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Mr Lyndon Rowe
Chairman
Economic Regulation Authority
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PERTH WA 6849

Attention: Alistair Butcher

Dear Lyndon

SUBMISSION OF THE TECHNICAL RULES PRELIMINARY REPORT

As Chair of the Technical Rules Committee (the "Committee"), I am pleased to provide the Committee's preliminary report, which is required under part 12.11(b) of the Electricity Networks Access Code 2004 (the "Code").

The report documents the extensive discussions that have occurred between Network Users, Western Power and the Office of Energy in relation to the proposed Technical Rules that were submitted by Western Power on 24 August 2005.

It recommends that the Authority should continue to work with Western Power and key Network stakeholders in developing Western Power's proposal. To assist the Authority, the report includes a version of the rules that has been extensively redrafted by Western Power to accommodate many of the issues raised by the Committee. It also documents the remaining issues on which the Committee could not reach consensus.

I would like to acknowledge the strong contribution that has been made by Committee members, including Western Power, to this process which is a key outcome of the Government's electricity reform program.

The Committee included representatives from Alinta, Perth Energy, TiWest, Western Power, Southern Cross Energy, and International Power Mitsui. In addition, assistance in the development of its advice was sought from the Urban Development Industry Association, as well as a wide range of stakeholders in the Small Generation Sector.

Yours sincerely

ANNE NOLAN
COORDINATOR OF ENERGY

12 December 2005

Government of Western Australia

Technical Rules Committee
Preliminary Report

December 2005

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1. EXECUTIVE SUMMARY

The Technical Rules Committee (Committee) was established by the Economic Regulation Authority (Authority) to provide it with advice on the approval of the proposed Technical Rules (Rules) submitted by Western Power on 24 August 2005 and relating to the parts of the South West Interconnected System it owns.

This Preliminary Report is submitted to the Authority in accordance with Section 12.11(b) of the *Electricity Networks Access Code 2004* (Access Code) and sets out the progress made by the Committee in developing its advice.

The Committee's membership is drawn from a wide cross-section of stakeholders and has lent substantial engineering expertise and commercial experience to the development of this advice. However, the Committee finds that the scope and impact of the Rules is such that legal and economic issues also need to be accounted for in the Authority's decision.

The Committee has attempted to identify and resolve these issues where possible. However, the Authority should bear in mind the Committee's advice may not cover all areas necessary to ensure the Rules best achieve the objectives set out in section 12.1 of the Access Code.

The Committee, including Western Power and in consultation with Authority, determined that the best use of its resources was to continue development of the proposed Rules with a view to updating Western Power's proposal. Consequently, at Appendix 2 this report contains a conformed version of the rules, which includes extensive redrafting of Western Power's submission to reflect the Committee's discussions.

The Committee considers that the changes made to the Rules since their submission in August 2005 represent a significant improvement, particularly from a technical perspective. However, concern remains in relation to their effectiveness in achieving Access Code objectives, particularly regarding the form of drafting and the legal impact and effectiveness of various Rules. The Committee considers that significant benefit would be gained from subjecting the rules to a detailed legal review.

Furthermore, whilst considering and resolving a large number of issues, the Committee has been unable to reach consensus in relation to an agreed form of drafting for 11 of the clauses. Where the Committee has been unable to reach consensus, the report includes (at Appendix 3A) detailed documentation of the issues and the discussions of the Committee that are intended to serve as a basis for continued consideration by the Authority.

Appendix A6.1 of the Access Code sets out the issues that must be addressed by the Technical Rules (unless the Authority considers that another form of the Rules will better achieve the objectives of the Access Code). The Rules must also seek to achieve the objectives that are set out in section 12.1. The Committee finds that Western Power's proposed Rules comply with Appendix 6 of the Access Code except for:

(a) performance standards in respect of *service standard* parameters; and
(b) the identity of the system operator for the *network*; and

The Committee also considers that the Authority should further consider the extent to which Western Power's commitments under sections 1.7.2 and 5.3.2 of the Rules meet the requirements of Appendix 6 of Access Code objectives.

The Committee has considered integration of the Rules within the existing legislative framework and, as a result the conformed Rules incorporate substantial amendments to resolve issues of overlap with existing legislation or regulations such as the Wholesale Electricity Market rules.

The fundamental recommendation of this report is that the Committee, including Western Power, advises the Authority not to approve Western Power's proposed Rules. Furthermore, the Committee considers that the Authority should continue development of the Rules, based on the conformed rules at Appendix 2.

Further advice as to how the Authority should approach a range of key issues such as Distribution System Design and the treatment of Small Generators in the Rules is contained within the body of the report.

On these issues the Committee acknowledges the assistance that has been provided, through attendance at meetings and the review of documentation and redrafting proposals, by the Urban Development Industry Association and a range of stakeholders in the small generation sector. This assistance has been central to the formation of the Committee's advice to the Authority on these matters.

2. INTRODUCTION

Some industry stakeholders have historically been concerned that the technical requirements imposed by Western Power represent a barrier to entry to new generators.

The Technical Rules have significant commercial implications to users. At the same time, the safe and reliable operation of the electricity network has been considered of paramount importance and a conservative approach has been previously adopted to departures from historical process and technical parameters.

The *Electricity Industry Act 2004* (Act) establishes a new process to allow the transparent assessment of these issues. The Act requires that the Network Service Provider (NSP) should formulate, and the Economic Regulation Authority (the Authority) should approve, a Technical Code. Therefore while the NSP will retain responsibility for the operation of the network, the technical parameters under which the network is operated and the requirements placed on network users will be subject to a level of transparent consultation and independent scrutiny.

The Technical Rules Committee (TRC) has a central role in this process and must advise the Authority in relation to the approval of the Technical Rules.

2.1 Access Code

The process for reviewing the Technical Rules is set out in the *Electricity Networks Access Code 2004* (Access Code), which is made under part 8 of the Act. The Access Code sets out the regulatory framework underpinning third party access to certain electricity networks in Western Australia (WA). Its objective is to promote the economically efficient investment in, and operation and use of, electricity networks in WA and in doing so, to promote competition in markets upstream and downstream of the electricity network.

The Authority administers the Access Code and is responsible for:

- approving access arrangements – including terms and conditions, prices and service delivery;
- providing regulatory oversight – such as monitoring, ringfencing and approval of annual price lists; and
- approving the technical rules.

The Access Code does not apply to all electricity networks in WA. Under section 3.1 of the Access Code the Western Power owned network within the South West Interconnected System (SWIS) is covered from the commencement of the Access Code. Apart from the SWIS network, only those networks that are the subject of a coverage application under subchapter 3.3 of the Access Code and which satisfy the coverage criteria set out in subchapter 3.2 of the Access Code will conceivably be subject to future Access and Technical regulation.

Such networks are referred to as 'covered networks'. The operator of a covered network must submit a proposed Access Arrangement and Technical Rules to the Authority for approval.

The Technical Rules consist of the standards, procedures and planning criteria governing the construction and operation of an electricity network. The matters that must be addressed by the Technical Rules for a network are set out in Appendix 6 of the Access Code and included in this report at Appendix 1.

2.2 Western Power's Technical Rules submission

Western Power submitted its proposed Technical Rules submission together with its Access Arrangement submission on the 24 August 2005. The submission, referred to in this report as the 'proposed technical rules', was subsequently published by the Authority and the formal role of the TRC commenced.

Prior to making its formal submission, Western Power made Chapter 1 (General Issues) and Chapter 4 (Inspection, testing, commissioning, disconnection & reconnection) of the Technical Rules available to the Committee who identified and resolved a range of issues. The amendments made as a result of these decisions were reflected in the proposed technical rules and are not discussed further in this report.

Western Power advised the Committee that it was keen to consult with industry on all the chapters but had been unable to complete this task in the time prior to submission of the Access Arrangement. It proposed to work with the Committee to develop a revised set of Rules which would incorporate improvements resulting from comments from Committee members.

3. THE TECHNICAL RULES COMMITTEE

The Committee was established to provide specialist knowledge and advice to the Authority on the approval of the proposed Technical Rules relating to the parts of the SWIS owned by Western Power.

3.1 Scope of the Committee

The Committee can be called on by the Authority to fulfil a range of functions that are set out in Chapter 12 of the Access Code. The Terms of Reference of the Technical Rules Committee are provided at Appendix 5.

The Access Code indicates that this preliminary report should set out the Committee's progress in performance of its duties, and that it should advise the Authority on matters that are the subject of deadlock amongst the Committee at this stage of the process.

3.2 Membership and additional consultation

In its Terms of Reference the Authority advised that the membership of the TRC would include:

(i) a representative of Western Power (the service provider);

(ii) persons representing other service providers of networks interconnected with Western Power's network within the SWIS, comprising a representative of:

a. Southern Cross Energy; and

b. International Power Mitsui Consortium (Kwinana Cogeneration Plant);

(iii) persons representing users of the network, comprising a representative of:

a. Alinta Limited;

b. Perth Energy Pty Ltd;

c. Tiwest Pty Ltd;

d. Wesfarmers Energy Limited; and

(iv) a representative of the Coordinator of Energy (Chair). [cf. s.12.19(a)(i)]

The names of current Technical Rules Committee members and their affiliations are provided in Appendix 6.

As would be expected, the skill set of TRC members reflects the nature of the organisations from which they are drawn. Members have extensive engineering experience in the management of electricity networks and the operation of facilities and equipment that is connected to these networks. Several current members also have commercial experience in the negotiation of network access contracts and electricity supply agreements.

Whilst the composition of the Committee is appropriate for the purpose of providing technical advice to the Authority, the scope and impact of the rules is such that legal and economic issues are also likely to affect the Authority's decision. The report attempts to identify these where possible. However, the Authority should bear in mind the Committee's advice may not cover all areas necessary to ensure that the Technical Rules best achieve the objectives of the Access Code.

Members were requested to consult widely within their respective businesses and/or industry sectors to ensure that as broad a range of network users as possible were consulted in relation to the proposed Technical Rules. This approach also increased the identification of issues that were not purely technical in nature.

The Committee also invited a range of additional presentations and participation from stakeholders other than those represented on the TRC in relation to particular aspects Western Power's proposed Technical Rules, namely, distribution system design and the technical requirements of small (<10MW) generators.

3.3 Committee process

TRC members provided written comments on each provision in the proposed technical rules to which they took issue. Prior to each meeting these comments were compiled, circulated to all members and formed the agenda for each meeting.

In providing their comments, TRC members were requested to focus on:

1. Whether the proposed technical rules satisfied the objectives set out in section 12.1 of the Access Code. That is that they:
    - are reasonable;
    - do not impose inappropriate barriers to entry to a market;
    - are consistent with *good electricity industry practice*; and
    - are consistent with relevant *written laws* and *statutory instruments*.

2. Any issues that members believed should be brought to the attention of the Authority including any implications the proposed Technical Rules may have on the achievement of the Access Code objectives (as set out in Section 2.1 of the Access Code).

Provisions of the proposed Technical Rules were passed by exception. That is, unless an issue was raised with a particular provision it was assumed to be endorsed by the Committee.

The Committee also reviewed the redrafted sections that Western Power made available to ensure the intent of the changes agreed in Committee had been maintained.

Summaries of all of the issues that have been discussed by the Committee have been included at Appendix 3 and provide a detailed record of the progress of the committee in developing its advice to the Authority.

4. THE PRELIMINARY REPORT

This report is provided to the Economic Regulation Authority by the Technical Rules Committee in accordance with Section 12.11 (b) of the Access Code and sets out the progress that has been made by the Committee in performing its obligations under section 12.23 of the Code.

In consultation with the Authority and Western Power, the Committee has taken the view that the most appropriate use of its time was to continue to develop the Technical Rules with a view to providing an ‘updated’ version of the rules in this Preliminary Report.

This updated, or conformed, version of the rules is attached at Appendix 2. The conformed version includes extensive redrafting of Western Power’s submission to reflect the discussions of the Committee (including Western Power in its role as a Committee member).

The conformed version of the rules also attempts to implement a more structured approach based on the following chapters.

Chapter	Contents
1	General obligations on all parties
2	Obligations on Western Power as NSP
3	Obligations on network Users
4	Processes and procedures for Inspection, Testing, Commissioning, Disconnection and Reconnection of facilities and equipment
5	Power System Security for those Users or Network Elements that are not provided for in the WEM rules (reduced considerably as a result of its intersection with the WEM rule).
6	Derogations.

The TRC considers that this structure, and the changes that have been made to the rules since the proposed Technical Rules were submitted in August, represent a significant improvement, particularly from a technical (engineering) perspective.

However, concern remains in relation to the Technical Rules’ effectiveness in achieving the Access Code objectives. In particular, the form of the drafting and uncertainty about the impact and effectiveness of various Technical Rules was raised as a concern by the Committee.

Where these issues were identified, the TRC has in many cases attempted to resolve them by making appropriate amendments where these could be agreed. However, the Committee believes that significant benefit could be gained from subjecting the rules to a detailed legal review.

The following Appendices form part of, and should be read in conjunction with, this report:

Appendix 1: Scope of the Technical Rules
Appendix 2: Conformed Rules
Appendix 3: Resolutions of the TRC
Appendix 4: Western Power submissions
Appendix 5: Membership of the TRC

4.1 Compliance with the Access Code

Unless the Authority considers, under section 12.32, that another form of the Technical Rules will better achieve the objectives of the Access Code, the Technical Rules must cover the issues outlined in Appendix A6.1 of the Access Code and must comply with the objectives that are set out in section 12.1 for the Technical Rules, including that they are consistent with the existing legislative framework.

The TRC finds that Western Power's proposed technical rules comply with Appendix 6 of the Access Code with the exception of:

(a) performance standards in respect of *service standard* parameters; and

(b) the identity of the system operator for the *network*; and

(c) Item (l), the *generation* and *load* forecast information that *users*, *consumers* and *generators* must provide to the *service provider*. (This item has been deleted from the Technical Rules as it is now dealt with in the Wholesale Electricity Market Rules).

These matters were not addressed in Western Power's Technical Rules submission. As a result, the Committee finds that in these respects the submission does not comply with the requirements that are set out under the Access Code.

The Committee also considers that the Authority should further consider the extent to which Western Power's commitments under sections 1.7.2 and 5.3.2 of the Technical Rules meet the requirements of Appendix 6 of the Access Code objectives. This is recommended as section 5 of the Technical Rules now deals (almost exclusively) with distribution connected users and the provisions above appear to seek to exclude Western Power's obligations to communicate details of curtailments with these Users. The Committee also notes that section 1.7.2 does not include an obligation to comply with relevant laws.

Identification of the Technical Rules that correspond to requirements under Appendix 6 of the Access Code is provided at Appendix 1. To the extent that these matters were not resolved, they are identified in the following sections as contentious (deadlocked) along with the relevant Technical Rule objective.

Recommendation 1

The Authority should consider whether the following matters are adequately dealt with in instruments other than the Technical Rules in a manner which satisfies the achievement of the objectives of the Code:

- performance standards in respect of service standard parameters; and
- the identity of the system operator for the network; and
- the generation and load forecast information that users, consumers and generators must provide to the service provider.

4.2 Compliance with applicable law

The Committee has attempted to consider integration of the Technical Rules within the existing legislative framework, and substantial changes have been made to allow for areas where the rules overlapped with provisions of the Wholesale Electricity Market rules.

One area in which a potential overlap was identified is Section 25 (1)(d) of the *Electricity Act 1945* (the Electricity Act) which sets out obligations for frequency control.

Rule 2.2.1 of the conformed rules states that Western Power will maintain frequency well within the limits set out in the Electricity Act for 99% of the time. Deviations for the remainder of the time may also stay within the limits set out in the Electricity Act, and will only move outside of those limits in situations where the network is affected by multiple unforeseen contingencies. The Committee does not consider that there is any conflict between the Technical Rules and the Electricity Act on this matter.

5. CONFORMED RULES

At the time of submission of the proposed Technical Rules, the Committee had completed its review of Chapters 1 and 4 and these had been redrafted to reflect the outcomes agreed by the Committee.

However, the remainder of Western Power's submission had not been considered by the Committee at the time of submission. As a result, the Committee's review, in consultation with Western Power, has led to extensive changes to Chapters 2,3,5 and 6 from those that were presented to the Authority on the 24 August 2005.

This report presents a high level description of the main structural changes that have been made to the proposed Technical Rules, as well as a description of issues on which the committee was unable to reach a resolution. The Committee's advice to the Authority is that the conformed rules that are at Appendix 2 represent a substantial improvement over the proposed Technical Rules and should be the basis for further development as part of the current regulatory process.

Appendix 3 provides a detailed summary of the issues raised and resolved by the Committee.

Recommendation 2
The Authority should adopt the conformed Technical Rules presented at Appendix 2 as the basis for any further developments. The Committee, including Western Power, advise that the Authority should not approve the proposed Technical Rules (24 August 2005 version).

5.1 General (Chapter 1)

Chapter 1 defines the scope, in terms of content and application, of the *Technical Rules* and provides rules of interpretation and refers to the dispute resolution process. It establishes the obligations of all parties and defines the methodology for variations, exemptions and amendments to the code. Clause 1.5 requires Western Power and Users to act reasonably.

There have been no changes to this chapter after the submission of the proposed Technical Rules.

5.1.1 Contentious (Open) Issues

There are no open or deadlocked issues in Chapter 1.

5.2 Transmission and distribution network performance and planning criteria (Chapter 2)

Chapter 2 sets system standards and defines the technical obligations of the network service provider to run the network in accordance with the Technical Rules. Substantial changes have been made to Chapter 2 as a result of discussions of the Committee and further reviews by Western Power.

It provides the planning and design criteria for both the transmission and distribution networks, and describes the actions that Western Power must take to ensure that the connection of Users occurs in a manner that will permit secure operation of the network with minimal adverse impact on other Users.

It is understood that Western Power made further changes to Chapter 2 in response to a review of the rules by PB Power, which has been retained by the Authority to provide further advice on Western Power's proposed Technical Rules. The Committee has not considered, and this report does not include discussion of, any changes made as a result of PB Power's review.

Network protection obligations have been significantly revised and moved from Chapter 3 to a new Section 2.10 to reflect the fact that they impact on Western Power.

In addition the current practice in respect of fault clearing times was more comprehensively defined by expanding Table 3.3 to include clearing times for the network at 33kV and below.

Chapter 2 has been refocussed on the obligations of the Network Service Provider and as a result several matters have been moved to Chapter 3 including:

- arrangements for system studies associated with connection of Users (now 3.1.2); and
- frequency boundaries for fault ride-through requirements of generators.

Other changes, that have been initiated by Western Power, include:

- Revisions to section 2.3.4 (Voltage Stability), to separately identify the long and short-term components of this phenomenon. The previous Transient Voltage Dip (TVD), (2.3.3.4) and Post-fault voltage recovery limit (TVR) (2.3.3.5) criteria have been combined into TVR and moved to the section on short-term voltage stability;
- The terminology of the planning criteria N-2, was changed to N-1-1 to emphasise that it contemplates two sequential contingencies, rather than a simultaneous (stacked) contingency; and

Further discussion on distribution network design issues is included at Section 3.3.1.1 of this report.

5.2.1 Contentious (Open) Issues

Frequency Variations: TR 2.2.1

A User was concerned that the reference to operation at a frequency up to 52.5 Hz is at variance with the other clauses in the section. In response, Western Power deleted the provision leaving specification of frequency variations to Table 2.1. However, the User remained concerned that the requirements in Table 2.1 could present a barrier to entry.

This concern was based on the User's strong view that large gas turbines being built at present are unlikely to comply with Table 2.1. The User contended that Western Power should make clear whether all large turbines will be exempt from strict compliance. If not, the User objects to the clause on the basis that it could be used to restrict entry of new generators and that it runs counter to the objectives of reducing generation costs in the SWIS.

However, given that the Access Code requires the Authority to publish any derogations granted to Users, the User concedes that there would be limited ability for Western Power to use this provision maliciously to prevent connection of large gas fired generators.

The issue remains open and is considered by the User to be a potential barrier to entry.

A full record of the discussion of this issue is at Appendix 3.1.

Stability Assessment: TR 2.3.7

A User considers that Western Power should move from its traditional deterministic approach to stability assessment studies, (i.e. 'stacking' the effects of multiple contingencies) towards a probabilistic approach.

The User believes that this is an area of frequent disagreement between Western Power and Users, which results in a significant barrier to entry.

Western Power advised that it considers a number of the specified contingency events to be interlinked, i.e. if one event occurs, another will generally follow. Also, for large 'system' events, there is a tendency to be conservative as the financial consequences can be substantial.

Western Power advised they can apply probability criteria at the zone sub-station level but to do this for the main system would require a vast amount of data that is largely not available.

The Committee consented to the Authority representative seeking advice from PB Power who advised that, at this stage, they did not consider that it would be possible to construct a mechanism within the rules that would provide sufficient clarity to Users, or security to Western Power.

Western Power provided further clarification that while Western Power does assess the worst case scenario, their procedures have changed and are now not as conservative as they were initially. However, the Committee is unable to come to consensus on this issue.

The User has restated his strong position that there needs to be a fundamental change of direction in how Western Power approaches system studies for the purpose of defining ultimate technical operational limits, versus interpreting that into commercial constraints.

A full record of the discussion on this issue is at Appendix 3.1.

Recommendation 3

Western Power should be required to work with the Authority and industry to develop a set of agreed criteria and agreements that are to be used as a pro-forma for carrying out system studies. The intent of this recommendation is to ensure that greater certainty around this key issue is provided to prospective Users

5.3 Chapter 3: TECHNICAL REQUIREMENTS OF USER FACILITIES

Chapter 3 sets out the obligations that are relevant to the connection of Users to the transmission and distribution networks.

Western Power's intent has been to structure the section to separately address the general requirements and protection requirements applicable to all classes of User; connection of generators; and connection of loads.

The section on connection of small generators to distribution networks (primarily TR 3.5) has been considerably amended and is discussed in detail in section dealt with in more detail in section 6.2 of this report.

Substantial changes have been made to Chapter 3 as a result of resolutions of the TRC, further reviews by Western Power and in response to a review of the rules by PB Power, the consulting company that has been retained by the Authority to provide further advice on Western Power's proposed Technical Rules.

These include:

- Clarifying the need for a User to be able to switch on and off using its own equipment and further definition of the circumstances where Western Power may not require this;
- Insertion of provisions relating to power system simulation studies (from Chapter 2);
- Amendments to provisions relating to the technical matters to be coordinated with generators, and the information requirements associated with these; and
- Changes to protection requirements as a consequence of moving these to section 2.10 (where necessary, references to provisions of Chapter 2 are included in Chapter 3).

5.3.1 Contentious (Open) Issues

Provision of Information: TR 3.2.3

Users advised that it can be difficult to obtain the information required by Western Power. They expressed concern at the possibility of an access application being held back because of Western Power requiring irrelevant data, and proposed that the information should be provided only when feasible.

The Committee suggested that the reasonableness clause at section 1.5 would address this issue and Western Power contended that it would be 'unreasonable for Western Power to continue requesting data from it if the User cannot provide it'.

Users requested advice from Western Power in relation to the possibility of providing for the data request in the specifications to purchase machinery rather than in the Technical Rules.

However, Western Power's response advised that the practice of requiring information in advance was good practice because:

- International and Australian standards permit data to change, sometimes considerably, from the specification to delivery.
- It is important to get data prior to connection being granted in order to enable power system studies to be done. It can be difficult to obtain data after purchase.
- Plant performance, data and modelling parameters may change considerably during plant operation, which creates the need for on-going verification.

The Committee noted that, despite the extensive listing of information that could be required by Western Power, not all of the information would be required of all applicants, and that Western Power would be required to act reasonably in this regard.

However, Users were still concerned that the rules did not allow sufficient flexibility and because of this, the issue is considered contentious (deadlocked) on the basis that the information requirements imposed could be unreasonable and may pose a barrier to entry.

Reactive power capability: TR 3.2.4.1

A User was concerned that the power factor performance range of alternators connected to the transmission system of 0.8 lag to 0.9 lead was excessive and that the requirement significantly increases the cost of the equipment, which would in turn be passed onto consumers.

The member noted that within other sections of the rules Users must provide a load with power factors in the range of >0.95 lagging and suggested that Western Power should respecify the power factor performance range to 0.9 lag to 0.9 lead.

Western Power advised that, in its view, the range was in accordance with relevant operational requirements, and that they were important in light of increasing demand for reactive support on the network.

The Committee agreed that in the case of generators with embedded loads, it was unreasonable to require a higher power factor at the connection point than that actually needed by the generator, given its export capability to the network.

Western Power prepared a paper on the matter for the Committee's consideration, the paper is at Appendix 4.6.

Users remain concerned that compliance costs associated with these settings may constitute a barrier to entry.

A full record of the discussion of this issue is at Appendix 3.1.

Recommendation 4

The Authority should consider the information at Appendix 4.6 and any further information or submissions that Western Power may be able to provide, in determining whether the requirements set out in 'TR 3.2.4.1 Reactive power capability' impose unnecessary compliance costs on network Users.

Generating Unit Response to Disturbances in the Power System: TR 3.2.4.3

The concerns raised by Users include:

a) The requirements exceed those limits set by the IEC and do not take account of the comparative size of the alternator on the power system;

b) The specification appears to be looser than the National Code and requires continuous unrestricted operation over a wide range of frequencies. The user contends that none of the machines currently on the system are capable of the requirement, and it would not be possible to obtain manufacturers consent to do this;

c) The requirement for Users to ensure the generating equipment is capable of remaining in service for frequency limits as per Fig 3.4 is onerous for particular machines. For example, steam turbines and gas turbines typically have UF thresholds set by OEM's at 47.5Hz or higher and are incapable of continuous operation at that level;

d) In section 3.2.4.3 (b) Voltage Excursions – Users to ensure generating unit capable of continuous uninterrupted operation even while the voltage at the connection point is between 0-80% for 450ms (as opposed to the National Electricity Code standard of 175ms due to their faster clearance times) or up to 110% for 10 secs is too onerous;

e) The requirement in section 3.2.4.3(c) for generators to be capable of uninterrupted operations at 4 Hz/sec is too onerous and should be replaced with an UFLS scheme to prevent such a high rate of change of frequency; and

f) The terms “leading” and “lagging” have different meanings from generator and network perspectives. These should be replaced with “absorb” and “supply”.

In relation to part a), Western Power responded that the smaller the system, the more frequency variations are experienced and that these requirements have been established to ensure generators do not trip. Western Power contends that they have made all agreed changes to the clause and has advised that they consider their requirements are consistent with the IEC.

In relation to part b), Western Power amended the section by deleting reference to continuous operation in Figure 3.5 and reducing the time interval to 1000 minutes (from 9999 minutes).

In relation to part c), Western Power has indicated their disagreement with the User’s concern. Western Power’s response is that that there are steam, gas, and combined cycle power stations in the SWIS which comply with 3.2.4.3(a).

In relation to part d), Western Power responded to the User’s concerns by clarifying that the purpose of the clause is that power stations should not trip due to a rapid reduction in frequency in order to allow the possibility of system recovery aided by under frequency load shedding. Western Power advised that the same requirement has been proposed for the NER.

Western Power has amended the terms “leading” and “lagging” in the clause and has also provided further information at Appendix 4.5 and 4.6.

The Committee noted the extensive changes had been made to these provisions. However, these had not been provided to the Committee in time for it to confirm that the amendments address the issues that have been raised.

Recommendation 5

The Authority should consider the information at Appendix 4.5 and 4.6 and any further information or submissions that Western Power may be able to provide, in determining whether the requirements set out in TR 3.2.4.3 (Generating Unit Response to Disturbances in the Power System) are unreasonable.

Monitoring and Control Requirements: TR 3.2.5

Users were concerned that there is insufficient technical detail to control what Western Power require in supplying Remote Monitoring Equipment for power stations and user substations.

Users considered that this uncertainty could constitute a barrier to entry as the equipment could vary in specification and complexity, with associated increase in compliance costs, at the discretion of Western Power.

Western Power asserted that, in their view, the NER provides less detail of requirements than the Technical Rules and so provision of more detail is not justified.

The Committee is deadlocked on this issue. A satisfactory agreement between the Committee and Western Power could not be reached and Users are concerned that this provision could constitute a barrier to entry.

A full record of the discussion of this issue is at Appendix 3.1.

Excitation Control System: TR 3.2.5.5

Users were concerned that it was unreasonable to require all synchronous generators greater than 30MW to have power system stabilisers (PSS's), without testing whether it is necessary for the particular network connection.

Users contended that the National Electricity Code does not require it and suggested that stabilisers be required only if power system studies demonstrate the need for them.

Western Power has stated that the provision of power system stabilisers is now recognised as good industry practice, and results in minimal additional cost for new generators. Western Power proposed no changes to this provision. However, Western Power advised that they would not require retrospective fitting of this equipment. The User representative maintained the opinion that the requirement is unreasonable.

This is an issue on which the Committee is deadlocked and Users are concerned that the requirement to install PSS's may be unreasonable.

A full record of the discussion of this issue is at Appendix 3.1.

Maximum Acceptable Total Fault Clearance Time: TR 3.4.2.5

Users were concerned that fault clearance times in tables 3.3 and 3.4 are significantly slower than those in the NEC. They contended that Western Power should aim to align the times with the NEC, because with these slow fault clearance times, generators would typically be subjected to unnecessary operational constraints, higher installation costs and export limitations.

User representatives on the Committee also raised concern with Western Power's practise of adding a safety margin of 20ms to the operating times when calculating total fault clearance times Western Power has advised the Committee that some changes have been made in relation to this practice, including the reductions of the 'safety margin' to 10ms. However, User concerns remain as to the rationale for using 20ms or 10 ms as opposed to any other number, including zero.

Users questioned why Western Power deals with slow fault clearing times by standardising to the lowest common denominator instead of using average system fault times.

Western Power advised it set slow fault times where the system can deal with them. Where a faster time is necessary, the new standard is applied. All new plants are required to comply with the new standards to enable costs to load users to be minimised.

The Committee considers this issue is one of deadlock as User concerns remain in relation to whether continuation of the existing practice was in accordance with good electricity industry practice.

A full record of the discussion of this issue is at Appendix 3.1.

5.4 Inspection, testing, commissioning, disconnection & reconnection (Chapter 4)

Chapter 4 defines rights, obligations and procedures, associated with these matters.

The only amendment to the proposed technical rules has been to better define the appropriate qualifications of professional engineers who provide certifications to Western Power on behalf of Users.

5.4.1 Contentious (Open) Issues

There are no contentious issues in relation to Chapter 4

5.5 Power system security (Chapter 5)

Chapter 5 of the Technical Rules now contains obligations and rights in four broad categories: Power System Security, Outage Planning, Co-ordination of Facilities and Co-ordination of Operation of Facilities.

The Technical Rules Committee identified a series of overlaps and potential conflicts between Chapter 5 of the proposed Technical Rules and Chapter 3 of the Wholesale Electricity Market (WEM) Rules and undertook further consultation with the Office of Energy, Western Power and the Authority in order to resolve these.

This group's view was that, where an overlap was identified it was appropriate that provision continue to be made in the WEM rules. Consequently, the group agreed to a series of amendments to the Technical Rules.

For consistency, it was also agreed that the Technical Rules should adopt the three stage definition of system operating state that is set out in the WEM rules. Thus the two stage approach that previously applied (Secure and Satisfactory) has been replaced in the proposed Technical Rules by the Market Rules definitions (Normal, High Risk and Emergency).

Clauses relating to System Security were deleted as they are covered by Chapter 3 of the WEM rules. These clauses relate to the obligations placed on the System Management entity (as defined in the WEM rules) to be responsible for Power System Security in the SWIS.

Obligations and rights placed upon Network Operators and Users for outage planning of their facilities are covered in Chapter 3 of the WEM rules. The scope of the WEM rules covers generators with “Capacity Credits” and network elements listed in the “outage schedule list”, as defined in the WEM rules.

Consequently, clauses in Chapter 5 have been revised so that their scope is limited only to Users who do not have to submit an outage plan under WEM rule 3.18.5 and network facilities not covered under the outage schedule list of the WEM.

The clauses relating to facility and operation co-ordination remain, as they are not covered under the WEM rules.

5.5.1 Contentious (Open) Issues

Western Power's Obligations: TR 5.3.2

Sections 5.3.2(b) and (c) were considered by User representatives to be of a legal nature and should be removed from the Technical Rules.

Western Power advised that according to their advice, the statement belongs in the Technical Rules.

In contrast, legal advice was provided by the Authority recommending the provisions be deleted.

The Committee has not been able to reach a satisfactory conclusion to the issue, and the issue is considered to be deadlocked.

A full record of the Committee discussions, including the legal advice that has been presented to the Committee is included at Appendix 3.1.

Transmission and Distribution Network Voltage Control: TR 5.5.1

The Authority is referred to the discussion under Stability Assessment (TR 2.3.7)

Protection or Control System Abnormality: TR 5.8.2

Under 5.8.2(b) in the proposed Technical Rules, Western Power may direct users to operate if Western Power considers there is a threat to system security. A User was concerned that the commercial impact of these directions may be large.

The Committee has not been able to reach a satisfactory conclusion to the issue as concerns remain in relation to the potential commercial impacts of such a direction and how these would be resolved ‘post event’.

A full record of the discussion of this issue is at Appendix 3.1.

5.6 Derogations (Chapter 6)

Chapter 6 defines derogations, their intent and procedure for granting derogations. Section 6.2 grants a blanket derogation for all existing plant connected to the system at the Rules commencement date.

There have been no changes to this chapter subsequent to the August 2005 version of the Technical Rules.

5.6.1 Contentious (Open) Issues

There are no contentious issues in this section

6. OTHER ISSUES

6.1 Distribution Design

Western Power's proposed Access Arrangement, which was submitted in parallel with the proposed Technical Rules, included a series of expenditure submissions resulting from changes to distribution system design and construction standards. Each of these impacted on the design and consequently the cost of installation of the distribution network.

In considering these provisions, the Committee notes that generally the distribution component of the network receives little attention in the rules and, while not as important for stability, is of the view that it needs to be adequately regulated to ensure reliability is maintained.

The Committee also notes that because its membership is drawn mainly from transmission connected Users, the Committee does not have all of the skills necessary to offer complete advice on these matters.

Western Power has advised that changes to distribution planning practices were included to:

1. Address the rapidly increasing demand for electricity by residential and industrial users; and
2. Ensure that Western Power's network was capable of meeting performance standards that are increasingly required as a result of (for example) the customer outage payments scheme.

The Committee determined that it could add value by considering the information that was provided in support of Western Power's expenditure requests, and expressing a qualified opinion as to the suitability of this information in justifying the expenditure requests.

The Committee also invited representatives of the Urban Development Institute of Australia (UDIA), the body representing the property industry in Western Australia, to contribute to discussions on these matters. Two representatives of the UDIA attended the TRC meeting held on 22 September 2005 and the Association provided a submission to the TRC, critiquing Western Power's proposals. The UDIA submission, and a consolidated version which incorporates Western Power's detailed responses to the issues raised in the UDIA submission, are included at Appendix 4.3.

Western Power also submitted the analytical basis for its changes to ADMD for the Committee's consideration. This report is also included at Appendix 4.3.

Proposed TR 2.10 'Increased ADMD Design Criteria (Residential)'

This clause refers to a design criteria of "50 year maximum load". It does not make any reference as to how this relates to the outcomes of the ADMD investigations that have been carried out by Western Power and presented to the Committee as justification of the rule.

The Committee notes that, whilst it may be reasonable that the assets have a 50 year operational life, it would seem difficult to forecast a 50 year load with any certainty. The Committee refers to the difficulty experienced in making single year forecasts of electricity demand growth and the fact that no distribution jurisdiction in Australia anticipated the growth in air conditioning load, which would be unlikely to have been included in forecasts made as little as 5 years ago. The Committee considers that this uncertainty requires some flexibility as to design processes.

There will continue to be increasing availability and use of various appliances. However their efficiency and the extent to which they replace existing technologies cannot be predicted with any certainty. Therefore it is difficult to determine what the net effect on energy use will be.

The methodology (ie the model) that is to be used to predict the future load requirement for a particular subdivision is not discussed in the Technical Rules and the lack of trend data that would allow determination of the accuracy of the fit of such a model over time is problematic. That is, whilst the proposed model may provide a reasonable fit, across socio-economic boundaries at this point in time, it is not known if the step is still continuing or approaching a stable equilibrium.

Given the level of uncertainty around this issue, it is possible that development of a determinative rule may not be possible. Including the model or equation that is used to calculate the ADMD within the technical rules may impose a cost in terms of certainty, but could be a more flexible and transparent approach to the issue.

'Over design' of the assets will provide a secure service but at a cost to the developer and/or land owner. The Committee notes that cable costs are the most significant element but reserving more transformer locations also has a cost in loss of saleable land and amenity to the adjoining occupiers.

Despite this, the benchmarking information supplied by Western Power indicates that this proposal is, on average, within the limits set in other Australian jurisdictions.

However, the Committee is unable to form a view as to how this relates to implementation, as it has not been provided with information that could be used to draw a relationship between the ADMD value and the 50 year planning horizon.

Proposed TR 2.10 'Increased Minimum Design Load Industrial/ Commercial lots'.

Comments made above regarding the applicability of ADMD values to planning horizons are also relevant in the proposed design requirements of industrial and commercial lots. Similarly, the uncertainty requires more flexible design paradigms which in this case may also include the consideration of HV only installations.

Land use on industrial or commercial land is likely to be more fluid than that of residential land. That is, over the serviceable life of the network there may be multiple land uses with varying energy intensities. Therefore, in order to protect maximum flexibility in future land use, it is reasonable to impose a minimum capacity requirement.

The Committee also accepts Western Power's observations in relation to the need to establish and construct network elements at an early stage of lot development to avoid difficulties in obtaining suitable sites once further development of the site had begun.

However, the Committee has no position as to whether the proposed minimum (of 110kVA irrespective of lot size) is reasonable and has not been provided with information which benchmarks the proposal against design criteria in other jurisdictions.

Proposed TR 2.5.2.4 'Limits on Radial High Voltage Feeders.'

Western Power has advised that having fewer customers on a non interconnectable part of the network means less customers are affected by either planned or unplanned outages on the network, thereby improving reliability to customers and reducing potential customer liability under the customer outage payments scheme.

This is proposed as the main driver for imposing this standard.

Western Power's rationale is that the penalty levied on WPC by Government (by virtue of the Customer Outage Payment Scheme) is similar to the cost for installing the necessary equipment. The advantage of limiting the number of customers effected by an outage upfront is that it avoids excessive customer liabilities in the event of a long duration outage.

Whilst the logic of Western Power's position is reasonable, the Committee has no view as to whether increased costs in the implementation of this standard are offset by reduced customer liabilities under the customer outage payments scheme. Simulation modelling that is beyond the scope of the Committee would be required to determine whether such a claim can be justified.

Proposed TR 2.5.2.5 'Low Voltage Distribution Networks'

Western Power has proposed a standard for residential subdivisions whereby all low voltage (415V) circuits will have a switching point every 16 customers. This is to improve operational flexibility during maintenance and outage situations for low voltage customers. In these situations greater interconnectivity means WPC can do work on the network without customers losing supply.

Western Power has stated that poor operability and no improvement to reliability will result if this standard is not approved by the Authority.

The Committee recognises the benefits of having greater flexibility when managing the network during situations of maintenance or outage. However, it has no additional information that would allow benchmarking of this standard against other jurisdictions and therefore no ability to advise the Authority as to whether the implementation of this standard is reasonable from a technical perspective.

Proposed TR 2.5.2.6 'Pole to Pillar connections mandatory.'

Western Power has advised that the purpose of this program is to improve reliability to customers in areas that are currently serviced by the overhead network. This occurs because underground service leads are less susceptible to storm related 'wire down' incidents, which account for 60% to 70% of storm related faults.

Western Power have also identified a safety benefit associated with this program, which extends the current mandatory requirements for undergrounding in new connections within the metropolitan area to upgrades within the Metropolitan area, and to new connections in regional areas.

Western Power does not state that this standard is necessary for the Corporation to comply with existing safety legislation or government policy relating to supply reliability.

It does not appear to have been subject to an economic evaluation.

The Committee agrees with Western Power's proposition that reliability benefits will be gained through the undergrounding of all new service leads.

<u>Proposed TR 2.5.2.7 Distribution Remote Control and Monitoring</u>

Western Power has advised that all new or replaced transformers and switches (RMUS) should be remotely operable and controlled from the Network Operations Control Centre. This requirement has been proposed because of the level of public scrutiny of the reliability on the distribution network.

The program will be used to improve reliability and increase the amount of data available for effective network operation and planning. Greater monitoring of the HV & LV networks will be achieved by installing remotely readable meters on all switch gear and transformers which will be connected to the SCADA system.

These design changes are intended to improve reliability and operability of the network and Western Power asserts that they will save on significant retrofitting costs.

The Committee notes that, whilst the proposal appears to be technically valid in that it is likely to result in higher reliability, and faster restoration of services in the event of an outage, it is not considered critical to the operation of the network and has not been subject to economic evaluation.

<u>Proposed TR 2.11 Distribution Construction Standard</u>

Western Power has advised that the design for overhead construction must be made fire proof, including by measures such as greater tree clearing profiles, sparkless fuses, covered conductors and under ground conductors. Western Power advises that this fire proofing is only required in high and extreme fire areas and that the consequence of not complying with Network fire proofing standards and coronial recommendations to reduce fire risk in high and extreme fire areas are likely to be a greater frequency of fires and the associated loss of life and damage to property.

The Committee has not had access to information on which to form a view on Western Power's assertions that the standard proposed is necessary due to safety and legal requirements.

Recommendation 6

In relation to the Distribution design changes, the Authority, in consultation with its advisers and the TRC, should develop an information request and require WP to make a single comprehensive submission to the Authority. The information request and submission should address all issues required to be assessed by the Authority under the Access Code, including the economic merits of the design changes.

6.2. Small Generators

Note: The TRC recognises that in some cases the Access Code, and therefore the Technical Rules, do not apply to Small Generators. At this stage the TRC considers that where possible the development of the Technical Rules should continue to consider the implications, and where the objectives of the Access Code and the Technical Rules are not compromised, seek to accommodate the interests of all network users.

The TRC convened a Small Generators Working Group (SGWG), representing Distribution connected Users with installed capacity of 30kVA to 10MW. This process sought to ensure that these interested stakeholders were able to provide comment on Western Power's proposal. Invitees and their affiliations are listed in Appendix 6.

The SGWG Working Group met on 20 October 2005 and key resolutions from that meeting were that:

- Continued engagement with small generation stakeholders in the rule-making process was necessary;
- There are potentially hundreds of standby diesel generators totalling over 100 MW of installed capacity that could be used for network and system wide capacity support at peak demand times;
- This capacity could only be accessed if the technical rules were set in such a way that these generators could occasionally operate in parallel;
- There was concern that the categorisation of generators was not sufficiently responsive to reflect the different technical requirements dictated by the generators size and connection type;
- A continuation of the current 'top-down' approach to outlining the requirements for small generators would place them under significantly more onerous requirements than were actually necessary;
- Development of 'stand-alone' information that presented technical requirements in a simplified manner would make a significant contribution to reducing a perceived barrier to entry; and
- Further work was required in the classification of categories of parallel operators with respect to the export/non-export of energy.
- Ongoing work with the Authority and the TRC and a commitment to continuous improvement in the Technical Rules would significantly enhance uptake.

In response to the issues raised at the meeting, Western Power undertook a range of amendments, focussing primarily on rule 3.5. These amendments, which are reflected in the conformed rules at Appendix 2, are described below.

Western Power has indicated that the main intent of the revisions implemented was simplifying the requirements for small generators by minimising cross-references to other sections, and to provide a more logical structure.

Amendments include:

- The preamble to Section 3.5 has been rewritten and incorporated in a new sub-clause 3.5.2, with the inclusion of parts of old clause 3.2.

- The original Table 3.5 cross-referenced a number of requirements in other parts of the document. The simpler and more straightforward of these have been repeated in Section 3.5 and the cross-references deleted. The remaining cross-references are to the more detailed requirements.
- The “bumpless transfer” mode of operation has been subdivided into “rapid transfer” (one second paralleling) and “gradual transfer” (one minute paralleling) modes. A new mode, “occasional parallel operation”, has been included.
- The requirements regarding substations, synchronising and safe shutdown have been grouped with the requirements of old clause 3.5.3 and included in new clause 3.5.5.
- The requirements regarding quality of supply have been grouped with the requirements of old clause 3.5.4 and included in new clause 3.5.6.
- Remote monitoring is now required only in specific cases.
- Various changes have been made to the protection requirements (new clause 3.5.8), including:
  - Emphasizing the role of the User in the design of the protection.
  - Clarifying the role of Western Power, which is to approve the protection philosophy but not the make of protection relays.
  - Permitting the use of fail-safe protection as an alternative to back-up protection
  - Requiring the use of IEC 60255 compliant relays for system protection for new installations but permitting the use of non-IEC 60255 relays when retrofitting existing installations for short-term paralleling or bumpless transfer – with the exception of the disconnection timer, which must be IEC 60255 compliant. Protection of the Users plant is not covered by these rules, and is at the discretion of individual Users.
  - Permitting the use of integrated control and protection devices subject to functional separation of protection elements.
  - Addition to table 3.6 of clause references and notes.
  - Requiring pole slip protection only where necessary for network protection.
  - Clarifying the requirements for islanding protection.
- The requirements for coordination between the User and Western Power, and for certification of the design and installation, have been clarified and grouped together.

Following the completion of redrafting, User representatives on the SGWG were requested to evaluate the changes and made the comments below.

Time constraints have restricted Western Power’s ability to respond to these comments. Therefore, the Authority is advised that further consultation with Western Power is required before resolution of these issues can be resolved.

<u>Main generator categories missing</u>

The revisions have not addressed the need for separate categories for Occasional Parallel Operation with Export and No Export for LV generators. Although the rules now include a category of "Occasional Parallel Operation, export or no export", the category does not differentiate protection requirements in Table 3.6 for LV generators that Export versus those LV generators Without Export.

For HV generators a No Export column is given separately from a column for Export, but this distinction is not included for LV generators. The same applies for the Short Term Test Parallel category in Table 3.6 which does not make it clear whether for LV generators the requirements assume No Export (as for the HV column). LV generators seeking to run in parallel with No Export for Test or Occasional operation purposes are the largest two categories of generators seeking to parallel at present

The protection requirements for No Export should be less onerous than for Export, so a category is required for No Export LV generators separate to Export in Table 3.6 and other related clauses.

<u>Specified protection types need further discussion with the SGWG.</u>

The actual protection types specified for each category still require further discussion between the small generator industry and Networks through the SGWG as they still appear to be more onerous than necessary for some applications/categories for small generators and therefore a barrier to entry.

The current version of the Technical Rules lists the protection types required in Table 3.6, but related clauses cause uncertainty about whether only some, or all of these types are required when some types of protection achieve more than one required outcome. Also it is not clear whether or not the specified protection is additional to control or protection functionality that may already exist as part of a proprietary piece of equipment such as a parallel transfer switch. It appears that no explicit consideration of the size of the generator relative to the capacity of the network supply to the point of connection of the generator has been included.

<u>Protection Requirements.</u>

The requirement for protection equipment to meet the IEC 60255 standard for all parallel generation situations needs further discussion with the SGWG. Whilst the reasons for this being prescribed are understood, this requirement should be questioned and discussed further. It is noted that substantial non-compliant control and protection equipment is already in use by the small generator industry around Australia and the rest of the world, and it is accepted by many electricity utilities and/or regulators. Such equipment is also currently being used by Western Power for certain applications. The SGWG considered that perhaps Western Power's proposed requirement is convenient, but it seems to be unnecessarily onerous and a barrier to entry for small generators.

It is important to the SGWG that an avenue for further detailed discussion of these issues is made available by the Technical Rules Committee and the Authority. These discussions will need to cover the technical detail and so involve appropriately qualified/experienced people familiar with the wide variety of small generator applications.

Recommendation 7

The Authority should continue consultation with the SGWG with a view to resolving the remaining issues.

6.3 Separation of responsibilities between System Management and NSP

In their current form the Technical Rules do not differentiate between the roles of System Management and the Network Service Provider. Whilst the TRC expects that this will not cause difficulty for the physical operation of the network, the TRC is of the view that differentiation between these two roles will enhance accountability and transparency in the manner in which the rules are administered.

Recommendation 8

The Authority should require Western Power to propose amendments to the Technical Rules to differentiate between the roles of System Management and that of the Network Service Provider

6.4 Legal Effect (Drafting)

On numerous occasions the Committee discussed issues relating to what it perceived to be errors in law, or drafting inconsistencies which may affect the legal standing of the Technical Rules.

An example was in the inconsistent use of definitions where in a number of instances the proposed Technical Rules used different terms to describe a unique event. In some cases the terms were defined, whilst in others they were not.

The Committee attempted to resolve these issues wherever they were identified. However, any remaining ambiguity may impact on the ability of the Authority, and Western Power, to enforce compliance with the Technical Rules.

Further concerns in relation to the inclusion of 'legal' statements has been expressed by User representatives. Users are particularly concerned where these act to exclude liability. An example of such a statement is contained in the second paragraph of 3.2.4.8 (b).

Users have expressed a strong view that such statements are commercial statements and as such should be contained within a commercial document, such as an Access Contract. However, Western Power has advised that, based on legal advice, it is not prepared to delete these statements.

Recommendation 9

The Authority should subject the Technical Rules to a legal review and redraft them where necessary.

The focus of the review should be on:

1. ensuring consistency of language and style between the rules and other regulatory instruments (such as the Access Code);
2. ensuring that obligations on parties are clear, effective and represent a balanced commercial outcome considering the relative risks in involved
3. considering whether legal 'exclusion' or 'liability' statements are appropriate for inclusion in the Technical Rules.

6.5 Requirement To Act Reasonably

The Committee agreed that where the Technical Rules provided for discretion to a party in the performance of an obligation it was incumbent on that party to exercise that discretion in a reasonable manner. Section 1.5 of Western Power's proposed Technical Rules provides clauses to that effect.

However, one of the User's remains concerned that Western Power's proposed clauses would not achieve the objective of requiring Western Power to act reasonably, and that the clauses did not appear to be legally robust nor did they adequately define the obligations.

The Committee agreed that the reasonableness clauses were applicable in conjunction with many critical operational clauses within the technical rules and that they may well be a focal point in any dispute.

Users were of the view that the clauses needed to be expanded, clarified and made more legally robust.

The concerned Users tabled the following provisions for the Authority's consideration.

> *"1.5.1 Determinations and Discretion*
> *Where Western Power is to make a determination or exercise a discretion, it must do so reasonably and in good faith and in a manner consistent with the objectives of these Rules.*
>
> *1.5.2 Failure to Fulfil a Technical Requirement*
>
> *(a) Subject to sub-paragraph (b), failure by a party applying to become a User to fulfil a technical requirement of these Rules will not, of itself, be ground for Western Power to reject the application if, in all the circumstances, rejecting the application for such failure would be an inappropriate barrier to entry into the market.*
>
> *(b) Sub-paragraph (a) only applies where the technical failure is such that it would not prejudice or put at risk the network of the facilities or other property of a User and is not contrary to good electricity industry practice.*
>
> *1.5.3 Reasons for Rejection*
> *If Western Power rejects an application to become a User it must provide written reasons for the rejection including why, in all the circumstances the rejection of the application is consistent with the objectives of these Rules. "*

In response, Western Power made the following comments in relation to the proposal.

- *The proposal puts the obligation on Western Power (WP) only to act reasonably, whilst no such obligation is placed upon Users. This is inadequate, because the Access Arrangement and Technical Rules specify the rights and responsibilities of both WP and Users.*
- *The content of the proposal is partly outside of the purpose and objectives of the Technical Rules. Whereas it is appropriate for WP to provide written reasons for rejecting an access application, it is inappropriate for WP, in the capacity of a Network Service Provider (NSP), to judge and discuss what is or*

what is not "an inappropriate barrier to entry into the market". The latter is for the economists, the Authority, Australian Competition and Consumer Commission and Government to decide.

The matter is deadlocked.

Recommendation 10

As part of the legal review, the Authority should have regard to comments provided by Users and Western Power in determining an appropriate form of the 'reasonableness' clause.

6.6 Narrative Content

The Committee found that extensive sections of Western Powers submission contained text that could not be supported for inclusion in a technical document of this nature. Throughout its deliberations, the committee identified these, and in many cases the conformed technical rules at Appendix 2 have deleted this text.

The Committee considers that the Authority should be mindful of only including rules which set out specific technical specifications or obligations and that these should not be obscured by 'value' or explanatory statements.

Appendix 1– Matters to be Addressed by Technical Rules

1. MATTERS TO BE ADDRESSED BY TECHNICAL RULES

Technical rules must address at least the following matters:

(a) performance standards in respect of *service standard* parameters; and

(b) the identity of the system operator for the *network*; and

(c) the technical requirements that apply to the design and operation of *facilities and equipment connected* to the *network*; and

(d) the standards which apply to the operation of the *network*, including in emergency situations; and

(e) obligations to test *facilities and equipment* in order to demonstrate compliance with the *technical rules*; and

(f) procedures that apply if the *service provider* believes that any part of *facilities and equipment* does not comply with the *technical rules*; and

(g) procedures that apply to the inspection of *facilities and equipment connected* to the *network*; and

(h) the standards which apply to control and protection settings for *facilities and equipment connected* to the *network*; and

(i) procedures that apply to the commissioning and testing of new *facilities and equipment connected* to the *network*; and

(j) procedures that apply to the disconnection of *facilities and equipment* from the *network*; and

(k) the information that a *user* must provide to the *service provider* in relation to the operation of *facilities and equipment connected* to the *network*; and

(l) the *generation* and *load* forecast information that *users*, *consumers* and *generators* must provide to the *service provider*; and

(m) *network* planning criteria, which must address at least the following matters:

(i) contingency criteria; and

(ii) steady-state criteria including:

A frequency limits; and

B voltage limits; and

C thermal rating criteria; and

D fault rating criteria; and

E maximum protection clearing times; and

F auto reclosing policy; and

G insulation coordination standard;

and

(iii) stability criteria including:

A rotor angle stability criteria; and

B frequency stability criteria; and

C voltage stability criteria;

and

(iv) quality of supply criteria including:

A voltage fluctuation criteria; and

B harmonic voltage criteria; and

C harmonic current criteria; and

D voltage unbalance criteria; and

E electro-magnetic interference criteria;

and

(v) construction standards criteria; and

(n) curtailment of *services* including matters such as:

(i) planned and unplanned maintenance, testing or repair of the *network;* and

(ii) breakdown of or damage to the *network*; and

(iii) events of *force majeure*; and

(iv) the *service provider's* obligations to comply with a *written law* or a *statutory instrument*.

2. MATTERS ADDRESSED BY THE CONFORMED TECHNICAL RULES

Matter to be addressed	**Section of Rules where the matter is addressed**
(c) the technical requirements that apply to the design and operation of *facilities and equipment connected* to the *network*	TR Chapter 3
(d) the standards which apply to the operation of the *network*, including in emergency situations;	TR Chapter 2
(e) obligations to test *facilities and equipment* in order to demonstrate compliance with the *technical rules*	TR 4.1
(f) procedures that apply if the *service provider* believes that any part of *facilities and equipment* does not comply with the *technical rules*;	TR 4.1
(g) procedures that apply to the inspection of *facilities and equipment connected* to the *network*	TR 4.1
(h) the standards which apply to control and protection settings for *facilities and equipment connected* to the *network*	TR 2.10 & TR 3.4
(i) procedures that apply to the commissioning and testing of new *facilities and equipment connected* to the *network*;	TR 4.2
(j) procedures that apply to the disconnection of *facilities and equipment* from the *network*	TR 4.3
(k) the information that a *user* must provide to the *service provider* in relation to the operation of *facilities and equipment connected* to the *network*	TR 5.8
(m) *network* planning criteria, which must address at least the following matters:	
(i) contingency criteria; and	TR 2.5
(ii) steady-state criteria including:	
A frequency limits;	TR 2.6.0
B voltage limits;	TR 2.6.1
C thermal rating criteria;	TR 2.6.2
D fault rating criteria;	TR 2.6.3
E maximum protection clearing times;	TR 2.10.2.5
F auto reclosing policy;	TR 2.10.3.7
G insulation coordination standard;	TR 2.3.3.2 & 2.3.3.3
(iii) stability criteria including:	
A rotor angle stability criteria;	TR 2.3.1

B frequency stability criteria; C voltage stability criteria:	TR 2.3.2 TR 2.3.3
(iv) quality of supply criteria including: A voltage fluctuation criteria B harmonic voltage criteria C harmonic current criteria D voltage unbalance criteria	 TR 2.2.3 TR 2.2.4 TR 2.2.4 TR 2.2.5
E electro-magnetic interference criteria	TR 2.2.6
(v) construction standards criteria	TR 2.11
(n) curtailment of *services* including matters such as	
(i) planned and unplanned maintenance, testing or repair of the *network*	TR 5.3.2
(ii) breakdown of or damage to the *network*	TR 5.3.2
(iii) events of *force majeure*;	TR 5.3.2
(iv) the *service providers* obligations to comply with a *written law* or a *statutory instrument*.	TR 5.3.2

DRAFT TECHNICAL RULES

FOR SUBMISSION TO

THE TECHNICAL RULES COMMITTEE
OF THE
ECONOMIC REGULATORY AUTHORITY

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Strategy and Regulation Branch
Networks Business Unit
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IMPORTANT NOTE: This document is subject to amendment (amendments must be performed in accordance with the Electricity Networks Access Code 2004). People referring to this document are advised to consult the Manager Strategy and Regulation, Networks Business Unit, Western Power Corporation, to ensure that they have the latest version. The document is available for downloading at Western Power's internet site: www.westernpower.com.au

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PREFACE

Western Power Corporation ("*Western Power*") was established on 1 January 1995 by the Electricity Corporation Act 1994 (the "Act").

The Act requires that *Western Power* provides open access to capacity in its electricity transmission and distribution networks. The principal objective of open access is to facilitate competition in the energy industry by allowing independent generators to supply associated loads by utilising *Western Power's* networks. The Electricity Networks Access Code 2004 "Access *Code*", which superseded the initial regulations, covers transmission and distribution networks. Chapter 12 of the 2004 "*Access Code*" requires *Western Power* to publish a Technical Rules "*Rules*". In addition, clause A6.1(m) requires *Western Power* to publish network planning criteria. The network planning criteria are included in this document.

This code covers the *South West Interconnected System* (SWIS).

These *Rules* details the technical requirements to be met by *Western Power* on its transmission and distribution networks and by *Users* who connect facilities to the transmission and distribution networks. In addition, the planning criteria to be applied to the network are contained within these *Rules*. Prospective *Users* or existing Users who wish to connect facilities to the transmission and distribution networks must first submit an access application to *Western Power* in accordance with the Access *Code*.

As this document is subject to amendment, people referring to this document are advised to consult the Manager Networks Strategy and Regulation, *Western Power* Corporation, at the address below, to ensure that they have the latest version.

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The document can also be examined/downloaded at *Western Power's* internet site: www.westernpower.com.au

It is important to note that amendments to this document, and variations and exemptions to *Rules* requirements granted to *Users*, can only be made in accordance with the *Code*.

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1 GENERAL

This section defines the scope of the *Technical Rules* for both it's content and it's application. It provides rules of interpretation and refers to the dispute resolution process. It establishes the obligations of all parties and defines the methodology for variations, exemptions and amendments to the code.

1.1 AUTHORISATION

These *Technical Rules* ("*Rules*") are made under clause 4.1 of the Electricity Networks Access Code 2004 "*Access Code*"). The *Rules* set out:

(a) performance standards in respect of service quality parameters in relation to the *electricity transmission and distribution network*;

(b) the technical requirements which apply to the design or operation of *plant* or equipment *connected* to the *electricity transmission and distribution network*;

(c) requirements relating to the operation of the *electricity transmission network* (including the operation of the *electricity transmission and distribution network* in emergency situations or where there is a possibility of a person suffering injury);

(d) obligations on *user*s to test *plant* or equipment in order to demonstrate compliance with the technical requirements referred to in paragraph (b) and the operational requirements referred to in paragraph (c);

(e) procedures which apply if *Western Power* believes that a *user*'s *plant* or equipment does not comply with the requirements of the *Technical Rules*;

(f) procedures relating to the inspection of a *user*'s *plant* or equipment;

(g) procedures which apply to system tests carried out in relation to all or a part of the *electricity transmission and distribution network*;

(h) requirements which relate to control and *protection* settings for *plant* or equipment *connected* to the *electricity transmission and distribution network*;

(i) procedures which apply in the case of the commissioning and testing of new *plant* or equipment *connected* to the *electricity transmission and distribution network*;

(j) procedures which apply to the *disconnection* of *plant* or equipment from the *electricity transmission and distribution network*;

(k) procedures relating to the operation of *generating units* and other *plant* or equipment as part of or *connected* to the *electricity transmission and* *distribution network* (including the giving of *dispatch* instructions and compliance with those instructions);

(l) *metering* requirements in relation to *connections*;

(m) the information which each *user* is required to provide *Western Power* in relation to the operation of *plant* or equipment *connected* to the *electricity transmission and distribution network* at the *user*'s *connection*s and how and when that information is to be provided;

(n) requirements in relation to under *frequency load shedding* with which *user*s must comply;

(o) any other matters relating to the *power system* (including the *electricity transmission and distribution network*) or *plant* or equipment *connected* directly or indirectly to the *electricity transmission and distribution network*; and

(p) the *network planning criteria* as required by clause A6.1(m) of the *Access Code*.

1.2 APPLICATION

In these *Technical Rules*, unless otherwise stated, a reference to *Western Power* refers to the Networks Business Unit of *Western Power* for the *South West Interconnected System. Other business units of Western Power are "users" under the Rules.*

- These *Rules* apply to:

  (a) *Western Power* in its role as the operator of the *electricity transmission and distribution network*;

  (b) every person who seeks access to *spare capacity* or *new capacity* or makes an *access application* under the *Access Code* in order to establish a *connection* or modify an existing *connection*;

  (c) every person to whom access to electricity transmission *and distribution* capacity is made available (including, without limitation, *Western Power* in its role as a trader of electricity and every person with whom *Western Power* has entered into an *access contract*); and

  (d) the *Arbitrator, as defined in the Access Code*.

These *Rules* apply to all *plant* and equipment installed:

(a) in the *Western Power electricity transmission and distribution network*s; and

(b) by *user*s who are *connected* (either directly or indirectly) to the *electricity transmission and distribution network*s, and who impact on the operation and security of the *electricity transmission and distribution network*s, including *embedded generators*.

1.3 COMMENCEMENT

These *Rules* come into operation on **dd Month 2006** ("*Rules commencement date*").

1.4 INTERPRETATION

In these *Rules*, words and phrases are defined in Attachment 1 and have the meanings given to them in Attachment 1, unless the contrary intention appears.

These *Rules* must be interpreted in accordance with the rules of interpretation set out in Attachment 2, unless the contrary intention appears.

1.5 *WESTERN POWER* AND *USERS* TO ACT REASONABLY

Subject to the Electricity Networks Access Code 2004 "*Access Code*", the *Western Power* and the *Users* must comply with these *Technical Rules*.

1.5.1 Exercising Discretion

To the extent that the *Western Power* and/or *Users* are granted any discretion under these *Technical Rules*, that discretion must be exercised reasonably and in a manner that is consistent with the objectives of these *Rules* and, in particular, consistent with *Good Electricity Industry Practice*.

1.5.2 Towards Each Other

The *Western Power* and a *User* must act reasonably towards each other in regard to these *Rules*, consistent with the objectives of these *Rules*.

1.6 DISPUTE RESOLUTION

All disputes concerning these *Rules* are to be resolved according to the clause 10.2 of the Electricity Networks Access Code 2004.

1.7 OBLIGATIONS

1.7.1 Obligations of *User*s

All *Users* must maintain and operate (or ensure their authorised *representatives* maintain and operate) all equipment that is part of their *facilities* in accordance with:

(a) relevant laws;
(b) the requirements of the *Access Code*;
(c) the requirements of these *Rules*; and
(d) *good electricity industry practice* and applicable *Australian Standards*.

Refer to clauses A3.71 to A3.78 (Liability and indemnity and Insurances) of the *Access Code*.

1.7.2 Obligations of *Western Power*

(a) *Western Power* must comply with the *power system* performance and *quality of supply* standards:

1) described in these *Rules*; and
2) in accordance with any *access contract* with a *User*.

(b) *Western Power* must:

(1) ensure that to the extent that a *connection point* relates to the *electricity transmission and distribution network,* every arrangement for *connection* with a *User* complies with all relevant provisions of these *Rules*;
(2) permit and participate in inspection and testing of *facilities* and equipment in accordance with clause 4.1;
(3) permit and participate in commissioning of *facilities* and equipment which is to be *connected* to its *network* in accordance with clause 4.2;
(4) advise a *User* with whom there is an *access contract* of any expected interruption characteristics at a *connection point* on or with its *network* so that the *User* may make alternative arrangements for *supply* during such interruptions, including negotiating for an alternative or backup *connection*; and
(5) use its reasonable endeavours to ensure that modelling data used for planning, design and operational purposes is complete and accurate and order tests in accordance with clause 4.1 where there are reasonable grounds to question the validity of data.

(c) *Western Power* must arrange for:

(1) management, maintenance and operation of the *electricity transmission and distribution network*s such that in the *satisfactory operating state*, electricity may be transferred continuously at a *connection point* up to the *agreed capability*;

(2) management, maintenance and operation of its *networks* to minimise the number and impact of interruptions to the *User* through adequate notification and consultation by using *good electricity industry practice*; and

(3) restoration of the *agreed capability* as soon as reasonably practicable following any interruption at a *connection point* on or with its *network*.

1.7.3 Obligations of *Users* With *Loads*

(a) Each *User* with a *load* must ensure that all *facilities* which are owned, operated or controlled by it and are associated with a *connection point* at all times comply with applicable requirements and conditions of *connection* for *loads:*

(1) as set out in clause 3.3; and

(2) in accordance with any *access contract* with *Western Power*.

(b) A *User* with a *load* must:

(1) comply with the reasonable requirements of *Western Power* in respect of design requirements of equipment proposed to be *connected* in accordance with clause 3.3;

(2) permit and participate in inspection and testing of *facilities* and equipment in accordance with clause 4.1;

(3) permit and participate in commissioning of *facilities* and equipment which is to be *connected* to a *network* location for the first time in accordance with clause 4.2;

(4) operate its *facilities* and equipment in accordance with any reasonable *direction* given by *Western Power*; and

(5) give notice of any intended permanent or extended time voluntary *disconnection* in accordance with clause 4.3.

1.7.4 Obligations of *Generators*

(a) A *Generator* must comply at all times with applicable requirements and conditions of *connection* for *generating units:*

(1) as set out in clause 3.2; and

(2) in accordance with any *access contract* with *Western Power*.

(b) Each *Generator* must:

(1) comply with the reasonable requirements of *Western Power* in respect of design requirements of equipment proposed to be *connected* to the *network* of *Western Power* in accordance with clause 3.2;

(2) permit and participate in inspection and testing of *facilities* and equipment in accordance with clause 4.1;

(3) permit and participate in commissioning of *facilities* and equipment which is to be *connected* to a *network* location for the first time in accordance with clause 4.2;

(4) operate *facilities* and equipment in accordance with any reasonable *direction* given by *Western Power*; and

(5) give notice of intended voluntary *disconnection* in accordance with clause 4.3.

1.8 VARIATIONS AND EXEMPTIONS FROM, AND AMENDMENTS TO, THE *RULES*

1.8.1 Variations and Exemptions to the *Rules*

Various clauses throughout these *Rules* permit variations or exemptions from *Rules* requirements to be granted to a *User* by reference to terms which include:

a) the requirements may be varied, but only with the agreement of *Western Power*;

b) unless otherwise agreed by *Western Power*;

c) unless otherwise agreed; and

d) except where specifically varied in an *access contract*.

In all cases, the requirements of these *Rules* can only be varied or waived for a *User* in accordance with the provisions of the *Access Code*. Any such variation or exemption must be granted for a specified period or indefinitely to *User(s)* by *Western Power*.

1.8.2 Amendments to the Rules

Western Power may amend these *Rules* only in accordance with the *Access Code*.

2. *TRANSMISSION AND DISTRIBUTION NETWORK* PERFORMANCE AND PLANNING CRITERIA

2.1 INTRODUCTION

This Chapter ~~Section~~ describes the technical performance requirements of the *transmission and distribution networks*, and the requirements for co-ordination between *Users* and *Western Power* to achieve these. In particular it sets out the obligations of *Western Power* with respect to the planning and design of the networks and the determination of network operating constraints.

In particular circumstances,~~,~~ *Western Power* may vary ~~the requirements may be varied, but only with the agreement of *Western Power*~~. However, where it ~~is~~ intend~~ed~~s to do so ~~vary the requirements set down, it~~ Western Power must be able to demonstrate~~d~~ that the variation will not have a material advers~~ely~~ ~~affect~~ effect on *Users* and *power system security*. Refer to Section 6 - *Derogations*.

~~Prior to a *User's facilities* being *connected* to the *power system*, the impact on *power system* performance due to the *User's facilities* is to be determined by *power system* simulation studies as specified by *Western Power*. These studies may be performed by the *User* or a third party, in which case, *Western Power* will require full details of the studies performed, including, assumptions made, results, conclusions and recommendations. However, acceptance of the studies performed by a *User* or a third party will be entirely at *Western Power's* discretion. Acceptance of *power system* studies by *Western Power* does not absolve *Users* of responsibility/liability for damages or losses incurred by others. *Western Power* reserves the right to perform its own studies and will provide details of such studies to the *User*. *Western Power* will make the final determination on the suitability of a *User's facilities* and the requirements to be fulfilled prior to and after the *facilities* are *connected*, in accordance with the *Access Code* and these *Rules*.move to Chapter 3]~~

2.2 POWER QUALITY

2.2.1 *Frequency* Variations

Western Power~~'s~~ must operate its network at a nominal frequency of ~~supply is~~ 50 Hz.

~~The~~ *Western Power* must use reasonable endeavours to maintain an accumulated synchronous time error of less than 10 seconds in *Western Power* networks ~~is not expected to exceed 10 seconds~~.

~~Operation outside the range 47.0 to 52.5 Hz need not be taken into account by Western Power and Users in the design of connected plant which may be disconnected if this is necessary for the protection of that plant.~~

The frequency operating standards for *Western Power* transmission *and distribution* networks are summarised in Table 2.1 below.

Table 2.1 Western Power's Frequency Operating Standards for SWIS.

Condition	Frequency Band	Target Recovery Time
No disturbance: South West Island[(1)]	49.8 to 50.2 Hz for 99% of time 49.5 to 50.5 Hz	- - -
Single *contingency event*	48.75 to 51 Hz	Normal Range ~~49.8 to 50.2 Hz~~ within 25 minutes For over-frequency events: Below ~~51.0 to~~ 50.5 Hz within 2 minutes
Multiple ~~C~~*contingency event*	47.0 to 52.0 Hz	Normal Range ~~49. 8 to 50.2 Hz~~ within 25 minutes For under-frequency events: Above ~~47.0 to~~ 47.5 Hz within 10 seconds Above ~~47.5 to~~ 48.0 Hz within 5 minutes Above ~~48.0 to~~ 48.5 Hz within 15 minutes For over-frequency events: Below ~~52.0 to~~ 51.5 Hz within 1 minute Below ~~51.5 to~~ 51.0 Hz within 2 minutes Below ~~51.0 to~~ 50.5 Hz within 5 minutes

Note: *(1) – an island is formed when connection between parts of the interconnected network is broken. The frequency band is applied within an electrical island as it forms and after it has stabilised.*

Western Power ~~will require the~~ must use ~~of~~ load shedding facilities (described in clause 2.4 in this section) to aid recovery of frequency to the range 49.5Hz to 50.5Hz. Frequency tolerance limits must be satisfied under the worst credible power system load and generation pattern, and the most severe ~~credible~~ contingencies of transmission plant including the loss of interconnecting plant leading to the formation of credible islands within the power system. After ~~Even with~~ the formation of islands, each island in the power system, which contains generation, must have sufficient load shedding facilities in accordance with clause 2.4 to aid recovery of frequency to the range 49.5Hz to 50.5Hz.

2.2.2 Power Frequency *Voltage* Variations

Western Power must plan and design *extensions* of its *networks* and equipment for control of *voltage* such that the minimum steady state *voltage* on the *transmission and high voltage distribution network* will be 90% of nominal *voltage* and the maximum steady state *voltage* will be 110% of nominal *voltage*. For low voltage distribution network, steady state voltage must be within:

~~–~~(a) ± 6% of the nominal voltage during *normal conditions*,
~~–~~(b) ± 8% of the nominal voltage during *maintenance conditions*,
~~–~~(c) ±10% of the nominal voltage during *emergency conditions*.

However, in some parts of the system *Western Power* may apply other limits ~~may be applied~~ following detailed *reliability*, *load*-flow, fault, harmonic~~s~~. and stability studies.

Step changes in voltage levels resulting from switching operations must ~~shall~~ not exceed the limits given in clause 2.6.1, Table 2.10.

A requirement for a target range of *voltage* magnitude at a *connection point* may be specified in *access contracts*. This may include a different target range under normal and post-contingency conditions (and how they may be required to vary with *loading*). Where more than one *User* is supplied such that independent control of *voltage* at their *connection points* is not possible a compromise target must be agreed by the relevant *Users*. *Western Power* and *Users* must consider ~~S~~short-time variations within 5% of the target values ~~must be considered~~ in the design of *plant* ~~by *Users*~~.

Short-circuits in different parts of the *network* cause "dips" in the power-*frequency* phase *voltage*s to values which will be dependent on the nature and location of the fault. During some faults, one or more of the phase to ground *voltage*s may fall to zero or may rise above the nominal *voltage* level. This voltage excursion depends on the fault clearing times and duration of voltage recovery, and may be ~~as~~ determined by computer simulations. The results of such simulations shall be presented in the form of the equivalent voltage excursion versus time curve at the intended connection point.

Western Power and *Users* must ensure that each *facility* that is part of a *transmission network or distribution network* is capable of continuous uninterrupted operation in the event that variations in *supply voltage* described in the previous paragraphs occur (other than when the *facility* is faulted).

2.2.3 Voltage fluctuations

Voltage fluctuation causes changes of the luminance of lamps which can create the visual phenomenon called flicker.

Western Power must apply ~~T~~the requirements for connecting large fluctuating loads (producing flicker) to transmission and distribution network that are set out in Australian / New Zealand Standard AS/ANZ 61000.3.7:2001.

The flicker severity is characterised by two quantities:

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

Under normal operating conditions flicker severity caused by voltage fluctuation in the transmission and distribution network should be within the planning levels shown in Table 2.2. for 99% of the time.

Table 2.2 Planning Levels for Flicker Severity

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

Notes:

1. *These values were chosen on the assumption that the transfer coefficients between MV or HV systems and LV systems is unity;*
2. *The planning levels in Table 2.2 are not intended to control flicker arising from uncontrollable events such as faults in the power system, etc.*
3. *For LV systems (415V) flicker will be evaluated in accordance with AS61000.3.5 Planning levels*

Measurements of flicker must ~~should~~ be carried out according to Australian / New Zealand Standard AS/NZS 4376. From the P_{st} values measured during the observation week the Cumulative Probability Functions (CPF) of P_{st} and P_{lt} ~~should~~ must be obtained and the percentiles $P_{st95\%}$, $P_{st99\%}$, $P_{lt95\%}$ and $P_{lt99\%}$ should be derived.

The 99% percentiles($P_{st99\%}$, $P_{lt99\%}$) ~~should~~ must not exceed the planning levels in Table 2.2.

The 95% percentiles ($P_{st95\%}$, $P_{lt95\%}$) are used to detect ~~useful for detecting~~ abnormal results (e.g. due to thunderstorms). If the ratio between 99% and 95% percentiles is greater than 1.3 ~~one should~~ the party carrying out the measurements must investigate the reason for the discrepancy.

~~The emission levels can be assessed by direct measurement or by calculation from the available data concerning the load and the system.~~

Western Power must verify compliance of ~~The~~the flicker emission level contribution for existing and new *Users* with its specified requirements ~~is subject to verification of compliance by *Western Power*~~. The contribution may be assessed by direct measurement or by calculation from the available data concerning the load and the system.

Western Power must allocate contributions to flicker ~~emission~~ limits in response to a connection inquiry or an application to connect and evaluate the acceptability for connection of fluctuating sources as follows:

(a) *automatic access standard: Western Power* must allocate contribution to ~~emission~~ limits no more onerous than the lesser of acceptance levels determined in accordance with either of the stage 1 or the stage 2 evaluation procedures defined in AS/ANZ 61000.3.7:2001; and

(b) *minimum access standard:* the determination by *Western Power* of acceptable contributions to ~~emission~~ limits must be undertaken in consultation with the party seeking *connection* using the stage 3 evaluation procedure defined in AS/ANZ 61000.3.7:2001.

The User ~~is responsible for maintaining the emissions~~ must maintain its contributions to flicker at the point of common coupling (PCC) below the limits specified by *Western Power*. ~~*Western Power* is responsible for the overall control of disturbance levels under normal operating conditions in accordance with these *Rules*.~~ The *U~~u~~ser* must ~~is~~ also ensure ~~responsible for ensuring~~ that during their design process they design their plant to meet the requirements.

2.2.4 Voltage Waveform Distortion

Western Power must apply the ~~The~~ requirements for connecting large distorting loads (producing harmonics and/or interharmonics) to transmission network that are set out in Australian / New Zealand Standard AS/ANZ 61000.3.6:2001. *Western Power* must not permit ~~E~~equipment that results in DC components, such as asymmetrical rectifiers, converters~~,~~ or half wave converters ~~etc that result in DC components will not be allowed~~ to connect to the network.

Users must ensure all their plant and equipment is designed to withstand without damage or reduction in life expectancy 100% of the limits

Under normal operating condition harmonic voltage in the transmission network ~~should~~ must not exceed the planning levels shown in Tables 2.3 & 2.4 as appropriate to the voltage level.

Table 2.3 Transmission planning levels for harmonic voltage in networks with system voltage less or equal 35kV (in percent of the nominal voltage)

Odd harmonics non multiple of 3		Odd harmonics multiple of 3		Even harmonics	
Order h	Harmonic voltage %	Order h	Harmonic voltage %	Order h	Harmonic voltage %
5	5	3	4	2	1.6
7	4	9	1.2	4	1

11 13 17 19 23 25 >25	3 2.5 1.6 1.2 1.2 1.2 $0.2 + 0.5\frac{25}{h}$	15 21 >21	0.3 0.2 0.2	6 8 10 12 >12	0.5 0.4 0.4 0.2 0.2
Total harmonic distortion (THD): 6.5 %					

Table 2.4 Transmission planning levels for harmonic voltage in networks with system voltage above 35kV (in percent of the nominal voltage)

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

Notes:

1. *The planning levels in Tables 2.3 & 2.4 are not intended to control harmonics arising from uncontrollable events such as geomagnetic storms, etc.*

2. *The total harmonic distortion (THD) is calculated from the expression*

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

where

U_{nom} *- nominal voltage of a system;*

U_1 *- fundamental voltage;*

U_h *- harmonic voltage of order h expressed in percent of the nominal voltage;*

In certain cases *interharmonic* voltages (where the frequencies are not integer multiples of the fundamental) give rise to flicker or cause interference in ripple control systems and therefore have to be restricted. In *Western Power*'s transmission networks the planning level for *interharmonic* voltages is equal to 0.2 %.

Measurements of harmonics and *interharmonics* ~~should~~ must be carried out according to Australian / New Zealand Standard AS/NZS 61000.4

– The maximum weekly value of THD and individual harmonics / *interharmonics* ~~should~~ must not exceed the planning levels;

Harmonics are generally measured up to h=40. In most cases this is adequate for the evaluation of distortion effects of power disturbances. However, higher order harmonics up to 100th order must be measured if *Western Power* considers them to be of important concern. ~~can be an important concern in some cases.~~

~~The distortion emission levels should be assessed either by direct measurement or by calculation from the available data concerning the load and the system.~~

Western Power must verify compliance of the ~~The~~ distortion emission level with its specified requirements. ~~contribution is subject to verification of compliance by *Western Power*~~. The distortion emission levels may be assessed either by direct measurement or by calculation from the available data concerning the load and the system.

