

Decision on Proposed Amendment of the Technical Rules for Western Power's South West Interconnected Network

Submitted by Western Power

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Economic Regulation Authority

WESTERN AUSTRALIA

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DECISION

1. The Authority's decision is that the proposed revisions to Western Power's Technical Rules comply with chapter 12 of the Electricity Networks Access Code 2004 (**Code**) and the Code objective. Accordingly, the Authority approves the Revised Technical Rules appended to this decision.
2. Section 12.15 of the Code states that, when the Authority approves technical rules for a network, it must specify a technical rules start date for the technical rules which must be consistent with the Code objective and at least 30 business days after the approval is published.
3. Consistent with section 12.15 of the Code, the Authority specifies 23 December 2011 as the start date for the Revised Technical Rules.

REASONS

Background

4. Technical Rules consist of the standards, procedures and planning criteria governing the construction and operation of an electricity network. Section 12.32 of the Code provides that, unless a different form of Technical Rules will better achieve the Code objective or the objectives set out in section 12.1 of the Code, the Technical Rules must address the matters listed in Appendix 6 of the Code.
5. The objectives for Technical Rules as specified in section 12.1 of the Code are that they:
 - a) are reasonable; and
 - b) do not impose inappropriate barriers to entry to a market; and
 - c) are consistent with good electricity industry practice; and
 - d) are consistent with relevant written laws and statutory instruments.
6. The Authority must not approve the Revised Technical Rules unless it is satisfied that they reasonably accommodate the interconnection of further networks in the future or if it considers that they would require any person to engage in an act (or omit to engage in an act) which would contravene a written law or statutory instrument.
7. Western Power submitted proposed revisions to its Technical Rules on 14 July 2011 to the Authority for approval. The Authority published its review of these revisions on 16 August 2011. Before approving the revisions proposed by Western Power, the Authority was required to consult with the public in accordance with the requirements of Appendix 7 of the Access Code. The consultation closed on 12 September 2011 and submissions were received from the following parties:
 - Synergy
 - Office of Energy

- System Management
 - Verve Energy
 - Vestas
 - AGL
 - Clean Energy Council
 - REpower (confidential)
 - Public Transport Authority
 - American Super Conductor Corporation.
8. Copies of the submissions received have been published on the ERA's website.¹
9. The Authority is not required by the Code to issue a detailed decision when approving revisions to the Technical Rules. However, the Authority is committed to a transparent decision making process and accordingly releases this Decision. This Decision contains both the Authority's Final Decision on the Revised Technical Rules and a summary of the issues raised by interested parties in the public consultation, together with the Authority's consideration of those issues.

Proposed Amendments

Changes to Proposed Revisions following public consultation

10. The ERA published its review of Western Power's proposed revisions to its Technical Rules on 16 August 2011 (**Authority's Review Report**)².
11. Following consideration of submissions received from interested parties on the **Authority's Review Report**, some further minor changes were made to the proposed revisions. Details of these changes and the reasons for them are set out in the table below. Western Power has modified its proposed revisions to the Technical Rules to incorporate these changes, which are included in the Revised Technical Rules attached as Appendix A.

Clause	Issue	Amendment
3.3.4.4(e)(1)(D)	Verve Energy considered the second sentence of this clause, regarding multiple fuel generators, is redundant as all thermal generators must be able to meet the required level of frequency response irrespective of the fuel (or fuels) being used.	It is agreed that the second sentence of the clause is unnecessary and it has therefore been removed.

¹ http://www.erawa.com.au/2/156/48/electricity_access__technical_rules.pm

² *Review and Proposed Amendment of the Technical Rules for Western Power's South West Interconnected Network.*

