Submission to the Economic Regulation Authority for amendments to the Technical Rules

November 2015 – Part A

Version Control

Version	Date	Description	Responsibility
12A	06/11/15	Layout and consistency edits	AR/LO

Revision/addendum

Version	Date	Description	Responsibility

Table of Contents

Glossary of terms

Acronym / term	Meaning
AC	Alternating Current
AQP	Applications and Queuing Policy
Authority	Economic Regulation Authority
CAG	Competing Applications Group
Access Code	Electricity Networks Access Code 2004[1]
CEC	Clean Energy Council
CP	Connection point
DC	Direct Current
DSOC	Declared Send Out Capacity
ETAC	Electricity Transfer Access Contract
kVA	kilo Volt Amperes (Apparent power)
LV	Low Voltage
MVA	Mega Volts Amperes (Apparent power)
MW	Mega Watts (Real power)
NSP	Network Service Provider
PPG	Private Parallel Generator
PUO	Public Utilities Office (formerly Office of Energy)
PV	Photo Voltaic
RIS	Required in Service (date)
SWIN	South West Interconnected Network
Technical Rules	Technical Rules, 23 December 2011[2].
User	Has meaning as defined in the Technical Rules section 1.3(b)(3)
WAER	Western Australian Electrical Requirements
WADCM	Western Australian Distribution Connection Manual
WPN	Western Power Network

[1] See https://www.erawa.com.au/about-us/legislation Electricity Networks Access Code 2004
[2] See https://www.erawa.com.au/cproot/10353/2/20120504%20Western%20Power%20Technical%20Rules.pdf

1 Executive Summary

This submission requests that the Economic Regulation Authority (**Authority**) consider and approve the various Technical Rules amendments proposed in section 3 and 4 of this document. These changes are requested pursuant to clause 12.50(c) of the *Electricity Networks Access Code 2004* (**Access Code**).

Western Power is aware of some challenges facing the current Technical Rules. The most pressing topics relate to the Technical Rules' ability to accommodate new technologies, in particular, embedded generation connecting to the distribution network. This submission (Part A) is the first of two sets of amendments proposed by Western Power, with the Part B submission to follow.

The proposed amendments are supported by assessments which have been carried out to ensure that their implementation will result in material benefits and do not create an adverse impact on the Users or the network.

Table 1 below provides a summary of the content of this submission.

Table 1: Summary of Part A proposed amendments

Ref.	Rules area	Summary of proposed amendment
A1	Direct Current (**DC**) injection	Change limit from zero to 0.5% of connection point rating (per phase)
A2	AS 4777 date references	Remove reference to the 2005 version of AS 4777
A3	Connection point related definitions	Add clarity and consistency in the use of the terms *connection point* and *connection assets.* Define the term *point of common coupling*.
A4	2011 Technical Rules amendments – comments from public submissions	Provide responses to the public comments on the 2011 Technical Rules review
A5	Corrections	Correction of typographical errors

2 Introduction

The Technical Rules operate in accordance with chapter 12 of the Access Code. Their purpose is to ensure that definitive technical requirements govern the planning, design and operation of the transmission and distribution networks. In addition, the Technical Rules set out the minimum standards for the facilities, both loads and generators, connected to the network, ensuring the safety of all network Users.

Western Power is proposing a number of amendments to ensure that the Technical Rules:

- apply in a way that is clear and reasonable
- do not impose unnecessary barriers to entry
- remain consistent with good electricity industry practice.

The amendments proposed in this document may have a flow on effect on multiple clauses within the Technical Rules and as such, each amendment is presented in a separate section, with changes and potential effects discussed in that section.

Section 3 of this document details a number of identified issues with the current version of the Technical Rules together with Western Power's proposed amendments. It also contains Western Power's responses to the Authority's request to further consider public submissions received too late to be considered as part of the 2011 review of the Technical Rules.

Section 4 recommends corrections to typographical errors identified in the current version of the Technical Rules.

2.1 Purpose

The purpose of this Part A amendment submission is to:

- address the clauses of the Technical Rules that are currently most challenged by new technology. In particular clauses relating to:
  - DC injection
  - clarifying the usage and definition of 'connection point', 'connection assets', and defining 'point of common coupling'
  - clarifying the capacity of the Technical Rules to adopt AS 4777 revisions.
- respond to the Authority's request to address matters raised in the public submissions during the final stages of the 2011 review of the Technical Rules.

2.2 Submission structure and context

The first set of amendments to the Technical Rules is found in this submission (Part A). A second set of amendments (Part B) will be submitted in early 2016.

Section 3 contains a series of tables with specific details for each of the proposed amendments, tabulated and structured to address the following:

- outline of the clause(s) of the Technical Rules affected by the proposed amendment
- description of the concern or issue with the existing version of the Technical Rules that the proposed amendment is addressing
- details of the proposed amendment with current wording of the Rule marked up with a ~~strikethrough~~ where words are deleted and an <u>underline</u> of any words being added
- description of the benefits of the proposed amendment (in alignment with the Access Code objectives)
- assessment of any identifiable risks associated with the proposed amendment
- results of the stakeholder engagement regarding the proposed amendment.