Western Power must allocate distortion emission limits in response to a connection inquiry or an application to connect and evaluate the acceptability for connection of distorting sources as follows:

~~(c)~~(a) *automatic access standard: Western Power* must allocate emission limits no more onerous than the lesser of acceptance levels determined in accordance with either of the stage 1 or the stage 2 evaluation procedures defined in AS/ANZ 61000.3.6:2001; and

~~(d)~~(b) *minimum access standard:* the determination by *Western Power* of acceptable emission limits must be undertaken in consultation with the party seeking *connection* using the stage 3 evaluation procedure defined in AS/ANZ 61000.3.6:2001.

The *User* must maintain ~~is responsible for maintaining~~ the total load harmonic current emissions at the PCC below the limits specified by *Western Power* ~~here~~. ~~*Western Power* is responsible for the overall control of distortion levels under normal operating conditions in accordance with these *Rules*. It is the users responsibility to~~ The *User* must also ensure that the limits are met at design and during the life of the connection.

2.2.5 Voltage Unbalance

Western Power must balance the phases of its network and User must balance the current drawn in each phase at each of its connection points so as to achieve 30-minute average levels of negative sequence voltage at all connection points that are equal to or less than the values set out in Table 2.5 below. In the event that these values are not achieved *Western Power* must address the level of unbalance caused by its network assets. It must also pursue all measures available under the *Access Code* and these *Rules* to remedy the situation in respect of *Users* whose *plant* does not perform in a manner that will enable the standard to be satisfied.

Users must ensure that all their *plant* and equipment is designed to withstand without damage or reduction in life expectancy 100% of the limits as specified in Table 2.5.

~~Responsibility of *Western Power* for *voltage* unbalance outside 100% of the limits specified in Table 2.5 must be limited to *voltage* unbalance caused by *network* assets and the pursuit of all measures available under the *Access Code* and these *Rules* to remedy the situation in respect of *Users* whose *plant* does not perform to the standards specified in this clause 2.2.5.~~

Table 2.5 Transmission limits for negative phase sequence component of voltage (in percent of the positive phase sequence component)

Nominal System Voltage (kV)	Negative Sequence Voltage (%)
> 100	1
10 - 100	1.5
< 10	2

Note:

1. *The limits in Table 2.5 are not intended to control negative sequence voltages occurring for a short period as the result of faults, single pole interruptions, line switching, transformer energisation, shunt capacitor bank energisation or shunt reactor energisation within the transmission network.*

2.2.6 Electromagnetic Interference

Western Power must ensure that the electromagnetic interference caused by the its own *primary plant* and equipment does not exceed the limits set out in Tables 1 and 2 of *Australian Standard* AS2344. A *User* must ensure that the electromagnetic interference caused by the *plant* and equipment at each of its *connection points* does not exceed the limits set out in Tables 1 and 2 of *Australian Standard* AS2344.

2.2.7 Assessment of Power Quality

Western Power or the party undertaking measurements on its behalf must ensure that the ~~The~~ power quality parameter measurements to assess compliance with these *Technical Rules* are ~~to be~~ taken as specified in Table 2.6 below:

Table 2.6 Power quality parameters measurement.

Parameter	Value measured	Frequency of measurement	Minimum measurement period	Data sampling interval
Fundamental Frequency	mean value over interval	Continuous	all the time	10 seconds
Power-frequency voltage magnitude	mean rms value over interval	Periodically	one week	10 minutes
Short-term flicker severity	P_{st}	Periodically	one week	10 minutes
Long-term flicker severity	P_{lt}	Periodically	one week	2 hours
Harmonic / interharmonic voltage and voltage THD	mean rms value over interval	Periodically	one week	10 minutes
Negative sequence voltage	mean rms value over interval	Periodically	one week	10 minutes

Notes:

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

2.3 STABILITY

Users must cooperate with *Western Power* to achieve stable operation of the power system and *Western Power* must take appropriate measures ~~must be taken~~ to prevent instability. Such preventive measures, including provision of any emergency controls as reasonably required, must be identified and provided for at the planning and design stage.
~~*Power system stability* is the ability of an electric power system, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical~~

~~disturbance, with most system variables bounded so that practically the entire system remains intact.~~

~~*Stability* is a condition of equilibrium between opposing forces. Depending of the network topology, system operating condition and the form of disturbance, different sets of opposing forces may experience sustained imbalance leading to different forms of instability.~~

The classification of power system stability in this clause ~~relies to a large extent on Joint IEEE / CIGRE Task Force on Stability Terms and Definitions report (CIGRE brochure No. 231, June 2003) and~~ is illustrated in Figure 2.1~~0~~. The classification indicates the main system variable in which instability can be observed.

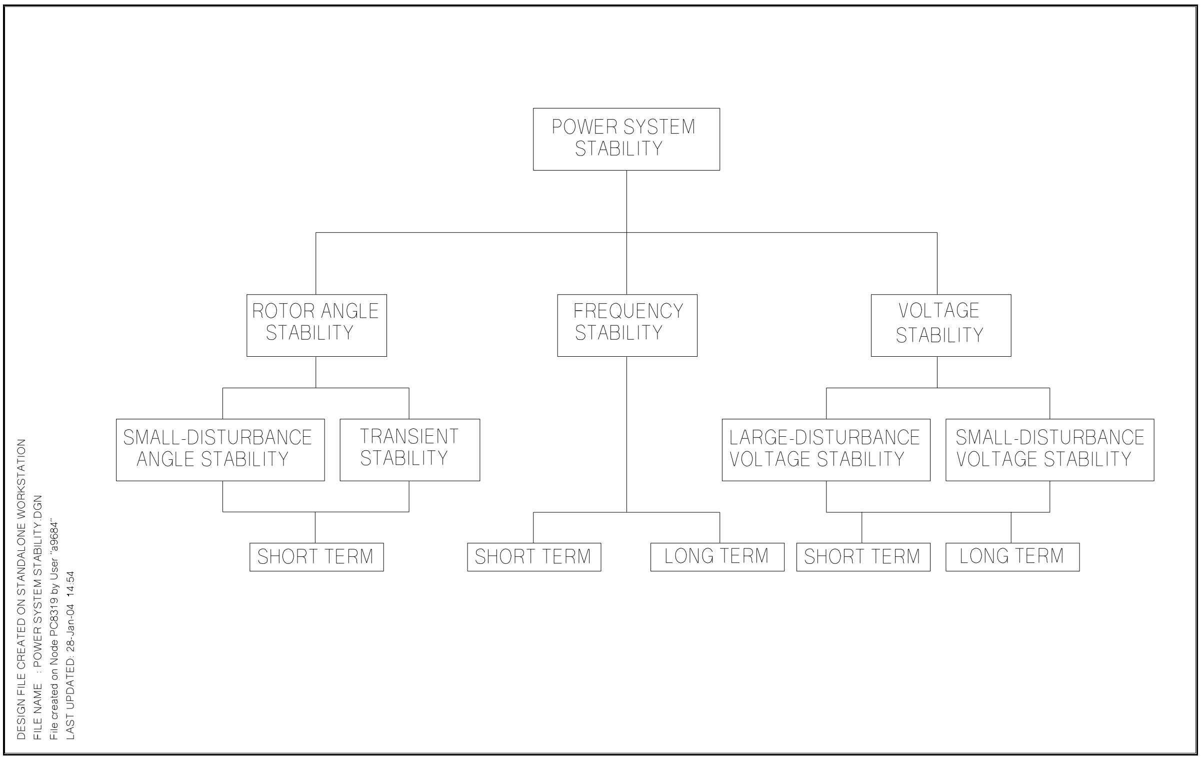


Figure 2.1~~0~~ – Classification of power system stability.

2.3.1 *Large Distirbance Rotor Angle Stability*

~~*Rotor angle stability* is the ability of synchronous machines of an interconnected power system to remain in synchronism after being subjected to a disturbance. Instability that may result occurs in the form of increasing angular swings of some generators leading to their loss of synchronism with other generators. Loss of synchronism can occur between one machine and the rest of the system, or between groups of machines, with synchronism maintained within each group after separating from each other. There are two forms of rotor angle stability: small-disturbance (or small-signal) and transient stability.~~

~~*Small-disturbance (or small-signal) rotor angle stability* is the ability of the power system to maintain synchronism under small disturbances. The disturbances are considered to be~~

~~sufficiently small if linearization of system equations is permissible for purposes of analysis. Small disturbances may be caused by routine switching (for example, line or capacitor), transformer tap changes, generator AVR setpoint changes, etc.~~

~~*Large-disturbance rotor angle stability or transient stability* is the ability of the power system to maintain synchronism when subjected to severe disturbances, for example a short circuit on a nearby transmission line. The resulting system response involves large excursions of generator rotor angles and is influenced by the non-linear power-angle relationship.~~

The *large disturbance* *rotor angle stability* criterion is:

> All generators connected to the power system ~~shall~~ must remain in *synchronism* following any system disturbance that is specified in clause 2.3.4.1.

~~For the mandatory~~ For the purpose of this clause *Western Power* must add a safety margin of 10 msec ~~that takes into account errors associated with~~ to the sum of the protection and circuit breaker operating times~~, refer to Attachment 1 – Glossary, definition of~~ when assessing the *total fault clearance time*.

~~System disturbances are as specified in clause 2.3.4.1.~~

Western Power must implement measures ~~Measures must be implemented~~ to prevent rotor angle instability from occurring. Such measures include, but are not limited to:

1) All transmission and distribution network faults must be cleared in sufficient time to prevent rotor angle instability.

2) The level of power transfer must not exceed 95% of the rotor angle stability limit.

~~The rotor angle stability problem involves the study of the electro-mechanical oscillations inherent in power systems, refer to clause 2.3.1.1 Damping of power system oscillations.~~

2.3.~~1.1~~2 *Small Disturbance Rotor Angle Stability* ~~Damping of Power System Oscillations~~

~~Rotor angle instability may occur after a few swings due to poor damping of power system oscillations. All~~ *Western Power* must ensure that all system oscillations, originating from either system electro-mechanical characteristics, electro-magnetic effect or non-linearity of system components, and triggered by any small or large disturbance in the power system must be well damped and that the power system ~~must be~~ is able to return to a stable operating state following the disturbance. The *small disturbance rotor angle stability* ~~following~~ criteria are ~~to be met.~~:

a) The *damping ratio* of electromechanical ~~the~~ oscillations ~~should~~ must be at least 0.1.

b) For electro-mechanical oscillations as a result of small disturbances, the *damping ratio* of the oscillation ~~should~~ must be at least 0.5.

c) In addition to a) and b), the *halving time* of any electro-mechanical oscillations ~~shall~~ must not exceed 5 seconds.

Western Power must take ~~A~~appropriate actions ~~should be taken~~ to prevent oscillations outside the above criteria.

2.3.~~2~~3 *Frequency Stability*

~~*Frequency stability* is the ability of a power system to maintain steady frequency following a severe system disturbance resulting in a severe imbalance between generation and load. Instability that may result occurs in the form of sustained frequency swings leading to tripping of generating units and/or loads.~~

Severe system disturbances may lead to the break-up of the system and its separation into islands. *Frequency ~~S~~stability* in this case is a question of whether or not each island will reach a state of operating equilibrium with minimal unintentional loss of load. It is determined by the overall response of the island as evidenced by its mean frequency, rather than relative motion of machines.

Western Power must take appropriate ~~Various~~ control actions ~~should be used~~ to restore the balance between load and generation in order to arrest the frequency excursion to within the plant capability of clause 3.2.4.3 and to return the frequency to ~~within~~ the normal operating limits within the target recovery time specified in ~~of~~ clause 2.2.1. They include but are not limited to the use of:

1. spinning reserve, and
2. under frequency load shedding (UFLS)~~, and~~

2.3.~~3~~4 *Voltage Stability*

Voltage stability is the ability of a power system to maintain steady voltages at all busses in the system after being subjected to a disturbance from a given operating condition. Instability that may result occurs in the form of a progressive fall or rise of voltages at some busses. A possible outcome of voltage instability is loss of load in the area, or tripping of transmission lines and other elements, including generators, by their protective systems leading to cascading outages.

The term *voltage collapse* is also often used. It is the process by which the sequence of events accompanying voltage instability leads to a blackout or abnormally low voltages in a significant part of the power system. *Voltage collapse* is associated with a deficit of reactive power.

2.3.~~3~~4.1 Long Term *Voltage Stability* ~~Criterion~~~~:~~

Long term *voltage stability* includes consideration of slow dynamic processes in the power system that are characterised by time constants of the order of tens of seconds or minutes. The analysis typically assumes that the system has survived an initial disturbance and is carried out by a series of load-flow simulations or by relying on dedicated long-term dynamics software.

~~All necessary steps should be taken to ensure that~~ The *long-term voltage stability* criterion that must be applied by *Western Power* is:

Voltage at all locations in the network must be stable following ~~instability does not occur for~~ the most onerous ~~system disturbance~~ post-contingent system state consistent with clause~~s~~ 2.5 and ~~2.6.5.~~ under all credible load conditions and generator schedules.

~~Reactive power reserve requirements to reduce the risk of voltage collapse are given in clause 2.6.5.~~

Western Power must ensure that adequate *reactive power reserves* are provided, based on *power system* studies such as those described below:~~.~~

Explanatory Note

Voltage stability is assessed by modelling the sources and consumption of reactive power Reactive power is obtained from a combination of static and dynamic sources. Static sources include, for example, reactors and capacitor banks, and the charging current of transmission lines. Dynamic sources include, for example, synchronous machines, operating as generators or synchronous compensators, and static VAr compensators.

1) For terminal substations in the metropolitan area the following procedure is used at present:
   a) The disturbance, which takes the system closest to voltage collapse, is determined by investigating likely worst case scenarios.
   b) 3% of the total installed LV *capacitor banks* plus the HV *capacitor bank* or reactive device that has the largest impact on the system are assumed to be out of service.
2) For other areas of the system, including radials, the following procedure is used to determine the *voltage* stability or transfer limit:
   (a) the normal peak system *generation* pattern that provides the lowest level of *voltage* support to the area of interest is assumed. (Of the *generators* normally in service in the area, the largest generator is assumed to be out-of-service due to a breakdown or other maintenance requirements. If another generator is assigned as a backup unit is assumed to brought into service to support the load area.

(b) The largest *capacitor bank*, or the reactive device that has the largest impact, in the area is assumed to be out-of-service where the area involves more than one substation.

(c) The tripping of a line or other plant or tripping of a *generator* that causes the largest reduction in system *voltage* support in the area of interest is taken as the disturbance used to establish the transfer limit or *reactive support* limit.

3) In all situations the following procedures are followed:

a) All loads are modelled as constant P & Q *loads*.

b) The *load* or power transfer to be used in the study is assumed to be 5% higher than the expected system *peak load*, or a 5% higher than the maximum expected *transfer* into the area. (The 5% margin includes a safety margin for hot weather, data uncertainty and uncertainty in the simulation.)

c) The analysis must demonstrate that a positive MVAr reserve margin is maintained at major load points, and that system *voltages* remain within the normal operating range for this 5% higher load.

d) All credible *generation* schedules are considered, and no generator's steady state MVAr limit may be reached.

e) System conditions are checked after the *outage* and both prior to and following tap changing of transformers.

2.3.4.2 Short Term *Voltage Stability*

Short term *voltage stability* is concerned with the power system surviving an initial disturbance and reaching a satisfactory new steady state. It is assessed by dynamic simulations in the transient stability timeframes.

Western Power must use power system simulation to assess the recovery of voltage to sustainable levels after the occurrence and clearance of a credible fault. Figure 2.2 illustrates matters to be assessed in relation to voltage stability immediately after clearance of a fault. ~~Two aspects of the voltage recovery are studied:~~

~~1.The voltage recovery immediately after clearance of the fault, as illustrated in Figure 2.2; and~~

~~2.~~1.~~Any voltage dip that results from the angular disturbance (power swing) that follows fault clearance, as illustrated in Figure 2.3.~~

The assessments must be made using simulation of the system response with the best available models of voltage-dependent loads (including representative separate models of motor loads where appropriate), and the assumption that no load, other than contractually committed load, is disconnected as a result of the fault.

The short-term voltage stability criteria that must be applied by *Western Power* are:

1. The voltage following fault clearance must recover and remain above 80% of nominal operating voltage within:

   - 400 ms in the Perth area
   - 800 ms in all other areas

2. In the all areas system voltages after a fault is cleared must recover to above 90% of nominal operating voltage within 5 seconds, and must subsequently be controllable in accordance with the long-term voltage stability criterion. (see Post Transient Voltage Deviation in Figures 2.1 and 2.2)

Western Power must implement measures to satisfy the short-term voltage stability criteria. These include, without limitation:

(a) The installation of adequate reactive power sources that respond in a timescale that matches the transient reactive power demands of the system; and/or

(b) The controlled disconnection of a load or generator whose voltage response would otherwise aggravate the situation, in accordance with a conditional *Connection Contract*.

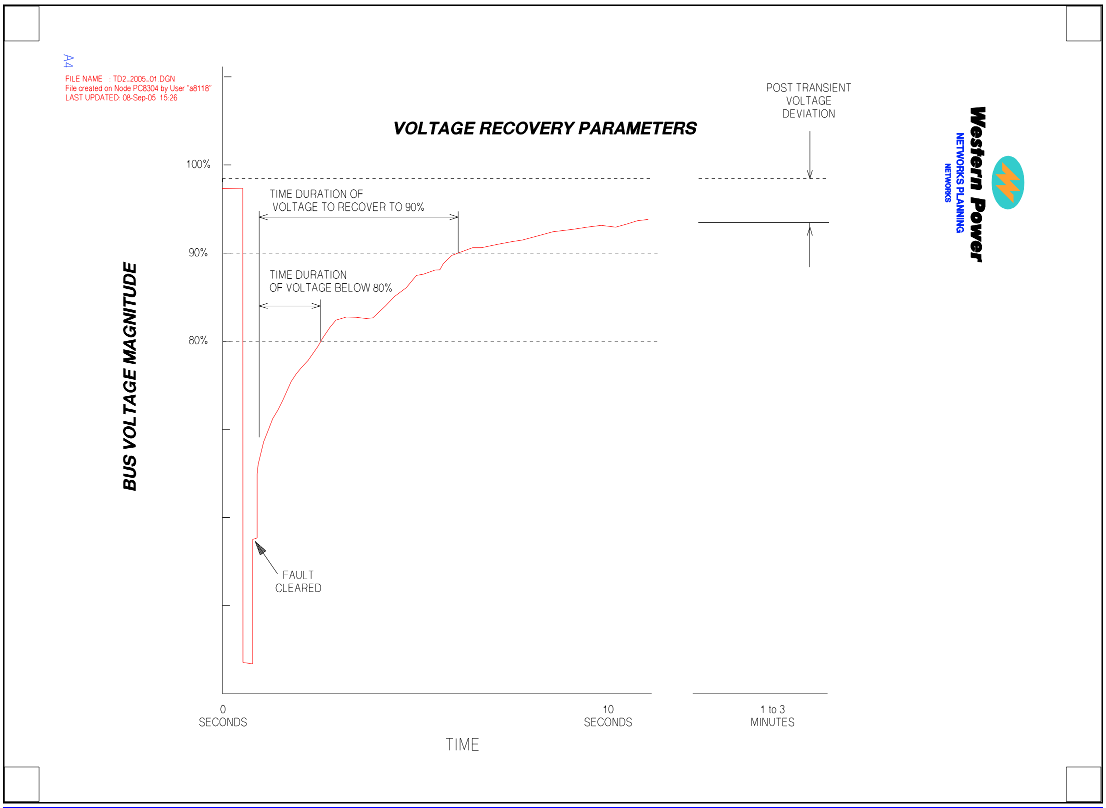
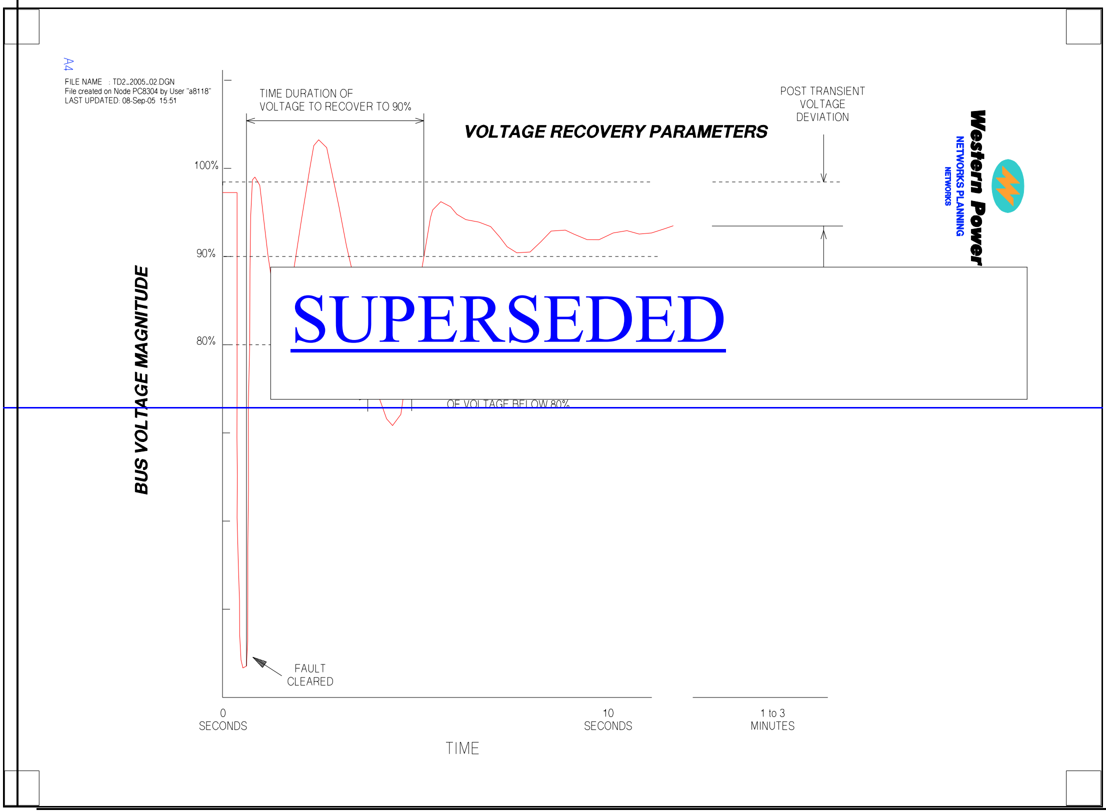


Figure 2.2 Illustration of voltage recovery immediately following fault clearance.



~~**Figure 2.3 Illustration of voltage dip due to a power swing following fault clearance.**~~

2.3.~~3.2~~5 Temporary Over-voltages

The temporary over-voltage criterion is:

Temporary AC over-voltages should not exceed the time duration limits given in Figure 2.3~~1~~

For the purpose of this clause, the voltage of supply is measured as the RMS phase voltage.

Western Power must take necessary steps to satisfy the criterion in respect of its network.

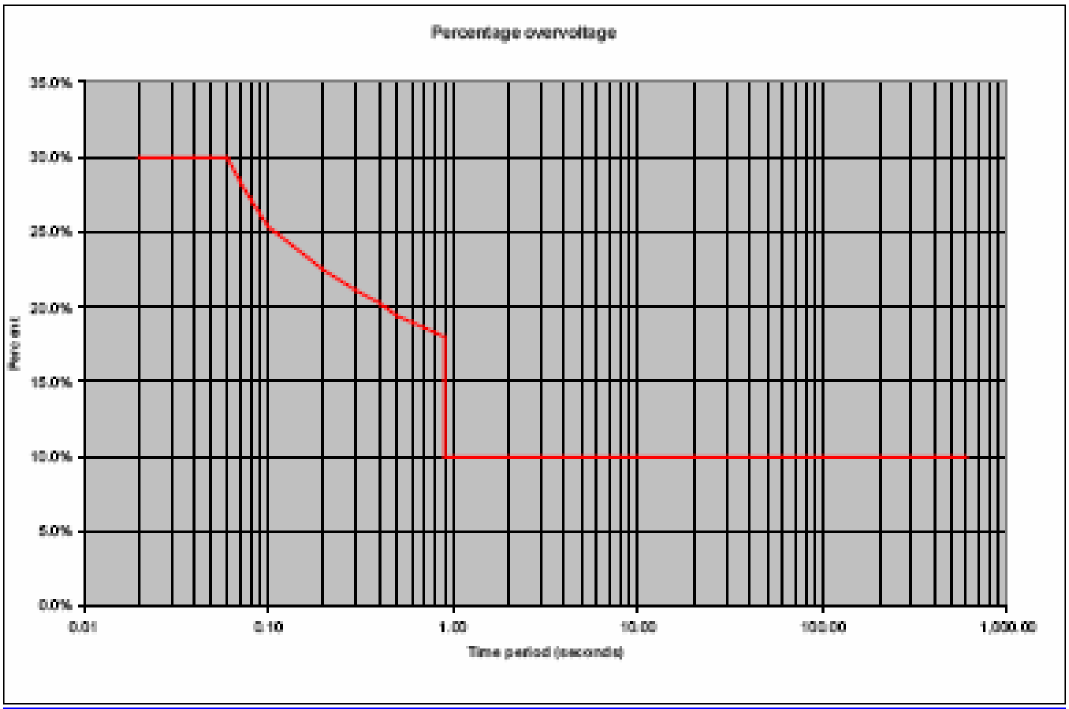


Figure 2.~~1~~3 - Highest Acceptable Level and Duration of AC Temporary Over-Voltage

2.3.~~3.3~~6 Transient Overvoltages

Western Power must ~~Surge arresters must be used to~~ ensure that the transient over-*voltage* seen by an item of *transmission and distribution plant* is limited to its impulse withstand level. This may require the installation of surge arresters or spark gaps.

~~2.3.3.4 Transient Voltage Dip Criteria (TVD)~~

~~The transient voltage dip limits (following fault clearance), which may be used in assessing the network performance as a reference, are as follows.~~

a) ~~In the metropolitan area, system transient voltages dips resulting from the power swings that follow a fault, should not drop below 75% of nominal operating voltage and should not remain below 80% of nominal operating voltage for more than 400ms during the power swing.~~

b) ~~In all country and remote areas, system transient voltages dips resulting from the power swings that follows a fault, should not drop below 70% of nominal operating voltage and should not remain below 80% of nominal operating voltage for more than 800ms during the power swing.~~

c) ~~In all metropolitan and country areas the post-transient voltage deviation limits shall be in accordance with the values specified in Table 2.10~~

~~Refer to Figure 2.2 for further details on a) and b).~~

~~Due consideration should be given to the Transient Voltage Dip limits to prevent motor loads being disconnected from the system by the undervoltage resulting from transient power swings.~~

~~2.3.3.5 Post-fault Voltage Recovery Limit~~

a) ~~In the metropolitan area, transmission system voltages after a fault on the system is cleared shall recover to levels above 80% of nominal operating voltage within 400ms counting from the end of the fault clearance.~~

b) ~~In all country and remote areas, transmission system voltages after a fault on the system is cleared shall recover to levels above 80% of nominal operating voltage within 800ms counting from the end of the fault clearance.~~

~~Refer to Figure 2.3 for further details.~~

~~Measures including those listed in clause 2.3.1 must be implemented to prevent post-fault voltage recovery from exceeding above limit.~~

2.3.~~4~~7 Stability Assessment

~~**General.** We have classified p~~Power system stability has been classified in clauses 2.3.1, 2.3.2, 2.3.3 and 2.3.~~3~~4 to manage the complexity of the problem and for convenience in identifying forms and causes of instability, applying suitable analysis tools and developing corrective measures. In any given situation, however, any one form of instability may not occur in its pure form. It is therefore important that the overall stability of the system be assessed, ~~should always be kept in mind~~ and that solutions to stability problems of one category should not be at the expense of another.

~~**Specifically.** Each~~ *Western Power* must assess system stability to ensure that all of the stability criteria stated in clauses 2.3.1, 2.3.2, 2.3.3 and 2.3.~~3~~4 ~~must be~~ are satisfied under the worst credible system load and generation pattern, and the most severe credible contingency event arising from application of the planning criteria of clause 2.5. ~~either,~~

~~a)A single credible contingency event consistent with the N-1 criterion of clause 2.5;~~

~~b)A double credible contingency event consistent with the N-2 criterion of clause 2.5.~~

~~These contingency events involve fault types specified in clause 2.3.4.1.~~

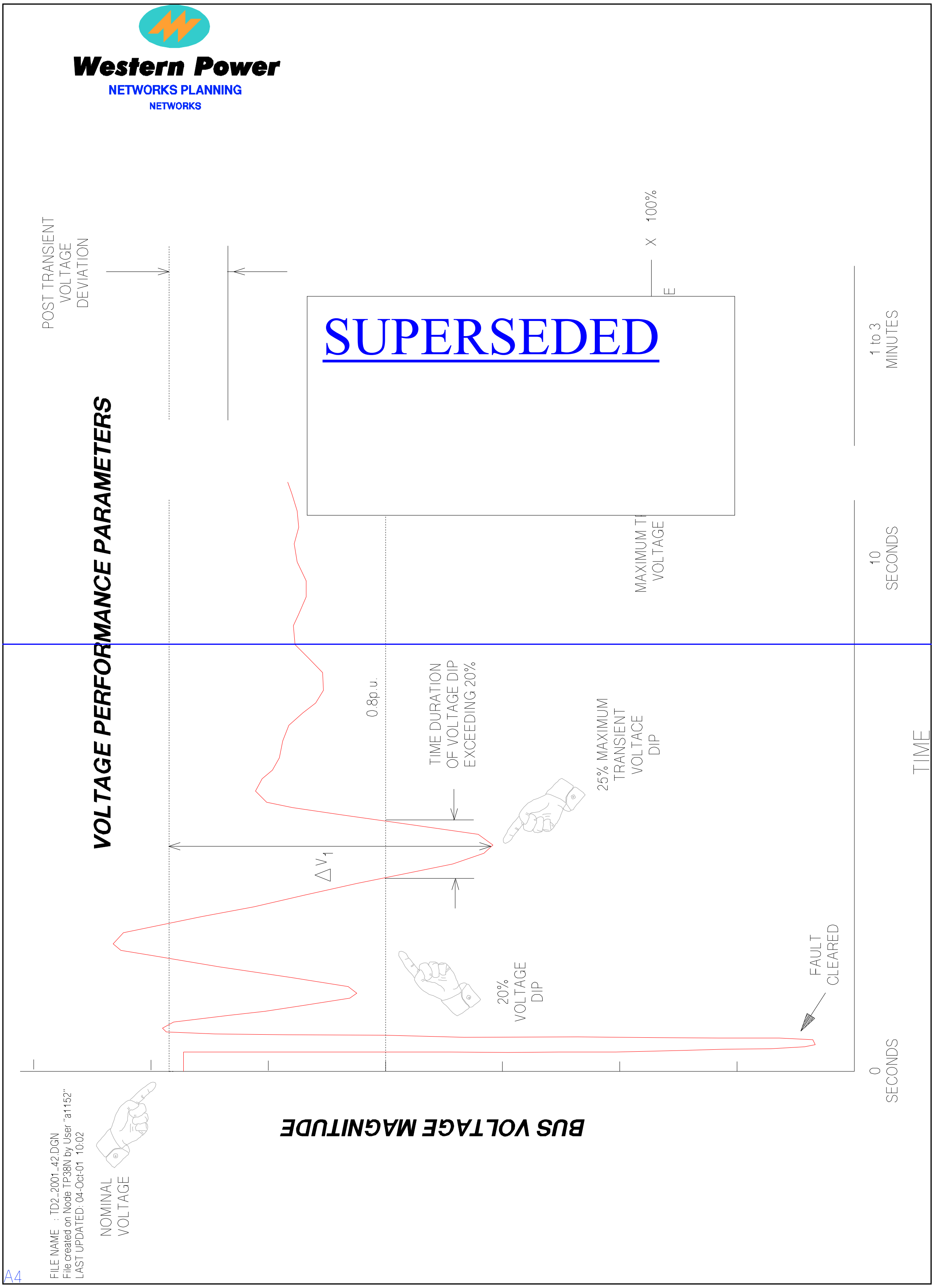
2.3.~~4.1~~8 Credible Fault Types ~~to be Studied~~

The most severe disturbance that can occur at any location within the power system from the following credible fault types must ~~is to~~ be used to determine the stability of the power system. The slower of the two main protection operating schemes must ~~should~~ be used as the fault clearance time to determine the stability of the power system.~~:~~

Western Power must assume that the fault types specified below are credible:

1) A three-phase-to-earth fault cleared by disconnection of the faulted component;
2) A single-phase-to-earth fault cleared by backup protection and the disconnection of the faulted component;
3) A single-phase-to-earth fault cleared, but after unsuccessful high-speed single-phase auto-reclosure onto persistent fault;
4) Sudden disconnection of a system component, e.g. a transmission line~~,~~ or a generation unit.

~~Figure 2.1 - Highest Acceptable Level and Duration of AC Temporary Over-Voltage~~


Western Power
NETWORKS PLANNING
NETWORKS
VOLTAGE PERFORMANCE PARAMETERS
POST TRANSIENT VOLTAGE DEVIATION
X 100%
MAXIMUM T
VOLTAGE
0.8p.u.
TIME DURATION OF VOLTAGE DIP EXCEEDING 20%
25% MAXIMUM TRANSIENT VOLTAGE DIP
20% VOLTAGE DIP
FAULT CLEARED
1 to 3 MINUTES
10 SECONDS
0 SECONDS
TIME
BUS VOLTAGE MAGNITUDE
NOMINAL VOLTAGE
FILE NAME : TD2_2001_42.DGN
File created on Node TP38N by User "a1152"
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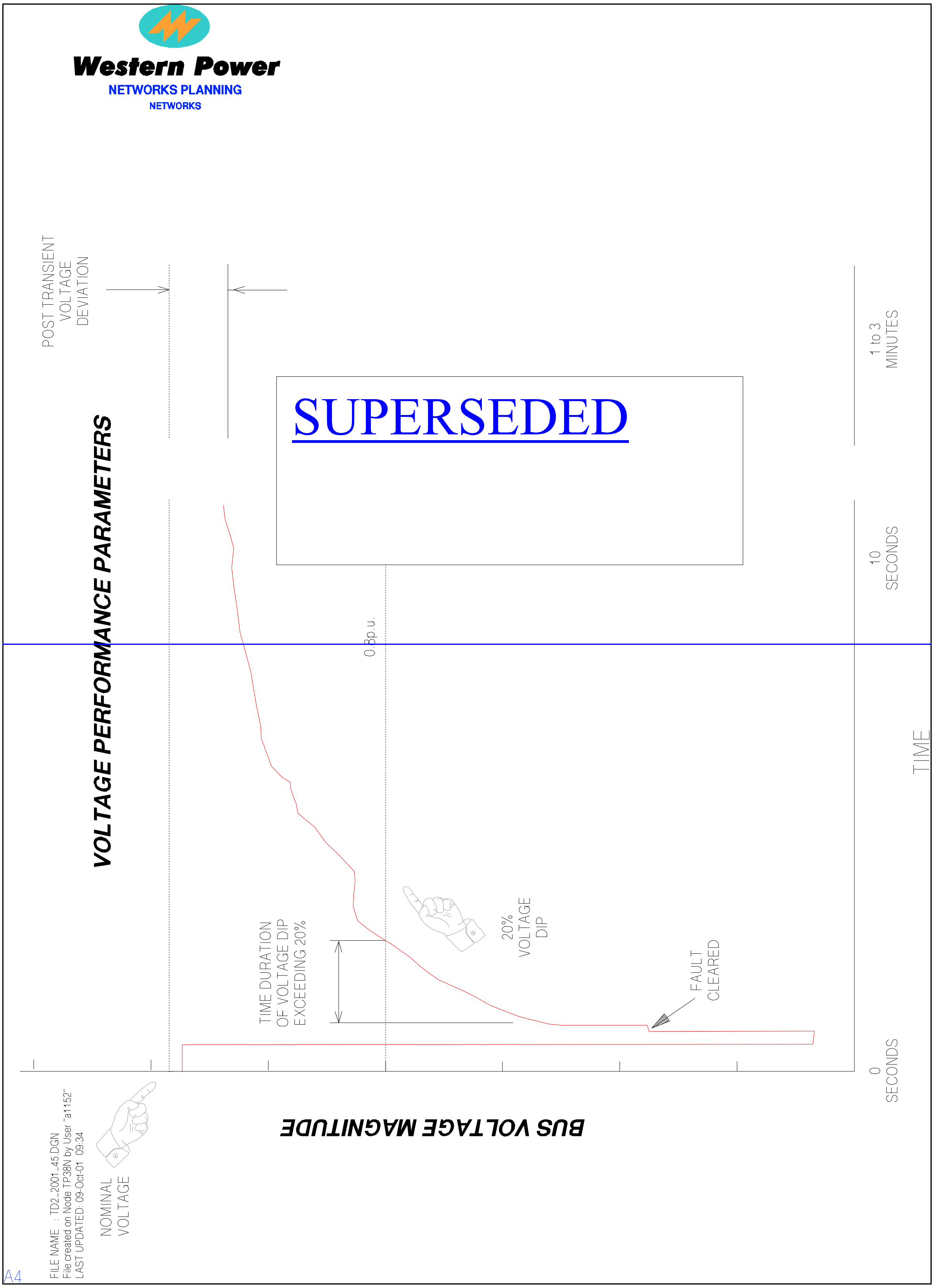
SUPERSEDED

~~Figure 2.2. Transient voltage dip (TVD) criteria.~~


Western Power
NETWORKS PLANNING
NETWORKS
VOLTAGE PERFORMANCE PARAMETERS
SUPERSEDED
POST TRANSIENT VOLTAGE DEVIATION
1 to 3 MINUTES
10 SECONDS
0.8p.u.
TIME
20% VOLTAGE DIP
TIME DURATION OF VOLTAGE DIP EXCEEDING 20%
FAULT CLEARED
0 SECONDS
BUS VOLTAGE MAGNITUDE
NOMINAL VOLTAGE
FILE NAME : TD2_2001_45.DGN
File created on Node TP38N by User "a1152"
LAST UPDATED: 09-Oct-01 09:34
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~~Figure 2.3 Transient voltage recovery (TVR) limits.~~

2.4 LOAD SHEDDING FACILITIES

2.4.1 *Load* to be Available for *Disconnection*

Western Power must ensure ~~It is a requirement for~~ *power system security* by arranging that up to 75% of the *power system load at* any time will be available for *disconnection*:

(a) under the automatic control of under*frequency* relays; and

(b) under manual or automatic control from *control centres*; and/or

(c) under the automatic control of under*voltage* relays.

To satisfy this overall criterion *Western Power* may, at its discretion, arrange for ~~In some circumstances, it may be necessary to have~~ up to 90% of the *power system load*, or up to 90% of the *load* within a specific part of the *network*, available for automatic *disconnection*. *Western Power* must ~~will~~ advise *Users* if this additional requirement is necessary.

Western Power may install s~~S~~pecial *load shedding* arrangements ~~may be required to be installed~~ to cater for abnormal operating conditions.

Subject to clauses 5.3.3(c) and 5.3.3(d), arrangements for *load shedding* must be agreed between *Western Power* and *Users* and can include the opening of circuits in a *transmission* or *distribution network*. The settings of a *load shedding* scheme shall be in accordance with the existing settings outlined in clause 2.4.3, unless otherwise agreed by *Western Power*.

Western Power must specify, in the *access contract,* control and monitoring requirements requirements for *load shedding facilities* if these are to be provided by a *User* that is connected at or above 33 kV ~~for *load shedding facilities*~~.

2.4.2 Installation and Testing of *Load Shedding Facilities*

If reasonably *required by Western Power a* *User*~~s~~ that controls a large load must:

(a) provide, install, operate and maintain *facilities* for *load shedding* in respect of any *connection point*.

(b) co-operate with *Western Power* in conducting periodic functional testing of the *facilities*, which must not require *load* to be *disconnected*, provided *facilities* are available to test the scheme without shedding *load*.

(c) apply under*frequency* settings to relays as determined by *Western Power*.

(d) apply under*voltage* settings to relays as determined by *Western Power*.

2.4.3 Existing Settings of Under-*frequency Load Shedding* Schemes

Explanatory note

The present settings for the *South West Interconnected System* under-*frequency load shedding* (UFLS) scheme are given in Table 2.7. The UFLS requirement and the settings specified in Table 2.7 are fully applicable to all User's loads. This includes loads in the User's system as long as the User's system, including its generation, is connected to the *Western Power* network.

Switchable *capacitor banks* at *substations* will ~~should also~~ be shed in accordance with Table 2.7.

Table 2.7
Under-*Frequency Load Shedding* Scheme Settings for the *South West Interconnected System*

Stage	*Frequency* (Hz)	Time Delay (sec)	*Load* Shed (%)	Cumulative *Load* Shed (%)	Capacitor shed (%)	Cumulative Capacitor Shed (%)
1	48.75	0.4	15	15	10	10
2	48.50	0.4	15	30	15	25
3	48.25	0.4	15	45	20	45
4	48.00	0.4	15	60	25	70
5	47.75	0.4	15	75	30	100

2.5 PLANNING CRITERIA ~~RELIABILITY OF THE TRANSMISSION AND DISTRIBUTION NETWORKS~~

~~*Reliability* of a power system refers to the probability of its satisfactory operation over the long run. It denotes the ability to supply adequate electric service on a nearly continuous basis, with few interruptions over an extended time period.~~

The ~~*reliability*~~ *planning* criteria in this clause 2.5 apply only to the *electricity transmission* and *distribution networks* and not to *connection* assets. *Western Power* must design *Connection* assets ~~will be designed~~ in accordance with a *User's* requirements and Chapter 3.

Western Power must take into account ~~The~~ the contingency criteria to which the *transmission* and *distribution network* has been designed ~~must be taken into account~~ when assessing the impact of a *User's* installation on other *Users*, or the *power system*.

2.5.1 Transmission Networks

In the context of network planning the *reliability* of a network refers to the probability of its satisfactory operation over the long run. It denotes the ability to supply adequate electric service on a nearly continuous basis, with few interruptions over an extended time period.

~~A fundamental reliability principle, that generally applies to all transmission plant in the power system, is that a single fault shall not cause disconnection of equipment beyond its fault clearing zone. Clearly, this principle does not apply to parts of the system designed to the (N-0) criterion or those protected by remedial action schemes.~~

Western Power must ~~will~~ design the *reliability* of power supply of each *sub-network* of its *transmission networks* in accordance with the following criteria as described below:

- N-0,
- N-1,
- N-~~2~~1-1,
- CBD, or
- Zone Substation Power Transformers: 1% Risk and Normal Cyclic Rating (NCR).

2.5.1.1 N-0 Criterion

A section of a *network* designed to the N-0 criterion may experience ~~result~~ in the loss of all *load* in the area supplied by the *transmission sub-network* for the loss of a *transmission element*.

The N-0 criterion is applied to sub-networks and zone substations with a load of less than 20 MVA.

~~The N-0 criterion is also applied to the 220 kV network supplying the Eastern Goldfields Region.~~

For zone substation power transformers, load shedding following the loss of a power transformer is permissible. *Western Power* may, at its discretion, install a ~~A~~ further power transformer ~~shall be installed~~ if there is insufficient backup to supply loads via the distribution network system to allow transformer maintenance at off peak times.

2.5.1.2 N-1 Criterion

Western Power must design to the N-1 criterion any part of the *transmission network* that is not identified within this clause 2.5.1 as being designed to another criterion.

The N-1 criterion means that an *outage* of one of the N components that make up the *transmission sub-network* must allow *supply* to be maintained to that area without loss of *load* at any load level and for any generation schedule.

The N-1 contingency criterion applies to:

1. All aspects of the steady-state criteria in clause 2.6.
2. All aspects of the stability criteria in clause 2.3
3. All aspects of the *power quality* criteria in clause 2.2.

For zone substation power transformers, supplying a total load greater than or equal to 20 MVA, no load must be shed for the loss of one transformer, apart from during -a brief switching period to transfer the load to unfaulted transformers via distribution network switching. *Western Power* must maintain capacity for this purpose.

2.5.1.~~2~~3 N-~~2~~1-1 Criterion

~~For the~~ *Western Power* must plan a *sub-network* designed to operate with the N-~~2~~1-1 criterion *Western Power* must plan a ~~the *network* must~~ be capable of withstanding the coincident planned and unplanned *outages* of *transmission elements* listed in Table 2.8 at up to 80% of the maximum normal power transfer. ~~*peak load*. It is to be assumed~~ *Western Power* must assume that during the planned *outage*, generation has been rescheduled to mitigate the effect of the subsequent *outage*.

The N-~~2~~1-1 contingency criterion applies to:

1. All aspects of the steady-state criteria in clause 2.6.
2. All aspects of the stability criteria in clause 2.3.

Table 2.8 Combinations of Transmission Elements Comprising the ~~a Double-Contingency (~~N-~~2~~1-1 Criterion~~)~~

~~N-2~~ *Maintenance* -*Outages* and *Contingencies*
transmission line maintenance and *transmission* line
transformer maintenance and *transformer*
transformer maintenance and *transmission* line
busbar maintenance and *transmission* line
busbar maintenance and *transformer*
circuit breaker maintenance and *transmission* line
circuit breaker maintenance and *transformer*
circuit breaker maintenance and *busbar* loss
transmission line maintenance and *transformer*

The N-~~2~~1-1 criterion means that the consequences of an ~~coincident planned and~~ unplanned outage ~~*outages*~~ of *transmission elements*~~s~~, coincident with a *maintenance outage* at or below 80% of *peak load*, will normally result in *supply* being maintained without loss of *load*, provided *generation* is rescheduled prior to the unplanned ~~second~~ *outage*.

In general, *Western Power* will design the bulk *transmission network* which interconnects the major *power stations* with the *transmission substations* ~~will be designed~~ to the N-~~2~~1-1 criterion~~a~~.

~~The~~ *Western Power* must apply the N-~~2~~1-1 criterion ~~is applied~~ to those parts of its network where the occurrence of a credible contingency during maintenance of another network element would result in unacceptable disruption to many customers. Currently it is applied to:

a) All 330kV lines, terminal stations and power stations, with the exception of the 330kV interconnection in the Bunbury load area.
b) All 132kV terminal stations in the Perth metropolitan area, and Muja power station 132kV substation.
c) All 132kV transmission lines that supply a sub-network comprising of more than 5 substations with total peak load exceeding 400MVA.
d) All power stations whose export to the transmission network exceeds 25% of the transmission network system peak.

Western Power must ensure that for ~~For~~ breaker fail events initiated by line or *transformer* faults, the operation of the *transmission sub-network* designed to the N-~~2~~1-1 criterion will ~~must~~ satisfy the steady state criteria at 80% of *peak load* / load transfer without generation re-scheduling. All *transmission plant* must be ~~is~~ assumed to be in service prior to the event.

2.5.1.~~3~~4 Perth CBD Criterion

Western Power must currently apply the Perth ~~The~~ CBD criterion ~~currently applies~~ to Milligan Street and Hay Street zone substations and connected networks. It may be extended in the future as the Perth Central Business District (CBD) grows. The Perth CBD Zone is defined in the Access Arrangement Document.

Western Power must design i~~I~~ndividual zone substations in the CBD area ~~shall be designed~~ to the N-1 planning criterion, for the loss of any:

- One transmission line, or
- One power transformer.

After a momentary supply interruption,
Western Power must restore the supply to 100% of loads ~~shall be restored~~ within 30 seconds by automatic transfer of loads to neighbouring zone substations via distribution network~~.~~ using ~~Spare~~ capacity that is maintained for this purpose ~~shall be maintained~~.

Western Power must design any ~~Any~~ group of zone substations in the CBD area ~~shall be designed~~ to the N-2 planning criterion for the combined outage and -loss ~~of~~ involving any:

- Two transmission lines,
- Two power transformers, or
- One transmission line and one power transformer.

After a short supply interruption, *Western Power* must restore the supply to 100% of loads ~~shall be restored~~ via distribution network switching, using ~~for which spare~~ feeder and zone substation capacity that is maintained for this purpose ~~shall be made available~~.

2.5.1.45 Zone Substation Power Transformers

Explanatory note

Zone substation power transformers require special consideration ~~are a special case~~ as they form the boundary between transmission and distribution network. ~~They are neither strictly N-1 or N-0.~~

Unlike other planning criteria that also apply to networks, there are two criteria that are applied exclusively to zone substation power transformers: the 1% Risk Criterion and NCR Criterion. They permit higher transformer utilisation than that permitted by the N-1 criterion, but lesser than that permitted by the N-0 criterion.

In contrast to the N-1 criterion, where transformers in a single zone substation provide backup for each other, the 1% Risk and NCR criteria are based on ~~the idea of~~ sharing a common spare transformer among a population of zone substation power transformers across a number of zone substations in a geographically confined area.

A trade off is limited load shedding risk, for as long as it takes to deploy and install a spare transformer. The acceptance of this risk determines the application of these two criteria.

The 1% Risk and NCR criteria apply to:

1. All aspects of the steady-state criteria in clause 2.6.
2. All aspects of the stability criteria in clause 2.3
3. All aspects of the *power quality* criteria in clause 2.2.

1% Risk Criterion

The 1% Risk criterion permits the loss of that ~~the~~ portion of the substation's peak load that is demanded for up to 1% of time in a year (87 hours per annum) following the outage of any component in the substation transformer circuit.

Western Power must currently apply the ~~The~~ 1% Risk criterion ~~is applied~~ to major regional zone substations.

Western Power must ~~shall~~ ensure that a suitable system spare transformer shall replace the failed transformer within a target period of 10 days.

In the meantime, *Western Power* must limit the load shedding ~~shall be restricted~~ to:

A maximum of one *feeder* at any one time on a rotational basis, and

Any individual *feeder* may be subjected to shedding only once per day.

Normal Cyclic Rating (NCR) Criterion

The NCR Risk criterion permits the loss of an amount of load equivalent to a transformer's pre-outage loading following the outage of any component in the substation transformer circuit.

Western Power must apply the ~~The~~ NCR Risk criterion ~~is applied~~ to zone substations in the Perth Metropolitan area.

Western Power must ~~shall~~ ensure deployment of a rapid response spare transformer (RRST) to temporarily replace the failed transformer within the target period of 12 hours.

In the meantime, *Western Power* must limit load shedding ~~shall be restricted~~ to:

The required number of feeders to reduce the load below the remaining capacity of the substation by taking into consideration the available distribution transfer capacity, and

Any individual *feeder* ~~may be subjected to shedding~~ only once until the RRST is installed

Following the deployment of the RRST, *Western Power* must ~~shall~~ install a suitable spare transformer or procure a new transformer to permanently replace the failed transformer and release the RRST to cater for future contingencies.

~~**2.5.1.5 N-1 Criterion**~~

~~The remainder of the *transmission network* shall be designed to the N-1 criterion.~~

~~A section of a *network* designed to the N-1 criterion means that an *outage* of one of the N components that make up the *transmission sub-network* should allow *supply* to be maintained to that area without loss of *load* at any load level and for any generation schedule.~~

~~The N-1 contingency criterion applies to:~~

- ~~All aspects of the steady-state criteria in clause 2.6.~~
- ~~All aspects of the stability criteria in clause 2.3~~
- ~~All aspects of the *power quality* criteria in clause 2.2.~~

~~For zone substation power transformers, supplying a total load greater than or equal to 20 MVA, no load shall be shed for the loss of one transformer, except as discussed in the next sentence. A short supply interruption, following the loss of any one power transformer, is permitted for a brief switching period to transfer the load to unfaulted transformers via distribution network switching. Spare capacity for this purpose shall be maintained.~~

2.5.2 Distribution Networks

Western Power must design and operate most ~~Most~~ distribution networks ~~are designed and operated~~ to the (N-0) criterion.

Explanatory note

Western Power designs its ~~it's~~ distribution networks as radial systems and in normal circumstances the loss of a component of the network will result in the loss of supply to a number of users. *Western Power* minimises ~~The~~ extent of the loss of supply ~~is minimised~~ by the use of reclosers and sectionalisers and the speed of fault location is improved through the use of fault indicators.

In the Perth central business district *Western Power* uses an open meshed, remotely switched, high voltage distribution network ~~is used~~ to ensure rapid restoration of supply to unfaulted sections of the network. In addition, the zone substations have automatic feeder reconfiguration to cover the loss of a step down transformer and the total loss of a single zone substation is ~~can be~~ covered by manual network reconfiguration.

In urban areas the density of users often results in an open, meshed network that *Western Power* operates is run radially with open points. This operating mode minimises fault levels and simplifies technical and operational requirements. In these situations improved supply restoration times are possible, although the initial loss of supply will still occur.

In rural areas the distribution network is, generally, radial and interconnections to reduce supply restoration times are often not possible.

Western Power must accommodate *Users* requiring additional security of supply above the standard design philosophy ~~will be accommodated~~ where possible, although, in some circumstances, on-site standby generation may be the only practical alternative.

Western Power has not designed the ~~The~~ distribution network ~~is not designed~~ for the islanded operation of generators and no *Western Power* distribution equipment is fitted with synchronizing equipment. Generators must disconnect from the network if the distribution feeder that they are connected to is separated from the remainder of the power system.

In summary ~~and in contrast to transmission networks,~~ distribution networks are generally radially operated. Following the fault clearance and isolation of the faulty component the supply is restored to customers. The time to restore supply largely depends on the location of the fault, and ~~a general rule is that~~ the restoration time generally decreases as the amount of load interrupted increases.

Contingency criteria for the distribution network therefore relates to the ability of the distribution network to be reconfigured after a fault so that the unfaulted portions of the network are restored. This is explained in more detail in the following sections.

2.5.2.1 Perth Central Business District High Voltage Distribution Feeders

The central business district (CBD) presents an important and sensitive load. Security and reliability of power supplies affect a large number of businesses, buildings and individuals. Therefore the planning criteria specific to the CBD are more "demanding" than for other areas of distribution networks.

The Perth CBD Zone is defined in the Access Arrangement Document.

Western Power must apply the following ~~The~~ criteria ~~adopted are that~~:

Supply may be lost but *Western Power* must use remotely controlled network restoration to ~~will~~ restore supply to the unfaulted portions of the network that lost supply.
For the loss of a zone substation, *Western Power* must ensure that the total load of that zone substation is ~~shall be~~ capable of being supplied from the adjacent zone substations via the distribution network.

2.5.2.2 Urban High Voltage Distribution Feeders

Existing distribution networks
Western Power must operate all ~~Any~~ existing distribution networks such ~~shall be operated so~~ that, for a zone substation feeder circuit or exit cable fault, the load of that feeder can be picked up by no more than four other feeders by manual reconfiguration. However, the overhead portions of a distribution network do not have any contingency criteria applied.

New distribution feeders
Western Power must apply the following design criteria to new distribution feeders:

(a) Whenever practical, any new feeder shall be ~~designed so that,~~ split into two radial spurs at the end of the zone substation exit cable~~, the feeder is split into two radial spurs~~.
(b) ~~Any new distribution feeder shall be designed so that, for~~ For a zone substation feeder circuit or exit cable fault, any other feeder must ~~does~~ not pick up more than 50% of the ~~feeder~~ load from the distribution feeder that ~~which~~ is out of service. The feeder(s) picking up the load can be from another zone substation.
(c) Any new underground distribution feeder, or portion of an underground feeder that has an installed transformer capacity of 1 MVA or more, shall be designed so that, as soon as adjacent developments permit, there is an alternative source of supply that is normally open, but can be closed to provide supply if a fault occurs on the normal supply.

2.5.2.3 Rural High Voltage Distribution Feeders

Western Power must normally design ~~The~~ radial ~~nature of~~ rural distribution feeders to the N-0 criterion. ~~normally precludes the application of contingency criteria to these feeders.~~ However, where technically and commercially feasible *Western Power* must provide interconnection between feeders ~~shall be provided~~.

2.5.2.4 Limits on Radial High Voltage Feeders

For all ~~All~~ radial High Voltage feeders (6, 11, 22 & 33 kV) *Western Power* must ~~shall~~ limit the number of domestic customers to a maximum of 860 or the ~~to a~~ load to ~~of~~ no more than 2 MVA, which ever is least. Above these limits the circuit *Western Power* must interconnect ~~shall be inter connected~~ to another part of the high voltage network.

2.5.2.5 Low Voltage Distribution Networks

Western Power must normally design radial low ~~Low~~ voltage distribution networks to the N-0 criterion. ~~are radial and interconnection is not a primary design criterion.~~ However, where technically and commercially feasible~~,~~ *Western Power* must provide interconnection between low voltage feeders ~~shall be provided~~.

For residential subdivisions *Western Power* must ensure that all low voltage (415V) circuits shall have a switching point for every 16 customers.

2.5.2.6 Pole to Pilar Connections Mandatory

Western Power must ensure that all ~~All~~ new connections and upgrades to existing overhead services to all customers will be underground. The overhead service must ~~will~~ be converted to underground consumer mains.

2.5.2.7 Distribution Remote Control and Monitoring

Western Power must apply the following design criteria:

(a) All new or replaced transformers and switches (RMUS) must ~~shall~~ be remotely operable and controlled from the control centre. On the transformers, provision for remote operation must ~~will~~ be made on all the LV circuits, i.e. transformer LV and each LV feeder circuit.

(b) All new and replaced transformers and switches must ~~shall~~ be remotely monitorable from the control centre.

2.6 STEADY STATE CRITERIA

Explanatory note

The steady state criteria define the adequacy of the transmission and distribution network to supply the energy requirements of *Users* within the component ratings of primary plant and frequency and voltage limits, taking account of planned and unplanned outages.

The steady state criteria apply to the normal continuous behaviour of the transmission and distribution network and also cover post disturbance behaviour once the network has settled.

Each of the steady state criteria must ~~should~~ be satisfied for the contingency criteria in clause 2.5 of these *Rules*~~-~~(N-1 and N-2 criteria where applicable).

2.6.0 Steady State Frequency Limits

The steady state *power system frequency* should not exceed the design limits specified in clause 2.2.1, Table 2.1, of these *Rules*~~. For SWIS, these values are:~~

- ~~Under normal operating conditions the network frequency shall be maintained at 50Hz ±0.2 Hz.~~
- ~~Under emergency conditions the network frequency may vary between 47 – 52 Hz, until the under frequency load shedding and other protection and control schemes restore balance between generation and consumption.~~

2.6.1 Steady State Voltage Limits

The steady state *power system voltage* must ~~should~~ not exceed the design limits specified in clause 2.2.2 of these *Rules*.

Step changes in *voltage* must ~~should~~ not exceed the limits specified in Table 2.10.

Table 2.10
Step - Change Voltage Limits

Cause ~~of~~ ~~Outage~~	Pre-Tap Changing		Post-Tap Changing (final steady state ~~volts~~)	
	e66kV	<66kV	e66kV	<66kV
Routine Switching*)	±3.7% (max)	±3.7% (max)	Transmission voltages must ~~should~~ be between 110% and 90% of nominal voltage	Must ~~Should~~ attain previous set point
Infrequent Switching or Events**)	+6%, -10% (max)	+6%, -10% (max)	Transmission voltages must ~~should~~ be between 110% and 90% of nominal voltage	Must ~~Should~~ attain previous set point

*) for example, capacitor switching, transformer tap action, motor starting

**) for example, tripping of generators, loads, lines and other components, typically as a result of faults

~~**Low Voltage**~~

~~The low voltage steady state voltage must be within:~~

~~· ± 6% of the nominal voltage during normal conditions~~

~~· ± 8% of the nominal voltage during maintenance conditions~~

~~· ± 10% of the nominal voltage during emergency conditions~~

2.6.2 Thermal limits:

~~The~~ *Western Power* must not exceed the thermal ratings of the *transmission and distribution network* components that are calculated on the following basis ~~should not be exceeded~~ under normal or emergency operating conditions ~~when calculated on the following basis:~~

1) *Transformers*: Normal cyclic rating as defined by IEC 354.
2) Switchgear: Normal manufacturer's name plate rating.
3) Lines: Summer or winter continuous ratings appropriate for the season based on:
   a) ambient temperature being that for 1% probability of daily maximum temperature not being exceeded over the summer season (December to February), and 25°C for winter;
   b) wind speed being 1.0m/s;
   c) solar radiation being 1000W/m^2 (weathered surface); and
   d) conductor design clearance temperature as defined in ESAA Code C(b)1.
4) Cables: Normal cyclic rating, calculated using the Neher McGrath methodology,

with maximum operating temperatures of 90°C~~ degrees~~ for XLPE cables; 70°C~~ degrees~~ for 11kV paper insulated cables, and 65°C ~~degrees~~ for 11kV paper insulated belted cable, and 22 kV and 33 kV paper insulated cables.

During an emergency, for a period of up to 12 hours, the maximum operating temperature shall be 80°C for paper insulated cables ~~shall be raised to 80 degrees C,~~ and 120°C for XLPE insulated cables. ~~120 degrees.~~

2.6.3 Fault rating limits

Western Power must apply the following criteria:

(a) The calculated maximum fault levels at any point in the *transmission networks* *must* ~~shall~~ not exceed 95% of the equipment fault rating at that point.

(b) ~~For safety reasons, t~~The fault level in any part of ~~throughout~~ the distribution network must not exceed the fault rating of any equipment in that part of the network at any time for any normal network configuration.

The *User* that causes an increase in ~~changes to~~ *distribution network* fault levels must ~~will~~ be responsible for any *plant* upgrades required as a result of the changed *power system* conditions.

Maximum fault levels ~~Criteria~~

Western Power must limit the ~~The~~ fault currents ~~levels are limited~~ to the following values throughout ~~all~~ *Western Power*'s distribution networks:

- 415 V networks 50 kA
- 6.6 kV networks 21.9 kA
- 11 kV networks 18.4 kA
- 22 kV networks 13.1 kA
- 33 kV networks 13.1 kA

Western Power and *Users* must ensure that equipment ~~Equipment~~ connected to the distribution network is ~~must be~~ designed to withstand these fault currents ~~levels~~ for 1 second.

2.6.4 Real and Reactive Generating Limits

In planning ~~a~~ its network *Western Power* must ~~it is necessary~~ to assess the reactive power requirements under light and heavy load conditions to ensure that the reactive demand placed on ~~the~~ generators and other static and dynamic sources of reactive power, to absorb or generate reactive power, does not ~~exceed~~ reach their ~~the capability of the generators~~ ratings.

An imbalance of system real power generation an load is indicated by the system frequency.~~Similarly, network~~ The frequency will fall if there is insufficient total generation to meet demand. Although the reduction in frequency will cause a reduction in power demand, it is unlikely that this will restore the balance. ~~, therefore~~ *Western Power* mustarrange to disconnect sufficient ~~amount of~~ load ~~must be disconnected~~ by automatic load shedding a specified in section 2.4 to enable the frequency to rise to an acceptable level.~~, as is explained in clause 2.4 of these *Rules*.~~

~~Limits to the active generation and reactive (VAr) generation and absorption capability of generating and reactive compensation plant such as *static VAr compensators* are not to be exceeded.~~

~~2.6.5 Transmission Reactive Planning Process~~

~~Reactive capacity is obtained from a combination of static and dynamic sources. Static sources include, for example, reactors and capacitor banks. Dynamic sources include, for example, synchronous machines, operating as generators or synchronous compensators, and static VAr compensators.~~

~~All necessary steps should be taken to ensure that *voltage* collapse does not occur for the most onerous outage of any power system element under credible *generation* schedules under all *load* conditions. It should be assumed that 3% of all installed LV *capacitor banks* in addition to one *capacitor bank* or reactive device that has the largest impact in the system are unavailable. Adequate *reactive power reserves* based on *power system* studies should be provided.~~

1)~~For terminal substations in the metropolitan area the following procedure is used at present:~~
  a)~~The disturbance, which takes the system closest to voltage collapse, is determined by investigating likely worst case scenarios.~~
  b)~~3% of the total installed LV *capacitor banks* plus the largest HV *capacitor bank* on the system are to be taken out of service.~~
2)~~For other areas of the system, including radials, the following procedure is used to determine the *voltage* stability or transfer limit:~~
  ~~(a) The normal peak system *generation* pattern that provides the lowest level of *voltage* support to the area of interest is assumed. (Of these *generators*, normally in service in the area, the largest generator is assumed to be out-of-service due to a breakdown or other maintenance requirements. If another generator is assigned as a backup unit then it may be brought into service to support the load area.~~
  ~~(b) The largest *capacitor bank*, or the one that has the largest impact, in the area is to be taken as out-of-service where the area involves more than one substation.~~
  ~~(c) The tripping of a line or other plant or tripping of a *generator* that causes the largest reduction in system *voltage* support in the area of interest is taken as the disturbance used to establish the transfer limit or *reactive support* limit.~~
3)~~In all situations the following procedures are to be followed:~~
  a)~~All loads are modelled as constant P & Q *loads*.~~

~~b)The *load* to be used in the study is to be taken as 5% higher than the expected system *peak load*, or a 5% higher *transfer* into the area. (The 5% margin includes a safety margin for hot weather, data uncertainty and uncertainty in the simulation.)~~

~~c)A positive MVAr reserve margin is to be maintained at major load points for this 5% higher load. (System *voltages* should remain within the normal operating range).~~

~~d)All credible *generation* schedules are to be considered with none of the steady state MVAr limits to be reached or exceeded.~~

~~e)System conditions are checked after the *outage* but both prior to and following tap changing of transformers.~~

~~2.7 SAFETY CRITERIA~~

~~As part of the planning process the safety risk should be considered for any new developments and existing *facilities* which may have a significant impact on safety. The safety risk is to be assessed in the planning process. Relevant bodies should be informed, consulted and steps taken to ensure safety is maintained to industry standards and statutory requirements, including but not limited to those of WA Electricity Regulations 2001~~.

~~2.8 ENVIRONMENTAL CRITERIA~~

~~*Western Power* Corporation's environmental policy states~~

~~–"*Western Power* will be recognised as a leader in environmental management by demonstrating responsible stewardship of its operations in the environment".~~

~~–*Western Power* will minimise adverse environmental effects while providing for the efficient and reliable generation, transmission and distribution of electricity.~~

~~*Western Power* commits to the following objectives to fulfil its environmental policy:~~

- ~~To consult openly and fully with the community and government where Corporation activity may affect the environment.~~
- ~~To ensure that planning and design for new projects and changes to existing processes provide for consideration of best environmental practice technology and timely impact assessment.~~
- ~~To carry out business in a resource efficient manner.~~

~~*Western Power* planning, construction and operation works embody environmental management principles including consultation, proactive planning, compliance, sustainable development and auditing for continuous improvement.~~

~~2.8.1 Enviromental Legislation~~

~~The *Environmental Protection Act (1986)* is the principle legislative framework for environmental protection in Western Australia.~~

~~Under the provisions of the Act, any new project or change to an existing installation, which may have a significant impact on the environment, must be referred to the Environmental Protection Authority (EPA) for assessment and approval.~~

~~In addition to the Environmental Protection Act (1986) other environmental legislation is applicable to *Western Power*'s activities and will be complied with. These include (but are not limited to): Environmental Protection & Biodiversity Action (1999), Aboriginal Heritage Act (1972), Conservation & Land Management Act (1984), Contaminated Sites Act (2003), Dangerous Goods Safety Act (2004), Wildlife Conservation Act (1950).~~

~~*Western Power*'s distribution networks will be developed so that these commitments are met.~~

~~2.8.2 Social Issues~~

~~*Western Power* will proactively inform and consult with government agencies, interested community groups and members of the community when planning new developments and facilities.~~

~~2.8.3 Electromagnetic Fields~~

~~Recognising the current state of scientific uncertainty regarding adverse health effects from exposure to power frequency electric and magnetic fields, *Western Power* shall act prudently and design, construct and operate all equipment and facilities to maintain electromagnetic frequency exposure to the public and *Western Power* employees at levels within industry standards.~~

~~2.8.4 Land-use Considerations~~

~~*Western Power* will avoid working within natural, cultural and historical sites. If unable to avoid working within these sites, *Western Power* will seek the necessary approvals from relevant Decision Making Authorities for planned activities or retrospective approvals for unplanned activities to ensure activities are consistent with the safe and reliable operation of the electricity supply network.~~

~~2.8.5 Noise~~

~~*Western Power* and *Users* shall plan, design, construct, augment or replace and operate works to comply with the noise levels established by the Environmental Protection (Noise) Regulations 1997. This may include building suitable noise enclosures to mitigate equipment noise.~~

~~2.8.6 Visual Amenity~~

~~Given that the community and customers are sensitive to the visual impact of electrical installations, *Western Power* shall conduct its electricity supply operations in a manner that minimises visual impact.~~

~~2.9 AUTOMATIC RECLOSURE OF TRANSMISSION OR DISTRIBUTION LINES~~

~~Where *automatic reclose equipment* is provided on *transmission lines* or *distribution lines*, check or blocking *facilities* must be applied to the *automatic reclose equipment* in those~~

~~circumstances where there is any possibility of the two ends of the *transmission line* or *distribution lines* being *energised* from sources that are not in *synchronism*.~~

2.~~10~~7 DISTRIBUTION DESIGN STANDARD ~~CRITERIA~~

Western Power must apply the following criteria:

(a) All residential subdivision networks will be designed to supply the 50 year maximum load anticipated for that area.

(b) All Commercial and Industrial subdivisions networks must ~~will~~ be designed to supply the 50-year maximum load anticipated for that area.

2.~~11~~8 DISTRIBUTION CONSTRUCTION STANDARDS~~S CRITERIA~~

Western Power must ~~shall~~ construct the overhead portions of its ~~it's~~ distribution networks in accordance with the Electricity Supply Association of Australia publication C (b) 1 - "Guidelines for Design and Maintenance of Overhead Distribution and Transmission Lines" and install the underground portions of its ~~it's~~ distribution networks in accordance with the Electricity Supply Association of Australia publication C (b) 2 - "Guide to the Installation of Cables Underground".

Other statutory requirements include, but are not limited to, Electricity Network Access Code 2004~~WA Electricity Distribution Regulations~~; the Guidelines for Electricity Transmission and Distribution work in Western Australia, current edition is 12/98, issued by Energy Safety (former Office of Energy); ESAA Guide to the use of separate connectors D (b) 30 – 1983; AS/NZS 2832.1:1998 "Cathodic protection of metals, pipes and cables"; AS/NZS 2648.1 – 1995 "Underground marking tape – Non detectable tape", etc.

In addition, all network extension or upgrades must comply with WPC's fire proofing requirements.

2.~~12~~9 DISTRIBUTION CARRIER SELECTION ~~CRITERIA~~

~~The Western Australian government is committed to the undergrounding of power to half of the distribution network in Perth and Regional Centres by 2010. In accordance with this objective, *Western Power* shall use underground cables for network reinforcement and extension within the Perth Metropolitan area and Regional Centres, where in *Western Power*'s opinion they are appropriate. Outside of these areas *Western Power* will install underground cables where technical and commercial considerations permit.~~

In designing extensions to the distribution network, *Western Power* must use ultimate load horizon planning ~~shall be used~~ to establish the network concept plan and the initial installation must ~~shall~~ conform to that concept plan and use carriers that are appropriately sized. This methodology eliminates the need to disrupt the community in future years as load growth occurs and results in the minimum life time cost to the community.

To achieve maximum cost efficiency in the installation of carriers, *Western Power* must apply the following criteria with the aim of achieving ~~standard conductor and cable sizes have been selected. This results in~~ minimum stock holdings and purchase prices, for standard conductors and cables, and giving the *Users* the least cost distribution network:

- (a) The standard carrier size that is equal to, or greater than that required for the reasonably foreseeable load, shall be used for each overhead network extension or reinforcement.
- (b) The standard carrier size that is equal to, or greater than that required for the horizon load, shall be used for each underground network extension or reinforcement.

2.10 *WESTERN POWER'S PROTECTION* REQUIREMENTS

2.10.1 Obligation to Provide Adequate *Protection*

Western Power Networks must provide for the *protection* of all *primary plant* in its system so that any faulted element is rapidly removed from service by the operation of circuit breakers or fuses. *Protection* schemes must be applied such that the integrity of the networks is maintained to the extent possible, there is the least possible disruption to users, and damage to the primary plant is minimised.

The reliability principle that *Western Power* must apply to all transmission plant in the power system is that a single fault shall not cause disconnection of equipment beyond its fault clearing zone. Clearly, this principle cannot be applied to parts of the system designed to the (N-0) criterion or those protected by remedial action schemes.

When any new *primary plant* is connected to a part of the network owned by *Western Power* *Western Power* must ensure that the existing reliability and performance of the *power system* is not degraded.

If the *connection* of new *primary plant* affects *critical fault clearance times* *Western Power* must ensure that the *protection* of both the new and the existing *primary plant* throughout the *power system* meets the new *critical fault clearance times*. Where existing *protection* does not do so *Western Power* must upgrade the relevant *protection*.

Western Power must also consider other *fault clearance time* requirements to preserve plant and system integrity and minimise impacts on *Users*. Typically, these requirements will arise from the need to minimise damage to primary plant, to limit system *voltage* and/or *frequency* disturbances resulting from faults and to prevent critical motor groups from stalling.

Prior to the detailed design phase and if all new *plant* data is unavailable, so that required clearance times cannot be determined *Western Power* may assume that all faults of any type must be cleared within the times specified in section 2.10.2.5.

2.10.2 Overall Protection Requirements

2.10.2.1 Minimum Standard of *Protection* Equipment

Western Power must ensure that all new *protection* equipment complies with IEC Standard 255 as a minimum requirement. *Western Power* must also ensure that any new Current Transformers and Voltage Transformers comply with IEC Standards 185 and 186 respectively.

2.10.2.2 Duplication of *Protection*

Transmission

Western Power must apply two fully independent *protections*, *connected* to operate in a "one out of two" arrangement, to comprise a complete scheme in accordance with the following details. Both *protections* must meet the *critical fault clearance times* and the *fault clearance time* requirements of section 2.10.2.5, and discriminate with other *Western Power protection.*

To implement the "one out of two" arrangement, *Western Power* must provide complete secondary equipment redundancy. This includes redundant *CT* and *VT* secondaries, auxiliary supplies, cabling and wiring, circuit breaker trip coils and batteries. Where both *protections* require end to end communications, independent *teleprotection signalling* equipment and communication channels must be provided. Further, where failure of the signalling will result in neither *protection* meeting the basic *sensitivity* and operating time criteria, independent communication bearers must be provided for each signalling channel.

To maintain the integrity of the two *protections* cross *connections* must not be made between trip circuits and other cross *connections* between *protections* shall be avoided. If cross *connections* between *protections* is unavoidable, sub-fused wiring must be employed to segregate this wiring from the tripping circuits. The design must make it possible to test and maintain either *protection* without interfering with the other.

The two fully independent *protections* may be dedicated to more than one item of *primary plant*. One of the *protections* may be a *remote backup protection.*
Distribution

Western Power shall protect each item of distribution *primary plant* by two *protections*, one of which may be a remote backup protection rather than a duplicate protection. *Protections* must meet the *critical fault clearance times* and the *fault clearance time* requirements of section 2.10.2.5, and discriminate with other *Western Power protection.*

Duplicate *protection* must be applied for islanding protection and when *a critical fault clearance time* exists.

2.10.2.3 Availability of *Protection*

Transmission

Western Power must ensure that all elements of both *protections*, including associated intertripping circuits, are well maintained so as to be available at all times, except that short periods of unavailability of one *protection* (up to 48 hours every 6 months) while maintenance or repair is being carried out, is acceptable. *Western Power* must remove the associated primary plant from service during longer periods of unavailability.

Distribution

Western Power must ensure that all equipment is protected and all elements of the protection, including associated intertripping, are available at all times. Unavailability of a *protection* (primary or backup) will require that *Western Power* take the associated primary plant out of service, except that short periods of unavailability of either primary or backup protection (up to 48 hours every 6 months) while maintenance or repair is being carried out, is acceptable.

2.10.2.4 *Protection* Performance where a Critical Fault Clearance Time Exists

Western Power must ensure that, where a *critical fault clearance time* exists on an item of primary *plant*, that item will be protected in such a manner that, with any single *secondary plant contingency*, a fault will be detected and cleared within the *critical fault clearance time*.

This means that the *primary plant* must be protected by *two fully independent protection schemes of differing principle*, each *protection scheme* capable of detecting and clearing *primary plant* faults within the *critical fault clearance time*. Such an arrangement must enable the *critical fault clearance time* to be met in the event of a single *secondary plant contingency*.

Western Power must keep adequate records of the design *fault clearance times* for all circuit breakers and *protections* for which a *critical fault clearance time* exists.

2.10.2.5 Maximum Acceptable *Total Fault Clearance Time*

Regardless of the *critical fault clearance time*, *Western Power* must protect each item of *plant* by *two fully independent protections of differing principle*. For all *plant* operating at a voltage of 220 kV and above both *protections* must meet the clearance times given in Table 2.11 below. For plant operating at 132kV and below at least one of the *protections* must meet the *total fault clearance times* as given in Table 2.11 below.

Table 2.11
Standard *fault clearance times* (msec) - *South West Interconnected System*

		Existing Equipment No CB Fail	Existing Equipment CB Fail	New Equipment No CB Fail	New Equipment CB Fail
220kV and above	Local end	120	370	100	250
	Remote end	180	420	140	290
66kV and 132kV	Local end	150	400	115	280
	Remote end	200	450	160	325
33kV and below	Local end	1160	1500	1160	1500
	Remote end	Not defined	Not defined	Not defined	Not defined

For 132kV and 66kV lines, where the *critical fault clearance times* exceed the above times, only one *protection* must meet the above times. The other *protection* must meet the smaller of the *critical fault clearance time* and the time shown in Table 2.12 below.

Table 2.12
Second *Protection* for 132kV and 66kV Lines Standard *fault clearance times* (msec)
South West Interconnected System

		Existing Equipment No CB Fail	Existing Equipment CB Fail	New Equipment No CB Fail	New Equipment CB Fail
132kV	Local end	150	400	115	280
	Remote end	400	650	400	565
66kV	Local end	1000	Not defined	115	280
	Remote end	Not defined	Not defined	400	565

In Tables 2.11 and 2.12 two sets of fault clearance times are given. The first set may be applied to existing equipment (i.e. existing at the *code commencement date*). The second set must be used for all new equipment.

In Tables 2.11 and 2.12, "Local end" refers to the first 50% of the line and the end of the line nearest the location of the fault and "Remote end" refers to the end of the line most distant from the location of the fault.

On 132kV lines that are longer than 40 km *Western Power* may apply the clearance times in Table 2.12 for both *protections*, provided the *critical fault clearance time* is not exceeded.

Total fault clearance times must be met during *abnormal plant conditions*.

On 66kV lines that are longer than 40km *Western Power* may apply the clearance times given for 132kV in Table 2.12 to one protection and the clearance times given for 66kV in Table 2.12 to the other protection, provided the *critical fault clearance* time is not exceeded.

2.10.2.6 Sensitivity of Protection

Western Power must ensure that all *protections* have sufficient *sensitivity* to detect and correctly clear all *primary plant* faults within their intended normal operating zones, under both normal and *minimum system conditions*. Under *abnormal plant conditions*, all primary system faults must be detected and cleared by at least one *protection*. *Remote backup protection* or standby *protection* may be used for this purpose.

The criterion for sufficient *sensitivity* of a protection must be that it will detect and correctly clear for half the fault current that will flow for the above conditions.

2.10.2.7 Clearance of *Small Zone Faults*

Western Power must ensure that a *small zone fault* will be detected and cleared by *backup protection* as specified in clause 2.10.3.7. The clearance time requirements for small zone faults are those specified in Clause 2.10.2.5 for Circuit Breaker Fail conditions. For a small zone fault coupled with a single protection failure the clearance times are 380msec for 220kV and 330kV, and 400msec for 66kV and 132kV. *Western Power* must reduce reliance on remote backup protection by ensuring that the circuit breaker fail protection covering the small zone fault initiates the circuit breaker fail protection of the circuit breakers that are being tripped to clear the small zone fault.