Clause	Issue	Amendment
3.3.4.5(f)	Verve Energy considers the specified minimum open loop gain of 200 fails to account for the impedance of the transformer between the generator and the point of connection with the grid. If low impedance transformers are used, the required gain is unnecessary.	This matter was discussed further with Verve Energy and Western Power. The term " <i>open loop gain</i> " in Tables 3.1 and 3.2 of the Rules has been replaced by the word " <i>gain</i> ". If this change does not fully address the issue raised by Verve Energy and remove all wording ambiguity, the matter should be revisited when the Rules are next revised.
3.7.3(e)	In its submission, Verve Energy stated that the clause needs to be reworded to remove the requirement for installation of inverter energy panels "in a manner recommended by the manufacturer". Verve Energy noted that the leading German manufacturer of inverters would recommend an installation that, while acceptable in Germany, does not meet the requirements of AS4777. Verve Energy suggested the wording be changed to: <i>Inverter energy systems must be designed, installed and commissioned in accordance with good electricity industry practice and in a manner that is accepted and approved by equipment manufacturers as recommended by the manufacturer.</i>	As situations could potentially arise where manufacturers have different views on what is acceptable, the wording has been amended to: <i>Inverter energy systems must be designed, installed and commissioned in accordance with good electricity industry practice and relevant Australian standards as recommended by the manufacturer.</i>
3.3.4.4(b)	System Management noted in its submission that this Rule (which relates to generator operating modes) was originally formulated for the "top up and spill" market, where a generator would follow its associated load. As this form of market is no longer in place the Rule should be revised to read: <i>Generating units must be capable of operation in a mode in which they will automatically and accurately alter active power output to allow for changes in associated loads the relevant dispatch level and for changes in frequency...</i>	The clause has been amended to: <i>Generating units must be capable of operation in a mode in which they will automatically and accurately alter active power output to allow for changes in associated loads the relevant dispatch level and for changes in frequency...</i>
3.7.4	Both Synergy and the Office of Energy were concerned that the reference to the West Australian Distribution Connection Manual (WADCM) gives a legal status to a Western Power technical guideline.	The clause has been amended to: <i>The User must make provision for an import/export meter, as per the Western Australian Distribution Connection manual or as otherwise approved by the Network Service Provider.</i> Should a User consider the NSP's requirements unreasonable, then it is able to seek relief under the reasonableness provisions of Rule 1.6.

Clause	Issue	Amendment
2.2.1	Synergy noted that the word “reminder” in the text box following Table 2.1 should be “remainder”.	The word “reminder” in the text box following Table 2.1 has been amended to “remainder”.

Responses to other matters raised in submissions

12. A number of interested parties expressed concern about the discretion given to Western Power in the Technical Rules. They argued that the Rules should be more prescriptive so that Users had more certainty as to what was acceptable. The Authority has considered these submissions but notes that:
- It would be difficult to write a prescriptive set of Rules that effectively addresses all potential situations;
 - In any case it is likely that such Rules would not meet the objectives of the Access Code in that they would necessarily be written to cater for a worst case scenario. There are many situations where the requirements that need to be placed on Users in order to meet the objectives of the Code will vary according to the location of the connection point on the network. If Users with connection points in favourable network locations were required to meet Rules requirements designed for worst case scenarios, they could incur unnecessary costs; and
 - This situation is recognised in the National Electricity Rules (NER) through the guaranteed access/negotiated access framework. It should be noted that this framework also implies a degree of uncertainty to Users.
13. The introduction of a negotiated access framework to avoid any unnecessary cost of Rules compliance would require a major restructuring of the Rules, which is not considered justified. The same outcome should be achievable through giving Western Power as network operator, discretion under the Rules and through the Rules exemptions process in clauses 12.33 to 12.39 of the Access Code. These processes, if they are to work as intended require Western Power to act reasonably and in an even handed way. Clause 12.4 of the Access Code requires that the network operator:
- ...**must** (our emphasis) grant the exemption if [it] determines that in all the circumstances the disadvantages of requiring the person applying for the exemption to comply with the requirement are likely to exceed the advantages.
14. Rule 1.6 requires both Western Power and users to act reasonably in regards to all matters concerning the Rules. Furthermore, the disputes procedure referenced in Rule 1.7 is available to any User that considers itself adversely impacted because Western Power does not use its discretion reasonably.
15. Synergy states in its submission that *“it appears no one has considered how the Technical Rules interact with the market rules, which appears to have given rise to two separate purported rights to control the dispatch of generators.”* The Authority notes that the market rules do not cover the operation of the distribution network. Section 5 of the Technical Rules deals with the operation and coordination of Western Power’s and users facilities to the extent not covered by the market rules. The Authority further notes that, when approving the existing Technical Rules,

significant consideration was given to the interaction of the Technical Rules and market rules and, as a result, significant changes were made at the time to Section 5 of the Technical Rules. The Independent Market Operator (**IMO**) was also asked to comment on potential areas of conflict. Since approving the existing Technical Rules, the Authority is not aware of any issues being raised in relation to Section 5.