3 Proposed changes – Part A 2015

3.1 DC injection amendment (Ref. A1)

	Sec.	Section Title	Ref.	Comments
A1	3.2.1(c)(3)	Harmonics	The limit of zero *DC injection* is not effective or practical.	Reset the limit to constrain DC from low voltage (**LV**) connected apparatus.
Guidelines				
Clause(s) of the Technical Rules affected by the proposed amendment			3.2.1 Power System Performance Standards … (c) Harmonics "(3) A *User* must not inject into the *transmission or distribution system* any DC component of current produced by its own *equipment."* Also affected are the Glossary section of the Technical Rules as well as Attachments 9 and 12, all of which require some minor amendments to ensure consistency.	
Concern or issue with the existing version of the Technical Rules that the proposed amendment is addressing			Section 3 of the Technical Rules sets out the technical requirements of User facilities. These include standards for harmonics, flicker, and electromagnetic interference. Excessive levels of DC injection may result in negative consequences on the network including increased harmonic distortion, corrosion, and reduced efficiency in the operation of devices reliant on magnetic cores. This is the rationale behind the original requirement for DC injection to be zero. Many types of loads currently connected at LV inject various levels of DC into connection points on the distribution network. This situation was detected (and costly treatment required) when applicants were seeking to connect solar PV inverters at ratings greater than 30 kVA (inverters below 30 kVA could connect without restriction). Therefore, the rule is imposing an unreasonable measure on Users and the network and, if enforced, the DC injection zero limit may be viewed as a barrier to entry. The task of enforcing zero DC is challenging, as the DC levels can be very small (values in milliamps)	

compared to alternating current (**AC**) that they are superimposed onto – meaning that a measurement uncertainty of less than 4% is difficult to achieve[3]. Hence, it is proposed to limit measurement to a minimum value of 5 mA.

Western Power issued a temporary DC injection exemption in November 2014 to address these issues.

Additionally, zero DC injection can be seen as overly conservative when compared to current Australian and international standards for LV grid connected inverters. Excerpts from three such standards are listed in the table below:

Table 2: Standards with DC injection limits

Standard/Country	Standard Summary of DC injection
AS 4777.2:2015 (Australia)	Section 5.9 discusses inverters with acceptable DC output below 0.5% of the rated inverter current (phase-to-phase or phase-to-neutral) or 5mA, whichever is greater. Section E also outlines tests to verify this.
IEEE1547:2003 (USA)	Section 4.3 states, “The Distributed Resources (DR) and its interconnection system shall not inject dc current greater than 0.5% of the full rated output at the point of DR connection”.
IEC 61727:2004 (Europe)	Section 4.4 states, “The PV system shall not inject DC current greater than 1% of the rated inverter output current, into the utility AC interface under any operating conditions”.

[3] Martina Calais, (2010) et al., Transformerless PV inversters - Recent test results and a discussion of DC current injection and safey issues. *Solar2010, AuSES Annual conference*.

Details of proposed amendment to a particular Rule. For clarity, the current wording of the Rules with a ~~strikethrough~~ represents words that have been deleted. An underline represents words that have been added

Proposed Changes to clause 3.2.1:

3.2.1 Power System Performance Standards

(c) Harmonics

Clauses (c)(1) and (c)(2) to remain 'as is', with clause (c)(3) to be removed and a text box added in its place as indicated below.

(3) A User must not inject into the transmission or distribution system any DC component of current produced by its own equipment.

Excessive DC injection (see cl. 3.2.1(g)) may lead to adverse effects in AC networks, such as causing high levels of harmonics and distortion effects in network assets which use magnetic cores, and corrosion of metallic assets in some circumstances.

Insert new clauses (g)(1) and (g)(2) and a textbox as follows:

(g) DC injection

(1) A User connecting at high voltage to the distribution system, or connecting to the transmission system, must not inject into the transmission or distribution system any DC component of current produced by its own equipment.

(2) A User connecting at low voltage must not inject into the distribution system any DC component of current produced by its own equipment that exceeds either 5 mA, or the maximum value calculated from 0.5% of the rated service capacity, per phase, of the connection point.

Proposed additions to the Glossary:

DC injection	A phenomenon where direct current (DC) is superimposed over the alternating current (AC) power system at a network connection point.

Proposed additions to Attachment 9:

ATTACHMENT 9 - LOAD CHARACTERISTICS AT CONNECTION POINT

Data Description	Units Data	Category
For all Types of Load		
Insert DC injection record after the 'Power factor' entry in the first section:		
Power factor range during normal operation	Text/diagram	S
DC injection levels		
(each phase and neutral, 4 values)	A	S

Proposed additions to Attachment 12:

ATTACHMENT 12 - TESTING AND COMMISSIONING OF SMALL POWER STATIONS CONNECTED TO THE DISTRIBUTION SYSTEM

A12.2 Certification

The Generator must provide certification by a chartered professional engineer with National Professional Engineers' Register Standing in relevant areas of expertise that the facilities comply with the Rules, the relevant connection agreement, good engineering practice and relevant standards. The certification must confirm that the following have been verified:

13. Systems or procedures are in place such that the testing, commissioning, operation and maintenance requirements specified in the Rules, this Attachment 12 and the connection agreement are adhered to; and

14. Operational settings as specified.; and

<table>
<tr><td></td><td><u>15. Allowable DC injection levels are not exceeded at the connection point.</u></td></tr>
<tr><td>Benefits of the proposed amendment (in alignment with Access Code objectives)</td><td>Historically, due to the majority of connections being load connections (rather than generators), this rule did not create a problem. However, with proliferation of the photo voltaic (PV) systems, some customers now face expensive additional works and modifications in order to be Technical Rules compliant and obtain approval for their connections. The issue has become unsustainable, as no other utility in Australia or New Zealand has a similar zero requirement.

While recognising that excessive DC level has the potential to cause significant problems in AC networks, adopting the proposed limit will accommodate ‘practicable’ levels of DC injection at low voltage.</td></tr>
<tr><td>Identifiable risks associated with the proposed amendment</td><td>Western Power anticipates that there may be some additional cost for installers to measure DC levels but these costs are not expected to increase materially.</td></tr>
<tr><td>Stakeholder engagement in support of the proposed amendment</td><td>The details of the proposed amendment have been communicated to and discussed with the Solar PV industry group.