2.10.2.8 Clearance of Faults Under Circuit Breaker Fail Conditions

Western Power must ensure that failure of a circuit breaker to clear a fault, due to either a mechanical or electrical failure, will be detected and that the primary fault current will be cleared by *backup protection* as specified in the clause 2.10.3.7.

2.10.2.9 Busbar Protection

Western Power must avoid connecting voltage transformers and surge diverters within the operating region of busbar buszone schemes.

2.10.2.10 DC Functions Of *Protection Apparatus*

Western Power must ensure that all *protection apparatus* functions shall be capable of operating with the battery *voltage* at a level that is able to be supplied by the DC supply for the full time specified in Clause 3.2.8. In addition, equipment must be specified with adequate allowance for the voltage drop between the DC supply and the plant location.

2.10.2.11 *Protection* Flagging and Indication

Western Power must ensure that all protective devices supplied to satisfy the *protection* requirements are either equipped with non volatile operation indicators (flags) or else *connected* to an event recorder. Such indicating, flagging and event recording shall be sufficient to enable the determination, after the fact, of which devices caused a particular trip.

Western Power must ensure that any failure of the tripping supplies, *protection* apparatus and circuit breaker trip coils will be alarmed and must put in place operating procedures to ensure that prompt action is taken to remedy such failures.

2.10.2.12 *Trip Supply Supervision* Requirements

Western Power must ensure that, where loss of *supply* would result in *protection scheme* performance being reduced, all *protection* secondary circuits have *Trip Supply Supervision*.

2.10.2.13 Trip Circuit Supervision Requirements

Western Power must ensure that all *protection* secondary circuits that include a circuit breaker trip coil shall have *Trip Circuit Supervision*. This equipment must monitor the trip coil when the circuit breaker is in both the open and closed position and alarm for an unhealthy condition.

2.10.2.14 Coordination of *Protection* Settings

Western Power must ensure that all new *protection* settings coordinate with existing *Western Power protection* settings.

2.10.2.15 Commissioning of *Protection*

Western Power must ensure that all commissioning and testing of *protection* is carried out by personnel suitably qualified and experienced in the commissioning, testing and maintenance of *primary plant* and *secondary plant* and equipment.

2.10.2.16 Maintenance of *Protection*

Western Power must ensure that all *Protection systems* are maintained at intervals of not more than 8 years for transmission and 12 years for distribution. It shall keep records of such maintenance.

Each scheduled routine test, or any unscheduled tests which become necessary shall include both a calibration check and an actual trip operation of the associated circuit breaker unless this tripping operation had been proven by a control trip using the same tripping contact or a trip for a system fault.

All maintenance and testing of *protection* must be carried out by personnel suitably qualified and experienced in the commissioning, testing and maintenance of *primary plant* and *secondary plant* and equipment.

2.10.3 Specific *Protection* Requirements

2.10.3.1 Transmission Lines and other *Plant* Operated at 66kV and above

Protection must be by *two fully independent protections of differing principle* that discriminate with the *Western Power power system* and that meet the critical *fault clearance times* or the fault clearance times specified in clause 2.10.2.5.

One of the *protections* must include earth fault *protection* to give additional coverage for low level earth faults and to provide *remote backup*.

2.10.3.2 Feeders, Reactors, Capacitors and other *Plant* Operated below 66 kV

Protection of these items must be by *two fully independent protections of differing principle*, each one discriminating with the *Western Power* network and capable of meeting the total *fault clearance time* requirements of clause 2.10.2.5. At least one of these *protections* must include earth fault *protection* so as to give additional coverage for low level earth faults and to provide *remote backup*.

Where there is no *critical fault clearance time*, the following shall be the minimum *protection* requirement:

- Three Phase Inverse Definite Minimum Time Overcurrent
- Three Phase Instantaneous Overcurrent (where this can be set without causing coordination problems)
- Inverse Definite Minimum Time Earth Fault

These *protections* must be backed up by an independent *protection* to ensure clearance of faults in the event of a *protection* failure. The *protection* systems must discriminate with other protections in *Western Power's network*.

Where the *Western Power protection* is overcurrent, the maximum operate time must be 1 second at maximum fault level.

Explanatory Note: Generally, *Western Power's* overcurrent and earth fault *protection* employs devices with standard inverse characteristics to BS142 with a 3 second curve at 10 times current and time multiplier of 1.0. This is the specification of the characteristic rather than the device setting. Operating times for other types of *protection* will generally be lower and will be dependent upon location.

2.10.3.3 Transformers

Protection must be by *two fully independent and complementary protections of differing principle*, each one discriminating with the *Western Power system* and capable of meeting the *critical fault clearance time* or the total *fault clearance times* in clause 2.10.2.5.

For *transformers* larger than 10 MVA at least one of the protections must be a *unit protection* and provide high speed fault clearance of *transformer* faults.

The two fully independent *protections* must be *complementary* such that, in combination, they provide dependable clearance of *transformer* faults within a specified time. In the event that there is a single failure to operate within the *secondary plant*, fault clearance must still be achieved by *transformer protection*, but may be delayed until the nature of the fault changes or evolves.

2.10.3.4 Check *Synchronising*

Western Power must install check *synchronising* interlocks on circuit breakers if the risk of out of *synchronism* closure is unacceptable.

Western Power must ensure that check *synchronising* interlocks include a feature such that circuit breaker closure via the check *synchronism* interlock is not possible if the permissive closing contact is closed prior to the circuit breaker close signal being generated. Such a feature is intended to protect the check *synchronism* interlock permissive contact from damage and to ensure out of *synchronism* closure cannot occur if the contact is welded closed.

2.10.3.5 *Protection* Alarm Requirements

Western Power must ensure that *protection* alarms are brought back to *Western Power's control centre. Western Power must alarm* any failure of its tripping supplies, self-monitored *protection apparatus* and circuit breaker trip coils and must put in place operating procedures to ensure that prompt action is taken to remedy such failures.

2.10.3.6 Backup Protection

Western Power must provide two fully independent forms of *backup protection* to detect and clear faults involving *small zones* or *circuit breaker failure*.

Such *protection schemes* must be capable of detecting and initiating clearance of uncleared or *small zone faults* under both normal and *minimum system conditions*. Under *abnormal plant conditions*, all primary system faults must be detected and cleared by at least one *protection scheme*. *Remote backup protection* or standby *protection* may be used for this purpose.

All other faults and combinations of faults within the contingency requirements specified in clause 2.5 (such as a small zone fault coupled with a breaker failure) must be detected and cleared, but not necessarily within the *critical fault clearance* time.

2.10.3.7 Automatic Reclose Equipment

Western Power may apply automatic reclose equipment in the *Western Power network* at its discretion. It is currently used in limited circumstances (e.g. on some radial transmission lines and in distribution).

3. TECHNICAL REQUIREMENTS OF *USER FACILITIES*

3.1 INTRODUCTION

This Section sets out details of the technical requirements which *Users* must satisfy as a condition of *connection* of any *plant* and equipment to the *power system* (including *embedded generators*), except where specifically varied in an *access contract*. It provides the specific requirements for both generators and load *U~~u~~sers*, together with details of the protection requirements necessary to ensure stable network operation.

3.1.1 Customer Main Switch

All *U~~u~~sers*, generators and loads, must be able to de-energise their own plant, equipment or substation without reliance on *Western Power*. Alternatively, the generator *User* must meet the following five requirements:

1. The *User* must be able to synchronise any parallel generating plant to the network across a circuit breaker owned by the *User*.
2. The *User* must be able to clear a fault on its equipment:
   (a) Without affecting any other *User* or potential user,
   (b) Without reducing network reliability, and
   (c) Within the fault clearance time specified in these *Rules*.
3. If:
   (a) The *User* has only one circuit at the point of attachment, and
   (b) If the relevant *Western Power* owned circuit breaker is located in a meshed substation, and if:
      (1) The *User*'s facilities are continuously manned with personnel capable of resetting a hand reset protection relay, or
      (2) The *User*'s facilities have self resetting relays,

   Then, the *User* may send a trip signal to the electrically closest *Western Power* owned circuit breaker, provided this arrangement satisfies point 2 above.
4. The *User* must own a visible point of isolation for each piece of equipment connected to the network.
5. The *User* must indemnify *Western Power* for any direct or indirect damage caused to the *User* resulting from the *User* electing to use *Western Power*'s circuit breaker to clear a fault under point 3 above.

~~3.~~

3.1.2 Power System Simulation Studies

Prior to a *User's facilities* being *connected* to the *power system*, the impact on *power system* performance due to the *User's facilities* must be determined by *power system* simulation studies. These studies may be performed by *Western Power*, the *User* or by a third party on behalf of the *User*. *Western Power* must specify the scope, existing network data and method for the studies before their commencement. The *User* must use reasonable endeavours to meet *Western Power's* study requirements and must seek approval for any variation. The *User* must include in its report to *Western Power* full details of the studies performed, including assumptions made, data sources, results, conclusions and recommendations. The *User* must also provide full details of equipment connected and associated models in accordance with these *Rules*. *Western Power* may require, on reasonable grounds, that additional studies be done or that studies be repeated. Acceptance of the studies performed by a *User* or a third party will be entirely at *Western Power's* discretion, but rejection must be based on reasonable grounds. *Western Power* must reserve the right to perform its own studies and must provide details of such studies to the *User*, where the results impact on the *User*'s connection requirements. *Western Power* must make the final determination on the suitability of a *User's facilities* and the requirements to be fulfilled prior to and after the *facilities* are *connected*, in accordance with the *Access Code* and these *Rules*. Reinforcement requirements to enable the *User* to connect must be determined in consultation with *Western Power*.

3.2 REQUIREMENTS FOR *CONNECTION* OF *GENERATORS*

For generating plant the combined rating ~~output~~ of which is less than 10 MW and which are connected to distribution network below 66kV the connection requirements of Section 3.5 shall apply.

NOTE: The 10 MW threshold is chosen to coincide with the cut-off size for compulsory participation in the WA wholesale market. The wholesale market participation is compulsory for the generation plant rated 10 MW and above.

~~*Western Power* will carry out detailed *power system* studies to determine performance requirements to be expected from a proposed new *generating unit* or modification to an existing *generating unit*.~~

Users will be responsible for ensuring that *plant* capabilities and ratings are monitored on an ongoing basis to ensure continued suitability as conditions on the *power system* change in the future (e.g. increasing fault levels as additional *plant* is *connected* to the *power system*). A

If, after installation of a *User's facilities*, it is found that the installation is adversely affecting the security or reliability of the *power system*, the *quality of supply*, or the installation does not comply with the *Rules* ~~*Code*~~ or the relevant *access contract*, the *User* shall be responsible for remedying the problem.

~~Unless otherwise specified, technical requirements for non-synchronous generators will apply at the connection point, rather than at the generator terminals, to allow flexibility in design.~~

A generating unit must have plant characteristics and control systems, including but not limited to the inertia (effective, presented to the power system), short-circuit ratio and power system stabilisers, sufficient to:

(1) not cause any reduction of inter-regional or intra-regional power transfer capability because of:

- (i) rotor angle stability,
- (ii) frequency stability, or
- (iii) voltage stability

by more than its loading level whenever it is ~~synchronysed~~ synchronised / connected relative to the level that would apply if the generating unit were disconnected;

(2) not cause instability that would adversely impact other *Users*.

~~Users and Western Power shall not be adversely affected by transients caused by relatively large non-synchronous generators.~~

~~A non-synchronous generator should not cause reduction of inter-regional or intra-regional power transfer capability by more than its loading level whenever it is connected relative to the level that would apply if the non-synchronous generator was disconnected.~~

Trip of the unit should not cause increased need for load shedding because of:

- (i) Rate-of-change-of frequency
- (ii) Magnitude of frequency excursion
- (iii) Active power imbalance
- (iv) Reactive power imbalance
- (v) Displacement of reactive capability

above the level that would apply if the generating unit were disconnected.

Users with relatively large non-synchronous generators are responsible that their transients do not adversely affect *Western Power* and other *Users*.

Unless otherwise specified, technical requirements for non-synchronous generators will apply at the connection point, rather than at the generator terminals, to allow flexibility in design.

3.2.1 Technical Characteristics

a) A *User* must ensure that its *synchronous generating unit(s)* comply with the requirements advised by *Western Power* as to the minimum subtransient reactance of the *generating unit(s)* to control fault levels on the *transmission* and/or *distribution network* ~~and/or *distribution network*~~.

A *User* must ensure that its *generating unit(s)* other than synchronous generating unit(s) complies with the requirements advised by *Western Power* as to the minimum / maximum fault current contribution of the *generating unit(s)* to control fault levels on the *transmission network* and/or *distribution network*.

If connection/disconnection of the *User* causes excessively high or low fault levels then this issue needs to be addressed by other action, at the time the application for connection/disconnection is processed.

b) T~~he requirements t~~o ensure stability of the *electricity transmission network* and maintain *power transfer capabilities* ~~may have an impact~~, where appropriate, the *User* must consider changes of ~~on~~ the generator, step-up transformer, turbine, inertia constant, turbine control or excitation system, etc, of the synchronous/induction *generating unit* or the control system characteristics/behaviour for an inverter or converter coupled generating unit.

c) All generating units, synchronous or otherwise, must provide voltage control within own reactive power capability of clause 3.2.4.1, as per the applicable control strategy, limits and range set out in clause 3.2.5.4. For non-synchronous generating units, when synchronised, the maximum permissible settling times of Table 3.1 shall apply (the last two rows).

3.2.2 Technical Matters to be Co-ordinated

The *User* and *Western Power* must use all reasonable endeavours to agree upon the following matters in respect of each new or altered *connection*:

a) Design at *connection point*;

~~b) Physical layout adjacent to *connection point*;~~

~~c)~~b) *Protection* ~~and backup~~;

~~d)~~c) Control characteristics;

~~e)~~d) Communications, *metered* quantities and alarms;

~~f)~~e) Insulation co-ordination and lightning protection;

~~g)~~f) Fault levels and fault clearing times;

~~h)~~g) Switching and *isolation facilities*;

~~i)~~h) Interlocking arrangements;

~~j) *Metering installations* as described in Section 6;~~

~~k)~~i) *Synchronising facilities*;

~~l)~~j) *Under frequency load shedding* and islanding schemes; and

~~m)~~k) Any special test requirements.

It is a precondition of ~~Prior to~~ *connection* to the *Western Power power system*, that the *User* must ~~shall have~~ provide~~d~~ to *Western Power* a signed written statement to certify that the equipment to be *connected* has been designed and installed in accordance with these *Rules* ~~this *Code*~~, all relevant standards, all statutory requirements and *good electricity industry practice*. The statement shall have been certified by a Chartered Professional Engineer qualified in a relevant area ~~with NPER standing with the Institution of Engineers, Australia~~, unless otherwise agreed.

3.2.3 Provision of Information

The *User* must provide all data reasonably required by *Western Power*.
Details of the kinds of data that may be required are included in Attachments 3 and 4 of this *Code*.

3.2.4 Detailed Technical Requirements Requiring Ongoing Verification

The technical requirements described in this section are required to be demonstrated by the methods described in clause 4.1.3 of this *Code.*

3.2.4.1 *Reactive power* capability

Each generating unit, and the power station in which the generating unit is located, must be capable of continuously providing its full reactive power output within the full range of steady state voltages at the *connection point* permitted under clause 2.2.2.

(a) Unless otherwise agreed by *Western Power*:

(1) Each *synchronous generating unit* must be capable of *supplying* a *reactive power* output coincident with rated real power output such that at the *generating unit's* terminals at nominal *voltage* the lagging *power factor* is less than or equal to 0.8 and at the same power output the *generating unit* must be capable of absorbing *reactive power* at a leading *power factor* less than or equal to 0.9. Refer to Figure 3.1 for details.

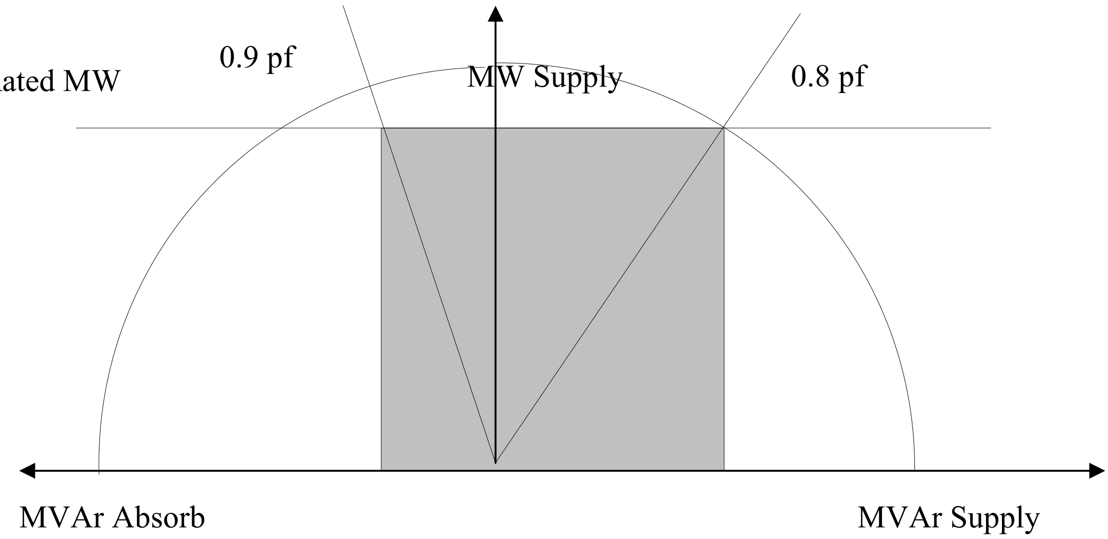


Figure 3.1 Synchronous Generating Unit Reactive Power Capability Requirements at Generator Terminals shown Shaded

(2) Each *induction generating unit* must be capable of *supplying a reactive power* output coincident with rated real power output such that at the *connection point* to the *network* at *nominal voltage* the lagging *power factor* is less than or equal to 0.95 and at the same power output the *generating unit* must be capable of absorbing *reactive power* at a leading *power factor* less than or equal to 0.95.

In some circumstances, a larger *power factor* range may be required. This will be determined by *power system* simulation studies. *Users* will be advised accordingly of any additional requirements. Refer to Figure 3.2 for details.

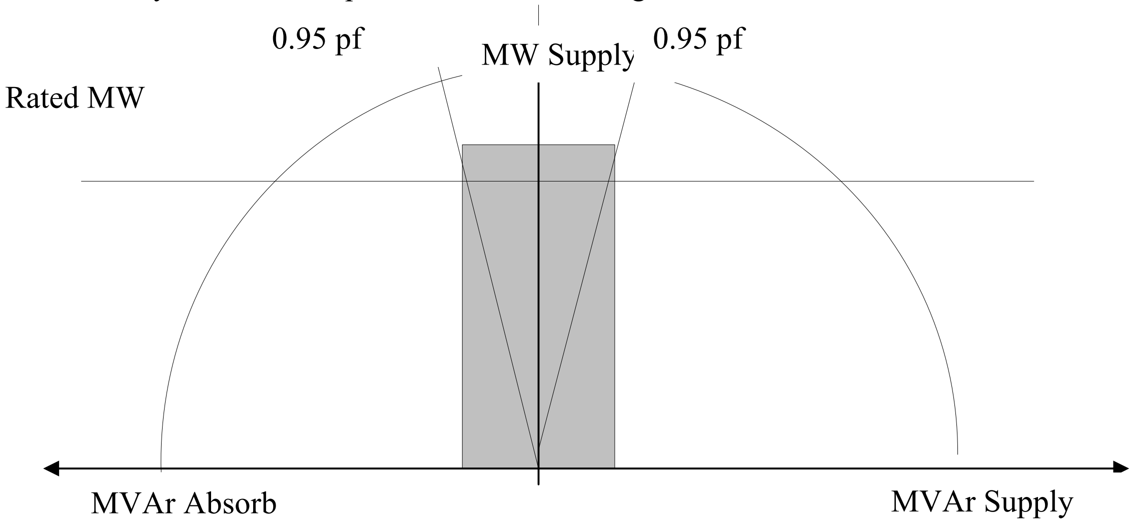


Figure 3.2 Induction Generating Unit Reactive Capability Requirements at Point of Common Coupling shown Shaded

(3) Each *inverter or converter coupled generating unit* shall be capable of supplying a reactive power such that at the inverter or converter connection point to the network at nominal voltage the lagging power factor is less than or

equal to 0.95 and shall be capable of absorbing reactive power at a leading power factor less than or equal to 0.95.

In some circumstances, a larger *power factor* range may be required. This will be determined by *power system* simulation studies. *Users* will be advised accordingly of any additional requirements. Refer to Figure 3.3 for details.

(4) For generators ~~for~~ not described by susbsections (1), (2) or (3), the power factor requirements shall be as advised by *Western Power*.

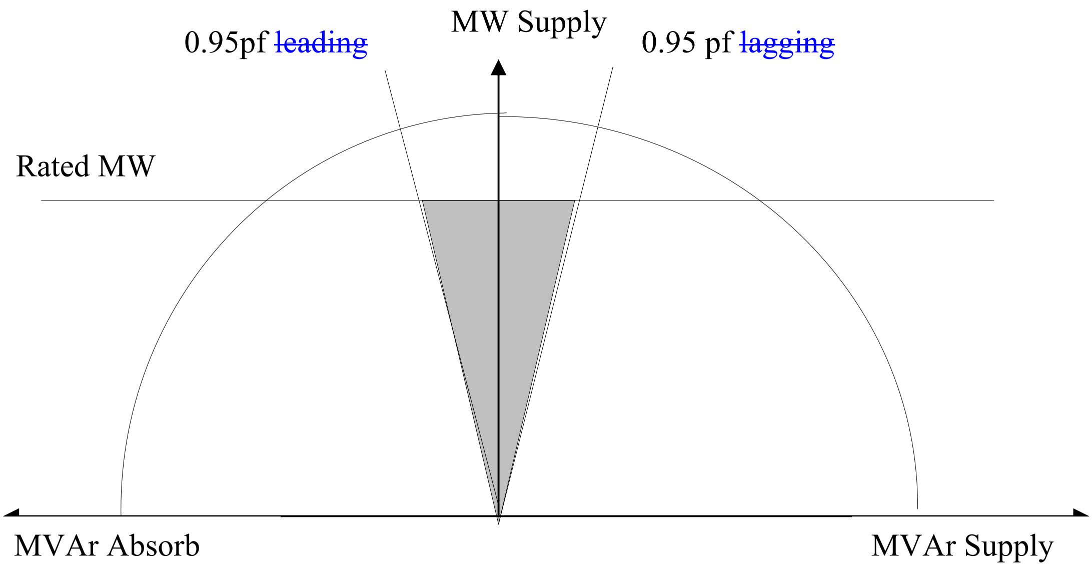


Figure 3.3 Inverter Coupled or Converter Coupled Generating Unit Reactive Capability Requirements at Point of Common Coupling shown Shaded

(b) In the event that the *power factor* capabilities specified in (a)(1), (a)(2) and (a)(3), as applicable, cannot be provided, the *User* must reach a commercial arrangement under the *access contract* with *Western Power* for the *supply* of the deficit in *reactive power* as measured at the *generating unit's* terminals.

(c) The *Generator connection* must be designed to permit the *dispatch* of the full *active power* and *reactive power capability* of the installation as specified in the *access contract* under all *power system* conditions contained in Section 2 of this *Code*.

3.2.4.2 Quality of Electricity Generated

When operating *unsynchronised*, a *synchronous generating unit* must *generate* a constant *voltage* level with balanced phase *voltage*s and harmonic *voltage* distortion equal to or less than permitted in accordance with either *Australian Standard AS* 1359 "General Requirements for Rotating Electrical Machines" or a recognised relevant international standard, as agreed between *Western Power* and the *User*.

For generating units other than synchronous generating units the contributions to *quality of supply* must be not less than that required to be provided by *Users* as defined in Clause 2.2.

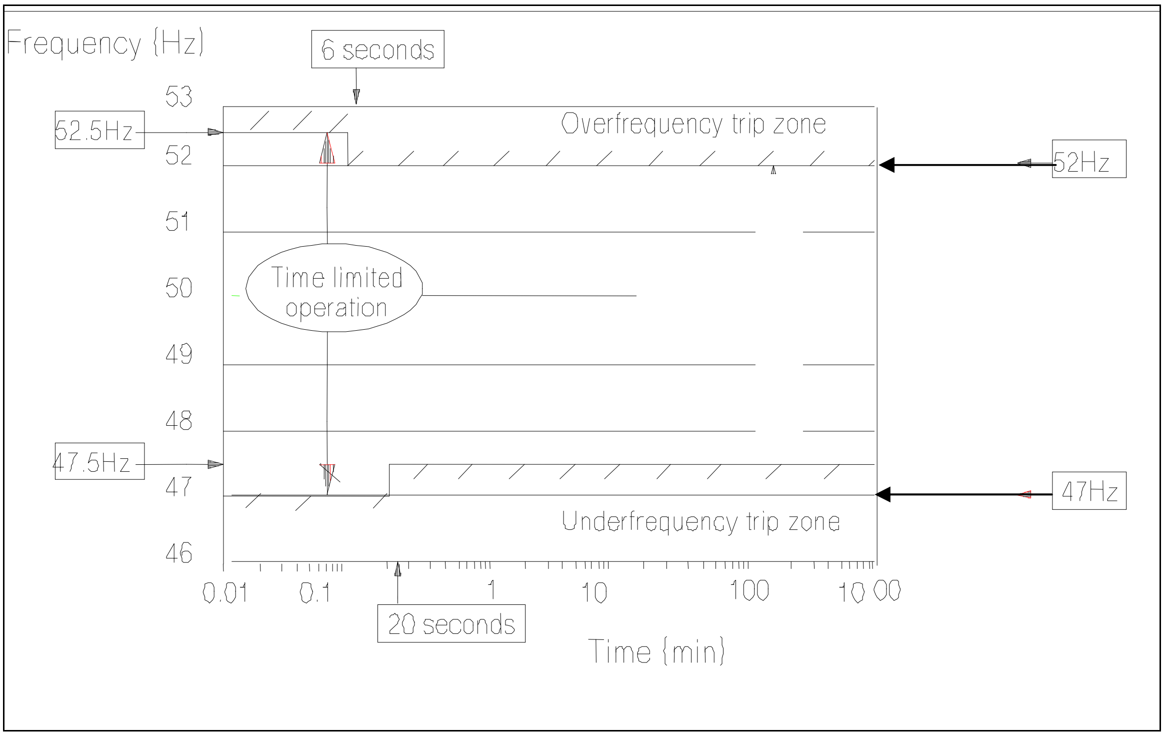
3.2.4.3 Generating Unit Response to Disturbances in the *Power System*

The following are design requirements for *generating units and their auxiliary* systems for continuous uninterrupted operation while being subjected to off-nominal frequency and voltage excursions. The *continuous uninterrupted operation* is defined at the end of this clause. *Network* performance requirements are detailed in Section 2 of this *Code*.

For distribution connected generators, some of these requirements may be relaxed when it is considered that failure to comply would not have a material impact on safety or system security

~~a)~~**Immunity to frequency excursions.** Users must ensure that within the power system frequency range and duration of Figure 3.4 all of their power system equipment will remain in service unless that equipment is required to be switched to give effect to load shedding in accordance with clause 2.4, or is required by *Western Power* to be switched for operational purposes ~~(Note: this sentence moved from clause 2.2.1). In particular, a *generating unit*, and the *power station* in which the *generating unit* is located, must be capable of continuous uninterrupted operation within the *power system frequency range* 47.5 to 52 Hz.~~

~~The minimum duration of operation at *frequencies* outside the range 47.5 to 52 Hz for the *South West Interconnected System* shall be in accordance with Figure 3.4.~~ Operation for a period of at least 20 seconds is required each time the frequency is below 47.5 Hz. Operation for a period of at least 6 seconds is required each time the frequency is above 52 Hz.



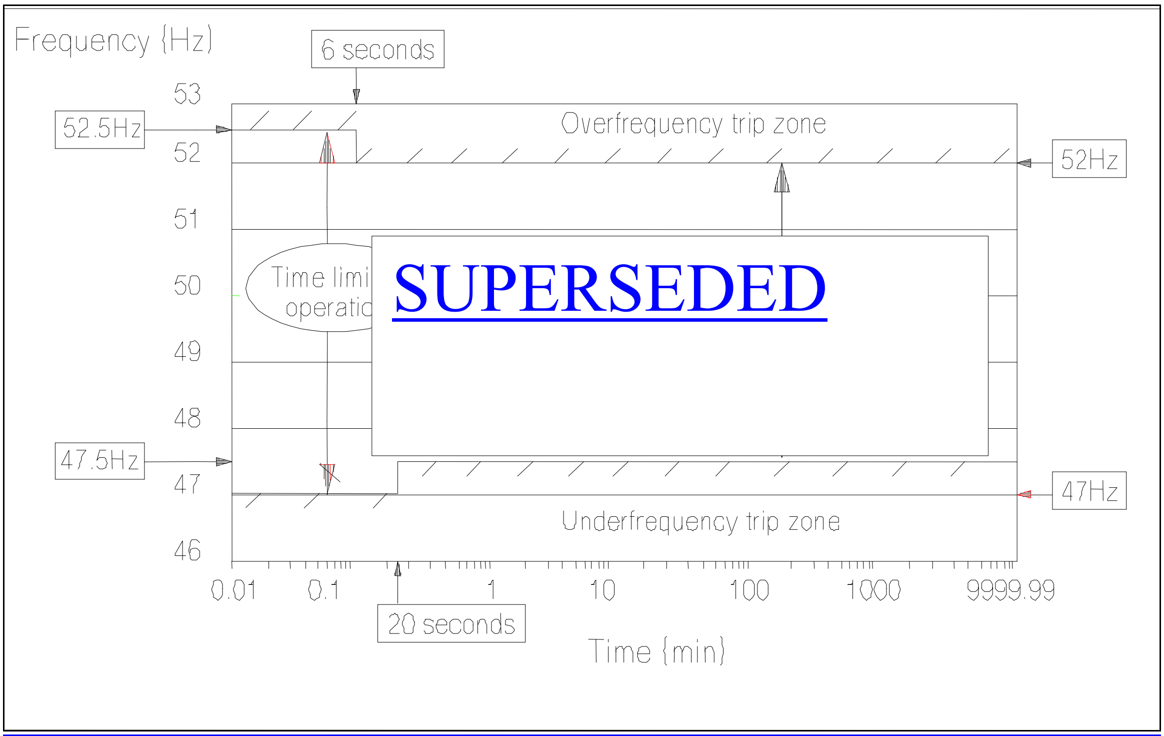
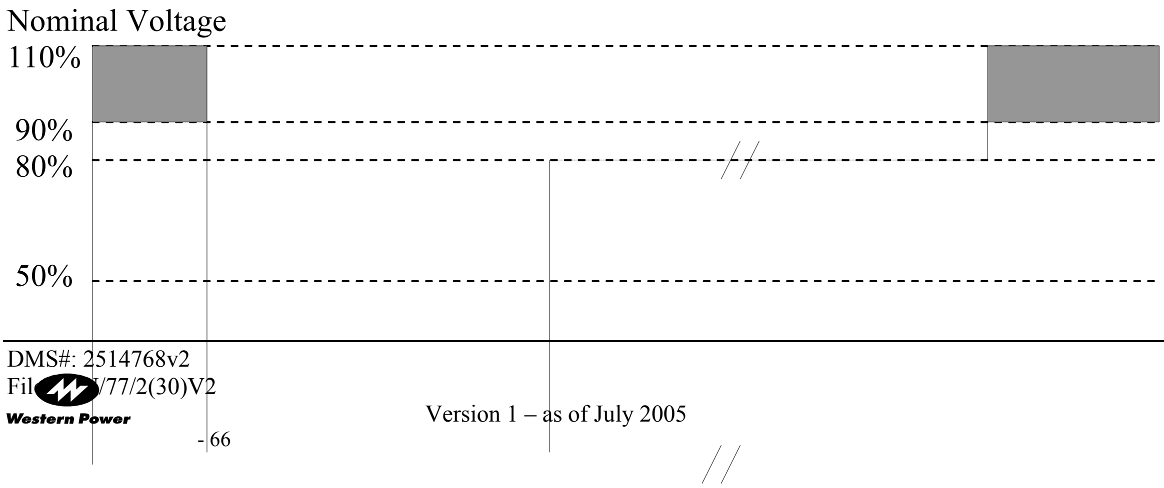


Figure 3.4 – Off Nominal Frequency Operation Capability Requirement for Generators

~~Sustained operation outside the range 47.5 to 52 Hz need not be taken into account by *Western Power* and *Users* in the design of *connected plant* which may be *disconnected* if this is necessary for the *protection* of that *plant*.~~ Below 47Hz, and above 52.5 Hz instantaneous tripping of *generators* is permitted.

b) **Immunity to voltage excursions.** A *generating unit*, and the *power station* in which the *generating unit* is located, must be capable of continuous uninterrupted operation for the range of *voltage* variation permitted by Clause 2.2.2 and Clause 2.3.3.2, and for *transmission or distribution network* faults which cause the *voltage* at the *connection point* to drop to between 0% and 80% of nominal voltage for a period of up to 450 milli second (based on 330kV CB fail protection time) in any one phase or combination of phases, followed by a period of ten seconds where *voltage* may vary in the range 80-110% of the nominal *voltage*, and a subsequent return of the *voltage* within the range 90-110% of the nominal *voltage*. See Figure 3.5 for details of the latter.



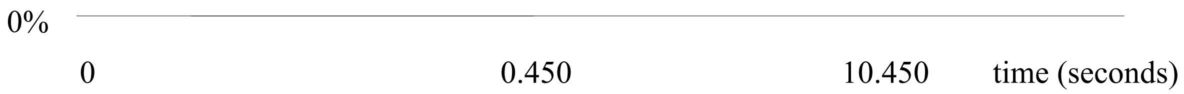


Figure 3.5 – Off Nominal Voltage Operation Capability Requirement for Generators that complement those of Figure 2.1

c) **Immunity to the rate-of-change-of-frequency.** A *generating unit*, and the *power station* in which the *generating unit* is located, must be capable of continuous uninterrupted operation for the rate-of-change-of-frequency of up to 4 Hz per second.

d) **Immunity to high speed auto reclosing.** A *generating unit*, and the *power station* in which the *generating unit* is located, must be capable of continuous uninterrupted operation for transients caused by high speed auto reclosing of transmission lines – reapplication of fault after unsuccessful reclosing.~~.~~

e) **Post-fault reactive power of a power station with non-synchronous generators.** After fault clearing, the *power station* in which a non-synchronous *generating unit* is located shall not absorb reactive power from the network ~~grid~~, and the absorption, if any, of inductive reactive power has to be terminated within 200ms after clearing of the fault.

f) **Post fault voltage control of the *connection point*.** Each *generating unit* must, in respect of any credible fault type and changed *power system* conditions after disconnection of the faulted element, deliver to the network active power and reactive power sufficient to ensure that the *connection point* voltage is within the range for continuous uninterrupted operation.

Continuous uninterrupted operation.

For the purpose of this clause 3.2.4.3 *continuous uninterrupted operation* shall mean other than disconnection due to protection operation. Protection operation shall not limit the capability of the generating unit in meeting the requirements of this clause.

The MW output shall return to pre-fault MW output, allowing for system voltage variation below 90% of nominal, within 200ms after the voltage has returned to between 80-110% of nominal voltage. The variation in MW output for non-dispatchable generators shall also be allowed for.

Synchronous generating units - the MVAr output shall be determined by clause 3.2.5.4.

Generating units, other than synchronous generating units, - the MVAr output shall return to the pre-fault MVAr within 200ms after the voltage has returned to between 80-110% of nominal voltage.

3.2.4.4 Partial L*oad* Rejection

A *generating unit* must be capable of continuous uninterrupted operation, during and following a *load* reduction which occurs in less than 10 seconds, from a fully or partially *load*ed condition provided that the *load* reduction is less than 30% of the *generating unit's nameplate rating* and the *load* remains above minimum load or as otherwise agreed between *Western Power* and the relevant *User* and stated in the *access contract* between them.

3.2.4.5 *Loadi*ng Rates

A *scheduled generating unit*~~-~~, in a thermally stable state, must be capable of increasing or decreasing *load* in response to a manually or remotely initiated *loading* order at a rate not less than 5% of *nameplate rating* per minute or as otherwise agreed between *Western Power* and the relevant *User,* stated in their *access contract*.

A Non-Dispatchable generating unit, must not increase or decrease its loading at a rate greater than 15% of nameplate rating per minute or as otherwise agreed between *Western Power* and the relevant *User,* stated in their *access contract*.

3.2.4.6 Safe Shutdown without External Electricity *Supply*

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

3.2.4.7 Restart Following Restoration Of External Electricity *Supply*

A *generating unit* must be capable of being restarted and *synchronised* to the *power system* without unreasonable delay following restoration of external *supply* from the *network power system* at the relevant *connection point*, after being without external *supply* for two hours or less, provided that the *generating unit* was *disconnected* for any reason other than a fault within the *generating unit*.

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

(a) delays not inherent in the design of the relevant start-up *facilities* and which could reasonably have been eliminated by the relevant *User*; and

(b) the start-up *facilities* for a new *generating unit* not being designed to minimise start up time delays for the *generating unit* following loss of external *supplies* for two hours or less and which could reasonably have been eliminated by the relevant *User*.

3.2.4.8 Protection of Generating Units From Power System Disturbances

(a) A *generating unit* must be automatically *disconnected* from the *power system* in response to conditions at the relevant *connection point* which are not within the agreed engineering limits for operating the *generating unit* or where the conditions may impact on other *Users*. These abnormal conditions will include and are not necessarily limited to:

(1) loss of *synchronism* (Out-of-step *protection*/pole-slip *protection* may need to be located on the *transmission network*; this should be determined by performing *power system* simulation studies);

(2) sustained high or low *frequency* outside the *power system frequency* range 47.~~5~~Hz to 52Hz - refer to clause 2.2.1;

(3) sustained excessive *generating unit* stator current that cannot be automatically controlled;

(4) excessive high or low stator *voltage*;

(5) excessive *voltage* to *frequency* ratio;

(6) excessive negative phase sequence current;

(7) loss of excitation;

(8) reverse power, and

(9) isolated operation of non-scheduled generation types and generation connected to distribution network to avoid uncontrolled supply of local loads.

(10) Any similar condition agreed between the *Generator* and *Western Power*.

(b) The actual settings of the *protection* equipment installed on a *generating unit* determined by the *User* to satisfy requirement (a) must be consistent with *power system* performance requirements specified in Section 2 and must be approved by *Western Power* in respect of their potential to reduce *power system security*. They must be such as to maximise *plant* availability, to assist the control of the *power system* under emergency conditions and to minimise the risk of inadvertent *disconnection* consistent with the requirements of *plant* safety and durability.

~~*Western Power* shall bear no responsibility for any loss or damage incurred by the *User* as a result of a fault on either the *power system*, the *User's facility* or within the *generating unit* itself.~~

3.2.4.9 User Protection Systems That Impact On Power System Security

Refer to Clause 3.4 for the requirements of *protection systems* for *Users' plant*. The requirements of Clause 3.4 apply only to *protection* which is necessary to maintain *power system security*. *Protection* solely for *User* risks is at the *User's* discretion.

3.2.4.10 Generator T*ransformer*

Generator transformer are generally needed to ensure compliance with the requirement that each generating unit, and the power station in which the generating unit is located, must be capable of continuously providing its full reactive power output within the full range of steady state voltages at the *connection point* permitted under clause 2.2.2.

Vector Group. The transformer type shall be agreed with *Western Power* with preference given to transformers with a zero sequence opening between high-voltage and low-voltage windings and a type that is compatible with the system at the *connection point* ~~consistent with *Western Power* practice~~.

Tapping. Unless otherwise agreed between *Western Power* and the *User*, the generator *transformer* of a *generating unit* or wind farm must be capable of on-*load* tap-changing within the range specified in the relevant *access contract* .

3.2.5 Monitoring and Control Requirements

3.2.5.1 Remote monitoring

Western Power will require the *User* to:

I. provide *remote monitoring equipment* ("*RME*") to enable *Western Power* to remotely monitor performance of a *generating unit* (including its *dynamic performance*) where this is reasonably necessary in real time for control, planning or security of the *power system*; and

II. upgrade, modify or replace any *RME* already installed in a *power station* provided that the existing *RME* is, in the reasonable opinion of *Western Power*, no longer fit for purpose and notice is given in writing to the relevant *User*.

In (I) and (II), the *RME* provided, upgraded, modified or replaced (as applicable) must conform to an acceptable standard as agreed by *Western Power* and must be compatible with *Western Power's SCADA system*, including the requirements of clause 5.12 of this *Code*.

Input Information to *RME* may include, but not be limited to, the following:

(a) Status Indications

(1) *generating unit* circuit breaker open/closed (dual point)
(2) remote *generation load* control on/off
(3) *generating unit* operating mode
(4) turbine control limiting operation
(5) *connection* to the *transmission* or *distribution network*

(b) Alarms

(1) *generating unit* circuit breaker / main switch tripped by *protection*
(2) prepare to off *load*
(3) *protection* defective alarms

(c) Measured Values

Transmission:
(1) Gross *active power* output of each *generating unit*
(2) Gross *reactive power* output of each *generating unit*
(3) Net station *active power* import or export at each *connection point*
(4) Net station *reactive power* import or export at each *connection point*
(5) *Generating unit* stator *voltage*
(6) *Generating unit transformer* tap position
(7) Net station output of *active energy* (impulse)
(8) *Generating unit* remote *generation* control high limit value
(9) *Generating unit* remote *generation* control low limit value
(10) *Generating unit* remote *generation* control rate limit value

Distribution:

(1) Main switch *active power* import or export
(2) Main switch *reactive power* import or export
(3) Voltage on *Western Power* side of main switch

(d) Such other input information reasonably required by *Western Power*.

A *User* must provide electricity supplies for the *RME* installed in relation to its *generating units* capable of keeping these *facilities* available for at least eight hours following total loss of *supply* at the *connection point* for the relevant *generating unit*.

3.2.5.2 Remote control

Western Power will require the *User* to:

I. Provide *remote control equipment* ("RCE") where reasonably necessary to enable *Western Power* to remotely control a generating unit circuit breaker, or other circuit breaker as detailed below; and

II. upgrade, modify or replace any *RCE* already installed in a *power station* provided that the existing *RCE* is, in the reasonable opinion of *Western Power*, no longer fit for purpose and notice is given in writing to the relevant *User*.

In (I) and (II), the *RCE* provided, upgraded, modified or replaced (as applicable) must conform to an acceptable standard as agreed by *Western Power* and must be compatible with *Western Power's SCADA system*, including the requirements of clause 5.12 of this *Code*.

Input Information to *RCE* may include, but not be limited to, the following:

(a) Control Facilities (typically for unmanned sites)

(1) Generating unit remote generation Stop Initiate
(2) Generating unit remote generation Start Initiate
(3) Generating unit remote generation Active Power setpoint
(4) Generating unit remote generation Reactive Power setpoint
(5) Generating unit remote generation Generator Step-Up transformer Tap Position

(b) Control Facilities (typically for distribution sites)

(1) An inter-trip for:
A feeder fault causing a feeder circuit breaker operation at the relevant zone substation
A trip command initiated by the control centre
SCADA communication failure

(2) A close enable interlock

These controls shall apply to the following plant as applicable:

Generating unit circuit breaker
Any other circuit breaker in the path between the network and the generators,
Installation main switch.

A *User* must provide electricity supplies for th *RCE* installed in relation to its *generating units* capable of keeping these *facilities* available for at least eight hours following total loss of *supply* at the *connection point* for the relevant *generating unit*.

3.2.5.3~~2~~ Communications Equipment

A *User* must provide communications paths (with appropriate redundancy) between the *RME* and RCE installed at any of its *generating units* to a communications interface at the relevant *power station* and in a location reasonably acceptable to *Western Power*. For connections to distribution network, this nominated location is in the zone substation from which the distribution feeder that the *User* is connected to emanates. Communications systems between this communications interface and the relevant *control centre* must be the responsibility of *Western Power* unless otherwise agreed.

Telecommunications between *Western Power* and *Generators* must be established in accordance with the requirements set down below for *operational communications*.

(a) Primary Speech Facility

Each *User* must provide and maintain equipment by means of which routine and emergency control telephone calls may be established between the *User's* responsible Engineer/Operator and *Western Power*.

The *facilities* to be provided, including the interface requirement between *Western Power's* equipment and the *User's* equipment must be specified by *Western Power*.

(b) Back-up Speech Facility

~~Where~~ *Western Power* ~~advises~~ may require a *User* ~~that~~ to provide a back-up speech *facility* ~~to~~ for the primary *facility* ~~is required,~~. Where a suitable facility cannot be viably sourced from a third party, *Western Power* ~~will~~ may elect to provide and maintain a separate telephone link or radio installation

This service provided by *Western Power* must ~~shall~~ ~~be responsible~~ include responsibility for radio system planning and for obtaining radio licenses for equipment used in relation to the *Western Power networks*.

3.2.5.4~~3~~ Turbine Control System

All *generating units* must have an automatic variable speed control characteristic. Turbine control systems must include *facilities* for both speed and *load* control except where approved by *Western Power*.

Generating units must normally be operated in a mode–in which they will automatically accurately alter (every four seconds) with a change in *associated loads* plus allow for changes in *frequency* of the *network* according to the performance requirements detailed below and in a manner to sustain high initial response. For steam generating units, this mode is known as the coordinated boiler follow mode.

The *User* must notify *Western Power* prior to a *generating unit* being operated in a mode (e.g. "turbine-follow" mode) where the *generating unit* will be unable to respond as specified and agreed.

Deadband

The dead band of a *generating unit* (sum of increase and decrease in *power system frequency* before a measurable *change* in the *generating unit's active power* output occurs) must be less than 0.05 Hz.

Control Range

For Dispatchable generating units

Overall response of a *generating unit* for *power system frequency* excursions must be settable and be capable of achieving an increase in the *generating unit's active power* output of up to 5% for a 0.1 Hz reduction in *power system frequency* for any initial output up to 85% of rated output and a reduction in the *generating unit's active power* output of up to 5% for a 0.1 Hz increase in *system frequency* provided the latter does not require operation below technical minimum (4% droop). For initial outputs above 85% of rated output, response capability must be included in the *access contract*, and the *User* must use reasonable endeavours to ensure that the *generating unit* responds in accordance with that contract. Thermal *generating units* must be able to sustain *load* changes of at least 10% for a *frequency* decrease and 20% for a *frequency* increase if changes occur within the above limits of output.

For Non-Dispatchable generating units

Overall response of a *generating unit* for *power system frequency* excursions must be setable and be capable of achieving a reduction in the *generating unit's active power* output for an increase in *system frequency* provided the latter does not require operation below technical minimum.

Non-dispatchable generating units with technologies which intrinsically allow the control of power output are required to be equipped with such controls to facilitate frequency control. For example, wind turbines with pitch control can control electric power output relative to the maximum energy that can be extracted from the wind.

Rate of Response

The *frequency* response must be ~~agreed between *Western Power* and the relevant *User* and~~ stated in the *User's* *access contract* ~~between them~~.

For Dispatchable generating units

For any *frequency* disturbance a *generating unit* must achieve at least 90% of the maximum response to power *generation* expected according to the droop characteristic within a time to be specified in the *access contract* and ~~advised to~~ approved by *Western Power*. This time shall be typically six seconds for thermal *generating units* and the new output shall be sustained for 30 seconds. The time shall be typically 30 seconds for hydro *generating units* and the new output shall be sustained indefinitely.

For Non-Dispatchable generating units

For any *frequency* disturbance a *generating unit* must achieve at least 90% of the maximum response to power *generation* expected within a time to be specified in the *access contract* and ~~advised to~~ approved by *Western Power*. The time shall be typically 2 seconds for wind and solar *generating units* and the new output shall be sustained indefinitely.

Connections to Distribution Netrwork

Upon the loss of supply from *Western Power*, each governing system shall cause it's generator frequency to drift at a minimum rate of 0.1 Hz per second per 1% difference between the real power output set point and the load connected to the generator.

3.2.5.~~5~~4 Excitation Control System

Control strategy

Unless otherwise agreed by *Western Power* under an *access contract*:

(a) The overriding objective of the *generating unit* excitation control system is to maintain the nominated voltage range at the *connection*.
The normal operating mode shall be such that each *Generator User* shall provide sufficient reactive power injection into, or absorption from, the *Western Power* network to meet the requirements of its associated loads, plus all reactive losses required to deliver its real power output at network voltages within the ranges expected during normal operation and under contingency conditions. The size of each reactive "step" shall be such that the *quality of supply* limits is not breached.

When a generator connected to the distribution system is supplying power to *Western Power* for generation support the normal operating mode shall be such that each *generating unit* is set to maintain a constant power factor (± 0.05) which is equal to the power factor of the peak feeder load that the *power station* is normally connected to. If the total *power station* export capacity exceeds the feeder peak load, then the combined power factor of the applicable zone substation transformer peak load shall be used.

When it is not possible for *generating units* supplying power to *Western Power* for generation support to operate at constant power factor and simultaneously maintain the nominated voltage range, then the generating units shall automatically vary their power factor within the stability limits of the units.

If the stability limit of the *generating units* is reached, then in order to ensure that the nominated voltage range at the *connection* is maintained, the *power station* has the following options (which are not mutually exclusive):

(a) Automatically reduce the real power export level appropriately.

(b) Automatically switch reactive power compensation devices. The size of each reactive "step" shall be such that the *quality of supply* limits is not breached.

Capabilities

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

(a) limiting *generating unit* operation at all *load* levels to within *generating unit* capabilities for continuous operation;

(b) controlling *generating unit* excitation to maintain the short-time average *generating unit* stator *voltage* at highest rated level (which must be at least 5% above the nominal stator *voltage* and is usually 10% above the nominal stator *voltage*). The upper voltage limits must be compatible with transformer selection of clause 3.2.4.10;

(c) maintaining adequate *generating unit* stability under all operating conditions including providing *power system* stabilising action if fitted with a *power system* stabiliser;

(d) providing five second ceiling excitation *voltage* at least twice the excitation *voltage* required to achieve maximum continuous rating at nominal *voltage*; and

(e) providing reactive current compensation settable for boost or droop unless otherwise agreed by *Western Power*.

New synchronous *generating units* must be fitted with fast acting *excitation control systems* utilising modern technology. AC exciter, rotating rectifier or *static excitation systems* must be provided for any new *generating units* with a rating greater than 30 MW or for new smaller *generating units* within a *power station* totalling in excess of 30 MW. *Excitation control systems* must provide *voltage* regulation to within 0.5% of the selected setpoint value.

All synchronous *generating units* with ratings in excess of 30 MW or smaller *generating units* within a *power station* totalling in excess of 30 MW, must incorporate power system stabiliser (PSS) circuits which modulate *generating unit* field *voltage* in response to changes in power output and/or shaft speed and/or any other equivalent input signal approved by *Western Power*. The stabilising circuits must be responsive and adjustable over a *frequency* range which must include frequencies from 0.1 Hz to 2.5 Hz. *Power system* stabiliser circuits may be required on synchronous *generating units* with ratings less than or equal to 30MW or smaller synchronous *generating units* within a *power station* totalling less than or equal to 30MW if *power system* simulations indicate such a requirement. Before commissioning of any *power system* stabiliser, its preliminary settings should be agreed by *Western Power*. The

User should propose these preliminary settings which should be derived from system simulation studies and the study results reviewed by *Western Power*.

The following performance characteristics are required for ac exciter, rotating rectifier and *static excitation systems*:

Table 3.1
Excitation System Performance Requirements

Performance Item	**Units**	**Static Excitation**	**AC Exciter or Rotating Rectifier**	**Notes**
***sensitivity*:** A sustained 0.5% error between the *voltage* reference and the sensed *voltage* will produce an *excitation* change of not less than 1.0 per unit.	gain	200 minimum	200 minimum	1
Field *voltage* rise time: Time for field *voltage* to rise from rated *voltage* to *excitation* ceiling *voltage* following the application of a short duration impulse to the *voltage* reference	s	.05 maximum	.5 maximum	2
Settling time with the generator *unsynchronised* following a disturbance equivalent to a 5% step change in the sensed generator terminal *voltage*.	s	1.5 maximum	2.5 maximum	4
Settling time with the generator *synchronised* following a disturbance equivalent to a 5% step change in the sensed generator terminal *voltage*. Must be met at all operating points within the generator capability.	s	2.5 maximum	5 maximum	4
Settling time following any disturbance which causes an *excitation* limiter to operate	s	5 maximum	5 maximum	4

Notes:

1. One per unit is that field *voltage* required to produce nominal *voltage* on the airgap line of the generator open circuit characteristic (Refer IEEE Standard 115-1983 - Test Procedures for Synchronous Machines). Excitation control system with both proportional and integral actions should achieve a minimum equivalent gain of 200.
2. Rated field *voltage* is that *voltage* required to give nominal generator terminal *voltage* when the generator is operating at its maximum continuous rating. Rise time is

defined as the time taken for the field *voltage* to rise from 10% to 90% of the increment value.

3 Settling time is defined as the time taken for the generator terminal *voltage* to settle and stay within an error band of $\pm1\%$ of its increment value.

4 Voltage overshoot is defined as the largest deviation of the terminal voltage over the step increment value during the transient state.

5 Field voltage means generator field voltage.

The structure and parameter settings of all components of the *excitation control system*, including the *voltage* regulator, *power system* stabiliser, power amplifiers and all *excitation* limiters, must be approved by *Western Power*.

The structure and settings of the *excitation control system* shall not be *changed*, corrected or adjusted in any manner without prior written notification to *Western Power*. *Western Power* may require *generating unit* tests to demonstrate compliance with requirements of Table 3.1. *Western Power* may witness such tests.

Settings may require alteration from time to time as advised by *Western Power*. –The preliminary settings backed up by any calculations and system studies to derive these settings must be made available to *Western Power* at least two months before the system tests stated in clause 4.1.3. -Any new settings, if found necessary during the tests to improve performance should be provided by the User.

Excitation limiters must be provided for under *excitation* and over *excitation* and may be provided for *voltage* to *frequency* ratio. The *generating unit* must be capable of stable operation for indefinite periods while under the control of any *excitation* limiter. *Excitation* limiters must not detract from the performance of any stabilising circuits and must have settings applied which are coordinated with all *protection systems*.

3.2.7~~6~~ Power Station Auxiliary *Transformers*

In cases where a *power station* takes its auxiliary supplies through a *transformer* via a separate *connection point,* the *User* must comply with the conditions for *connection* of *load*s (Clause 3.3) in respect of that *connection point*.

3.2.8~~7~~ Synchronising

For a synchronous generating unit the *User* shall provide and install manual or automatic *synchronising* at the generator circuit breakers.

Check *synchronising* shall be provided on all generator circuit breakers and any other circuit breakers, unless interlocked (as outlined in clause 3.4.3.5), that are capable of *connect*ing the *User*'s *generating plant* to the *transmission or distribution network*.

Prior to the initial *synchronisation* of the generating unit(s) to the *transmission or distribution network*, the *User* and *Western Power* shall agree on the operational procedures necessary for *synchronisation*.

3.2.9~~8~~ Secure Electricity Supplies

Secure electricity supplies of adequate capacity to provide for the operation for at least eight hours of *plant* performing *metering*, communication, monitoring, and *protection* functions, on the loss of AC supplies, must be provided by a *User*.

3.2.10~~9~~ Design Requirements For *Users' Substations*

Users must comply with the requirements of clause 3.3.5.

3.2.11~~10~~ Computer Model

Users are required to provide a model suitable for use in the software package which is used by *Western Power*, currently PSS/E. The model should automatically initialise its parameters from load flow simulations. Once a simulation case has been compiled, changes in the load flow such as changes in voltage, generator output, voltage setpoint shall not require the study case to be recompiled. The model shall to be supported for changes and updates in the nominated software for the duration of connection of the equipment to the network. It is the preference of *Western Power* that the model be made available to the provider for inclusion in the standard PSS/E library. The source code of the model shall also be provided.

Users are required to demonstrate that the model adequately represents the performance of the physical unit over its load range and over the system frequency operating range of clause 2.2.1, Table 2.1.

The structure and parameter settings of all components of the turbine and excitation control equipment must be provided to *Western Power* in sufficient detail to enable the dynamics of these components to be characterised for short and long term simulation studies. This must include a control block diagram in suitable form to perform dynamic simulations and proposed settings for the turbine *and excitation* control *systems* for all expected modes of turbine control system operation. These parameters must not be varied without prior approval of *Western Powe*r.

The applicable structure and parameter settings shall include but not be limited to :

(1) Speed/*load* controller
(2) Key protection and control loops
(3 Actuators (for example hydraulic valve positioning systems)
(4) Limiters

3.2.12~~11~~ Plant performance during start-up, shut-down and daily operation

In order to assess the impact of the plant to the grid the proponent should provide the following data: MW, MVAr, and, where applicable, flicker coefficients and harmonic profile of the plant during start-up, shut-down and daily operation / intermittent fuel (wind) variations (for example a typical 24 hour power curve measured at 15-minute intervals or better if available; maximum kVA output over a 60 second interval, etc,).

Measurement of power quality characteristics (including flicker and harmonics) in accordance with IEC 61400-21 shall be provided for all wind turbines proposed for connection to the network.

3.3 REQUIREMENTS FOR *CONNECTION* OF *LOAD*S

The following applies to the *connection* of *load*s to *transmission* and *distribution networks*. It represents typical requirements and particular provisions may be waived for small *Users* and *Users* that have no potential to affect other *Users*, at the discretion of *Western Power* subject to Clause 1.5.

A load *User* must have plant capabilities, protection and control systems sufficient to:

(1) not cause excessive load fluctuations, reactive power draw or, where applicable, stalling of motor loads that would adversely impact other *Users* or *Western Power*.

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

(i) frequency stability, or

(ii) voltage stability

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

Note: this requirement is intended to safeguard from transients caused by relatively large *Users* with high proportion of motor loads. For example, to safeguard one mining operation from another.

3.3.1 Information

Before any new or additional equipment is *connected*, the *User* may be required to submit the following kinds of information to *Western Power*:

(a) ~~(a)~~ Interface *protection* details including, line diagram, grading information, secondary injection and trip test certificate on all circuit breakers ~~A single line diagram with the *protection* details.~~

(b) ~~(b)~~ *Metering system* design details for equipment being provided by the *User*.

(c) ~~(c)~~ A general arrangement locating all the equipment on the site~~.~~, and where appropriate an appropriately certified structural diagram.

(d) ~~(d)~~ A general arrangement for each new or altered *substation* showing all exits and the position of all electrical equipment.

(e) ~~(e)~~ Type test certificates for all new switchgear and *transformers*, including measurement *transformers* to be used for *metering* purposes in accordance with Section 6 (*metering*) of this *Code*.

(f) ~~(f)~~ The proposed methods of earthing cables and other equipment to comply with the relevant *Regulations*, plus a single line earthing diagram.
(g) ~~(g)~~ *Plant* and earth grid test certificates from approved test authorities.
~~(h) (h) A secondary injection of *protection* and trip test certificate on all circuit breakers.~~
(h) ~~(i)~~ Certification that all new equipment has been inspected before being *connected* to the *supply*.
(i) ~~(j)~~ Operational procedures.
(j) ~~(k)~~ Details of potentially disturbing *loads*.
(k) ~~(l)~~ *SCADA* arrangements.
(l) Load details including maximum demand profiles
(m) A line diagram *and main cable routes* and *preferred point of connection* details
(n) Operating procedures

Typically a small domestic user will only be required to provide items (m) and (n).

In addition, the *User* must provide all data reasonably required by *Western Power*. Details of the kinds of data that may be required are included in Attachment 3 and any submission must comply with the Western Australian Electrical Requirements.

3.3.2 Design Standards

A *User's* installation must comply with the relevant *Australian Standards* as applicable at the time of first installation in the facility, Electricity (Supply Standard and System Safety) Regulations 2001, *good electricity industry practice* and this *Code*, including, but not limited to, the *power quality* standards as specified in clause 2.2.

All *plant* ratings shall co-ordinate with the equipment installed on the *Western Power power system*.

Users will be responsible for ensuring that *plant* capabilities and ratings are reviewed on an ongoing basis to ensure continued suitability as conditions on the *power system* change in the future (e.g. increasing fault levels, or reduced critical fault clearing times, as additional *plant* is *connected* to the *power system*

If, after installation of a *User' facilities*, it is found that the installation is adversely affecting the security or reliability of the *power system*, the *quality of supply*, or the installation does not comply with the Code or the relevant *access contract* then the *User* shall be responsible for remedying the problem.

3.3.3 User Protection Systems that Impact on Power System Security

Refer to Clause 3.4 for the requirements of *protection systems* for *Users' plant*. The requirements of Clause 3.4 apply only to *protection* which is necessary to maintain *power system security*. *Protection* solely for *User* risks is at the *User's* discretion.

3.3.4 *Power Factor* Requirements

Power factor ranges to be met by load *Users* connected to the *transmission network* are shown in the table 3.2 below:

Table 3.2
Power Factor Requirements (Loads)

Permissible Range	
Supply Voltage (nominal)	*Power factor* Range (half-hour average, unless otherwise specified by *Western Power*)
220kV / 330 kV 66kV / 132 kV <66kV	0.96 lagging to unity 0.95 lagging to unity 0.9 lagging to 0.9 leading

For load *Users* connected to the *distribution network*, the power factor range to be met by load *Users* is 0.8 lagging to 0.8 leading, or as otherwise specified in the access contract, where necessary to ensure the satisfactory operation of the distribution network.

Western Power may permit a lower lagging or leading *power factor* where this will not reduce *system security* and/or *quality of supply*, or require a higher lagging or leading *power factor* to achieve required *power transfer*s.

If the *power factor* falls outside the range specified here any critical *loading* period nominated by *Western Power*, the *User* must, where required by *Western Power* in order to economically achieve required *power transfer* levels, take action to ensure that the *power factor* falls within range as soon as reasonably practicable. This may be achieved by installing additional *reactive plant* or reaching a commercial agreement with *Western Power* to install, operate and maintain equivalent *reactive plant* as part of *connection assets*.

Users who install *shunt capacitors* to comply with *power factor* requirements must comply with *Western Power's* reasonable requirements to ensure that the design does not severely attenuate audio *frequency* signals used for *load* control or operations.

A *User* who installs *static VAr compensator* systems for either *power factor* or *quality of supply* requirements must ensure its control system does not interfere with other normal control functions on the *electricity transmission* and *distribution network*. Adequate filtering *facilities* should be provided if necessary to absorb any excessive harmonic currents.

3.3.5 Design Requirements for *Users*' *Substations*

The following requirements apply to the design, station layout and choice of equipment for a *substation*:

(a) Safety provisions must comply with requirements applicable and notified by *Western Power*;

(b) Where required by *Western Power* appropriate interfaces and accommodation must be incorporated by the *User* for *metering*, communication *facilities*, remote monitoring and *protection* of *plant* which is to be installed in the *substation* by *Western Power*.

(c) A *substation* must be capable of continuous uninterrupted operation with the levels of *voltage*, harmonics, unbalance and *voltage* fluctuation from all sources as defined in Section 2 of this *Code*.

(d) Earthing of *primary plant* in the *substation* must be in accordance with the Electricity *Supply* Association of Australia Safe Earthing Guide, AS3000 and the Western Australian Electrical Requirements. A users earthing system must satisfy the requirements of these publications without any reliance on *Western Power* facilities.

(e) *Synchronisation facilities* or reclose blocking must be provided if *generating units* are *connected* through the *substation*.

(f) Secure electricity supplies of adequate capacity to provide for the operation for at least eight hours of *plant* performing *metering*, communication, monitoring, and *protection* functions, on loss of AC supplies, must be provided.

(g) *Plant* must be tested to ensure that the *substation* complies with the design and specifications which have been certified as required by clause 3.3.5(k).

(h) The *protection* equipment required would normally include *protection schemes* for individual items of *plant*, back-up arrangements, auxiliary d.c. supplies and instrumentation *transformers*.

(i) Insulation levels of *plant* in the *substation* must co-ordinate with the insulation levels of the *network* to which the *substation* is *connected* without degrading the design performance of the *network*.

(j) All *U~~u~~sers*~~, generators and loads~~, must be able to de-energise their own plant/equipment/substation without reliance on *Western Power*.

(k) Prior to *connection* to the *Western Power power system*, the *User* shall have provided to *Western Power* a signed written statement to certify that the equipment to be *connected* has been designed and installed in accordance with this *Code*, all relevant standards, all statutory requirements, WA Electrical Requirements and *good electricity industry practice*. The statement shall have been certified by a Chartered Professional Engineer qualified in a relevant area ~~with NPER standing with the Institution of Engineers, Australia~~, unless otherwise agreed.

3.3.6 Load Shedding Facilities

Unless agreed otherwise by *Western Power*, *Users* are required to provide automatic load shedding facilities in accordance with clause 2.4.

3.3.7 Monitoring and Control Requirements

3.3.7.1 Remote Monitoring

Western Power may ~~will~~ require ~~the~~ large transmission and distribution connected Users to:

I. provide *remote monitoring equipment* ("*RME*") to enable *Western Power* to remotely monitor status and indications of the *load facilities* where this is reasonably necessary in real time for control, planning or security of the *power system* or where the *User* has been contracted for curtailable load service or interruptible load service; and

II. upgrade, modify or replace any *RME* already installed in a *user's substation* provided that the existing *RME* is, in the reasonable opinion of *Western Power*, no longer fit for purpose and notice is given in writing to the relevant *User*.

In (I) and (II), the *RME* provided, upgraded, modified or replaced (as applicable) must conform to an acceptable standard as agreed by *Western Power* and must be compatible with *Western Power's SCADA system*, including the requirements of clause 5.12 of this *Code*.

Input Information to *RME* may include, but not be limited to, the following:

(a) Status Indications

- (1) relevant circuit breakers open/closed (dual point) within the *plant*
- (2) relevant isolators within the *plant*
- (3) *connection* to the *transmission or distribution network*
- (4) relevant earth switches

(b) Alarms

- (1) *protection* operation
- (2) *protection* fail
- (3) battery fail - AC and DC
- (4) *Trip Circuit Supervision*
- (5) *Trip Supply Supervision*

(c) Measured Values

- (1) *active power load*
- (2) *reactive power load*
- (3) *load* current
- (4) relevant *voltages* throughout the *plant, including voltage on Western Power side of main switch*

(d) Power Quality Monitoring Equipment.

Western Power may require the User to provide power quality recording equipment at the point of coupling and on the interconnecting lines in order to record key power quality parameters for remote monitoring of power quality indexes to ensure compliance of the requirements in clause 2.2. of this code. *Western Power* will specify, install and operate this equipment.

The key power quality parameters in digital form may include but are not limited to the following :

- Voltage and current harmonic spectrum up to the 50th order.
- Voltage and current unbalance factors
- Profile of transient rms voltage, rms current and average frequency over 5 cycle during system disturbance
- Other parameters reasonably required by *Western Power*.

3.3.7.2 Communications Equipment

A *User* must provide electricity supplies for the *RME* installed in relation to its *plant* capable of keeping these *facilities* available for at least eight hours following total loss of *supply* at the *connection point* for the relevant *plant*.

A *User* must provide communications paths (with appropriate redundancy) between the *RME* installed at its *plant* to a communications interface at the relevant *plant* and in a location reasonably acceptable to *Western Power*. Communications systems between this communications interface and the relevant *control centre* must be the responsibility of *Western Power* unless otherwise agreed.

3.3.8 Secure Electricity Supplies

Secure electricity supplies of adequate capacity to provide for the operation for at least eight hours of *plant* performing *metering*, communication, monitoring, and *protection* functions, on loss of AC supplies, must be provided by a *User*.

3.4 USERS' *PROTECTION* REQUIREMENTS

The requirements of this clause 3.4 apply only to a *User'~~s~~* *protection* ~~which~~ that is necessary to maintain *power system security*. It is the *User's* responsibility to provide adequate *protection* (at the *User's* discretion) of all *User* owned *plant* to ensure the safety of the public and personnel, and to minimise damage. *Protection* installed solely to cover risks associated with a *User's plant* and equipment is at the *User's* discretion. The extent of a *User's plant* and equipment ~~which~~ that will need to conform with the requirements of this clause 3.4 will vary from installation to installation. Consequently, each installation will need to be assessed individually by *Western Power*. *Users* will be advised accordingly.

It is important to note that the requirements of this clause 3.4 are designed to adequately protect *Western Power's power system*. The requirements are not necessarily adequate to protect *Users' plant* and equipment. As stated above, *protection* installed solely to cover risks associated with a *User's plant* and equipment is at the *User's* discretion.

The requirement for *User* protection is the same as those for *Western Power* (refer to clause 2.10) except as stated in the clauses below.

3.4.1 Obligation to Provide Adequate *Protection*

3.4.1.1 System Reliability and Integrity

Refer to clause 2.10.1.1.

~~The *connection* of any new *primary plant* to either *Western Power* or *User* owned parts of the system carries with it an obligation on all parties to ensure that the existing reliability and performance of the *power system* is not degraded.~~

~~Inclusion of voltage transformers and surge diverters within the operating region of busbar buszone schemes is to be avoided.~~

To improve grading on the network the transformer type shall be agreed with *Western Power* with preference given to transformers with a zero sequence opening between high-voltage and low-voltage windings and a type that is ~~consistent with Western Power practice~~ compatible with the system at the connection point..

~~Where *connection* of new *primary plant* affects *critical fault clearance times*, it will be necessary to ensure that the performance of the *protection* of both the new and the existing *primary plant* throughout the *power system* meets the new *critical fault clearance times* and requirements where necessary. Where existing *protection* does not do so, that *protection* shall be upgraded.~~

~~Where a *critical fault clearance time* does not exist, there may be~~ *The User* must also meet other *fault clearance time* requirements imposed by *Western Power* ~~in the interests of~~ to preserve plant and system integrity and ~~other~~ minimise impacts on other *User*s. Typically, these requirements will arise from the need to minimise damage to primary plant, limit system *voltage* and/or *frequency* disturbances resulting from faults or to prevent critical motor groups from stalling.

~~Such clearance time requirements may not be known until all new *plant* data is available and the detailed design phase has commenced. Therefore, until clearance times are determined, it shall be assumed that all faults of any type shall need to be cleared within the times specified in section 3.4.2.5.~~

3.4.2 Overall *Protection* Requirements

3.4.2.1 Minimum Standard of *Protection* Equipment

Refer to clause 2.10.2.1.

~~All *protection* equipment must at least comply with IEC Standard 255.~~

3.4.2.2 Duplication of *Protection*

Transmission

Refer to clause 2.10.2.2.

Both *protections* must meet the *critical fault clearance times* and clearance time requirements of clause 2.10.2.5, be located on *User* equipment and discriminate with *Western Power protection*.

Except in an emergency, a *User* must notify *Western Power* at least 5 *business days* prior to taking a *protection* out of service.

~~Two fully independent *protections*, *connected* to operate in a "one out of two" arrangement, will comprise a complete scheme. To maintain the integrity of the two *protections*, cross *connections* between protections are to be avoided. If cross connections are made between protections, sub-fused wiring is to be employed to segregate this wiring from the tripping circuits. Cross connections are not acceptable on trip circuits. Also it must be possible to test and maintain either *protection* without interfering with the other.~~

~~To implement the "one out of two" arrangement, complete secondary equipment redundancy is required. This includes *CT* and *VT* secondaries, auxiliary supplies, cabling and wiring, circuit breaker trip coils and batteries. Where both *protections* require end to end communications, independent *teleprotection signalling* equipment and communication channels must be provided. Further, independent communication bearers are needed for each signalling channel where failure of the signalling will result in neither *protection* meeting its basic *sensitivity* and operating time criteria.~~

The two fully independent *protections* need ~~may~~ not be dedicated to the one item of *primary plant*. One of the *protection*s may in fact be a *remote backup protection*. Both *protection*s must, however, meet the *critical fault clearance time*s and clearance time requirements of section 3.4.2.5, be located on *User* equipment and discriminate with *Western Power protection*.

Distribution

Refer to clause 2.10.2.2.

~~Duplication of protection is generally not required in distribution networks.~~

~~Duplication of protection is required for islanding protection and when *a critical fault clearance time* does exist.~~

~~Each item of plant must be protected by two protections, one of which may be a remote backup.~~

Except in an emergency, a *User* must notify *Western Power* at least 5 *business days* prior to taking a *protection* out of service if this *protection* is required to met a *critical fault clearance time.*

3.4.2.3 Availability of *Protection*

Transmission

Refer to clause 2.10.2.3.
~~A *User* must ensure that all elements of both *protections*, including associated intertripping, are well maintained so as to be available at all times. Short periods of unavailability of one *protection* (up to 48 hours every 6 months) while maintenance or repair is being carried out is acceptable. Longer periods of unavailability will require the associated *primary plant* to be taken out of service.~~

Except in an emergency, a *User* must notify *Western Power* at least 5 *business day*s prior to taking a *protection* out of service.

Distribution

Refer to clause 2.10.2.3.
~~The User shall ensure that all it's equipment is protected and that all elements of the protection, including associated intertripping, are available at all times. Unavailability of the protection will require the associated primary plant to be taken out of service.~~

Except in an emergency, a *User* must notify *Western Power* at least 5 *business days* prior to taking a *protection* out of service if this *protection* is required to met a *critical fault clearance time.*

3.4.2.4 *Protection* Performance Where Critical Fault Clearance Time Exists

Refer to clause 2.10.2.4
~~Where a *critical fault clearance time* exists on an item of *plant*, that item shall be protected in such a manner that, with any single *secondary plant contingency*, a fault will be detected and cleared within the *critical fault clearance time*.~~

~~This shall mean that~~ W~~w~~h~~ere a *critical fault clearance time* exists, *plant* shall be protected by *two fully independent protection schemes of differing principle*, each *protection scheme* capable of detecting and clearing *plant* faults within the *critical fault clearance time*. Such an arrangement enables the *critical fault clearance time* to be met even under single *secondary plant contingency* conditions.~~

3.4.2.5 Maximum Acceptable *Total Fault Clearance Time*

Refer to clause 2.10.2.5
~~All items of *plant* shall be protected in such a manner that, with any single *secondary plant contingency*, a fault will be detected and cleared within the *critical fault clearance time*.~~

~~This shall mean that *Pplant* shall be protected by *two fully independent protections of differing principle*, each *protection* capable of detecting and clearing *plant* faults within the required clearance time. Such an arrangement enables the clearance time to be met even under single *secondary plant contingency* conditions.~~

~~Regardless of the *critical fault clearance time*, each item of *plant* shall be protected by *two fully independent protections of differing principle*. For all *plant*, except lines 132kV and below, both *protections* are required to meet the clearance times given in Table 3.3 below. For lines 132kV and below, at least one of the *protections* is required to meet the *total fault clearance times* as given in Table 3.3 below. Note that in Tables 3.3 and 3.4 below two sets of fault clearance times are given, one set is acceptable for existing equipment (ie existing at the *code commencement date*). The other set must be used for all new equipment.~~

~~Table 3.3~~

~~Standard *fault clearance times* (msec) - *South West Interconnected System*~~

		~~Existing Equipment No CB Fail~~	~~Existing Equipment CB Fail~~	~~New Equipment No CB Fail~~	~~New Equipment CB Fail~~
~~220kV and above~~	~~Local~~	~~120~~	~~370~~	~~100~~	~~250~~
	~~Remote~~	~~180~~	~~420~~	~~140~~	~~290~~
~~66kV and 132kV~~	~~Local~~	~~150~~	~~400~~	~~115~~	~~280~~
	~~Remote~~	~~200~~	~~450~~	~~160~~	~~325~~
33kV and below	Local	1160	1500	1160	1500
	Remote	not defined	not defined	not defined	not defined

For *voltages* below 66kV in both the *South West Interconnected System*~~ and *North West Interconnected System*~~, the clearance times will be as specified by *Western Power* in the *access contract*.

Where *critical fault clearance times* exist, *Users* shall maintain a record of design *fault clearance times* for all circuit breakers and protections within their *plant*. This record shall be made available to *Western Power* on request.

~~For 132kV and 66kV lines, where the *critical fault clearance times* exceed the above times, only one *protection* is required to meet the above times. The other *protection* is required to meet the smaller of the *critical fault clearance time* and the times shown in Table 3.4 below.~~

~~Table 3.4~~

~~Second *Protection* for 132kV and 66kV Lines Standard *fault clearance times* (msec)~~

~~*South West Interconnected System*~~

		~~Existing Equipment No CB Fail~~	~~Existing Equipment CB Fail~~	~~New Equipment No CB Fail~~	~~New Equipment CB Fail~~
132kV	Local	~~150~~	~~400~~	~~115~~	~~280~~
	Remote	~~400~~	~~650~~	~~400~~	~~565~~
66kV	Local	~~1000~~	~~>1000~~	~~115~~	~~280~~
	Remote	~~>1000~~	~~>1000~~	~~400~~	~~565~~

~~On 132kV lines the second *protection* standard *fault clearance times* will be satisfactory for both *protections* if the line between the *User's substation* and the *Western Power substation* is more than 40km and the *critical fault clearance times* are not exceeded~~.

~~66kV lines greater than 40km require one *protection* to meet the clearance times given for 132kV in Table 3.4 and the other *protection* meeting the clearance times for 66kV given in Table 3.4. In both cases the *critical fault clearance times* are not to be exceeded~~.

~~In the Tables 3.3 and 3.4~~for the 66kV and above, "~~Local" refers to a fault within the first~~ 50% ~~65% of the line and "Remote" refers to the last~~ 50% ~~35% of the line~~.

3.4.2.6 Sensitivity of Protection

Refer to clause 2.10.2.6.
~~All *protections* must have sufficient *sensitivity* to detect and correctly clear all *primary plant* faults within their intended normal operating zones, under both normal and *minimum system conditions*. Under abnormal *plant* conditions, all primary system faults must be detected and cleared by at least one *protection* on the *User*'s equipment. *Remote backup protection* or standby *protection* may be used for this purpose.~~

~~The *protection* will be considered to have sufficient *sensitivity* if it will detect and correctly clear for half the fault current that will flow for the above conditions.~~

3.4.2.7 Clearance of *Small Zone Faults*

Refer to clause 2.10.2.7.
~~*Small zone faults* shall be detected and cleared by *backup protection* as specified in clause 3.4.3.7. The clearance time requirements for small zone faults are the same as those specified in Clause 3.4.2.5 for Circuit Breaker Fail conditions and for a small zone fault coupled with a single protection failure, clearance times required are 380msec for 220kV and 330kV, and 400msec for 66kV and 132kV. The reliance on remote backup protection shall be reduced by ensuring that circuit breaker fail protection initiates the circuit breaker fail protection of the circuit breakers that they are tripping.~~

3.4.2.8 Clearance of Faults Under Circuit Breaker Fail Conditions

Refer to clause 2.10.2.8.

~~Failure of a circuit breaker, due to either a mechanical or electrical fault, to clear a fault shall be detected and the primary fault current shall be cleared by *backup protection* as specified in the clause 3.4.3.7.~~

3.4.2.9 Protection of Interconnections and Ties

The *User* shall provide *protection* to detect and clear faults on the *interconnection* or tie between their system and the *Western Power power system*.

Where a *protection scheme* provides a back up function, it shall have sufficient *sensitivity* to detect and correctly clear all *primary plant* faults within its intended back up operating zone, under both normal and *minimum system conditions*.

It should be noted that where current at the point of fault is composed of multiple contributions, *protection* intended to detect and clear the fault will need sufficient *sensitivity* to detect the contribution current. Generally, such contributions will be less than the *minimum fault current*.

Under abnormal *primary plant* conditions (that may be identified during the detailed design phase) any fault must be detected and cleared by at least one *protection scheme* somewhere in the system. *protection schemes* affording *remote backup* may be used for this purpose.

