <i>reactive power</i> at rated kW	<u>kvar</u> export	S, D, R2
Maximum leading (underexcited) <i>reactive power</i> at rated kW	<u>kvar</u> import	S, D, R2

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Lagging reactive short time capability at rated kW, terminal voltage and speed	kvar for time	D, R1
Attachments		
Performance chart (Indicating effect of temperature and voltage)	Graphical data	S, D, R1

Notes:

- 1: A separate data sheet is required for each generating unit.
- 2: Where there is more than one generating unit, the identifier should be the same as used on the single line diagram.
- 3: Base quantities must be clearly stated

Induction <u>generating systems</u> ¹		
Item	Unit	Data Category
Identifier ²		
Make	Text	D
Model	Text	D
Rated kVA	kVA	S, D, R1
Rated kW (sent out)	kW (sent out)	S, D, R1
Reactive consumption at rated kW	kvar	S, D, R1
Nominal terminal voltage	kV	D
Synchronous speed	rpm	D
Rated speed	rpm	D, R1
Maximum speed	rpm	D, R1
Rated frequency	Hz	D
Single or (effectively) double cage machine	Text	D, R1
<u>Generating system</u> reactances (saturated)		
Transient reactance ²	%	D, R1
Subtransient reactance ²	%	D, R1
Control: network commutated or self commutated	Text	S, R1
Attachments		

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Curves showing torque, <i>power factor</i> , efficiency, stator current, kW output versus slip (+ and -).	Graphical Data	S, D, R1
Notes: 1: A separate data sheet is required for each generating unit . 2: Where there is more than one generating unit , the identifier should be the same as used on the single line diagram. 3: Base quantities must be clearly stated.		

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<u>Inverter-connected generating systems¹</u>		
Item	Unit	Data Category
Identifier ²		
Make	text	D
Model	text	D
Maximum kVA output over a 60 s interval	kVA	S, D, R1
Maximum fault current contribution	kA rms symmetrical	S, D, R1
Control modes (<i>voltage, power factor</i>)	text	S, D, R1
Attachments		
Reactive capability curve (indicating effect of temperature and voltage)	Graphical Data	S, D, R1
Long-term flicker factor for generating system³		S, D, R2
Long term flicker factor for wind farm³		S, D, R2
Harmonics current spectra ³		S, D, R2

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Notes:*		
1:	A separate data sheet is required for each generating unit .	
2:	Where there is more than one generating unit , the identifier should be the same as used on the single line diagram.	
3:	In accordance with IEC 61400-21.	

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Wind Turbine/Wind Farm		
Item	Unit	Data Category
Flicker factors in accordance with IEC61400-21	Text / Diagram	S, D, R2
Annual average wind speed	metre/sec	S
Harmonics current spectra	Text / Diagram	S, D, R2
Attachments		
A typical 24 hour power curve measured at 15-minute intervals or better if available		S, D, R2
Startup profile kW, kvar vs time for individual wind turbine		S, D, R2
Startup profile kW, kvar vs time for <i>wind farm</i> total		S, D, R2
kW, kvar vs time profiles for individual wind turbine under normal ramp up and ramp down conditions		S, D, R2
High wind shutdown profile kW, kvar vs time for individual wind turbine		S, D, R2
High wind shutdown profile kW, kvar vs time for <i>wind farm</i> total		S, D, R2
Low wind shutdown profile kW, kvar vs time for individual wind turbine		S, D, R2
Low wind shutdown profile kW, kvar vs time for <i>wind farm</i> total		S, D, R2
Power curve kW vs wind speed		S, D, R2
Spatial arrangement of <i>wind farm</i>		S, D, R1

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ATTACHMENT 11 TEST SCHEDULE FOR SPECIFIC PERFORMANCE VERIFICATION AND MODEL VALIDATION

A11.1 General

- (a) Recorders must be calibrated/checked prior to use.
- (b) Recorders must not interact with any equipment control functions.
- (c) One chart recorder must be used to provide on site monitoring and rapid evaluation of key quantities during tests even though a digital recorder may be used.