16. The submissions received from interested parties raised a number of specific points which the Authority does not consider require further amendment to the proposed revised Technical Rules. A summary of the points raised together with the Authority's response is set out in the table below. The Authority's responses have been formed taking account of advice from its Technical Adviser and, where necessary, seeking further clarification from the interested party and Western Power.

Clause and Issue Raised	Response
<p>1.9.1(b)</p> <p>Synergy considers this Rule, which requires Western Power to consult with the IMO or System Management before granting a Rules exemption that may impact the operation and security of the power system, could have the effect of requiring Western Power to divulge commercially sensitive information.</p>	<p>The purpose of this Rule is to ensure that the IMO and System Management can be held fully accountable for the operation of the SWIS. Western Power's power to grant exemptions from the Rules was not intended to give it an ability to influence the operation of the market for its own benefit and the Rule is intended to limit its ability to do this.</p> <p>The effect of an exemption is to grant a User relief from complying with a particular requirement of the Rules. There is no requirement for a User to seek relief, but should it choose to do so, it has the option of not providing commercially sensitive information or requesting that it not be disclosed.</p>
<p>2.2.10</p> <p>AGL note that the difference between the over-voltage requirement in Figure 2.1 of the Rules and the corresponding NER over-voltage requirement is smaller than it appears because the Rules requirement is referenced to the nominal voltage whereas the NER requirement is referenced to the normal voltage (which can exceed the nominal voltage by 10%).</p>	<p>Noted.</p>
<p>2.3.4(a)</p> <p>The Public Transport Authority (PTA) considers the Rules do not specify a process as to how customer limits on harmonics are to be allocated by Western Power.</p>	<p>Specifying this process is considered unnecessary and would make the Rules overly prescriptive. There is an overriding requirement on Western Power to act reasonably when applying the Rules and, consistent with this obligation, the Authority would expect that it would consult with all affected parties before allocating harmonic limits in respect of a point of common coupling.</p>

<p>3.2.1(a)</p> <p>Clean Energy Council considers it is not clear whether over-voltage studies will be based on the system “as is” or will take other developments into account.</p> <p>Vestas considers there is no certainty with the proposed amendments that the findings of any study by Western Power will mandate the upper level of the performance standards.</p>	<p>The over-voltage studies are not intended to define generator connection requirements but to determine the maximum over-voltage level that can exist at a proposed connection point. Western Power should not be in a position where it could be held liable for allowing a generator to connect if the voltage at a connection point could potentially exceed the capability of the connected plant. Hence, it would need to be based on the system as it existed at the time of first connection.</p> <p>The study by Western Power will determine the maximum overvoltage that can occur at a particular connection point. This is to the advantage of a prospective User as it avoids the installation of equipment with a higher over-voltage withstand capability than needed at a particular location.</p>
<p>3.2.1(d)</p> <p>The PTA notes that railway substations cannot be connected across all three phases of the transmission system.</p> <p>Synergy also notes that the Rule does not recognise the unique situation where loads require a two phase connection to the transmission network.</p> <p>REpower considers the Rules should only state what value of negative phase sequence voltage doubly-fed induction generators (DFIGs) should be able to withstand. DFIGs should not be made accountable for the voltage asymmetry at the connection point.</p>	<p>The Rules are written to meet the requirements for typical loads and cannot be expected to cover all eventualities. Rules exemptions can be negotiated and should be used to deal with atypical situations, such as the connection of large two-phase loads, on a case by case basis. This allows conditions to be imposed on a case by case basis to ensure that other grid users are not unreasonably disadvantaged.</p> <p>Existing two phase loads were protected under the “grandfathering” provisions in Rule 1.9.4.</p> <p>The PTA should discuss its particular requirements with Western Power with a view to obtaining exemptions for those Rules requirements that it is unable to meet.</p> <p>The negative phase sequence voltage that DFIGs should be able to withstand is specified in clause 2.2.5. Clause 3.2.1(d) gives the NSP the ability to take action with generators or loads that inject excessive negative sequence voltage into the network. However if REpower wind turbines produce symmetrical currents there is no issue.</p>