3.4.2.10 DC Functions Of *Protection Apparatus*

Refer to clause 2.10.2.10.
~~All *protection apparatus* functions shall be capable of operating with the battery *voltage* at a level~~ able to be supplied by the DC supply voltage for the full time specified in Clause 3.2.8. In addition, equipment shall be specified with adequate allowance for the voltage drop from the DC supply and the plant location. ~~of 80% of the nominal DC *supply voltage*. This will generally require circuit breaker trip coils to operate down to 70% of nominal DC *supply voltage*.~~

3.4.2.11 *Protection* Flagging and Indication

Refer to clause 2.10.2.11.
~~All protective devices supplied to satisfy the *User/Western Power connection*~~ protection ~~requirements shall be equipped with non volatile operation indicators (flags) or shall be *connected* to an event recorder. Such indicating, flagging and event recording shall be sufficient to enable the determination, after the fact, of which devices caused a particular trip.~~

Any failure of the *User*'s tripping supplies, Protection Apparatus and circuit breaker trip coils shall be alarmed within the *Users* installation and operating procedures put in place to ensure that prompt action is taken to remedy such failures.

3.4.2.12 *Trip Supply Supervision* Requirements

Refer to clause 2.10.2.12.
~~All *protection* secondary circuits, where loss of *supply* would result in *protection scheme* performance being reduced, shall have *Trip Supply Supervision*.~~

3.4.2.13 Trip Circuit Supervision Requirements

Refer to clause 2.10.2.13.
~~All *protection* secondary circuits that include a circuit breaker trip coil shall have *Trip Circuit Supervision*. This equipment is to monitor the trip coil with the circuit breaker in both the open and closed position and alarm for an unhealthy condition.~~

3.4.2.14 DETAILS OF PROPOSED *USER PROTECTION*

Unless otherwise agreed by *Western Power*, *User*s shall provide *Western Power* with sufficient ~~full~~ details of proposed *protection* designs, together with all relevant *plant* parameters for *Western Power*'s approval, within 3 months of signing the access contract but not later than a minimum of 12 months prior to *energisation* of the protected *primary plant*. *Western Power* shall provide comments on a *User*'s proposed *protection* designs within 30 ~~65~~ *business day*s, unless otherwise agreed. Refer to Attachment 4.

3.4.2.15 Details of Proposed *User Protection* Settings

Unless agreed otherwise, *User*s shall provide *Western Power* with full details of proposed *protection* settings on all *plant* that may impact on *Western Power's power system*, as per the

Attachment 4, a minimum of 65 *business days* prior to *energisation* of the protected *primary plant*. Refer to clause 4.2.3. *Western Power* shall provide comments on a *User*'s proposed *protection* settings within 30 *business days*, unless otherwise agreed.

3.4.2.16 Coordination of *Protection* Settings

The *User* shall ensure that all their *protection* settings coordinate with existing *Western Power protection* settings. Where this is not possible, the *User* shall ~~will~~ be responsible for revising *Western Power* Settings and/or upgrading *Western Power* or other *User*s' equipment, where required.

Generally, *Western Power protection* which discriminates on the basis of time employs devices with standard inverse characteristics to BS142 with a 3 second curve at 10 times current and time multiplier of 1.0. Note that this is the specification of the characteristic rather than the device setting. Distance relay zone 2 time is generally set to 300msec.

Specific details of *Western Power protection* are available on request.

3.4.2.17 Commissioning of *Protection*

Refer to clause 2.10.2.15.

Western Power shall have ~~reserves~~ the right to witness the commissioning tests on any of the *User*'s *protection* that it deems to be important or critical for the reliable operation and integrity of the *Western Power power system*.

~~All commissioning and testing of *User* owned *protection* shall be carried out by personnel suitably qualified and experienced in the commissioning, testing and maintenance of *primary plant* and *secondary plant* and equipment.~~

3.4.2.18 Maintenance of *Protection*

Refer to clause 2.10.2.16.

Users shall keep the maintenance records, and must make them available to *Western Power* upon request. Refer also to clause 4.1.4.

~~*Users* shall regularly maintain their *protection systems* at intervals of not more than~~ 8 years for transmission and 12 years for distribution ~~5 years~~. ~~Records shall be kept of such maintenance and these may be reviewed by *Western Power*. Refer also to clause 4.1.4~~.

~~Each scheduled routine test, or any unscheduled tests which become necessary shall include both a calibration check and an actual trip operation of the associated circuit breaker~~unless tripping operation had been proven by a control trip using the same tripping contact or a trip for a system fault.

~~All maintenance and testing of *User* owned *protection* shall be carried out by personnel suitably qualified and experienced in the commissioning, testing and maintenance of *primary plant* and *secondary plant* and equipment.~~

3.4.3 Specific *Protection* Requirements

3.4.3.1 Transmission Lines and other *Plant* Operated at 66kV and above

Refer to clause 2.10.3.1.
~~Where a *critical fault clearance time* exists, *protection*~~ shall ~~will be by *two fully independent protections of differing principle*, each one discriminating with the *Western Power power system* and capable of meeting the *critical fault clearance time*.~~

~~Where there is no *critical fault clearance time*, *protection* will be by *two fully independent protections of differing principle* that discriminate with the *Western Power power system*. These *protections*~~ shall ~~are to meet the *fault clearance times* specified in clause 3.4.2.5~~.

~~In either case, one of the *protections* shall include earth fault *protection* to give additional coverage for low level earth faults and to provide some *remote backup*.~~

3.4.3.2 Feeders, Reactors, Capacitors and other *Plant* Operated below 66 kV

Refer to clause 2.10.3.2.
~~Where a *critical fault clearance time* exists, *protection* of these items will be by *two fully independent protections of differing principle*, each one discriminating with the *Western Power power system* and capable of meeting the *critical fault clearance time*. At least one of these *protections* shall also include earth fault *protection* so as to give additional coverage for low level earth faults and to provide some *remote backup*.~~

~~Where there is no *critical fault clearance time*, the following shall be the minimum *protection* requirement:~~

- ~~Three Phase Inverse Definite Minimum Time Overcurrent~~
- ~~Three Phase Instantaneous Overcurrent~~
- ~~Inverse Definite Minimum Time Earth Fault~~

~~This *protection* must be backed up by an independent *protection* to ensure clearance of faults with a *protection* failure. The *protection* is also required to discriminate with the *Western Power power system*. Where the *Western Power protection* is overcurrent, the maximum~~ clearance ~~operate~~ time shall ~~will~~ be 1.1 ~~second at maximum fault level~~. The clearance time requirement for the protection shall also be dependent on the number of autoreclosing shots set on the feeder as this will impact the total thermal impact on plant. Clearance times per shot are to meet the following formula: 2.2/(N+1) where N is the number of autoreclose shots (autoreclose shots here taken to mean number of reclosure attempts before lockout).

~~Generally, *Western Power* overcurrent and earth fault *protection* employs devices with standard inverse characteristics to BS142 with a 3 second curve at 10 times current and time multiplier of 1.0. Note that this is the specification of the characteristic rather than the device setting. Operating times for other types of *protection* will generally be lower and will be dependent upon location~~.

3.4.3.3 Transformers

Refer to clause 2.10.3.3.

~~Where a *critical fault clearance time* exists, *protection* will be by *two fully independent protections of differing principle*, each one discriminating with the *Western Power system* and capable of meeting the *critical fault clearance time*.~~

~~Where there is no *critical fault clearance time*, *protection* will be by two fully independent *protections* which are *complementary* and discriminate with the *Western Power power system*. These *protections* are to meet the *fault clearance times* specified in clause 3.4.2.5.~~

~~*Protection* of *transformers* larger than 10 MVA will require at least one of the protections to be a *unit protection* and provide high speed fault clearance of *transformer* faults.~~

~~The composition of each of the two fully independent *protections* should be *complementary* such that, in combination, they provide dependable clearance of *transformer* faults within a specified time. With any single failure to operate of the *secondary plant*, fault clearance must still be achieved by *transformer protection*, but may be delayed until the nature of the fault changes or evolves.~~

3.4.3.4 Generators

Protection of *generators* shall generally be at the discretion of the *User*, but must be sufficient to protect the generator from faults on the *Western Power power system*. *Protection* will be by *two fully independent protections of differing principle*, each one discriminating with the *Western Power power system*. Where a *critical fault clearance time* exists, each *protection* must be capable of meeting the *critical fault clearance time*. These *protections* are to meet the *fault clearance times* specified in clause 3.4.2.5.

In addition, the *User* shall provide *protection* and controls to achieve, even under circuit breaker fail conditions, the following functions:

- Separation of the *Users generation* from the *Western Power power system* in the event of any of the above *protections* operating.
- Separation of the *Users generation* from the *Western Power power system* in the event of loss of *supply* to the *Users* installation from the *Western Power power system*.
- Prevention of the *Users generation* from *energising de-energised Western Power plant*, or *energising* and *supplying* an otherwise isolated portion of the *Western Power power system*.
- Adequate *protection* of the *Users* equipment and complete installation without reliance on back up from *Western Power protection*.

3.4.3.5 Check *Synchronising*

Refer to clause 2.10.3.4.
~~Check *synchronising* interlocks shall include a feature such that circuit breaker closure via the check *synchronism* interlock is not possible if the permissive closing contact is closed prior to the circuit breaker close signal being generated.~~

Note: ~~Such a feature is intended to protect the check *synchronism* interlock permissive contact from damage and to ensure out of *synchronism* closure cannot occur if the contact is welded closed.~~

~~Distinction should be drawn between check *synchronising* interlocks and *synchronising facilities* (refer to clause 3.2.7).~~

If t~~T~~he check *synchronising* interlocks are ~~may be~~ installed on circuit breakers within the *Western Power power system*, because ~~where~~ the risk of out of *synchronism* closure is unacceptable, ~~.~~ they must ~~This will~~ be installed by *Western* Power as part of the *Western Power's* works for the *connection* ~~r~~.

In addition, the check *synchronising* interlocks shall be installed on all *User*'s circuit breakers capable of out-of-*synchronism* closure, unless otherwise interlocked.

3.4.3.6 *Protection* Alarm Requirements

Specific requirements and the interface point to which alarms shall be provided will be mutually decided during the detailed design phase. These alarms will be brought back to the *Western Power control centre* via the installed *SCADA system* supplied by the *User* in accordance with clause 3.2.5.1 or clause 3.3.7.1, as applicable.

In addition, any failure of the *User's* tripping supplies, *protection apparatus* and circuit breaker trip coils must be alarmed within the *User*s installation and operating procedures put in place to ensure that prompt action is taken to remedy such failures.

3.4.3.7 Backup Protection

Refer to clause 2.10.3.6.
~~Two fully independent forms of *backup protection* shall be provided to detect and clear faults involving *small zones*.~~

~~*Protection* shall also be provided to detect and clear faults involving *circuit breaker failure*.~~

~~All other faults (such as a small zone fault coupled with a breaker failure) shall be similarly detected and cleared, though it is not expected that system stability would be maintained.~~

~~*Protection* shall also be provided to detect and clear, without system instability, faults, in accordance with clauses 2.3 and 2.5.~~

Where *critical fault clearance time*s do not exist, or are greater than the times given in section 3.4.2.5, the clearance times are to be as specified by *Western Power* in the *access contract*.

~~Such *protection schemes* shall be capable of detecting and initiating clearance of uncleared or *small zone faults* under both normal and *minimum system conditions*. Under abnormal *plant* conditions, all primary system faults must be detected and cleared by at least one *protection scheme* on the *User*'s equipment. *Remote backup protection* or standby *protection* may be used for this purpose.~~

3.4.3.8 Islanding of a *User's Facilities* from the *Power System*

~~Unless otherwise agreed by *Western Power*, a~~A *User* shall ensure that islanding of its *generation plant* together with part of the *Western Power power system*, cannot occur upon loss of *supply* from the *Western Power power system*. This should not preclude a design which allows a *User* to island its own *generation* and *plant load*, thereby maintaining *supply*

to that *plant*, upon loss of *supply* from the *Western Power power system*. Islanding must only occur in situations where the *power system* is unlikely to recover from a major disturbance. ~~Unless agreed otherwise by *Western Power*, islanding based on frequency signal alone should not occur above 47.5 Hz.~~ Islanding shall not occur unless the frequency excursion exceeds the limits of Clause 3.2.4.3(a), Figure 3.4.
~~Unless otherwise agreed by *Western Power*, t~~The *User* shall provide *facilities* to initiate islanding.

*User*s must co-operate to agree with *Western Power* the type of initiating signal and settings to ensure compatibility with other *protection* settings on the *network* and to ensure compliance with the requirements of clause 2.2.1. Where a *User* does not wish to meet the requirements of clause 2.2.1, appropriate commercial arrangements will be required between the *User*, *Western Power* and/or another *User(s)* to account for the higher level of *access service*.

3.4.3.9 Automatic Reclose Equipment

Refer to clause 2.10.3.7.
~~*Automatic reclose equipment* is used in limited circumstances in the *Western Power power system* (eg on some radial transmission lines and in distribution).~~ The installation and use of *automatic reclose equipment* in a *User's facility* and in the *power system* shall only be permitted with the prior written agreement of *Western Power*.

~~Where *automatic reclose equipment* is provided on *transmission lines* or *distribution lines*, check or blocking *facilities* must be applied to the *automatic reclose equipment* in those circumstances where there is any possibility of the two ends of the *transmission line* or *distribution lines* being *energised* from sources that are not in *synchronism*.~~

3.4.3.10 Circuit Breaker Live Close Inhibit at *Western Power* Zone Substations

To back up the Facilities islanding protection where there is a reasonable risk of the *Users* facility islanding with other than own load, *Western Power's* works for the *connection* of a generator to a distribution feeder must ~~will~~ require the installation of a circuit close inhibit interlock on the feeder circuit breaker at the zone substation.

3.5 REQUIREMENTS FOR *CONNECTION* OF SMALL *GENERATORS* TO THE *DISTRIBUTION NETWORK*

This section addresses the particular requirements for small generators and groups of small generators (power stations) of aggregate rated capacity 30 kVA to 10 MW connected to the distribution systems. It does not diminish the obligation of the User to comply with the other requirements of the Technical Rules except where specifically stated in this section.

~~Whereas most of the requirements of Section 3.2 apply to generators of all sizes, this section identifies those requirements that apply to smaller generators and to identifies additional requirements for small generators connected to the distribution systems.~~

The issues addressed by this section are:

a) The possibility that generating units ~~Generators~~ embedded in distribution networks may affect the quality of supply to other ~~adjacent distribution connected~~ *Users* ~~customers~~, cause reverse power flows, use up network capacity and increase ~~safety~~ risks for operational personal.

b) The possibility ~~It is possible~~ that a distribution connected power station could become 'islanded' on to part of the distribution network when mains supply is lost resulting in safety and quality of supply concerns.

~~c)Identification of the paragraphs of section 3.2 relevant to small generators.~~

~~User's responsibilities~~

~~Safety and reliability are paramount and access applications for access proposed installationsto the distribution networks will be evaluated accordingly. In circumstances where it is apparent that safeguards are needed in addition to the requirements of this section, Networks may specify additional performance requirements.~~

~~This section is not intended to specify requirements for plant performance other than in those areas that present a risk to the external network and to other users. It is expected that *Users* will design and specify equipment for the facility with reference to good industry practice, industry standards and recommendations of manufacturers.~~

~~*Users* must give proper consideration to safety and reliability of plant both internal to the installation and externally and shall be entirely responsible for safety and quality of supply within the facility. It may be necessary for a *User* to augment these requirements to ensure satisfactory safety and performance within the facility.~~

~~Evaluation of connection applications will also determine the extent to which the proposed generators(s) will impact other users, use capacity of the existing networks, and interfere with telecommunications and distribution signalling.~~

3.5.1 Information to be provided by the *User*

Users must provide all information reasonably required by *Western Power*. Details of the kinds of information that may be required are included in Attachments 3 and 4 of this *Code*.

In order to assess the impact of the plant on the network *Western Power* will require the *User* to provide data on:

(a) *Generating unit* aggregate real and reactive power;
(b) Flicker coefficients and harmonic profile of the plant (where applicable)

Load data shall be provided in the form of:

(c) a typical 24 hour power curve measured at 15-minute intervals (or better if available);
(d) maximum kVA output over a 60 second interval;
(e) other form as agreed with *Western Power*.

Users shall provide details of the proposed operation of their plant during start-up, shut-down, normal daily operation, intermittent fuel or wind variations and under fault or emergency conditions.

Data on power quality characteristics (including flicker and harmonics) in accordance with IEC 61400-21 shall be provided for all wind turbines proposed for connection to the network.

For *generating units* of aggregate rating 5 MW and above, Networks will assess the need for dynamic simulation studies and may require the *User* to provide a computer model in accordance with the requirements of section 3.2.10.

3.5.2 Safety and Reliability

These Requirements are intended to provide minimum safety and reliability standards for the network and other *Users*. Subject to meeting these Requirements *Users* are responsible for design of their own installations in accordance with applicable standards and regulations, good industry practice and recommendations of manufacturers. *Users* may need to augment these Requirements to ensure satisfactory safety and performance within their own facilities.

Safety and reliability of the network and other *Users* are paramount and access applications for proposed installations will be evaluated accordingly. As part of the assessment process for connection applications, Networks will also determine the extent to which the proposed *generating unit(s)* will:

(a) impact other *Users*,
(b) use capacity of the existing networks, and
(c) interfere with telecommunications and distribution signalling.

Where it is apparent that an installation may create particular problems or risks not covered by this section, Networks will refer the matter to the *User* and may require the *User* to provide additional measures. If, after installation of a *User's facilities*, it is found that the installation is adversely affecting the security or reliability of the *power system*, the *quality of supply*, or the installation does not comply with the *Code* or the relevant *access contract*, the *User* shall be responsible for remedying the problem.

The *User* shall review the capabilities and ratings of the *plant* regularly to ensure its continued suitability as conditions change (e.g. increasing fault levels as additional *plant* is *connected* to the network).

3.5.3~~1~~ Requirements of section 3.2 applicable to small power stations

Table 3.5 lists specific clauses of Section 3.2 that apply to small generators in addition to the requirements of this section.

Table 3.5

Specific paragraphs of Section 3.2 applicable to small distribution-connected *generating units* in the range 30 kVA to 10 MW

Clause	**Requirement**	**Notes**
3.2.4.1	Reactive Power capability	
3.2.4.3	Generating unit response to disturbances	
3.2.4.8	Protecting of generating units from power system disturbances	In most cases compliance with this section (3.5) will ensure compliance with section 3.2.4.8
3.2.5.3	Turbine control system	Applicable requirements
3.2.5.4	Excitation control systems	Applicable requirements

~~While not all the requirements of Section 3.2 will apply to distribution connected power stations, Table 3.5 below lists the parts of Section 3.2 that shall apply.~~

~~**Table 3.5**~~

~~**Paragraphs of Section 3.2 that apply to small distribution connected power stations**~~

~~**30 kVA to 10 MW**~~

~~3.2~~	~~Requirements for connection of generators – preamble~~
~~3.2.1~~	~~Technical characteristics~~
~~3.2.2~~	~~Technical matters to be coordinated~~
~~3.2.3~~	~~Provision of information~~
~~3.2.4.1~~	~~Reactive Power capability~~
~~3.2.4.2~~	~~Quality of Electricity generated~~
~~3.2.4.3~~	~~Generating unit response to disturbances~~
~~3.2.4.6~~	~~Safe shutdown without external supply~~
~~3.2.4.8~~	~~Protecting of generating units from power system disturbances~~
~~3.2.4.9~~	~~User protection systems that impact on system security~~
~~3.2.5.3~~	~~Turbine control system~~
~~3.2.5.4~~	~~Excitation control systems~~
~~3.2.7~~	~~Synchronising~~

~~3.2.9~~	~~Design requirements for users' substations~~
~~3.2.11~~	~~Plant performance during start-up, shut-down and daily operation~~

3.5.4~~2~~ Facility categories

3.5.4.1 Generator types

This section covers *generating units* of all types, whether using renewable or non-renewable energy sources, of rated aggregate capacity 30 kVA to 10 MW and connected to the *distribution network.*

Unless otherwise specified, technical requirements for non-synchronous generators will apply at the *connection point*, rather than at the generator terminals, to allow flexibility in design.

~~Generator types~~

~~This section addresses all generators, whether renewable energy or non-renewable, of rated aggregate capacity 30 kVA to 10 MW and connected to the distribution networks. It includes but is not limited to the following types:~~

~~Synchronous generators~~
~~Induction generators~~
~~Inverter connected energy sources, both line and self commutated.~~

3.5.4.2 Connection voltages and types

- High Voltage connected: 3 phase, 6.6kV, 11 kV, 22kV or 33kV
- Low voltage connected: 1, 2 or 3 phase plus neutral, 240V or 415V

~~Connection voltages~~

~~High Voltage connected: 3 phase, 6.6kV, 11 kV, 22kV or 33kV~~
~~Low voltage connected: 1, 2 or 3 phase plus neutral, 240V or 415V.~~

3.5.4.3 Modes of operation

- Continuous parallel operation, export or no export.
- Occasional parallel operation, export or no export, includes units participating in peak lopping and system peak load management up to 200 hours per year
- Short term test paralleling: export or no export, maximum duration of parallel operation 2 hours per event and 24 hours per year.
- Bumpless transfer:
  (a) rapid transfer - synchronised for a maximum of one second per event.
  (b) gradual transfer – synchronised for a maximum of 60 seconds per event.

~~Modes of operation~~

~~Continuous parallel operation: includes generators participating in system peak load management, export or no export.~~

~~Occasional parallel operation: export or no export, maximum duration of parallel operation 200 hours per year~~

~~Short term test paralleling: export or no export, maximum duration of parallel operation 2 hours per event and 10 24 hours per year.~~

~~Bumpless transfer: synchronised for a maximum of one 1 second per event to enable smooth transfer of load.~~

3.5.4.4 *Generating unit* characteristics

To assist in controlling network fault levels, *User*s must ensure that:

(a) synchronous generators comply with *Western Power* requirements relating to minimum sub-transient reactance.

(b) *generating unit*s other than synchronous generators comply with *Western Power* requirements relating to minimum / maximum fault current contribution

If connection/disconnection of the *User* causes excessively high or low fault levels this must be addressed by other action at the time the application for connection/disconnection is processed.

All *generating unit*s, synchronous or otherwise, must provide voltage control within their own reactive power capabilities in accordance with clause 3.2.4.1 and the applicable control strategy, limits and ranges set out in clause 3.2.5.4.

3.5.5 Connection and operation

3.5.5.1 *Users*' substations

Users' substations must comply with the requirements of clause 3.3.5.

3.5.5.2 Customer main switch

The facility shall contain one Customer Main Switch for each *connection point* and one Generator Main Switch for each *generating unit*. For larger installations, additional points of connection and Customer Main Switches or a dedicated feeder may be required.

Switches shall be automatically operated, fault current breaking and making, ganged switches. The facility may also contain similarly rated interposed Customer Paralleling Switches for the purpose of providing alternative synchronised switching operations.

At each *connection point* there shall be a means of visible isolation accessible to *Western Power*'s operational personnel. This may be a withdrawable switch, a switch with visible contacts, a set of removable links or other approved means.

~~3.5.3 Connection arrangements~~

~~The facility shall contain one Customer Main Switch for each point of connection and one Generator Main Switch for each generator. For a larger installation, additional points of connection and Customer Main Switches or a dedicated feeder may be required.~~

~~Switches shall be automatically operated, fault current breaking and making, ganged switches. unless otherwise approved. The facility may also contain similarly rated interposed Customer Paralleling Switches for the purpose of providing alternative synchronised switching operations.~~

3.5.5.3 Synchronising

For a synchronous *generating unit* the *User* shall provide and install manual or automatic *synchronising* equipment at each generator circuit breaker.

Check *synchronising* shall be provided on all generator circuit breakers and any other switching devices, unless interlocking is provided as outlined in clause 3.4.3.5, that are capable of *connecting* the *User*'s *generating plant* to the *network*.

Prior to the initial *synchronisation* of the generating unit(s) to the *distribution network*, the *User* and *Western Power* shall agree on the operational procedures necessary for *synchronisation*.

3.5.5.4 Safe shutdown without external supply

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

3.5.6 Power quality and voltage change

The requirements of section 2.2 (*Power Quality)* shall be met with the facility connected to the network.

In addition to this requirement, the change in network voltage resulting from opening or closing the customer main switch or a generator switch shall not exceed 2%. This requirement may be achieved by synchronising individual generators sequentially at intervals of no less than 2 minutes. On low voltage feeders, voltage changes up to 5% may be allowed in some circumstances with the approval of *Western Power*.

The voltage rise resulting from export of power to the network shall not exceed 2% and shall not cause operating voltage limits to be exceeded.

When operating *unsynchronised*, a *synchronous generating unit* must generate a constant voltage level with balanced phase voltages and harmonic voltage distortion equal to or less than permitted in accordance with either Australian Standard AS 1359 "General

Requirements for Rotating Electrical Machines" or a recognised relevant international standard, as agreed between *Western Power* and the *User*.

~~3.5.4 Power quality and voltage change~~

~~The requirements of section 2.2 POWER QUALITY shall be met with the facility connected to the network.~~

~~In addition to this requirement, the change in network voltage resulting from opening or closing the customer main switch or a generator switch shall not exceed 2%. This requirement may be achieved by synchronising individual generators sequentially at intervals of no less than 2 minutes.~~

~~The voltage rise resulting from export of power to the network shall not exceed 2% and shall not cause operating voltage limits to be exceeded.~~

3.5.7~~5~~ Remote monitoring and communications

Remote monitoring of the facility will not be required in all cases. However for large generators, where there is substantial export to the network; where the facility is participating in system peak load management; or where concerns for safety and reliability arise that are not adequately addressed by automatic protections and interlocks, Networks may require remote monitoring of some functions in accordance with sections 3.2.5.1 and 3.2.5.2.

-A primary speech facility in accordance with 3.2.5.2 shall be provided for all facilities.

3.5.8~~6~~ Protection

The *User* shall provide as a minimum the protection functions specified in Table 3.6 in accordance with the aggregate rated capacity of *generating units* at the *connection point*. This table covers only the minimum protection considered necessary for safe and reliable operation of the distribution system. It remains the responsibility of the *User* to provide any necessary additional protection internal to the facility as discussed in Section 3.5.2.

The *User*'s proposed protection functions and settings are subject to approval by *Western Power*, who will assess their likely effect on the distribution system and may specify modified or additional requirements to ensure satisfactory network quality, safety and reliability.

The design of the *User*'s protection systems shall ensure that failure of any protection device cannot lead to a disturbance or safety risk to *Western Power* or to other *User*s. This may be achieved by:

(a) providing back-up protection; or
(b) designing the protection to be fail-safe, e.g. to trip on failure

For new installations, all protection equipment shall comply with the IEC 60255 series of standards. Integrated control and protection equipment may be used provided that it can be demonstrated that the protection functions are functionally independent of the control functions, i.e. failure or maloperation of the control features will not impair operation of the protection.

For retrofits of existing installations to allow bumpless transfer, the disconnection timer must comply with IEC 60255. *Western Power's* preference is that control of the automatic transfer switch comply with IEC 60255 too. Other existing protection equipment is not required to be IEC 60255 compliant. Automatic transfer switches shall comply with AS 60947.6 or other applicable standards.

Table 3.6
Summary of protection requirements for small generators

Protection required for network (Note 1)		Permanent parallel operation Occasional parallel operation					Short term test parallel				Bumpless Transfer	
		HV generating plant		LV generating plant			HV generating plant	LV generating plant				
		No export	Export	Aggregate capacity kVA			No export	Aggregate capacity kVA			Rapid (≤ 1s)	Gradual (≤ 60s)
Type	Reference			≤150	150 - 250	≥250		≤150	150 - 250	≥250		
Under / over voltage & frequency	Clause 3.2.4.3	X	X	X	X	X	X	X	X	X	X	X
Loss of mains (islanding)	Clause 3.4.3.8	X	X		X	X	X			X		
Overcurrent	Clause 3.4.3.2	X	X	X	X	X	X	X	X	X	X	X
Earth fault	Clause 3.4.3.2	X	X		X	X	X		X	X	X	X
Reverse power	Clause 3.2.4.8	X	X			X						
Directional overcurrent		X	X			X						
Neutral voltage displacement		X	X	X	X	X	X	X	X	X		
Loss of DC supply to protection	Note 2.	X	X		X	X	X			X		
Pole slipping		X	X			X						
Disconnection by timer							X	X	X	X	X	X

Notes:

1: X indicates required protection.
2. Loss of a protection DC supply shall immediately trip all switches that depend on that supply for operation of their protection.

~~The *User* shall provide the protection functions specified in Table 3.6 in accordance with the aggregate rated capacity of generators at the point of connection. Compliance with the requirements of this table does not diminish the obligation of the *User* to comply with~~

~~sections 3.4 and 3.2.4.8. This table addresses only those protections considered necessary for safe and reliable operation of the distribution system and it remains the responsibility of the User to provide protections internal to the facility as discussed at the beginning of Section 3.5.~~

~~Protection relay types and proposed settings shall be approved by Networks. However Users shall satisfy themselves that approved relays meet the requirements for protecting their own facilities.~~

~~Networks shall perform studies to evaluate proposed protections in the context of the distribution system to which connection is proposed and may vary these requirements or specify additional requirements to ensure satisfactory quality, safety and reliability.~~

~~The User shall provide adequate back-up from other protections to ensure that failure of any one protection shall will be detected by neighbouring protections and plant isolated with time delays acceptable to Networks.~~

~~Where integrated control and protection equipment is proposed, it shall be demonstrable that the control features are functionally separate from the protection functions.~~

~~Table 3.6~~
~~Summary of protection requirements for small generators~~

Protection required for network	Permanent parallel operation Occasional parallel operation					Short term test parallel				Bumpless transfer
	HV generating plant		LV generating plant			HV generating plant	LV generating plant			
			Aggregate capacity kVA				Aggregate capacity kVA			
	No export	Export	<150	150-250	>250	No export	<150	150-250	>250	
Under/over voltage & frequency	*	*	*	*	*	*	*	*	*	*
Loss of mains)	*	*		*	*	*			*	
Overcurrent	*	*	*	*	*	*	*	*	*	*
Earth fault	*	*		*	*	*		*	*	*
Reverse power	*	*			*					
Directional overcurrent	*	*			*					
Neutral voltage displacement	*	*	*	*	*	*	*	*	*	
Loss of DC supply to protection	*	*		*	*	*			*	
Pole slipping	*	*			*					
Disconnection by timer						*	*	*	*	*

~~*Notes:*~~
~~** indicates required protection*~~

3.5.8~~6~~.1 Pole slipping protection

Notwithstanding the requirements of Table 3.6, where it is determined that the disturbance resulting from loss of synchronism is likely to exceed that permitted in Section 2.2 the *User* must be required to install pole slipping protection.
~~Sustained pole slipping of a generator or group of generators will not be permitted. The *User* must install suitable protections to detect this condition except where it is evident that the level of disturbance resulting from loss of synchronism would not exceed that permitted in Section 2.2. Nevertheless the User may choose to install this protection to mitigate risk of plant damage within the facility.~~

3.5.8~~6~~.2 Islanding ~~Loss of mains~~ protection and intertripping

For sustained parallel operation, islanding protection of two different functional types shall be provided. In most cases the other forms of protection specified in Table 3.6 will effectively meet this requirement. Nevertheless the *User* is required to demonstrate that two different means of islanding protection have been provided.

Islanding protection shall operate within 3 seconds to ensure disconnection before the first *network* reclosing attempt (typically 5 seconds). Relay settings are to be agreed with *Western Power*.

In cases where the risk of undetected islanding of part of the distribution network and the customer facility remains significant, *Western Power* may also require the installation of an intertripping link between the customer main switch(es) and the feeder circuit breaker(s) in the zone substation.
~~For sustained parallel operation, loss of mains protection of two different functional types shall be provided. Operating times for this protection must be coordinated with Network settings for automatic reclosing to ensure disconnection before the first reclosing attempt, (typically 5 seconds).~~

~~In cases where the risk of undetected islanding of part of the distribution network and the customer facility remains significant, Networks may also require the installation of an intertripping link between the customer main switch(es) and a feeder circuit breaker(s) in the zone substation.~~

3.5.8.3 Protection of *Users*' plant

Refer to Clause 3.4. Note that the requirements of Clause 3.4 apply only to *protection* necessary to maintain *power system security*. Design and specification of *protection* intended only to guard against risks within the *User's* installation is the responsibility of the *User*.

Any failure of the *User*'s tripping supplies, protection apparatus or circuit breaker trip coils must be alarmed within the *User*'s installation and operating procedures put in place to ensure that prompt action is taken to remedy such failures. As an alternative to alarming, generator main switches may be automatically tripped.

3.5.8~~6~~.4~~3~~ Operating limits

Power system studies may indicate a risk that network ratings or operating limits will be exceeded with the facility connected. As an alternative to network augmentation, *Western Power* ~~Networks~~ may require additional protection~~s~~ to ensure that operating limits and agreed import/export limits are not exceeded.

3.5.9 Technical matters to be agreed

The *User* and *Western Power* must use all reasonable endeavours to agree upon the following matters in respect of each new or altered *connection*:

l) Design at *connection point*;

m) Physical layout adjacent to *connection point*;

n) Back-up (alternative) supply arrangements.

o) *Protection* and backup;

p) Control characteristics;

q) Communications, *metered* quantities and alarms;

r) Insulation co-ordination and lightning protection;

s) Fault levels and fault clearing times;

t) Switching and *isolation facilities*;

u) Interlocking arrangements;

v) *Synchronising facilities*;

w) *Under frequency load shedding* and islanding schemes; and

x) Any special test requirements.

3.5.10 Certification

Prior to *connection* to the *network*, the *User* shall provide to *Western Power* a signed statement certifying that the equipment to be *connected* has been designed and installed in accordance with these *Rules*, all relevant standards, all statutory requirements and *good electricity industry practice*. The statement shall be certified by an engineer registered on the National Professional Engineers' Register (NPER) with relevant experience, unless otherwise agreed.

~~3.5.7 Computer model~~

~~For individual generators or power stations rated 3 MW and above, Networks may require the User to providesupply a computer models for power system simulation dynamic studies in accordance with the requirements of section 3.2.10.~~

4. INSPECTION, TESTING, COMMISSIONING, *DISCONNECTION* AND RE*CONNECTION*

4.1 INSPECTION AND TESTING

4.1.1 Right of Entry and Inspection

a) *Western Power* or any of its *representatives* (including authorised agents) may, in accordance with clause 4.1, inspect a *facility* of a *User* and the operation and maintenance of that *facility* in order to:

1) assess compliance by the relevant *User* with its operational obligations under the *Access Code* or *Technical Rules*, or an *access contract*; or
2) investigate any possible past or potential threat to *power system security; or*
3) conduct any periodic familiarisation or training associated with the operational requirements of the *facility*.

b) If *Western Power* wishes to inspect the *facilities* of a *User* under clause 4.1.1(a), *Western Power* must give that *User* at least:

- 2 *business days'* notice or as otherwise agreed by the parties, or
- 10 *business days'* notice for a non-urgent issue

in writing of its intention to carry out an inspection. In the case of an emergency condition affecting the *power system* which *Western Power* reasonably considers requires access to the *User's facility*, prior notice is not required, however, *Western Power* shall notify the *User* as soon as practicable after deciding to enter the *User's facility* of the nature and extent of *Western Power's* activities at the *User's facility*.

c) A notice given under clause 4.1.1(b) must include the following information:

1) the name of the *representative* who will be conducting the inspection on behalf of *Western Power*;
2) subject to clause 4.1.1(h), the time when the inspection will commence and the expected time when the inspection will conclude; and
3) if associated with clause 4.1.1(a)(1) then the nature of the suspected non-compliance with the *Rules* or *access contract* , or if associated with clauses 4.1.1(a)(2) or 4.1.1(a)(3) then the relevant reasons for the inspection.

d) *Western Power* may not carry out an inspection under clause 4.1 within 6 months of any previous inspection except for the purpose of verifying the performance of corrective action claimed to have been carried out in respect of a non-conformance observed and documented on the previous inspection or for the purpose of investigating an operating incident in accordance with clause 5.8.11.

e) At any time when the *representative* of *Western Power* is in a *User*'s *facility*, that *representative* must:

1) cause no damage to the *facility;*
2) only interfere with the operation of the *facility* to the extent reasonably necessary and approved by the relevant *User* (such approval not to be unreasonably withheld or delayed);
3) observe "permit to test" access to sites and clearance protocols of the operator of the *facility*, provided that these are not used by the *facility* solely to delay the granting of access to site and inspection;
4) observe the requirements of the operator of the *facility* in relation to occupational health and safety and industrial relations matters, which requirements are of general application to all invitees entering on or into the *facility*, provided that these are not used by the *facility* solely to delay the granting of access to site and inspection; and
5) not ask any question other than as reasonably necessary for the purpose of such inspection or give any *direction*, instruction or advice to any person involved in the operation or maintenance of the *facility* other than the operator of the *facility* or unless approved by the operator of the *facility*.

f) Any *representative* of *Western Power* conducting an inspection under this clause 4.1.1 must be appropriately qualified and experienced to perform the relevant inspection. If so requested by the *User*, *Western Power* shall procure that a *representative* of *Western Power* (other than an employee) gaining access under these *Rules* or an *access contract* enters into a confidentiality undertaking in favour of the *User* in a form reasonably acceptable to the *User* prior to gaining such access.

~~g) The costs of inspections under this clause 4.1.1 must be borne by the *User* if the suspected non-compliance is later proved by tests.~~

~~h)~~g) Any inspection under clause 4.1.1(a) must not take longer than one *day* unless *Western Power* seeks approval from the *User* for an extension of time (such approval not to be unreasonably withheld or delayed).

~~i)~~h) Any equipment or goods installed or left on land or in premises of a *User* after an inspection conducted under clause 4.1.1 do not become the property of the relevant *User* (notwithstanding that they may be annexed or affixed to the relevant land or premises).

~~j)~~i) In respect of any equipment or goods left on land or premises of a *User* during or after an inspection, a *User*:

1) must not use any such equipment or goods for a purpose other than as contemplated in these *Rules* without the prior written approval of the owner of the equipment or goods;
2) must allow the owner of any such equipment or goods to remove any such equipment or goods in whole or in part at a time agreed with the relevant *User* with such agreement not to be unreasonably withheld or delayed;
3) must not create or cause to be created any mortgage, charge or lien over any such equipment or goods; and

4.1.2 Right of Testing

(a) If *Western Power* has reasonable grounds to believe that equipment owned or operated by a *User* may not comply with the *Access Code, Rules* or the *access contract*, *Western Power* may require testing of the relevant equipment by giving notice in writing to the *User*.

(b) If a notice is given under clause 4.1.2(a) the relevant test is to be conducted at a reasonable time mutually agreed by the parties.

(c) The *User* who receives a notice under clause 4.1.2(a) must co-operate in relation to conducting tests requested under clause 4.1.2(a).

(d) Tests conducted in respect of a *connection point* under clause 4.1.2 must be conducted using test procedures agreed between the relevant *Users,* which agreement is not to be unreasonably withheld or delayed.

(e) Tests under clause 4.1.2 must be conducted only by persons with the relevant skills and experience.

(g) If *Western Power* requests a test under this clause 4.1.2, *Western Power* may appoint a *representative* to witness a test and the relevant *User* must permit a *representative* appointed under this clause 4.1.2(g) to be present while the test is being conducted.

(h) Subject to clause 4.1.2(i), a *User* who conducts a test must submit a report to *Western Power* within a reasonable period after the completion of the test and the report is to outline relevant details of the tests conducted, including but not limited to the results of those tests.

(i) If a performance test or monitoring of in-service performance demonstrates that equipment owned or operated by a *User* does not comply with the *Access Code,* these *Rules* or the relevant *access contract* then the *User* must:

(1) promptly notify *Western Power* of that fact; and
(2) promptly advise *Western Power* of the remedial steps it proposes to take and the timetable for such remedial work; and
(3) diligently undertake such remedial work and report at monthly intervals to *Western Power* on progress in implementing the remedial action; and
(4) conduct further tests or monitoring on completion of the remedial work to confirm compliance with the relevant technical requirement.

(j) *Western Power* may attach test equipment or *monitoring equipment* to *plant* owned by a *User* or require a *User* to attach such test equipment or *monitoring equipment,* subject to the provisions of clause 4.1.1 regarding entry and inspection.

(k) In carrying out monitoring under clause 4.1.2(j), *Western Power* must not cause the performance of the monitored *plant* to be *constrained* in any way.

4.1.3 Tests to Demonstrate Compliance with *Connection* Requirements for *Generators*

(a) Each User must provide evidence to *Western Power* that each of its generating units complies with the technical requirements of Clause 3.2 and the relevant access contract. In addition, each User must provide facilities to carry out power system tests prior to commercial operation in order to verify acceptable performance of each generating unit, and provide information and data necessary for computer model validation. These test requirements, primarily for synchronous generators are detailed in Table A10.1 of Attachment 9. *Western Power* will specify test requirements for other forms of non-synchronous generation.

Other special tests may be specified by *Western Power*, and Users will be advised accordingly. Examples of some of these special tests are listed in Table A10.2 of Attachment 9. Where testing is not practical, *Western Power* may request a User to install recording equipment at appropriate locations in order to confirm compliance of performance.

These tests shall only be performed after the machines have been tested and certified by a Chartered Professional Engineer qualified in a relevant area ~~with NPER standing with the Institution of Engineers, Australia~~, unless otherwise agreed. Also, that the machine's turbine controls, AVR, excitation limiters, power system stabiliser, and associated protection functions have been calibrated and tuned for commercial operation to ensure stable operation both on-line and off-line. All final settings of the AVR, PSS, excitation limiters should be indicated on the control transfer block diagrams and made available to *Western Power* before the tests.

The User shall forward test procedures which incorporate test requirements in Attachment 9 and details of the recorders and measurement equipment to be used in the tests to *Western Power* for approval 30 business days before the tests. The User is responsible for providing all necessary recorders and other measurement equipment for the tests.

The User is also responsible for coordinating the tests and liaising with all parties involved including *Western Power* System Control Centre. A representative from *Western Power* may witness the test to ensure compliance of performance and data requirements. *Western Power* will indicate if such witnessing is required. The *Western Power* representative will be on site for the purpose of witnessing tests only and not to give any formal approvals or permissions related to the testing.

All test results and associated relevant information including final transfer function block diagrams and settings of AVR, PSS, UEL and OEL shall be forwarded to *Western Power* within 10 business days after the test.

(b) Each *User* must negotiate in good faith with *Western Power* to agree on a compliance monitoring program, including an agreed method, for each of its *generating units* to confirm ongoing compliance with the applicable technical requirements of Clause 3.2 and the relevant *access contract.* The negotiations should consider first the use of high speed data recorders and similar non-invasive methods for verifying the plant performance.

(c) If a performance test or monitoring of in-service performance demonstrates that a *generating unit* is not complying with one or more technical requirements of Clause 3.2 and the relevant *access contract* then the *User* must:

(1) promptly notify *Western Power* of that fact; and
(2) promptly advise *Western Power* of the remedial steps it proposes to take and the timetable for such remedial work; and
(3) diligently undertake such remedial work and report at monthly intervals to *Western Power* on progress in implementing the remedial action; and
(4) conduct further tests or monitoring on completion of the remedial work to confirm compliance with the relevant technical requirement.

(d) If *Western Power* reasonably believes that a *generating unit* is not complying with one or more technical requirements of Clause 3.2 and the relevant *access contract, Western Power* may instruct the *User* to conduct tests within 25 *business days* to demonstrate that the relevant *generating unit* complies with those technical requirements and if the tests provide evidence that the relevant *generating unit* continues to comply with the technical requirement(s) *Western Power* must reimburse the *User* for the reasonable expenses incurred as a direct result of conducting the tests.

(e) If *Western Power*:

(1) is satisfied that a *generating unit* does not comply with one or more technical requirements; and
(2) does not have evidence demonstrating that a *generating unit* complies with the technical requirements set out in Clause 3.2; or
(3) holds the reasonable opinion that there is or could be a threat to the *power system security,*

Western Power may direct the relevant *User* to operate the relevant *generating unit* at a particular *generated* output or in a particular mode until the relevant *User* submits evidence reasonably satisfactory to *Western Power* that the *generating unit* is complying with the relevant technical requirement.

(f) A *direction* under clause 4.1.3(e) must be recorded by *Western Power*.

(g) From the *Rules commencement date* or from the date of access, whichever is the later, each *User* must maintain records and retain them for a minimum of 7 years (from the date of creation of each record) for each of its *generating units* and *power stations* setting out details of the results of all technical performance and monitoring conducted under this clause 4.1.3 and make these records available to *Western Power* on request.

4.1.4 Routine Testing of *Protection* Equipment

a) Subject to clause 3.4.2.18, a *User* must cooperate with *Western Power* to test the operation of equipment forming part of a *protection scheme* relating to a *connection point* at which that *User* is *connected* to a *network* and the *User* must conduct these tests:

1) prior to the *plant* at the relevant *connection point* being placed in service; and
2) at intervals specified in the *access contract* or in accordance with an asset management plan agreed between *Western Power* and the *User*.

b) A *User* shall, on request from *Western Power*, demonstrate to *Western Power*'s satisfaction the correct calibration and operation of the *User*'s protective devices.

4.1.5 Testing by *User*s of their own *Plant* Requiring Changes to Agreed Operation

(a) A *User* proposing to conduct a test on equipment related to a *connection point,* which requires a change to the operation of that equipment as specified in the *access contract*, must give notice in writing to *Western Power* of at least 15 *business days* except in an emergency.

(b) The notice to be provided under clause 4.1.5(a) is to include:

(1) the nature of the proposed test;
(2) the estimated start and finish time for the proposed test;
(3) the identity of the equipment to be tested;
(4) the *power system* conditions required for the conduct of the proposed test;
(5) details of any potential adverse consequences of the proposed test on the equipment to be tested;
(6) details of any potential adverse consequences of the proposed test on the *power system*; and
(7) the name of the person responsible for the coordination of the proposed test on behalf of the *User*.

(c) *Western Power* must review the proposed test to determine whether the test:

(1) could adversely affect the normal operation of the *power system* ;
(2) could cause a threat to *power system security*;
(3) requires the *power system* to be operated in a particular way which differs from the way in which the *power system* is normally operated; or
(4) could affect the normal *metering* of *energy* at a *connection point;*

(d) If, in *Western Power's* reasonable opinion, a test could threaten public safety, damage or threaten to damage equipment or adversely affect the operation of the *power system*, *Western Power* may direct that the proposed test procedure be modified or that the test not be conducted at the time proposed.

(e) *Western Power* must advise any other *User*s who will be adversely affected by a proposed test and consider any reasonable requirements of those *User*s when approving the proposed test.

(f) The *User* who conducts a test under this clause 4.1.5 must ensure that the person responsible for the coordination of a test promptly advises *Western Power* when the test is complete.

(g) If *Western Power* approves a proposed test, *Western Power* must use its reasonable endeavours to ensure that *power system* conditions reasonably required for that test are provided as close as is reasonably practicable to the proposed start time of the test and continue for the proposed duration of the test.

(h) Within a reasonable period after any such test has been conducted, the *User* who has conducted a test under this clause 4.1.5 must provide *Western Power* with a report in relation to that test including test results where appropriate.

4.1.6 Tests of *Generating Units* Requiring Changes to Agreed Operation

(a) *Western Power* may, at intervals of not less than 12 months per *generating unit*, require the testing by a *User* of any *generating unit connected* to the *network* of *Western Power* in order to determine analytic parameters for modelling purposes or to assess the performance of the relevant *generating unit* and *Western Power* is entitled to witness such tests. *Western Power* must have reasonable grounds for requiring such tests.

(b) Adequate notice of not less than 15 *business days* must be given by *Western Power* to the *User* before the proposed date of a test under clause 4.1.6(a).

(c) *Western Power* must use its reasonable endeavours to ensure that tests permitted under this clause 4.1.6 are to be conducted at a time which will minimise the departure from the *commitment* that is due to take place at that time .

(d) If not possible beforehand, a *User* must conduct a test under clause 4.1.6 at the next scheduled *outage* of the relevant *generating unit* and in any event within 9 months of the request.

(e) A *User* must provide any reasonable assistance requested by *Western Power* in relation to the conduct of tests.

(f) Tests conducted under clause 4.1.6 must be conducted in accordance with test procedures agreed between *Western Power* and the relevant *User* and a *User* must not unreasonably withhold its agreement to test procedures proposed for this purpose by *Western Power*.

(g) *Western Power* must provide to a *User* such details of the analytic parameters of the model derived from the tests referred to in clause 4.1.6 for any of that *User's generating units* as may reasonably be requested by the *User*.

4.1.7 *Power System* Tests

(a) Tests conducted for the purpose of either verifying the magnitude of the *power transfer capability* of *transmission networks* or investigating *power system* performance must be coordinated and approved by *Western Power*. *Western Power* or a *User* requesting such tests must have reasonable grounds for requiring such tests.

(b) The tests described in clause 4.1.7(a) may be conducted whenever:

(1) a new *generating unit* or *facility* of a *Customer, User* or a *network* development is commissioned that is calculated or anticipated to substantially alter *power transfer capability* through the *transmission network*;
(2) setting changes are made to any *turbine control system* and *excitation control system*, including *power system* stabilisers; or
(3) a test is required to verify the performance of the *power system* or to validate computer models.

(c) *Western Power* must notify all *Users* which could reasonably be expected to be affected by the proposed test at least 15 *business days* before any test under this clause 4.1.7 may proceed and consider any reasonable requirements of those *Users* when approving the proposed test.

(d) Operational conditions for each test must be arranged by *Western Power* and the test procedures must be coordinated by an officer nominated by *Western Power* who has authority to stop the test or any part of it or vary the procedure within pre-approved guidelines if it considers any of these actions to be reasonably necessary.

(e) Each *User* must cooperate with *Western Power* when required in planning, preparing for and conducting *transmission* and *distribution network tests* to assess the technical performance of the *networks* and if necessary conduct co-ordinated activities to prepare for *power system* wide testing or individual, on-site tests of the *User's facilities* or *plant,* including *disconnection* of a *generating unit*.

(f) *Western Power* may direct operation of *generating units* by *Users* during *power system tests* if this is necessary to achieve operational conditions on the *transmission* and *distribution networks* which are reasonably required to achieve valid test results.

(g) *Western Power* must plan the timing of tests so that the variation from *dispatch* that would otherwise occur is minimised and the duration of the tests is as short as possible consistent with test requirements and *power system security*.

4.2 COMMISSIONING

4.2.1 Requirement to Inspect and Test Equipment

(a) A *User* must ensure that any of its new or replacement equipment is inspected and tested to demonstrate that it complies with relevant *Australian Standards*, relevant international standards, these *Rules, Access Code* and any relevant *access contract* prior to or within an agreed time after being *connected* to a *transmission* or *distribution network,* and *Western Power* is entitled to witness such inspections and tests.

(b) The *User* must produce test certificates on request by *Western Power* showing that the equipment has passed the tests and complies with the standards set out in clause 4.2.1(a) before *connection* to the *power system*, or within an agreed time thereafter.

4.2.2 Co-ordination During Commissioning

A *User* seeking to *connect* to a *network* must cooperate with *Western Power* to develop procedures to ensure that the commissioning of the *connection* and *connected* facility is carried out in a manner that:

1) does not adversely affect other *Users* or affect *power system security* or *quality of supply* of the *power system*; and
2) minimises the threat of damage to any other *User's* equipment.

4.2.3 Control and *protection* settings for equipment

(a) Not less than 65 *business day*s prior to the proposed commencement of commissioning of any new or replacement equipment that could reasonably be expected to alter performance of the *power system*, the *User* must submit to *Western Power* sufficient design information including proposed parameter settings to allow critical assessment including analytical modelling of the effect of the new or replacement equipment on the performance of the *power system*.

(b) *Western Power* must:

(1) consult with other *Users* as appropriate; and
(2) within 20 *business days* of receipt of the design information under clause 4.2.3(a), notify the *User* of any comments on the proposed parameter settings for the new or replacement equipment.

(c) If *Western Power's* comments include alternative parameter settings for the new or replacement equipment, then the *User* must notify *Western Power* within 10 *business day*s that it either accepts or disagrees with the alternative parameter settings suggested by *Western Power*.

(d) *Western Power* and the *User* must negotiate parameter settings that are acceptable to them both and if there is any unresolved disagreement between them, the matter must be referred to the *Referee*.

(e) The *User* and *Western Power* must co-operate with each other to ensure that adequate grading of *protection* is achieved so that faults within the *User's* facility are cleared without adverse effects on the *power system*.

4.2.4 Commissioning Program

(a) Not less than 65 *business day*s prior to the proposed commencement of commissioning by a *User* of any new or replacement equipment that could reasonably be expected to alter performance of the *power system*, the *User* must advise *Western Power* in writing of the commissioning program including test procedures and proposed test equipment to be used in the commissioning.

(b) *Western Power* must, within 20 *business days* of receipt of such advice under clause 4.2.4(a), notify the *User* either that it:

(1) agrees with the proposed commissioning program and test procedures; or

(2) requires changes in the interest of maintaining *power system security*, safety or *quality of supply*.

(c) If *Western Power* requires changes, then the parties must co-operate to reach agreement and finalise the commissioning program within a reasonable period.

(d) A *User* must not commence the commissioning until the commissioning program has been finalised and *Western Power* must not unreasonably delay finalising a commissioning program.

4.2.5 Commissioning Tests

(a) *Western Power* has the right to witness commissioning tests relating to new or replacement equipment that could reasonably be expected to alter performance of the *power system* or the accurate *metering* of *energy*, including *SCADA* equipment.

Prior to *connection* to the *Western Power power system*, the *User* shall have provided to *Western Power* a signed written statement to certify that the equipment to be *connected* has been installed in accordance with the *Access Code,* these *Rules*, the relevant *access contract*, all relevant standards, all statutory requirements and *good electricity industry practice*. The statement shall have been certified by a Chartered Professional Engineer qualified in a relevant area ~~with NPER standing with the Institution of Engineers, Australia~~, unless otherwise agreed.

(b) *Western Power* must, within a reasonable period of receiving advice of commissioning tests, notify the *User* whose new or replacement equipment is to be tested under this clause 4.2.5 whether or not it:

(1) wishes to witness the commissioning tests; and

(2) agrees with the proposed commissioning times.

(c) A *User* whose new or replacement equipment is tested under this clause 4.2.5 must submit to *Western Power* the commissioning test results demonstrating that a new or replacement item of equipment complies with these *Rules* or the relevant *access contract* or both to the satisfaction of *Western Power.*

(d) If the commissioning tests conducted in relation to a new or replacement item of equipment demonstrates non-compliance with one or more requirements of these *Rules* or the relevant *access contract* then the *User* whose new or replacement equipment was tested under this clause 4.2.5 must promptly meet with *Western Power* to agree on a process aimed at achievement of compliance of the relevant item with these *Rules*.

(e) *Western Power* may direct that the commissioning and subsequent *connection* of the *User's* equipment should not proceed if the relevant equipment does not meet the technical requirements specified in clause 4.2.1.

(f) All commissioning and testing of *User* owned equipment shall be carried out by personnel experienced in the commissioning of *power system primary plant* and *secondary plant*.

4.3 *DISCONNECTION* AND RE*CONNECTION*

4.3.1 Voluntary *Disconnection*

(a) Unless agreed otherwise and specified in an *access contract*, a *User* must give to *Western Power* notice in writing of its intention to permanently *disconnect* a *facility* from a *connection point*.

(b) A *User* is entitled, subject to the terms of the relevant *access contract*, to require voluntary permanent *disconnection* of its equipment from the *power system* in which case appropriate operating procedures necessary to ensure that the *disconnection* will not threaten *power system security* must be implemented in accordance with clause 4.3.2.

4.3.2 Decommissioning Procedures

(a) In the event that a *User*'s facility is to be permanently *disconnected* from the *power system*, whether in accordance with clause 4.3.1 or otherwise, *Western Power* and the *User* must, prior to such *disconnection* occurring, follow agreed procedures for *disconnection*.

(b) *Western Power* must notify other *Users* if it believes, in its reasonable opinion, the terms and conditions of such a *access contract* will be affected by procedures for *disconnection* or proposed procedures agreed with any other *User*. The parties must negotiate any amendments to the procedures for *disconnection* or the *access contract* that may be required.

(c) Any *disconnection* procedures agreed to or determined under clause 4.3.2(a) must be followed by *Western Power* and all *Users*.

4.3.3 Involuntary *Disconnection* (refer also to clause 5.8)

a) *Western Power* may *disconnect* a *User's facilities* from a *network :*

1) during an emergency in accordance with clause 4.3.5;
2) in accordance with relevant laws; or
3) in accordance with the provisions of the *User's access contract.*

b) In all cases of *disconnection* by *Western Power* during an emergency in accordance with clause 4.3.5, *Western Power* is required to undertake a review under clause 5.8.11 and *Western Power* must then provide a report to the *User* advising of the circumstances requiring such action.

4.3.5 *Disconnection* During an Emergency

Where *Western Power* may *disconnect* a *User's facilities* during an emergency under these *Rules* or otherwise, then *Western Power* may:

a) request the relevant *User* to reduce the *power transfer* at the proposed point of *disconnection* to zero in an orderly manner and then *disconnect* the *User's* facility by automatic or manual means; or
b) immediately *disconnect* the *User's facilities* by automatic or manual means where, in *Western Power's* reasonable opinion, it is not appropriate to follow the procedure set out in clause 4.3.5(a) because action is urgently required as a result of a threat to safety of persons, hazard to equipment or a threat to *power system security*.

4.3.6 Obligation to Re*connect*

Western Power must re*connect* a *User*'s *facilities* to a *transmission* or as soon as practicable if:

(a) a breach of the Access *Code, Rules* or *access contract* giving rise to *disconnection* has been remedied; or
(b) the *User* has taken all necessary steps to prevent the re-occurrence of the breach and has delivered binding undertakings to *Western Power* that the breach will not re-occur.

5. POWER SYSTEM SECURITY

5.1 SCOPE

For the purpose of Power System operations, this section applies to *Western Power's* and *Users* facilities not covered under the Wholesale Electricity Market Rules. The *Rules* acknowledge for Market Generators, as defined under the Wholesale Electricity Market Rules and generally greater than 10MW, the rules that apply for power system operation and co-ordination are found within the Wholesale Electricity Market Rules. *Users* should make reference to those rules and *Western Power* whilst interpreting the scope of this section.

5.~~1~~2 INTRODUCTION

5.~~1~~2.1 Purpose and Application of Section 5

(a) This Section of the *Rules*, which applies to, and defines obligations for *Western Power* and all *Users* ~~:~~

~~(1) provides the framework for achieving and maintaining a secure *power system*;~~

~~(2) provides the conditions under which *Western Power* issue *directions* to *Users* so as to maintain or re-establish a secure *power system*;~~

(3) has the following aims:

~~(i) to detail the principles and guidelines for achieving and maintaining *power system security*;~~

~~(ii) to establish the processes for the assessment of the adequacy of *power system* reserves;~~

~~(iii)~~(i) to establish processes and arrangements to enable *Western Power* to plan and conduct operations within the *power system* ~~to achieve and maintain *power system security*~~; and

~~(iv)~~(ii) to establish arrangements for the actual *dispatch* of *generating units* and *loads* by *Users*.

~~(b) By virtue of this Section, *Western Power* has responsibility for *power system security*.~~

5.2. 2 Time for Undertaking Action

An event which is required under Section 5 of the *Rules* to occur on or by a stipulated *day* must occur on or by that *day* whether or not a *business day*.

~~5.2 *POWER SYSTEM SECURITY* DEFINITIONS AND PRINCIPLES~~

~~This clause sets out certain definitions and concepts that are relevant to Section 5 of the *Rules*.~~

~~A fundamental security principle, that generally applies to all transmission plant in the power system, is that a single fault shall not cause disconnection of equipment beyond its fault clearing zone. This principle does not apply to parts of the system designed to the (N-0) criterion or those protected by remedial action schemes.~~

~~*Security* of a power system refers to the degree of risk in its ability to survive imminent disturbances (contingencies) without interruption of customer service. It relates to robustness of the system to imminent disturbances and, hence, depends on the system operating condition as well as the contingent probability of disturbances.~~

~~5.2.1 *Satisfactory Operating State*~~

~~The *power system* is defined as being in a *satisfactory operating state* when:~~

a)~~the *frequency* at all energised *busbars* of the *power system* is in accordance with the frequency operating standards as specified in Table 2.1;~~

b)~~the *voltage* magnitudes at all energised *busbars* of the *transmission* and *distribution network* are within the relevant limits set by *Western Power* in accordance with these Rules and clause 2.2.2 of these Rules;~~

c)~~the current flows on all *transmission and distribution lines* of the *transmission and distribution network* are within the ratings (accounting for time dependency in the case of emergency ratings) as defined by *Western Power*;~~

d)~~all other *plant* forming part of or impacting on the *power system* is being operated within the relevant operating ratings (accounting for time dependency in the case of emergency ratings) as defined by *Western Power*;~~

(e)~~the configuration of the *transmission and distribution network* is such that the severity of any potential fault is within the capability of transmission and distribution circuit breakers and distribution reclosers/switches to *disconnect* the faulted circuit or equipment; and~~

(f)~~the conditions of the *power system* are stable in accordance with requirements designated in or under clause 2.3.~~

~~5.2.2 Secure Operating State~~

~~(a) The *power system* is defined to be in a *secure operating state* if, in *Western Power's* reasonable opinion, taking into consideration the appropriate *power system security* principles described in clause 5.2.4:~~

~~(1) the *power system* is in a *satisfactory operating state*; and~~

~~(2) The *power system* can be promptly returned to a *satisfactory operating state* following the occurrence of *credible contingency events* (events considered in accordance with clause 2.5 of these Rules) with the *frequency and voltage* remaining within the limits specified in clauses 5.2.1(a) and 5.2.1(b), respectively.~~

~~(b) Without limitation, in forming the opinions described in clause 5.2.2(a), *Western Power* must:~~

~~(1) consider the impact of each of the potentially *constrained interconnectors*; and~~

~~(2) use the *technical envelope* as the basis of determining events considered to be *credible contingency events* at that time.~~

~~(c) A part of the *power system* is considered to be in a *secure operating state*, even though *Western Power* considers the provisions of clause 5.2.2(a)(2) to be not satisfied, where:~~

~~(1) The design of that part of *power system* does not meet this level of security; and~~

~~(2) the *Users* connected to that part of the *transmission or distribution network* have accepted such lower level of security. A *User* is considered to have accepted such lower level of security in relation to a part of the *power system* so designed unless the *connection contract* between that *User* and *Western Power* provides otherwise; and~~

~~(3) *Users* have provided automatic and/or manually *interruptible load* in accordance with their *access contract* and these Rules.~~

~~5.2.3 *Technical Envelope*~~

~~(a) The *technical envelope* means the technical boundary limits of the *power system* for achieving and maintaining the *secure operating state* of the *power system* for a given demand and *power system* scenario.~~

~~(b) *Western Power* must determine and revise the *technical envelope* (as may be necessary from time to time) by taking into account the prevailing *power system* and *plant* conditions as described in clause 5.2.3(c).~~

~~(c) The *technical envelope* determination must take into account matters including but not limited to:~~

~~(1) the *Western Power* forecast total *power system load*;~~

~~(2) the provision of the applicable *contingency capacity reserves*;~~

~~(3) operation within all *plant* capabilities and *constraints* on the *power system*;~~

~~(4) *contingency capacity reserves* available to handle *credible contingency events* in accordance with clause 2.5 of these Rules;~~

~~(5) agreed *generation load constraints*;~~

~~(6) *constraints* on the *transmission* and *distribution network*, including short term limitations;~~

~~(7) *frequency* control requirements;~~

~~(8) *reactive power* support and *ancillary services* requirements; and~~

~~(9)the existence of proposals for any major equipment or *plant* testing, including the checking or possible changes in *transmission/distribution plant* availability.~~

~~(10)The performance standards.~~

~~5.2.4 General Principles for Maintaining *Power System Security*~~

~~The *power system security* principles are as follows:~~

~~(a) To the extent practicable, the *power system* should be operated such that it is and will remain in a *secure operating state*.~~

~~(b) Following a *credible contingency event* or a significant *change* in *power system* conditions, it is possible that the *power system* may no longer be in a condition which could be considered secure on the occurrence of a further *contingency event*. In that case, *Western Power* should take all reasonable actions to adjust, wherever possible, the operating conditions with a view to returning the *power system* to its *secure operating state* as soon as it is practical to do so, and, in any event, within thirty minutes.~~

~~(c) Adequate *load shedding facilities* initiated automatically by *frequency* or *voltage* conditions outside the *normal operating frequency or voltage excursion band* should be available and in service to restore the *power system* to a *satisfactory operating state* following significant *contingency events*.~~

~~(d) *Users* shall be required, either under their *access contracts*, to provide and maintain all required *facilities* consistent with both their *access contract* and *good electricity industry practice* and operate their equipment in a manner:~~

~~(1) to assist in preventing or controlling instability within the *power system*;~~

~~(2) to assist in the maintenance of, or restoration to a *satisfactory operating state* of the *power system*;~~

~~(3) to prevent uncontrolled separation of the *transmission and distribution network* into isolated *regions* or partly combined *regions*, *intra-regional transmission* break-up, or *cascading outages*, following any *power system* incident; and~~

~~(4) in accordance with the technical requirements of their *access contract*~~

~~(e) *Users* shall arrange sufficient *black start-up* provisions so as to allow the restoration and any necessary restarting of their *generating units* following a *black system* condition.~~

~~5.2.5 Time for Undertaking Action~~

~~An event which is required under Section 5 of the *Rules* to occur on or by a stipulated *day* must occur on or by that *day* whether or not a *business day*.~~

5.3 *POWER SYSTEM* OPERATION CO-ORDINATION ~~*SECURITY*~~ RESPONSIBILITIES AND OBLIGATIONS

5.3.1 Responsibility of *Western Power* for Operation Co-ordination of the *Power System* ~~*Security*~~

The *Western Power power system security responsibilities* are:

~~(a) to maintain *power system security*;~~

(b) to take reasonable steps to coordinate ~~ensure that~~ *high voltage* switching procedures and arrangements that are utilised by *Users* to provide adequate *protection* of the *power system*;

~~(c) to assess potential infringement of the *technical envelope* or *power system operating procedures* which could affect the security of the *power system*;~~

~~(d) to operate the *power system* within the limits of the *technical envelope*;~~

(e) to operate all *plant* and equipment under its control or co-ordination within the appropriate operational or emergency limits which are either established by *Western Power* or advised by the respective *Users*;

(f) to assess the impacts of any technical and operational *constraints* on the operation of the *power system*;

~~(g) to monitor the *dispatch* of *generating units* and *associated loads* to ensure they stay within both their allowable limits and the dynamic limits of the *technical envelope*;~~

~~(h) to determine any potential *constraint* on the *operation* of *generating units* and *loads* and to assess the effect of this *constraint* on the maintenance of *power system security*;~~

~~(i) to assess the availability and adequacy, including the dynamic response, of *contingency capacity reserves* and *reactive power reserves* in accordance with Section 2 of these Rules and to take reasonable steps to ensure that appropriate levels of *contingency capacity reserves* and *reactive power reserves* are available:~~

~~(1) to ensure the *power system* is, and is maintained, in a *satisfactory operating state*; and~~

~~(2) to arrest the impacts of a range of significant multiple *contingency events* (affecting up to 90% of the total *power system load*) to allow a prompt restoration or recovery of *power system security* , taking into account under-*frequency or under voltage* initiated *load shedding* capability provided under *access contracts* or as otherwise;~~

~~(j) to make available to *Users* as appropriate, information about the potential for, or the occurrence of, a situation which could significantly impact, or is significantly impacting on *power system security*.~~

~~(k) to refer to other *Users*, as *Western Power* deems appropriate, information of which *Western Power* becomes aware in relation to significant risks to the *power system* where actions to achieve a resolution of those risks are outside the responsibility or control of *Western Power*;~~

~~(l) to utilise resources and services provided or procured as *ancillary services* or otherwise to maintain or restore the *satisfactory operating state* of the *power system;*~~

~~(m) to co-ordinate the operation of *black start-up facilities* in response to a partial or total *black system* condition sufficient to re-establish a *satisfactory operating state* of the *power system*;~~

(n) to interrupt, subject to clause 5.3.2, *User connections* as necessary during emergency situations to facilitate the re-establishment of the *satisfactory operating state* of the *power system*;

~~(o) to direct (as necessary) any *User* to take action necessary to ensure, maintain or restore the *power system* to a *satisfactory operating state*;~~

(p) to co-ordinate and direct any rotation of widespread interruption of demand in the event of a major *supply* shortfall or disruption;

(q) ~~to determine the extent to which the levels of *contingency capacity reserves* and *reactive power reserves* are or were appropriate through appropriate testing, auditing and simulation studies;~~

(r) to investigate and review all major transmission *network power system* operational incidents and to initiate action plans to manage any abnormal situations or significant deficiencies which could reasonably threaten *power system security*. All *User's* shall co-operate with such action plans. Such situations or deficiencies include without limitation:

(1) *power system frequencies* outside those specified in the definition of *satisfactory operating state*;

(2) *power system voltages* outside those specified in the definition of *satisfactory operating state*;

(3) actual or potential *power system* instability; and

(4) unplanned/unexpected operation of major *power system* equipment.

5.3.2 *Western Power*'s Obligations

(a) *Western Power* must use its reasonable endeavours, as permitted under the *Access Code*, including through the provision of appropriate information to *Users* to the extent permitted by law and under these Rules, to achieve the *Western Power power system* safety and *operation co-ordination* ~~*security*~~ *responsibilities* in accordance with ~~*power system security* principles and~~ *good electricity industry practice*.

(b) Where an obligation is imposed on *Western Power* under this Section of the *Rules* to arrange or control any act, matter or thing or to ensure that any other person undertakes or refrains from any act, that obligation is limited to a requirement for *Western Power* to use reasonable endeavours as permitted under the *Access Code*, including to give such *directions* as are within its powers, to comply with that obligation.

(c) If *Western Power* fails to arrange or control any act, matter or thing or the acts of any other person notwithstanding the use of *Western Power's* reasonable endeavours, *Western Power* will not be taken to have breached such obligation.

(d) *Western Power* must make accessible to *Users* such information as:

(1) *Western Power* considers appropriate;

(2) *Western Power* is permitted to disclose in order to assist *Users* to make appropriate market decisions related to open access *to Western Power's transmission* and *distribution networks*; and

~~(3) *Western Power* is able to disclose to enable *Users* to consider initiating procedures to manage the potential risk of any necessary action by *Western Power* to restore or maintain *power system security*,~~

~~provided~~ that, in doing so, *Western Power* must use reasonable endeavours to ensure that such information is available to those *Users* who request the information on an equivalent basis.

In the event that *Western Power*, in its reasonable opinion for reasons of safety to the public, *Western Power* personnel, *Users*' equipment or *Western Power* equipment ~~or for *power system security*~~, needs to interrupt supply to any *User* of the transmission system, *Western Power* will (time permitting) consult with the relevant *User* prior to executing that interruption. At the distribution system level, the consultations are generally impractical because of the large number of customers.

If the network is operating outside the permissible limits, *Users* may be disconnected.

Western Power must arrange controls, monitoring and secure communication systems which are appropriate in the circumstances to facilitate a manually initiated, rotational *load shedding* and restoration process which may be necessary if there is, in *Western Power's* *reasonable* opinion, a prolonged major *power system* disruption.

5.3.3 *User* Obligations

(a) Users must ensure that appropriately qualified and competent persons undertake distribution and transmission network operations performed on their behalf.

(b) All *Users* must co-operate with and assist *Western Power* in the proper discharge of the *Western Power power system* operation co-ordination ~~*security*~~ *responsibilities*.

(c) All *Users* must operate their *facilities* and equipment in accordance with any reasonable *direction* given by *Western Power*.

(d) ~~All~~ *Users* which are not supplied from feeders included in *Western Power*'s under frequency load shedding scheme must provide automatic *interruptible load* in accordance with clause 2.4.

(e) *User*~~'~~*s* which are not supplied from feeders included in *Western Power*'s under frequency load shedding scheme must provide their *interruptible load* in manageable blocks spread over a number of steps within under-*frequency* bands from 49.0 Hz down to 47.0 Hz as nominated by *Western Power*.

5.4 *POWER SYSTEM* FREQUENCY CONTROL

~~5.4.1 *Power System* Frequency Control Responsibilities~~

~~*Western Power* must use its reasonable endeavours to:~~

~~(a) control the *power system frequency* and associated time error; and~~

~~(b) ensure that the *power system frequency operating standards* set out in these *Rules* are achieved.~~

5.4.~~2~~1 Operational Frequency Control Requirements

To assist in the effective monitoring of *power system frequency* by *Western Power* the following provisions apply:

~~(a) The power to control and direct the output of all *generating units* and supply to *loads* is given to *Western Power* pursuant to clause 5.9.~~

(b) Each *User* must ensure that all of its *generating units* have automatic and responsive turbine speed control *systems* ~~and automatic *load* control schemes~~ in accordance with the requirements of clause 3.2, so as to automatically adjust for *changes* ~~in associated *power* demand or loss of *generation*~~ as they ~~it~~ occurs through response to the resulting excursion in *power system frequency* ~~and *associated load*~~.

~~(c) *Western Power* must use its reasonable endeavours to arrange to be available and specifically allocated to *regulating duty* such *generating plant* as *Western Power* considers appropriate which can be automatically controlled or directed by *Western Power* to ensure that normal *load* variations do not result in *frequency* deviations outside the limitations specified in clause 5.2.1(a).~~

~~(d) *Western Power* must use its reasonable endeavours to arrange *ancillary services* and contractual arrangements associated with the availability, responsiveness and control of necessary *contingency capacity reserve* and the rapid un*loading* of *generation* as may be reasonably necessary to cater for the impact on the *power system frequency* of potential *power system* disruptions ranging from the *critical single credible contingency event* to the most serious *contingency events*.~~

~~(e) *Western Power* must use its reasonable endeavours to ensure that adequate *facilities* are available and are under the *direction* of *Western Power* to allow the managed recovery of the *satisfactory operating state* of the *power system*.~~

5.5 CONTROL OF *NETWORK VOLTAGES*

5.5.1 *Transmission and Distribution Network Voltage* Control

(a) *Western Power* must determine the adequacy of the capacity to produce or absorb *reactive power* in the control of the *transmission and distribution network voltages*.

(b) *Western Power* must assess and determine the limits of the operation of the *transmission and distribution network* associated with the avoidance of *voltage* failure or collapse under *credible contingency event* scenarios.

(c) The determination referred to in clause 5.5.1(b) must include a review of the voltage stability of the *transmission network*.

(d) The limits of operation of the *transmission network* must be translated by *Western Power,* into key location operational *voltage* settings or limits, *transmission line* capacity limits, *reactive power* production (or absorption) capacity or other appropriate limits to enable their use by *Western Power* in the maintenance of *power system security*.

(e) *Western Power* must use its reasonable endeavours to maintain *voltage* conditions throughout the *transmission and distribution network* in accordance with the technical requirements specified in Section 2.

(f) *Western Power* must use its reasonable endeavours to arrange the provision of *reactive power facilities* and *power system voltage* stabilising *facilities* through:

(1) contractual arrangements for *ancillary services* with appropriate *Users*;

(2) obligations on the part of *Users;* or under their *access contracts*;

(3) provision of such *facilities* by *Western Power*.

(g) Without limitation, such *reactive power facilities* may include:

(1) *synchronous generator voltage controls* usually associated with *tap-changing transformers*; or *generator* AVR setpoint control (rotor current adjustment);

(2) *synchronous condensers* (compensators);

(3) *static VAR compensators* (SVC);

(4) *static synchronous compensators* (STATCOM);

(5) *shunt capacitors*;

(6) *shunt reactors*;

(7) series capacitors.

5.5.2 Reactive Power Reserve Requirements

(a) *Western Power* must use its reasonable endeavours to ensure that sufficient *reactive power reserve* is available at all times to maintain or restore the *power system* to a *satisfactory operating state* after the most *critical contingency event* as determined by previous analysis or by periodic contingency analysis by *Western Power*.

~~(b) If *voltages* are outside acceptable limits, and the means of *voltage* control set out in this clause 5.5 are exhausted, *Western Power* must take all reasonable actions, including to direct *changes* to demand (through selective *load shedding* from the *power system*), additional *generation* operation or reduction in the *transmission/distribution line* flows but only to the extent necessary to restore the *voltages* to within the relevant limits. A *User* must comply with any such *direction*.~~

5.5.3 Audit and Testing

Western Power must arrange, co-ordinate and supervise the conduct of appropriate tests to assess the availability and adequacy of the provision of *reactive power* devices to control and maintain *power system voltages* ~~under both *satisfactory operating state* and *contingency event* conditions~~.

5.6 *PROTECTION* OF *POWER SYSTEM* EQUIPMENT

5.6.1 *Power System* Fault Levels

(a) *Western Power* must determine the fault levels at all *busbars* of the *Western Power transmission network* as described in clause 5.6.1(b)*;*

(b) *Western Power* must ensure that there is public information available about the *transmission* and *distribution network* which will allow the determination of fault levels for normal operation of the *power system. Western Power* will make available on request the *credible contingency events* which *Western Power* considers may affect the configuration of the *power system* so that *Western Power* and *Users* can identify their *busbars* which could potentially be exposed to a fault level which exceeds the fault current ratings of the circuit breakers and other equipment associated with that *busbar*.

5.6.2 *Power System Protection* Co-ordination

Western Power must use its reasonable endeavours to co-ordinate the *protection* settings for equipment connected to the *transmission and distribution network*. *Users* with *protection* systems that impact *power system security* and *reliability* must ensure their settings co-ordinate with *Western Power*'s *protection*. Such *Users* must provide their protection data to *Western Power*. Such *Users* may not adjust settings without *Western Power*'s approval. Specific requirements are described in clauses 3.4.2.15 and 4.2.3.

5.6.3 Audit and Testing

Western Power must use its reasonable endeavours to co-ordinate such inspections and tests as *Western Power* thinks appropriate to ensure that the *protection* of the *transmission* and *distribution network* is adequate to protect against damage to *power system plant* and equipment. Such tests must be performed according to the requirements of clause 4.1.

5.6.4 Short-Term Thermal Ratings of *Power System*

(a) *Western Power* may act so as to use, or require or recommend actions which use the full extent of the thermal ratings of *transmission* and *distribution elements* to maintain *power system security*, including the short-term ratings (being time dependent ratings), as defined by *Western Power* from time to time.

(b) *Western Power* must use its reasonable endeavours not to exceed the *transmission* and *distribution element* ratings and not to require or recommend action which causes those ratings to be exceeded.

5.6.5 Partial *Outage* of Power *Protection* Systems

(a) Where there is an *outage* of one *protection* of a *transmission element*, *Western Power* must determine, the most appropriate action. Depending on the circumstances the determination may be:

(1) to leave the *transmission element* in service for a limited duration;

(2) to take the *transmission element* out of service immediately;

(3) to install or direct installation of a temporary *protection*;

(4) to accept a degraded performance from the *protection*, with or without additional operational measures or temporary *protection* measures to minimise *power system* impact; or

(5) to operate the *transmission element* at a lower capacity.

(b) If there is an *outage* of both *protections* on a *transmission element* and *Western Power* determines this to be an unacceptable risk to *power system security*, *Western Power* must take the *transmission element* out of service as soon as possible and advise any affected *Users* immediately this action is undertaken.

(c) Any affected *User* must accept a determination made by *Western Power* under this clause 5.6.5.

5.7 *POWER SYSTEM* STABILITY CO-ORDINATION

5.7.1 Stability Analysis Co-ordination

(a) *Western Power* must use its reasonable endeavours to ensure that all necessary calculations associated with the stable operation of the *power system* as described in clause 2.3 and for the determination of settings of equipment used to maintain that stability are carried out and to co-ordinate these calculations and determinations.