A11.2 Recorder Equipment

Signals shall be digitally recorded and processed and require:

- (a) an analogue to digital conversion with at least 12 bit accuracy at full scale;
- (b) a sampling rate of at least 3000 samples per second (i.e. 3kHz) for up to 10 seconds unless specified otherwise;
- (d) departure from linearity of no more than 0.1% in the slope of normalised output versus input. Normalised means value/full range value; and
- (e) DC offset errors not greater than 0.05% of full scale in the analogue circuitry.

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A11.3 Frequency response

- (a) A minimum bandwidth of DC - 10kHz is required (0dB at DC, -3dB at 10kHz). Suitable filtering is required to eliminate aliasing errors.
- (b) For relatively slow changing signals (such as main exciter quantities, transducers for MW output etc.) a recording device bandwidth of DC - 100Hz is required.
- (c) All test results required in rms values are to be derived at a minimum rate of 100 samples per second.

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A11.4 Signal Requirements and Conditioning

- (a) Suitable input signal level must be used and allowance must be made for excursions during transients.
- (b) Subtraction of an appropriate amount of floating DC from input signals such as stator *voltage* must be provided so that any perturbations are clearly observable on an on-site chart recorder.
- (c) Galvanic isolation and filtering of input signals must be provided whenever necessary.

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A11.5 Form of Test Results

These must consist of:

- (a) a brief log showing when tests were done (time, date, test alphanumeric identification);
- (b) chart recordings appropriately annotated;

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- (c) relevant schematics of equipment and the local transmission system configuration;
- (d) lists of data collected manually (e.g. meter readings);
- (e) data on Microsoft Excel spreadsheets;
- (f) SCADA type printouts showing the User’s *power system* configuration at the start of, end of, and any other appropriate time during the test sequence; and
- (g) other relevant data logger printouts (from other than the recorder equipment referred to in section [A11.2](#)).

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A11.6 Test Preparation and Presentation of Test Results

Information/Data Prior to Tests

- (a) A detailed schedule of tests agreed by the Network Service Provider. The schedule must list the tests, when each test is to occur and whose responsibility it will be to perform the test.
- (b) Schematics of equipment and subnetworks plus descriptive material necessary to draw up/agree upon a schedule of tests.
- (c) Most up to date relevant technical data and parameter settings of equipment as specified in [Attachment 4 to Attachment 9](#).

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Test Notification

- (a) A minimum of 15 business day prior notice of test commencement must be given to the Network Service Provider for the purpose of arranging witnessing of tests.
- (b) The *Network Service Provider's representative* must be consulted about proposed test schedules, be kept informed about the current state of the testing program, and give permission to proceed before each test is carried out.
- (c) Unless agreed otherwise, tests must be conducted consecutively.

Test Results

- (a) Test result data must be presented to the *Network Service Provider* within 10 *business days* of completion of each test or test series.
- (b) Where test results show that [generating unit or generating system](#) performance does not comply with the requirements of these *Rules* or the *access contract* or *connection agreement* [the Generator must](#) rectify [the](#) problem(s) and [the test must, unless otherwise be elected by the Network Service Provider, be repeated](#).

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A11.7 Quantities to be Measured

- (a) Wherever appropriate and applicable for the tests, the following quantities must be measured on the [generating unit or generating system](#) under test using either the same recorders or, where different recorders are used, time scales must be synchronised to within 1 msec:

[Synchronous generating unit and excitation control system](#)

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- 3 stator L-N terminal *voltages*
- 3 stator terminal currents
- *Active power MW*
- *Reactive power MVar*
- *Generating unit rotor field voltage*
- *Generating unit rotor field current*
- Main exciter field *voltage*
- Main exciter field current
- AVR reference *voltage*
- *Voltage* applied to AVR summing junction (step etc.)
- *Power system* stabiliser output
- DC signal input to AVR