<p>3.3.3.1(a) and 3.3.3.3(b)</p> <p>Vestas and Verve Energy consider the temperature dependency requirements impose an unreasonable impost for extreme events.</p> <p>Verve Energy considers the paragraph should require the designer to consider reasonable contingency events in the design of its power station and ensure capability under these conditions.</p> <p>Clean Energy Council and REpower also raised concerns regarding the extreme temperature limits.</p> <p>Vestas considered that it is not clear in Attachment 4, Note 1, how the site specific maximum ambient temperature is defined. In addition, generators may need to be derated at extremely high temperatures.</p>	<p>The purpose of Rule 3.3.3.1 is to ensure that the grid retains voltage stability by requiring generators to have the capability of producing reactive power to support their real power dispatch. The intent of the extreme temperature provision is to provide a basis for requiring generators to reduce their level of real power generation on extreme temperature days if they are not able to also provide the reactive power required by the system.</p> <p>Rule 3.1(b) has been included in the amended Rules to provide an avenue for the reactive power requirement to be relaxed in certain circumstances (such as extreme temperature days) by agreement with Western Power where this is appropriate. Western Power would need to consult with System Management and/or the IMO in accordance with Rule 1.9.1(b) before reaching such an agreement.</p> <p>A proponent that agreed to limit the active power output of the generator to a level where it could meet the reactive power generation requirements specified in clause 3.3.3.3 would normally be allowed to connect. While there may be some operating restrictions in extreme temperature situations this Rule should not be a barrier to connection. Users should discuss any such issues with Western Power.</p> <p>The maximum ambient temperatures used by Western Power for system analysis purposes are those shown in the explanatory box in clause 3.3.1(a). If operating restrictions are agreed at extreme temperatures it is likely that Western Power will require data related to both restricted and unrestricted operation.</p>
<p>3.3.3.1(b)</p> <p>Vestas and American Superconductor Corporation (AMSC) consider the requirement for continuous voltage control is out of step with similar codes in other parts of the world including the NER. Mechanically switched equipment can provide effective situations where other more sophisticated equipment functionality may not be required.</p>	<p>Due to the variable active power output of wind and other non-synchronous generators, a STATCOM or other similar device is considered necessary to maintain a stable voltage at the connection point. This is particularly the case on the SWIS because of the relatively low levels of reactive power available, due in part to the spinning reserve policy. Should Vestas or AMSC encounter a situation where they consider a STATCOM is not needed at a particular location, they should discuss the possibility of an exemption with Western Power.</p>

<p>3.3.3.1(f)</p> <p>Clean Energy Council notes that, depending on the technology used for the reactive power equipment, reactive current under very low voltage conditions may not be possible as these devices go into an inhibition mode (i.e. able to stay connected but not able to provide reactive current).</p>	<p>Generators using technology that prevented reactive current under low voltage conditions would not be able to connect without first getting an exemption from the Rules. This would need to be considered on a case by case basis by Western Power.</p>
<p>3.3.3.1(g)</p> <p>This Rule allows the NSP to accept a capital contribution towards the provision of reactive power injection sources in place of a proponent being required to meet the reactive power requirements of the Rules. Verve Energy considers that the basis for determining the required capital contribution would seem to be punitive if Western Power's actual costs to provide some or all of the proponent's reactive power requirements are less than it would cost the proponent.</p>	<p>The Rule requires a capital contribution towards the provision of new sources of reactive power on the network rather than necessarily towards a specific project and reflects the fact that the need for new sources of reactive power on the network is ongoing. Arguably, it would also be punitive if, as a result of contributions being tagged to specific projects, different contributions were required from generators facing similar costs to meet their reactive power requirement.</p>
<p>3.3.3.3(d)</p> <p>Clean Energy Council notes that there is no time period specified for how long a generator should stay connected in an event where there is a high rate of change of frequency.</p>	<p>No time requirement is needed. If the rate of change of frequency exceeds four Herz per second, the generator may trip immediately. If the rate of change is lower than this, then the generator must remain connected until the system frequency moves outside the envelope shown in Figure 3.4 (or alternative frequency operating envelope where an exemption has been granted).</p>
<p>3.3.3.3(e)</p> <p>Clean Energy and Vestas note that it is not clear which is the new curve in Figure 3.6.</p>	<p>This is a formatting problem that only occurred in the track change version of the revised Rules.</p>