(b) *Western Power* must facilitate establishment of the parameters and endorse the installation of *power system* devices which are approved by *Western Power* to be necessary to assist the stable operation of the *power system* .

5.7.2 Audit and Testing

Western Power must arrange, co-ordinate and supervise the conduct of such inspections and tests as it deems appropriate to assess the availability and adequacy of the devices installed to maintain *power system* stability.

5.8 POWER SYSTEM SECURITY OPERATIONS

5.8.1 *Users*' Advice

A *User* must promptly advise *Western Power* at the time that the *User* becomes aware of any circumstance which could be expected to adversely affect the secure operation of the *power system* or any equipment owned or under the control of the *User*.

5.8.2 *Protection* or Control System Abnormality

(a) If a *User* becomes aware that any relevant *protection* or *control system* is defective or unavailable for service, that *User* must advise *Western Power*. If *Western Power* considers it to be a threat to *power system security*, *Western Power* may direct that the equipment protected or operated by the relevant *protection* or *control system* be taken out of operation or operated as *Western Power* directs.

(b) A *User* must comply with a *direction* given by *Western Power* under clause 5.8.3(a).

~~5.8.3 *Western Power's* Advice on *Power System* Emergency Conditions~~

~~(a) *Western Power* must advise affected or potentially affected *Users* of all relevant details promptly after *Western Power* becomes aware of any circumstance with respect to the *power system* which, in the reasonable opinion of *Western Power*, could be expected to materially adversely affect *supply* to or from *Users*.~~

~~(b) Without limitation, such circumstances may include:~~

~~(1) electricity capacity shortfall, being a condition where there is insufficient *generation* or *supply* options available to enable the secure *supply* of the total *load* in a *region*;~~

~~(2) unexpected disruption of *power system security*, which may occur when:~~

~~(i) an unanticipated major *power system contingency event* occurs; or~~

~~(ii) significant environmental or similar conditions, including weather, storms or fires, are likely to, or are affecting the *power system*; or~~

~~(3) *black system* condition.~~

~~5.8.4 Managing a *Power System* Contingency Event~~

~~(a) During the period when the *power system* is affected by a *contingency event Western Power* must carry out actions, in accordance with the guidelines set out in these *Rules*:~~

~~(1) identify the impact of the *contingency event* on *power system security* in terms of the capability of the *transmission network*;~~

~~(2) identify and implement the actions required in each affected *region* to restore the *power system* to its *satisfactory operating state*.~~

~~(b) When *contingency events* lead to potential or actual electricity *supply* shortfall events, *Western Power* must follow the procedures outlined in clause 5.8.~~

5.8.~~5~~3 Managing Electricity Supply Shortfall Events

(a) If, at any time, there are insufficient *transmission or distribution supply* options available to securely *supply* total *load* in a *region*, then, *Western Power* may undertake all or any of the following:

(1) recall of *transmission* and *distribution* equipment *outages*;

(2) *disconnect* one or more points of *load connection* as *Western Power* considers necessary;

(3) direct a *User* to take such steps as are reasonable to immediately reduce its *load*. Any temporary *load* reduction shall be such that preference in supply is given where necessary, to domestic customers, then commercial customers and finally industrial customers.

(b) A *User* must use all reasonable endeavours to comply with a notice given under clause 5.8.5 (a)(3).

(c) If there is a major *supply* shortfall, *Western Power* must implement, to the extent practicable, a sharing of *load shedding* across *interconnected regions* up to the *power transfer capability* of the *network*.

~~5.8.6 *Directions* by *Western Power* Affecting *Power System Security*~~

~~(NOTE: This clause is in accordance with previous regulation 30 of the Transmission *Regulations and previous regulation 32 of the Distribution Regulations, and is unclear where these powers reside in the new legislative framework This note to be deleted in the final document.)*~~

~~Subject to *Western Power* giving a *User* a reasonable period of time to take appropriate action:~~

~~(a) *Western Power* may give reasonable *directions* to any *User*:~~

~~(1) requiring the *User* to do any act or thing which *Western Power* considers reasonably necessary to ensure, to maintain or re-establish the *power system* in a *satisfactory operating state*, including but not limited to:~~

~~(i) establish or remove a connection;~~

~~(ii) disconnect a connection;~~

~~(iii) switch off a generator;~~

~~(iv) call plant or equipment into service;~~

~~(v) commence operation od any plant or equipment or maintain, increase or reduce generation or absorption of active or reactive power output by any plant or equipment;~~

~~(vi) shut down or vary operation of any plant or equipment;~~

~~(vii) shed or restore load, or;~~

~~(viii) do any other act or thing necessary to be done;~~

~~or~~

~~(2) for or with respect to, reasonable standards and procedures to be observed by the *User*:~~

~~(i) to achieve *power system security* in any region or, where there may be risk to equipment forming part of the *power system*,~~

~~security of equipment, any other person; or~~

~~(ii) to maintain *voltage* levels or *reactive power reserves* through the part of the *power system* in a *region*~~

~~(3) A direction under subclauses (1) or (2) must specify the period within which the direction must be complied with and for how long the direction must be complied with.~~

~~(4) A direction under subclauses (1) or (2) must be recorded by Western Power~~

~~(5) If a person (in this document called the "first person") is directed to do something under subclauses (1) or (2) but does not comply with the direction, then *Western Power* may authorise a *Western Power* employee or another person to carry out that direction and the first person must do all such things as the first person is requested by the authorised person to do in order to assist the authorised person to carry out that direction.~~

~~(b) A *User* must use all reasonable endeavours to comply within a reasonable period of time with any such *directions* given to it by *Western Power*. If a *User* does not comply with a *direction* within a reasonable period of time and as such a *satisfactory operating state* cannot be re-established, *Western Power* may *disconnect* the *User* without further recourse.~~

5.8.~~7~~4 *Disconnection* of Generating Units and/or ~~*Associated*~~ *Load*s

(a) Where, under the *Access Code* or these Rules, *Western Power* has the authority or responsibility to *disconnect* either a *generating unit* or ~~its *associated*~~ *load*, then it may do so (either directly or through any agent) as described in clause 4.3.

(b) The relevant *User* ~~*and associated load*~~ must provide all reasonable assistance to *Western Power* for the purpose of such *disconnection*.

~~5.8.8 Emergency Black Start-up *Facilities*~~

~~*Users, other than non-dispatchable generators, such as wind generators,* must ensure they have sufficient *facilities* available and operable, or make alternative arrangements, for their own black start-up requirements.~~

~~5.8.9 Local Black System Procedures~~

~~(a) *User, other than non-dispatchable generators,* must develop the draft *black system procedures* for each of its *power stations* and must submit those procedures for approval by *Western Power*.~~

~~(b) *Western Power* may request amendments to a *User*'s draft *black system procedures* or any proposed changes as *Western Power* reasonably considers necessary by notice in writing to the *User*, where use is to be made of the *transmission network*.~~

~~(c) If *Western Power* and a *User* are unable to agree on the amendments, the matter may be dealt with under the Dispute Resolution Section of the *Access Code (Chapter 10* and *Appendix 5)*.~~

~~5.8.10 Black System Start-up~~

~~(a) *Western Power* must advise a *User* if, in *Western Power*'s reasonable opinion, there is a *black system* condition which is affecting, or which may affect, that *User*.~~

~~(b) If a *User* is providing *black start-up facilities* under an *agreement* with another *User*, then the *local black system procedures* for that *User* must be consistent with these *Rules* and their *access contracts*.~~

~~(c) *Western Power* may by notice in writing to the relevant *User* require such amendments to the *local black system procedures* for a *User* which, in its reasonable opinion, are needed for consistency with:~~

~~(1) actual *power system* requirements; or~~

~~(2) if the *User* is providing *black start-up facilities* to another *User* under an *agreement*, the relevant connection *contract or Access Code*.~~

~~(d) If *Western Power* advises a *User* of a *black system* condition, and/or if the terms of the relevant *local black system procedures* require the *User* to take action, then the *User* must comply with the agreed requirements of the *local black system procedures*.~~

~~(e) If there is a *black system* condition, then a *User/Customer* must comply with *Western Power's* instructions with respect to the timing and magnitude of *load* restoration, as well as subsequent *load* movements or *disconnections*.~~

5.8.~~11~~5 Review of Operating Incidents

(a) *Western Power* may ~~must~~ conduct reviews of significant operating incidents or deviations from normal operating conditions in order to assess the adequacy of the provision and response of *facilities* or services~~, and the appropriateness of actions taken to restore or maintain *power system security*~~.

(b) For all cases where *Western Power* has been responsible for the *disconnection* of a transmission *User*, a report of the review carried out must be provided by *Western Power* to the *User* advising of the circumstances requiring that action. This generally does not apply to distribution system, due to the large number of customers.

(c) A *User* must co-operate in any such review conducted by *Western Power* (including making available relevant records and information).

(d) A *User* must provide to *Western Power* such information relating to the performance of its equipment during and after particular *power system* incidents or operating condition deviations as *Western Power* reasonably requires for the purposes of analysing or reporting on those *power system* incidents or operating condition deviations.

(e) *Western Power* must provide to a *User* such information or reports relating to the performance of that *User's* equipment during *power system* incidents or operating condition deviations as that *User* reasonably requests and in relation to which *Western Power* is required to conduct a review under this clause.

5.9 ~~*POWER SYSTEM SECURITY* RELATED MARKET~~ OPERATIONS, MAINTENANCE AND EXTENSION PLANNING

~~5.9.1 Dispatch Related Limitations on Generators~~

~~A *Scheduled Generator* must not, unless in the *Scheduled Generator's* reasonable opinion public safety would otherwise be threatened or there would be a material risk of damaging equipment or the environment:~~

~~(a) *dispatch* any *energy* from a *scheduled generating unit*, except:~~
- ~~(1) in accordance with the procedures specified in these *Rules* and its Technical Requirements for connection; or~~
- ~~(2) in accordance with an instruction from *Western Power*; or~~
- ~~(3) as a consequence of operation of the *generating unit's* automatic *load* following scheme approved by *Western Power*; or~~
- ~~(4) in accordance with a procedure agreed with *Western Power*; or~~
- ~~(5) in connection with a test conducted in accordance with the requirements of these *Rules* or a procedure agreed with by *Western Power*;~~

~~(b) adjust the *transformer tap position* or *excitation control system voltage* set-point of a *scheduled generating unit* except:~~
- ~~(1) in accordance with an instruction from or by agreement with *Western Power*; or~~
- ~~(2) in response to remote control signals given by *Western Power* or its agent; or~~
- ~~(3) if, in the scheduled *generator's* reasonable opinion, the adjustment is urgently required to prevent material damage to the *scheduled generator's plant* or associated equipment, or in the interests of safety; or~~
- ~~(4) in connection with a test agreed with *Western Power* and conducted in accordance with these *Rules* or procedures agreed with *Western Power*.~~

~~(c) *energise* a *connection point* in relation to a *scheduled generating unit* without prior approval from *Western Power*. This approval must be obtained immediately prior to *energisation*;~~

~~(d) *synchronise* a *scheduled generating unit* to, or *de-synchronise* a *scheduled generating unit* from, the *power system* without prior approval from *Western Power* except *de-synchronisation* as a consequence of the operation of automatic *protection* equipment or where such action is urgently required to prevent material damage to *plant* or equipment or in the interests of safety;~~

~~(e) change the *frequency response mode* of a *scheduled generating unit* without the prior approval of *Western Power*; or~~

~~(f) remove from service or interfere with the operation of any *power system* stabilising equipment installed on that *generating unit*.~~

~~5.9.2 Commitment of Generating Units~~

~~In relation to any *User's generating unit*, the *User* must confirm with *Western Power*, the expected *synchronising* time at least one hour before the expected actual *synchronising* time, and update this advice 5 minutes before *synchronising* unless otherwise agreed with *Western Power*. *Western Power* may require further notification immediately before *synchronisation*.~~

~~5.9.3 De-commitment or Output Reduction by Generators~~

~~(a) Any *Scheduled Generator* intending to reduce output or de-commit own generation must notify *Western Power* well in advance. To do this a *User* will have to both apply for it and include it in the *outage* and production plans they submit to *Western Power* in accordance with clause A3.56 of the *Access Code, as is outlined in* clause 5.9.5 here.~~

~~(b) A *scheduled generator* must confirm with *Western Power* the expected *de-synchronising* time at least one hour before the expected actual *de-synchronising* time, and update this advice 5 minutes before *de-synchronising* unless otherwise agreed with *Western Power*. *Western Power* may require further notification immediately before *de-synchronisation*.~~

~~(c) Information to be confirmed with *Western Power* to *de-commit* a *generating unit* if there is to be no automatic and coincident reduction in the *User's associated load* must include:~~
~~(1) the time to commence decreasing the output of the *generating unit*;~~
~~(2) the *ramp rate* to decrease the output of the *generating unit*;~~
~~(3) the time to *de-synchronise* the *generating unit*; and~~
~~(4) the output from which the *generating unit* is to be *de-synchronised*.~~

~~(d) Any *User* who wishes to take a *generator* out-of-service must first reduce the *associated load* demand by an amount equal to the *generator* output to be reduced. Once the demand has been reduced, the *generator*'s *load* may be reduced. Clearance must be obtained from *Western Power* before commencing this exercise.~~

~~5.9.4 Generation *Plant* Changes~~

~~A *User* must, without delay, notify *Western Power* of any event which has changed or is likely to change the operational availability or *load* following capability of any of its *generating units*, whether the relevant *generating unit* is *synchronised* or not, as soon as the *User* becomes aware of the event.~~

5.9.5 Operation, Maintenance and Extension Planning

In accordance with clause A3.56 of the *Access Code* for coordination purposes, operation, maintenance and extension planning and co-ordination shall be performed as follows:

(1) On or before 1 July and 1 January each year, each user must provide to *Western Power*:

(a) a maintenance schedule in respect of the plant and equipment connected at each of its connections for the following financial year; and

(b) a non-binding indicative planned maintenance plan in respect of the plant and equipment connected at each of its connections for each of the 2 financial years following the financial year to which the maintenance schedule provided under paragraph (a) relates.

(2) A User must provide *Western Power* with any information that *Western Power* reasonably requests considering maintenance of plant and equipment connected at the User's connections.

(3) A User must ensure that a maintenance schedule provided by the User under clause (1) is complied with, unless otherwise agreed with *Western Power*.

(4) A maintenance schedule or a maintenance plan must:

(a) specify the dates and duration of planned outages for the relevant plant or equipment which may have an impact on the electricity transmission network;

(b) specify the work to be carried out during each such an outage;

(c) be in writing in substantially the form requested by *Western Power*; and

(d) be consistent with good electricity industry practice.

(5) If a User becomes aware that a maintenance plan provided by the User under subclause (1) in respect of one of its connections will not be complied with, then the User must promptly notify *Western Power*.

5.10 *POWER SYSTEM* OPERATING PROCEDURES

~~**5.10.1 *Power System* Operating Procedures**~~

~~The *power system operating procedures* are:~~

~~(1) any instructions which may be issued by *Western Power* from time to time relating to the operation of the *power system*; and~~

~~(2) any guidelines issued from time to time by *Western Power* in relation to *power system security*.~~

5.10.~~2~~1 *Transmission and Distribution Network* Operations

(a) *Western Power* must conduct or direct operations on the *transmission and distribution network* in accordance with the appropriate *power system operating procedures and good electricity industry practice*.

(b) A *User* must observe the requirements of the relevant *power system operating procedures*.

(c) *Users* must operate their equipment interfacing with the *transmission and distribution network* in accordance with the requirements of the *Access Code*, these *Rules*, any applicable *access contract*, *agreement,* and *Western Power*'s Electrical Safety Instructions and procedures.

(d) *Users* must ensure that *transmission distribution network* operations performed on their behalf are undertaken by competent persons.

5.10.~~3~~2 Switching of Reactive Power *Facilities*

(a) *Western Power* may instruct a *User* to place reactive *facilities* belonging to or controlled by that *User* into or out of service for the purposes of maintaining *power* *system security* where prior arrangements concerning these matters have been made between *Western Power* and a *User*.

(b) Without limitation to its obligations under such prior arrangements, a *User* must use reasonable endeavours to comply with such an instruction given by *Western Power* or its authorised agent.

5.11 *POWER SYSTEM SECURITY* SUPPORT

5.11.1 Remote Control and Monitoring Devices

(a) All remote control, operational *metering* and monitoring devices and local circuits as described in Section 3, must be installed and maintained by a *User* in accordance with the standards and protocols determined and advised by *Western Power* (for use in the *Western Power control centre*) for each:

(1) *generating unit* and *associated load connected* to the *transmission or distribution network*;

(2) *substation connected* to the *network*; and

(3) *ancillary service* provided by that *User*.

(b) The provider of any *ancillary services* must arrange the installation and maintenance of all *remote control equipment* and *remote monitoring equipment* in accordance with the standards and protocols determined by *Western Power* for use in the *Western Power control centre*.

(c) The controls and monitoring devices must include the provision for indication of *active power* and *reactive power* output, and to signal the status and any associated alarm condition relevant to achieving adequate *protection* control and indication of the *transmission network*, and the *User's plant* active and reactive output consumption.

5.11.2 Operational Control and Indication Communication *Facilities*

(a) In accordance with clauses 3.2.5.1, 3.2.5.2, 3.3.8.1 and 3.3.8.2, as applicable, each *User* must provide and maintain the necessary primary and, where nominated by *Western Power*, back-up communications *facilities* for control, operational *metering* and indication from the relevant local sites to the appropriate interfacing termination as nominated by *Western Power*.

5.11.3 *Power System* Voice/Data Operational Communication *Facilities*

(a) *Users* must advise *Western Power* of each nominated position for the purposes of giving or receiving *operational communications* in relation to each of its *facilities*. The position so nominated must be that responsible for undertaking the operation of the relevant equipment of the relevant *User*.

(b) Contact personnel details which must be forwarded to *Western Power* include:

(1) title of contact position;

(2) the telephone numbers of that position;

(3) the telephone numbers of other available communication systems in relation to the relevant *facility*;

(4) a facsimile number for the relevant *facility*; and

(5) an electronic mail address for the relevant *facility*.

(c) Each *User* must provide, for each nominated position, two independent telephone communication systems fully compatible with the equipment installed at the appropriate *control centre* nominated by *Western Power*.

(d) Each *User* must maintain both telephone communication systems in good repair and must investigate faults within 4 hours, or as otherwise agreed with *Western Power*, of a fault being identified and must repair or procure the repair of faults promptly.

(e) Each *User* must establish and maintain a form of electronic mail facility as approved by *Western Power* for communication purposes (such approval may not be unreasonably withheld).

(f) *Western Power* must advise all *Users* of nominated persons for the purposes of giving or receiving *operational communications*.

(g) Contact personnel details to be provided by *Western Power* include title, telephone numbers, a facsimile number and an electronic mail address for the contact person.

5.11.4 Records of *Power System* Operational Communication

(a) *Western Power* and *Users* must record each telephone *operational communication* in the form of log book entries or by another auditable method which provides a permanent record as soon as practicable after making or receiving the *operational communication*.

(b) Records of *operational communications* must include the time and content of each communication and must identify the parties to each communication.

(c) Voice recordings of telephone *operational communications* may be undertaken by *Western Power* and *Users*. *Western Power* and the *User* must ensure that when a telephone conversation is being recorded under this clause, the persons having the conversation receive an audible indication that the conversation is being recorded in accordance with relevant statutory requirements. Voice recordings may be used as an alternative to written logs.

(d) *Western Power* and *Users* must retain all *operational communications* records including voice recordings for a minimum of 7 years.

(e) In the event of a dispute involving an *operational communication*, the records of that *operational communication* maintained by, or on behalf of *Western Power* will constitute prima facie evidence of the contents of the *operational communication*.

5.11.5 Agent Communications

(a) A *User* may appoint an agent (called a "*User Agent*") to coordinate operations of one or more of its *facilities* on its behalf, but only with the prior written consent of *Western Power*.

(b) A *User* which has appointed a *User Agent* may replace that *User Agent* but only with the prior written advice to *Western Power*.

(c) *Western Power* may only withhold its consent to the appointment of a *User Agent* under clause 5.11.5(a), if it reasonably believes that the relevant person is not suitably qualified or experienced to operate the relevant *facility* at the interface with a *transmission or distribution network.*

(d) For the purposes of the *Access Code* and these *Rules*, acts or omissions of a *User Agent* are deemed to be acts or omissions of the relevant *User*.

(e) *Western Power* and its *representatives* (including authorised agents) may:

(1) rely upon any communications given by a *User Agent* as being given by the relevant *User*; and

(2) rely upon any communications given to a *User Agent* as having been given to the relevant *User*.

(f) *Western Power* is not required to consider whether any instruction has been given to a *User Agent* by the relevant *User* or the terms of those instructions.

5.12 NOMENCLATURE STANDARDS

(a) A *User* must use the *nomenclature standards* for *transmission* and *distribution* equipment and apparatus as agreed with *Western Power* or failing agreement, as determined by *Western Power*.

(b) A *User* must use reasonable endeavours to ensure that its *representatives* comply with the *nomenclature standards* in any *operational communications* with *Western Power*.

(c) A *User* must ensure that name plates on its equipment relevant to operations at any point within the *power system* conform to the requirements set out in the *nomenclature standards*.

(d) A *User* must use reasonable endeavours to ensure that nameplates on its equipment relevant to operations within the *power system* are maintained to ensure easy and accurate identification of equipment.

(e) A *User* must ensure that technical drawings and documentation provided to *Western Power* comply with the *nomenclature standards*.

(f) *Western Power* may, by notice in writing, request a User to change the existing numbering or nomenclature of transmission and distribution equipment and apparatus of the User for purposes of uniformity, and the User must comply with such request provided that if the existing numbering or nomenclature conforms with the nomenclature standards.

5.13 *OBLIGATION TO FOLLOW WESTERN POWER'S DIRECTIONS*

5.13.1 Purpose of Directions

In order to maintain power system security and perform other tasks under these *Rules* it may be necessary, from time to tome, for *Western Power* to issue directions regarding the action and conduct of *Users* and others.

5.13.2 Application of Directions

Without limitation, *Users* and others may be required to follow directions under the following clauses of these *Rules*:

5.1.1(a)(2)

5.3.1 (o)
(p)

5.3.2 (b)

5.3.3 (c)

5.4.2 (a)
(c)
(e)

5.5.2(b)

5.6.5(a)(3)

5.8.2 (a)
(b)

5.8.5(a)(3)

5.8.6 (a)

(a)(3)

(a)(4)

(a)(5)

5.13.3 Power to Issue Directions

For the avoidance of doubt, Clause 5.13.1 does not create a separate head of power to issue directions.

6. DEROGATIONS

6.1 PURPOSE AND APPLICATION

(a) This Section prevails over all other Sections of these *Rules*.

(b) *Derogations* of *Users* are:

(1) those provisions of the other Sections of the *Rules* which shall not apply either in whole or part to particular *Users* or potential *Users* or others in relation to their *facilities* for a fixed or indeterminate period;

(2) any provisions which substitute for those provisions which are not to apply; and

(3) applicable only to that particular *User* or potential *User*.

(c) *Derogations* are for the purpose of:

(1) enabling *Users* to effect an orderly transition to the provisions of the *Rules* from those provisions currently applying;

(2) providing specific exemptions from the *Rules* for pre-existing arrangements *which Western Power* determines must continue beyond a specific transition period; and

(3) providing specific exemptions from the *Rules* for future arrangements which *Western Power* determines to be acceptable.

(d) Applications for *derogations* must be submitted to and processed by *Western Power* in accordance with clauses 12.33 to 12.39 of the *Access Code*.

6.2 TRANSMISSION AND DISTRIBUTION NETWORKS AND FACILITIES EXISTING AT DD MONTH 2006

All *plant* and equipment in the *South West Interconnected System*, and all *facilities* connected to these *networks* existing at **DD MONTH 2006** are deemed to comply with the requirements of these *Rules*. If at any time it is found that an installation is adversely affecting *power system security*, *reliability* of the *power system* and/or the *quality of supply*, the relevant *User* shall be responsible for remedying the problem.

ATTACHMENT 1

GLOSSARY

In these *Rules*, unless the contrary intention appears:

(a) a word or phrase set out in column 1 of the table below has the meaning set out opposite that word or phrase in column 2 of the table below; and

(b) a word or phrase defined in the Electricity Industry Act 2004 ("*Act*") and Electricity Networks Access Code 2004 ("*Access Code*") has the meaning given in that *Act* or that *Code* (as the case requires), unless redefined in the table below.

Abnormal Plant Conditions	Are, for the purpose of clause 2.10 and 3.4, those that prevail at a particular location in the *power system* with the least number of *generators* normally connected at times of minimum generation, plus one worse case generator outage, in combination with up to either two *primary plant outages* or one *primary plant outage* and one secondary plant outage. The *primary plant outage(s)* shall be those which, in combination with the minimum generation and the secondary system outage, lead to the lowest fault current at the particular location and/or the maximum reduction in sensitivity of the remaining secondary system for the fault type under consideration. Primary outages and contingency requirements are as defined in Clause 2.5.1 however for abnormal conditions no allowance is made for busbar maintenance or loss.
access contract	Has the meaning given in the *Act*.
access application	Has the meaning given in the *Access Code*.
access services	Has the same meaning as "covered service" in the *Access Code*.
active energy	A measure of electrical energy flow, being the time integral of the product of *voltage* and the in-phase component of current flow across a *connection* point, expressed in Watthours (Wh) and multiples thereof.
active power	The rate at which *active energy* is transferred.
active power capability	The maximum rate at which *active energy* may be transferred from a *generating unit* to a *connection point* as specified in an *access contract*.
agreed capability	In relation to a *connection point,* the capability to receive or send out *active power* and *reactive power* for that *connection point* determined in accordance with the relevant *access contract*.
ancillary services	Has the same meaning as "covered service (e)" in the *Access Code*.
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associated load	A *load* which is normally supplied by a particular *generator* and is associated with that *generator* by ownership or some contractual arrangement. The *load* may be remote from the *generator* or on-site.
augment, augmentation	Has the meaning given in the *Access Code*.
Australian Standard (AS)	The most recent edition of a standard publication by Standards Australia (Standards Association of Australia).
automatic reclose equipment	In relation to a *transmission line*, the equipment which automatically recloses the relevant line's circuit breaker(s) following their opening as a result of the detection of a fault in the *transmission line*.
back up protection	A *protection* intended to supplement the main *protection* in case the latter should be ineffective, or to deal with faults in those parts of the *power system* that are not readily included in the operating zone of the main *protection*.
black start capability	In relation to a *generating unit*, the ability to start and *synchronise* without using supply from the *power system*.
black start-up facilities	The *facilities* required to provide a *generating unit* with *black start-up capability*.
black system	The absence of *voltage* on all or a significant part of the *transmission network* following a major *supply* disruption, affecting one or more *power stations* and a significant number of customers.
breaker fail	In relation to a *protection scheme*, that part of the *protection scheme* that protects a *User's facilities* against the non-operation of a circuit breaker that is required to open.
busbar	A common *connection point* in a *power station substation* or a *transmission* or *distribution network substation*.
business day	Has the meaning given in the *Access Code*.
capacitor bank	A type of electrical equipment used to generate *reactive power* and therefore support *voltage* levels on *transmission* or *distribution lines*.
cascading outage	The occurrence of an uncontrollable succession of *outages*, each of which is initiated by conditions (e.g. instability or overloading) arising or made worse as a result of the event preceding it.
change	Includes amendment, alteration, addition or deletion.
circuit breaker failure	A circuit breaker will be deemed to have failed if, having received a trip signal from a *protection scheme*, it fails to interrupt fault current within its design operating time.
Rules, Technical Rules	These *Rules* called the *Technical Rules* prepared by *Western Power* under clause 4.1 of the *Access Code*.

Rules commencement date	The date given in clause 1.3 of these *Rules*.
commitment	The commencement of the process of starting up and *synchronising* a *generating unit* to the *power system*.
complementary	In relation to *protection*, two *protection schemes* are said to be complementary when, in combination, they provide dependable clearance of faults on *plant* within a specified time, but with any single failure to operate of the *secondary plant*, fault clearance may be delayed until the nature of the fault changes.
connect, connected	To form a physical link to or through the *transmission or distribution network*, by direct or indirect connection, so as to have an impact on *power system security, reliability* and *quality of supply*.
connection	The physical link between a *User* and *Western Power* (via a *connection asset*) that allows the transfer of electricity from one to the other.
connection contract	Has the same meaning as "connection service contract" in the *Access Code*.
connection asset	The electrical equipment that allows the transfer of electricity between the electricity transmission or distribution network and an electrical system that is not part of that network. This includes any transformers or switchgear at the point of interconnection (including those that operate at a nominal voltage of less than 66kV) but does not include the lines and switchgear at the connection that form part of the electricity transmission or distribution network.
connection point	The agreed point of *supply* established between *Western Power* and a *User*.
constraint, constrained	A limitation on the capability of a *network, load* or a *generating unit* preventing it from either transferring, consuming or generating the level of electrical power which would otherwise be available if the limitation was removed.
contingency capacity reserve	Actual *active* and *reactive energy* capacity, *interruptible load* arrangements and other arrangements organised to be available to be utilised on the actual occurrence of one or more *contingency events* to allow the restoration and maintenance of *power system security*.
contingency event	An event affecting the *power system* which *Western Power* expects would be likely to involve the failure or removal from operational service of a *generating unit* or *transmission/distribution element*.
control centre	The *facility* used by *Western Power* for directing the minute to minute operation of the *power system*.
controller	Has the same meaning as "designated controller" in Appendix 3 of the *Access Code*.

control system	Means of monitoring and controlling the operation of the *power system* or equipment including *generating units connected* to a *transmission* or *distribution*.
converter coupled generating unit	A generator uses a machine, device, or system that changes its alternating-current power to alternating-current power acceptable for power system connection.
credible contingency event	A *contingency event* the occurrence of which *Western Power* considers to be reasonably possible in the surrounding circumstances. This will include events such as the disconnection of any single generating unit or transmission or distribution line with or without the application of a fault.
critical fault clearance time	Refers to the maximum *total fault clearance time* that the *power system* can withstand without one or both of the following conditions arising: 1. Instability (refer to clause 2.3); and 2. Unacceptable disturbance of *power system voltage* or *frequency*.
critical credible contingency event	A *critical credible contingency event* considered by *Western Power*, in the particular circumstances, is an event that has potential for the most significant impact on the *power system* at that time. This would generally be the instantaneous loss of the largest *generating unit* or a fault on a *transmission element* on the *power system*. However, this may involve the consideration by *Western Power* of the impact of the loss of any *interconnection* under abnormal conditions.
current rating	The maximum current that may be permitted to flow (under defined conditions) through a *transmission* or *distribution line* or other item of equipment that forms part of a *power system.*
current transformer (CT)	A *transformer* for use with *meters* and/or protection devices in which the current in the secondary winding is, within prescribed error limits, proportional to and in phase with the current in the primary winding.
Customer	A person who engages in the activity of purchasing electricity *supplied* through a *transmission* or *distribution network.*
damping ratio	A standard mathematical parameter that characterises the shape of a damped sine wave.
day	Unless otherwise specified, the 24 hour period beginning and ending at midnight Western Standard Time (WST).
decommission, decommit	In respect of a *generating unit*, ceasing to generate and *disconnecting* from a *network.*
derogation	Modification, variation or exemption to one or more provisions of the *Rules* in relation to a *User* according to Section 6.

de-synchronising/ de-synchronisation	The act of *disconnection* of a *generating unit* from the *power system*, normally under controlled circumstances.
differing principle	Two *protections* are said to be of *differing principle* when their functioning is based on different measurement or operating methods, or use similar principles but have been designed and manufactured by different organisations.
direction	A direction issued by *Western Power* to any *User* requiring the *User* to do any act or thing which *Western Power* considers necessary to maintain or re-establish *power system security* or to maintain or re-establish the *power system* in a *reliable operating state* in accordance with these *Rules*.
disconnection, disconnect	The operation of switching equipment or other action so as to prevent the flow of electricity at a *connection point*.
dispatchable generating unit	A generator that in its satisfactory normal operating state is capable of closely controlling its real power output
dispatch	The act of committing to service all or part of the generation available from a *scheduled generating unit*.
distribution network	Has the same meaning as 'distribution system' in the *Act*.
dynamic performance	The response and behaviour of *networks* and *facilities* which are *connected* to the *networks* when the *satisfactory operating state* of the *power system* is disturbed.
electrical energy loss	*Energy* loss incurred in the production, transportation and/or use of electricity.
Electricity Referee	Has the meaning given in the Dispute Resolution section of the *Access Code* (Chapter 10 and Appendix 5)
electricity transmission capacity	Has the same meaning as "capacity" in Appendix 3 of the *Access Code,* when it is applied to a transmission system.
electricity transmission network, network, transmission network	All have the same meaning as "transmission system" in the *Act*.
embedded generator	A *generator* which supplies on-site *loads* or *distribution network loads* and is *connected* either indirectly (ie. via the *distribution network*) or directly to the *transmission network*.
emergency conditions	Characterise operation after a significant network element has been removed from service other than in a planned manner.
energise/energisation	The act of operation of switching equipment or the start-up of a *generating unit*, which results in there being a non-zero *voltage* beyond a *connection point* or part of the *transmission / distribution network*.

energy	*Active energy* and/or *reactive energy*.
energy data	The data that results from the measurement of the flow of electricity in a power conductor. The measurement is carried out at a *metering point.*
excitation control system	In relation to a *generating unit*, the automatic *control system* that provides the field excitation for the generator of the *generating unit* (including excitation limiting devices and any power system stabiliser).
extension	An *augmentation* that requires the *connection* of a power line or *facility* to the *transmission* or *distribution network.*
facility	A generic term associated with the apparatus, equipment, buildings and necessary associated supporting resources provided at, typically: (a) a *power station* or *generating unit*, including *black start-up facilities*; (b) a *substation* or *power station substation*; (c) a *control centre*.
fault clearance time	The time interval between the occurrence of a fault and the fault clearance.
financial year	A period commencing on 1 July in one calendar year and terminating on 30 June in the following calendar year.
frequency	For alternating current electricity, the number of cycles occurring in each second. The term Hertz (Hz) corresponds to cycles per second.
frequency operating standards	The standards which specify the frequency levels for the operation of the *power system* set out clause 2.2.
frequency response mode	The mode of operation of a *generating unit* which allows automatic changes to the generated power when the *frequency* of the *power system* changes.
Frequency stability	Is the ability of a *power system* to attain a steady frequency following a severe system disturbance that has resulted in a severe imbalance between generation and load. Instability that may result occurs in the form of sustained frequency swings leading to tripping of generating units and/or loads.
generated	In relation to a *generating unit,* the amount of electricity produced by the *generating unit* as measured at its terminals.
generating plant	In relation to a *connection point*, includes all equipment involved in generating electrical *energy*.
generating system	A system comprising one or more *generating units.*

generating unit	The actual generator of electricity and all the related equipment essential to its functioning as a single entity including step-up *transformer connecting* it to the *power system*, and includes *embedded generators*.
generation	The production of electrical power by converting another form of *energy* in a *generating unit*.
generation centre	A geographically concentrated area containing a *generating unit* or *generating units* with significant combined generating capability.
Generator	A person who engages in the activity of owning, controlling, or operating a *generating system* that *supplies* electricity to, or who otherwise *supplies* electricity to, a *transmission network* or *distribution network*.
good electricity industry practice	Has the meaning given in the *Access Code*.
governor system	The automatic *control system* which regulates the speed and power output of a *generating unit* through the control of the rate of entry of the primary *energy* input (for example, steam, gas or water) into the *generating unit*. New terminology is turbine control system.
halving time	Is the elapsed time required for the magnitude of a damped sine wave to reach half its initial value.
Induction generating unit	The alternating current generator-whose rotor currents are produced by induction from its stator windings and when driven above synchronous speed by an external source of mechanical power converts mechanical power to electric power. It employs a conventional induction machine.
Doubly fed induction generating unit	A special wound rotor design of the induction machine, which is effectively a combination of the converter coupled generating unit (rotor side) and conventional induction generating unit (stator side).
instrument transformer	Either a *current transformer* (*CT*) or a voltage transformer (*VT*).
interconnection, interconnector, interconnect, interconnected	A *transmission line* or group of *transmission lines* that connects the *transmission networks* in adjacent *regions*.
interruptible load	A *load* which is able to be *disconnected*, either manually or automatically initiated, which is provided for the restoration or control of the *power system frequency* by *Western Power* to cater for *contingency events* or shortages of *supply*.
intra-regional	Within a *region*.
inverter coupled generating unit	A generator which uses a machine, device, or system that changes its direct-current power to alternating-current power acceptable for power system connection.

large disturbance	The disturbance is considered to be sufficiently large or severe if linearization of system equations in not permissible for the purposes of analysis. The resulting system response involves large excursions of system variables from their pre-disturbance values, and is influenced by non-linear power-angle relationship and other non-linearity effects in power systems. Large disturbance is typically caused by a short circuit on a nearby power system component (for example, transmission line, transformer, etc).
large disturbance rotor angle stability	See *transient rotor angle stability.*
load	A *connection point* at which electrical power is delivered to a person or the amount of electrical power delivered at a defined instant at a *connection point*.
load centre	A geographically concentrated area containing *load* or *loads* with a significant combined consumption capability.
load shedding	Reducing or disconnecting *load* from the *power system*.
local black system procedures	The procedures, described under clause 5.8.9 applicable to a *User* as approved by *Western Power* from time to time.
maintenance conditions	Characterise operation when a significant element of the network has been taken out of service in a planned manner so that maintenance can be safely carried.
maximum fault current	The current that will flow to a fault on an item of *plant* when *maximum system conditions* prevail.
maximum system conditions	For any particular location in the *power system*, *maximum system conditions* as those which will prevail with the maximum number of *generators* normally connected at times of maximum *generation*.
minimum fault current	The current that will flow to a fault on an item of *plant* when present day *minimum system conditions* prevail.
minimum system conditions	For any particular location in the *power system*, *minimum system conditions* as those which will prevail with the least number of *generators* normally connected at times of minimum *generation*, in combination with one *primary plant outage*. The *primary plant outage* shall be taken to be that which, in combination with the minimum *generation*, leads to the lowest fault current at the particular location for the fault type under consideration.
monitoring equipment	The testing instruments and devices used to record the performance of *plant* for comparison with expected performance.

month	Unless otherwise specified, the period of beginning at 12.00 am on the "relevant commencement date" and ending at 12.00 am on the date in the "next calendar month" corresponding to the commencement date of the period. If the "relevant commencement date" is the 29th, 30th or 31st and this date does not exist in the "next calender month", then the end date in the "next calender month" shall be taken as the last day of that month.
multiple contingencies	Refers to the occurrence of more than one contingency event either simultaneously or sequentially, which occurrence is beyond the planning criterion for the network.
nameplate rating	The maximum continuous output or consumption in MW or MVA of an item of equipment as specified by the manufacturer.
NATA	National Association of Testing Authorities.
network	See definition for *electricity transmission network*.
network capability	The capability of the *network* or part of the *network* to transfer electricity from one location to another.
network losses	*Energy* losses incurred in the transfer of electricity over a *transmission* or *distribution network*.
network planning criteria	The criteria prepared by *Western Power* under section A 6.1(m) of the *Access Code*.
new capacity	Any increase in electricity generation, transmission or distribution capacity which would arise from enhancement to or expansion of the electricity generation, transmission or distribution system.
nomenclature standards	The standards approved by *Western Power* relating to numbering, terminology and abbreviations used for information transfer between *Users* as provided for in clause 5.12.
non-credible contingency event	A *contingency event* other than a *credible contingency event*. It means a *contingency event* in relation to which, in the circumstances, the probability of occurrence is considered by *Western Power* to be very low.
Non-Dispatchable generating unit	A generator that in its satisfactory normal operating state is not capable of closely controlling its real power output.
normal conditions	Characterise operation when all significant elements of a network are in service and operation is within the secure technical envelope.
normal operating frequency band	In relation to the *frequency* of the *power system*, means the range for no disturbance condition specified in ~~clause 5.2.1(a)~~ clause 2.2.1, Table 2.1.

normal operating frequency excursion band	In relation to the *frequency* of the *power system*, means the range specified as being acceptable for infrequent and momentary excursions of *frequency* outside the *normal operating frequency band* being the range specified in ~~clause 5.2.1(a)~~ clause 2.2.1, Table 2.1..
operational communication	A communication concerning the arrangements for, or actual operation of the *power system* in accordance with the *Rules*.
outage	Any planned or unplanned full or partial unavailability of plant or equipment.
peak load	Maximum *load*.
plant	Includes all equipment involved in generating, utilising or transmitting electrical *energy*.
power factor	The ratio of the *active power* to the apparent power at a point.
power station	In relation to a *Generator*, a *facility* in which any of that *Generator's generating units* are located.
power system	The electricity power system including associated *generation* and *transmission and distribution networks* for the *supply* of electricity, operated as an integrated arrangement.
power system operating procedures	The procedures to be followed by *Users* in carrying out operations and /or maintenance activities on or in relation to primary and *secondary equipment connected* to or forming part of the *power system* or *connection points*, as described in clause 5.10.1.
power system security	The safe scheduling, operation and control of the *power system* on a continuous basis in accordance with the principles set out in clause 5.2.4.
power system stability	Is the ability of an electric *power system*, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical disturbance, with most system variables bounded so that practically the entire system remains intact.
power transfer	The instantaneous rate at which *active energy* is transferred between *connection points*.
power transfer capability	The maximum permitted *power transfer* through a *transmission network* or part thereof.
primary plant	Refers to apparatus which conducts *power system load* or conveys *power system voltage*.
protection	Used to describe the concept of detecting, limiting and removing the effects of *primary plant* faults from the *power system*. Also used to refer to the apparatus required to achieve this function.

protection apparatus	Includes all relays, *meters*, power circuit breakers, synchronisers and other control devices necessary for the proper and safe operation of the *power system*.
protection scheme	A collection of one or more sets of *protection* for the purpose of protecting *facilities* and the *electricity transmission* or *distribution network* from damage due to an electrical or mechanical fault or due to certain conditions of the *power system*.
protection system	A system which includes all the *protection schemes* applied to the system.
quality of supply	Has the meaning, with respect to electricity, technical attributes to a standard referred to in clause 2.2, unless otherwise stated in these *Rules* or an *access contract*.
ramp rate	The rate of *change* of electricity produced from a *generating unit*.
reactive energy	A measure, in varhours (VArh) of the alternating exchange of stored energy in inductors and capacitors, which is the time-integral of the product of *voltage* and the out-of-phase component of current flow across a *connection point*.
reactive plant	*Plant* which is normally specifically provided to be capable of providing or absorbing *reactive power* and includes the *plant* identified in clause 5.5.1(g).
reactive power	The rate at which *reactive energy* is transferred. *Reactive power* is a necessary component of alternating current electricity which is separate from *active power* and is predominantly consumed in the creation of magnetic fields in motors and *transformers* and produced by *plant* such as: (a) alternating current generators (b) capacitors, including the capacitive effect of parallel *transmission* wires; (c) *synchronous condensers*.
reactive power capability	The maximum rate at which *reactive energy* may be transferred from a *generating unit* to a *connection point* as specified in an *access contract*.
reactive power reserve	Unutilised sources of *reactive power* arranged to be available to cater for the possibility of the unavailability of another source of *reactive power* or increased requirements for *reactive power*.
reactive power support/reactive support	The provision of *reactive power*.

reactor	A device, similar to a *transformer*. Arranged to be *connected* into the *transmission or distribution network* during periods of low *load* demand or low *reactive power* demand to counteract the natural capacitive effects of long *transmission lines* in generating excess *reactive power* and so correct any *transmission voltage* effects during these periods.
region, regional	An area determined by *Western Power*, being an area served by a particular part of the *transmission network* containing one or more major *load centres* or *generation centres* or both.
regulating duty	In relation to a *generating unit*, the duty to have its generated output adjusted frequently so that any *power system frequency* variations can be corrected.
reliability	The probability of a system, device, *plant* or equipment performing its function adequately for the period of *time* intended, under the operating conditions encountered.
reliable	The expression of a recognised degree of confidence in the certainty of an event or action occurring when expected.
remedial action scheme	A Remedial Action Scheme (RAS) or System Protection Scheme (SPS) is *designed to detect abnormal system conditions and take predetermined, corrective action (other than the isolation of faulted elements) to preserve system integrity and provide acceptable system performance*
remote back up protection	Refers to the detection and initiation of tripping at a location other than that at which the main *protection scheme* of the faulted *plant* is located. *Remote back up protection* provides a means of detecting and initiating clearance of *small zone faults* or fault contributions supplied via failed circuit breakers.
remote monitoring equipment (RME)	Equipment installed to enable monitoring of a *facility* from a *control centre*, including a remote terminal unit (*RTU*).
representative	In relation to a person, any employee, agent or *Consultant* of: (a) that person; or (b) a *related body corporate* of that person; or (c) a third party contractor to that person.
reserve	The *active power* and *reactive power* available to the *power system* at a nominated *time* but not currently utilised.

rotor angle stability	Is the ability of synchronous machines of an interconnected power system to remain in *synchronism* after being subjected to a disturbance. Instability that may result occurs in the form of increasing angular swings of some generators leading to loss of *synchronism* between generators. Loss of synchronism can occur between one machine and the rest of the system, or between groups of machines, with synchronism maintained within each group after separating from each other. There are two forms of rotor angle stability: small-disturbance and transient stability.
RTU	Means a Remote Terminal Unit installed within a substation to enable monitoring and control of a facility from a *control centre*.
satisfactory operating state	In relation to the *power system*, has the meaning given in clause 5.2.1.
SCADA system	Supervisory control and data acquisition equipment which enables *Western Power* to continuously and remotely monitor, and to a limited extent control, the import or export of electricity from or to the *power system*.
scheduled generating unit	A *generating unit* which is dispatched by *Western Power*.
secondary equipment, secondary plant	Those assets of a *facility* and the *electricity transmission* or *distribution network* which do not carry the *energy* being traded, but which are required for control, protection or operation of assets which carry such *energy*.
secondary plant contingency	Any single failure of *secondary plant*.
security	*Security* of a power system refers to the degree of risk in its ability to survive imminent disturbances (contingencies) without interruption of customer service. It relates to robustness of the system to imminent disturbances and, hence, depends on the system operating condition as well as the contingent probability of disturbances.
secure operating state	In relation to the *power system* has the meaning given in clause 5.2.2.
sensitivity	In relation to *protection schemes*, has the meaning in clause 3.4.2.6 for normal operating zones and the meaning in clause 3.4.2.9 for back up operating zones.
settlements	The activity of producing bills and credit notes for *Users*.
shunt capacitor	A type of *plant connected* to a *network* to generate *reactive power*.
shunt reactor	A type of *plant connected* to a *network* to absorb *reactive power*.
single contingency	In respect of a *transmission network*, a sequence of related events which result in the removal from service of one *transmission line*, *transformer* or other item of *plant*. The sequence of events may include the application and clearance of a fault of defined severity.

single credible contingency event	An individual *credible contingency event* for which a *User* adversely affected by the event would reasonably expect, under normal conditions, the design or operation of the relevant part of the meshed *power system* would adequately cater, so as to avoid significant disruption to *power system security*.
small disturbance	The disturbance is considered to be sufficiently small if linearization of system equations is permissible for the purposes of analysis. The resulting system response involves small excursions of system variables from their pre-disturbance values. Small disturbances may be caused by routine switching (for example, line or capacitor), transformer tap changes, generator AVR setpoint changes, etc.
small-disturbance rotor angle stability	Is the ability of the power system to maintain *synchronism* under *small disturbances*.
small zone fault	A fault which occurs on an area of *plant* that is within the zone of detection of a *protection scheme*, but for which not all contributions will be cleared by the circuit breaker(s) tripped by that *protection scheme*. For example, a fault in the area of *plant* between a *current transformer* and a circuit breaker, fed from the *current transformer* side, may be a *small zone fault*.
South West Interconnected System	The *network* in South West of the state of Western Australia, extending from Geraldton to Albany areas and across to the Eastern Goldfields, as defined in the *Act*.
spare capacity	Any portion of firm capacity or non-firm capacity not committed to existing users.
standby power	Electricity generated by any person under an arrangement relating to the provision of standby, backup or emergency electricity for loads associated with a user, and includes such electricity generated by that user.
static excitation system	An *excitation control system* in which the power to the rotor of a synchronous *generating unit* is transmitted through high power solid-state electronic devices.
static VAR compensator	A device specifically provided on a *network* to provide the ability to generate and absorb *reactive power* and to respond automatically and rapidly to *voltage* fluctuations or *voltage* instability arising from a disturbance or disruption on the *transmission* or *distribution network.*
static synchronous compensator	A device specifically provided on a *network* to provide the ability to generate and absorb *reactive power* and to respond automatically and rapidly to *voltage* fluctuations or *voltage* instability arising from a disturbance or disruption on the *transmission* or *distribution network*

substation	A *facility* at which lines are switched for operational purposes. May include one or more *transformers* so that some *connected* lines operate at different nominal *voltages* to others.
supply	The delivery of electricity as defined in the *Act*.
synchronise	The act of *synchronising* a *generating unit* to the *power system*.
synchronising, synchronisation	To electrically *connect* a *generating unit* to the *power system*.
synchronism	Is a condition in which all machines of the synchronous type (generators and motors) that are connected to a network rotate at the same average speed, resulting in controlled sharing of the transfer of power. Loss of *synchronism* causes uncontrolled transfers of power between machine groups, causing severe and widespread disturbances of supply to customers, disconnection of transmission lines, possible damage to synchronous machines and system shutdown.
synchronous condensers	*Plant*, similar in construction to a *generating unit* of the *synchronous generator* category, which operates at the equivalent speed of the *frequency* of the *power system*, specifically provided to generate or absorb *reactive power* through the adjustment of rotor current.
synchronous generator voltage control	The automatic *voltage control system* of a *generating unit* of the *synchronous generator* category which changes the output *voltage* of the *generating unit* through the adjustment of the generator rotor current and effectively changes the *reactive power* output from that *generating unit*.
synchronous generator, synchronous generating unit	The alternating current generators which operate at the equivalent speed of the *frequency* of the *power system* in its *satisfactory operating state*.
system protection scheme	See Remedial Action Scheme (RAS)
tap-changing transformer	A *transformer* with the capability to allow internal adjustment of output *voltages* which can be automatically or manually initiated while on-line and which is used as a major component in the control of the *voltage* of the *transmission and distribution networks* in conjunction with the operation of *reactive plant*. The *connection point* of a *generating unit* may have an associated tap-changing transformer, usually provided by the *Generator*.
technical envelope	The limits described in clause 5.2.3.
teleprotection signalling	Equipment used to transfer a contact state from one location to another using communications equipment. The equipment used for this purpose will meet the *reliability* and quality requirements of *protection* equipment.
thermal generating unit	A generating unit which uses fuel combustion for electricity generation.

time	Western Standard Time, being the time at the 120th meridian of longitude east of Greenwich in England, or Co-ordinated Universal Time, as required by the National Measurement Act, 1960.
total fault clearance time	Refers to the time from fault inception to the time of complete fault interruption by a circuit breaker or circuit breakers. This is to be taken, as a minimum, to be equal to 10ms plus the circuit breaker maximum break time plus the maximum protection operating time.
transformer	A *plant* or device that reduces or increases the *voltage* of alternating current.
transformer tap position	Where a tap changer is fitted to a *transformer*, each tap position represents a *change* in *voltage* ratio of the *transformer* which can be manually or automatically adjusted to change the *transformer* output *voltage*. The tap position is used as a reference for the output *voltage* of the *transformer*.
transient rotor angle stability	*Transient rotor angle stability* or *Large disturbance rotor angle stability* is the ability of the *power system* to maintain *synchronism* when subjected to severe disturbances, for example a short circuit on a nearby transmission line. The resulting system response involves large excursions of generator rotor angles and is influenced by the non-linear power-angle relationship.
transmission	Activities pertaining to a *transmission network* including the conveyance of electricity.
transmission element	A single identifiable major component of a *transmission network* involving: (a) an individual *transmission* circuit or a phase of that circuit; (b) a major item of *transmission plant* necessary for the functioning of a particular *transmission* circuit or *connection point* (such as a *transformer* or a circuit breaker).
transmission line	A power line that is part of a *transmission network*.
transmission network	See definition for *electricity transmission network*.
transmission network connection point	A *connection point* on a *transmission network*.
transmission network test	Test conducted to verify the magnitude of the *power transfer capability* of the *transmission network* or investigating *power system* performance in accordance with clause 4.1.7.
transmission plant	Apparatus or equipment associated with the function or operation of a *transmission line* or an associated *substation*, which may include *transformers*, circuit breakers, *reactive plant* and *monitoring equipment* and control equipment.

trip circuit supervision	A function incorporated within a *protection* that results in alarming for loss of integrity of the *protection's* trip circuit. *Trip circuit supervision* supervises a *protection's* trip supply together with the integrity of associated wiring, cabling and circuit breaker trip coil.
trip supply supervision	A function incorporated within a *protection* that results in alarming for loss of trip supply.
turbine control system	The automatic *control system* which regulates the speed and power output of a *generating unit* through the control of the rate of entry into the *generating unit* of the primary *energy* input (for example, steam, gas or water). Old terminology is governor system.
two fully independent protections of differing principle	Where an item of *plant* is required to be protected by *two fully independent protections of differing principle*, such *protections* shall, in combination, provide dependable clearance of faults on that *plant* within a specified time, with any single failure to operate of the *secondary plant*. To achieve this, complete *secondary plant* redundancy is required including, but not necessarily limited to, *current transformer* and *voltage transformer* secondaries, auxiliary supplies, signalling systems, cabling, wiring, and circuit breaker trip coils. Auxiliary supplies include DC supplies for *protection* purposes. Therefore, to satisfy the redundancy requirements, each fully independent *protection* would need to have its own independent battery and battery charger system supplying all that *protection's* trip functions. The *protections* shall be so chosen as to have *differing principles* of operation.
unit protection	Generally, a *protection scheme* that compares the conditions at defined *primary plant* boundaries and can positively identify whether a fault is internal or external to the protected *plant*. *Unit protection schemes* can provide high speed (less than 150 milliseconds) *protection* for the protected *primary plant*. Generally, *unit protection schemes* will not be capable of providing *back up protection*.
user	Has the meaning given in the *Access Code*.
voltage	The electronic force or electric potential between two points that gives rise to the flow of electricity.
voltage collapse	Is the process by which a sequence of events accompanying voltage instability leads to a blackout or abnormally low voltages in a significant part of the *power system*.
voltage stability	Is the ability of a *power system* to attain steady voltages at all busbars after being subjected to a disturbance from a given operating condition. Instability that may result occurs in the form of a progressive fall or rise of voltages at some busbars. Possible outcomes of voltage instability are loss of load in an area, or the tripping of transmission lines and other elements, including generators, by their protective systems leading to cascading outages.

voltage transformer (VT)	A *transformer* for use with *meters* and/or protection devices in which the *voltage* across the secondary terminals is, within prescribed error limits, proportional to and in phase with the *voltage* across the primary terminals.
Western Power	Has the meaning given as "*Western Power* Corporation" in the *Access Code*, but modified in accordance with clause 1.2 of this *Rules*.
Western Power power system security responsibilities	The responsibilities described in clause 5.3.1.
wind farm	A *power station* consisting of one or more wind powered *generating units*

ATTACHMENT 2

RULES OF INTERPRETATION

Subject to the Electricity Industry Act 2004 "*Act*" and Electricity Networks Access Code 2004 "*Access Code*", these *Rules* must be interpreted in accordance with the following rules of interpretation, unless the contrary intention appears:

(a) a reference in these *Rules* to a contract or another instrument includes a reference to any amendment, variation or replacement of it;

(b) a reference to a person includes a reference to the person's executors, administrators, successors, substitutes (including, without limitation, persons taking by novation) and assigns;

(c) if an event must occur on a *day* which is not a *business day* then the event must occur on the next *business day*;

(d) any calculation shall be performed to the accuracy, in terms of a number of decimal places, determined by *Western Power* in respect of all *Users*;

(e) if examples of a particular kind of conduct, thing or condition are introduced by the word "**including**", then the examples are not to be taken as limiting the interpretation of that kind of conduct, thing or condition;

(f) a *connection* is a *User's connection* or a *connection* of a *User* if it is the subject of an *access contract* between the *User* and *Western Power*; and

(g) a reference to a half hour is a reference to a 30 minute period ending on the hour or on the half hour and, when identified by a time, means the 30 minute period ending at that time.

ATTACHMENT 3

SUMMARY OF SCHEDULES OF TECHNICAL DETAILS TO SUPPORT APPLICATION FOR CONNECTION AND ACCESS CONTRACT

A3.1. Various sections of the *Code* require that *Users* submit technical data to *Western Power*. This attachment summarises schedules which list the typical range of data which may be required and explains the terminology. Data additional to those listed in the schedules may be required. The actual data required will be advised by *Western Power* at the time of assessment of a *transmission or distribution access application*, and will form part of the technical specification in the *access contract*.

A3.2. Data is coded in categories, according to the stage at which it is available in the build-up of data during the process of forming a *connection* or obtaining access to a *network*, with data acquired at each stage being carried forward, or enhanced in subsequent stages, eg. by testing.

Preliminary system planning data

This is data required for submission with the *access application*, to allow *Western Power* to prepare an offer of terms for an *access contract* and to assess the requirement for, and effect of, *network augmentation* or *extension* options. Such data is normally limited to the items denoted as Standard Planning Data (S) in the technical data schedules S1 to S5.

Western Power may, in cases where there is reasonable doubt as to the viability of a proposal, require the submission of other data before making an access offer to *connect* or to amend an *access contract*.

Registered system planning data

This is the class of data which will be included in the *access contract* signed by both parties. It consists of the preliminary system planning data plus those items denoted in the attached schedules as Detailed Planning Data (D). The latter must be submitted by the *User* in time for inclusion in the *access contract*.

Registered data

Registered Data consists of data validated and *augmented* prior to actual *connection* a provision of access from manufacturers' data, detailed design calculations, works or site tests etc. (R1); and data derived from on-system testing after *connection* (R2).

All of the data will, from this stage, be categorised and referred to as Registered Data; but for convenience the schedules omit placing a higher ranked code next to items which are expected to already be valid at an earlier stage.

A3.3. Data will be subject to review at reasonable intervals to ensure its continued accuracy and relevance. *Western Power* must initiate this review. A *User* may *change* any data item at a time other than when that item would normally be reviewed or updated by submission to *Western Power* of the revised data, together with authentication documents, eg. test reports.

A3.4. Schedules S1 to S5, which are given in the respective Attachments 4 to 8, cover the following data areas:

(a) Schedule S1 - *Generating Unit* Design Data. This comprises *generating unit* fixed design parameters.

(b) Schedule S2 - *Generating Unit* Setting Data. This comprises settings which can be varied by agreement or by *direction* of *Western Power*.

(c) Schedule S3 - *Transmission Network* and *Plant* Technical Data. This comprises fixed electrical parameters.

(d) Schedule S4 - *Transmission Plant* and Apparatus Setting Data. This comprises settings which can be varied by agreement or by *direction* of *Western Power*.

(e) Schedule S5 - *Load* Characteristics. This comprises the estimated parameters of *load* groups in respect of, for example, harmonic content and response to *frequency* and *voltage* variations.

A3.5. A *Generator* that *connects* a *generating unit*, that is not a *synchronous generating unit*, must be given exemption from complying with those parts of schedules S1 and S2 that are determined by *Western Power* to be not relevant to such *generating units*, but must comply with those parts of Schedules S3, S4, and S5 that are relevant to such *generating units*, as determined by *Western Power*. For this non-synchronous generating unit, additional data may be requested by *Western Power*.

Codes:

S = Standard Planning Data

D = Detailed Planning Data

R = Registered Data (R1 pre-*connection*, R2 post-*connection*)

ATTACHMENT 4

SCHEDULE S1 - GENERATING UNIT DESIGN DATA

Symbol	Data Description	Units	Data Category
	Power Station Technical Data:		
	Connection Point to *Network*	Text, diagram	S, D
	Nominal *voltage* at *connection* to *Network*	kV	S
	Total Station Net Maximum Capacity (NMC)	MW (*sent out*)	S, D, R2
	At Connection Point:		
	Maximum 3 phase short circuit infeed calculated by method of AS 3851 (1991)		
	· Symmetrical	kA	S, D
	· Assymetrical	kA	D
	Minimum zero sequence impedance	(a+jb)% on 100 MVA base	D
	Minimum negative sequence impedance	(a+jb)% on 100 MVA base	D
	Individual Synchronous Generating Unit Data:		
	Make		
	Model		
MBASE	Rated MVA	MVA	S, D, R1
PSO	Rated MW (*Sent Out*)	MW (*sent out*)	S, D, R1
PMAX	Rated MW (*Generated*)	MW (Gen)	D
VT	Nominal Terminal *Voltage*	kV	D, R1
PAUX	Auxiliary *load* at PMAX	MW	S, D, R2
Qmax	Rated Reactive Output at PMAX	MVAr (*sent out*)	S, D, R1
PMIN	*Minimum Load* (ML)	MW (*sent out*)	S, D, R2
H	Inertia Constant for all rotating masses connected to the generator shaft (for example, generator, turbine, etc)	MWs/rated MVA	S, D, R1
Hg	*Generator* Inertia Constant (applicable to *synchronous condenser* mode of operation)	MWs/rated MVA	S, D, R1
GSCR	Short Circuit Ratio		D, R1
ISTATOR	Rated Stator Current	A	D, R1
IROTOR	Rated Rotor Current at rated MVA and *Power Factor*, rated terminal volts and rated speed	A	D,R1
VROTOR	Rotor *Voltage* at which IROTOR is achieved	V	D, R1
VCEIL	Rotor *Voltage* capable of being *supplied* for five seconds at rated speed during field forcing	V	D, R1
ZN	Neutral Earthing Impedance	(a+jb)% on MVA base	
	Generating Unit Resistance:		
RA	Stator Resistance	% on MBASE	S, D, R1, R2
RF	Rotor resistance at 20°C	ohms	D, R1

Symbol	Data Description	Units	Data Category
	Generating Unit Sequence Impedances (saturated):		
Z0	Zero Sequence Impedance	(a+jb)% on MBASE	D,R1
Z2	Negative Sequence Impedance	(a+jb)% on MBASE	D,R1
	Generating Unit Reactances (saturated):		
XD’(sat)	Direct Axis Transient Reactance	% on MBASE	D,R1
XD”(sat)	Direct Axis Sub-Transient Reactance	% on MBASE	D,R1
	Generating Unit Reactances (unsaturated):		
XD	Direct Axis Synchronous Reactance	% on MBASE	S, D, R1, R2
XD’	Direct Axis Transient Reactance	% on MBASE	S, D, R1, R2
XD”	Direct Axis Sub-Transient Reactance	% on MBASE	S, D, R1, R2
XQ	Quadrature Axis Synch Reactance	% on MBASE	D, R1, R2
XQ’	Quadrature Axis Transient Reactance	% on MBASE	D, R1, R2
XQ”	Quadrature Axis Sub-Transient Reactance	% on MBASE	D,R1, R2
XL	Stator Leakage Reactance	% on MBASE	D, R1, R2
XO	Zero Sequence Reactance	% on MBASE	D, R1
X2	Negative Sequence Reactance	% on MBASE	D, R1
XP	Potier Reactance	% on MBASE	D, R1
	Generating Unit Time Constants (unsaturated):		
TDO’	Direct Axis Open Circuit Transient	Seconds	S, D, R1, R2
TDO”	Direct Axis Open Circuit Sub-Transient	Seconds	S, D, R1, R2
TKD	Direct Axis Damper Leakage	Seconds	D, R1, R2
TQO’	Quadrature Axis Open Circuit Transient	Seconds	D, R1, R2
TA	Armature Time Constant	Seconds	D, R1, R2
TQO”	Quadrature Axis Open Circuit Sub-Transient	Seconds	D, R1, R2
	Charts:		
GCD	Capability Chart	Graphical data	D, R1, R2
GOCC	Open Circuit Characteristic	Graphical data	R1
GSCC	Short Circuit Characteristic	Graphical data	R1
GZPC	Zero *power factor* curve	Graphical data	R1
	V curves	Graphical data	R1
GOTC	MW, MVAr outputs versus temperature chart	Graphical data	D, R1, R2
	Generating Unit Transformer:		
GTW	Number of windings	Text	S, D
GTRn	Rated MVA of each winding	MVA	S, D, R1
GTTRn	Principal tap rated *voltage*s	kV/kV	S, D, R1
GTZ1n	Positive Sequence Impedances (each wdg)	(a + jb) % on 100 MVA base	S, D, R1
GTZ2n	Negative Sequence Impedances (each wdg)	(a + jb) % on 100 MVA base	S, D, R1

Symbol	Data Description	Units	Data Category
GTZOn	Zero Sequence Impedances (each wdg)	(a + jb) % on 100 MVA base	S, D, R1
	Tapped Winding	Text, diagram	S, D, R1
GTAPR	Tap Change Range	kV - kV	S, D
GTAPS	Tap Change Step Size	%	D
	Tap Changer Type, On/Off load	On/Off	D
	Tap Change Cycle Time	Seconds	D
GTVG	Vector Group	Diagram	S, D
	Earthing Arrangement	Text, diagram	S, D
	Saturation curve	Diagram	R1
	Generating Unit Reactive Capability (At machine terminals):		
	Lagging *Reactive Power* at PMAX	MVAr export	S, D, R2
	Lagging *Reactive Power* at ML	MVAr export	S, D, R2
	Lagging Reactive Short Time capability at rated MW, terminal *voltage* and speed	MVAr (for time)	D, R1, R2
	Leading *Reactive Power* at rated MW	MVAr import	S,D, R2
	Generating Unit Excitation System:		
	Make		
	Model		
	General description of *excitation control system* (including block diagram transfer function & parameters)	Text, diagram	S, D
	Rated Field *Voltage* at rated MVA and *Power Factor* and rated terminal volts and speed	V	S, D, R1
	Maximum Field *Voltage*	V	S, D, R1
	Minimum Field *Voltage*	V	D, R1
	Maximum rate of change of Field *Voltage*	Rising V/s	D, R1
	Maximum rate of change of Field *Voltage*	Falling V/s	D, R1
	Generating Unit and exciter Saturation Characteristics 50 - 120% V	Diagram	D, R1
	Dynamic Characteristics of Over *Excitation* Limiter (drawn on capability generator diagram)	Text/ Block diagram	D, R2
	Dynamic Characteristics of Under *Excitation* Limiter (drawn on capability generator diagram)	Text/ Block diagram	D, R2
	Generating Unit Turbine / Load Controller (Governor):		
	Make		
	Model		
	General description of turbine *control system* (including block diagram transfer function & parameters)	Text, diagram	S, D
	Maximum Droop	%	S, D, R1

Symbol	Data Description	Units	Data Category
	Normal Droop	%	D, R1
	Minimum Droop	%	D, R1
	Maximum *Frequency* Dead band	Hz	D, R1
	Normal *Frequency* Deadband	Hz	D, R1
	Minimum *Frequency* Deadband	Hz	D, R1
	MW Deadband	MW	D, R1
	Generating Unit Response Capability:		
	Sustained response to *frequency* change	MW/Hz	D, R2
	Non-sustained response to *frequency* change	MW/Hz	D, R2
	Load Rejection Capability	MW	S, D, R2
	Mechanical Shaft Model: (Multiple-Stage Steam Turbine Generators only)		
	Dynamic model of turbine/*Generator* shaft system in lumped element form showing component inertias, damping and shaft stiffness.	Diagram	D
	Natural damping of shaft torsional oscillation modes.(for each mode)		
	- Modal *frequency*	Hz	D
	- Logarithmic decrement	Nepers/Sec	D
	Steam Turbine Data: (Multiple-Stage Steam Turbines only)		
	Fraction of power produced by each stage:		
	Symbols KHP KIP KLP1 KLP2	Per unit of Pmax	D
	Stage and Reheat Time Constants:		
	Symbols THP TRH TIP TLP1 TLP2	Seconds	D
	Turbine frequency tolerance curve	Diagram	S, D, R1
	Gas Turbine Data:		
HRSG	Waste heat recovery boiler time constant (where applicable eg for cogeneration plant)	Seconds	D
	MW output versus turbine speed (47-52 Hz)	Diagram	D, R1, R2
	Type of turbine (heavy industrial, aero derivative etc)	Text	S
	Number of shafts		S,D
	Gearbox Ratio		D

Symbol	Data Description	Units	Data Category
	Fuel type (gas, liquid)	Text	S,D
	Base load MW vs temperature	Diagram	D
	Peak Load MW vs temperature	Diagram	D
	Rated exhaust temperature	°C	S,D
	Controlled exhaust temperature	°C	S,D,R1
	Turbine frequency tolerance capability	Diagram	D
	Turbine compressor surge map	Diagram	D
	Hydraulic Turbine Data		
	Required data will be advised by *Western Power*		
	Windfarm/Wind Turbine Data[1)]		
	A typical 24 hour power curve measured at 15-minute intervals or better if available;		S, D, R1
	maximum kVA output over a 60 second interval		S, D,R1
	Long-term flicker factor for generator		S, D, R1
	Long term flicker factor for windfarm		S,D,R1
	Maximum output over a 60 second interval	kVA	S,D,R1
	Harmonics current spectra	A	S,D,R1
	Power curve MW vs windspeed	Diagram	D
	Spatial Arrangement of windfarm	Diagram	D
	Startup profile MW, MVAr vs time for individual Wind Turbine Unit and Wind Farm Total	Diagram	D
	Low Wind Shutdown profile MW, MVAr vs time for individual Wind Turbine Unit and Wind Farm Total	Diagram	D
	MW, MVAr vs time profiles for individual Wind Turbine Unit under normal ramp up and ramp down conditions.	Diagram	D
	High Wind Shutdown profile MW, MVAr vs time for individual Wind Turbine Unit and Wind Farm Total	Diagram	D
	Induction Generator Data		
	Make		
	Model		
	Type (squirrel cage, wound rotor, doubly fed)		
MBASE	Rated MVA	MVA	S,D,R1
PSO	Rated MW (*Sent out*)	MW	S,D,R1
PMAX	Rated MW (*Generated*)	MW	D
VT	Nominal Terminal Voltage	kV	S,D,R1
	Synchronous Speed	rpm	S,D,R1
	Rated Speed	rpm	S,D,R1
	Maximum Speed	rpm	S,D,R1
	Rated Frequency	Hz	S,D,R1
Qmax	Reactive consumption at PMAX	MVAr import	S,D,R1

1) Measurement of power quality characteristics (including flicker and harmonics) in accordance with IEC 61400-21 shall be provided for all wind turbines proposed for connection to the network. This will require a test report on flicker and harmonics in accordance with IEC61400-21

Symbol	Data Description	Units	Data Category
	Curves showing torque, power factor, efficiency, stator current, MW output versus slip (+ and -).	Graphical data	D,R1,R2
	Number of capacitor banks and MVAr size at rated voltage for each capacitor bank (if used).	Text	S
	Control philosophy used for VAR/voltage control.	Text	S
H	Combined inertia constant for all rotating masses connected to the generator shaft (for example, generator, turbine, gearbox, etc) calculated at the synchronous speed	MW-sec/MVA	S,D,R1
	Resistance		
Rs	Stator resistance	% on MBASE	D,R1
Rs	Stator resistance versus slip curve, or two extreme values for zero (nominal) and unity (negative) slip	Graphical data or % on MBASE	D,R1
	Reactances (saturated)		
X’	Transient reactance	% on MBASE	D,R1
X’’	Subtransient reactance	% on MBASE	D,R1
	Reactances (unsaturated)		
X	Sum of magnetising and primary winding leakage reactance.	% on MBASE	D,R1
X’	Transient reactance	% on MBASE	D,R1
X’’	Subtransient reactance	% on MBASE	D,R1
Xl	Primary winding leakage reactance	% on MBASE	D,R1
	Time Constants (unsaturated)		
T’	Transient	sec	S,D,R1,R2
T’’	Subtransient	sec	S,D,R1,R2
Ta	Armature	sec	S,D,R1,R2
To’	Open circuit transient	sec	S,D,R1,R2
To’’	Open circuit subtransient	sec	S,D,R1,R2
	Converter Data		
	Control: network commutated or self commutated		
	Additional data may be required by *Western Power*		
	Doubly Fed Induction Generator Data		
	Required data will be advised by *Western Power*		

ATTACHMENT 5

SCHEDULE S2 - GENERATING UNIT SETTING DATA

Description Category	Units	Data
Protection Data:		
Settings of the following protections:		
Loss of field	Text	D
Under *excitation*	Text, diagram	D
Over *excitation*	Text, diagram	D
Differential	Text	D
Under *frequency*	Text	D
Over *frequency*	Text	D
Negative sequence component	Text	D
Stator overvoltage	Text	D
Stator overcurrent	Text	D
Rotor overcurrent	Text	D
Reverse power	Text	D
Control Data:		
Details of *excitation control system* incorporating, where applicable, individual elements for power system stabiliser, under excitation limiter and over excitation limiter described in block diagram form showing transfer functions of individual elements, parameters and measurement units (preferably in IEEE format, but suitable for use in the software package nominated by *Western Power*. Currently, that package is PSS/E): The source code of the model shall also be provided, as per clause 3.2.10.	Text, diagram	D,R1,R2
Settings of the following controls:		
Details of the turbine control *system* described in block diagram form showing transfer functions of individual elements and measurement units (preferably in IEEE format, but suitable for use in the software package nominated by *Western Power*. Currently, that package is PSS/E). The source code of the model shall also be provided, as per clause 3.2.10.	Text, diagram	D,R1,R2
Stator current limiter (if fitted)	Text, diagram	D
Manual restrictive limiter (if fitted)	Text	D
Load drop compensation/VAr sharing (if fitted)	Text, function	D
V/f limiter (if fitted)	Text, diagram	D

ATTACHMENT 6

SCHEDULE S3 NETWORK AND PLANT TECHNICAL DATA OF EQUIPMENT AT OR NEAR CONNECTION POINT

Description	Units	Data Category
Voltage Rating		
Nominal v*oltage*	kV	S, D
Highest *voltage*	kV	D
Insulation Co-ordination		
Rated lightning impulse withstand *voltage*	kVp	D
Rated short duration power *frequency* withstand *voltage*	kV	D
Rated Currents		
Circuit maximum current	kA	S, D
Rated Short Time Withstand Current	kA for seconds	D
Ambient conditions under which above current applies	Text	S,D
Earthing		
System Earthing Method	Text	S, D
Earth grid rated current	kA for seconds	D
Insulation Pollution Performance		
Minimum total creepage	mm	D
Pollution level	Level of *IEC* 815	D
Controls		
Remote control and *data transmission arrangements*	Text	D
Network Configuration		
Operation Diagrams showing the electrical circuits of the existing and proposed main *facilities* within the *User's* ownership including *busbar* arrangements, phasing arrangements, earthing arrangements, switching *facilities* and operating *voltage*s.	Single line Diagrams	S, D, R1
Network Impedances		
For each item of *plant* (including lines): details of the positive, negative and zero sequence series and shunt impedances, including mutual coupling between physically adjacent elements.	% on 100 MVA base	S, D, R1
Short Circuit Infeed to the Network		
Maximum *Generator* 3-phase short circuit infeed including infeeds from *generating units connected* to the *User's system*, calculated by method of AS 3851 (1991).	kA symmetrical	S, D, R1
The total infeed at the instant of fault (including contribution of induction motors).	kA	D, R1

Description	**Units**	**Data Category**
Minimum zero sequence impedance of *User's network* at *connection point*.	% on 100 MVA base	D, R1
Minimum negative sequence impedance of *User's network* at *connection point*.	% on 100 MVA base	D, R1
Load Transfer Capability:		
Where a *load*, or group of *loads*, may be fed from alternative *connection points*:		
Load normally taken from *connection point* X	MW	D, R1
Load normally taken from *connection point* Y	MW	D, R1
Arrangements for transfer under planned or fault *outage* conditions	Text	D
Circuits Connecting Embedded Generating Units to the Network:		
For all g*enerating units*, all connecting lines/cables, *transformers* etc.		
Series Resistance (+ve, -ve & zero seq.)	% on 100 MVA base	D, R
Series Reactance (+ve, -ve & zero seq.)	% on 100 MVA base	D, R
Shunt Susceptance (+ve, -ve & zero seq.)	% on 100 MVA base	D, R
Normal and short-time emergency ratings	MVA	D,R
Technical Details of g*enerating units* as per schedules S1, S2		
Transformers* at *connection points:		
Saturation curve	Diagram	R

ATTACHMENT 7

SCHEDULE S4 - NETWORK PLANT AND APPARATUS SETTING DATA

Description	Units	Data Category
Protection Data for Protection relevant to Connection Point:		
Reach of all *protections* on *transmission lines*, or cables	ohms or % on 100 MVA base	S, D
Number of *protections* on each item	Text	S, D
Total fault clearing times for near and remote faults	ms	S, D, R1
Line reclosure sequence details	Text	S, D, R1
Tap Change Control Data:		
Time delay settings of all *transformer* tap changers.	Seconds	D, R1
Reactive Compensation (including filter banks):		
Location and Rating of individual *shunt reactors*	MVAr	D, R1
Location and Rating of individual *shunt capacitor* banks	MVAr	D, R1
Capacitor Bank capacitance	microfarads	D
Inductance of switching reactor (if fitted)	millihenries	D
Resistance of capacitor plus reactor	Ohms	D
Details of special controls (e.g. Point-on-wave switching)	Text	D
For each shunt reactor or capacitor bank (including filter banks):		
Method of switching	Text	S
Details of automatic control logic such that operating characteristics can be determined	Text	D, R1
FACTS Installation:		
Data sufficient to enable static and dynamic performance of the installation to be modelled	Text, diagrams control settings	S, D, R1
Under frequency load shedding scheme:		
Relay settings (frequency and time)	Hz, seconds	S, D
Islanding scheme:		
Triggering signal (e.g. voltage, frequency)	Text	S, D
Relay settings	Control settings	S, D

ATTACHMENT 8

SCHEDULE S5 - LOAD CHARACTERISTICS AT CONNECTION POINT

Data Description	Units	Data Category
For all Types of Load		
Type of *Load* eg controlled rectifiers or large motor drives	Text	S
Rated capacity	MW, MVA	S
Voltage level	kV	S
Rated current	A	S
For Fluctuating Loads		
Cyclic variation of *active power* over period	Graph MW/time	S
Cyclic variation of *reactive power* over period	Graph MVAr/time	S
Maximum rate of change of *active power*	MW/s	S
Maximum rate of change of *reactive power*	MVAr/s	S
Shortest Repetitive time interval between fluctuations in *active power* and *reactive power* reviewed annually	s	S
Largest step change in *active power*	MW	S
Largest step change in *reactive power*	MVAr	S
For commutating power electronic load:		
No. of pulses	Text	S
Maximum *voltage* notch	%	S
Harmonic current distortion (up to the 50th harmonic)	A or %	S

ATTACHMENT 9

TEST SCHEDULE FOR SPECIFIC PERFORMANCE VERIFICATION AND MODEL VALIDATION

A9.1 General

(a) Recorders should be calibrated/checked prior to use.
(b) Recorders should not interact with any *plant* control functions.
(c) One chart recorder shall be used to provide on site monitoring and rapid evaluation of key quantities during tests even though a digital recorder may be used.

A9.2 Recorder Equipment

<u>Digital Recorder</u>

Signals which are to be digitally recorded and processed require:
(a) an analogue to digital conversion with at least 12 bit accuracy at full scale.
(b) a sampling rate of at least 3000 samples per second (ie 3kHz) for up to 20 seconds unless specified otherwise.
(c) recordings in ASCII format in either a 3½” floppy disc or zip disc readable on IBM or IBM compatible computer.
(d) departure from linearity of no more than 0.1% in the slope of normalised output versus input. Normalised means value/full range value.
(e) DC offset errors not greater than 0.05% of full scale in the analogue circuitry.
(f) 20 - 30 recording channels are required

<u>Chart Recorder</u>

Signals which are to be recorded on charts require:
(a) a chart speed of at least 20mm/sec
(b) at least 10 second recording period
(c) at least 30mm in deviation of quantities
(d) compliance with (d) & (f) of requirements for Digital Recorder

<u>Tape Recorder</u>

Signals which are to be recorded on Tape require :
(a) analogue to digital transcription for analogue recordings **or** transcription to multiple chart recordings which are properly annotated.
(b) production of digital data in ASCII format on either a 31/2” floppy disc or zip disc.
(c) compliance with (d) & (f) of requirements for Digital Recorder.