Further, in early 2015, Western Power engaged an external consultant to research and provide recommendations with regards to DC injection in the Western Australian Technical Rules context. This independent study consisted of three parts:
• benchmarking of DC injection approaches by Australian and New Zealand utilities
• analysis of survey results, international literature, standards, and subject matter expert advice
• recommendation of best practice position.

Western Power’s DC injection amendments are aligned with the independent consultant’s recommendations summarized below.

<table>
<tr><th colspan="2">Revise allowable DC limits for differing connection types and sizes.</th></tr>
<tr><td>LV connected generators and loads:</td><td>Revise limit of allowable DC injection to that of AS4777 (namely a maximum of 5mA or 0.5% of the current capacity at</td></tr>
</table>
</td></tr>
</table>

		the connection point).
	HV connected generators and loads:	Maintain the Technical Rules requirement for zero DC current injection limit for HV connected systems.
	In addition, Western Power expects broad support for the proposed amendment due to the general industry and stakeholder endorsement of the temporary DC injection exemption. The proposed amendment seeks to incorporate this exemption into the Technical Rules thus addressing the issues outlined above.	

3.2 AS 4777 date amendments (Ref. A2)

Ref.	Sec.	Section Title	Issue	Comments
A2	3.7	Various	Remove references to the 2005 version of AS 4777	AS 4777 applicability under clause 3.7 of the Technical Rules would otherwise be restricted to only those inverters certified under AS 4777-2005.
Proposed changes				
Clause(s) of the Technical Rules affected by the proposed amendment			Clause 3.7 – Requirements for connection of *energy* systems to the *low voltage distribution system* via inverters Attachment 12 – Testing and commissioning of small power stations *connected* to the distribution system	
Concern or issue with the existing version of the Technical Rules that the proposed amendment is addressing			The changes are proposed to ensure that the Technical Rules reference the most current version of AS 4777 without the requirement to update them each time the standard is updated and/or amended. It is desirable that inverters comply with the most current, applicable Australian and/or New Zealand standard. Connection applications can then be further assessed for any additional requirements that	

	may be necessary by the *Network Service Provider* (**NSP**) because of specific conditions that apply for the proposed connection.
Details of proposed amendment to a particular Rule. For clarity, the current wording of the Rules with a ~~strikethrough~~ represents words that have been deleted. An <u>underline</u> represents words that have been added	**<u>Proposed changes in clause 3.7:</u>** 3.7.3 Relevant Standards (a) The installation of primary inverter *energy* systems must comply with the relevant *Australian Standards* and international standards. (b) <u>In order to be considered for *connection* to the grid under this clause 3.7 and other *Network Service Provider's* requirements</u>, inverter systems must <u>first</u> satisfy the requirements of *Australian Standard* 4777~~-2005~~ "Grid connection of *energy* systems via inverters" as published and revised <u>from time to time.</u> ~~The following parts of this standard apply:~~ ~~(1) *AS* 4777.1 – 2005 Part 1 Installation requirements.~~ ~~(2) *AS* 4777.2 – 2005 Part 2 Inverter requirements.~~ ~~(3) *AS* 4777.3 – 2005 Part 3 Grid *protection* requirements.~~ (c) The term 'inverter *energy* system' in these *Rules* has the same meaning as in *AS* 4777~~-2005~~. (d) A type-test report or type-test certificate from an independent and recognised certification body showing compliance of inverter plant with *AS* 4777~~.2-2005~~ must be supplied to the *Network Service Provider*. 3.7.7 Protection (b) A *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 4777~~-2005~~ and

	the connection agreement at all times. **Proposed changes in attachment 12:** A12.15 Routine Testing • Where in-built inverter *protection systems* compliant with the AS 4777 ~~2005~~ requirements are permitted in small power stations with an aggregate rating of more than 30 kVA but less than 100 kVA, 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 provide the certified results to the *Network Service Provider* upon request.
Benefits of the proposed amendment (in alignment with Access Code objectives)	The administrative task of routinely seeking an amendment to the Technical Rules for new versions of AS 4777, as these may be released from time to time, appears to be counter-productive. AS 4777 is a national standard, which is developed under the auspices of Standards Australia. As such, it is revised under a rigorous and thorough process. This set of amendments is recommended on the basis that the expected 2015 and subsequent updates to AS 4777 will be suitable for adoption against the Access Code and Technical Rules objectives on the WPN. Western Power's analysis of and input into subsequent updates to this standard may result in a future need to adjust some requirements, but under the present Standards Australia review and amendment processes, this risk is deemed low.
Assessment of any identifiable costs and risks associated with the proposed amendment	**Unacceptable changes made to AS 4777** A risk exists where changes might be made to AS 4777 that are not acceptable to Western Power. Although this is considered unlikely, in such circumstances, Western Power can apply clause 3.7.1(b) and not approve unacceptable proposed connections until any identified issues are resolved. **Protection costs on the distribution network** As the number of inverters deployed on Western Power's distribution networks rise, there is a likelihood that costs for distribution system based protection will increase. This issue is independent of the proposed change, which at an individual inverter level brings no direct

	increased costs.
Stakeholder engagement in support of the proposed amendment	Consultation with Technical Rules stakeholders, who are also involved in the periodic amendments to AS 4777, confirmed that the adoption of updates to the standard should be made automatically rather than require a separate update to the Technical Rules.