Steam Turbine

- Shaft speed
- *Load* demand signal
- Valve positions for control and interceptor valves
- Turbine control set point

Gas turbine

- Shaft speed (engine)
- Shaft speed of turbine driving the *generating unit*
- Engine speed control output
- Free turbine speed control output
- *Generating unit*-compressor speed control output
- Ambient/turbine air inlet temperature
- Exhaust gas temperature control output
- Exhaust temperature
- Fuel flow
- Turbine control / *load* reference set point

Hydro

- Shaft speed
- Gate position
- * Turbine control /*load* reference set point

- (b) The *Network Service Provider* must specify test quantities for power equipment other than those listed above, such as those consisting of wind, solar and fuel cell *generating units* which may also involve AC/DC/AC power conversion or DC/AC power *inverters*.
- (c) Additional test quantities may be required and advised by the *Network Service Provider* if other special tests are necessary.
- (d) Key quantities such as stator terminal *voltages*, currents, *active power* and *reactive power* of other *generating units* on the same site and also *interconnection* lines with the *transmission or distribution system* (from control room readings) before and after each test must also be provided.

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SCHEDULE OF TESTS

Table A11.1 - Schedule of tests

Test No	TEST DESCRIPTION		
	General Description	Changes Applied	Test Conditions
C1	Step change to AVR <i>voltage</i> reference with the <i>generating unit</i> on open circuit.	(a) +2.5 % (b) -2.5 % (c) +5.0 % (d) -5.0 %	<ul style="list-style-type: none"> nominal stator terminal volts
C2A	Step change to AVR <i>voltage</i> reference with the <i>generating unit connected</i> to the system. (with the <i>power system stabiliser</i> out of service) Generating unit output levels: (i) 50% rated MW, and (ii) 100% rated MW	(a) +1.0 % (b) -1.0 % (c) +2.5 % (d) -2.5 % (e) +5.0 % (f) -5.0 % repeat (e) & (f) twice see note (1) below	<ul style="list-style-type: none"> nominal stator terminal volts unity or lagging <i>power factor</i> system base <i>load</i> OR typical conditions at the local equipment and typical electrical connection to the <i>transmission or distribution system</i> tests for (i) must precede tests for (ii) smaller step changes must precede larger step changes
C2B	As for C2A but with the PSS in service	Same as in C2A	Same as in C2A
C3A	Step change to AVR <i>voltage</i> reference with the <i>generating unit connected</i> to the system. (With PSS out of service) System Conditions : (i) system minimum <i>load</i> with no other <i>generation</i> on the same bus OR relatively weak connection to the <i>transmission or distribution system</i> , and (ii) system maximum <i>load</i> and maximum <i>generation</i> on same bus OR relatively strong connection to the <i>transmission or distribution system</i>	(a) +5 % (b) -5 % repeat (a) & (b) twice; see note (5) below	<ul style="list-style-type: none"> nominal stator terminal volts unity or lagging <i>power factor</i> <i>Generating unit</i> output at 100% rated MW

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TEST DESCRIPTION			
Test No	General Description	Changes Applied	Test Conditions
C3B	As for C3A but with the PSS in service	Same as in C3A	As for C3A.
C4	Step change of MVA on the <i>transmission or distribution system</i> PSS Status : (i) PSS in service, and (ii) PSS out of service	Switching in and out of <i>transmission or distribution lines</i> (nominated by the <i>Network Service Provider</i>)	<ul style="list-style-type: none"> nominal stator terminal volts unity or lagging <i>power factor</i> system base <i>load</i> OR typical conditions at the local equipment and typical electrical connection to the <i>transmission or distribution system</i> <i>generating unit</i> output at 50% rated MW
C5	<i>load rejection (active power)</i>	(a) 25% rated MW (b) 50% rated MW (c) 100% rated MW see notes below	<ul style="list-style-type: none"> nominal stator terminal volts unity <i>power factor</i> smaller amount must precede larger amount of <i>load rejection</i>
C6	steady state over-excitation limiter (OEL) operation	<i>Mvar</i> outputs at OEL setting slow raising of excitation to just bring OEL into operation see notes below	<ul style="list-style-type: none"> 100% MW output 75% MW output 50% MW output 25% MW output min. MW output
C7	steady state under-excitation limiter (UEL) operation	<i>Mvar</i> outputs at UEL setting slow lowering of excitation to just bring UEL into operation see notes below	<ul style="list-style-type: none"> 100% MW output 75% MW output 50% MW output 25% MW output min. MW output
C8	Manual variation of <i>generating unit</i> open circuit voltage	Stator terminal volt (Ut) (a) increase from 0.5 pu to 1.1 pu (b) decrease from 1.1 pu to 0.5 pu see notes below	<ul style="list-style-type: none"> in 0.1 pu step for Ut between 0.5-0.9 pu in 0.05 pu step for Ut between 0.9-1.1 pu