A9.3 Frequency response

(a) Where digital or chart recordings of power *frequency* waveforms are to be made a minimum bandwidth of DC - 10kHz is desirable (0dB at DC, -3dB at 10kHz). Suitable filtering is required to eliminate aliasing errors.
(b) For relatively slowly changing signals (such as main exciter quantities, transducers for MW output etc) a recording device bandwidth of DC - 100Hz is desirable, the minimum acceptable bandwidth being DC - 10Hz.

A9.4 Signal Requirements and Conditioning

(a) Suitable input signal level should be used and allowance must be made for excursions during transients

(b) Subtraction of an appropriate amount of floating DC from input signals such as stator *voltage* should be provided so that any perturbations are clearly observable on an on site chart recorder

(c) Galvanic isolation and filtering of input signals should be provided whenever necessary.

A9.5 Form of Test Results

These shall consist of:

(a) a brief log showing when tests were done (time, date, test alphanumeric identification).

(b) chart recordings appropriately annotated.

(c) relevant schematics of equipment and the local network configuration.

(d) lists of data collected manually (eg meter readings).

(e) data in ASCII format.

(f) *SCADA* type printout showing the *power system* configuration at the start of, end of, and any other appropriate time during the test sequence.

(g) other relevant data logger printout (from other than those recorders referred to in Section A9.2).

A9.6 Test Preparation And Presentation of Test Results

Information/data prior to tests

(a) a detailed schedule of tests agreed by *Western Power*. The schedule should list the tests, when each test is to occur and whose responsibility it will be to perform the test.

(b) Schematics of equipment and subnetworks plus descriptive material necessary to draw up/agree upon a schedule of tests

(c) Most up to date relevant technical data and parameter settings of equipment as specified in Attachments 4 to 8 of these *Rules*.

Test Notification

(a) A minimum of 15 business day prior notice of test commencement should be given to *Western P~~p~~ower* for the purpose of arranging witnessing of tests.

(b) *Western Power*'s representative should be consulted about proposed test schedules, be kept informed about the current state of the testing program, and give permission to proceed before each test is carried out.

(c) Unless agreed otherwise, tests should be conducted consecutively.

Test Results

(a) Test result data must be presented to *Western Power* within 10 *business days* of completion of each test or test series.

(b) Where test results are not favourable it will be necessary to rectify problem(s) and repeat tests.

A9.7 Quantities to be Measured

(a) Wherever appropriate and applicable for the tests, the following quantities should be measured on the machine under test:

Generator and Excitation System

- 3 stator L-N terminal *voltages*
- 3 stator terminal currents
- *Active Power* MW
- *Reactive Power* MVAR
- Generator rotor field *voltage*
- Generator rotor field current
- Main exciter field *voltage*
- Main exciter field current
- AVR reference *voltage*
- *Voltage* applied to AVR summing junction (step etc)
- *Power system* stabiliser output
- DC signal input to AVR

Steam Turbine

- Shaft speed
- Load demand signal
- Valve positions for control and interceptor valves
- Turbine control setpoint

Gas turbine

- Shaft speed (engine)
- Shaft speed of turbine driving the generator
- Engine speed control output
- Free turbine speed control output
- Generator-compressor speed control output
- Ambient/turbine air inlet temperature
- Exhaust gas temperature control output
- Exhaust temperature
- Fuel flow
- Turbine control /load reference set point

Hydro

- Shaft speed
- Gate position
- Turbine control /load reference set point

(a) *Western Power* will specify test quantities for power plant other than those listed above, such as those consisting of wind, solar and fuel cell generators which may also involve AC/DC/AC power conversion or DC/AC power inverters.

(b) Additional test quantities may be requested and advised by *Western Power* if other special tests are necessary.

(c) Key quantities such as stator terminal *voltages*, currents, *active power* and *reactive power* of other *generating units* connected on the same bus and also interconnection lines with *Western Power network* (from control room readings) before and after each test must also be provided.

SCHEDULE OF TESTS

Table A9.1 - Schedule of tests

	TEST DESCRIPTION		
Test No	General Description	Changes Applied	Test Conditions
C1	Step change to AVR voltage reference with the generator on open circuit	(a) +2.5 % (b) -2.5 % (c) +5.0 % (d) -5.0 %	• nominal stator terminal volts
C2A	*Step change to AVR voltage reference with the generator connected to the system.* (with the Power System Stabiliser out of service) Generator output levels: (i)50% rated MW, and (ii)100% rated MW	(a) +1.0 % (b) -1.0 % (c) +2.5 % (d) -2.5 % (e) +5.0 % (f) -5.0 % repeat (e) & (f) twice see note i. below	• nominal stator terminal volts • unity or lagging power factor • system base load OR typical conditions at the local plant and typical electrical connection to the transmission or distribution system • tests for (i) should precede tests for (ii) • smaller step changes should precede larger step changes
C2B	*As for C2A but with the PSS in service*	Same as in C2A	Same as in C2A
C3A	*Step change to AVR voltage reference with the generator connected to the system.* (With PSS out of service)	(a) +5 % (b) –5 % repeat (a) & (b) twice;	• nominal stator terminal volts • unity or lagging power factor

	TEST DESCRIPTION		
Test No	General Description	Changes Applied	Test Conditions
	System Conditions : (i) system minimum load with no other generation on the same bus OR relatively weak connection to the transmission or distribution system, and (ii) system maximum load and maximum generation on same bus OR relatively strong connection to the transmission or distribution system	see note v. below	• Generator output at 100% rated MW
C3B	As for C3A but with the PSS in service	Same as in C3A	As for C3A.
C4	Step change of MVA on the transmission or distribution system PSS Status : (i) PSS in service, and (ii) PSS out of service	Switching in and out of Transmission or distribution lines (nominated by *Western Power*)	• nominal stator terminal volts • unity or lagging power factor • system base load OR typical conditions at the local plant and typical electrical connection to the transmission or distribution system • generator output at 50% rated MW
C5	load rejection (real power)	(a) 25 % rated MW (b) 50 % rated MW (c) 100 % rated MW see notes below	• nominal stator terminal volts • unity power factor • smaller amount should precede larger amount of load rejection
C6	steady state over-excitation limiter (OEL) operation	MVAr outputs at OEL setting slow raising of excitation to just bring OEL into operation	• 100% MW output • 75% MW output • 50% MW output • 25% MW output • min.MW output

	TEST DESCRIPTION		
Test No	General Description	Changes Applied	Test Conditions
		see notes below	
C7	steady state under-excitation limiter (UEL) operation	MVAr outputs at UEL setting slow lowering of excitation to just bring UEL into operation see notes below	• 100% MW output • 75% MW output • 50% MW output • 25% MW output • min. MW output
C8	Manual variation of generator open circuit voltage	Stator terminal volt (Ut) (a) increase from 0.5 pu to 1.1 pu (b) decrease from 1.1pu to 0.5 pu see notes below	• in 0.1 pu step for Ut between 0.5-0.9 pu • in 0.05 pu step for Ut between 0.9-1.1 pu
C9	MVAr capability at full MW output. System maximum load and maximum generation. Test conducted with as high an ambient temperature as possible.	Generator MW and MVAr output levels set to 100% of rated values and maintained for one hour.	• System maximum load and generation • Ambient temperature as high as possible

Notes:

i. for tests C2A and C2B care must be taken not to excite large or prolonged oscillations in MW etc. Therefore, smaller step changes should always precede larger step changes to avoid such oscillations.

ii. The Figure A9.1 below shows the step changes referred to in the schedule of tests given above. An example is given of a +5% step to the summing junction and then a –5% step. Removal of the +5% ("-5%") step is deemed to be a –5% step.

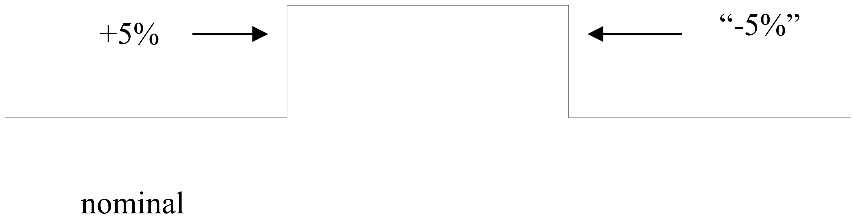

Figure A9.1 - Application of Step Signal

Unless specified otherwise the “-5%” step method shown in Figure 10.1 is used.

iii. for test C5, the instantaneous overspeed protection should be set at an agreed level depending on unit capability.

iv. “system” means “power system”

v. OR a lower step change, with a larger safety margin, as agreed by *Western Power*

vi. tests C1,C6, C7 and C8 need not be witnessed by *Western Power*

SPECIAL SYSTEM TESTS THAT MAY BE REQUESTED

Table A9.2 – Schedule of special system tests

Test No	TEST DESCRIPTION General Description	 Changes Applied	 Test Conditions
S1	Load rejection (reactive power)	(a) -30 % rated MVAR (b) +25 % rated MVAR see notes below	• nominal stator terminal volts • 0 or minimum MW output
S2	Load rejection (reactive power)	(a) -30 % rated MVAR see notes below	• nominal stator terminal volts • Excitation on Manual Control
S3	Step change of MVAR on the transmission system	Switching in and out of (a) a transformer (b) a reactor (c) a capacitor	• parallel transformers on staggered taps others as determined by WPC
S4	Islanding of a subsystem consisting of User's generators plus load with export of power via a link to *Western Power*'s main transmission system.	opening of the link	• 5-10% of generated MW exported via the link • 90-95% of generated MW used by the subsystem's load
S5	AVR/OEL changeover	transformer tap change OR small step to AVR voltage reference	• initially under AVR control at lagging power factor but close to OEL limit
S6	AVR/UEL changeover	transformer tap change OR small step to AVR voltage reference	• initially under AVR control at leading power factor but close to UEL limit
S7	Testing of a FACTS device (SVC, TCR, STATCOM, etc)	• step change to reference value in the summing junction of a control element • line switching • others as appropriate	• MVA initial conditions in lines as determined by WPC
S8	Tripping of an adjacent generator	tripping of generating unit(s)	• initial generator loading as agreed
S9	Variable frequency injection into the AVR summing junction (with PSS out of service)	0.01-100 rad/sec see notes below	• as determined by WPC
S10	Step change to governor/load reference	(a) 2.5 % step increase in MW demand signal (b) 2.5 % decrease in MW demand	• plant output at 50-85% of rated MW • others as agreed with *Western Power*

		signal (c) equivalent of 0.05Hz subtracted from the governor speed ref. (d) equivalent of 0.1 Hz added to governor speed reference see notes below	
S11	Overspeed capability to stay in the range of 52.0 to 52.5Hz for a minimum of 6 seconds	(a) Digital governor: use software, where practical, to put a step in the speed reference of the turbine governor such that the target speed is 52.0Hz and the overshoot in speed remains above 52Hz and in the range 52-52.5Hz for about 6 sec (b) Use a manual control to raise speed from 50Hz so as to stay in the 52 to 52.5 Hz range for a minimum of 6 sec (c) Where it is practical, use a function generator to inject an analogue signal in the appropriate summing junction, so that the turbine stays in the 52-52.5 Hz range for a minimum of 6 sec.	• Unsynchronised unit at rated speed and no load
S12	Underspeed capability	To be proposed by the manufacturer	

Notes:

i. For tests S1(a) and S2 the VAR absorption should be limited so that field voltage does not go below 50% of its value at rated voltage and at no load (ie rated stator terminal voltage with the generator on open circuit).

ii. For test S1(b) the VAR load should not allow stator terminal voltage to exceed 8% overvoltage (ie 108% of rated value) as a result of the applied change.

iii. For test S1 and S2, the instantaneous overvoltage protection should be operative and set at an agreed level greater than or equal to 10% overvoltage.

iv. For test S2, it may be easier to use AVR control first and then change to manual (provided the change is "bumpless") before the unit trips.

v. For test S9, care has to be taken not to excite electromechanical resonances (eg poorly damped MW swings) if the machine is on line.

vi. For the tests S10 plant characteristics may require the changes be varied from the nominal values given. Larger changes may be considered in order to more accurately determine plant performance.

vii. For test S5 a positive step is applied of X% from the sub-OEL value. But for test S6 a –Y% step from the sub-UEL value as shown in Figure A9.2 is required.

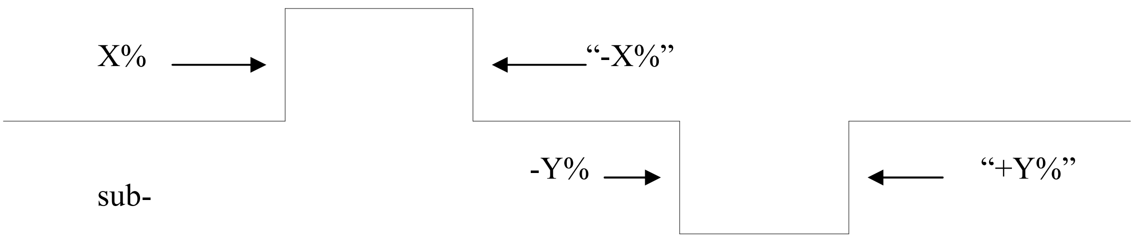

Figure A9.2 - Application of Step Signal

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Appendix 3 – Resolutions of the Technical Rules Committee

Appendix 3.1 provides details of the discussion of issues that the Committee was unable to reach consensus on.

Appendix 3.2 details issues where the Committee has reached a resolution but the agreed changes have not been adopted in the Technical Rules at Appendix 2.

Appendix 3.3 details the issues that have been considered and completed by the Committee. This section therefore shows the changes made from the Technical Rules submitted to the Authority on 24 August 2005 in producing the conformed Technical Rules at Appendix 2.

APPENDIX 3.1 - CONTENTIOUS ISSUES

CHAPTER 1 – GENERAL

1.8.1 Variations And Exemptions To The Code

Issue

- The last paragraph should be reviewed as it exists in the Access Code and does not need to be repeated.

Discussion

Western Power advised that their legal advice recommends that the clause be retained, as the Access Code does not apply to consumers. The Committee's position was that the clause should be deleted.

It was agreed that Western Power would seek further legal advice. The Committee has not been advised of the results of this review.

The Committee has not been able to reach a satisfactory conclusion to the issue.

Suggested Action

Authority to consider whether this paragraph should be retained.

CHAPTER 2 – TRANSMISSION AND DISTRIBUTION NETWORK PERFORMANCE AND PLANNING CRITERIA

2.2.1 Frequency Variations

Issue

- The inclusion of operation up to 52.5 Hz is at variance with the other clauses in the section. For example, in a multiple contingency event in table 2.1 the frequency is not to exceed 52 Hz.

Discussion

Western Power has deleted the provision, leaving specification of frequency variations to Table 2.1.

However, this did not fully address the concern of the User Representative on the Committee who provided the following further comments:

> *"I still have fundamental problems with item 137, clause 2.2.1. I do not believe there is a large gas turbine being built today that can comply with the letter of table 2.1. It is my understanding that Western Power have given exemptions to two of the new gas turbine plants and have been asked for exemption from a third. If Western Power are going to exempt all large turbine sites from strict compliance it should be in the regulations to avoid capricious application of the regulations. If they are not going to exempt large*

turbine sites I must continue my objection to the clause on the basis that it could be used to restrict new generation to steam turbines and runs counter to the Government objectives of reducing generation costs in the SWIS".

Further Note: The Committee member concerned has advised that whilst he still maintains his position in relation to this clause, the fact that under Section 12.38 of the Access Code, the Service Provider must advise the Authority, and the Authority must publish any exemptions granted should mitigate the possibility that Western Power may use this requirement capriciously.

The issue remains open, and is considered by the member to be a barrier to entry.

Suggested Action

The Authority should consider whether the requirements set out in Table 2.1 are appropriate.

2.3.7 Stability Assessment

Issue

- Western Power requires studies to take account of the worst credible load and generation pattern and most severe credible contingency event, without considering whether the combination of these events is still credible; and
- the extent of investment required to prevent blackouts appears excessive and could be avoided by adopting a more probabilistic approach.

The User presented the following example to illustrate their concerns:

> *"For the Eastern Goldfields case, minimum generation pattern, fault at 1% of line length on a 3-terminal transmission line (with slow clearances), bolted 3-phase-to-earth fault, all 4 saturated reactors (2 at Merredin and 2 at Kalgoorlie) being at the bottom of their control limits, concurrently at peak Eastern Goldfields load with outage of largest capacitor bank in the EGF, plus slower of protection operating schemes to be used … this was deemed to be a "credible" scenario by WPC in a previous study. Each contingency is arguably 'credible' but the coincidence / combination of all events had a probablility of less than 1 in 500,000 for any given year ! Resultant effect is voltage collapse, similar to loss of the main 220kV line or major fault in WPC's system which had a higher probability of occurrence. "*

Discussion

The Committee member's view is that Western Power needs to move towards a probabilistic approach in studies, rather than defaulting to their traditional deterministic approach, which tends to stack contingencies on top of contingencies.

The member believes that this is an area of frequent disagreement between Western Power and Users, which results in a significant barrier to entry.

Western Power advised that a number of these contingency events are interlinked, i.e. if one event occurs, another will generally follow. There is also a tendency to be conservative with regard to big system events.

However, a User noted that a voltage collapse event will result in the lights going off. The extent of investment required to prevent this appears excessive and could be avoided by adopting a more probabilistic approach. Although all events could occur individually, it is unlikely that they will all occur simultaneously.

Western Power's response was that voltage collapse events also damage plant with potentially substantial financial consequences. Western Power advised that whilst it could apply probability criteria at the zone sub-station level, doing the same for the main system would require a vast amount of data.

The Authority representative offered to seek advice from PB Power. The Committee proposed that these consultants should be provided with the assumptions currently applied by Western Power and requested to examine their appropriateness. Their response follows:

> *"**The Regulatory Response**:*
>
> *The short response is as follows; the current technical rules do not provide sufficient direction to make a determination on the issue raised. We do not feel that it is either possible or advisable to construct a mechanism within the technical rules that would be able to provide clarity or direction at the level of technical detail sufficient to reconcile the issue at hand.*
>
> *In the longer version;*
>
> > *The "dispute" between the 2 parties appears to be one where both are approaching a complex technical issue from the perspective that best suits their respective businesses. This is, of course, how they should be approaching the issue.*
> >
> > *If we assume that both parties are factually correct in their analysis (although this has not been proven – refer below discourse), then the fact that they are not in agreement indicates that there is a degree of ambiguity as to the application of technical standards. From PB's experience, it is quite likely that both analyses could fall within the current envelope described by "good electricity industry practice" (GEIP).*
> >
> > *The system planning standards applied across the Australian electricity industry vary considerably both between and within businesses. Therefore it is possible (possibly likely) that both parties are applying GEIP in arriving at their respective positions.*
> >
> > *It would be possible to construct a prescriptive set of principles within the Technical Rules that would minimise, but not completely remove, the potential for ambiguity and divergence in the application of system planning standards. These rules would be very detailed and lengthy and most certainly be inconsistent with the level of detail in the other sections of the technical rules. They would also have the adverse affect of reducing the opportunities for efficiency and innovation by Western Power and would certainly become out-dated in a relatively short space of time as planning standards continue to evolve.*
> >
> > *Therefore, we do not feel that it is either possible or advisable to construct a mechanism within the technical rules that would be able to provide clarity or direction at the level of technical detail sufficient to reconcile the issue at hand.*
> >
> > *In this scenario, the only remaining mechanism for deciding on the correct outcome would appear to be the legal system.*

***The Technical Response**:*

1. *With the limited information to hand, it is difficult to completely understand the problem. While we agree that this study scenario appears to assume a combination of circumstances that one would expect to occur very rarely, the information provided then states that the impact is the same as if there is a fault on the long stringy line or even if there is a fault on the main system around Perth. The issue should be the frequency with which any event will occur that places the system over a particular stress threshold, not the probability of a particular scenario occurring.*

2. *It is no surprise that there are stability issues. The Western Australia system has these two generation centres interconnected by a very long low voltage line. The arrangement is analogous to two weights connected together by a spring. If the spring is very stiff and you move one weight the second weight will move with the first if the spring is very stiff. As the spring becomes weaker the degree to which the second weight will follow the first reduces. In this case the "stiffness" of the 420 km 220 kV line is inadequate given the amount of generation at the Kalgoorlie end.*

3. *It appears that whether or not a three phase fault is a credible contingency is not the real issue. If a fault in the Perth metropolitan area will cause Kalgoorlie generation to go unstable than I would expect a single phase to earth fault on the 220 kV interconnection to also be problematic, and nobody is arguing that such a fault contingency is not credible. If single phase faults can cause problems then the issue of whether or not a three phase fault is a credible contingency is irrelevant. It is also not clear to me whether the concern is voltage stability, rotor angle stability or both. There is talk about a voltage stability problem but the fact that the main concern arises when all the generation in Kalgoorlie is running indicates to me as if the problem is rotor angle stability. There are a couple of parts of the NZ grid where there are voltage constraints (including Auckland which is a real worry) but the problem is too <u>little</u> generation at the constrained end – not too much.*

4. *We also have concerns about the way the terms "probabilistic" and "deterministic" are used since the analogy with network planning is flawed. Whether or not the grid will be unstable under a particular operating condition if a fault occurs in a deterministic problem. Assessing the frequency with which such events are likely to occur is probabilistic. Since instability will make it difficult to maintain frequency within tolerance the issue becomes the appetite of the Western Australian consumers to tolerate frequency (and voltage) oscillations on the network. Given that the decision has now been made to connect a combined cycle gas turbine to the network, Western Power's nervousness about the situation is understandable.*

5. *What is probably required are stability studies to get a better feel as to the types and locations of faults that create a problem under different system operating conditions. An assessment can be then be made as to the frequency of such fault occurring – historic fault data would be analysed to provide objective information. This would then allow a technical operating envelope to be developed so that that the probability of faults occurring that would cause stability problems is low enough to be acceptable. "*

Further, Western Power advised that there can be concerns over the accuracy of modelling, so management measures are conservative. While Western Power does take the worst case scenario fault strategy, they indicated that over time, the policy had been to relax these requirements gradually.

The Committee agreed that whilst this was welcome, follow up discussions with Users would be useful.

Despite this, the User holds the following view:

> *"Traditional approach used by Western Power in stacking contingencies in studies needs to be balanced against the probability of the stacked events occurring simultaneously, and the consequences. If the intent is to determine the 'technical envelope', fine. The problem is with the application of the technical envelope. The concept of an envelope is that it defines the upper (or lower) boundaries and recognises there is a wide area inside the envelope in which the probability of events are more likely but the consequences are considerably less severe. Western Power should allow operation within the technical envelope. Instead, traditional approach is Western Power stacks the contingencies, finds the extreme edge of the envelope and uses this as operational constraints but does not allow or recognise operation inside the envelope - leading to considerable loss of commercial opportunities. E.g. if stacking of contingencies results in finding the absolute export level is 40MW, but more likely system conditions is actually such that system can safely support an export level of 100MW, Western Power still imposes the 40MW export limit resulting in 60MW of loss opportunity or sales. There needs to be a fundamental change of direction in how Western Power approaches system studies for the purpose of defining ultimate technical operational limits, versus interpreting that into commercial constraints."*

The Committee considers that this issue is contentious.

Suggested Action

Western Power should be required to develop a set of agreed criteria and agreements that could be used as a pro-forma for providing more certainty to prospective Users in relation to the terms under which system studies are carried out.

CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

3. TECHNICAL REQUIREMENTS OF USER FACILITIES

3.2.3 Provision of Information

Issue

- The requirement for the 'User to provide all data reasonably required by Western Power' is sometimes impossible to obtain, despite the request being deemed reasonable;
- The possibility of access applications being held back because of Western Power requiring irrelevant data; and
- why is it necessary to provide for the data request in the Technical Rules rather than in the specifications to purchase machinery.

Discussion

User representatives of the Committee advised that it can be difficult to obtain the information required by Western Power and proposed that the information should be provided only when feasible. Members suggested that the overarching reasonableness clause would address the issue.

User representatives of the Committee expressed concern at the possibility of an access application being held back because of Western Power requiring non-relevant data, and that users should have a way out if they are unable to provide the data requested. Western Power contended that it would be unreasonable for Western Power to continue requesting data if the user cannot provide it.

The Committee requested that Western Power consider covering the data request in the specifications to purchase machinery and as part of the access application process. No changes were made to the Technical Rules as a result.

The Committee requested Western Power to provide advice as to why it is necessary to provide for the data request in the Technical Rules rather than in the specifications to purchase machinery. Western Power's response was that the proposed approach is good electricity industry practice, and provided the following justification:

1. *"The relevant international and Australian standards permit data to change, sometimes considerably, from the specification to delivery;*
2. *It is important to get data prior to connection being granted in order to enable power system studies to be done and it is difficult to obtain data after that; and*
3. *The plant performance, data and modelling parameters may change considerably during plant operation, which crates the need for on-going verification."*

The Committee considers that this issue is contentious as agreement could not be reached between members.

Suggested Action

The Authority should consider requiring Western Power to redraft the section so that Western Power is only able to request relevant and reasonably available data.

<u>3.2.4.1 Reactive power capability</u>

Issue

- The power factor performance range of alternators connected to the transmission system of 0.8 lag to 0.9 lead was considered by Users on the Committee to be excessive.
- Connections in the distribution system at 33kV and below this power factor range may be acceptable, requiring generators to supply down as low as 0.8 into the transmission system is unreasonable and significantly increases the cost of the equipment, which in turn will be passed onto the ultimate users.
- Western Power should respecify the power factor performance range to 0.9 lag to 0.9 lead.

Discussion

Western Power proposed to establish different reactive power capability requirements for synchronous and non-synchronous generators and stated that it was important to enforce these requirements in light of strongly increasing demand for reactive support on the network. Western Power also clarified that "the point of common coupling" referred to the generator's terminal.

The Committee noted that, in the case of generators with embedded loads, it is unreasonable to require a higher power factor at the connection point than that actually needed by the generator, given its export capability to the network, only to cover reactive power capability requirements. Western Power agreed with this.

The Committee also suggested that synchronous generators should be given the option to provide the required reactive power capability using a technology of their choice so long as they are able to meet Western Power's requirements.

Members of the Committee agreed that these requirements issue may constitute a barrier to entry due to excessive costs. Western Power was requested to explore the options discussed and prepare a paper on the matter for the Committee's consideration.

Western Power has provided a paper on reactive power capability to the Committee, which is at Appendix 4. Western Power advised that since that time, they are preparing an updated version of the paper on reactive power capability that would include reference to the relevant Australian and international standards (AS 1359.101:1997 and IEC 60034-1:2004) which specify that "… the rated power factor for synchronous generators shall be 0.8 lagging (over-excited)…". Western Power advised that this reference demonstrates that Western Power's plant performance requirement of Section 3.2.4.1(a) is consistent with the relevant standards.

The Committee is in deadlock on this issue as User representatives consider these requirements to constitute a barrier to entry.

<u>3.2.4.3 Generating Unit Response to Disturbances in the Power System</u>

Issue

- Western Power requirements exceed those limits set by the IEC, and that Western Power does not take into account the comparative size of the alternator to the power system. User suggested amending to be in line with IEC.
- The specification appears to be more onerous than the National Code and requires continuous unrestricted operation over a wide range of frequencies. The User advised it is likely that none of the machines on the system at the moment are capable of these requirements and it would not be possible to obtain manufacturers consent to do this.
- In section 3.2.4.3(a) , the requirement for Users to ensure generating equipment capable of remaining in service for frequency limits as in Figure 3.4 is onerous for particular machines. The User gave the example that steam turbines and gas turbines typically have UF thresholds set by OEM's at 47.5Hz or higher so are incapable of continuous operation at that level.
- The requirement in section 3.2.4.3(b) to ensure generating unit capable of continuous uninterrupted operation even while voltage at connection point is between 0-80% for 450ms or up to 110% for 10 secs is too onerous.

- Iin section 3.2.4.3(c) where Users generators are required to be capable of uninterrupted operations at 4 Hz/sec is too onerous. The User suggested that Western Power instead implement an UFLS scheme to prevent such a high rate of change of frequency.
- The terms “leading” and “lagging” have different meanings from the generator’s and the network’s perspectives. A User suggested these be replaced these terms with “absorb” and “supply”.

Discussion

Western Power advised that the smaller the system, the more frequency variations are experienced. These requirements have been established to ensure generators do not trip.

A User indicated that in their view, the time that generators are required to run at the suggested frequencies constitute a barrier to entry. Western Power advised that this is not a continuous requirement because there is an obligation on Western Power to return the system to its normal operation status as soon as possible.

Further submissions from Western Power on this matter are at Appendix 4.

The Committee requested that Western Power provide explanation of the changes that have been made to 3.2.4.4, regarding whether the requirements have been relaxed, whether the relaxation material/ sufficient, what the impact is of the new sub clause (f) is expected to be, and whether it is reasonable.

Western Power provided the following comment:

> *“The deletions have brought the provisions in line with the NER, having regard for the different frequency control standards (and capability) of the much smaller WP system.*
>
> *Similarly, the new clause (f) has been included as it is proposed in the latest NER revision. It is our understanding that it was triggered by problems with non-synchronous generators that were tripping because of the sensitivity of their inverters to low volts. This new section (f) eliminates possibility for different interpretations by allocating the responsibility to each generating unit to produce enough MW or MVAr in order to generate enough voltage drop across their own connection asset (typically the step-up transformer and line) so that their generators remain connected when the volts at the connection point drop to zero. This permits designers of such a plant to optimise internal plant design behind the connection point.*
>
> *Regarding clause (c), the new NER revision proposes exactly the same clause and the same value of 4 Hz per second. They came independently to the value of 4 Hz per second, which would be experienced in Tasmania following the loss of the DC link to the mainland.”*

The Committee has not been able to reach a satisfactory conclusion to the issue.

3.2.4 Monitoring and Control Requirements

Issue

- There is insufficient technical detail to control what Western Power ask for where they ask the User to supply the Remote Monitoring Equipment for power stations and user substations; and
- Where Western Power require power quality monitoring to be fitted to the users facilities on a case by case basis then the costs should be borne by Western Power if the users facilities meet this code in relation to power quality and performance.

Discussion

Users requested more detail as to what is required for the Remove Monitoring equipment, which can vary in technical and commercial cost and complexity at the discretion of Western Power.

Western Power asserts that some amendments have been made and that the NER provides less detail of requirements than the Technical Rules, and so provision of more detail is not justified.

The Committee noted that this is not reasonable justification for not providing the requested information and is deadlocked on this. Users consider that this provision represents a material barrier to entry.

Suggested Action

That Western Power provide detail of the reasonable capabilities of the equipment expected.

3.2.5.5 Excitation Control System *(previously numbered 3.2.5.4)*

Issue

- The requirement that all synchronous generators >30MW must have power system stabilisers (PSS) without any test as to whether this is a necessity for the particular network connection is an imposition. The User noted that the National Electricity Code does not require PSS and suggested that these should be required only if there is a demonstrated need for them.

Discussion

Western Power's response was that the provision of power system stabilisers is recognised as good industry practice, and has minimal cost for new generators. Western Power proposed no changes to this provision.

This is an issue on which the Committee is deadlocked, Users consider that the requirement is unreasonable.

3.4.2.5 Maximum Acceptable Total Fault Clearance Time

Issue

- Sufficient detail is not provided with regard to the requirement that the Plant be protected by two independent protection schemes of differing principle;
- Fault clearance times in Tables 3.3 and 3.4 are significantly slower that in NEC, reflection of slow clearance times in Western Power's network compared to the

NEC. The User gave the example of > 220kV, where the NEC table stipulates Local end = 100ms and Remote end = 120ms, whilst Western Power's table stipulates: Local end = 120ms and Remote end = 180ms;

- Slow fault clearance times lead to instability of generators and sustained depression of voltage levels in the system affecting customer installations. The User suggested these conditions would subject the User's generators would to unnecessary operational constraints, higher installation costs and export limitations;
- Western Power should aim to align the protection clearance times within its system to match the NEC, preferably on a proactive basis, but as a minimum when the performance of that system is unduly affecting Users;
- Narrative sections were to be removed from the Technical Rules; and
- Western Power's practice of adding a further 20ms to the operating times when calculating total fault clearance times should be discontinued.

Discussion

A User noted concern that clearance times in Western Power's rules are significantly longer than what they consider would be regarded as acceptable in today's electricity industry.

They also expressed a view that Western Power's practice of adding a further 20ms to the operating times when calculating total fault clearance times should be discontinued. Western Power has advised the Committee that some changes have been made in relation to this practice, including the reductions of the 'safety margin' to 10ms. However, User concerns remain as to the rationale for using 20ms or 10 ms as opposed to any other number (including 0).

The Committee also noted that narrative sections were to be removed from the Technical Rules. Western Power has replaced a large part of the 'narrative' in section 3.4.2.2 with simpler statements. Western Power noted that the changes are consistent with and required by, moving most Protection clauses to 2.10. The Committee agreed that the concern over the inclusion of 'narrative' were addressed.

The Committee noted the need to clarify the requirement for a plant to be protected by two independent protection schemes of differing principles. Western Power advised that the section should read that minimum requirement is that systems have two protection schemes, and if the system is Critical Fault Clearance Time it should have two independent protections schemes of differing principle. Users considered that the redrafting provided by Western Power did not clearly address the User concern.

Users questioned why Western Power deals with slow fault clearing times by standardising to the lowest common denominator instead of using average system fault times.

Western Power advised it set slow fault times where the system can deal with slow fault times. Where a faster time is necessary, the new standard is applied. All new plant is required to comply with the faster times. This enables costs to load users to be kept to a minimum.

The Committee have been unable to reach a satisfactory resolution to the issue and considers the issue to be deadlocked

CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

There are no contentious issues in chapter 4.

CHAPTER 5 – POWER SYSTEM SECURITY

5.3.2 Western Power's Obligations

Issue

- Sections 5.3.2(b) and (c) are of a legal nature and should be removed from the Technical Rules.

Discussion

Western Power sought legal advice on whether they should remove the subclauses from the Technical Rules and advised that based on this, they were unwilling to remove the clauses.

Western Power’s response was to retain the section 5.3.2(b) and (c) following further legal advice was for the following reasons:

1. *“The obligation of Western Power dealt under this clause pertains to the power system as a whole and, as such, it should be placed in the Rules.*
2. *The obligation of Western Power dealt under this clause is not directed towards any individual User, therefore it should not be placed in the Access Contract.*
3. *The very general nature of the provisions demands that they be left in the Rules: they provide a limit on Western Power's obligations which should apply in the case of every access-seeker. It is not a provision which should be the subject of negotiation in each case.*
4. *Such provisions are better placed in the Technical Rules so that they are non-negotiable.*
5. *These provisions limit Western Power's obligations to do certain things to only making "reasonable endeavors".*
6. *It is entirely proper for Western Power's responsibility for the matters discussed in sections 5.3.2(b) and (c) be limited to "reasonable endeavors", because of the vagaries of running the Network in accordance with the Rules: Western Power should not be held to have beached its obligations for events beyond its reasonable control.”*

In contrast, the legal advice that was provided by the Authority recommends the subsections be deleted:

> *“In my view, it is not appropriate for clauses 5.3.2(b) and 5.3.2(c) to be contained in the technical rules.*
>
> *Nature of clauses 5.3.2(b) and 5.3.2(c) of the proposed technical rules:*
>
> *Section 12.1 of the Electricity Networks Access Code 2004 (Code) sets out the objectives of the technical rules, being 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.*
>
> *Section 12.32 of the Code states "[u]nless a different form of technical rules will better achieve the Code objective or the objectives set out in section 12.1, the technical rules must address the matters listed in Appendix 6."*
>
> *Appendix 6 contains a non exhaustive list of what the technical rules must contain. It is clear from Appendix 6 that the technical rules should consist of detailed rules concerning the standards, procedures and planning criteria governing the construction and operation of an electricity network.*
>
> *Clauses 5.3.2(b) and 5.3.2(c) are limitations on Western Power's obligations under the technical rules. They do not prescribe obligations on Western Power but rather concern a situation where Western Power has not complied with the technical rules. That is, they are invoked once a party has alleged that Western Power has not fulfilled its obligations under the technical rules. They do not concern the standards, procedures and planning criteria governing the construction and operation of an electricity network. Accordingly, in my view, they concern a legal issue rather than a technical one.*
>
> *As noted above, section 12.1 of the Code and Appendix 6 require that the technical rules consist of detailed rules concerning the standards, procedures and planning criteria governing the construction and operation of an electricity network.*
>
> *The technical rules do not stand alone. A party seeking access to Western Power's network will also enter into other instruments with Western Power such as a contract for services. It is in these instruments that issues of a legal nature, such as issues concerning breaches of obligations and limitations of a party's rights, are more appropriately dealt with.*
>
> *Further, section 12.5 of the Code provides that the technical rules prevail over a contract. This is important to ensure that the standards, procedures and planning criteria governing the construction and operation of an electricity network are uniform. However, issues concerning the legal rights between the parties (including limitation of those rights) should be dealt with by the parties rather than being overridden by section 12.5 of the Code and the technical rules. Therefore, in my view, clauses 5.3.2(b) and 5.3.2(c) should be removed from the technical rules."*

The Committee has not been able to reach a satisfactory conclusion to the issue, and this is an issue of deadlock

<u>5.5.1 Transmission and Distribution Network Voltage Control</u>

The Authority is referred to the discussion under Stability Assessment (TR 2.3.7)

<u>5.6.5 Partial Outage of Power Protection Systems</u>

Issue

- Western Power must act reasonably and be liable to a post-event objection. The User raised the concern that section 5.6.5(c) seemed to say that Western Power is not accountable for the actions it takes in the event of a partial outage; and
- Is this clause appropriate in this chapter, and within the Technical Rules as a whole.

Discussion

Western Power that 5.6.5(c) was required and noted concern that the systems operators should not be constrained from making decisions because of concern about possible future impacts.

The Committee recognised the need to ensure that System Management is uncontrained in its decision making. However, Users remain concerned at how the commercial implications of these decisions had been resolved.

5.8.2 Protection or Control System Abnormality

Issue

- The commercial impact of the requirement for Users to operate per Western Power's direction if Western Power considers it a threat to system security to be large.

Discussion

The Committee has not been able to reach a satisfactory conclusion to the issue and User concerns remain in relation to the potential commercial impacts of such a direction.

5.8.3 Managing Electricity Supply Shortfall Events (56)

Issue

- The clause, previously numbered 5.8.5(a)(3), is a policy issue rather than a matter for the Committee; and
- Can contractual arrangements override the Technical Rules?

Discussion

Western Power clarified that this section's intent is to manage load-shedding in an equitable way. The purpose is to have general rules to allow Western Power to undertake load-shedding.

The Committee noted that the Authority may not accept having a policy on supply preferences in the Technical Rules. Members of the Committee also questioned if shedding should be allowed to affect an embedded load.

Western Power advised that in the case of embedded loads, contractual arrangements would override the Technical Rules. The Committee indicated that Western Power should confirm that contractual arrangements could override the Technical Rules and whether there is the need for a specific notice that this could be contracted out of.

Western Power advised it would seek further legal advice to confirm that contractual terms and conditions can override the Technical Rules in this case. Western Power has not provided this information to the Committee at the time of writing this report.

The Committee has not been able to reach a satisfactory conclusion to the issue.

Action required

Western Power should provide clarification that contractual arrangements can override the Technical Rules. Section 12.5 of the Access Code suggests otherwise.

CHAPTER 6 – DEROGATIONS

There are no contentious issues in chapter 6.

APPENDIX 3.2 - RESOLVED ISSUES PENDING REDRAFTING

The following issues have been agreed by the Committee but are not reflected in the conformed Technical Rules at Appendix 2.

Chapter 1 – General

1 GENERAL

Issue

- Western Power should consider numbering all paragraphs of the Technical Rules for ease of identification and reference. For example, the bullet points currently in section 1.2 should be avoided.

Outcome

Western Power agreed to consider this. However, it was not resolved.

Suggested Action

As an issue of drafting style, and for clarity of use, the ERA should consider requiring Western Power to number each paragraph in the Technical Rules.

1.1 AUTHORISATION

Issue

- Member suggestion that the first paragraph of section 1.1 should be "Users" instead of "users".

Outcome

Western Power agreed to this amendment.

Suggested Action

Western Power to amend.

1.2 APPLICATION

Issue

- A review of the references to Western Power in the first bullet point of this section is required as the references were considered to be confusing.

Outcome

Western Power agreed that this clause contained a confusion of terms.

Suggested Action

Western Power to amend part c) of this section by changing the first reference to "Western Power" to "other business units in Western Power".

Issue

- There should be a clarification between the Network Service Provider and the System Operator, as there is in the National Code.

Outcome
Western Power contended that this was time consuming and not essential at this time.

Suggested Action

Western Power to suggest amendments necessary to distinguish between System Management and the Network Service Provider

Issue

- The phrase “who impact” in point (b) of the section following “These Rules apply to all plant and equipment installed..” should be altered to include users who may impact on the operation of the networks.

Outcome
Western Power agreed to this amendment.

Suggested Action

Western Power to amend this section to remove the words “who impact”.

<u>1.7.1 Obligations of Users</u>

Issue

- The term “good electricity industry practise” should have capital letters.

Outcome

Western Power agreed to this amendment.

Suggested Action
Western Power to capitalise the words “Good Electricity Industry Practise”.

<u>1.8.1 Variations And Exemptions To The Code</u>

Issue

- The word “phrase” should be used instead of “terms” to avoid the connotation of a contract.

Outcome

Western Power agreed to this amendment.

Suggested Action

Western Power to amend this section to include the word “phrase’ instead of “terms”.

CHAPTER 2 – TRANSMISSION AND DISTRIBUTION NETWORK PERFORMANCE AND PLANNING CRITERIA

2.1 INTRODUCTION

Issue

- The third line of the second paragraph of the introduction be amended to require that variations must not materially affect Users.

Outcome

The Committee noted that an adverse effect may be small, but under this clause Western Power could still not allow variations.

A Committee member also suggested that that if the User requires it Western Power should demonstrate to the User. Western Power commented that adding "to the User" is not appropriate because there will probably be many Users affected by a Western Power action. Western Power also suggested that "must be able to demonstrate", be left, rather than "must demonstrate to (the regulator)" because the regulator would not want to deal with every instance.

Western Power agreed to redraft the section

Suggested Action

Western Power to amend this section to say, 'In particular circumstances *Western Power* may vary the requirements. However, where it intends to do so *Western Power* must be able to demonstrate that the variation will not have a material adverse effect on *Users* and *power system security*.".

2.2.2 Power Frequency Voltage Variations

Issue

- The nominal voltage (415Kv) should be stated in this section.

Outcome

Western Power agreed to the amendment and noted that use of '415 V' is required by legislation.

Suggested Action

Western Power to amend this section by inserting '(415 V)' after 'low voltage' in the last sentence of the first paragraph.

2.2.3 Voltage fluctuations

Issue

- Is the intent to require that the referenced standard is complied with. (see also section 2.2.4)

Outcome

Members of the Committee suggested that if all this information complies with Australian Standards, it should just say "comply with requirements of Australian Standards".

Western Power advised that this is dependent on whether these standards comply with Australian Standards and questioned if standards would change automatically

Western Power also noted that the national code states the year of the Australian Standards.

Western Power advised that the designation of Standards includes the date at the end e.g. ":2001" and agreed to amend the rules to this effect.

Suggested Action

Western Power to amend this section to include the date in all references to standards.

Issue

- A definition of "emission levels/limits" and reconciliation of sections a) and b) with c) and d) is required.

Outcome

Members of the Committee noted this section contains formatting issues and uses the terminology emission levels/limits interchangeably. The Committee noted the need to use tighter language.

Western Power agreed to this amendment.

Suggested Action
Western Power to change all references in the section to the most appropriate term and provide a definition in the glossary.

2.6.2 Thermal limits

Issue

- Users were concerned that the language of the document appears to model an internal document.

Outcome

Western Power agreed to review this section and amend the narrative content.

Committee Suggested Action

Western Power to amend the section as follows:

> *"1) Transformers: Normal cyclic rating as defined by AS2374 - 7*
>
> *2) Switchgear: Normal manufacturer's name plate rating, de-rated for ambients above normal service conditions nominated in AS2650, using AS3768 criteria*
>
> *3) Lines: Summer or winter continuous ratings appropriate for the season based on:*
>
> > *(a) ambient temperature being that for 1% probability of daily maximum temperature not being exceeded over the summer season (December to February), and 25C for winter;*
> > *(b) wind speed being 1.0m/s crosswind*
> > *(c) solar radiation being 1000W/m2 (mid bright - weathered surface); and*
> > *(d) conductor design clearance temperature as defined in ESAA Code C(b)1.*

4) Cables: Normal cyclic rating, calculated using the methodology specified in IEC 60853, with maximum operating temperatures of 90 degrees for XLPE cables; 70 degrees for 11kV paper insulated cables, and 65 degrees for 11kV paper insulated belted cable, and 22 kV and 33 kV paper insulated cables. During an emergency, for a period of up to 12 hours, the maximum operating temperature for paper insulated cables shall be raised to 80 degrees C, and for XLPE insulated cables 105 degrees.
Underground cable ratings must be based on measured soil thermal resistivity at 1% moisture summer, and 4% winter, otherwise 2.5 C.m/w for summer."

2.9 Distribution Carrier Selection *(previously numbered 2.12)*

Issue

- This section appears to be a statement of policy rather than a technical requirement.

Outcome

Western Power reviewed this section and agreed to amend.

Suggested Action

Western Power to amend the section to read "Western Power must select:", followed by the existing dot points.

CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

3.1 INTRODUCTION

Issue

- The requirement that all users, generators and load must be able to de-energise their own plant, equipment or substation without reliance on Western Power imposes a significant unnecessary cost and therefore constitutes a barrier to entry for new generators.
- This is not in the old rules or the Interim Technical Code, at least for generators. In existing arrangements in WA where there are generator CBs, the Generator Step-up Transformer (and Auxiliary Transformers in many cases) remain connected to the system when the generator circuit breaker is open. All rely on Western Power to de-energise these transformers.
- Network switching is required for all existing Western Power generators connected to the transmission system, whether or not they have generator circuit breakers, and to new and proposed power stations currently in development. The older Western Power units (all generators at Kwinana and Muja) require network switching each time a generating unit is place in or out of service. They also require network switching to isolate station auxiliary transformers.
- In other Australian jurisdictions, network switching is employed to connect and disconnect generation (most of the large units) or to de-energise generator transformers (smaller or more recent units). Normal practice is to have a single disconnector (isolating switch) at the Grid Company switchyard, and maybe another disconnector at the transformer if the connection point is several kilometres away.

Outcome

Users indicated that currently all users and generators rely on Western Power to de-energise and an issue may arise with the connection and disconnection of Western Power's own equipment if networks and generation are separated.

Western Power informed that this section had been included to ensure each party is given appropriate control consistent with its liability and agreed to consider whether this section could be dealt with under the access contract.

The Committee noted that in its redrafting, Western Power has incorporated two new clauses instead of considering whether the section could be moved to the access contract.

In relation to 3.1.1, members of the Committee requested that Western Power provide advice regarding the intent of this provision. Western Power's response was that section 3.1.1 belongs to Chapter 3 of Technical Rules as it addresses a particular technical requirement and clarified that the intent of 3.1.1 is to address the original clause, which was capable of different interpretations (as evidenced by the comments). The new clause more carefully defines the present practice.

Western Power also suggested that the second point of the section could be rewritten to read,: "Western Power must ensure that the User's design is such that the User can:..".

Members of the Committee also questioned how the User is to know whether they can clear a fault without reducing network reliability (and how is this defined), and requested clarification of the terms "'meshed substation" and "visible point of isolation".

Western Power noted that "network reliability" is defined in Chapter 2 and agreed to include "Visible point of isolation" and "meshed substation" in the Glossary.

The Committee also noted that subparagraph 5 is a legal concept that is covered in the Access Contract. Western Power agreed to delete this paragraph.

A member of the Committee questioned the origin of the clause 3.1.2 and expressed that it appears to be an attempt to somewhat relax some of the requirements on system studies, but required redrafting unless Users consider that it is reasonable. Western Power's response was that the section originated from Chapter 2 and had been revised to address Committee comments. Western Power advised that they consider that the content is fair and reasonable, but that the text may benefit from further review.

Suggested Action

Western Power to amend the section by:

- Amending the second point to begin, "Western Power must ensure that the User's design is such that"
- Including definitions of "visible point of isolation" and "meshed substation" in the Glossary; and
- Deleting the fifth paragraph.

Issue

- Concern at the use of 'User' and the definition of 'customer'.

Outcome

Western Power has amended the term 'user' in the clause.

The Committee noted also that the definition of 'customer' conflicts with the definition under the *Electricity Industry Act 2004*. Western Power agreed to amend the definition.

Suggested Action

Western Power to amend the definition of 'customer' to reflect the definition in the *Electricity Industry Act 2004*.

3.2 REQUIREMENTS FOR CONNECTION OF GENERATORS

Issue

- Connection requirements for < 66kV should not be contained in separate WPC document (NP-2005). They should be included as part of Technical Rules.

Outcome

Members of the Committee suggested that the contents of the NP-2005 document should be included in the Technical Rules so the document includes all requirements for generators. Western Power informed that NP-2005 is being reviewed. Western Power also confirmed that NP-2005 still regulates the requirements for small generators until the Technical Rules are approved under the Access Code.

Western Power agreed to finalise revision of the NP-2005 document and include it as an attachment to the Technical Rules.

Suggested Action

Western Power to include the document NP-2005 as an attachment to the Technical Rules.

Issue

- The comment box in this section is not an appropriate justification for the 10MW limit for small generators and is repetitious.

Outcome

Members of the Committee questioned whether the use of a market threshold is appropriate for a technical requirement.

The Committee requested that Western Power provide advice regarding the justification for the 10MW threshold or an explanation of why it needs to be tied to the Wholesale Electricity Market requirements.

Western Power agreed to remove repetition in the section, and advised that while they consider that the 10MW threshold provides equity among market participants, Western Power would consider an alternative proposal for the threshold.

Suggested Action

Western Power agreed to amend the section by changing to threshold for small generators to 0.05MW and deleting the second sentence.

Issue

- The statement, "Users and Western Power shall not be adversely affected by transients cause by relatively large non-synchronous generators" as they considered it to be commentary is not a technical requirement.

Outcome

Western Power clarified that the statement was meant to be an obligation. The Committee agreed that Western Power should reword the sentence as an obligation and remove any duplication. The clause has been deleted and is not in the Technical Rules at Appendix 2.

In addition, the Committee noted that the conformed Technical Rules appeared to contain two new paragraphs. The first paragraph was considered by some Committee members to not make sense, and the second appeared to address the issue but seemed vague and surely better dealt with either explicitly as part of system design and actual technical requirements.

Western Power clarified that the paragraphs were relocated within the section. Western Power also agreed to put the last paragraph into context by adding ' Unless stated otherwise the technical requirements of most Users are specified at their connection points, except that the requirements for synchronous generators are specified at their terminals.' to the section 3.1, the introduction.

Suggested Action

Western Power to amend the second to last paragraph of section 3.2 to , "Users that connect non-synchronous generators must ensure that they do not permit them to produce transients that have a material adverse effect on other Users or Western Power." to provide clarity".

<u>3.2.1 Technical Characteristics</u>

Issue

- Section 3.2.1(b) appears to be commentary.

Outcome

Western Power agreed that the clause could be clarified.

Suggested Action

Western Power to amend the section to read, "b) A User that applies to connect a generator that does not meet the requirements of clause 3.2.1 must make necessary changes to the generator, step-up transformer, turbine, inertia constant, turbine control or excitation system, etc, of the synchronous/induction generating unit or of the control system characteristics/behaviour of an inverter or converter coupled generating unit to satisfy this clause before connection.".

<u>3.2.4.1 Reactive power capability</u>

Issue

- Section, 3.2.1(4)(c) states that the generator connection must be designed to permit the dispatch of the full active and reactive power capability of the installation. However, sometimes network conditions or access agreement conditions preclude dispatch at full machine capability so why design for maximum when the actual value could be less.

Outcome

Committee members requested that Western Power advise why this clause cannot be specified so that the limit is agreed in the Access Agreement, with the maximum Limit at User discretion.

Western Powers agreed that the Reference is to reactive power capability of the installation. Western Power clarified that this means the nett capability after allowing for auxiliary power and captive loads, and iIf generator does not wish to export full capability this can be stated in access contract.

Suggested Action

Western Power to amend this section by adding 'nett' to the clause between the words 'full' and 'active'.

3.2.4.3 Generating Unit Response to Disturbances in the Power System

Issue

- Clarification of the requirement in section 3.2.4.3(d) is required.

Outcome

Western Power explained that the section relates to the reapplication of faults in the event of an unsuccessful high speed auto re-closing.

Suggested Action

Western Power to amend the section by changing the end of (d) to "including the reapplication of the fault during unsuccessful reclosing".

3.3.5 Design Requirements for Users' Substations

Issue

- Section 3.3.5(k) should be worded as a precondition of connection.

Outcome

Western Power agreed to this amendment.

Suggested Action

Western Power to reword the clause as a requirement of connection.

3.4.2.14 Details of Proposed User Protection

Issue

- The timeframe for notification is too long, creating an unreasonable constraint on users who do not have this information available within their system due to design constraints for larger projects. Users suggested amending the 12 month notification period to 6 months.

- 30 business days for a response from Western Power is excessive, where 20 working days is more in keeping with most contractual arrangements.

Outcome

The Committee noted that generators may not have the full details information available 12 months before. A Committee member advised that the reasonable time depends on type of plant.

Western Power outlined for the Committee the times for submission and review and suggested there would not be time for implementing changes.

Member of the Committee suggested deleting the word 'full" and adding the word 'sufficient' to mean that if Western Power were to make an additional query the User would need to answer it.

Western Power agreed to these amendments.

Suggested Action

Western Power to amend the section by:

- Altering the review period to '… within 3 months of signing the access contract but not later than a minimum of 6 months prior to *energisation";*
- replacing "full" with "sufficient"; and
- altering the time for Western Power to respond to 20 working days.

CHAPTER 4 - INSPECTION, TESTING, COMMISSIONING, DISCONNECTION AND RECONNECTION

<u>4.3.1 Voluntary Disconnection</u>

Issue

This appears in the Model Access Contract. Suggest that the network access agreement should require the notice to disconnect or otherwise it is unnecessary.

Outcome

The Committee agreed that subclause 4.3.1(a) should appear either in the Model Access Contract or in the Technical Rules.

Suggested Action

Western Power to remove the section from the Technical Rules.

<u>4.3.2 Decommissioning Procedures</u>

Issue

- clarification of the phrase "such access agreement" in subclause 4.3.2(b).

Outcome

Western Power agreed to amend this clause.

Suggested Action

Western Power to amend this section to read "such an access contract".

4.3.6 Obligation to Reconnect

Issue

- Is it reasonable to require a guarantee that a breach won't reoccur?

Outcome

The User suggested instead saying "has done all things as a reasonable and prudent operator to ensure it doesn't reoccur". Western Power advised that their legal advice was to retain "binding undertaking" in the clause and agreed to include the phrase 'good electricity industry practice'

Suggested Action

Western Power to amend the section to read, "binding undertaking consistent with *Good Electricity Industry Practice*."

CHAPTER 5 – POWER SYSTEM SECURITY

5.1 SCOPE

Issue

- The paragraph entitled "Scope" should be reviewed.

Outcome

Western Power agreed to redraft the section.

Suggested Action

Western Power to amend the section say, "This section covers Power System Operations, Outage Planning and Co-ordination of Network and Users Facilities. The Rules acknowledge that the Wholesale Electricity Market Rules also cover Outage Planning for generators registered as Market Generators and holding capacity credits. Section 5.9 of the *Rules* does not apply to those generators.".

5.4.1 Operational Frequency Control Requirements

Issue

- Not all generators have turbines.

Outcome

Western Power agreed to amend the section. Further analysis showed an overlap with the Wholesale Electricity Market Rules. Part of the section has been deleted, as they are considered to be covered in the Market Rules Ancillary Services provisions.

Suggested Action

Western Power to amendment the section to remove the word 'turbine', add the word 'prime mover', and move the clause to chapter 3.

5.5.2 Reactive Power Reserve Requirements

Issue

- User suggestions to consider replacing the term ‘most critical contingency event’ with ‘most onerous credible event’ in section 5.5.2(a).

Outcome

Members of the Committee agreed that Western Power should consider replacing the term ‘most critical contingency event’ with ‘most onerous credible event’.

Western Power's view is that The term “critical credible contingency event” is preferred over “most onerous credible event” as it used in National Electricity Rules in its section 4.2.3(d. Western Power advised that the “critical single credible contingency event” at any particular time is the single credible contingency event considered by NEMMCO, in the particular circumstances, to have the potential for the most significant impact on the power system at that time. This would generally be the instantaneous loss of the largest generating unit on the power system or alternatively might be the loss of any interconnection under abnormal conditions.

The Committee agreed that this explanation sufficiently addresses the issue.

Western Power also agreed to as defined in the Market Rules, to ensure the consistent use of defined terms.

Suggested Action

Western Power to amend the section by replacing the term ‘Satisfactory Operating State’ with ‘Normal Operating State’.

5.6.1 Power System Fault Levels

Issue

- Western Power should be obliged to advise users when there is a material change in fault levels that may affect the user.

Outcome

The User noted that Users may not know what changes have been made to the system and the original wording requires them to ask. The Committee discussed whether the onus to advise of changes to fault levels should be on Western Power.

Members of the Committee noted that from the perspective of safety, system security and the management of communication flows, the suggestion is well-founded. Western Power agreed to notifying Users (but not consumers) and redrafted the section to “…ensure that there is public information available..”.

Members of the Committee suggested that this did not reflect the intent of the issue, which was to proactively notify users. The Committee agreed that sending an email to Users was appropriate.

Western Power advised they could inform registered Users by email that fault levels have been updated and displayed on the web. However, Western Power’s view is that it must be the ultimate responsibility of Users to inform themselves of the updated fault levels and it must be the responsibility of Users to register for the circulation list and keep their email address updated.

Suggested Action

Western Power to amend the section to reflect that they will send an email notifying of changes to fault levels to the User's registered email address.

CHAPTER 6 – DEROGATIONS

There are no issue which are resolved pending agreed drafting changes in Chapter 6.

APPENDIX 3.3 – RESOLVED ISSUES

CHAPTER 1 – GENERAL

1.2 APPLICATION

Issue
That a final bullet point regarding small generators was added to the redrafted copy.

Outcome

Western Power explained that the section has been moved to section 3.2 and was originally intended for when there was not a separate section 3.5 for small generators.

Western Power proposed that an additional consultation process for small generators on section 3.5 be held.

Western Power also suggested a similar process may be appropriate for the After Diversity Maximum Demand (ADMD) issue. It was clarified that the ADMD issue was referred to the Committee and was best addressed by them.

Status

Complete

CHAPTER 2 – TRANSMISSION AND DISTRIBUTION NETWORK PERFORMANCE AND PLANNING CRITERIA

2. TRANSMISSION AND DISTRIBUTION NETWORK PERFORMANCE AND PLANNING CRITERIA

Issue

The document needs to be proof read to correct typographical and grammatical errors.

Outcome

Western Power agreed with this comment and agreed to review the drafting. Western Power also noted that the current draft also addresses comments made by PB Power in its review, and generally attempts to define accountabilities for all matters.

In addition, the Committee agreed to carry out a review of the documents prior to completion.

Status
Complete

2.1 INTRODUCTION

Issue

Is the third paragraph of the introduction unreasonable? A valid study has to be performed and if a study by a third party is valid, then Western Power has no right to withhold its consent. Moreover the same rights and obligations should accrue to a User regardless of who conducted a valid study. The parties should negotiate the terms of reference of the study and the party to undertake it in a reasonable commercial manner.

Outcome

Users noted that the sentence "acceptance of power system studies by Western Power does not absolve Users of responsibility/ liability for damages or losses incurred by others" is a commercial clause and should be in the Model Access Contract.

Western Power agreed to remove the reference to costs.

Users also noted that the section on studies should have a separate heading outlining the contingencies to be studied. Western Power noted that the issue also exists in Chapter 3 in the obligations on generators and that a section on system studies should only exist in one place.

Uers advised that Western Power and Southern Cross Energy had previously agreed on a study guidance template prior to a study being carried out. This document was to be circulated and discussed at a future Committee meeting.

The section has been moved to a new section, 3.1.2: Power System Simulation Studies.

Status

Complete

<u>2.2.1 Frequency Variations</u>

Issue

Clarification of the significance of the statement in the second paragraph. The suggestion to phrase the third paragraph positively, that operation inside the range should be taken into account.

Outcome

Western Power agreed to review the paragraphs with a view to deleting them. Western Power amended the second paragraph and deleted the third paragraph.

Status

Complete

Issue

a)The frequency ranges appears to be phrased so as to constrain recovery. Suggest restyle them.

b) What the difference is between the "multiple contingency" section and the "emergency" aspects of section 2.6.0.

Outcome

a) Users suggested that instead of specifying the contingency in Table 2.1 section on Multiple Contingency, Western Power should use ‘less than’.

b) The Committee noted that section 2.6.0 repeats information in Table 2.1 and suggested that 2.6.0 says “Steady state frequency limits will be in accordance to frequency in Table 2.1”

Western Power agreed to amend the sections by changes to the table and amendments to 2.6.0.

Status

Complete

Issue

The definition of “Normal Operating Frequency Band” says to refer to section 5.2.1, which then refers you to Table 2.1. Suggest the definition refer straight to Table 2.1.

Outcome

Western Power agreed to amend the definition to refer to Table 2.1.

Status

Complete

2.2.2 Power Frequency Voltage Variations

Issue

Definitions in the glossary are needed for the terms normal, maintenance and emergency conditions.

Outcome

Western Power agreed to add definitions for these terms to the glossary. This is reflected in the Technical Rules at Appendix 2.

The Committee also suggested that Western Power go the through the document to ensure the definitions are consistent. The Committee also requested Western Power explain if these requirements interact with the Wholesale Electricity Market system states and if they should be used here.

Western Power advised there is no inconsistency with Wholesale Electricity Market states.

Status

Complete

2.2.3 Voltage fluctuations

Issue

The section below Table 2.2 should be reviewed and amended to improve is readibility.

Outcome

Western Power agreed to review and amend the style of this section.

Status
Complete

2.2.5 Voltage Unbalance

Issue

The clarity of the sentence at the third paragraph of section 2.2.5 would be improved by restructuring into multiple sentences.

Outcome

Users noted that the paragraph is very confusing and it is assumed to mean that Western Power has two responsibilities: responsible for network assets, and pursuit of all methods under the code to remedy if users do not perform to specified standards.

The Committee also agreed that Western Power was to redraft the section to reflect the national code.

After the submission of the 7 November version of the Technical Rules the Committee noted that Western Power inserted new text in the section but had not addressed the issue that the provision requires a better structure. The Committee enquired whether the drafting now reflects the national Code.

Western Power replied with the following comment:

> *"The original text was consistent with the first issue of the NEC. The current NER is more complex and prescriptive, and this is considered to be unwarranted. The suggested amendment was intended to improve the structure by deleting paragraph 3, and restating the intent as an addition to paragraph 1.*
>
> *If this has not achieved the aim Western Power would agree to reverting to the original, or considering an alternative structure."*

Status

Complete

2.3 STABILITY

Issue

That there is unnecessary a lot of preamble on definition of stability and types / classification of stability which should be removed.

Outcome

Western Power noted that if a preamble clarifies matters, it may be useful to retain. Users were of the view that that the Technical Rules should only contain rules, not unnecessary explanations. Western Power to consider transfer of all additional comments and explanations to a reference document, e.g. guidelines.

Western Power agreed to remove narrative material from the Rules.

Status

Complete

2.3.1 Large Disturbance Rotor Angle Stability

Issue

This section also contains unnecessary preamble. Users suggested that the only portion that is relevant is item in box, i.e. Criteria is “all generators connected to the power system shall remain in synchronism”, and requested clarification on the the definition and measurement of “in synchronism:”.

Outcome

Western Power agreed to insert a definition of “in synchronism” and remove narrative text from the section.

Status

Complete

Issue

The requirement for “all generators to remain in synchronism” should be clarified.

Outcome

Users noted that a generator will not always be able to remain in synchronism. The requirement should be qualified e.g. by the words “within technical envelope”.

However, Western Power advised that the technical envelope will not contain sufficient detail to address this issue. The technical detail is contained in paragraph 2.3.4.

The Committee also queried the difference between paragraph 2.3.1 and Chapter 5 as they both appear to deal with network stability. Western Power advised that Chapter 2 deals with planning criteria, while Chapter 5 specifies the day-to-day requirements on the network service provider and users to maintain network stability.

Western Power has amended this section,

Status

Complete

Issue

The Safety Margin refers to Attachment 1 – Glossary, definition of total fault clearance time, try to simplify.

Outcome

Western Power agreed to include ‘10ms’ in the main text of the document..

Status

Complete

Issue

The remainder of the clause contains more narrative text. Also the reference to 2.3.4.1 is not relevant here. These should be removed.

Outcome

Western Power agreed to remove the narrative text in the section and remove the reference to section 2.3.4.1. This is reflected in the Technical Rules at Appendix 2.

Status

Complete

<u>2.3.2 Small Disturbance Rotor Angle Stability (previously 2.3.1.1: Damping of Power System Oscillations)</u>

Issue

Clarification of the measurement of criteria mentioning ratios of 0.1, 0.5 would be useful.

Outcome

The Committee noted it would be useful to insert a graph which illustrates damping.

Western Power agreed to include a graph either in the Rules or in the reference document.

In addition, the Committee noted that at present, the rules require damping ratios to comply with the standards set out in paragraphs (a) to (c). The Committee queried whether damping ratios should meet all these requirements, or whether these requirements have inadvertently been combined. Under the NEC, they do not appear to be cumulative.

Western Power agreed to examine whether they have been combined correctly (i.e. which apply to power system oscillations, and which apply to excitation control systems?).

Western Power has redrafted this section and advised that it does not consider that including a graph in the Rules would add value or lessen confusion. Western Power agreed that this should be included in a reference document in due course.

Status

Complete

<u>2.3.3 Frequency Stability (previously numbered 2.3.2)</u>

Issue

Suggest removing the motherhood clause or clarifying its relevance.

Outcome

The Committee noted that Chapter 2 generally specifies the system standards. However, at times, it also specifies functions of the network service provider.

Western Power agreed that to the extent that Chapter 2 contains rules which specify functions of the network service provider, these rules will be transferred to Chapter 5.

Western Power agreed to delete the section.

Status

Complete

2.3.4.1 Long Term Voltage Stability (previously 2.3.3.1: Voltage Stability Criterion)

Issue

The measurement to ensure ‘Voltage instability does not occur …’ should be clarified, for example volts does not drop below X p.u. for Y msec, or that a voltage collapse does not occur. ‘Voltage collapse’ should be defined.

Outcome

Users suggested that definitions of “voltage instability” and “voltage collapse” should be inserted. Western Power agreed and inserted the necessary definitions.

The Committee noted that it is unclear who takes which “necessary steps”. It was agreed that the Rules should clearly specify which obligations apply to which parties.

Western Power redrafted this section to include an explanatory note submitting that this Explanatory Note will improve the clarity of the provision, and avoid disputation.

Users questioned the value of the explanatory note, as it appears narrative. In addition, it questioned Western Power’s previous agreement to transfer NSP to Chapter 5 from Ch 2 when it should be the other way around.

Status

Complete

2.3.6 Transient Overvoltages *(previously numbered 2.3.3.3)*

Issue

Users questions whether this section is stating the obvious, and whether it could be deleted..

Outcome

Users questioned whether this obligation applied only to the Network service Provier. Western Power confirmed this.

Users also questioned whether the statement adds value to the Technical Rules. It was noted that the statement ensures that Western Power will use surge arresters. Users noted that the statement requires further clarification as it is unclear to what extent surge arresters should be used.

The provision has been amended.

Status

Complete

Previous section 2.3.3.5: Post-fault Voltage Recovery Limit

Issue

There should also be a criteria which says that if a generator improves an area's voltage dip performance from prior to connection of the generator, even if it does not meet the criteria in absolute terms, should still be regarded as acceptable /pass. – e.g. in the Eastern Goldfields. Effectively, a 'no worse / better than before' criteria - i.e. any improvement to the voltage dip and/or recover times than prior to the addition of a new generator in a region who's TVD performance is poor, should be deemed acceptable.

For example, in the Eastern Goldfields, connection of Independent Power Producers (IPP's) provides additional reactive reserves, and improves system stiffness and considerably speeds up the voltage recovery for the whole region post fault clearance, but may be slightly outside of the stipulated voltage recovery time limits.

Furthermore, studies used to quantify the TVD/ PFVR performance must take into account the modelling of motors within the whole power system (not just in the metropolitan area) and tripping of such motors as the voltage dips below known industry thresholds.

Note: WPC's system model allows for tripping of motors only in the metropolitan area and does not allow for tripping of any motor load in the Eastern Goldfields despite voltage levels dropping to nearly zero during faults. This makes the voltage recovery more onerous than in reality as the motors would need to re-accelerate up to speed again, and depresses the voltage for longer in any study which uses this model.

Outcome

Users noted that refusal to connect a new generator to the network because it does not meet the criteria of clause 2.3.3.4 could be prohibitive for new entrants.

Western Power indicated that they provided a redraft of a number of clauses of Chapter 2 (including clause 2.3.3.4, which is now clause 2.3.3.2). Western Power also indicated that the new criteria for non-Perth areas are a substantial relaxation of Western Power's previous criteria and should not be relaxed any further.

The Committee noted that in areas where the network already meets the requirements set out in (redrafted) clause 2.3.3.2, a new generator will (by definition) always have to meet the requirements of this clause. However, in areas where the network does not meet these requirements, a generator should be allowed to connect if its connection results in an improvement of the area's voltage dip performance – regardless of whether the generator meets the requirements of clause 2.3.3.2.

Areas where the network does not meet the requirements of clause 2.3.3.2 are generally on the outskirts of the network. If you want to attract new investment into these areas you will have to create attractive conditions.

Western Power agreed to examine whether our entire network meets the conditions of clause 2.3.3.2. If so, no further amendment is required to clause 2.3.3.2. If not, Western Power will revise.

Western Power advised that the technical intent of these two clauses has been combined into the new clause 2.3.4.2, and a new title has been used: "short-term voltage stability". This combines and relaxes the two criteria. The text has been relocated under the general heading of “voltage stability”. Note that the previous version did not make clear what the criteria were addressing.

Status

Complete

2.3.8 Credible Fault Types *(previously 2.3.4.1: Fault Types to be Studied)*

Issue

This section includes 3-phase-to-earth faults. This is not credible or considered credible in the NEC..

Outcome

Western Power clarified that three-phase-to-earth faults are considered credible events in the National Electricity Market. This can be inferred from S5.1.2.1 and S5.2.5.1 of the NEC.

Users suggested that Clause 4.2.3(e) of the NEC suggests that these faults are not considered credible events in the NEM but noted that the NEC could be interpreted either way.

Western Power advised that to amend this clause, Western Power needs robust evidence that treating these faults as non-credible events will not adversely impact on power system security.

The Committee agreed that an alternative solution would be to include a section that specifies the criteria Western Power will apply when selecting credible events, and when deciding whether to stack these events or not. Users agreed that Western Power should consider redrafting with regard to this.

Users considered that Western Power’s amendmentsodn’t address the issues and requested that Western Power advise why they haven't provided the section specifying criteria that apply, and when deciding to 'stack' events.

Western Power’s response is as follows:
The credible fault types are consistent with the NEM, noting that WP does not generally achieve sufficiently low tower footing resistances (due to soil type) to satisfy the NEM threshold for use of two-phase to earth faults. WP has checked historic fault records and has confirmed a sufficiently high incidence of three phase faults to justify this. PB Power’s report is consistent with this conclusion.

The Committee is satisfied that this explanation addresses the issue, given that the National Electricity Code appears open to interpretation.

Status

Complete

2.4.1 Load to be Available for Disconnection

Issue

The references to the last paragraph and the corresponding clause of the network access agreement are circular.

Outcome

Users suggested that the correct place for this section is the access contract.

Western Power noted that this section should be redrafted to differentiate between bigger and smaller customers, for bigger customers there will be some negotiation, for smaller customers there will be none.

Users noted that the rules at appendix 2 incorporate some changes to allow for load shedding facilities for larger customers. and requested that Western Power provide further justification for retaining this section in the Technical Rules.

Western Power replied as follows:

> *"The intent of this section is to establish WP's obligations to procure and manage load shed services. This includes requiring load shedding to be provided by some, but not all, Users. Those who are required to provide the service should be given some information about reasonable requirements, or else they might think they are being victimised and disputes would ensue. Detailed arrangements would certainly need to go in Contract of those affected. It would not be a standard requirement.'*

Status

Complete

2.5 Planning criteria

Issue

Several references to 'the making available of capacity' are vague and in need of better definition.

Outcome

Users noted that sections 2.5.1.3, 2.5.1.4 and 2.5.1.5 refer to spare capacity, which should be better defined and that these sections should describe the current state of the system rather than what the Network Service Provider is going to do, making it difficult for generators planning to come onto the system.

Western Power does not agree and would be wary of changing their approach on this issue.

Users noted that as Western Power plans internally it makes it hard for new generators to plan where to place generation. This is not just for new entrants, but also existing ones.

Western Power amended this section, including deletions of the references to spare capacity.

Status

Complete

2.5.1.1 N-0 Criterion

Issue

N-0 criterion is applied to the 220kV network supplying the Eastern Goldfields, but N-1 on other parts of that network and for assessing IPP generator connections. Generators are no different to the 220kV line so should equally be assessed on N-0 criteria. Suggest this is recognised and the section amended accordingly.

Outcome

Western Power advised that they no longer apply the N-0 criterion for the Eastern Goldfields Region network. Western Power agreed to amend the Technical Rules accordingly.

A User suggested that the criteria used to asses the network should be consistent with those used to assess generators. Western Power noted that the reliability of generators is a market issue, while the reliability of the network is a network issue. The Technical Rules should only deal with network issues.

Status

Complete

2.6.2 Thermal limits

Issue

Is the list of steady state voltages a repetition of section 2.2.2?

Outcome

Western Power agreed that the section was repetitive and agreed to amend the section to avoid duplication.

Status

Complete

2.6.3 Fault rating limits

Issue

Most residential fault clauses will be 6kA or 3kA. The Technical Rules should have fault levels that residences can maintain. Also, this section needs to refer to nominal voltage of 415kV.

Outcome

Western Power agreed to review and amend this section, but advised it cannot specify anything above current standards.

Status

Complete

Previous section 2.8: Environmental Criteria

Issue

Users advised it was appropriate to state Western Power's environmental policy in the Rules This is also an issue in 2.8.1. Suggest adding "as revised from time to time".

Outcome

The Access Code requires compliance with all laws. There is no need to repeat these policy statements.

Western Power agreed to delete

Status

Complete

CHAPTER 3 – TECHNICAL REQUIREMENTS OF USER FACILITIES

<u>3. TECHNICAL REQUIREMENTS OF USER FACILITIES</u>

Issue

The document contains discretions to the benefit to Western Power. For example, 3.4.3.8 says "unless otherwise agreed by Western Power".

Outcome

Western Power agreed to tidy the drafting style and take into account the overarching reasonableness clause when conferring discretions on itself.

Status

Complete

Issue

General comment covering clauses 3.2, 3.2.5.2, 3.2.5.4, 3.3.2, 3.3.7.2, 3.4.2.16, 3.4.2.17, 3.4.3.5 and 3.4.3.10. There are prolific references to the allocation of costs.

Outcome

Western Power agreed to remove references to costs from the Technical Rules..

Status

Complete, references to costs have been removed throughout the Technical Rules.

<u>3.2 REQUIREMENTS FOR CONNECTION OF GENERATORS</u>

Issue

This section does not take into account the size of the generation unit in relation to the system. At 10 or 20 MW the system interface and stability performance may be all right but at 200 MW and above the system is so small and weak that the user cannot meet these requirements. This disadvantages large suppliers.

This same constraint is not placed on MUJA, Collie or other large units within the system.

Suggest amending to take account of size of unit in relation to total system load.

Outcome

The Committee recognised that the issue is that all generators of 10 MW and above are treated the same way, despite the fact that the impact that they may have on the system varies greatly. Users believe that because WP does not have to comply with these requirements there is a competitive neutrality issue and a bias against large units.

The Committee requested that Western Power provide advice as to why it is not possible to take account of the size of the unit in relation to total system load. Western Power's response was as follows:

The issue is not the size of the generator relative to the system load, but the size of the generator relative to the strength of the system at the point it is connected. A small generator connected to distribution systems can have as much impact as a large generator connected to a transmission system. (Consider that it is not possible to connect a large generator to a distribution system.

Conversely if the small generator is connected to the transmission system it would have little effect: but this does not often happen). Note also that generators connected to distribution systems may be subjected to greater influence from network disturbances, because distribution faults remain connected for longer times.

Each case needs to be considered on its merits, and it is not possible to define requirements based solely on generator size. All generators, including Collie and Muja, met the requirements of the time of their connection.

The Committee considers this response addresses the issue.

Status

Complete

Issue

Pre-emptive assumption that all generators need 'power system stabilisers' in order to meet the requirement of the technical code. Suggestion that the clause specify the requirements without prescribing solutions to achieve the requirements.

Outcome

The Committee discussed whether the requirement for all generators to have power system stabilisers, irrespective of whether system stability studies warrant it, are an unnecessary cost imposition.

It was noted that the cost of retrofitting machines is high (around $100,000). Western Power advised that there would need to be a strong case for Western Power to require the retrospective installation of power system stabilisers.

Users suggested that the requirement to have power system stabilisers should be limited to new plants. This should be a recommendation, not an obligation.

Western Power advised that the more generators that have power system stabilisers, the easier it is to control oscillations. If all Users share the costs, it will help the system work better for longer. USers agreed that if the power system stabilisers are needed to maintain the steady state of the system, then there may be a need for this requirement.

The Committee also requested that Western Power address that there were a few sections in chapter 3 which deal with the same issue and that the wording of the section should be tidied.

The Technical Rules that Western Power submitted to the Committee on 7 November 2005 did not reflect these outcomes. The Committee requested that Western Power advise why the drafting had not been tidied, whether any of the duplicate sections has been amended, and why it is possible or not to amend this section to provide further comfort to users.

Western Power's response was as follows:

> *"We considered redrafting and concluded to retain reference to stabilisers in Section 3.2 for the sake of clarity and ease of reading. An alternative would be to delete the whole second part of the sentence (where reference is also made to the inertia and short-circuit ratio).*
>
> *Retrofitting is not required for existing generators, as per the blanket derogation of Chapter 6. So all will have the original equipment, except Western Power who has retrofitted stabilisers on all its machines after SWIS experienced widespread system oscillations. HF agreed that stabilisers are needed because they help to maintain steady state of the system, in the same manner turbine governors are needed. We discussed that, in both cases, the best outcome is achieved by sharing the control duty among all, or as many as possible, machines in the power system, and concluded that the requirement should stay."*

The Committee considers that Western Power's explanation addresses the issue.

Status
Complete

3.2.1 Technical Characteristics

Issue

Disconnection of generators causing low fault levels – requires 'other action to be address..'. Such as, and why? Need to clarify intent or consequences.

Outcome

Western Power advised that this requirement only applies to plants that are at the design/installation stage to avoid new plants from affecting other users.

Western Power agreed to redraft the section so that the requirement to take 'other action' only applied to plants at the design stage.