<p>3.3.3.3 (g)</p> <p>Verve Energy considers the post fault voltage requirement cannot be met by intermittent generators when operating at low real power levels.</p> <p>Clean Energy Council notes that failure to include a proviso that the post fault performance criteria is subject to energy source availability would result in the Rules undermining the market's ability to provide renewable energy.</p>	<p>The text box in Rule 3.3.3.3(a) provides an avenue for a proponent to seek relief in this situation.</p> <p>Rule 3.3.3.3(g) requires operation only within the range of <i>continuous uninterrupted operation</i>. This is defined in Rule 3.3.3.3(h) which states that allowance may be made for any variation in the active power output of non-synchronous generating units due to variation in the primary source of energy – see Rule 3.3.3.3.(h)(2)(A).</p>
<p>3.3.3.8(b) (2)</p> <p>Clean Energy Council considers that this Rule, which requires the generator to remain connected during system frequency excursions, should have inserted at the end "...or as agreed with the NSP".</p>	<p>This is not appropriate. Any change to the frequency ride through requirement would require an exemption from the applicable Rules.</p>
<p>3.3.3.5 and 3.3.4.4</p> <p>System Management notes there is a difference in terms used in these two clauses. It considers that for steam and gas turbines "dispatchable generating units" should be used, and for wind solar and most biomass generators "non-dispatchable generating units" should be used. It should be noted that all generating units are subject to dispatch by System Management albeit for wind generators it is only a reduction in output.</p>	<p>The two Rules make a distinction between a <i>scheduled generating unit</i> and a <i>dispatchable</i> generating unit. A <i>scheduled generating unit</i> is defined in the glossary as a <i>generating unit that is dispatched by system management</i> whereas a <i>dispatchable generating unit</i> is defined as a <i>generating unit that, in its satisfactory operating state, is capable of closely controlling its real power output</i>. Hence, the two terms are different. As System Management does not schedule or manage the operation of generating units rated below 10 MW, steam and gas turbines (and diesel engines) rated below this level are <i>dispatchable</i> but not <i>scheduled</i>.</p>

<p>3.3.4.4(f)(2)</p> <p>REpower notes that this Rule does not state in detail how non-dispatchable generating units should respond to frequency disturbances.</p> <p>Vestas notes that for dispatchable generating units the rate of response takes into account the technical challenges these technologies face, while for non-dispatchable units “this same generosity seems to be missing”.</p>	<p>The response of non-dispatchable generating units to system frequency disturbances is specified in Rule 3.3.4.4(e)(2). The qualitative nature of this requirement reflects the current low penetration of non-dispatchable generation in the SWIS and indicates that the focus of the Rules is to ensure that the response of any such generation that is connected does not exacerbate a potentially unstable system condition. REpower should discuss this further with Western Power.</p> <p>Rule 3.3.4.4(f) needs to be read in conjunction with Rule 3.3.4.4(e). This latter Rule places stringent requirements on the control range required of dispatchable generating units compared to the corresponding requirements for non-dispatchable units.</p>
<p>3.4.1(b)</p> <p>Synergy considers this Rule is an example of the Technical Rules being used to impose general binding contractual arrangements with no restrictions such as a requirement to act reasonably or to consider the commercial impact on a User.</p>	<p>This Rule is necessary to ensure the security of the power system. There is an overarching requirement in Rule 1.6 for both the NSP and Users to act reasonably.</p>
<p>3.4.7</p> <p>The PTA and Synergy considered requirements in relation to the power factor of connected loads are unclear.</p> <p>The PTA considered the Rules do not specify a load range at which the required power factor limit should be applied, nor do they specify the point at which the power factor should be measured.</p> <p>Synergy considered the power factor requirements required additional notes and clarifications so that Users are fully informed.</p>	<p>Based on advice from its technical adviser, the Authority considers the Rule as written is both clear and reasonable. Rule 3.4.1 states that customer load requirements apply at the connection point and at all times. In accordance with Rule 3.4.1 the power factor requirements apply at all times. This is reasonable since low power factors result in additional losses that are a burden on all Users.</p> <p>Rule 3.4.7(c) gives Western Power discretion to relax the Rule, when this would not impact the operation of the network.</p>