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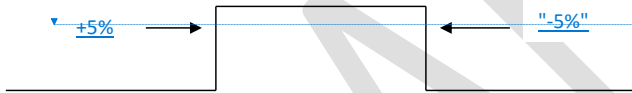
TEST DESCRIPTION			
Test No	General Description	Changes Applied	Test Conditions
C9	<p><u>Mvar</u> capability at full MW output.</p> <p>System maximum <i>load</i> and maximum <i>generation</i>. Test conducted with as high an ambient temperature as possible.</p>	<p><i>Generating unit</i> MW and <u>Mvar</u> output levels set to 100% of rated values and maintained for one hour.</p>	<ul style="list-style-type: none"> System maximum <i>load</i> and <i>generation</i> Ambient temperature as high as possible

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Notes:

- For tests C2A and C2B care must be taken not to excite large or prolonged oscillations in MW etc. Therefore, smaller step changes must always precede larger step changes to avoid such oscillations.
- Figure A11.1 below shows the step changes referred to in the schedule of tests given above. An example is given of a +5% step to the summing junction and then a -5% step. Removal of the +5% ("-5%") step is deemed to be a 5% step.

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Fig A11.1 - Application of step signal

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Unless specified otherwise the "-5%" step method shown in Figure A11.1 is used.

- For test C5, the instantaneous overspeed *protection* must be set at an agreed level depending on generating unit capability
- "system" means "*power system*"
- OR a lower step change, with a larger safety margin, as agreed by the *Network Service Provider*
- Tests C1, C6, C7 and C8 need not be witnessed by the *Network Service Provider*

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SPECIAL SYSTEM TESTS THAT MAY BE REQUESTED

Table A11.2 – Schedule of special system tests

TEST DESCRIPTION			
Test No	General Description	Changes Applied	Test Conditions
S1	Load rejection (<i>reactive power</i>).	(a) -30 % rated MVAR (b) +25 % rated MVAR see notes below	nominal stator terminal volts 0 or minimum MW output
S2	Load rejection (<i>reactive power</i>).	(a) -30 % rated MVAR see notes below	nominal stator terminal volts Excitation on Manual Control
S3	Step change of MVAR on the <i>transmission system</i> .	Switching in and out of (a) a <i>transformer</i> (b) a <i>reactor</i> (c) a capacitor	parallel <i>transformers</i> on staggered taps other as determined by the <i>Network Service Provider</i>
S4	Islanding of a subsystem consisting of <i>User's</i> <i>generating units</i> plus load with export of power by means of a link to the <i>Network Service Provider's</i> main <i>transmission system</i> .	opening of the link	5-10% of <i>generated</i> MW exported by means of the link 90-95% of <i>generated</i> MW used by the subsystem's <i>load</i>
S5	AVR/OEL changeover	<i>transformer</i> tap change OR small step to AVR <i>voltage</i> reference	initially under AVR control at lagging <i>power factor</i> but close to OEL limit
S6	AVR/UEL changeover	<i>transformer</i> tap change OR small step to AVR <i>voltage</i> reference	initially under AVR control at leading <i>power factor</i> but close to UEL limit
S7	Testing of a FACTS device (SVC, TCR, STATCOM, etc.)	step change to reference value in the summing junction of a control element line switching others as appropriate	MVA initial conditions in lines as determined by the <i>Network Service Provider</i>