3.3 Clarifying definitions (Ref. A3)

3.3.1 'Connection point' definition

Ref.	Sec.	Section Title	Issue	Comments
A3a	Glossary	Various	Clarify the term 'connection point' as used in the Technical Rules.	The term *connection point* appears in multiple clauses throughout the Technical Rules. It can be used in the context of a physical point on the network, or as a contractual point. The current Technical Rules definition is "the agreed point of *supply* established between the *Network Service Provider* and a *User.* For reference, the Access Code defines connection point as "a point on a covered network identified in, or to be identified in, a contract for services as an *entry point* or *exit point*. Both these definitions are contractual in nature.
Proposed amendment				

<table>
<tr><td>Clause of the Technical Rules affected by the proposed change</td><td>Attachment 1 - Glossary</td></tr>
<tr><td>Concern or issue with the existing version of the Technical Rules that the proposed amendment is addressing</td><td>
The Technical Rules Glossary currently defines the connection point as: “the agreed point of supply established between the Network Service Provider and a User”.

Within the electrical industry the terms “connection point”, “point of attachment” and “point of supply” tend to be used interchangeably with respect to a physical point on the network. The point of attachment can be defined as “a point on the network at which network assets (owned by Western Power) are connected to assets owned by another person”. This is a physical point as distinct from the contractual term connection point.

Other documents referring to the “point of supply” as shown in Table 3.

Table 3 ‘point of supply’ usage in other documents
<table>
<tr><th>Document</th><th>Point of supply reference</th></tr>
<tr><td>Western Australian Electrical Requirements (WAER) January 2014.
WAER is issued by:
Director of Energy Safety
Department of Commerce
Government of Western Australia</td><td>Point of supply: The junction of the consumers mains with -
• conductors of the network operator’s distribution works (including the service cable) or transmission works; or
• output terminals of electricity generation works within the premises</td></tr>
<tr><td>AS/NZS 3000:2007

AS/NZS 3000 is issued by Standards Australia</td><td>1.4.75 Point of supply

The junction of the consumers mains with -
(a) conductors of an electricity distribution system; or
(b) output terminals of an electricity generating system within the premises.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td>WADCM 2015
WADCM is issued jointly by:
Western Power and Horizon Power</td><td>Point of supply usage is aligned with AS 3000:2007 clause 1.4.75 wording.</td></tr>
<tr><td>Details of proposed amendment to a particular Rule. For clarity, the current wording of the Rules with a ~~strikethrough~~ represents words that have been deleted. An <u>underline</u> represents words that have been added</td><td colspan="2">It is intended to amend the definition of connection point so as to accommodate both the contractual nature and the physical nature of the term.
<table><tr><td>connection point</td><td>For contractual purposes connection point is defined as “a point on the network identified in, or to be identified in, a contract for services as an entry point or exit point or a bi-directional point”. With reference to a physical location, connection point is defined as “a point on the network at which network assets (owned by Western Power) are connected to assets owned by another person”.</td></tr></table>For clarification the following definitions will be added to the Glossary.
<table><tr><td>bi-directional point</td><td>A single connection point at which electricity is transferred into and out of the network.</td></tr><tr><td>entry point</td><td>A single connection point at which electricity is more likely to be transferred into the network than out of the network.</td></tr><tr><td>exit point</td><td>A single connection point at which electricity is more likely to be transferred out of the network than into the network.</td></tr></table></td></tr>
<tr><td>Benefits of the proposed amendment (in alignment with Access Code objectives)</td><td colspan="2">The proposed definitions add clarity to the concept of a connection point.</td></tr>
<tr><td>Assessment of any identifiable costs and risks associated with the proposed amendment</td><td colspan="2">Western Power has not identified any risks associated with the proposed change. The definition of a connection point is for clarification only and does not change its substance in any way. The new definitions for bi-directional point, entry point and exit point are taken from the Access Code. They assist in understanding the connection point definition and are not used in the Technical Rules in any other section.</td></tr>
</table>

Stakeholder engagement in support of the proposed amendment	The update to the definition of a *connection point* has originated from engagements with the PUO officers – in particular, in relation to comments submitted by the PUO in 2011 and discussed in section 3.4 of this submission. Further, engagements with Users of the Technical Rules identified numerous cases where those Users were uncertain about where their connection is assessed for Technical Rules compliance, that is, what is their *connection point*.

3.3.2 'Connection assets' definition

Ref.	Sec.	Section Title	Issue	Comments
A3b	Glossary	Various	Clarify the term 'connection assets' as used in the Technical Rules.	The current definition of *connection assets* is confusing and is inconsistent with the definition in the Access Code. Therefore, the Technical Rules definition needs to be updated to provide clarity and ensure consistency with the Access Code.
Proposed amendment				
Clause of the Technical Rules affected by the proposed change			Attachment 1 - Glossary	

<table>
<tr>
<td>Concern or issue with the existing version of the Technical Rules that the proposed amendment is addressing</td>
<td>
The Technical Rules glossary currently defines connection asset as:

“the equipment that allows the transfer of electricity between the electricity transmission or distribution system and an electrical system that is not part of the transmission or distribution system.” This includes any transformers or switchgear at the point of interconnection (including those that operate at a nominal voltage of less than 66 kV) but does not include the lines and switchgear at the connection point that form part of the transmission or distribution system”.

The Access Code defines connection assets as:

“for a connection point, all of the network assets that are used only in order to provide covered services at the connection point”.

The significant point about the Access Code definition is that it includes all dedicated assets.

An important reason for defining connection assets is that it can facilitate contestable provision of those assets that are dedicated to a single customer. Whether the connection assets are ultimately owned by Western Power or the customer is a matter for commercial negotiation. Under the contributions policy, the customer fully funds the cost of connection assets thus removing any financial incentive for the customer to choose not to own the connection assets.