<p>3.7.4</p> <p>The Office of Energy raises issues in respect of payment for the bi-directional meter.</p> <p>Synergy is concerned about the changes to this clause. It presented extensive legal argument in relation to its concerns but has not proposed alternative wording that would satisfy its concerns.</p>	<p>The issue of payment for an import/export meter is outside of the scope of the Rules, which cover technical rather than commercial matters. Under Section 5.1(k) of the Access Code, metering must be dealt with in the Access Arrangement rather than the Rules.</p> <p>The only proposed change to this clause related to making it explicit that provision for only one (not two) meters was required. Should Synergy consider that the wording needs to be changed beyond that, it should provide its proposed alternative wording for the next revision to the Rules.</p>
<p>3.7.6.2</p> <p>Verve Energy considers Figure 3.7 should show an AC isolator close to the inverter. Verve Energy, however, also suggests that this is a level of detail that should be dealt with in either AS 4777 or the WA Electrical Requirements and that rules should be about functional performance rather than installation detail.</p> <p>Verve Energy considers that for the second row of Table 3.5 (supply to the user from the inverter only without a parallel network connection) to be a valid mode the inverter needs to be a special type designed for this mode of operation.</p>	<p>Figure 3.7 is intended to indicate the functionality required for connection of small inverter coupled generator to the network. The need for, and location of, a second isolation switch is installation detail that Figure 3.7 is not intended to show. The figure should therefore remain unchanged.</p> <p>Noted. There is no requirement in the Rules for this mode of operation to be available in all installations.</p>
<p>4.2.2(c)</p> <p>Verve Energy considers this Rule (which prohibits connection of a new installation to the network unless it complies with the requirements of the Rules and the WA Electrical Requirements) goes well beyond its intent.</p>	<p>The Rule does not apply to disconnection of unsafe users (as suggested by Verve Energy) but to the commissioning of new equipment. The certification of compliance has always been a requirement prior to connection of new equipment for the first time and the Rule codifies current practice.</p>

Issues to be considered in future

- 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.

<p>The Office of Energy has concerns relating to the definition of “consumer”, “generators” and “users”.</p>	<p>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.</p>
<p>The Office of Energy has raised issues relating to the definition of “generating units” with regard to photovoltaic installations.</p>	<p>This is a new issue that cannot be addressed as part of this review.</p>
<p>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.</p>	<p>Noted. This issue is outside the scope of this review. If this becomes a problem, Western Power may seek a change to the Rules.</p>
<p>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.</p>	<p>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.</p>

Summary of Final Amendments

18. The Table below summarises the amendments to be made to the current approved Technical Rules. It should be noted that this schedule does not include minor changes of an editorial nature or cross-referencing changes and corrections. A number of the amendments are described further in the **Authority’s Review Report**.

Clause	Title	Issue
	Preface	Western Power’s contact details in the preface have been altered to remove reference to a specific manager.
1.4	Commencement	Clause amended to clarify the date on which revisions to the Technical Rules are deemed to apply.

Clause	Title	Issue
1.9.1(b)	Exemptions	Clause 1.9.1(b) has been included to require the Network Service Provider (NSP) to consult with the Independent Market Operator and System Management before granting an exemption that affects power system operation or security. This recognises that System Management is functionally independent of Western Power in undertaking its responsibilities under the Wholesale Electricity Market (WEM) Rules. The change prevents Western Power, as an NSP, from granting exemptions from the Technical Rules that might impact the operation of the WEM without first consulting with the WEM.
2.2.1	Frequency variations	The word “reminder” in the text box following Table 2.1 has been amended to “remainder”.
2.2.2	Voltage step change limits.	Table 2.2 has been updated for clarity and for consistency with AS/NZS 61000.3.7
2.2.5	Negative sequence	The clause has been modified to specify the 10 minute average voltage level, consistent with the requirement of the relevant Australian standard.
2.2.10	Over-voltage envelope	The clause has been modified in accordance with paragraphs 29-33 of the Authority’s Review Report.
2.3.7.1	Network modelling assumptions.	The clause has been modified in accordance with paragraphs 72-76 of the Authority’s Review Report.
2.3.10 2.3.7.1(a)	Credible contingency events	The definition of a critical contingency event has now been moved to the glossary.
2.5.3	Perth CBD Criterion	The definition of Perth CBD has been changed to refer to the geographic supply areas rather than the network supplied from specific substations.
3.1	Map with temperature rating of equipment	<p>Western Power requested that the current Technical Rules be revised to ensure that large generators can meet their reactive power and frequency ride through capabilities for all ambient temperatures at which the generator was likely to operate.</p> <p>A map has been included in an explanatory box within clause 3.3.3.1(a) that indicates the maximum ambient temperature at which these requirements will be assessed for different network locations. These maximum ambient temperatures may not apply where relevant operating restrictions have been agreed in accordance with new clause 3.1(b).</p> <p>In practice this means that a generator will need to be capable of producing its registered real and reactive power outputs at all ambient temperatures up to the level shown in the explanatory box in clause 3.3.1(a). Should a generator wish to limit its output at high ambient temperature this will need to be declared in advance and recorded in the connection agreement.</p>