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S8	Tripping of an adjacent <i>generating unit</i>	tripping of <i>generating unit(s)</i>	initial <i>generating unit</i> loading as agreed
S9	Variable <i>frequency</i> injection into the AVR summing junction (with PSS out of service)	0.01-100 rad/sec see notes below	as determined by the <i>Network Service Provider</i>
S10	Step change to governor/ <i>load</i> reference	2.5 % step increase in MW demand signal 2.5 % decrease in MW demand signal equivalent of 0.05Hz subtracted from the governor speed ref. equivalent of 0.1 Hz added to governor speed reference see notes below	equipment output at 50-85% of rated MW others as agreed with the <i>Network Service Provider</i>
S11	Overspeed capability to stay in the range of 52.0 to 52.5Hz for a minimum of 6 seconds	Digital governor: use software, where practical, to put a step in the speed reference of the turbine governor such that the target speed is 52.0Hz and the overshoot in speed remains above 52Hz and in the range 52-52.5Hz for about 6 sec Use a manual control to raise speed from 50Hz so as to stay in the 52 to 52.5 Hz range for a minimum of 6 sec Where it is practical, use a function <i>generating unit</i> to inject an analogue signal in the appropriate summing junction, so that the turbine stays in the 52-52.5 Hz range for a minimum of 6 sec.	Unsynchronised unit at rated speed and no <i>load</i>
S12	Underspeed capability	To be proposed by the manufacturer	
S13	Any other test to demonstrate compliance with a declared or registered equipment performance characteristic.	To be advised	

Notes:

- For tests S1(a) and S2 the *var* absorption must be limited so that field *voltage* does not go below 50% of its value at rated *voltage* and at no *load* (i.e. rated stator terminal *voltage* with the *generating unit* on open circuit).
- For test S1(b) the *var load* must not allow stator terminal *voltage* to exceed 8% overvoltage (i.e. 108% of rated value) as a result of the applied change.
- For test S1 and S2, the instantaneous overvoltage *protection* must be operative and set at an agreed level greater than or equal to 10% overvoltage.

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4. For test S2, it may be easier to use AVR control first and then change to manual (provided the change is "bumpless") before the unit trips.
5. For test S9, care has to be taken not to excite electromechanical resonances (e.g. poorly damped MW swings) if the machine is on line.
6. For the [test S10](#) equipment characteristics may require the changes be varied from the nominal values given. Larger changes may be considered in order to more accurately determine equipment performance.

For test S5 a positive step is applied of X% from the sub-OEL value. But for test S6 a -Y% step from the sub-UEL value as shown in Figure A11.2 is required.

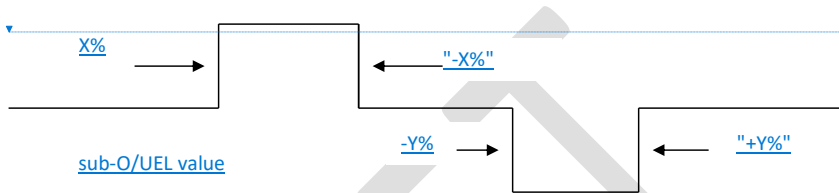


Figure A11.2 - Application of Step Signal

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ATTACHMENT 12 TESTING AND COMMISSIONING OF SMALL POWER STATIONS CONNECTED TO THE DISTRIBUTION SYSTEM

A12.1 Application

This attachment lists the specific requirements for the certification, testing and commissioning of generating systems, connecting to the distribution system in accordance with clauses 3.6 and 3.7 and for which the provisions of clause 4.2 apply.