The Technical Rules definition provides no such clarity. The first sentence is consistent with connection assets being those dedicated to the customer; however the rest of the definition is not clear. For example, it excludes lines at a connection point - but by definition a connection point is a discrete point on the network.
</td>
</tr>
<tr>
<td>Details of proposed amendment to a particular Rule. For clarity, the current wording of the Rules with a ~~strikethrough~~ represents words that have been deleted. An <u>underline</u> represents words that have been</td>
<td>
It is important that there is consistency between the Technical Rule and the Access Code definitions for connection assets. Further, Western Power considers that there is no technical reason for that definition not to include all dedicated assets, be they lines, switchgear or transformers.

<table>
<tr><td>Connection assets</td><td>For a connection point, means all of the network assets that are used only in order to transfer electricity to or from the connection</td></tr>
</table>
</td>
</tr>
</table>

added	*point*.
Benefits of the proposed amendment (in alignment with Access Code objectives)	The proposed definition adds clarity to the concept of *connection assets*.
Assessment of any identifiable costs and risks associated with the proposed amendment	Western Power has not identified any risks relating to this change. The revised definition of *connection assets* is for clarification only and does not change its substance in any way. Further, it ensures consistency with the Access Code.
Stakeholder engagement in support of the proposed amendment	The *connection assets* definition amendment has come from recent Western Power engagements and assessments of Technical Rules exemptions related to large industrial loads. The need to better define the Technical Rules definition of *connection assets* is apparent and the proposed amendment aligns with the Access Code definition.

3.3.3 'Point of common coupling' definition

Ref.	Sec.	Section Title	Issue	Comments
A3c	Glossary	Various	Define the term *point of common coupling* as used in the Technical Rules.	Currently, there is no definition of a *point of common coupling* within the Technical Rules.
Proposed amendment				

Clause of the Technical Rules affected by the proposed change	The term *point of common coupling* is used in clause 2.3 Obligations of Network Service Provider in relation to power system performance: • clause 2.3.3(a) – flicker • clause 2.3.4(a) – harmonics
Concern or issue with the existing version of the Technical Rules that the proposed amendment is addressing	There is a general understanding within the electrical power industry with respect to the term *point of common coupling* but for the purposes of the Technical Rules, a general understanding is not sufficient - particularly when the customer is required to meet the power quality requirements defined in sections 2.3.3 and 2.3.4 at the *point of common coupling*. The term *point of common coupling* does not appear to be defined in a consistent or useful way in any particular documents. For example, in the IEEE standard 519, "Standard Practices and Requirements for Harmonic Control in Electrical Power Systems," it is defined as "the interface between sources and loads on an electrical system". This definition is quite useful in that it links the *point of common coupling* to the point at which a source (generator) of harmonic distortion or voltage flicker will impact upon a load. However, such a broad definition means that the *point of common coupling* is difficult to identify in every situation. The most common point at which a customer is required to meet harmonic distortion or voltage flicker standards is at the connection point. In the vast majority of cases these requirements are able to be met by customers at no or minimal additional expense. However, there are instances where the standards cannot be easily met at the connection point. Examples of such could include timber mills with large starting currents for their saw motors, and mines where the large motors and controllers can be significant sources of both harmonic distortion and voltage flicker. In these instances Western Power does consider whether moving the point of common coupling downstream from the connection point is an acceptable and economic approach to allow the standards to be met while not impacting upon the power quality of other Users.

<table>
<tr><td>Details of proposed amendment to a particular Rule. For clarity, the current wording of the Rules with a ~~strikethrough~~ represents words that have been deleted. An <u>underline</u> represents words that have been added</td><td>It is proposed to amend the Technical Rules glossary to include a definition of the point of common coupling.<table><tr><td>Point of common coupling</td><td>The point on the WPN at which Western Power requires compliance with the Technical Rules clauses 2.3.3(a) and 2.3.4(a). Under normal circumstances this compliance is required at the connection point but Western Power may, at its sole discretion allow the “point of common coupling” to be at a point on the network upstream[4] from the connection point, where it is reasonable to do so in accordance with good electricity industry practice.</td></tr></table></td></tr>
<tr><td>Benefits of the proposed amendment (in alignment with Access Code objectives)</td><td>The proposed definition adds clarity to the concept of the point of common coupling.</td></tr>
<tr><td>Assessment of any identifiable costs and risks associated with the proposed amendment</td><td>Western Power did not identify any risks to this change. Insertion of a definition of a point of common coupling reflects the common industry understanding of the term. It is consistent with the approach Western Power has historically applied to this term.</td></tr>
<tr><td>Stakeholder engagement in support of the proposed amendment</td><td>The point of common coupling definition amendment has come from recent Western Power engagements and assessments for Technical Rules exemptions related to large industrial loads. The exclusion of the definition for this term in the Technical Rules glossary may have been an oversight in previous versions of the Technical Rules.</td></tr>
</table>

[4] That is, further into the network, closer to *transmission network* elements and thus, further ‘upstream’ from the *User’s connection point*.

3.4 Comments on 2011 public submissions (Ref. A4)

This section addresses comments in the 2011 Technical Rules public submissions which were not able to be considered at that time for the 2011 update of the Technical Rules.