Clause	Title	Issue
2.2.5, 3.2.1(d)	Negative sequence voltage	<p>The negative sequence voltage requirement has been modified to a 10 minute average consistent with the requirements of the relevant Australian standard.</p> <p>Clause 3.2.1(d)(2) prohibits the connection of single phase loads to the transmission system. Such a connection requirement is very rare and likely to be needed only by specialised large loads, such as those of the electric rail system. This change would mean that any such connection would require an exemption from the Technical Rules, which the Authority envisages would only be granted following a public consultation process.</p>
3.2.1(a)	Overvoltage Tolerance	<p>A text box has been added to indicate that generators that are unable to tolerate the overvoltage levels specified in Figure 2.1 may be allowed to connect if the NSP determines that high overvoltage levels will not occur at the proposed connection point. See paragraph 32 of the Authority's Review Report.</p>
3.3.3.1	Reactive power capability	<p>This clause has been amended to clarify existing requirements.</p> <p>Clause 3.3.3.1 (b) has been inserted to require the reactive power controller to be continuously variable, except for tap change operation of the generator transformer. This is not a requirement of the current Technical Rules but is standard industry practice.</p> <p>Clause 3.3.3.1(e) has been included to clarify that the reactive power capability may be designed into the facility by the provision of an additional reactive power source, if the required level of reactive power cannot be provided by the generator machine in the conventional manner.</p> <p>Clause 3.3.3.1(f) has been added to specify the minimum reactive power capability of a generator should the voltage at the connection point fall below normal levels. This requirement recognises that generator reactive power is needed in extreme operating situations to assist the power system return to a normal operating condition.</p> <p>Clause 3.3.3.1(g) has been added to allow Western Power to agree to waive the reactive power requirements of a generator connection in return for a capital contribution and clarifies the assessment of this contribution. The capital contribution must be used for the provision of reactive power capability elsewhere on the network. This provision recognises that some modern generators are not designed to meet the reactive power capability in the Technical Rules and that reactive power injection closer to the load will often be more beneficial to power system operation.</p>

Clause	Title	Issue
3.3.3.3(a)	Generating Unit Response to Power System Disturbances.	The applicability of the explanatory box has been extended to include generators connected to the transmission system. See paragraph 45 of the Authority's Review Report. The Authority is aware, for example that combined cycle gas turbines may be unable to meet the off-nominal frequency tolerance specified in Figure 3.4. This change provides an avenue through which connection of such generators may be negotiated.
3.3.3.3(f)	Post-fault reactive power of a power station with non-synchronous generating units	An explanatory box has been added to clarify the intent of this clause.
3.3.3.3(g)	Generating unit response to disturbances in the power system: post fault voltage control of a connection point	A minor change has been made to the wording of this clause to make it more generic.
3.3.3.3(h)(3)	Continuous uninterrupted operation	A minor change has been made to the wording of this clause to reduce potential ambiguity.
3.3.3.5(b)	Ramping rates	Wording has been changed to reflect comment by the Technical Rules Committee in relation to the impact of the variable energy source of wind powered generation. See paragraph 93 of the Authority's Review Report.
3.3.4.4(a)	Frequency control	Wording has been changed to reflect comment by the Technical Rules Committee.
3.3.4.4(b)	Frequency control	Explanatory box has been deleted as requested by the Technical Rules Committee. The explicit requirement that the active power output be changed every four seconds has also been deleted. In response to concerns raised by System Management the clause has been amended to: <i>Generating units must be capable of operation in a mode in which they will automatically and accurately alter active power output to allow for changes in associated loads the relevant dispatch level and for changes in frequency...</i>
3.3.4.4(e)	Frequency control	The terms "synchronous" and "non-synchronous" have been replaced by "dispatchable" and "non-dispatchable" to better reflect the intent of this requirement.
3.3.4.4(e)(1)(D)	Frequency control	The clause has been clarified by specifying that, for multi-fuel generators, the requirement must be met irrespective of the fuel being used. As identified by Verve Energy, the second sentence of the clause is unnecessary and has been removed.
3.3.4.4(e)(2)	Frequency control	The requirement for non synchronous generators to have settable frequency response has been deleted. In addition, the explanatory box requiring wind turbines to have pitch control fitted has been deleted.