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A12.2 Certification

The Generator must provide certification by a chartered professional engineer with National Engineering Register standing in relevant areas of expertise that the facilities comply with the Rules, the relevant connection agreement, good electricity industry practice and relevant standards. The certification must confirm that the following have been verified:

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1. The single line diagram submitted to the Network Services Provider has been checked and accurately reflects the installed electrical system;
2. All required switches present and operate correctly as per the single line diagram;
3. The specified generation facility is the only source of power that can be operated in parallel with the distribution system;
4. The earthing systems comply with Australian Standards AS/NZS 3000 and AS/NZS 2067 and do not rely upon the Network Service Provider's earthing system;
5. Electrical equipment is adequately rated to withstand specified network fault levels;
6. All protection apparatus (that serves a network protection function, including back-up function) complies with IEC 60255 and has been correctly installed and tested. Interlocking systems specified in the connection agreement have been correctly installed and tested;
7. The islanding protection operates correctly and disconnects the small power station from the network within 2 seconds;
8. Synchronizing and auto-changeover equipment has been correctly installed and tested;
9. The delay in reconnection following restoration of normal supply is greater than 1 minute;
10. The protection settings specified in the connection agreement have been approved by the Network Service Provider and are such that satisfactory coordination is achieved with the Network Service Provider's protection systems;
11. Provision has been made to minimise the risk of injury to personnel or damage to equipment that may be caused by an out-of-synchronism fault;
12. Control systems have been implemented to maintain voltage, active power flow and reactive power flow requirements for the connection point as specified in the connection agreement;
13. Systems or procedures are in place such that the testing, commissioning, operation and maintenance requirements specified in the Rules, and the connection agreement are adhered to; and
14. Operational settings as specified.

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A12.3 Pre-commissioning

Commissioning may occur only after the installation of the metering equipment.

A12.4 Commissioning Procedures

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The commissioning of a *generating unit* shall include the checks and tests specified in clauses A12.5 to A12.14.

A.12.5 Operating procedures

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- The single line diagram shall be checked to confirm that it accurately reflects the installed plant;
- The documented operating procedures agreed with the *Network Service Provider* and have been implemented as agreed;
- Naming, numbering and labelling of plant agreed with the *Network Service Provider* has been followed; and
- Operating personnel are familiar with the agreed operating procedures and all requirements to preserve the integrity of the *protection* settings and interlocks and the procedures for subsequent changes to settings.

A12.6 Protection systems

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- *Protection apparatus* has been manufactured and installed to required standards;
- The settings and functioning of *protection systems* required for the safety and integrity of the *distribution system* operate correctly (at various power levels) and coordinate with the *Network Service Provider's protection systems*. This will include the correct operation of the *protection systems* specified in the *connection agreement* and, in particular:
 - islanding *protection* and coordination with automatic reclosers export/import limiting *protection*;
 - automatic changeover schemes; and
 - fail-safe *generating unit or generating system* shutdown for auxiliary *supply* failure or loss of *distribution system supply*; and,
- Any required security measures for *protection* settings are in place.

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A12.7 Switchgear installations

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- Switchgear, instrument *transformers* and cabling have been manufactured, installed and tested to required standards.

A12.8 Transformers

- *Transformer(s)* has been installed and tested to required standards; and
- *Transformer* parameters (nameplate inspection) are as specified and there is correct functioning of on-load tap changing (when supplied).

A12.9 Earthing

- The earthing connections and the design value(s) of earthing electrode impedance are delivered; and
- The earthing systems comply with *AS/NZS 3000* and *AS/NZS 2067* and do not rely upon the *Network Service Provider's* earthing system

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A12.10 Generating units

A12.10.1 Unsynchronised/ disconnected

- *Generating unit* parameters are as specified (nameplate inspection);
- *Generating units* have been manufactured to meet the requirements of the *Rules* for riding through *power system* disturbances;
- Earthing arrangements of the *generating unit* are as specified;
- Correct functioning of automatic *voltage* regulator for step changes in error signals (when specified);
- Achievement of required automatic *voltage* regulator response time (when specified); and
- Correct functioning of automatic synchronizing equipment prior to *synchronisation*.