3.4.1 Introduction

The following issues were raised in the 2011 public submissions (extract included below): [5]

17. Several issues raised by interested parties had not previously been raised or considered. Further discussion and consultation is required to resolve these issues so they should be considered at the next Rules revision. A summary of these issues is set out in the table below.	
Contribution source and issue	*Comments made*
1a) The Office of Energy has concerns relating to the definition of "consumer", "generators" and "users".	*This is a new issue that should be held over to the next review. It should be noted that the definition of "User" in Rule 1.3(b)(3)(B) was intended to require that the Rules apply to any person with control of the generation or load at a connection point, irrespective of whether or not that person had signed an access or connection contract directly with the NSP.*
1b) The Office of Energy has raised issues relating to the definition of "generating units" with regard to photovoltaic installations.	*This is a new issue that cannot be addressed as part of this review.*
2) Verve Energy had concerns relating to 3.7.7.2 and considers it is not desirable that all small inverters be programmed to synchronise one minute after system restoration to normal since it may result in all inverters coming online at the same time.	*Noted. This issue is outside the scope of this review. If this becomes a problem, Western Power may seek a change to the Rules.*
3) Clean Energy Council considers the requirements of 3.3.3.3(c) for a generator to be able to ride through voltage dips should vary depending on the connection voltage.	*This was not raised by the Technical Rules Committee and has not been considered. Any change would need to wait for the next Rules revision*

The purpose of the following section is to analyse the suggestions and comments in each of the submissions listed in the table above. Western Power's assessment and responses are guided by comparing the anticipated costs, benefits and risks for the suggested changes.

[5] http://www.erawa.com.au/cproot/10030/2/20111110%20-%20D77312%20-%20Decision%20on%20Proposed%20Amendment%20of%20the%20Technical%20Rules%20for%20the%20Western%20Power%20Network.pdf (see pps 11 and 12)

3.4.2 PUO submission

Comments received from the PUO in relation to the 2011 review of the Technical Rules identified ambiguity in the definition of *consumer*, *generators*, *users* and *generating units*.

1a) PUO – Definition of terms

<<quote below is taken directly from the Office of Energy (PUO) submission[6]>>

In addition to those matters covered by the Authority in the Review Report the Office has identified two other matters that warrant consideration.

3.1 Definitions of key terms

The Office has noted the divergence between the Rules and the Code in how these documents define a number of key terms. In some cases, the definitions adopted by the Rules may create confusion or include or exclude situations in ways that Western Power may not have intended.

3.1.1 "consumer"

The Code defines a "consumer" as a person who consumes electricity, noting that "consumers" can also be "users", but by implication "consumers" are not limited to "users".

The Rules define a "consumer" as a "user" who consumes electricity through a connection point. The Office is uncertain as to why the Rules adopt a more restricted definition of the term than is used within the Access Code. However, the purpose of the restricted definition may be to preclude electricity customers which do not have service contracts with the network operator. This may lend weight to the view that Western Power may have intended for the definition of "user" provided by the Rules to be interpreted narrowly and to exclude "consumers" with which it does not have service contracts (see 3.1.3 below).

3.1.2 "generator"

The Code defines a "generator" as a person who generates electricity with no further qualification. The Rules, on the other hand, define a "generator" as a person who supplies electricity to the network.

The Office queries why it is the case that the definition of 'generator' in both the Code and the Rules refers to "any person", and yet the Rules' definition of a "consumer" is limited to only those persons that are "users".

As a separate matter, Western Power recently executed its first Connection Contract to provide for the installation of a photovoltaic "generator" which is electronically prevented from exporting electricity. The photovoltaic system has been covered under a Connection Contract rather than an Electricity Transfer Access Contract (ETAC) because no retailers were willing to connect the system under their own ETACs. The Office is of the understanding that the current Rules definition of a "generator" does not cover the person with whom Western Power negotiated the Connection Contract.

Many of the provisions in sections 3.6 and 3.7 of the Rules impose obligations on "generators". On account of the present difficulty that proponents of embedded photovoltaic facilities are having in negotiating buy-back contracts with retailers, it is likely these

[6] http://www.erawa.com.au/cproot/10039/2/20111110%20-%20D75582%20-%20public%20submission%20-%20Western%20Power%20technical%20rules%20review%20-%20Office%20of%20Energy.pdf (see s. 3.1 p. 4)

proponents may increasingly seek to negotiate Connection Contracts with Western Power.

The Office suggests that a broader definition of "generator" under the Rules warrants consideration.

3.1.3 "users"

Section 12.4 of the Code states that the service provider (Western Power) and "users" of a network must comply with the Rules. The Code defines a "user" as a person who has a contract for services with the network operator.

The Rules define "users" to include applicants seeking access to the network as well as any person who already enjoys access to the network. This second class of "user" of the network includes, but is not limited to, those persons who have an access contract or connection agreement with the network operator.

It is the Office's view that the definition of a "user" provided for in the Rules is sufficiently broad as to raise the possibility that it could cover customers who have no contractual relationship with the network operator. It is clear from section 12.4 of the Code that the Rules are intended to be binding on "users" as defined in the Code. It may not have been Western Power's intention to broaden the coverage of this definition to include general electricity customers.

The Office understands that Western Power applies the Rules as if "users" are limited to those parties with whom they have a contract for services. Where a "consumer" or "generator" is not the "user", it appears to be industry practice for the "user" to require, through their supply contract with the "consumer" or "generator" that the counterparty will comply with the Rules. This practice contributes to the Office's view that Western Power may not have intended for the term "user" to be interpreted broadly in the manner that may be permitted by the current wording of the Rules.

The Office suggests that a narrower definition of "user" under the Rules warrants consideration, in particular, whether it should be more closely aligned to the Code's definition of "user" to ensure consistency between the two documents.

1a) Western Power response

Western Power has met with the PUO representatives on several occasions to discuss the best ways to address the comments made in the 2011 submission. After consultation with the PUO, Western Power has established that at this stage, these definitions do not impact on the application of the Technical Rules.

The interdependencies between the words *users* and *consumers* mean that there is a myriad of meanings of these words in many documents, which are often pivotal in implementing technical work based on the Technical Rules (e.g. Access Arrangement and connection agreements). Amending the Technical Rules definitions would have a significant flow on effect in these documents.

In Western Power's experience, the definitions of *consumer*, *generator(s)* and *user* have not created any issues to date.