Status

Complete

3.2.2 Technical Matters to be Co-ordinated

Issue

In section 3.2.2(b), why is physical layout adjacent to connection point an important issue?

Outcome

Western Power advised that the section has been included to deal with safety issues related to telecommunication lines, water pipes and so forth. Users noted that the user is required to provide Western Power with a signed written statement certifying that its equipment meets statutory safety requirements, 3.2.2(b) is not needed. In addition, 3.2.2(a) appeared to cover the content of 3.2.2(b).

Western Power agreed to delete section 3.2.2(b

Status

Complete

Issue

The statement ‘Prior to connection to the Western Power power system, the User shall have provided to Western Power..’ ought to be rephrased to the effect of, ‘it is a precondition of connection that.. must be submitted’.

Outcome

The Committee agreed that Western Power should redraft the section to reflect it as a precondition.

Status

Complete

Issue

Section 3.2.2(c) should possible speak only of Protection. Backup is a market issue. The requirements for a Chartered Professional Engineer should be sufficient as the NPER is a subset that does not necessarily add to the standing held by Chartered status.

Outcome

The Committee agreed that Western Power should delete the word ‘and backup’ from sub-section (c) and provide clarification on the different levels of engineering accreditation and qualifications.

Western Power has addressed the issue,

Status

Complete

<u>3.2.4.1 Reactive power capability</u>

Issue

Is this a requirement of an individual generator unit or combined generation facility (i.e. can reactive requirements be satisfied by installation of capacitors instead of by alternator design?).

Outcome

The Users requested Western Power to advise if reactive requirements can be satisfied by installation of capacitors instead of by alternator design. Western Power's response is as follows:

> *"The purpose of this clause is to ensure that there are adequate controllable reactive power sources, so that they will respond immediately to contingencies, such as fault and disconnection of a line. A capacitor bank does not satisfy the requirement for response and controllability. Therefore no change should be made."*

The Committee is satisfied that this issue has been addressed with no change to the section.

Status

Complete

<u>3.2.4.5 Loading Rates</u>

Issue

Is the rate excessive for a thermal plant? By placing this expectation in the document it places the prospective generator at a disadvantage. Suggest amending to be in line with what is reasonably achievable using thermal plant (1.5% ~ 2%).

Outcome

Western Power clarified that this clause does not require thermal plants to load up from 0, but from 50%. Users agreed that Western Power was to check the load rate capabilities of coal stations and present a proposal to address this matter.

Western Power made an addition to the clause to make clear that this response is not required during start-up, only 'in a thermally stable state'.

Status

Complete

Issue

Has the requirement in the 2nd paragraph given proper consideration to wind turbines?

Outcome

The Committee noted that wind turbines would not be able to comply with the loading rates required. It was noted that wind generators could apply to the Economic Regulation Authority for an exemption from the application of this rule.

The Authority indicated that, while exemptions can be granted, it would be preferable to make the Technical Rules as generic as possible. The Committee noted that the words "or as otherwise agreed between Western Power and the relevant user" (paragraph 1) address the concern in relation to generation units that cannot comply with the loading rates required.

The Committee agreed to leave clause unchanged.

Status

Complete

3.2.4.7 Restart following Restoration Of External Electricity Supply

Issue

Requirement of restart after being without external power for 2 hours or less is onerous for some generators, e.g. if not motored when suddenly tripped, GT's are locked out for 4 hrs. Users requested that Western Power should consider relaxing the requirements.

Outcome

Users noted that this requirement would act as a barrier to entry, as it would exclude certain technologies or force generators using such technologies to have another unit in standby to provide black start up capability.

Western Power clarified that this section does not require the generating unit to restart within two hours, but to re-start without unreasonable delay. The examples of unreasonable delay provided under section 3.2.4.7 exclude delays inherit in the design of the relevant facility. Therefore, the four-hour lock out would be considered a reasonable delay and the generating unit would comply with the requirements of this section. Western Power was also informed that this section has been deleted from the National Electricity Code.

Users noted that the interpretation of the examples of what constitutes an unreasonable delay was unclear, particularly example (b), and suggested that example (b) should be redrafted to clarify its intent.

Western Power redrafted this section to include 'and which could reasonably have been eliminated by the relevant *User*'.

Status

Complete

3.2.4.8 Protection of Generating Units from Power System Disturbances

Issue

Generators must be automatically disconnected in response to certain conditions at connection point, methods and settings of which are agreed with Western Power yet Western Power not responsible for any loss or damage as a result of fault on Power System after this. This is a legal and possibly commercial matter – depends on circumstances.

Outcome

Users noted that liability matters should not be dealt with in the Technical Rules and that the best place to deal with this matter is the access contract.

Western Power explained that the intent of this section is to provide some level of immunity to facilitate decision-making by system operators, particularly in emergency situations.

Users requested that Western Power consider moving this clause to the access contract. Western Power amended the section to remove the legal issue. Users requested Western Power to explain why the section shouldn't be in the Access Contract.

Western Power explained that Equivalent provisions are included in the National Electricity Rules. Including them in the Technical Rules means they apply to all generators, and are not subject to negotiation. Users were satisfied that this addressed the issue.

Status

Complete

<u>3.2.4.10 Generator Transformer</u>

Issue

Why there is a requirement to be capable of on load tap changing? This is seldom used and there is high capital cost to implement this.

Outcome

Western Power clarified that the section does not require all generating units and wind farms to be capable of on-load tap-changing. The section sets out that this is required “unless otherwise agreed between Western Power and the User”.

Users noted that the section states that, so long as generators are capable of providing their full reactive power output within the range specified by Western Power, then the requirement for generators to be capable of on-load tap-changing does not apply. It was also added that the generator would also be protected by the overarching reasonableness clause.

Users indicated that it is not clear what a “vector group” and “tapping” are, and questioned if definitions should be provided. Western Power indicated that Vector Group and Tapping are standard unambiguous terms and their inclusion in the Glossary is not warranted.

In relation to the paragraph dealing with the vector group, Users commented that the requirement for the transformer type to be “consistent with Western Power practice” is too open and more detailed specifications are needed to buy equipment. Western Power responded that Western Power would be able to provide users with that information readily. However Western Power agreed to replace the words “consistent with Western Power practice” (in paragraph 2 dealing with the vector group) with “compatible with the system at the connection point”. This outcome is reflected in the Technical Rules at Appendix 2.

Issue

‘Tapping’ – stray reference to ‘wind farms’. Need to ensure proper definitions are set up.

Outcome

The Committee queried whether the reference to wind farms in this section was necessary. Western Power clarified that the reference had been included at the request of wind farm proponents and informed that each wind farm will be treated as a unit. Western Power noted that a definition of “wind farm” may be needed.

Western Power has included a definition of “wind farm”.

Status

Complete

3.2.5 Monitoring and Control Requirements

Issue

The requirement for the User to provide Remote Monitoring Equipment for Western Power to monitor generators dynamic performance is very prescriptive and specific and often entails installation of very costly high speed digital processing equipment. Suggest deletion.

Also, the requirement to upgrade, modify or replace if RME deemed no longer suitable is at whose cost?

Outcome

Users raised the question of whether the requirement for users to provide remote monitoring equipment is too prescriptive and onerous and asked whether this was reasonably needed. It was noted that this requirement might be reasonable in the National Electricity Market, and would be reasonable in the event of the four-way split of Western Power proceeds.

The Committee noted that section 3.2.5 appears to enable Western Power to require remote monitoring only where it is reasonable. It was suggested to add the words “where reasonably necessary” at the beginning of the section. It was then noted that the cost of the electrical equipment that would be needed to comply with this section is only approximately $5,000.

The Committee agreed to leave the section as originally drafted.

Status

Complete

3.2.5.1 Remote monitoring

Issue

In section 3.2.5.1(c), the provision of Gross real and reactive power values should not be needed. This is of particular importance if the generator has a large in-house load or customer. A competitor holding market power should not be able to see that far into the generator's business. The provision is acceptable if Western Power was replaced by Networks as the system manager.

Outcome

This issue was discussed under clause 3.2.5.

Status

Complete

3.2.5.2 Remote control

Issue

No allowance for manned sites where functionality of remote control can be achieved. No allowance for manned sites where functionality of remote control can be achieved without installation of actual remote control equipment, but procedural / operator controls coordinated with WPC control centre, e.g. for generators where not 100% of output is dispatched to Western Power grid. Suggest providing an allowance or recognition of this.

Outcome

Users indicated that this section should only apply to un-manned sites that fully dispatch their generated electricity to the grid, and is not appropriate for manned sites that do not dispatch their full generation to the grid (i.e. sites serving embedded loads).

Western Power agreed to redraft this section to reflect this by including the words "where reasonably necessary".

Status

Complete

3.2.5.3 Communications Equipment *(previously numbered 3.2.5.2)*

Issue

This clause originally had the same clause reference as the section entitled 'Remote control'. Also cost of communications path to be borne by user, unless otherwise as determined by WPC is a commercial matter and should be removed.

Outcome

Western Power agreed to amend the clause referencing to show this section as 3.2.5.3. This is reflected in the Technical Rules at Appendix 2.

Western Power also explained that the assignment of responsibilities in this clause is the same as in the National Electricity Rules. This is a common requirement that should not be up for negotiation, and is better placed in the Technical Rules.

Status

Complete

3.2.5.4 Turbine Control System *(previously numbered 3.2.5.3)*

Issue

Clarification needed as to whether the definition in Control Range is equivalent to 4% Droop.

Outcome

Western Power clarified that the control range is equivalent to the 4% droop. The Committee requested that this be reflected in the definition of "control range".

Western Power added the words "(4% droop)" to the definition of "control range". This outcome is reflected in the Technical Rules at Appendix 2.

Status

Complete

Issue

The statement in the section Control Range, ‘must be included in the access agreement, and the User must use reasonable endeavours to ensure that the generating unit responds in accordance with that agreement.’ is superfluous.

Outcome

Users suggested that the statement be deleted. However, Western Power chose to retain the statement and was requested by Users to provide an explanation.

Western Power explained there are two separate issues: making the generator capable of achieving certain performance, and actually operating the unit so that it does achieve this performance. An operator can inhibit performance; hence the provision that means that he should not do this.

The Committee is satisfied that the issue has been addressed.

Status

Complete

Issue

Is it appropriate to provide for hydroelectricity in the third last paragraph?

Outcome

Western Power contended that it is not impossible that hydro units could be connected, there why omit them.

Status

Complete

Issue

In the second last paragraph, ‘...to be specified in the access agreement and advised to Western Power’, presumably Western Power can read the agreement for themselves?

Outcome

Western Power amended the section by changing 'advised to' to 'approved by'. Users noted that the change does not address the question that if the information is in the access contract and Western Power is a party to that contract, why they need to be additionally advised of it. However the Committee noted that the issue is a minor point and is satisfied that the issue can be closed.

Status
Complete

<u>3.2.5.5 Excitation Control System *(previously numbered 3.2.5.4)*</u>

Issue

In Table 3, Excitation System Performance Requirements, Performance requirements are prescriptive but unable to comment whether this is too onerous or whether this imposes additional costs – this should be referred to Excitation System manufacturers for comment.

Outcome

The Committee asked whether the requirements in table 3 were reasonable and suggested to test them. Western Power clarified that the requirements were from the National Electricity Code and were considered to be standard. Western Power also confirmed that, when this section of the National Electricity Code was drafted, the excitation system performance requirements were based on what were considered to be standard specifications at that time.

The Committee agreed to leave section as originally drafted.

Status

Complete

Issue

Regarding the settings of excitation control systems, the statement that 'From time to time, may need to be changed as advised by WPC' requires that costs be borne by Users and is dependent on periodicity of changes. This is a commercial matter and should be removed.

Outcome

Western Power agreed to remove references to costs..

Status

Complete

Issue

What is meant by "When a generator connected to the distribution system is supplying power to Western Power for generation support"? This should refer to generators exporting via the network.

Outcome

Western Power clarified that the statement is intended to identify generators that are connected but not exporting power.

The Committee considered the issue to be addressed.

Status

Complete

<u>3.2.10 Computer Model</u>

Issue

- Some vendors do not have the software models in the format required by Western Power. However, they are available as mathematical models developed to IEEE standards. Users consider that the requirement to provide models in the format specified by Western Power is unreasonable.

- If PSSE can accept the IEEE standard it should be adopted; otherwise the number of generator suppliers will be limited, possibly resulting in increased cost of generation.

Outcome

Western Power's responded that in the past, where they have not specified the format in which Users should provide information, the models provided by users have not worked in Western Power’s software. This has caused delays in the preparation of studies in the range of six to twelve months. Western Power also noted that PSSE is standard software in Australia.

Western Power commented that delays in processing of an access application must be expected if an unsuitable model is submitted and that in their view, the requirements are consistent with the practice in the National Electricity Market.

The Chair of the Committee noted strong concerns in relation to any policy that would act to slow down the processing of Access Applications.

Another User stated they whilst agreed that a standard is required, most generator suppliers are global not Australian. The User requested clarification of whether PSSE can accept the IEEE standard and advised that in their opinion if so it should be adopted; otherwise the number of generator suppliers will be limited, possibly resulting in increased cost of generation.

Western Power advised that the IEEE standard was too broad and not compatible with the framework. The PSSE model needs to be developed and approved in conjunction with the manufacturer and was essential if they are to streamline the study process.

Status

Complete

3.3 REQUIREMENTS FOR CONNECTION OF LOADS

Issue

The phrase “at the discretion of Western Power” in the first paragraph should be tempered.

Outcome

Users agreed that the reasonableness clause added to section 1.5 addresses the issue. This is reflected in the Technical Rules at Appendix 2.

Status

Complete

3.3.5 Design Requirements for Users' Substations

Issue

In section 3.3.5(k) the statement, ‘Prior to connection, signed written statement by Chartered Professional Engineer of NPER-3 standing …’ is no longer current,.

Outcome

The Committee was informed that having a NPER standing is not a professional qualification. The only difference between a chartered engineer and an engineer with NPER standing is that chartered engineers may be audited from time to time, while engineers with NPER standing are audited on an annual basis.

The Committee suggested that the most important issue is that the engineer should be qualified in a relevant field. and that irrespective of the engineer's qualification, the user is liable for any problems arising as a result of the design of its equipment and therefore it could be up to the user to decide who signs the statement required by Western Power. However, there should be quality assurance in relation to the person responsible for signing the statement.

Western Power replaced the words "a Chartered Professional Engineer with NPER-3 standing with the Institution of Engineers, Australia" with "a Chartered Professional Engineer qualified in a relevant area".

Status

Complete

3.3.7.1 Remote Monitoring

Issue

Whether it is necessary to require Users to provide Remote Monitoring Equipment for quite extensive visibility of User's plant. Suggested that the size of users current load demand at any point in time is all that Western Power needs. Also, the issue of compliance with monitoring of power quality can be addressed via spot measurements, not via permanent and costly installation of monitoring equipment.

Suggest the original drafting provides an undue imposition. Test if truly needed or just nice to have. The imposition brings expense to User, should this be passed to Western Power?

Outcome

Users enquired whether this was a blanket imposition or would only be imposed on large loads. Western Power indicated that it was not a blanket imposition and that Western Power does not monitor loads.

The Committee agreed that the overarching reasonableness clause at section 1.5 addresses the issue

Status

Complete

3.4.2.2 Duplication of Protection

Issue

The third paragraph should be reworded.

Outcome

Users suggested the description of the requirements be amended to say ‘need not’ instead of ‘may not’ for clarity.

Status

Complete

3.4.2.5 Maximum Acceptable Total Fault Clearance Time

Issue

The phrase ‘this shall mean...’ appears to be repeated in section 3.4.2.5 and 3.4.2.4.

Outcome

Users noted that narrative content should be deleted.

Western Power has deleted large parts of the narrative style text in section 3.4.2.5 and 3.4.2.4 and replaced with simpler statements. This agreed outcome is reflected in the Technical Rules at Appendix 2.

Status
Complete

3.4.2.14 Details of Proposed User Protection

Issue

The requirement for full details to be provided to Western Power a minimum of 12 months prior to energisation and comments within 65 business days (i.e. 3.5 mths after) is too slow

Outcome

Western Power advised that it has considered the resources required to approve applications and considers present time is necessary and confirmed the response time has been reduced from 65 days to 30 days. This is reflected in the Technical Rules at Appendix 2.

Status

Complete

3.4.2.16 Coordination of Protection Settings

Issue

With regard to the requirement for the User to pay for costs associated with assessment – this is part of normal network coordination activity. It is a commercial issue and should be deleted from the Technical Rules.

Outcome

The Committee noted that Western Power has not implemented an amendment to remove the intention of the User paying costs of upgrade from the Technical Rules. Users requested Western Power to provide a suggestion for amendment.

Western Power's response was that it is necessary that responsibilities be included in the Technical Rules. Responsibility should lie with User to achieve adequate protection of his plant.. No change is proposed.

The Committee is satisfied that the issue has been addressed.

Status

Complete

<u>3.4.2.17 Commissioning of Protection</u>

Issue

User to pay for Western Power to witness commissioning tests.

Outcome

The Committee could not find reference to costs

Status

Complete

<u>3.4.3.5 Check Synchronising</u>

Issue

If Western Power requires additional protection with their facilities including synchronising it should be at Western Power's cost.

Outcome

Power will pay costs. Western Power advised that that the intent is that these works are part of the connection works, although not necessarily physically located at the connection point. Costs would be as for the other connection works.

The Committee is satisfied that the issue has been addressed.

Status

Complete

CHAPTER 4 – INSPECTION, TESTING, COMMISSIONING, DICONNECTION AND RECONNECTION

<u>4.1.1 Right of Entry and Inspection</u>

Issue

In subclause 4.1.1(b), the format of the required notice periods should be clarified. Suggested the format be changed to:

- In case of emergency……immediately
- In case of urgency……….2 days
- In case of non-urgent……10 days

Outcome

The Committee is satisfied that the issue has been addressed.

Status

Complete

4.1.3 Tests to Demonstrate Compliance with Connection Requirements for Generators

Issue

All directions from Western Power, such as those in 4.1.3(f), ought to be recorded.

Outcome

Western Power agreed that all directions should be recorded and agreed to place a clause to that effect in Chapter 1.

Status

Complete

4.2.5 Commissioning Tests

Issue

The reference to NPER-3 classification of an engineer to sign a written statement in subclause 4.2.5(a).

Outcome

The Committee agreed to change the wording to indicate a chartered engineer with relevant experience.

Status

Complete

CHAPTER 5 – POWER SYSTEM SECURITY

5. POWER SYSTEM SECURITY

Issue

The following general issues were considered by the Committee:

1. Defined terms should be provided with the chapters of the Technical Rules;
2. The use of different qualifiers such as “credible”, “most critical” and “significant” and their meanings if they were undefined terms;
3. Ongoing references to costs in Technical Rules; and
4. The potential need to have a section early in the chapter detailing Western Power’s right to direct, rather than referring to this right through the chapter. This should be integrated with section 5.11 (Power System Security Support).

Outcome

1. Users agreed that this issue had been addressed by the discussion in Issue 1. Western Power agreed to submit a glossary of defined terms.

2. Western Power indicated that some of the terms used were defined in the National Electricity Code. Users agreed the issue could be resolved with the inclusion of a glossary in the Technical Rules.

3. The Committee agreed that commercial matters should be dealt with under the access contract. References to costs have been deleted, and Western Power advised they has been moved to the Model Access Contract.

4. The Committee agreed that it would be useful to consolidate all of Western Power's powers to direct in one section and a new clause 5.13 has been drafted.

The Committee debated several aspects of Clause 5.13, and concluded that it would be prudent of Western Power to develop auditable procedures for requirements for directions and reporting in licensing. The Committee also agreed that all directions should be recorded, and Western Power confirmed that this is current practice.

The Committee concluded that clause 5.13 addresses the need to a section detailing Western Power's right to direct.

Status

Complete

5.2.1 Purpose and Application of Section 5

Issue

Clarification of the understanding that Western Power's responsibility for power system security is not conferred by the Technical Rules as set out in this section (previously numbered 5.1.1(b)) but by the Market Rules.

Outcome

Members of the Committee met with the Office of Energy and the Authority to identify the overlap with the Market Rules.

Section 5.1 was added to the Technical Rules to outline the scope of the Technical Rules and their relation to the Market Rules for power system security. Other parts of the chapter relating to power system security have been deleted as they are covered by the Market Rules.

Status

Complete

Previous section 5.2: Power System Security Definitions and Principles

Issue

1. The consideration to move the second paragraph to section 5.2.4, and delete the word "clearly" to neaten the style.
2. The meaning of the phrase "imminent disturbance".

Outcome

Western Power agreed to redraft the paragraph to remove the word "clearly".

Users highlighted the need for consistency of language and definitions in the document. Western Power agreed to several deletions to clarify the section.

Further analysis of the section highlighted an overlap with the Market Rules. This section has been deleted, and is not in the Technical Rules at Appendix 2, as it is considered to be covered in the Wholesale Electricity Market Rules.

Status

Complete

Issue

Explanation of the term 'remedial action scheme'. The suggestions to replace the word 'without' to say '...measure of the system's ability to survive disturbances with minimal interruption to customers".

Outcome

Western Power agreed to these changes. However, further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted.

Status

Complete

Previous section 5.2.1: Satisfactory Operating State

Issue

That frequency and voltage limits should be defined for the satisfactory operating state, and different voltage limits should be determined for different parts of the network.

Outcome

Several Users members agreed that unless notified or negotiated otherwise, normal standards of service should apply. Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted, and is not in the Technical Rules at Appendix 2, as it is considered to be covered in the Wholesale Electricity Market Rules.

Status

Complete

Previous section 5.2.2: Secure Operating State

Issue

The question if in 5.2.2(c)(2), the fact that the user connected to a specific part of the network means they accept a lower level of security should be reflected in the connection agreement.

Outcome

Western Power clarified that the section related to the case of radial systems, where it is not possible to promptly return to the satisfactory operating state. Committee members noted that users should not be deemed to have accepted a lower level of security unless they negotiate otherwise and that the section should be redrafted to reflect the intent described by Western Power.

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted,

Status

Complete

Issue

The definition of 'stable' and proof of compliance with stability criteria is contentious. Also contentious is the acceptance of what constitutes a credible contingency event and the application of a probabilistic instead of deterministic approach to studying contingencies.

Outcome

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted.

Status

Complete

Issue

Silence on this issue should be taken to mean that normal service is expected, and if the Connection Agreement is the correct instrument referenced.

Outcome

Users agreed that unless notified or negotiated otherwise, normal standards of service should apply. A term which covers both the technical compliance agreement contained in the Model Standard Access Contract and the existing connection agreements was needed.

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted.

Status

Complete

Issue

The Committee suggested that frequency and voltage limits be defined for the satisfactory operating state, and that different voltage limits should be determined for different parts of the network.

Outcome

Several Committee members agreed that unless notified or negotiated otherwise, normal standards of service should apply.

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted.

Status
Complete

Previous section 5.2.3: Technical Envelope

Issue

With regard to:
- 5.2.4(c)(5), that the words ‘agreed generation load constraints’ did not make sense;
- 5.2.4(c)(9), that technical envelopes should only be developed for the current case or considering confirmed projects, not speculative ones; and
- 5.2.4(c)(10), that the performance standards appear too ambiguous.

Outcome
- Western Power clarified that the terms refers to generation dispatch constraints. Western Power redrafted the section to replace the terms ‘agreed generation load constraint’ with ‘agreed generation dispatch constraint’.
- Western Power clarified that only the existing plant is considered in developing the technical envelope. Users agreed the leave the section as originally drafted.
- Western Power agreed that the reference to performance standards in the Technical Rules is ‘loose’, but follow the NEC model where detailed performance standards are set out in a separate document. USers agreed that Western Power should consider drafting performance standards and that standards should be dfined in chapter 2 of the Technical Rules. Western Power agreed to insert ‘defined in chapter 2’ at the end of 5.2.4(c)(10).

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted.

Status

Complete

Previous section 5.2.4: General Principles for Maintaining Power System Security

Issue

It is difficult to get to the secure operating state in 30 minutes. Section should require the system to return to the satisfactory operating state within 30 minutes and then return to the secure operating state.

Outcome

Western Power redrafted the Technical Rules by deleting the words “and, in any event, within thirty minutes.

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted.

Status

Complete

Issue

Duplication in relation to black start-up, also in section 5.8.8.

Outcome

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted.

Status

Complete

Issue

The proposal to replace the words ‘should take all reasonable actions’ with ‘must take all reasonable actions’.

Outcome

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted.

Status

Complete

Issue

That section 5.2.4(d) could be read as intending to impose constraints on the access arrangement.

Outcome

Western Power indicated that this was not the intention. Users also questioned if the section should be moved to chapter 3 of the Technical Rules or deleted, or if there should be reference to the access contract.

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted

Status

Complete

Issue

The request that section 5.2.4(d)(3) be simplified.

Outcome

Western Power agreed to review the section in the context of the Access Code.

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted

Status

Complete

Issue

As originally drafted, 5.2.4(e) appears to require all power stations to have black start-up facilities.

Outcome

Western Power agreed to redraft the section to clarify that it only applies to certain generators who are contracted for this ancillary service.

Further analysis of the section highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted.

Status

Complete

<u>5.2. 2 Time for Undertaking Action</u>

Issue

The proposal that this section be placed somewhere more visible.

Outcome

The clause, previously numbered 5.2.5, is now part of the section introduction and is numbered 5.2.2..

Status

Complete

<u>5.3.1 Responsibility of Western Power for Operation Co-ordination of the Power System</u>

Issue

As originally drafted, section 5.3.1(b) appeared to state that Western Power is responsible for users' switching procedures. The suggestion that the wording be reviewed to reflect that Western Power's role is to coordinate switching activities.

Outcome

Users agreed the section should be amended to reflect that Western Power's role is to coordinate switching activities.

Status

Complete

Issue

The operational and emergency limits of plant and equipment should be agreed between Western Power and the user, not 'either established by Western Power or advised by the respective users'.

Outcome

The Committee discussion included Western Power noting that if users notify Western Power of the rating of their plants and operate them within that rating, there should not be a problem in enabling users to advise Western Power of their operational and emergency limits.

The Committee agreed to leave section 5.3.1(e) as originally drafted.

Status

Complete

Issue

Duplication between subsections (q) and (i) and the suggestion that the subsections be amended or merged.

Outcome

Western Power agreed to review this section to avoid duplication. Tthe original content of both (q) and (i) have been deleted.

Status

Complete

Issue

The sentence ‘all Users shall cooperate with such action plans at their own cost’ in section 5.3.1(r) is too open.

Outcome

Users agreed that costs should be covered by the access contract, not the Technical Rules. The Committee agreed that the obligation to cooperate in the technical sense could be left in the Technical Rules.

Status

Complete

Issue

Whether the requirement in section 5.3.1(b) is already covered by Energy Safety legislation.

Outcome

Western Power agreed to review the wording of the section to remove any duplication.

Western Power advised that their legal advice is that there is no duplication.

Status

Complete

5.3.2 Western Power's Obligations

Issue

That the final sentence of section 5.3.2(e) be deleted or included as a footnote.

Outcome

Western Power indicated that the sentence was included to ensure the clause does not apply to consumers. The Committee agreed to leave section 5.3.2(e) as originally drafted.

Status

Complete

Issue

Redrafting of section 5.3.2(g) to avoid dependence on Western Power's opinion.

Outcome

Western Power noted that the sentence should be kept as it has been included to protect Western Power, but agreed to include a reasonableness test.

Status

Complete

5.3.3 User Obligations

Issue

Not all generators have the capability to provide interruptible load in the way required by the originally drafted sections 5.3.3(d) and (e).

Outcome

Western Power agreed to review the wording of the section taking into account that some users would have difficulty providing load shedding services, and the suggestion that the obligation to participate in load shedding should be revisited.

Status

Complete

5.4 POWER SYSTEM FREQUENCY CONTROL

Previous section 5.4.1: Power System Frequency Control Responsibilities

Issue

The wording in section 5.4.1 should reflect that Western Power must use its 'best endeavours', not 'reasonable endeavours'.

Outcome

It was noted that these statements have the same meaning from a legal standpoint. Users agreed to leave section 5.4.1 as originally drafted.

Further analysis showed an overlap with section 2.2 of the Market Rules. This section has been deleted.

Status

Complete

Operational Frequency Control Requirements

Issue

The section, previously numbered as 5.4.2(a), does not take into account the obligations of generators with embedded loads and the obligations placed upon generators as a result of other bilateral contracts.

Outcome

Western Power asserted that the issue would not arise if parties were acting reasonably.

In addition, Users suggested checking the treatment of generators with embedded loads under the Market Rules. This highlighted an overlap with the Wholesale Electricity Market Rules. This section has been deleted,

Status

Complete

Issue

Clarification on whether the section on operational frequency control requirements previously numbered as 5.4.2(a) allowed for instructional control.

Outcome

It was clarified that the section did allow for instructional control, and the Committee's decided to leave section 5.4.1 as originally drafted.

Further analysis showed an overlap with the Wholesale Electricity Market Rules. This section has been deleted..

Status

Complete

Issue

Whether this section conflicts with the Market Rules, which appear to have priority.

Outcome

The Committee member suggested that section 5.4.2 appears to conflict with sections 7 and 3.10 of the Market Rules, which deal with dispatch and ancillary services. Western Power noted that section 5.4.2 deals with the technical requirements of generators, whilst the Market Rules deal with matters at a higher level.

Status

Complete

<u>5.5.1 Transmission and Distribution Network Voltage Control</u>

Issue

Section 5.5.1(f) potentially conflicting with the Market Rules.

Outcome

Western Power agreed to consider the possible overlap of section 5.5.1(f) with the Market Rules.

At meeting 12, Western Power explained Western Power's standpoint on stacking contingencies. The Committee were satisfied that the discussion addressed the issue.

Status

Complete

5.6.2 Power System Protection Co-ordination

Issue

That there may be protection system settings that Western Power may not want to change, that users may want to change.

Outcome

The Committee agreed that the overarching reasonableness clause addressed the issue by covering withholding of approvals.

Further analysis of the clause led the Committee to question whether the section should be moved to chapter 2, or if it is covered by the Market Rules. Western Power responded that Co-ordination of the Network and User's facilities sits in this section for protection, stability and control functions. Hence this is the correct place.

Users were satisfied that this further issue has been addressed, and no changes were made to the Technical Rules at Appendix 2.

Status

Complete

5.6.4 Short-Term Thermal Ratings of Power System

Issue

Whether the term 'reasonable endeavours' was strong enough.

Outcome

The Committee was advised that legally, using 'reasonable endeavours' is the same as using 'best endeavours'. The Committee agreed to leaving the clause as originally drafted.

Status

Complete

5.6.5 Partial Outage of Power Protection Systems

Issue

If they reasonably can, Western Power should inform Users to inform Users before outages.

Outcome

Western Power clarified that it would not be possible to notify Users in advance because the section deals with unplanned outages. The Committee requested that users should be notified whenever possible.

The Committee agreed that the overarching reasonableness clause added to section 1.5 addressed this issue. No change to clause 5.6.5 is reflected in the Technical Rules at Appendix 2.

Status

Complete

5.7.2 Audit and Testing

Issue

Does this section imply that audit and testing will be done at Western Power's cost?

Outcome

The Committee reiterated its agreement to not address cost issues under the Technical Rules

Status

Complete

Previous section 5.8.6: Directions by Western Power Affecting Power System Security

Issue

There is a need to recognise formal lines of communications and who is authorised to issue the direction from Western Power.

Outcome

Users noted that the purpose of the new regime is to move away from the overarching powers of direction granted to Western Power under the old regime. The Committee was also informed that this issue has been considered during the development of the Electricity Networks Access Code. It was agreed that powers of direction would sit within the Electricity Transmission Regulation until all power of direction are dealt with under other instruments. In the meantime, powers of direction should not be recreated in the Technical Rules.

Status

Complete

Issue

Typographical error in 5.8.6(a)(1)(v).

Outcome

This section has been deleted.

Status

Complete

Issue

All directives from Western Power should be recorded. This should be part of a general clause on directives.

Outcome

The Committee agreed that it would be useful to consolidate all of Western Power's powers to direct in one section. Western Power agreed to do this and drafted a new clause, 5.13.

Users questioned that the new section 5.13 does not address the issues raised; specifically that Western Power should be explicitly required to record any such direction.Users also suggested that consideration be given to moving this section to the front of the document where it would be much easier to find.

Western Power confirmed that the obligation to record any direction is given in section 5.11.4.

This section has been deleted

Status

Complete

Issue

Clumsiness of paragraph 5.8.6(a)(5).

Committee Suggested Action
The issue has been addressed and there is no recommendation for further change.

Previous section 5.8.9: Local Black System Procedures

Issue

Suggestion to modify wording so that it becomes a Western Power responsibility to provide or procure system wide black start capability, with amendments flowing to sections 5.8.9 and 5.8.10.

Outcome

The Committee raised the concern that the section was already covered by the Market Rules. Western Power advised that section 5.8.8-5.8.10 overlapped with sections 3.9-3.11 of the Market Rules.

Sections 5.8.8, 5.8.9 and 5.8.10 have been deleted.

Status

Complete

Issue

That sections 5.8.8 and 5.8.9 are unreasonable and conflict with the Market Rules.

Outcome

Western Power advised that section 5.8.8-5.8.10 overlapped with sections 3.9-3.11 of the Market Rules. Sections 5.8.8, 5.8.9 and 5.8.10 have been deleted and are not in the Technical Rules at Appendix 2.

Status

Complete

Previous section 5.9.4: Generation Plant Changes

Issue

This section needs to be reconciled with the Market Rules as there is substantial conflict.

Outcome

Analysis of this section led to the deletion of section 5.9.1-5.9.4, as commitment and dispatch of generators overlap with section 7 of the Market Rules.

Status

Complete

Issue

If section 5.9.3(d) applied only to generators with output contracted to the grid, or any generator. If the term scheduled generator is included it needs to be defined.

Outcome

Analysis of this section led to the deletion of section 5.9.1-5.9.4, as commitment and dispatch of generators overlap with section 7 of the Market Rules.

Status

Complete

Issue

In section 5.9.3(d), if you’re selling into the STEM, how do you reduce the load?

Outcome

Analysis of this section led to the deletion of section 5.9.1-5.9.4, as commitment and dispatch of generators overlap with section 7 of the Market Rules.

Status

Complete

Issue

In section 5.9.3(d) a literal reading would force an output reduction by other generators. Suggest replacing “first” in the first line by “at the same time”. It is assumed that this rule applies only where there is an associated load.

Outcome

Analysis of this section led to the deletion of section 5.9.1-5.9.4, as commitment and dispatch of generators overlap with section 7 of the Market Rules.

Status

Complete

5.9.5: Operation, Maintenance and Extension Planning

Issue

User suggested that the requirements for Users to provide 3-year maintenance plans should only apply for 'major maintenance' and that compliance with major maintenance outage plans should be reasonably flexible and take into account some leniency in date shifts.

Outcome

Member of the Committee requested that the clause be redrafted to be more reasonable and flexible. Western Power did not make changes, with the assertion that outage planning requirements reflect the 3 year 1 year philosophy given in sections 3.18 – 3.20 of the Market Rules and so is seen as reasonable. Western Power also noted that most generators will be governed by the market rules rather than section 5.9.

The Committee considered this explanation to address the issue and no change has been made to the clause.

Status
Complete

5.11 POWER SYSTEM SECURITY SUPPORT

Issue

Review of 5.11.2 not possible at the original time of review as chapter 3 is referenced.

Outcome

This issue was considered as part of the review of chapter 3.

Status
Complete

CHAPTER 6 – DEROGATIONS

6. DEROGATIONS

Issue

Derogations should not be left to the discretion of Western Power. This is a major policy issues that ought to be considered at a senior forum.

Outcome

The Committee discussed whether the Access Code is a more appropriate instrument to cover derogations. The Committee agreed that Western Power would review Chapter 12 of the Access Code to determine whether derogations are already covered by it, and if so, delete the chapter.

Western Power sought advice and provided the following comments on Chapter 6, which seek to justify retention of chapter 6:

"Based on the preliminary legal advice, Western Power is of the opinion that Section 6.1 should be retained in the Technical Rules for the following reasons:

a) *the Access Code does not apply to any individual User. It is a high level document that guides the creation of an Access Arrangement and an Access Contract. Therefore, nothing in the Access Code justifies a deletion from the Technical Rules. There is no duplication. For example, Chapter 12 facilitates the creation of the Technical Rules, it does not act as a substitute for them.*
b) *So the Technical Rules ought probably still have Derogations, even if they are unlikely to be granted under an Access Arrangement and Access Contract that have been approved by the ERA.*
c) *A granted Derogation may mean that Networks is effectively offering a non-standard service, so extra charges may be properly payable by the User.*
d) *The recommendation would be to retain section 6.1.*

Clause 6.2

a) *The recommendation would be to retain clause 6.2, as it grants a blanket exemption to all existing plant, because of no paperwork involved."*

Users consider Western Power's response to adequately justify the retention of Chapter 6. This is reflected in the Technical Rules at Appendix 2.

Status

Complete

Appendix 4 - Western Power Submissions

Sub-appendix 4.1	ERIU TRC ADMD Submission With Links
Sub-appendix 4.2	ERIU TRC Technical Rules and Market Rules Overlap (B)
Sub-appendix 4.3	WP Responses to UDIA submission
Sub-appendix 4.4	WPC Submission to TRC Immunity Frequency Excursions 3.2.4.3(a)
Sub-appendix 4.5	WPC Submission to TRC Immunity to voltage excursions 3.2.4.3(b)
Sub-appendix 4.6	WPC Submission to TRC Reactive Power Capability 3.2.4.1

SUBMISSION TO THE TECHNICAL RULES COMMITTEE

WESTERN POWER TECHNICAL RULES

"ADMD " SUBMISSION "WITH LINKS"

JUSTIFICATION FOR THE NEWLY INCLUDED CLAUSES:

"2**.10 DISTRIBUTION DESIGN STANDARD CRITERIA "**
"2**.5.2.4 LIMITS ON RADIAL HIGH VOLTAGE FEEDERS "**
"2**.5.2.6 POLE TO PILAR CONNECTIONS MANDATORY "**
"2**.5.2.7 DISTRIBUTION REMOTE CONTROL AND MONITORING"**

AND ADDITIONAL WORDING TO CLAUSES

2.8.5 (LAST SENTENCE)
2.5.2.5 (LAST SENTENCE)

The following is an extract from Appendix 7 of the Western Power's Access Arrangement.

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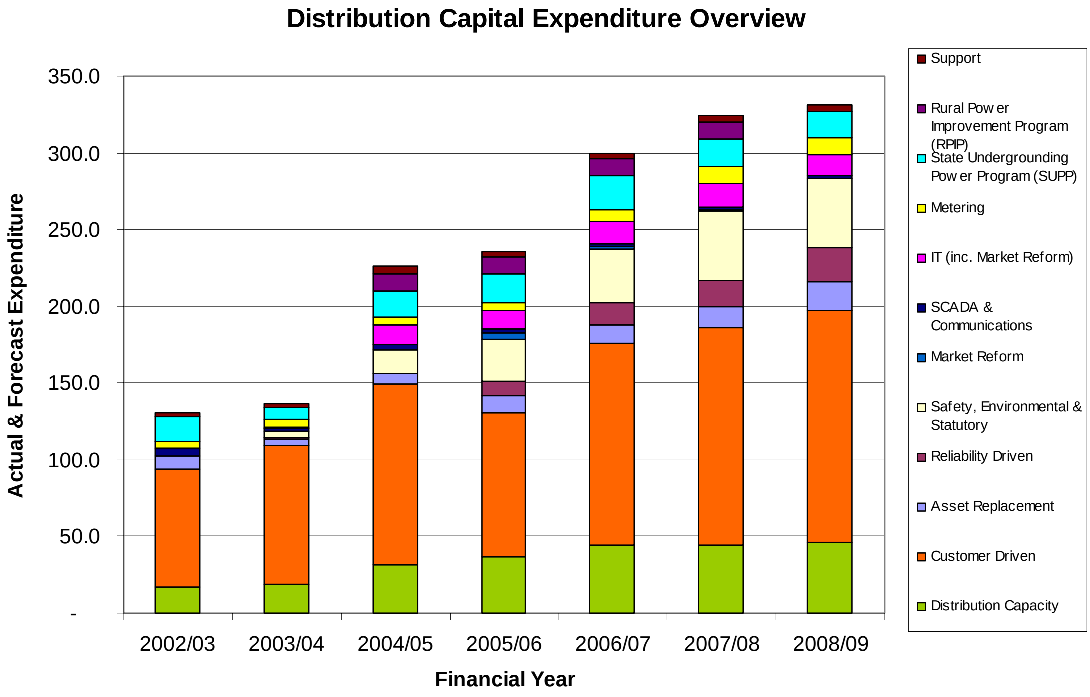
8. Distribution Forecast Capital Expenditure

The following charts provide the historical and projected expenditures for the Western Power Networks distribution business.

Figure 1 - Distribution Capital Expenditure (Resource Constrained)



Western Power Networks is proposing to increase average distribution capital expenditure by 74% over the regulatory period. This level of expenditure has been determined by utilising a two step approach. Firstly, a "bottom up" approach was used to identify individual capital projects that should be included in the distribution capital works program based on safety, environmental, statutory, supply quality and load /customer growth requirements. Then the projects were prioritised and the lower priority projects deferred until a works program was developed that was deliverable with the resources available to Western Power Networks. This resulting increase in distribution capital expenditure is referred to as the "resource constrained" capital expenditures. The increase in overall distribution capital expenditure is in response to a number of key drivers that are already or will impact the Network business over the next 3-5 years.

The drivers that have resulted in Western Power Networks having to increase expenditures over the regulatory period on distribution capital expenditure are:

Clause 2.10

Driver 1 – Load Growth. This driver relates to the necessity to provide additional infrastructure to cater for the connection of new customers or the augmentation of the existing network in order to cater for the additional load generated by new customers coupled with the intrinsic load growth of existing customers.

Western Power currently designs and constructs a large proportion of the connection assets for new residential, industrial and commercial customers even though it is operating in a contestable environment. Connection assets constructed by external contractors are "gifted" to Western Power and are not included in this category.

As a result of Western Australia's unprecedented high levels of population growth and the high levels of load growth generated primarily by new air conditioning load, including its effect on load factor, Western Power has a substantial amount of new distribution assets to construct and commission over the interim and regulatory period. In addition there is a substantial amount of augmentation work required on existing distribution feeders and zone substation integration to cater for the additional load. This augmentation includes a substantial amount of backbone feeder conductor replacement to improve both capacity and fault level rating

Driver 2 – Reliability

Clauses
2.5.2.4
2.5.2.5
2.5.2.7

This driver relates to the decision Western Power Networks made in January 2005, to target a 25% improvement in SAIDI and SAIFI (all faults statistics) across the SWIS – over the next 4 years. This target represents the first step in meeting the Energy Safety Directorates' (ESD) target.

Some of the capital works projects included in the Access Arrangement Submission primarily to cater for increased load growth or increased fault levels have an impact on network performance. Their contributions to meeting the target reduction in SAIDI and SAIFI have been acknowledged and identified.

The projects included in this category have been primarily designed to achieve reductions in SAIDI and SAIFI of sufficient magnitude to bridge the gap between the reductions achieved by the capital projects with a secondary impact on network performance and the reductions required in order to achieve the targeted 25% improvements.

Driver 3 – Asset Condition

Clause
2.5.2.6

Western Power's distribution assets have a weighted average remaining life of 56% in 2005. In order to ensure a continued safe and reliable operating environment assets at the end of their service life need to be replaced with modern equivalent assets.

In order to determine the appropriate level of investment required to be made on the distribution infrastructure Western Power engaged PB Associates to develop an age, condition and risk based replacement model. This model has been populated with Western Power's distribution asset data and the replacement capital expenditures determined by the model have been used as the basis of the projected expenditures in the Asset Replacement category in the Access Arrangement Submission.

The levels of expenditures included in the Access Arrangement Submission for Asset Replacement do not arrest the decline in weighted average asset age, with the weighted average remaining life decreasing from 56% to 52% over the regulatory period.

Clauses
2.5.2.6
2.8.5

Driver 4 – Safety, Environment and Statutory. This Driver relates to Western Power's compliance with directives and remedial actions agreed with the ESD, and compliance with statutes, acts, regulations and standards, in particular the Electricity (Supply Standards & System Safety) Regulation 2001.

Some of the remedial actions agreed with the ESD have been instigated in accordance with recommendations made by the State Coroner and others have been instigated by Western Power to minimise safety and environmental risks in accordance with good industry practice. All the projects included in this category directly relate to the achievement of mandated safety, environmental, and compliance outcomes or industry accepted prudent avoidance of adverse outcomes.

Main impact on Clauses

The impact of each driver is;

2.10

1. **Load Growth**. The average capital expenditure over the regulatory period will increase from an historical $121M to a "resource constrained" expenditure of $185M per annum, an increase of approximately 153%.

2.5.2.4
2.5.2.5
2.5.2.7

2. **Reliability**. The average capital expenditure over the regulatory period will increase from an historical $2M to a "resource constrained" expenditure of $18M per annum, an increase of 900%.

2.5.2.6

3. **Asset Condition**. The average capital expenditure over the regulatory period will increase from an historical $8M to a "resource constrained" expenditure of $15M per annum, an increase of approximately 188%.

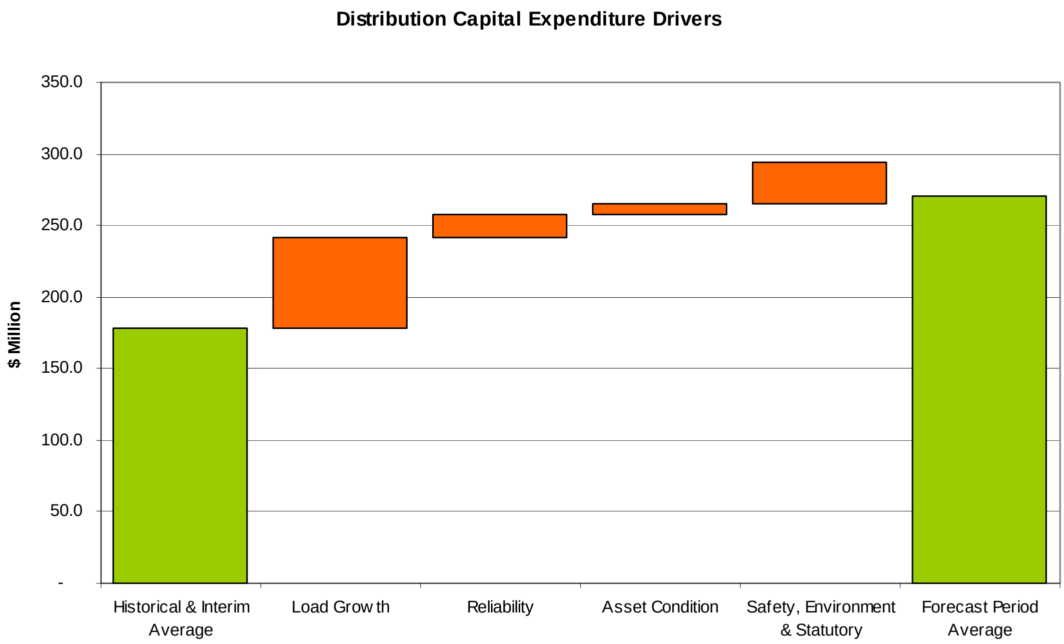
2.5.2.6
2.8.5

4. **Safety, Environment and Statutory**. The average capital expenditure over the regulatory period will increase from an historical $12M to a "resource constrained" expenditure of $41M per annum, an increase of approximately 342%.

As can be seen from the following chart, the summation of the driver impacts is greater than the proposed forecast expenditure. The reason for the difference is that the forecast expenditures have been reduced to recognise the assessed constraints in future resource availability.

However, the information and analysis contained in the subsequent sections of this chapter is based on the unconstrained level of expenditure identified as necessary to satisfy the key business drivers.

Figure 2 – Distribution Capital Expenditure Drivers



Main impact on Clause

2.10

Load Growth

The average expenditure over the regulatory period will increase from an historical $121M to a "resource constrained" expenditure of $185M per annum, an increase of approximately 153%. The average "unconstrained " projected distribution capital expenditure, as detailed below, over the Regulatory Period was $239M per annum, and hence the resource constrained levels of expenditure are considered very prudent.

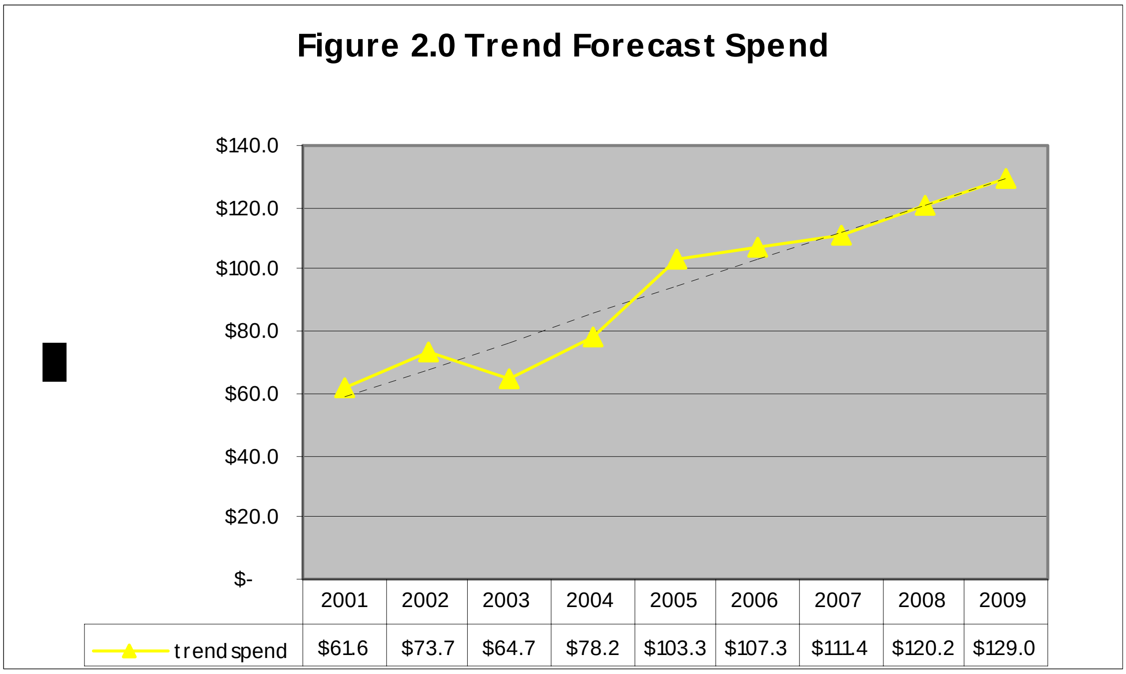
There are two significant components of distribution capital expenditure associated with load growth. The direct works associated with connecting new customers to the network and the indirect works associated with augmenting the existing network to cater for both the new customers and the intrinsic load growth of the existing customers.

The two components responsible for the increase in projected expenditures on customer driven works are the increasing number and costs of customer connections, and changes to the standards and policies affecting the design requirements for connection assets. Western Australia is currently experiencing a period of high growth which is being reflected in a continued growth in the quantity of new underground residential subdivisions (URD) being commissioned and a sustained growth in number of commercial and industrial connections. Western Power has used historical data to determine the forecast projected expenditures on a business as usual basis over the regulatory period.

In addition Western Power has found it necessary to revise design policies and standards including the electrical design standards applicable to new customer connection to compensate for the high penetration of reverse cycle air conditioning loads. These air conditioning loads have a major impact on the after diversity maximum demand (ADMD) assumptions which determine the electrical capacity of the connection assets and avoid the need for further investment in the distribution infrastructure for power quality reasons.

Other design policies and standards changes include the reduction of padmount substation noise, reduction in the number of customers on radial feeders, increased design loads for commercial and industrial customers, underground pole to pillar connections, installation of remote monitoring and control of ring maim switches (RMU), changes to street light designs, increased approval costs, fire proof construction in fire risk areas, and the need to source wood poles outside Western Australia.

The underlying expenditure trend has been determined by using linear regression analysis and historical expenditure data to predict future expenditures as detailed in the following chart. The projected expenditures over the three year regulatory period are $111.4M, $120.2M, and $129.0M respectively.



The individual design changes which have been added to the base line trend are as follows:

Main impact on Clause 2.8.5

Transformer Noise Abatement.

This design change is in response to an EPA requirement for substations in residential areas to have low ambient noise emissions. To satisfy the EPA requirement Western Power Networks will have to construct masonry or other similar noise deadening screen walls around kiosk substations in residential areas. Western Power Networks has allowed $0.8M / annum for these works.

Increased ADMD Design Criteria.

Main impact on Clause 2.10 1st sent.

Western Power Networks has carried out a detailed investigation into current ADMDs in a range of demographic areas within the SWIS and also reviewed experiences in other Australian States. The recommendations from this report have been adopted, resulting in Western Power Networks using a formula to predict design ADMD based on lot price and lot/dwelling size. For example the formula provides an ADMD of 4.5kVA for a medium sized house on a medium priced lot and 7.2kVA for a high priced lot.

The application of this formula to new URD designs should avoid likely future overloading of distribution transformers and LV circuits which are extremely difficult and hence expensive to retrospectively augment. Western Power Networks has estimated that the impact of this design change will incur additional expenditures of $19.1M / annum

Increased Minimum Design Load Industrial / Commercial Lots.

Main impact on Clause 2.10 1last sent.

Western Power Networks currently uses a standard rate of 200kVA per ha as the design load for industrial and commercial subdivisions. This approach produces unrealistically low design loads for small lots.

Customers who eventually develop these smaller lots still have air conditioning requirements and in many instances their load requirements are no longer in proportion to the lot size. Western Power Networks propose to continue to utilise this standard rate of 200kVA per ha but to also impose a minimum load requirement irrespective of lot size of 110kVA.

The application of this design change should avoid likely future overloading of distribution transformers and LV circuits which are extremely difficult and hence expensive to retrospectively augment. Western Power Networks has estimated that the implementation of this design change will incur additional expenditures of $5.2M / annum, as the new minimum load would affect approximately 70% of all industrial and commercial subdivisions.

Street Light Changes.

This design change reflects changing community and local government requirements in relation to streetlighting design. Generally there has been a move Australia wide to design all new streetlighting in accordance with the current Australian Standards and the costs for this design change has been incorporated into this capital expenditure category. This move is driven by coronial inquiry recommendations, motorists and pedestrian security expectations

In addition local councils are demanding more control over the visual landscape in CBD and other community spaces such as parks and gardens. As distributors are the major and in many instances the only supplier of these lighting services there is increasing pressure to provide a greater range of lighting options which usually involve higher capital and operating costs. Western Power Networks has now included a range of more decorative luminaries to cater for this need and developed new streetlighting tariffs for these fittings.

These luminaries will be used at road upgrades, roundabouts and street beautification projects. Western Power Networks has estimated that the additional capital expenditures associated with design change are $1.8M / year.

Work Approvals.

Western Power Networks now incurs additional costs to obtain the necessary approvals prior to commencing construction relating to Native Title, EPA studies and Die Back Studies which affects work in urban fringe and country areas. Council charges also affect all projects.

Western Power Networks has estimated that obtaining the necessary approvals for future works will incur additional costs of $4.8M / year. These studies and approvals are an integral part of carrying out a distribution business and hence form an integral part of the total costs associated with these works.

Fireproof Construction.

This design change relates to the installation of either covered conductor, ABC or underground cable in areas subject to high fire risk. These design changes complement the intent of the strategies outlined in the Bushfire Management Plan and also fall into the category of design criteria that a prudent operator would be expected to utilise in bushfire prone areas.

Western Power Networks has estimated the implementation of this design change would incur additional costs of $2.3M per annum.

Wood Pole Replacements.

Western Power has been forced, due to a lack of availability of Jarrah poles, to source wood poles from the eastern states and overseas. However the pole suppliers have advised that the cost of these poles will rise by 100%

Western Power Networks has allowed an additional $3.7M for sourcing wood poles from these areas.

Main impact on Clause 2.5.2.4

Reduced Number of Customers on HV and LV Spur lines.

These two design changes relate primarily to improving supply reliability. The HV design changes involve the installation of interconnectors between HV spurs involving more switchgear and cables and also limiting the number of customers on HV spur lines to 860. Each of these projects has been estimated at approximately $80,000

The LV design changes involve the installation of additional Uni Pillars in LV underground circuits so isolated LV circuits can be back-fed after faults have been identified. The installation of a Uni Pillar every fourth pillar to facilitate switching or the connection of remote generation has been estimated at $100

Western Power Networks has estimated that incorporation of these deign changes would incur additional capital expenditure of $5.4M / Annum

Main impact on Clause

2.5.2.6

Replacement of Overhead services with UG Pole to Pillar (P2P).

The provision of underground service connections for all new installation in metropolitan Perth has been mandatory for the last 8 years. This project involves making the provision of all new and replacement services in country areas also mandatory. This approach will also eliminate the Twistie problem on those services utilising this termination clamp and will also substantially reduce the probability of any further single customer outages which historically relate to service wires and their connections.

The proposal also includes making it mandatory to install underground services when upgrading existing residential, commercial and industrial services in metropolitan Perth.

Western Power Networks has estimated that adoption of this proposal will incur additional capital expenditures of $8.0M / annum.

Main impact on Clause

2.5.2.7

DCRM of Switchgear and Transformers.

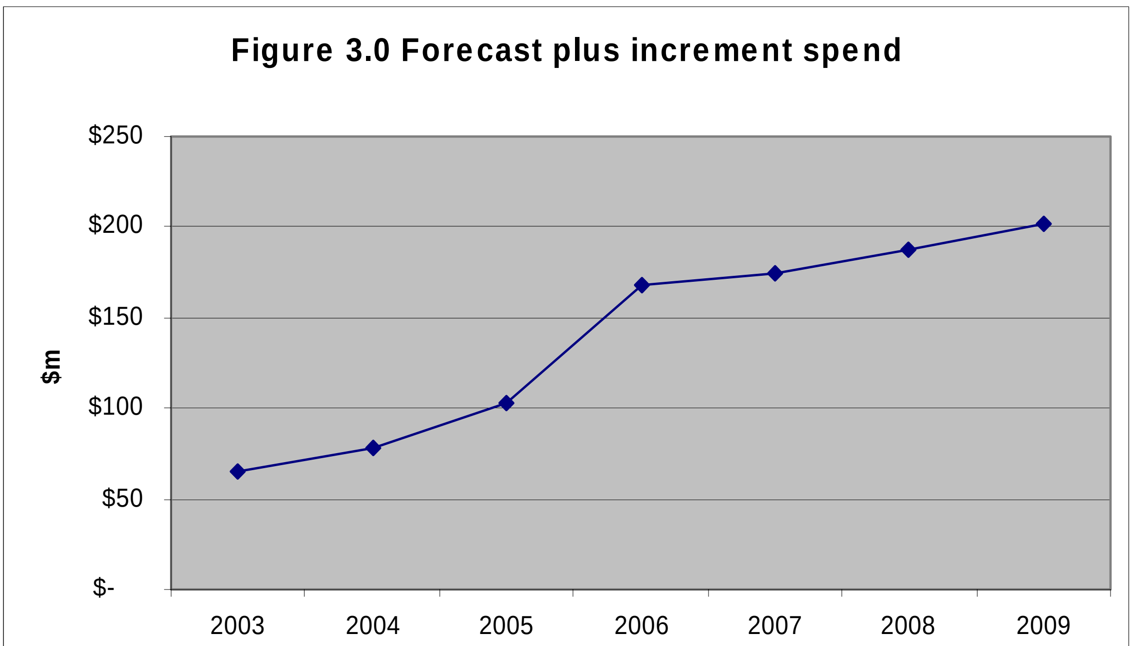
This proposal essentially is designed to improve supply reliability and consists of the remote supervision and operation of switchgear and transformers in suburban Perth.

The project involves the installation of distribution remote control and monitoring equipment at the time of installation. The anticipated cost for RMUs DCRM is $26,000 and for transformer installations $20,000

Western Power Networks has estimated that the capital expenditure associated with the implementation of this proposal is $6.8M / year.

The chart below details the total projected "unconstrained" capital expenditures for both the underlying trend expenditure and the expenditures associated with the additional design changes for direct customer connection works.

Figure 3 – Forecast Total Customer Driven Spend



In addition to the expenditures Western Power incurs in the connection of new customers it also incurs expenditures increasing the capacity of the existing network infrastructure to cater for the additional load imposed by the connection of these new customers and the intrinsic load growth of existing customers,

Western Power Networks uses a bottom up approach to determine the location and the magnitude of specific augmentation and replacement projects. Each augmentation project is supported by a concise planning project identifying the issues requiring resolution, possible solutions and selection of the preferred option.

The underlying reasons for these augmentation projects are as follows:

- The presence of small cross section conductor in close proximity to zone substations which impose thermal constraints on feeder ratings and/or cannot sustain the fault levels at that location

- Distribution feeder thermal overloading due to customer load growth in the area resulting in either the construction of additional feeders or increasing the HV distribution feeder voltage from 6kV to 11kV or 22kV

- Distribution feeder voltage constraints due to load growth in rural areas resulting in either the installation of voltage regulators, capacitors, or the construction of additional feeder sections.

- Exceeding the distribution planning guidelines requiring feeder loads to be kept below 80% of their NCR, so that one feeder can be offloaded to four other feeders. The zone substation NCR capacity criterion has driven up the loading on existing feeders significantly.

- The need to integrate (over 4 year period) 13 new greenfields zone substations into the distribution network and 5 new replacement zone substations requiring conversion of distribution feeder voltage from 6kV to 11kV or 22kV. Each new greenfield zone substation requires an additional three or four feeders to be constructed and commissioned

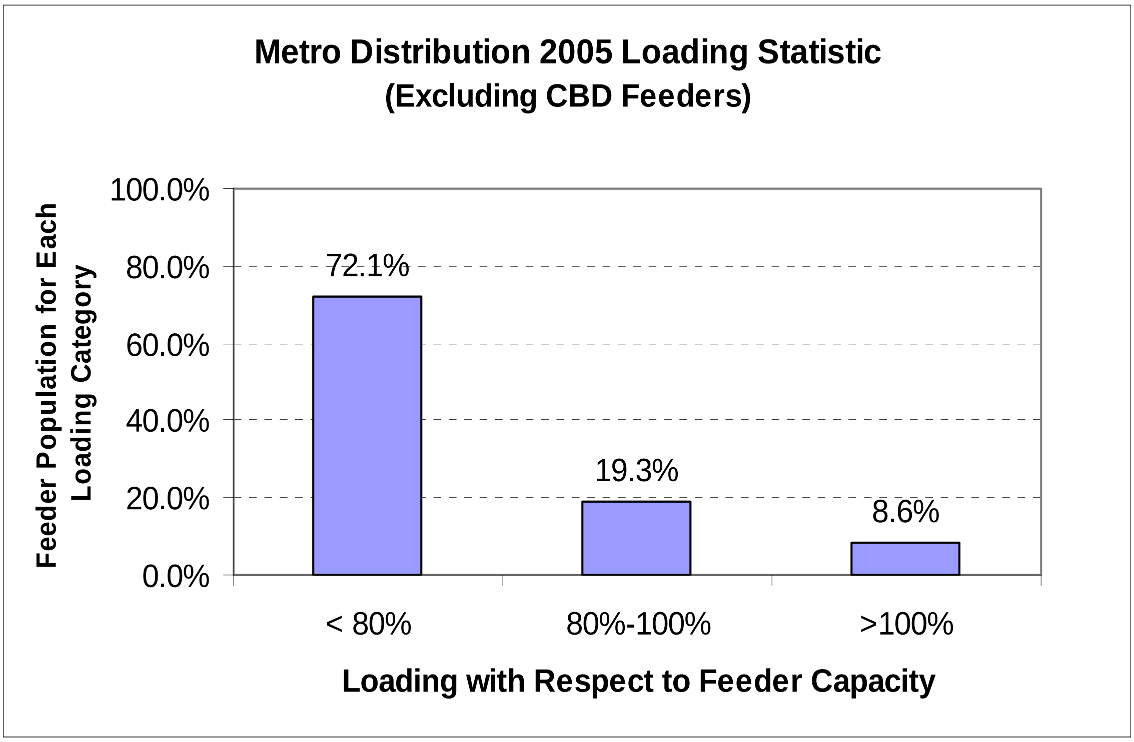
- Increasing fault levels in the metropolitan area due to the penetration of UG cables and the integration of new zone substations. The existence of underrated conductors can also cause under voltage situations which impact on power quality.

The following graph clearly illustrates the current situation in regard to the loading of distribution feeders in the Perth Metropolitan area excluding the Central Business District, with 27.9% of these feeders exceeding 80% of their capacity and 8.6%

overloaded. This situation also impacts on CAIDI by limiting the number of feeders that can be backed up during outages,

The reason for this situation is the under investment that has occurred in the past due to the high level of expenditures required for customer connection works, as a result of the very high customer and peak load growth that Western Australia has experienced over recent years.

Figure 4 - Metropolitan Distribution Feeder Loading



Western Power Networks has developed a software program that is very successful in predicting the location of potential overloaded distribution transformers based on customer connection data. The high penetration of air conditioners over the last few years (due their lower purchase prices) has resulted in the demand of existing customers in developed areas increasing rapidly. A similar phenomenon has occurred in all other states but is particularly evident in the current load factor of Western Australia's closest neighbour, South Australia. Western Power Networks has had to react to transformer overloads as they occurred during recent summer periods but this software facilitates a far more orderly proactive program to be implemented. This planned approach allows optimised distribution transformer utilization as replaced transformers can be rotated into appropriately loaded substations.

Western Power Networks plans to replace 180 distribution transformers in 2005/06 at an estimated expenditure of $4.7M and a further 228 distribution transformers over the control period (128 units in 2006/07, 50 units in 2007/08 and a further 50 units in 2008/09) at an estimated cost of $9M over the three year control period.

LV circuit monitoring by Western Power Networks when changing overloaded transformers has indicated that 50% of the low voltage circuits connected to these overloaded transformers are also overloaded and require rectification. Individual LV circuits can exhibit extremely high load growth, far higher than general system load growth, due to the limited diversity of connected loads. Based on the transformer replacement program, Western Power Networks has programmed to rectify 440 residential LV circuits and 140 commercial LV circuits over the three year control period.

Based on historical costs an allowance of $16,000 has been allowed for the rectification of each residential LV circuit and $32,000 for the rectification of each commercial LV circuit. The proposed spend on removal of LV circuit overloads is $2.24M in 2006/07, $4.8M in 2007/08 and $4.8M in 2008/09.

Historical, interim and "unconstrained" projected expenditures (nominal dollars) for distribution capacity related expenditures, i.e. works associated with augmenting the existing network are as follows:

Figure 5 - Distribution Capacity Related Expenditure

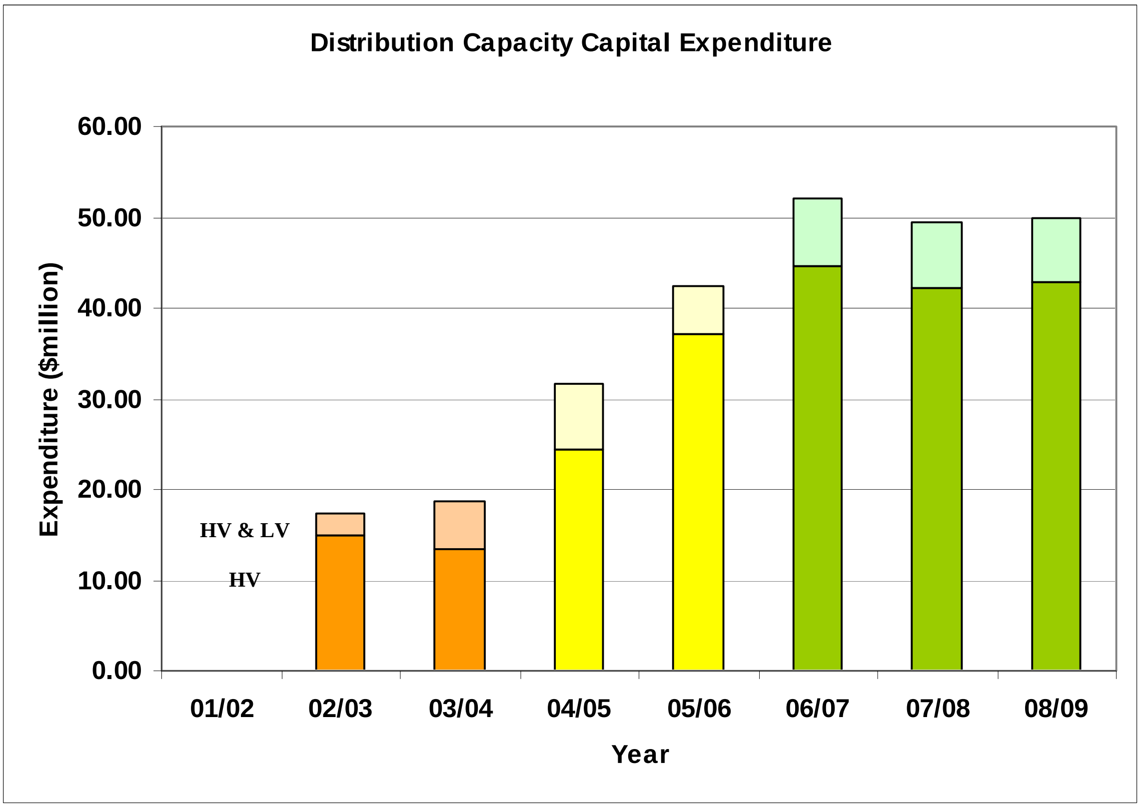
Distribution Capacity	**Historical Data**			**Interim**		**Review Period**		
($million)	**01/02**	**02/03**	**03/04**	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**
Capital Expenditure	-	17.30	18.68	31.71	43.84	51.89	50.09	50.98

This data is illustrated graphically below highlighting the steady increase in expenditure from 2003/04 to 2006/07 when the higher level of expenditure is maintained over the review period. Western Power Networks acknowledges that over the past decade network capacity enhancement has not kept up with load and customer growth. This is highlighted by the large percentage of distribution feeders currently loaded above the planning limit of 80% of normal rating and also the large number of locations where the existing conductor fault capacity is less than the fault level

The adoption of the NCR criteria has resulted in increased utilization of substations up to 90% of total capacity where the number of feeder circuits provided corresponds to the original N-1 substation loading cap (resulting in high feeder utilization). Western Power has prioritised projects to target overloaded feeders to avoid asset failure.

HV augmentation projects are expected to continue at a similar level after 2008/09 as the same drivers for HV distribution capital expenditure are anticipated to be ongoing.

Figure 6 - Distribution Capacity Related Expenditure



Hence the total "unconstrained" forecast demand related distribution capital expenditures over the Regulatory Period are $226M in 2006/07, $238M in 2007/08, and $253M in 2008/09.

Main impact on Clauses

2.5.2.4
2.5.2.5
2.5.2.7

Reliability

The average capital expenditure over the regulatory period will increase from an historical $2M to a "resource constrained" expenditure of $18M per annum, an increase of 900%. To place this proposed level of distribution capital expenditure into context the average "unconstrained " projected distribution capital expenditure, as detailed below, is $20M per annum, and hence the resource constrained levels of expenditure are considered very prudent.

Western Power's network performance based on all faults statistics[1] as at June 2004, is detailed in the chart below.

[1] Excluding major event days in accordance with SCNRRR and IEEE1366 definitions.

Figure 7 - Western Power Networks Performance Figures – June 2004

Region	SAIFI	SAIDI	CAIDI
Urban	3.61	260	72
Rural	4.43	547	124
SWIS	**3.70**	**298**	**81**

In January 2005, Western Power Networks management set a target of 25% improvement on SAIDI and SAIFI across the SWIS – over the next 4 years (commencing during 2005/2006). This target represents the first step in meeting the Energy Safety Directorate's target.

These targets represent a total improvement of 75 SAIDI minutes across the SWIS. The SAIDI targets over the next four years are:

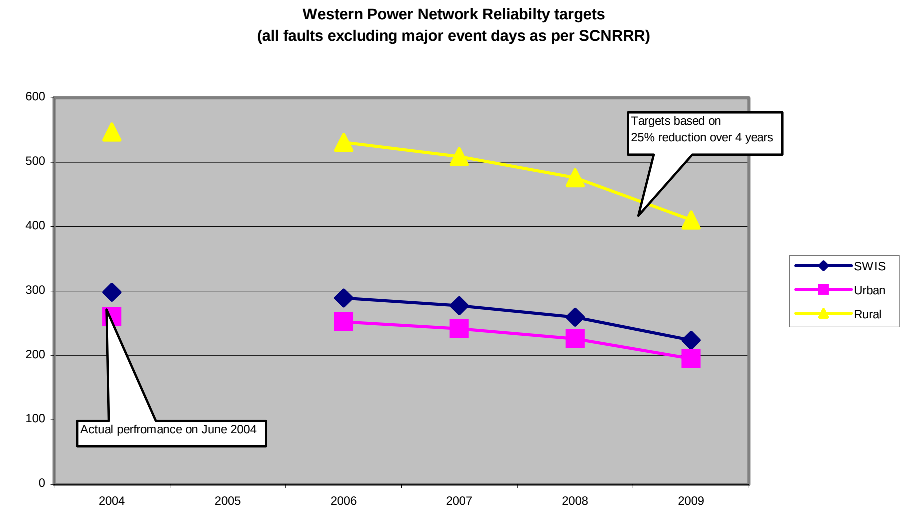
Figure 8 - Western Power Networks Performance Targets[2] (Regulatory Period)

	SWIS	Urban	Rural
June 2006	289	252	531
June 2007	277	242	509
June 2008	259	226	476
June 2009	224	195	410

The planned reductions in SAIDI over the Review Period are shown graphically below:

[2] All faults excluding major event days in accordance with SCNRRR and IEEE1366 definitions.

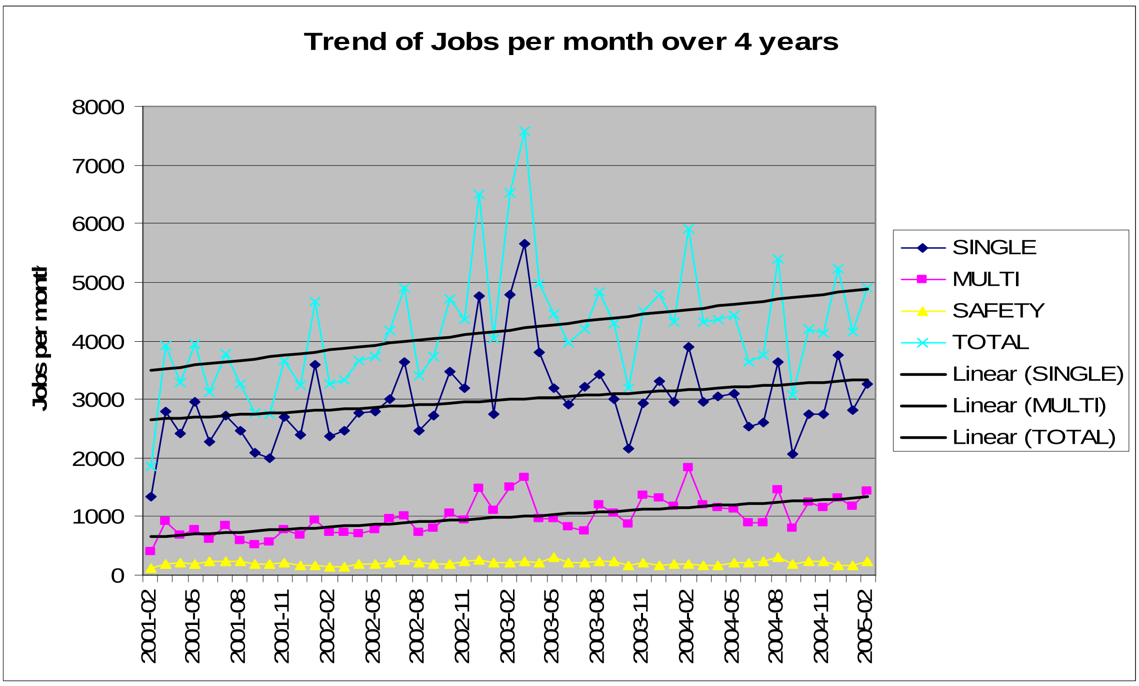
Figure 9 - Western Power Networks SAIDI Targets



Western Power Networks Management adopted the targeted 25% reduction in SAIDI because substantial evidence exists that the current levels of Network Reliability are unacceptable to customers. Western Power Networks has a substantial press clipping register which clearly illustrates that the current number of unplanned outages and outage duration is unacceptable to the general public. In addition comments made by political parties during the last election indicate that other key stakeholders believe that the current level of supply reliability is unacceptable.

In addition other key indicators are exhibiting a worsening trend such as the total number of emergency jobs being received as indicated by the graph below.

Figure 10 - Western Power Networks Fault Job History



Furthermore, a third of overall customers believe that the quality of supply has declined, in past years. This was illustrated in the Retail tracking survey carried out for Western Power which identified a steep decline in the last 6 months in relation to perceived reliability performance, both in terms of the number of outages and fluctuations - declining 13%.

In addition, Networks has carried out a customer survey that indicates that 49% of customers do not feel favourably towards Western Power Network. This figure reflects a declining level of customer satisfaction over recent months. Whilst reliability of supply is important to most customers (86%) many customers believe that a lack of maintenance is the main contributor to poor reliability (43%). Furthermore 58% of respondents who had experienced an outage in the last 12 months were not satisfied with Western Power Network's response to their outage.

In order to achieve the target improvements described above Western Power Networks has reviewed all the capital and operating projects in the Access Arrangement Submission and identified those that have some secondary impact on system performance and reliability (Indirect Strategies). The impact of these projects on the overall SWIS SAIDI has been assessed in order to determine the quantum of additional reliability enhancing projects required to be incorporated in order to achieve the desired outcome.

The combined effect of the SAIDI impacts of both the Indirect Effect Strategies and the reliability enhancement projects (Direct Strategies) would achieve an outcome greater that the proposed 25% reduction in SAIDI over the review period. However, the fact that resource constraints will result in Western Power Networks delivering a less than optimum capital works program will reduce the number of capital projects and result in a lower reduction of SAIDI minutes. This outcome will not be quantified until the final capital works program has been determined and the impact of the included projects assessed.

The Direct Strategies that have been included in the Access Arrangement Submission in order to achieve the desired 25% improvement in SAIDI and SAIFI across the SWIS over the regulatory period as follows:

Main impact on Clause

2.5.2.7

Distribution Automation Strategies.

This strategy will introduce smart mechanisms and remote control methodologies for the prompt identification of faulted network sections and supply restoration to un-faulted sections. The strategy will be approached in two phases: ***Phase 1*** – Pilot Project Initiatives and ***Phase 2*** – Distribution Automation Rollout

Phase 1 of this project involves targeting equipment such as remote-control load break switches, reclosers, fault indicators, sectionalisers, etc. The remote control of these devices will considerably enhance Western Power Network's ability to respond to faults quickly thus minimising outage durations, particularly for those customers connected to sections of a feeder not affected by a fault.

The pilot program will concentrate on a small sample of feeders (1-2) with poor reliability performance and test automation techniques in order to monitor performance and outcomes in a controlled situation. Western Power Networks has estimated that Phase I will cost $467,000 pa.

It is expected that the pilot program will reduce system SAIDI by 2 minutes over 4 years

Phase 2, the rollout of any remote control and/or automation technology, will be dependant on the successful outcome of the pilot Project Initiatives. Assuming that the pilot program is successful it is expected that rollout of Phase 2 can contribute to a SWIS SAIDI improvement of up to 21 SAIDI minutes over the next 4 years.

Phase 2 will include the rollout of 1,000 Line Fault Indicators (LFI) over the next four years at an estimated cost of $1.5M, the installation of 100 remote controlled pole top switches (PTS) per annum over the net four years at an estimated cost of $1,17M, and the installation of 20 additional reclosers per annum over the next 4 years at an estimated cost of $0.9M pa.