A12.10.2 Voltage changes

- *Voltage* transients at the *connection point* on connection are within specified limits; and
- Step changes in *voltage* on connection and disconnection (both before and after tap-changing) are within required limits.

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A12.10.3 Synchronous generating units

- The *generating unit* is capable of specified sustained output of active power (when required);
- The *generating unit* is capable of required sustained *generation* and absorption of *reactive power*, (when required);
- Correct operation of over- and under-excitation limiters (when required); and
- Response time in constant *power factor* mode is within limits (when required).

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A12.10.4 Asynchronous generating units

- Starting inrush current is within specified limits;
- *Power factor* during starting and normal operation is within specified limits; and
- Rating and correct operation of *reactive power* compensation equipment.

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A12.10.5 Inverter connected (non-AS/NZS 4777.2 certified) generating units

- *Power factor* during starting and normal operation is within specified limits; and
- Rating and correct operation of *reactive power* compensation equipment.

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A12.10.6 Harmonics and flicker

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- Network flicker and harmonics levels before and after connection and confirmation that limits have not been exceeded (not required for directly *connected* rotating machines).

A12.10.7 Additional requirement for wind farms

- The level of variation in the output of a wind *generating unit* or *wind farm* is within the limits specified in the *connection agreement*.

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A12.11 Interlocks and intertripping

- Correct operation of interlocks, check synchronizing, remote control, permissive interlocking and intertripping.

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A12.12 Voice and data communications

- Correct operation of primary and back up voice and data communications systems

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A12.13 Signage and labelling

- Signage and labelling comply with that specified in the relevant *connection agreement*.

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A12.14 Additional installation specific tests

- The *Network Service Provider* may specify additional installation specific tests and inspections in respect of the physical and functional parameters that are relevant for parallel operation of the small *power station* and coordination with the *distribution and transmission system*.

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A12.15 Routine testing

- The *Generator* must test *generating unit protection systems*, including back-up functions, at regular intervals not exceeding 3 years for unmanned sites and 4 years for manned sites and keep records of such tests.
- Where in-built *inverter protection systems* compliant with the AS/NZS 4777.2 requirements are permitted in small power stations with an aggregate rating of more than 30kVA but less than 100kVA, these *protection systems* must be tested for correct functioning at regular intervals not exceeding 5 years. The *User* must arrange for a suitably qualified person to conduct and certify the tests and *supply* the results to the *Network Service Provider*.

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A12.16 Non-routine testing

The *Network Service Provider* may inspect and test the small *power station* to re-confirm its correct operation and continued compliance with the *Rules*, *connection agreement*, good electricity industry practice and relevant standards. In the event that the *Network Service Provider* considers that the installation poses a threat to safety, to *quality of supply* or to the integrity of the *distribution and transmission system* it may *disconnect* the *generating equipment*.

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ATTACHMENT 13 GUIDANCE ON ECONOMIC JUSTIFICATION

This Attachment is intended to provide guidance on the economic considerations and justification needed for the investment in *transmission* infrastructure when designed to a higher or lower standard than outlined in the *transmission system planning criteria* in section 2.5 of these Rules.

This guidance is not intended to replace or override requirements in the *Access Code* or other higher order regulatory instruments, such as the *Act* or the *WEM Rules*.

When determining the costs and benefits of any proposed deviation from the applicable *transmission system planning criteria*, the *Network Services Provider* should consider, where applicable:

- Calculating the capital, operating and whole-life costs of a design that is compliant with these Rules to act as a benchmark for comparison against the alternative design.
- Valuing the potential *reliability* impacts of the alternative design. This is expected to include consideration of effects on:
 - the *Network Service Provider's* performance metrics (for example, system minutes lost, customer interruptions), and
 - other metrics for valuing effects for *Users* (for example, using value of customer reliability).
- Valuing the potential impacts of the alternative design on operational activities and *outage* management plans. Considerations could include, but are not limited to, effects on:
 - incremental network losses.
 - *Essential System Services (ESS)* (for example, where the alternative design affects the market cost of *generation* or *load rejection*).
 - *reactive power* requirements, including *generation* loading, if applicable.
 - the *WEM* including system *constraint* management, and potential *re-dispatch* of *generation* to alleviate system *constraints* if contingencies occur.
 - operational risk mitigation (for example, the use of temporary *generation* to maintain operational capabilities).
 - deliverability of the works program.
- Performing whole-life and net present value costing calculations for the alternative design taking account of:
 - capital and operating costs of the alternative design, or if the alternative design is to defer or negate investment, calculating the expected additional operational costs associated with the existing infrastructure.
 - *power system* operational costs (for example, the effects of network losses, *ESS*, *reactive power* requirements, the *WEM* and operational risk mitigation).
 - costs of any *constraint* management or *re-dispatch* of *generation*.
 - typical annual system loading.

Notes:

Typical annual system loading may be considered using system *load* duration curves to develop equivalent annualised values for the above cost values.

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- sensitivities of the above, where applicable, to evaluate how the identified costs may change through credible ranges of values.
- cost of undertaking outages between alternative designs.
- Documenting other factors that may be affected by the alternative design, such as:
 - impacts on other *generation* or any connection queue.
 - precedent for future connection designs, and
 - any other benefits the alternative design may provide.

Notes:

For some of these aspects it may be necessary to evaluate the impacts using a qualitative evaluation scale as calculating quantitative values for direct financial impacts may not be possible.

When determining whether to proceed with any proposed deviation from the applicable *transmission system planning criteria*, the *Network Services Provider* should:

- Undertake a multiple criteria evaluation that considers whether the whole-life cost for the alternative design is comparable to the benchmark compliant design option, or whether it is significantly higher or lower (based on the guidance above).
- If the quantitative analysis indicates there is a significant and identifiable cost saving through the alternative design, then reference should be made to supporting qualitative evaluation to identify if any of these are considered sufficiently critical to outweigh the potential cost savings.
- If the quantitative analysis indicates the alternative design is broadly comparable with the compliant design or the costs are higher, then unless the qualitative evaluation suggests there are significant non-quantified benefits that can be obtained, then the compliant design should be progressed.

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RECORD OF AMENDMENTS AND REVISIONS

Request date	Date Rules effective	Clauses(s)	Summary of change
November 2015	1 August 2016	3.2.1 (c) (3) DC injection	Remove clause
		AS 4777:2005 date amendments in various places	Remove AS 4777(2005) date in various places. Update reference to AS/NZS 4777 series as applicable .
		Attachment 1, Glossary	Clarification of definitions: <ul style="list-style-type: none"> ▪ <i>Connection point</i> ▪ <i>Connection assets</i> ▪ <i>Point of common coupling</i>
		Various	Typographical corrections
March 2016	1 December 2016	Attachment 1, Glossary 2.3.7.1 (c) <i>power transfer conditions</i>	Redefine <i>credible contingency</i> events Add new cl. with reporting requirement
		2.5.2.2 (b) N-1 criterion	Clarify <i>User</i> agreed access connections
		Attachment 1, Glossary 2.9.4 Maximum fault clearance times	Include a capacity for <i>Network Service Provider</i> to accommodate <i>protection weak infeed</i> assessments
April 2016	1 December 2016	2.5.4 (b) Normal cyclic rating (NCR) criterion	Amend criterion definition and application
		2.5.8 (c) 2.7 3.4.6 (a)	Electricity (Supply Standards and System Safety) Regulations 2001 replaced by Electricity (Network Safety) Regulations 2015
	1 December 2016 Revision 2	4.2.1 (b) Section 5	Typographical corrections 22 November 2016
	1 December 2016 Revision 3	Figure 3.3, p. 43. 3.6.1 3.5.2(d) Various sections/clauses	Typographical corrections, image, omissions and reformatting 17 January 2017