Proposal and next steps

After engagement with the PUO representatives, it was determined that no amendments to the terms will be sought at this time. If the terms were to be amended, the changes would be likely to have a materially adverse effect on the network service provider and Users – with significant effort and cost required to revise and/or rewrite documents, and/or to renegotiate agreements.

Western Power recommends that opportunities that may tighten alignment between the various definitions be sought out and implemented as part of future reviews.

1b) PUO – PVs

<<quote below is taken directly from the PUO's submission[7]>>

3.2 Inverters and the definition of a generating unit

A photovoltaic system is comprised of a string of panels wired to an inverter and potentially multiple inverters can be wired together. Photovoltaic technology being modular, an inverter and associated panels can be installed and connected to the grid and further panels on a second inverter can then be installed subsequently.

The Rules define a "generating unit" as "the equipment used to generate electricity and all the related equipment essential to its functioning as a single entity". A "generating system" is defined as "a system comprising one or more generating units". A "power station" is defined as "one or more generating units at a particular location" along with the associated equipment and buildings.

The Office is uncertain as to whether an individual inverter (and the associated string of panels), located among a set of inverters, could be regarded as a generating unit in its own right. If this is the case, the Office queries whether the entire set of inverters and panels constitutes a "generating system" and/or a "power station".

Inverters can be readily purchased off-the-shelf at sizes below the 30kW threshold for a "small generator". The Office questions whether the Rules incentivise a proponent to adopt a sequencing strategy such that the applications for each inverter and associated string of panels were made and assessed in sequence rather than all at once. If an application was made for each installation separately and the inverter capacity in each case was below 30 kW, it seems plausible that this series of sequential applications would be subject to different rules than might be applied where a single application for all of the inverter capacity was submitted.

The Office is of the view that any facility should be assessed against the same set of rules whether an application was submitted for the inverter capacity in its entirety or applications for each inverter and string of panels were made in sequence."

[7] http://www.erawa.com.au/cproot/10039/2/20111110%20-%20D75582%20-%20public%20submission%20-%20Western%20Power%20technical%20rules%20review%20-%20Office%20of%20Energy.pdf (see s. 3.1 p. 5)

1b) Western Power response

Western Power's response to this part of the PUO's 2011 submission is given from two perspectives:

i. With the growth in PV systems penetration into the distribution network, there may be a case for including clarification of 'inverter specific' massed 'generation'. However, the definitions presently in the Technical Rules are interpreted with respect to how the systems present at the connection point. For example, if a small inverter installation (subject to cl. 3.7) is increased at its network connection point, it may be subject to more stringent requirements of cl. 3.6.

ii. Western Power currently assesses applications - which include NMI, connection point and meter number information - to be able to properly determine applicable requirements. If an existing system is to be expanded, information on all existing systems is required. This is used to avoid a sequencing strategy (as raised above) being used for aggregation of less than 30 kVA applications at a single location. If abnormalities or variations are found, an audit is carried out to determine what is required for the application to progress.

Proposal and next steps

As noted in 1a) above, the definition and application of the *connection point* in the Technical Rules is proposed to be amended.

It is proposed that this issue be revisited after the *connection point* work to determine the value of re-defining or differentiating any other terms such as a *generating unit* or an *inverter/inverting unit*.

3.4.3 Verve (now Synergy)

2) Verve (now Synergy) – Synchronising small inverters

<<quote here is taken directly from the Verve public submission[8]>>

Synchronising – It is not desirable that all small inverters reconnect one minute after the voltage disturbance that caused them to trip. As the quantum of urban solar PV inverter systems increases (currently well over 100MW and rising) there is the risk that a brown out in Perth causes +100MW of solar generation to trip and then switch back on one minute later. Whilst it is difficult to avoid inverter tripping unless they have under-voltage ride through (not yet available in small inverters), it is possible that different inverters could be programmed with different reconnection times so that the solar power comes back on in a more progressive manner rather than having it all come back on in the same instant. Also it would be better to have the reconnection delay times spread over a time period ending in less than one minute so that substation transformers (usually have a one minute tap change delay time) don't react (change taps) to the short-term voltage change during the period that the solar inverters are off and waiting to reconnect.

2) Western Power response

Western Power has engaged with the person who raised the issue to clarify and better understand it. The idea of all inverters being set to one minute to reconnect 'as a group' is possibly not sound, particularly after solar PV inverter proliferation reaches a high level. This issue is dealt with in AS 4777 inverter requirements, which specifies ramping reconnection of inverters once the network recovers after a supply interruption.

Western Power believes that this is not a Technical Rules matter with the issue having been adequately addressed in AS 4777, as described below.

[8] http://www.erawa.com.au/cproot/10036/2/20111110%20-%20D75340%20-%20public%20submission%20-%20Western%20Power%20technical%20rules%20review%20-%20Verve%20Energy.pdf (see last para p. 3)

Proposal and next steps

A random start up timer could address system wide disturbances but this may still result in localised flicker and voltage fluctuation problems at LV levels – so the AS 4777 committee considered this issue and has decided on a "soft start" approach. Below is an extract from the draft standard DR AS/NZS 4777.2:2015.