Clause	Title	Issue
3.3.4.4(f)	Rate of response	The clause was reworded to meet the changes suggested by the Technical Rules Committee. However, the Authority did not agree to include Western Power's proposed requirement in respect of coordination of the set values, as this is adequately covered in Section 4 of the Technical Rules.
3.3.4.5	Voltage Control System	The second sentence in the explanatory box has been deleted as the required reactive power capability of all generator types is specified in clause 3.3.3.1.
3.3.4.5(b)	Voltage control system	Consistent with the view of the Technical Rules Committee, the clause has been amended to focus on outcomes and remove requirements as to how these might be achieved.
3.3.4.5(c)	Voltage control system	In consultation with Western Power, minor changes have been made to the wording to make the clause less prescriptive.
3.3.4.5(f)	Voltage control system	This matter was discussed further with Verve Energy and Western Power. The term " <i>open loop gain</i> " in Tables 3.1 and 3.2 of the Rules has been replaced by the word " <i>gain</i> ".
3.3.4.5(g)	Voltage control system	A minor change has been made to the wording of the sensitivity requirements in Table 3.2, as suggested by the Technical Rules Committee.
3.4.8(e)	Earthing	See paragraphs 37-39 of the Authority's Review Report. The clause includes a new provision that allows a user to utilise a Western Power easement for its earthing grid where this is legally possible.
3.6.3(a)	Information to be provided by the Generator	The wording of this clause has been amended to dissuade Western Power from seeking information that is not reasonably required.
3.6.5	Requirements of clause 3.3 applicable to small power stations	Changes have been made to Table 3.4 as suggested by the Technical Rules Committee and to be consistent with the changes to clause 3.3.4.4.
3.6.8(b)	Power quality and voltage change	This clause has been amended to indicate that sequential starting of generators should occur after intervals of at least two minutes.
3.6.8(c)	Power quality and voltage change	This clause has been amended to authorise Western Power to waive the requirement for generators contracted to provide voltage control ancillary services.
3.6.9	Remote control, monitoring and communications	Threshold for remote generator monitoring and trip control reduced from 1 MW to 1 MVA. See paragraph 36 of the Authority's Review Report.

Clause	Title	Issue
3.6.9(d)	Remote control, monitoring and communications	This clause has been amended to require a backup speech communication channel rather than a dedicated telephone link.
3.6.10	Protection	This clause has been amended to incorporate changes agreed by the Technical Rules Committee and to incorporate the changes described in paragraphs 50-60 of the Authority's Review Report.
3.7.1(b)	Scope of clause 3.7	This new subclause has been included to confirm that small inverter coupled generators should not be connected if supply to existing users will be adversely affected as a result. See paragraph 84 of the Authority's Review Report.
3.7.2	Energy System Capacity, Imbalance and Assessment	This clause now explicitly states that the impact of larger inverter energy systems on existing users will be reviewed before they are allowed to connect.
3.7.3 3.7.7 3.7.8.3	Re-confirmation of correct operation	These clauses have been amended in accordance with the recommendations in the Final Outcomes Report of the Small Photovoltaic Generation Systems Working Group. See paragraphs 81-88 of the Authority's Review Report.
3.7.3(e)	Standards	As identified by Verve Energy, potentially situations could arise where manufacturers have different views on what is acceptable and therefore the wording has been amended to: <i>Inverter energy systems must be designed, installed and commissioned in accordance with good electricity industry practice and relevant Australian standards.</i>
3.7.4	Metering	Wording clarified to require provision for a single import/export meter rather than two separate meters.
3.7.5.1 3.7.9, Table 3.7	Signage	Specific signage requirements have been deleted in accordance with the recommendations in the Final Outcomes Report of the Small Photovoltaic Generation Systems Working Group.
4.2.2	Commissioning	A new subclause 4.2.2(c) has been added, consistent with the discussion in paragraph 68 of the Authority's Review Report.
4.3.4(a)	Involuntary disconnection	Clause 4.3.4(a) has been amended to clarify the circumstances in which Western Power is authorised to disconnect a facility from the network without the consent of the user. An explanatory box confirms that disconnection might occur if Western Power became aware that the earthing grid had been modified to the extent that it might no longer comply with the required standards.
Attachment 1	Glossary	Some definitions have been added and/or modified.

Appendix 1 – Approved Revised Technical Rules