> *"6.3.5.3.2 Soft ramp up after connect or reconnect*
>
> *All inverters shall have this mode. This mode shall be enabled as per Clause 7.7 and for the increase in power required by Clause 7.5.3 after frequency decreased to the required limit.*
>
> *7.7 Connection and reconnection procedure*
>
> *Only after all of the following conditions have been met shall the automatic disconnection device operate to connect or reconnect the inverter to the grid*
>
> *(a) the voltage of the grid has been maintained within the limits of AS 60038 (for Australia) or IEC 60038 (for New Zealand) for at least 60 s;*
>
> *(b) the frequency of the grid has been maintained within the range 47.5 Hz to 50.15 Hz for at least 60 s;*
>
> *(c) the inverter and the grid are synchronized and in-phase with each other; and*
>
> *(d) no external signal is present or DRM 0 asserted requiring the system to be disconnected.*
>
> *After the automatic disconnection device operates to connect or reconnect the inverter the output shall rate limit increase in power generation to the set power rate limit (WGra) for increase in power of Clause 6.3.5. Unconstrained power operation may recommence after the automatic disconnection device operates to connect or reconnect the inverter, when either the rated power output is reached or the required output power level of the inverter exceeds the available energy source.*
>
> *Compliance shall be determined by type testing in accordance with the tests as specified in Appendix F and Appendix G."*

This arrangement effectively addresses the issue raised. After a system restart, inverter energy systems will come back on line with a ramping up connection, but this will be controlled and in synchronisation with the re-energisation of local distribution network elements.

3.4.4 Clean Energy Council (CEC)

3) CEC – Ride through capability
<<quote below is taken directly from the CEC submission[9]>> *Clause 3.3.3.3(C) The ride through capability should be provided depending on the voltage level at which the generator connection is made.*

3) Western Power response
Western Power has engaged with the CEC to gain clarity on this suggestion. Western Power understands that this comment may refer to other Technical Rules requirements – as some clauses list requirements for voltage levels above and below 6 kV. In the case of cl. 3.3.3.3(c), specifying this requirement as a percentage of voltage level has been proven to be satisfactory to date. In addition, Western Power has no record of any other internal or external feedback that this has caused any network problems or issues with access or Users' services.
Proposal and next steps:
As no evidence to support this being a high priority issue has been identified, Western Power does not consider there is a need to seek an amendment to the Technical Rules at this time. Western Power will monitor this issue and, if required, consider it again when making future amendments to the Technical Rules.

[9] http://www.erawa.com.au/cproot/10034/2/20111110%20-%20D75141%20-%20public%20submission%20-%20Western%20Power%20technical%20rules%20review%20-%20Clean%20Energy%20Council.pdf (see para 3 p. 3)

4 Typographical corrections 2011 version (Ref. A5)

Corrections required in the current Technical Rules clauses are listed below. The current wording of the clause is marked up in blue with a ~~strikethrough~~ for deletions and underline for insertions or additions.

4.1 Corrections

2.2.11 Long Term Voltage Stability

(b) The long term *voltage stability* criterion is that the *voltage* at all locations in the *power system* must be stable and *controllable* following the most onerous post-contingent system state following the occurrence of any *credible contingency* event under all credible *load* conditions and *generation* patterns.

3.3.1 General

(e)(5)

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.

3.3.3.1 Detailed Technical Requirements Requiring Ongoing Verification

(b)

The controller must also meet the relevant performance requirements of clause 3.3.4.5.

(f) If the *voltage* at the *connection point* falls below the steady state level permitted by clause 2.2.2, the output *current* of the *facility* must not be less than the output *current* of the *facility* if it was providing the maximum *reactive power* required by this clause 3.3.3.1 when generating its maximum rated *active power* with the *connection point* at *nominal voltage*.

(g) The Network Service Provider may agree not to require full compliance with the requirements of this clause 3.3.3.1 in return for a capital contribution towards the provision of new sources of reactive power within the transmission or distribution network. The basis for determining the required capital contribution must be the additional capital cost that the proponent would reasonably be expected to incur if full compliance with the requirements of this clause was not waived.

3.6.1 Overview

This clause 3.6 addresses the particular requirements for the connection of small generating units and groups of small generating units of aggregate rated capacity up to 10 MW (small power stations) to the distribution system where such generating units are

not subject to dispatch by System Management in accordance with the Market Rules. This does not apply to the connection of energy systems rated at up to 10 kVA single phase and 30 kVA three phase ~~and~~ connected to the low voltage system via inverters, in respect of which clause 3.7 applies.

The issues addressed by this clause 3.6 are: 1. the possibility that *generating units* embedded in *distribution systems* may affect the *quality of supply* to other *Users,* cause reverse *power transfer,* use up *distribution system* capacity, create a *distribution system* switching hazard and increase risks for operational personnel, and 2. the possibility that a small *power station* or a number of small *generating units connected* to the *distribution system* could become islanded on to a part of the distribution system that has become *disconnected* from the *power system*, resulting in safety and *quality of supply* concerns.

3.6.10.3 Islanding Protection

(c) For *power stations* rated above 1 MVA, each functional type of islanding *protection scheme* must be incorporated into a physically separate *protection* relay. These may share the same *voltage* and current transformers but must be *connected* to different secondary windings. 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*.

3.6.12 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 ~~the~~ affected *protection apparatus* forms part of a *protection system* comprised of *two fully independent protection schemes of differing principle*, 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.

5.7.1 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 ~~e~~affect the secure operation of the *power system*.

Attachment 5 - SUBMISSION REQUIREMENTS FOR ELECTRICAL PLANT PROTECTION

Page 164 - Trip details (diagrammatic or by trip matrix)

Attachment 12 - TESTING AND COMMISSIONING OF SMALL POWER STATIONS CONNECTED TO THE DISTRIBUTION SYSTEM

A12.1 Application

This attachment ~~specifies~~ lists the specific requirements for the certification, testing and commissioning of generating units connecting to the distribution system in accordance with clause 3.6 and for which the provisions of clause 4.2 apply.

A12.2 Certification

The Generator must provide certification by a chartered professional engineer with National Professional Engineers~~'~~ Register (NPER) or equivalent s~~S~~tanding in relevant areas of expertise that the facilities comply with the Rules, the relevant connection agreement, good engineering practice and relevant standards.