Worst Performing Feeder Program

In order to substantially improve the SWIS SAIDI quickly it is planned to identify and implement technical solutions for the top 40 worst feeders. The work will include activities such as targeted siliconing, bird-proofing, fitting tightening, surge arrestor installation, spreader installation, line patrol, line thermographic surveys, spreader/spacer installation, vegetation control etc. In addition the work will include targeted conductor replacement including undergrounding and the use of covered conductors as appropriate.

This strategy will target the worst 20 Metro, worst 10 North Country and the worst 10 South Country feeders. The cost is expected to be $15.7M pa and result in a 49 minute improvement in SAIDI over 4 years.

Rural Power Improvement Project (RPIP) Stage 2

Stage 2 of this project will provide visibility and control to 78 existing reclosers which will substantially reduce response times after a fault has occurred. It is anticipated that the program will improve SAIDI by 2 minutes over 4 years.

Emergency Generator Project

This strategy is designed to reduce the impact of unplanned outages on SAIDI by providing back up supply to customers via a mobile generator set. In addition customers can at times be supplied via a mobile generator set when restoration times associated with restoring permanent supply are expected to be lengthy such as repairing cable faults in URD subdivisions. This technique is accepted practice in other distribution businesses.

The cost of purchasing the mobile generators is $1.2M in 2006/07 and their use is expected to improve SAIDI by 6 minutes over the next 4 years.

Power Quality Upgrades

This expenditure is associated with the resolution of customer enquiries and complaints relating to power quality and in particular to voltage levels. The expenditure is associated with the remedial works associated with the maintenance of voltage levels within statutory limits.

Expenditures have been relatively constant over recent years and Western Power Networks is predicting that they will remain at approximately the same levels over the review period, namely $5M per annum. Whilst this expenditure is necessary to maintain voltage levels within statutory limits it would have negligible to no impact on system reliability.

Expenditures

The projected expenditures for Reliability Driven expenditures for the Review Period are shown in the chart below. They include expenditures for the distribution automation strategies and worst performing feeder improvement program.

Figure 11 - Reliability Driven Expenditure

	Year		
	06/07	07/08	08/09
Cost per annum ($million)	20.6	19.8	19.8
SAIDI minutes improvement	28.7	25.5	22.9

Asset Condition

The average capital expenditure over the regulatory period will increase from an historical $8M to a "resource constrained" expenditure of $15M per annum, an increase of approximately 188%.– Unconstrained capital expenditure on distribution asset replacement as forecast by PB Associates model were $48M per annum and hence resource constrained expenditures of $15M per annum are considered more than justified.

The age, condition and risk associated with failure of the non run to failure (RTF) distribution assets triggers replacement capital expenditures on distribution infrastructure. Run to failure assets are replaced upon failure and the replacement costs expensed. In order to determine the magnitude and timing of this replacement asset expenditure Western Power engaged PB Associates to develop an age, condition and risk distribution asset replacement model. This model has been populated with Western Power's asset data including asset quantities, age profiles, and with modern equivalent replacement costs.

The model has been used to predict distribution asset replacement expenditures over the regulatory period and also the weighted average remaining life of these assets. The model has indicated that Western Power's distribution assets have a weighted average remaining life of 55% in 2005. Western Power's distribution assets have a current Replacement Cost $2.86 billion and an ODV $1.7 billion. Recommended asset replacement expenditures of, on average, $42.26M per annum infer that the assts have a service life of between 50 and 100 years and therefore do not appear unreasonable.

The model incorporates the current backlog of assets identified for replacement in the MIMS data base and has predicted total asset replacement expenditures over the regulatory period of $143.77m as detailed in the summary chart below. The model has also predicted that these levels of investment will not arrest the decline in weighted average asset age, with the weighted average remaining life decreasing from 54% to 52% over the regulatory period.

Distribution Asset Replacement Model							
	Group	**Deferred**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**TOTAL**
	ID	**2005**	**2005**	**2006**	**2007**	**2008**	**REVIEW**
TOTAL CAPEX Requirement $ m		39.574	51.077	42.069	48.060	56.084	PERIOD
Average Expenditure over 20 year period			105.622	105.622	105.622	105.622	
Weighted Average Remaining Life			0.551	0.539	0.526	0.516	
WARL (Using Standard Asset Lives)			0.551	0.539	0.526	0.516	
AUTO	1		0.000	0.007	0.007	0.007	0.020
HVOH	2		1.899	0.449	0.366	0.489	1.303
HVUG	3		0.000	0.037	0.044	0.069	0.150
LVOH	4	0.017	4.235	6.859	8.450	10.174	25.483
LVUG	5		0.036	0.146	0.187	0.169	0.502
DIHV	6		0.020	0.000	0.006	0.014	0.020
DOF	7		3.114	4.005	3.117	5.979	13.101
DSTR	8		1.221	0.624	0.916	0.598	2.138
FLTI	9		0.000	0.000	0.001	0.000	0.002
FSDO	10		0.153	0.173	0.234	0.370	0.777
FSDU	11		23.587	15.002	14.820	14.742	44.563
FSSW	12		0.271	0.288	0.194	0.256	0.738
HVTM	13		0.473	0.406	0.459	0.383	1.249
LVDF	14		2.243	0.772	0.840	1.032	2.644
PAUS	15		0.000	0.001	0.001	0.007	0.009
PTSD	16		1.386	3.678	1.931	6.504	12.113
PWOD	17	3.838	10.051	5.831	12.951	11.817	30.599
REAC	18		0.000	0.000	0.000	0.000	0.000
RECL	19		0.019	0.013	0.008	0.013	0.034
SBST	20		0.000	0.008	0.001	0.004	0.013
SD	21		0.235	0.278	0.133	0.329	0.739
SECT	22		0.000	0.000	0.003	0.002	0.006
SWDC	23		0.104	0.058	0.053	0.043	0.154
RTF	24		0.000	0.000	0.000	0.000	0.000
POLE REIN	25	2.247	2.004	0.993	3.340	3.084	7.417
				39.628	48.060	56.084	143.77

As the following chart clearly demonstrates there has been substantial underinvestment in the replacement of distribution assets. Western Power has identified additional aged assets that it would like to replace over the coming regulatory period.

Figure 12 – Asset Replacement Capital Expenditure

Distribution	Historical Data			Interim		Review Period		
CAPITAL EXPENDITURE	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Asset Replacement	-	8.22	4.00	6.60	3.84	39.63	48.06	56.08

Main impact on Clause

2.5.2.7

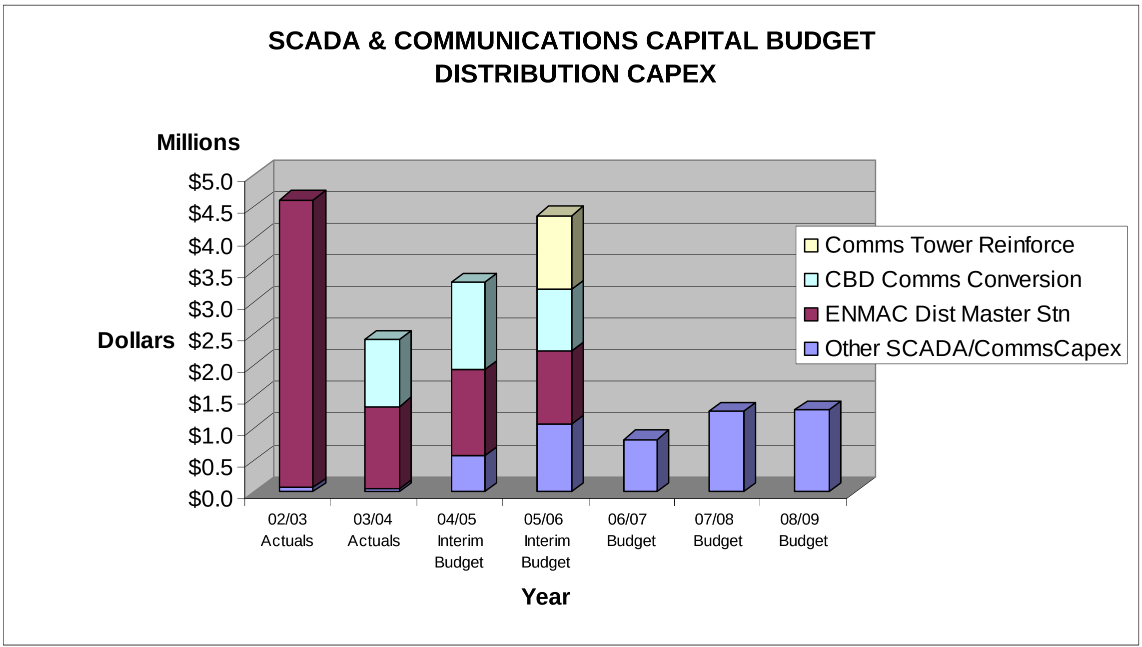
Scada & Communications

The Western Power Networks SCADA and Communications group is responsible for the asset replacement of distribution infrastructure (e.g. CBD SCADA communications fibre, pole-top automation equipment, etc.) and implementation of new infrastructure which compliments electricity infrastructure (e.g. optical fibre infrastructure interconnecting distribution substations, mobile radio etc). It does not include SCADA and communication components of capital works sponsored by others for example pole top automation projects including RPIP.

The projected capital expenditures relate primarily to the provision of 'backbone" infrastructure and not to individual SCADA and communication expenditures associated with individual projects which are included in the project expenditures. The capital projects scheduled for commissioning during the review period are as follows:

- Communications asset replacement projects supporting the distribution system (e.g. mobile radio - $1.9M over 6 years to ensure continuity of critical services at end of life).
- SCADA asset replacement projects supporting the distribution system (e.g. replacement of the metro recloser network - $.8M over 2008 - 2010)
- Communications enhancement projects for mobile radio and distribution automation (e.g. Northcliffe Mobile Radio base and Mt Barker district recloser automation

Figure 13 - SCADA & Communications Expenditure



It is notable that there are no major capital projects planned over the review period. The ENMAC master station is scheduled for commissioning in 2005/06, and the projects included in the review period relate primarily to minor asset replacement and enhancement projects.

Due to the specialised technical nature of the SCADA and Communications projects, each project is individually designed and costed. Western Power Networks is confident in the efficiency of the SCADA and Communications Group as they have demonstrated their competitiveness on the open market.

Although SCADA and communications infrastructure in isolation have only minimal impact on safety, environment and reliability, with the notable exception of the radio network, they are essential elements in the overall delivery of these outcomes. They provide the links between system operations and the primary power system assets, enabling remote supervision and control which have major impacts on supply reliability, operator safety, and environmental outcomes.

Information Technology

The Western Power Networks IT expenditures include all capital Information Technology projects and all capital purchases for printers, PDA's software etc. The Western Power Networks Personal Computer (PC) fleet is leased and the associated expenditures therefore appear as operating expenditures.

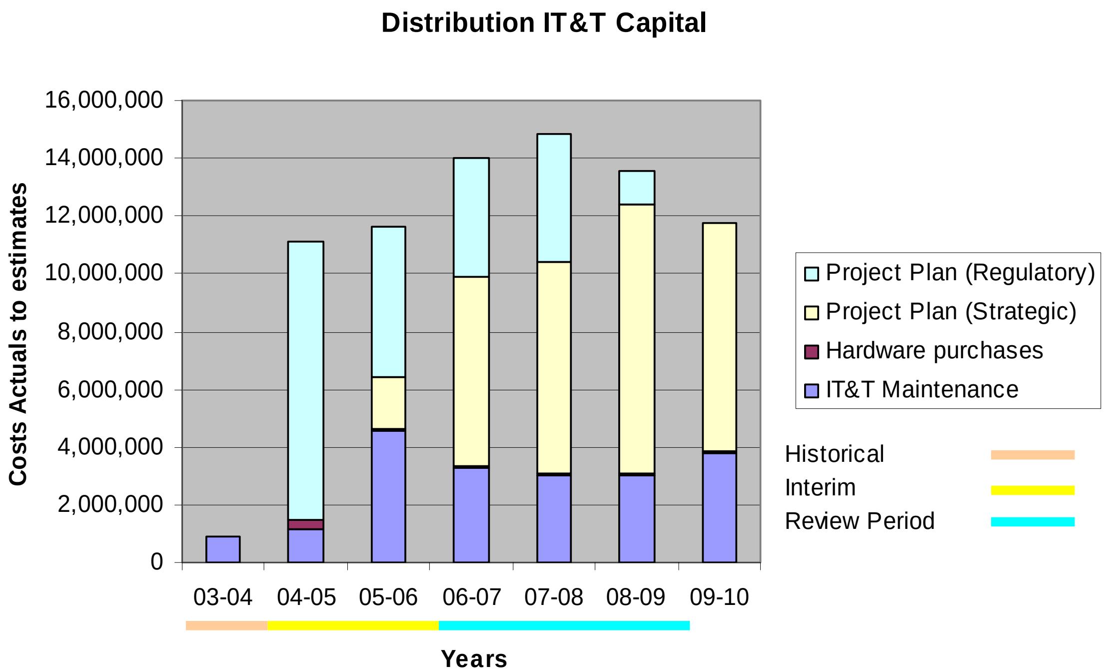
Detailed market design[3] suggests that System Management needs to be ring-fenced and is expected to have significant Information Technology reform costs to meet wholesale market needs. Western Power Networks has made no allowance for the ring fencing of System Management as the rules for ring fencing are not yet clear.

The IT forecast expenditures are required to increase based on a number of key drivers;

- **Regulatory Project Plan** - Expenditure associated with market reform projects,
- **Strategic project Plan -** Replacement of existing Information Technology systems as they approach or have passed the end of their economical and useful life, and
- **Maintenance and Hardware Purchases -** A return to sustainable maintenance levels following a period of constrained expenditure.

The following figure provides a breakdown of the relative contributions of the above drivers to the overall capital expenditure forecasts.

Figure 14 - Information Technology Distribution Capital Expenditure



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[3] KEMA Consulting 4th November 2003

Regulatory Project Plan

The Western Power Networks reform projects are associated with the implementation of government directives to disaggregate Western Power Networks and facilitate competition and open access in line with federal COAG directives.

The proposed Western Power Networks Information Technology projects associated with market reform are as follows;

1. **Metron** - Works include the planning, development and implementation of a Metering Business System to enable the dissemination of metering data to the Western Australian Energy Market participants.

2. **Compliance reporting** – Works include determining compliance reporting needs and the implementation of a solution to best meet needs of Networks and the Regulator.

3. **Standalone business systems** - Configuration of the corporate systems adopted by Networks after corporate disaggregation is complete. Works include Internet, Intranet, MIMS, Financial modelling, Treasury, DMS, Messaging.

4. **Networks Customer Information System** - Replacement of mostly manual processes with an off the shelf package that supports access billing, and provides Networks with capability to manage customers (retailers and non-energy customers) in a de-regulated environment as an independent business unit.

Significant market reform expenditures have occurred in all states that have implemented retail competition in the electricity and gas markets. The vast majority of these expenditures have been incurred in the Information Technology business groups due to the need to radically alter systems to meet the new working arrangements.

The systems identified by Western Power Networks relating to market reform are consistent with meeting the government reforms.

The projected Western Power Networks expenditures associated with market reforms include both disaggregation and competition reforms. On this basis, the Western Power Networks expenditure compares favourably with state-by-state comparisons.

Strategic Project Plan

Over the past 2-3 years, Western Power Corporation's (WPC) and Networks' Business Unit charter and strategic direction have been significantly impacted by the State's Electricity Reform agenda. A number of major IT&T initiatives have been deferred whist reform projects were planned and implemented. These deferments include a number of major Information Technology systems. A number of these systems are 10 years old or greater[4], well in excess of industry norms.

[4] The Graphical Information System (GIS) is in excess of 20 years old.

Examples of projects that were placed on hold, or did not commence include Workforce Management, and GIS Review/Replacement, as well as significant asset management and decision modelling initiatives.

The proposed Western Power Networks Information Technology projects associated with strategic system replacement are as follows;

1. **Trouble Call Management System** – Replacement of the existing outage management systems with a system that is able to provide a higher level of availability than the current systems and that enables system operations to meet regulatory reporting requirements and monitor minimum response times required to restore outages.

2. **Work Force Management –** Replacement of the mostly manual processes with an automated off the shelf package that supports construction, maintenance, and connection work. The proposed package includes demand forecasting, resource planning and work scheduling as well as including mobile communications for the field workforce.

3. **GIS replacement –** The current networks GIS Suite has a diminishing ability to support business processes and goals. This project seeks to rationalise Networks GIS applications to meet the core business requirements, and to move from platforms that are no longer supported.

The existing IT&T infrastructure is predominantly legacy, including platforms and software that, in some cases, constrains flexibility and presents a risk to business continuity.

Maintenance and Hardware Purchases

IT&T expenditure has come through a recent history of imposed budget constraints and a deferred disaggregation program that limited opportunities to implement strategic IT&T initiatives.

The base levels of IT&T maintenance and hardware purchases projected for the regulatory period are consistent with the ongoing expenditures associated with maintaining network Information Technology systems.

Safety, Environment and Statutory

The average capital expenditure on safety, environment and statutory capital works over the regulatory period will increase from an historical $12M to a “resource constrained” expenditure of $41M per annum, an increase of approximately 342%. The unconstrained projected expenditures on these capital works was on average $54M per annum and hence the resource constrained projected expenditures are considered to be clearly justified.

The unconstrained expenditures are detailed below and also include the capital cost of ensuring metering compliance.

Figure 15 – Safety, Environmental & Statutory Expenditure

Distribution CAPITAL EXPENDITURE	Historical Data			Interim		Review Period		
	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Safety, Environmental & Statutory	-	0.01	4.26	15.30	26.43	40.68	43.84	46.91

Western Power Networks have included the following safety, environmental and statutory projects in the Access Arrangement Submission.

Overhead Service Wires With Twisties

The recent double fatality in Wyndham prompted a capital replacement program to replace services with twisty connections. In 2003/2004 a pro-active pilot test program commenced to gather data on the condition of these assets.

In September 2003 the Systems Services Branch released an interim branch instruction. This instruction detailed the inspection and replacement requirements for Overhead Service Cables and the termination hardware (updated in December 2003). The following summarises the branch instruction:

All new or upgraded overhead service cables must be replaced with Cross Linked Polyethylene (XLPE) service cable and terminated using the approved wedge type clamp.

All Polyvinyl Covered (PVC) overhead service cables disconnected from the customer's point of attachment must be replaced with Cross Linked Polyethylene (XLPE) service cable and terminated using the approved wedge type clamp.

A survey of overhead customer service connections by meter readers commenced in late February 2004, which will identify the extent of some of the key issues within the SWIS distribution network. The survey will be a SWIS-wide inspection and will cover some of the key issues which can be identified visually.

Capital approval was given in early March 2004 based on the expected results from the meters survey of overhead customer service connections. Several replacement options were considered including undergrounding the overhead services, however Western Power has decided to replace all existing PVC services with Cross Linked Polyethylene insulated service cable terminated with approved wedge type clamps

The total projected expenditure over the regulatory period for twisties replacement is $45,520,921

Conductive Metal Streetlight Poles

A number of electric streetlight shock incidents have been experienced by members of the public from contact with metal streetlight structures. These incidents seem to have been due to inadequate earthing and/or deterioration or damage of insulation through abrasion inside the metal streetlight arm or luminare thereby energizing the metal structure.

As a result, a ‘design-out’ solution has been developed for all new and replacement metal streetlight poles and an inspection program undertaken to identify and rectify any existing metal street light poles with either inadequate earthing or wiring with deteriorated insulation. All new installations, including the luminaries will be double insulated. There are approximately 60,000 existing metal streetlight poles in the SWIS which will be inspected and where necessary maintained.

The total projected expenditure over the regulatory period for the identification and rectification of conductive metal streetlight poles is $9,180.805

Distribution Conductive Power Poles Step and Touch Potential Mitigation

This risk was highlighted during the investigation of 3 potentially fatal electric shocks to members of the public in the Perth metropolitan area. An estimated 51,000 poles in the SWIS are at special or frequented locations that need to meet the ESAA C(b))1 limits for touch and step potential. The risk is likely to be greater at locations far from the source of supply because the fault level will be lower and there will be less chance of detecting and clearing a fault. A replacement/bonding (CMEN) program is planned to address the problem.

The rectification of this safety issue is also clearly required under the provisions of the Electricity (Supply Standards & System Safety) Regulation 2001.

The total projected expenditure over the regulatory period for the identification and rectification of conductive power poles step and touch potential is $3,003,532

Streetlight Switch Wires

There have been 2 fatalities in the last 10 years and 2 potentially fatal electric shock incidents in the past 4 years to the public from fallen streetlight wires. Almost two years ago a member of the public received an electric shock from a fallen corroded copper streetlight switch wire close to the coast in Geraldton. It is estimated that there are 250,000 meters of old small-gauge copper switch wires for controlling streetlights in the SWIS that has been corroding and is at risk of failing. When it does, it may fall to the ground and pose a significant risk of electrocution while the switch wire is energised.

The rectification of this safety issue is also clearly required under the provisions of the Electricity (Supply Standards & System Safety) Regulation 2001.

The total projected expenditure over the regulatory period for the identification and replacement of corroded small gauge streetlight switch wires is $2,203,681.

URD Cable Pits

There are 5711 below-ground cable pits with insulated piercing connectors (IPC’s) used to supply power mainly to residential customers that have been installed in the SWIS as part of the Retrospective Underground Power program. A number of electric shock incidents have been reported by the public and Western Power Networks employees resulting from such installations. These incidents were caused by either the degradation of the IPC insulation or the incorrect installation of the IPC where not all the available connections were required to be used.

A program to replace these URD cable pits with above ground pillars has commenced and up until March 2005 approximately 25% of these pits had been replaced in accordance with the solution agreed with the ESD.

The total projected expenditure over the regulatory period for the replacement of these URD pits with aboveground pillars is $2,494,461.

Henley Cable Boxes

There has been a number of Henley cable box explosive failures in public areas resulting in shrapnel (metal) spread over a wide area. Such failures could have serious consequences, especially in high traffic areas (e.g. shopping centre car parks) where there is a high risk of injury to the public or damage the vehicles. There are an estimated 2,000 Henley cable boxes, which need to be replaced based on site location and traffic with the more critical known sites being resolved first.

This is an industry wide issue and the replacement of the Henley cable boxes would be required in accordance with the provisions of the Electricity (Supply Standards & System Safety) Regulation 2001.

The total projected expenditure over the regulatory period for the replacement of these Henley cable boxes is $9,721,329.

Cattle Care

The aim of the project is to deny cattle access to the Aldrin/Dieldrin that was applied to the base of wooden poles of power lines that were built prior to 1986. The project is largely reactionary and based on farms that are seeking quality assurance systems.

The project has been initiated to comply with prudent avoidance requirements of Quality Assurance Accreditation Schemes and mitigate the risk of potential contamination of beef with chlorinated hydrocarbon pesticides. The consequences of not taking action include potential loss of shipments of beef at market door (eg. USA) and potentially disastrous flow on effects for the export market in this commodity and possibly other farm produce.

As the provision of barriers is dependent on customer requests, an allowance of 2000 barriers at current cost of approximately $250 each has been included in the projected expenditures for the regulatory period.

The total projected expenditure over the regulatory period for the installation of concrete barriers is $520,700.

Pole Top Switch (PTS) Earthing Mats

Five years ago a Western Power Networks operator received a near fatal electric shock. Temporary measures have been taken until a permanent solution is implemented. About 3,000 pole-top switches in the metro area have ineffective earthing mats and so pose a significant risk of injury to switching operators.
This project is on-going and as field inspections reveal problems, the appropriate technical solution is implemented.

The rectification of this safety issue is also clearly required under the provisions of the Electricity (Supply Standards & System Safety) Regulation 2001.
The total projected expenditure over the regulatory period for the installation of earthing mats underneath PTS operating handles is $7,553,197.

Live-frame Shrouding

Many of the LV frames in district substations have exposed bare live copper busbars. This has been recognised as hazardous to personnel accessing the site and must be rectified so as to protect switching operators and substation inspectors from unnecessary risk of electrocution. The program will involve shrouding the busbars or installing barrier boards. Initial estimates suggest that around 2,500 units will require upgrading.

The solution agreed with the ESD involves shielding the exposed unprotected live busbars to prevent inadvertent contact and revising access locking and permit requirements.

The rectification of this safety issue, which has already caused one electrocution, is also clearly required under the provisions of the Electricity (Supply Standards & System Safety) Regulation 2001.

The total projected expenditure over the regulatory period for the installation of the shielding is $1,953,783.

Wrapped Copper LV Neutral Service Connections

Typically there are a number of potentially fatal electric shock incidents per year directly attributed to faulty wrapped neutral connections. They are usually caused by open circuit or high resistance overhead neutral connections. It’s estimated that about 200,000 connections need to be bypassed or replaced.

The removal of this safety issue is an outcome agreed with the ESD and clearly required under the provisions of the Electricity (Supply Standards & System Safety) Regulation 2001.

The total projected expenditure over the regulatory period for the replacement of this type of service is $5,068.992.

Inadequate Reinforcing of Transformer Poles

Recently a transformer pole with limited reinforcement fell over into the middle of a suburban street. Western Power has engaged GHD to re-evaluate the strength of its pole top substation structures and they have indicated that these structures need to be reinforced by installing additional ground line reinforcements.

It is estimated that around 3,000 poles may not be suitable for carrying the weight of 50kVA or larger transformers, and need to be refurbished. This will upgrade the mechanical strength of the respective structures preventing failure with the attendant damage to transformers and reduction of risk to public.

The removal of this safety issue is clearly required under the provisions of the Electricity (Supply Standards & System Safety) Regulation 2001.

The total projected expenditure over the regulatory period for the additional ground line reinforcement is $2,309,350.

Main impact on Clause

2.8.5

Padmount Transformer Noise

The project consists of the construction of noise barriers around padmount substation transformers to reduce noise emissions such that they comply with the requirements of the Environmental Protection (Noise) Regulations. The program of noise mitigation work is to be completed at 26 substations over a 4-year period and is to be completed by the end of 2008.

Non compliance with the requirements of the Western Australian Noise Regulations to reduce the impact of noise emissions on substation neighbours could result in fines of $25000 and $5000 per day under Section 51 of EP Act or fines of $5000 under Sections 79, 80, 81 and 82 of EP Act.

The total projected expenditure over the regulatory period for the installation of sound barriers is $6,590,605.

River Crossings

The ESD has advised Western Power that it requires all bare conductor river crossings to be either placed underground or in some agreed circumstances replaced with Hendrix cables installed with substantially increased height above MHW.

Western Power has commenced a program to replace the river crossings in the SWIS and the projected expenditure for the regulatory period is $444,840.

Bushfire Mitigation

Bushfire Mitigation includes the following expenditure categories in accordance with the Bushfire Management Implementation Plan 2004/05:

Bushfire Mitigation
- wires down
- pole over
- conductor clashing HV
- conductor clashing - LV
- fire safe fuses
- line fireproofing

This project has been instigated as a result of a desire of both the West Australian Government and Western Power to reduce the potential for either loss of life and/or property as a result of bush fires initiated by either the transmission or distribution network infrastructure.

All of the individual projects that in combination comprise the Bushfire Mitigation works would fall under the provisions of the Electricity (Supply Standards & System Safety) Regulation 2001.

The total projected expenditure for bushfire mitigation over the regulatory period is $33,630,807

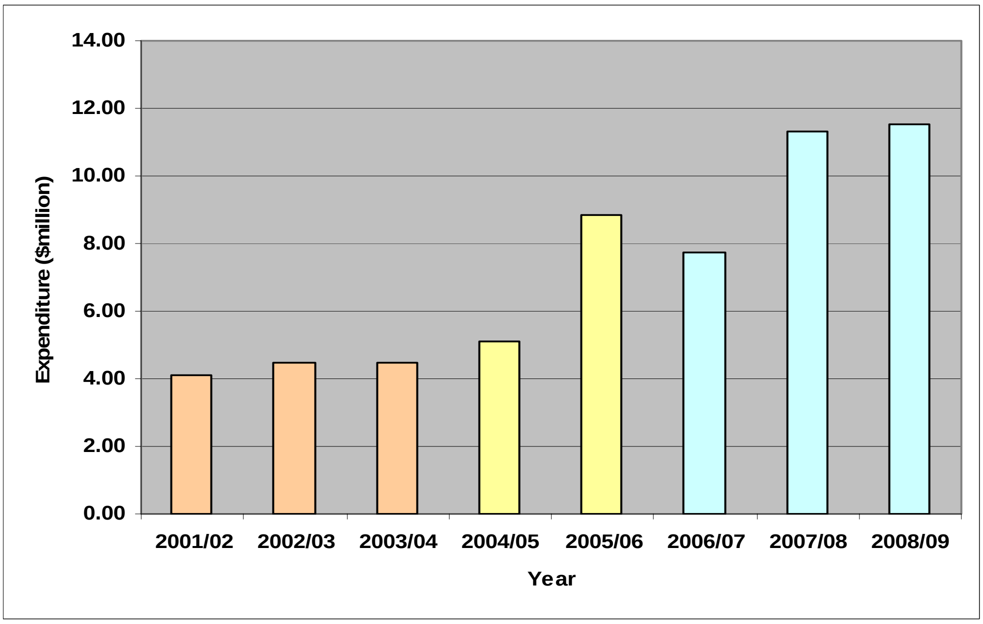
Metering

Metering Capital expenditure includes all expenditures relating to the supply of meters and communications equipment, capitalised meter installation and commissioning activities for new CT metered installations, and the creation of the network connection point. The forecast presented in the table below includes expenditure for new connections, and a compliance meter change program required for regulatory compliance.

Figure 16 - Metering Capital Expenditure

	Historical Data			Interim		Review Period		
($million)	**01/02**	**02/03**	**03/04**	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**
Metering	$4.12	$4.48	$4.50	$5.08	$8.82	$7.75	$11.30	$11.52

Figure 17 - Metering Capital Expenditure



The two main components of the metering expenditure are very different in nature. The new connections component is an ongoing expenditure type for the network business which has shown a gradual increase over the last few years. Generally, Western Power Networks have found the increase in new connection requirements to be in line with increases in Gross State Product (GSP) and have therefore used the forecasts for GSP as a basis to forecast the expected increases in the volume of new connections.

Figure 18 – New Connections Volume

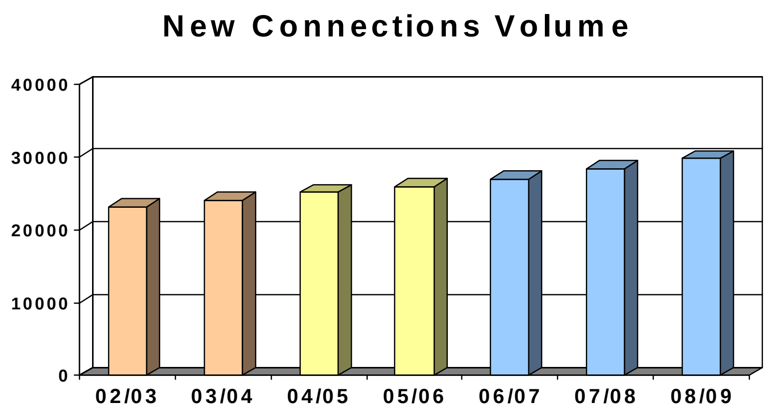
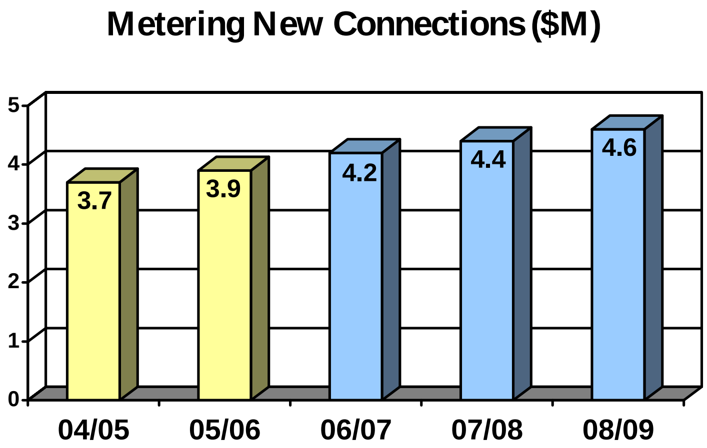


Figure 19 – Metering New Connections



The second main component of the Metering capital program is a meter replacement program required to comply with the Electricity (Supply Standards and System Safety) Regulations 2001 - regulation 9(1). This regulation requires the network business to conduct testing of the accuracy of meters and where a meter population is identified as falling outside the accuracy requirements, based on a sample testing program, the population of meters must be replaced within a three year period. This expenditure type is not regular but is mandatory to maintain compliance as inaccurate meter populations are identified through the testing program.

The sample test program has identified approximately 100,000 single phase meters which must be replaced and expenditure of $9.8 million for replacement of these meters has been forecast between 2004/05 and 2006/07.

A testing program for 3 phase meters is currently in progress and due to the similarity in age and quality of the 3 phase and single meter populations, Western Power Networks has assumed that a similar number of 3 phase meters will require replacement. A forecast of approximately $16.5 million has been made for the replacement of 3 phase meters and this replacement program will be spread over a 3 year period commencing in 2007/08. Once these replacement programmes are completed it is expected that expenditure for compliance with the Electricity Regulations will decrease markedly.

The forecasts for the bulk replacement program are based on replacement of existing electro-mechanical meters with electronic interval meters (both single phase and 3 phase). Western Power Networks have chosen to install electronic interval meters, as the additional time of use data may assist with demand side management and therefore delay augmentation related capital works. These meters are only marginally more expensive than electro-mechanical meters.

Special Programs

Rural Power Improvement Program (RPIP)

Main impact on Clause

2.5.2.6

The Rural Power Improvement Program (RPIP) is a targeted 4-year, $48 million capital expenditure program. The broad objective of the program is to enhance power supplies in country areas. Selected projects are 50% funded by the Office of Energy (OoE) and 50% by Western Power Network. The program commenced in 2004/05 and is scheduled to be completed in 2007/08.

Figure 20 - RPIP Capital Expenditure

	Historical Data			Interim		Review Period		
($million)	**01/02**	**02/03**	**03/04**	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**
RPIP	-	-	-	11.00	13.00	12.00	12.00	12.00

The RPIP expenditure shown in the above chart and table is broken into 3 phases:

- Phase 1 – projects with a value of $17.6 million have been selected and approved by OoE and are currently in progress. Completion is expected in 2005/06;

- Phase 2 – $20 million worth of projects have been selected and approved by OoE and will commence in 2005/06, a further $10.4 million will be allocated to projects later in the period. Completion of Phase 2 projects is expected in 2007/08.

- Phase 3 – a third phase has been included in the regulatory period forecasts based on the assumption that this successful government endorsed program will be extended with a similar funding level. Projects for Phase 3 would commence in 2008/09.

RPIP is a broad scale reliability enhancement program with emphasis on targeting poorly performing feeders in rural areas. The program does not include projects in Metro and CBD areas of the network. The program budget has been evenly split between projects with a capacity enhancement benefit and asset renewal projects. The typical result of these projects is significant improvement in the number and frequency of interruptions to supply, experienced in the targeted local area.

RPIP is a committed program throughout the first 2 years of the regulatory period and provides benefits to customers in rural areas. Based on the extension of other targeted programs such as SUPP, it is anticipated that the WA Government will extend this program for a further period and therefore an additional $12 million has been included for 2008/09.

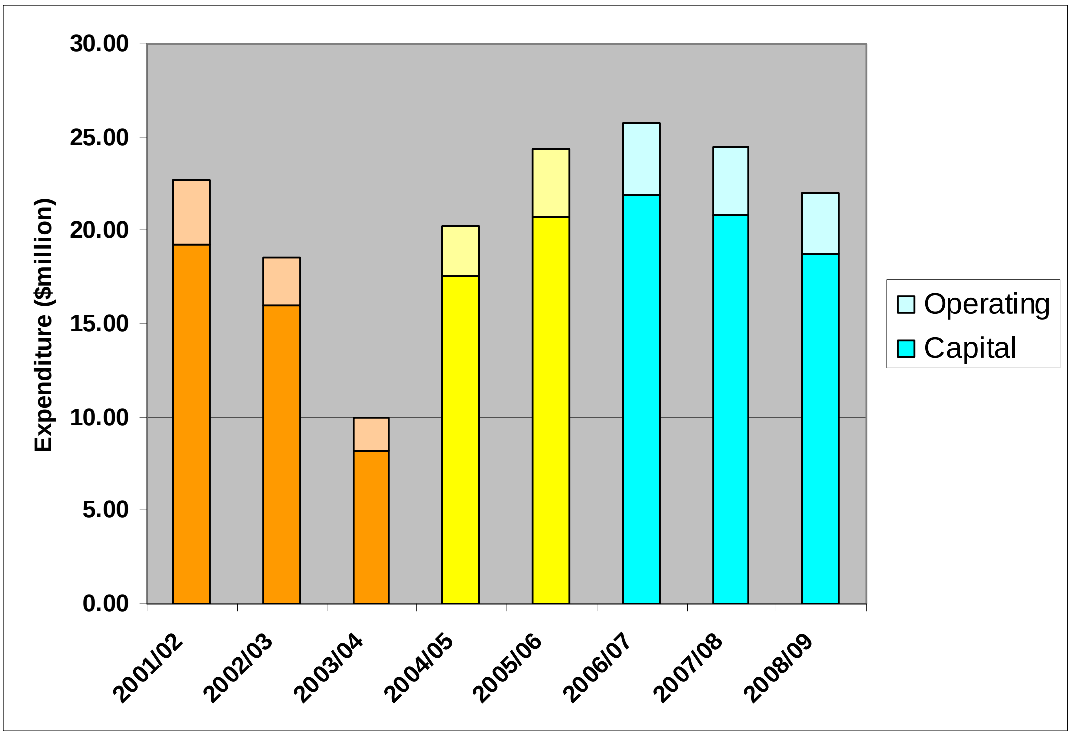
State Underground Power Program (SUPP)

The State Underground Power Program (SUPP) is a WA government initiative to underground 50% of the Perth metropolitan area with a corresponding increase in regional areas by 2010. SUPP capital and operating expenditure includes all expenditures relating to retrospective undergrounding of overhead power systems for selected project areas in the Perth metropolitan and regional areas. The committed total budget (including capital and operating expenditure) is $20 million per annum.

Figure 21 – SUPP Capital & Operating Expenditure

	Historical Data			Interim		Review Period		
($million)	**01/02**	**02/03**	**03/04**	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**
SUPP Capex	19.251	15.990	8.173	17.562	20.697	21.894	20.839	18.712
SUPP Opex	3.419	2.596	1.771	2.700	3.644	3.855	3.669	3.295
SUPP TOTAL	**22.670**	**18.586**	**9.944**	**20.914**	**24.340**	**25.750**	**24.510**	**22.010**

Figure 22 - SUPP Capital and Operating Expenditure



The Western Australian Government commenced the SUPP program in 1996 to retrofit metropolitan areas with underground power for network reliability and amenity reasons. A commitment was made to achieve 50% of Perth with underground power by 2010. The funding arrangements for this program are 25% from WA Government, 25% from Western Power Networks and 50% from the Local Government Authority (LGA). Award of the funding is competitive and LGA's are required to apply for inclusion of specific areas in the program.

The capital component of the expenditure relates to the underground cable installation whilst the operating expenditure component relates to provision of underground services to connect individual properties.

The recently re-elected government has committed to a continuation of SUPP with election promises including a continuation of current funding levels.

The Round 4 selection process will commence in 2005 with projects expected to commence in 2007. Western Power Networks expects that the level of expenditure required in Round 4 will be in the order of $24 million per annum in order to achieve the stated target of 50% undergrounding by 2010.

The selection criterion for round 4 projects is currently under discussion and is expected to be based on the following items:

- 50% for power system improvement criteria (reliability, capacity, power quality);
- 20% for general suitability, amenity improvement;
- 20% for value for money based on expected project cost and number of residences;
- 5% for LGA funding credibility;
- 5% for community support survey results.

The application, evaluation and selection process of the SUPP applications is rigorous, and there is keen competition for the limited funding available.

END OF DOCUMENT
“ADMD SUBMISSION WITH LINKS”, WP TO ERIU TRC.

SUBMISSION TO THE TECHNICAL RULES COMMITTEE

WESTERN POWER TECHNICAL RULES

OVERLAP BETWEEN MARKET RULES AND TECHNICAL RULES

Table of Content

OVERVIEW OF POWER SYSTEM SECURITY CLAUSES IN TECHNICAL RULES AND MARKET RULES

1. OMISSIONS REQUIRED

1.1 Market Rules

Nothing in the market rules needs to be removed.

Issue 1 – Different Terminology. Terminology proposed by KEMA consulting is used in the Market Rules (normal state, high risk state, and emergency state). It differs from the National Electricity Rules terminology that is adopted in the Technical Rules (satisfactory state, and secure state). There is no substantial conceptual difference in these two approaches for describing power system security, both of which are adequate for the purpose. The problem appears to be mainly semantic.

Resolution 1 – Consult if the departure from the National Electricity Rules terminology in Market Rules is acceptable to the industry.

Details –

Market Rules - 3 states: Normal, High Risk & Emergency.

Technical Rules - 2 states: Secure & Satisfactory.

Normal is similar to Secure except Normal stipulates no load-shedding is in place.

High Risk is similar to Satisfactory except High Risk stipulates no load-shedding is in place.

Emergency is similar to satisfactory except Emergency stipulates load-shedding is in place.

1.2 Technical Rules

Due to similarity of the two approaches, the relevant clauses in Market and Technical Rules are also similar. As a result, the majority of clauses in Section 5 of Technical Rules defining the power security concept, Clauses 5.1, 5.2, 5.3, 5.4, 5.8 & 5.9, can be removed or substantially shortened by removing the responsibilities of the System Management. Then, the scope of Section 5 would reduce to defining responsibilities and obligations on the Network Operator and Network Users for the network reliability and security.

Issue 2 – Outage co-ordination. There is an outage co-ordination/operation rules that must be repeated in both Rules due to difference in coverage. Market Rules apply to Market generators and a defined list of Network Elements, which are located mainly in the transmission system. The rules for the remainder of the Network Elements (generally small generators, distribution and transmission elements that have no market impact) must still be retained in the Technical Rules. This is illustrated in Figure 1. The same considerations also apply to the power system operation, not just outage coordination.

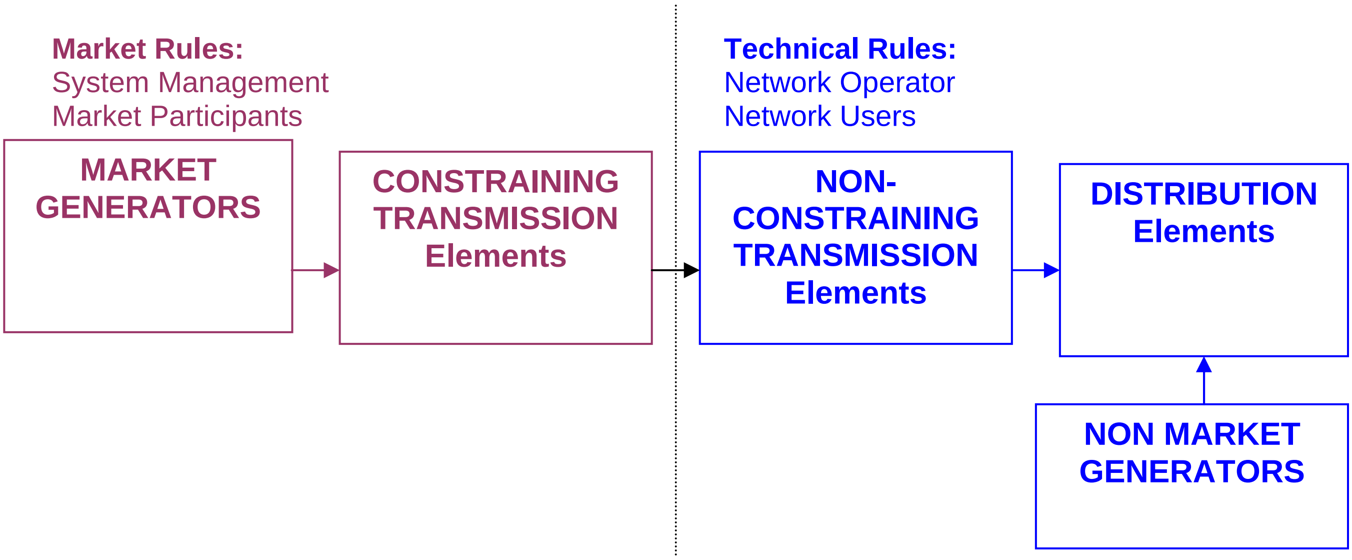


***Figure 1** - Domain of application of Market Rules (left) and Technical Rules (right) in the operational time-frames. Dotted vertical line represents a boundary.*

Resolution 2 –

- Consult if the apparent repeat of rules in Market and Technical Rules is acceptable.
- Also consult if reference to the Market Rules in Technical Rules may be more acceptable (for example, wording in the Technical Rules that, say, "This section applies to outage co-ordination of facilities not covered by the Market Rules."). The later would result in the Technical Rules loosing independence of the Market Rules.
- Consult if the Market Rules should explicitly delegate the authority to the Technical Rules for the parts of the network Market Rules do not cover. Market Rules are currently silent on this issue.

2 CHANGES REQUIRED

2.1 Act/Market Regulations/Market Rules

The System Management is required to operate SWIS in a secure and reliable manner. This obligates the System Management to look after the SWIS right down to the household level and small non-market generators. Reliable manner generally means outage planning/operations consistent with the good electricity industry practice.

This obligation however does not match the pan out in the rules where System Management looks only after market generators and a limited number of transmission facilities, as illustrated in Figure 1.

The question yet to be answered is whether the System Management can delegate some responsibility for operation in reliable manner to the Network Operator under the Market Rules/Regulations.

2.2 Market Rules

The dispatch of Reactive power in rule 7.6.2 is not supported elsewhere in the Market Rules.

> "7.6.12. System Management may give a direction to a Market Participant (other than Western Power) in respect of a Scheduled Generator or Non-Scheduled Generator registered by the Market Participant with regard to the reactive power output of that Facility in accordance with any power factor required under the Technical Rules applying to the relevant Network."

The remainder of the Market Rules is silent, although they should be captured by the operating procedures.

The Technical Rules are more prescriptive in its requirements for reactive operation, these should be placed in the Market Rules as they would be removed from the Technical Rules.

The Market Rules needs to include Standing Data for reactive capability and step-up transformer details. Recording of dispatch instructions for voltage control must also include instructions for change tap-position and voltage set-points, operation of synchronous condensers, etc.

2.3 Technical Rules

No changes are required, other than those discussed in Section 1.2 here.

Western Power presented a draft set of Technical Rules for the Technical Rule Committee dated July 2005. This included various requirements some of which were new requirements.

At the request of the ERA Technical Committee Western Power submitted a copy of their report into the investigation of suitable future ADMDs for urban residential subdivisions. The ERA Technical Committee requested the UDIA and others provide comment on the Western Power report and the relevant parts of the funding submission.

The UDIA provided comment on three items, an increase in the ADMDs used in urban residential subdivisions, an increase in the ADMDs used in commercial/industrial subdivisions and noise abatement requirements for transformers. Western Power was invited to respond.

Below is an amalgamation of the UDIA comments, Western Power responses and the recommendation of the Technical Rules Committee.

1. Load growth

UDIA COMMENT

We acknowledge that Western Power has carried out research into this, and we fully support the notion that all systems should be designed using the correct load criteria. However we are also very wary of over-designing the system by using ADMD values, which are too high, because under the current arrangement the cost of this will be directly borne by the buyers of new residential lots in Western Australia.

Using the figures in the Western Power submission and assuming a lot production rate of 12,000 new lots per annum, the increase in cost/lot will be of the order of $4,000. We believe this is a significant impost to pass onto lot buyers in Western Australia, and may stifle development.

The industry is concerned that Western Power may not have taken into consideration the recent changes to design parameters in their reports, nor undertaken a detailed enough study on relevant projects.

WPC RESPONSE

This part of the letter appears to concern residential subdivisions and our response to this part accordingly refers to this only.

The figures in the submission were based on 20000 residential lots per annum and equate to an average increased cost per lot of $1,700. This is for all additional requirements. The estimated average additional cost due to the increased ADMDs was $1,100 per lot. This cost estimate is based on WPC option A costs for subdivisions and does not include trenching and cable laying. We envisage trenching and cable laying would only increase the cost by 10% - 15%.

Western Power is well aware that any increase in costs will be borne by residential lot buyers. The proposed new values are realistic and they are not exorbitant when compared with values used by other utilities in Australia. Table 1 below illustrates this.

ESTATE CATEGORY			
Network Operator	Units/Townhouses Low Cost Housing	Middle/Upper Income Housing	Prestige Upmarket
Energex	3	5	7
ETSA	4	6	12
Integral Energy	4.5 – 6	7	9
NTPW	4	4	6

Table 1 – Sample ADMDs used by other Australian distributors

Rather than adopt a small number of fixed ADMD values, as has been done in the eastern states, Western Power have done considerable work in order to align the ADMDs to socio economic factors. We believe this will minimise the cost impact on the bulk of new residential lots especially at the lower end of the market.

We believe that the values proposed if anything are on the low side, are fair and reasonable and will not result in over-design of the network. However, WPC will be monitoring ADMDs on an ongoing basis and as the results of this monitoring will be used to adjust them in future. The ADMDs will be suitable for the majority of the network. However, as is the case at present, it will be the responsibility of the subdivision designers to identify if particular subdivisions require a higher ADMD.

ERA TECHNICAL COMMITTEE COMMENT

The cost per lot calculation used by the UDIA was not aligned with the figures submitted by Western Power. The Western Power estimated value represents less than a 1% additional cost in the median price of lots in WA.

We address the specific examples raised by the UDIA as follows:

1.1

UDIA COMMENT

Loads on transformers are now limited to name plate rating and only within the last year transformers were loaded to 20% above name plate rating.

WPC RESPONSE

This is not accurate. For many years prior to this there has been an understanding between Western Power and the majority of designers that the transformer was only to be loaded to the nameplate rating. Not all designers were willing to accept this unwritten requirement and this led Western Power to change the design software. The generic software programme LVDesign had originally been set up to flag that the transformer was overloaded at 120% of the nameplate rating. This was altered in the last 18 months to flag at 100% of the nameplate rating. The 120% rating is a cyclic rating only applicable for typical residential load curves. It is not appropriate for non-cyclic loading that occurs on hot days.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT

Design transformers to nameplate rating are acceptable. Western Power has satisfactorily addressed the issue raised by the UDIA.

1.2

UDIA COMMENT

LVDesign is more sensitive to volt drops along the main feeder cables.

WPC RESPONSE

We would require some clarification of this point before we could comment. However, we do not expect this would impact the outcome of the work on ADMDs.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT

Western Power have indicated that their design work in determining ADMDs is based on the latest methodology and standard software. No further action is required.

1.3

UDIA COMMENT

ADMDs have recently increased to 3.5kVA and 4kVA, which, with these recent design parameter changes, equates to an ADMD allocation of near 6kVA already, without further prescriptive changes.

WPC RESPONSE

A standard urban residential subdivision design ADMD of 3.5kVA for gas areas and 4.0kVA for non-gas areas has been in use for approximately 1 year. Note, that all designers currently use as minimum of 3.5kVA with many requesting even higher values. In some cases we have had requests for up to 20kVA per lot. With the new methodology, the majority (75%) of lots are expected to require an ADMD of 4.5kVA or less. This represents less than a 30% increase in the existing design values. We don’t understand where the 6kVA value comes from.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT

The load increase is moderate and prudent given that actual load readings have been used to verify the values. Western Power has satisfactorily addressed the issue raised by the UDIA.

1.4

UDIA COMMENT

Western Power's data appears to be from subdivisions designed using the old ADMD allocation methodology and therefore the data won't reflect the recent design parameters used today. Perhaps more recent subdivisions should be considered in more detail

WPC RESPONSE

The subdivisions were redesigned (electrically) using current design parameters and reflected current design standards. The subdivisions used in the estimate of costs were originally designed within the last 5 years.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
Western Power has satisfactorily addressed the issue raised by the UDIA.

1.5

UDIA COMMENT
Peppermint Grove was allocated 4kVA per lot ADMD, however the number of transformers appear to be the same now as the original design which was undertaken in 1998. Based on Western Power's new ADMD calculation formula these lots should be allocated at least 11kVA, which if correct would indicate that the existing system would have surely failed long ago.

WPC RESPONSE
WPC has been forced to upgrade many transformers in many established areas including Peppermint Grove.

In a number of instances houses in Peppermint Grove require their own transformer and where possible these are used to reinforce the system. Two recent requests for houses in this suburb have been for 110 amps and 200 amps respectively.

For two recent subdivisions in Peppermint Grove, the design consultant nominated ADMDs of 15kVA and 20kVA respectively.

The above items have amply demonstrated that 4kVA per lot is not sufficient.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
There is sufficient anecdotal data to confirm Western Power has required additional transformer capacity to be installed since its original design. Western Power has satisfactorily addressed the issue raised by the UDIA.

1.6

UDIA COMMENT
Anecdotal evidence within the Western Power report seems to indicate that the penetration of airconditioning may have reached saturation some time ago. Their reports are based upon a further increase in airconditioning penetration and more computers in the home. Airconditioning penetration appears stable and computers are simply getting more and more energy efficient, with the prevalence of LCD screens for example. The same may be said for most other household electrical equipment.

WPC RESPONSE
We do not believe that penetration of air conditioners has levelled out. As well as more houses installing air-conditioning there will be many houses adding additional air conditioners or upgrading their systems. That is, many people now buy split systems and they air-condition their house in stages rather than have the more traditional fully ducted systems

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
Increased penetration of airconditioning needs to be allowed for in new and existing suburbs. Western Power has satisfactorily addressed the issue raised by the UDIA.

1.7

UDIA COMMENT
We consider that establishing a range of ADMDs from 4 to 11kVA being specific to areas within suburbs based on land value and socio economic factors etc, may have significant issues. The most expensive lots are often smaller, and perhaps not family homes. Diversity in these areas may be higher than the 'cheaper' areas.

WPC RESPONSE
There are numerous instances where multistorey dwellings are being built on smaller lots. Overall the floor area tends to be similar.

We have proposed a methodology that allows us to determine the effect of floor area and where designers are able to verify that smaller floor areas will be used in a particular locality, this will be considered when preparing the design parameters.

It is a universal practice to consider and socio economic factors when determining loads. The load readings have verified this as being appropriate. Having a variable value of ADMD based on these factors is much more flexible than that used in the eastern states.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
The proposed methodology allows greater flexibility when determining loads and is one that should used. Western Power has satisfactorily addressed the issue raised by the UDIA.

1.8

UDIA COMMENT
We understand transmission network increase in load at the substation is documented as 3% per year and presumably this would reflect the increase of new loads as well as an increase of existing loads however the quantum is somewhat curiously different to the large quantum leap in ADMD values.

WPC RESPONSE
The increase in system summer peak kW demand in 2003 and 2004 was 10.3% and 9.9% respectively. These are historically very high increases.

The peak for 2005 was a further 3% up on 2004 although Western Australia did not experience hot weather conditions of the previous years.

There has been some media speculation that this summer will be hotter than average. The 3 month look ahead forecast from the Bureau of Meteorology does not show a marked increase in summer maxima there is an increased likelihood of higher minimum temperatures. Should Western Australia experience weather conditions similar to 2004 (with high minimum temperatures) then a further 9% increase in peak demand is forecast. This is because high overnight temperatures foster the protracted use of air-conditioners, which typically extends to the following day and peak load period.

The system peak is comprised of residential, commercial and industrial loads. However, the ADMD increases proposed have been based on load readings taken on a range of residential profiles, thus we are confident of their validity.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
Western Power has satisfactorily addressed the issue raised by the UDIA.

1.9

UDIA COMMENT
From the later 1980's Western Power levied the cost of a 500kVA transformer even though a 315kVA transformer was installed. Western Power logic was to upgrade the transformer when the load justified the increase capacity transformer. However perhaps these 315kVA transformers have not been monitored and therefore the upgrade was never done and part of the reason transformers failed. The circumstances of transformer failure is also unclear from Western Power's reporting, transformer age, pole-tops or ground mounted, etc?

WPC RESPONSE
WPC used to installed smaller capacity transformer to ensure greater transformer utilisation. However, we have not employed this practice for many years now.

Western Power is aware of the various causes of load growth on transformers and has considered these when determining the proposed ADMDs. As previously advised, 25% of the failed through overload transformers were the ground-mounted type and were nowhere near the end of their useful working life. In cases where smaller capacity transformer were installed initially, eg 315kVA rather that 500kVA Txs, we found the designed capacity, eg 500kVA, was insufficient and the transformers had to be replaced with 630kvA and 1000kVA transformers plus additional transformers had to be installed to overcome the capacity problems. In the first stage of the summer ready projects, an additional 5 off 1000kVA transformers were installed in Applecross alone.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
Anecdotal data verifies that the loads originally designed for were insufficient and the transformers were not just overloaded due to smaller sizes being installed initially.
Western Power has satisfactorily addressed the issue raised by the UDIA.

1.10

UDIA COMMENT
Western Power hasn't undertaken design work for subdivisions for near on 10 years and their lack of understanding is evident when you review their design information. It is expected that the industry designers certainly have more experience with the detailed design, planning and staging issues than Western Power's people and as such industry designers could and should have been included in the design ADMD review.

WPC RESPONSE
We are confident that our design staff are up to date with design requirements and we believe our reviews have been satisfactorily designed. Our design staff include people who until recently have been "industry designers". Our design staff requires considerable design expertise in order to review the external designs submitted.

WPC did offer to a joint WPC/UDIA working group to propose alternative designs and costing to those produced by WPC but have had no response from UDIA. WPC has been in discussion with the UDIA since early July 2005. Thus, we are disappointed that these sorts of comments are being made in a public document.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
Western Power has satisfactorily addressed the issue raised by the UDIA.

1.11

UDIA COMMENT
Is the traditional 4 x 2 house still the product that the market is demanding, and have demographic shifts been considered?

WPC RESPONSE
The load is based simply on floor area and affluence irrespective of the house configuration. The ranges of floor areas were based on ABS data. We have proposed a range of standard floor area sizes with larger floor areas for more expensive houses.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
As for item 1.7, the proposed methodology provides flexibility and should be adopted. Western Power has satisfactorily addressed the issue raised by the UDIA.

1.12

UDIA COMMENT
Has the introduction of BASIX where the industry is to meet new BCA building codes on energy efficient construction been considered? Are new homes not going to become more and more energy efficient?

WPC RESPONSE
WPC has been actively involved with BASIX for WA. Our discussions with Eastern States, utilities have revealed no reduction in peak loads and they have no intention of modifying their design ADMDs in the foreseeable future. BASIX has only recently been introduced and the first houses designed to meet BASIX are only now coming onto the market. It will be many years before any trends might be evident. The aim of BASIX is to reduce energy consumption not peak loads.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
There is no evidence presently to suggest BASIX will affect the ADMDs. However a watching brief by load logging will enable this to be monitored and identify any emerging trends. Western Power has satisfactorily addressed the issue raised by the UDIA.

1.13

UDIA COMMENT
Has Western Power considered alternative engineering solutions to that of simply prescribing a possibly oversized system, such as power factor correction equipment?

WPC RESPONSE
Western Power has previously investigated distributed power factor correction equipment for low voltage systems. Residential loads generally have a reasonable power factor. There is then little gain in transformer available capacity achieved by the installation of capacitors. Switching would be required to limit over voltages during light load periods. To increase feeder capacity, correction equipment would be required at the end of every LV feeder. It is usually not cost effective to install power factor correction equipment en masse at this level. Western Power uses power factor correction occasionally at low voltage where it is appropriate. On the network, correction tends to be more cost effective at higher voltages. Capacitors are installed in all new zone substations (typically 22kV).

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
Installation of power factor correction equipment en masse on the distribution network is not a feasible alternative. Western Power has satisfactorily addressed the issue raised by the UDIA.

In Conclusion

UDIA COMMENT
Not applicable.

WPC RESPONSE
Although cost and price is an important consideration, we believe that the public expect the electrical infrastructure installed in subdivisions to be adequate to cater for their normal demands in the foreseeable future.

Notwithstanding this, we have not simply doubled our ADMD design values nor applied fixed values, as has traditionally been the practice here and in the eastern states.

The proposed methodology and values have been independently endorsed by an industry specialist (PB Power).

We believe that our new ADMDs are necessary to ensure adequate electrical infrastructure is installed in subdivisions.

We seek the endorsement of the ERA to introduce the new ADMDs as soon as possible.

ERA TECHNICAL COMMITTEE PROPOSED RECOMMENDATION
The new ADMD values are comparable with values used elsewhere in Australia in similar areas. The report prepared by Western Power has been independently reviewed. Western Power has advised that it will monitor future loads and seek to

alter the ADMDs where found appropriate. The figures supplied by Western Power indicate that for the majority of new lots the additional cost will be less than 1% of the median lot price.

In light of the high press profile and customer sensitivity the new methodology needs to be adopted as soon as possible.

It is recommended that the new ADMDs be introduced as soon as is feasible.

Industrial/Commercial Developments

UDIA COMMENT
The allocation of 110kVA per lot will significantly reduce the number of industrial / commercial lots which can connect to the transformer, due to protection restrictions and as such there will be at least one transformer per 3 to 4 lots. The quantity of low voltage cable will increase significantly and perhaps the placement of the transformers won't match the purchaser's requirements. This eventually leads to more high voltage installation and the existing network under utilised.

Perhaps it is time to review the network design requirements for commercial / industrial developments, such as installation of a high voltage network only with the transformer being installed when the lot is developed and has a known demand.

WPC RESPONSE
We do not envisage there will be any protection restrictions for the minimum 110kVA load requirement as this is a load size is presently supplied from the low voltage network.

We don't envisage there will be a significant increase in use of low voltage cable as we presently run 240 sq mm in the street to provide supply to each lot and we will continue to do this for this load size.

For these smaller lots we don't see transformer locations on one side or the other of a lot frontage will be critical as the volt drop on the low voltage network will not be near the statutory limits. Most customers will be supplied from the low voltage network not transformers. However, for the smaller lots it critical to secure transformer and switchgear sites at the time of development as we have found getting sites retrospectively causes significant loss of developable land to the end use customer and is a source of great angst to the customer. Having the transformer sites secured before the land is sold will ensure the land purchaser can get maximum use from their lot.

WPC will be reviewing its design practices when introducing the minimum 110kVA per lot policy to ensure optimum designs. However, as most of the lots will continue to be serviced from the low voltage network we will not be able to have high voltage installations only.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT
The new minimum load for small commercial/industrial lots is prudent. It allows for reasonable loads within the subdivision. The new policy allows an orderly expansion of the network with no one end use customer having to suffer loss of developable room on their lot or additional costs to meet foreseeable loads that should have been catered for during subdivision. The committee endorses WPC's proposal and it should be implemented as soon as practical.

2. Acoustic

UDIA COMMENT

EPA is requiring noise abatement for transformers, which means transformer kiosks, will need to be inside a masonry enclosure in residential areas. Perhaps an acoustic engineer can be engaged on behalf on the industry to investigate further. This noise abatement will mean brick compounds around all transformers if they can't be located on POS.

WPC RESPONSE

WPC has engaged an acoustic engineer and been in discussion with a transformer supplier to find solutions to the transformer noise problem. The transformer supplier has not been able to achieve the required noise reduction by transformer design changes thus, an acoustic engineer was engaged to developed up a range of masonry enclosures for various size transformers. WPC is also investigating, with an acoustic engineer and a transformer supplier the option of low profile enclosure. The advantage of a low profile enclosure, if they are successful, will be the transformers can be more discretely located around a subdivision, rather than having to install big brick buildings for each transformer. At this stage the alternative enclosures are of similar cost to masonry enclosures.

Regardless of what method is chosen for the noise mitigation, noise attenuation is required for transformers to comply with the EPA legislation.

ERA TECHNICAL COMMITTEE PROPOSED COMMENT

The EPA noise requirements are mandatory and all new transformers need to comply with this standard. This design change needs to be implemented as soon as practical.

ERA TECHNICAL COMMITTEE GENERAL COMMENT

In the absence of any other comments on the Technical Rules the rules should all be adopted as defined in Western Power's Technical Rules submission.

SUBMISSION TO THE TECHNICAL RULES COMMITTEE

WESTERN POWER TECHNICAL RULES

CLARIFICATION FOR THE PROPOSED CLAUSE “3.2.4.3(a) IMMUNITY TO FREQUENCY EXCURSIONS”

1. INTRODUCTION

The purpose of this document is to provide clarification for the proposed requirement for immunity to frequency excursions, as agreed at the 5th meeting of the TRC on 27 May 2005 when comments on the Western Power’s draft Chapter 3 were discussed.

This clause 3.2.4.2(a) refers to section 2 of draft Technical Rules which is yet to be submitted, and this submission provides the relevant Table 2.1 in Appendix B.

Refer to Appendix A for the draft requirements for immunity to frequency excursions.

Refer to Appendix B for the frequency operating standards for SWIS.

2 REQUIREMENTS FOR GENERATORS

2.1 NEC Requirements

Currently, the NEC requirements for immunity to frequency excursions are those for the frequency operating standards.

This will change shortly, as the work is in progress to add margins between the two.

When this change becomes effective, then the plant immunity will be required to wider frequency variations than those defined by the NEC frequency operating standards.

2.2 SWIS Requirements

The approach adopted for SWIS requires plant immunity to a wider range of the frequency excursions than those defined by the SWIS frequency operating standards of Table 2.1 (see Appendix B).

The former are illustrated in Appendix A, the latter in Appendix B.

3 RELEVANT CONSIDERATIONS FOR SWIS

Western Power proposed requirements of Appendix A are largely based on the recently revised UK Grid Code.

The Regulator in the UK carried out extensive consultations with leading plant manufacturers, who confirmed that their equipment can comply (one of the main issues was inflexibility of early combined cycle plant, the mass proliferation of which significantly worsened the performance of their isolated system).

A similar approach was adopted in NZ, also prompted by the Malaysian 1996 blackout.

"Continous operation"

The use of the phrase "continous operation" in Figure 3.4 (see Appendix A) is not quite right because the time scale of Figure 3.4 is limited to 10,000 minutes or just under 7 days.

Clarifications "time limited operation" and "continuous operation" in Figure 3.4 stem from the UK Grid code terminology (their requirements are verbally formulated and there is no time limit for the operation in the frequency range between 47.5 and 52 Hz).

The two comments are meant to highlight the fact that new generating plant is required to stay connected for at least 20 seconds each time the frequency drops between 47 and 47.5 Hz (this was a contentious issue, we understand).

The extreme frequency excursions of Figure 3.4 should be read in conjunction with Table 2.1 of Appendix B which states how tightly the SWIS frequency should be regulated, during normal operation and during single and multiple contingencies.

Table 2.1 states how the system should be operated and sets target performance levels for System Operation.

The margin between the target system performance of Table 2.1 and design plant immunity of Figure 3.4 is a safety margin designed to ensure that the generating plant is tripped only when it is essential for system reasons (for example when a stability limit is reached).

We do not want to experience trip of a major generator, for example, because a fan or a pump in its auxiliary system stalled. This could be overcome at the plant design stage by marginally increasing the rating of critical pumps and fans so they could deliver rated flow at reduced frequency as specified in Figure 3.4.

4 CONCLUSION

We trust that this submission explains our requirements for immunity to frequency excursions. They should be considered in conjunction with the SWIS frequency operating standards of Table 2.1.

Appendix A - Clause 3.2.4.3(a)
Proposed requirements for immunity to frequency excursions

3.2.4.3 Generating Unit Response to Disturbances in the *Power System*

The following are design requirements for *generating units and their auxiliary* systems for continuous uninterrupted operation while being subjected to off-nominal frequency and voltage excursions. The *continuous uninterrupted operation* is defined at the end of this clause. *Network* performance requirements are detailed in Section 2 of this *Code*.

a) **Immunity to frequency excursions.** Users must ensure that within the power system frequency range and duration of Figure 3.4 all of their power system equipment will remain in service unless that equipment is required to be switched to give effect to load shedding in accordance with clause 2.4, or is required by *Western Power* to be switched for operational purposes (Note: this sentence moved from clause 2.2.1). In particular, a *generating unit*, and the *power station* in which the *generating unit* is located, must be capable of continuous uninterrupted operation within the *power system frequency range* 47.5 to 52 Hz.

The minimum duration of operation at *frequencies* outside the range 47.5 to 52 Hz for the *South West Interconnected System* shall be in accordance with Figure 3.4. Operation for a period of at least 20 seconds is required each time the frequency is below 47.5 Hz. Operation for a period of at least 6 seconds is required each time the frequency is above 52 Hz.

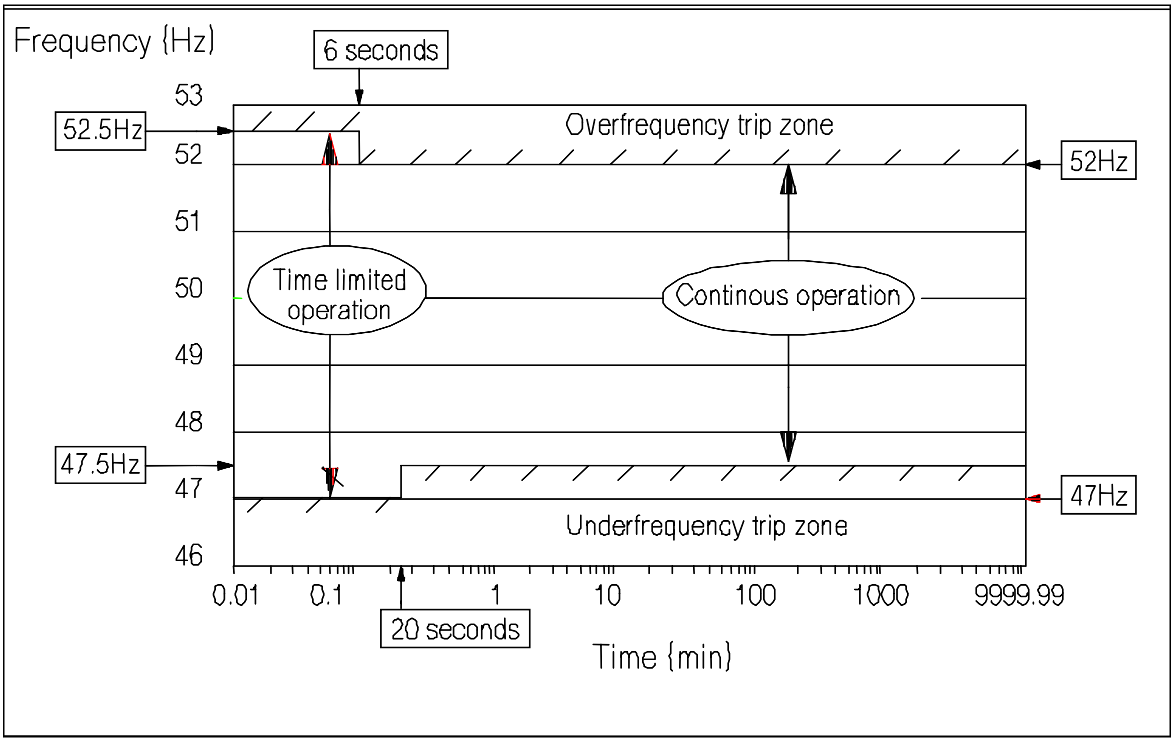


Figure 3.4 – Off Nominal Frequency Operation Capability Requirement for Generators-

Appendix A - Clause 3.2.4.3(a)
Proposed requirements for immunity to frequency excursions

Sustained operation outside the range 47.5 to 52 Hz need not be taken into account by *Western Power* and *Users* in the design of *connected plant* which may be *disconnected* if this is necessary for the *protection* of that *plant*. Below 47Hz, and above 52.5 Hz instantaneous tripping of *generators* is permitted.

Appendix B - Frequency operating standards for SWIS

2.2.1 *Frequency* Variations

Western Power's nominal frequency of supply is 50 Hz.

The accumulated synchronous time error in Western Power networks is not expected to exceed 10 seconds.

The frequency operating standards for Western Power transmission networks are summarised in Table 2.1 below.

Table 2.1 Western Power's Frequency Operating Standards for SWIS.

Condition	Frequency Band	Target Recovery Time
No disturbance: South West Island(1)	 49.8 to 50.2 Hz for 99% of time 49.5 to 50.5 Hz	- - -
Single contingency(2)	48.75 to 51 Hz	49.8 to 50.2 Hz within 25 minutes For over-frequency events: 51.0 to 50.5 Hz within 2 minutes
Multiple Contingency	47.0 to 52.0 Hz	49. 8 to 50.2 Hz within 25 minutes For under-frequency events: 47.0 to 47.5 Hz within 10 seconds 47.5 to 48.0 Hz within 5 minutes 48.0 to 48.5 Hz within 15 minutes For over-frequency events: 52.0 to 51.5 Hz within 1 minute 51.5 to 51.0 Hz within 2 minutes 51.0 to 50.5 Hz within 5 minute

Notes: (1) – an island is formed when connection between parts of the interconnected network is broken. The frequency band is applied within an electrical island as it forms and after it has stabilised.

(2) – 48.75 Hz corresponds to the first stage of underfrequency load shedding (see clause 2.4).

Appendix B - Frequency operating standards for SWIS

SUBMISSION TO THE TECHNICAL RULES COMMITTEE

WESTERN POWER TECHNICAL RULES

FURTHER JUSTIFICATION FOR THE PROPOSED CLAUSE

3.2.4.3(b) “Immunity to voltage excursions”

1. INTRODUCTION

Clause 3.2.4.3(b): ‘Immunity to voltage excursions’ addresses a performance requirement for generators connected to the SWIS. In a presentation to stakeholders: “Proposed changes to Electricity Transmission Access Technical Code - Second Round of Consultation” of 27 August 2003, it was proposed that the previous requirement for a 1 second fault ride-through capability be reduced to 0.45 seconds. This 450 millisecond requirement is now part of the draft Technical Rules.

The slide used in this earlier presentation is shown in Figure 1 below.

Refer to Appendix A for the draft requirements and to Appendix B for the comments on clause 3.2.4.3(b) (item number 97).

2. BASIS OF REQUIREMENT

The purpose of this requirement is to ensure that power system security is not compromised by disconnection of generators during disturbances. This requirement is that no single fault should cause the loss of any generator or equipment outside the fault clearance zone.

Should this requirement not be achieved, it may become necessary to restrict generation connection in some areas or to carry additional spinning reserve to avoid additional load shedding.

For no circuit breaker fail events the fault would normally be cleared within the critical fault clearing time (CFCT) to preserve system stability. CFCTs are less the fault ride through requirement so that it would be exceptional for generators to be subject to voltage depressions of duration as high as that of the fault ride through requirement.

The requirement for the SWIS parallels the requirement of the National Electricity Rules of 175ms which is the CB fail back-up protection clearance time at 400kV and above (clause S5.2.5.3(b) and Table S5.1a.2). The 80% voltage for 10 seconds requirement also corresponds to the NER.

In the SWIS the corresponding clearing time at 330kV and 220kV, is 420 milliseconds. In consideration of this Collie Power Station which is connected to the 330kV system was designed to meet 450 msec fault duration and was tested accordingly. It is proposed that 450msecs fault ride through be a requirement for new power stations.

It should be noted that the requirement for immunity to zero volts refers to the connection point rather than the generator terminals. Consequently the voltage at the terminals of a generator connected to the power system via a step up transformer would not be zero but a voltage determined by the generator and transformer impedances and pre-fault operating conditions. The requirement is therefore less severe than for zero volts at the generator terminals.

Currently all WP power stations are able to meet this requirement.

3. ALTERNATIVES CONSIDERED

Whereas a 330kV fault with circuit breaker failure represents a system condition that would have widespread effects, individual faults on lower voltage parts of the system of longer duration eg one second at 66kV may have more severe consequences for a region but less impact overall than a 330kV system fault. Some of the other contingencies considered are illustrated in Fig 1. Whereas more possibilities would be covered by increasing the ride through requirement to 650msec or 1000 msecs as shown, it was considered that requiring generation ride through for the chosen scenario of a 330kV circuit breaker fail would be satisfactory for ensuring that system reliability was not unduly compromised.

4. TESTING FOR COMPLIANCE

The proposed fault ride through capability requirement is not representative of typical system conditions during a disturbance but is a generator performance requirement. It is also not proposed that individual generators be subject to testing for this capability. Nevertheless proponents would be required to demonstrate that generator auxiliary systems are capable of surviving such voltage excursions without stalling or disconnecting. It is expected that this would be less of an issue for gas turbine plant than coal fired power stations.

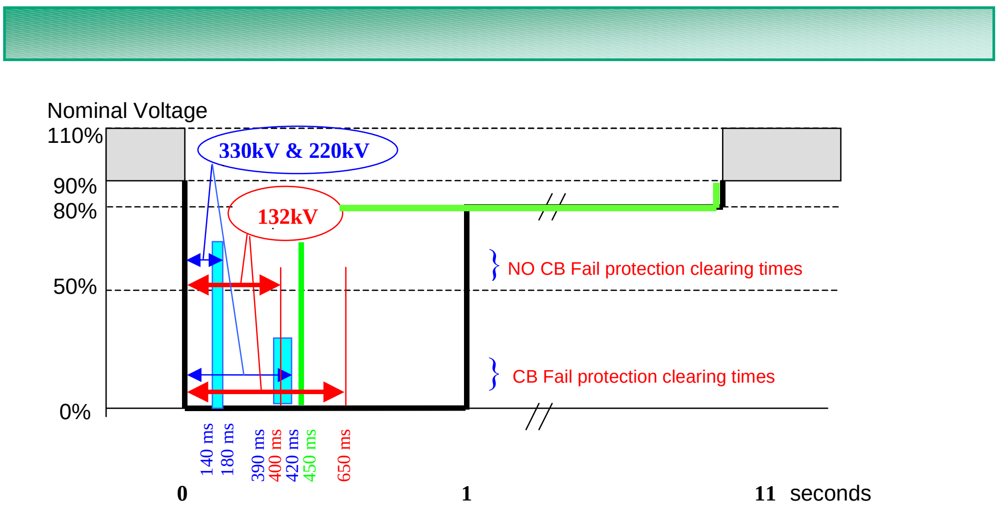


Figure 3.5 – Voltage variation during voltage dip

Comparison of old (solid black line) and new (green line) requirements and rationale.

Overhead 26

Figure 1 Fault Ride Through Requirement

5. REQUIREMENTS IN OTHER JURISDICTIONS

As an example of overseas requirements, The Nordel (Scandinavian) "Operational Performance Specifications for Thermal Power Units larger than 100MW" 1995 document specifies the following: The units shall be designed so that they can withstand the following generator voltage variation resulting from faults in the grid, without disconnecting from the grid:

- step reduction to 25% of the rated generator voltage lasting for 0.25 seconds

The 0.25 second requirement is again based on back up protection clearing time. It should be noted that the 25% rated voltage refers to the generator terminals rather than the point of connection to the network as required for the SWIS, and it accounts for the voltage drop across the step-up transformer impedance during the fault period.

6. COMMENTS ON ISSUES RAISED

Testing:

As stated above, it is not proposed to test primary plant for conformity to this clause. Testing would be confined to auxiliary plant.

Reasonableness:

The proposed 450msec duration is based on the same methodology as used in the NEM and represents a considerable relaxation of our previous requirement of 1 second. Whereas the 175msec NEC requirement is based on the 400kV+ back up fault clearing time, the SWIS 450msec requirement is based on the current performance of our 330kV system. The requirement is also consistent with performance requirements in the Nordel power system

It can be expected that as ageing plant is replaced, this fault clearing time will diminish and hence so will the duration of the fault ride through requirement.

7. CONCLUSION

It is recommended that the TRC endorse this proposal.

Appendix A
Clause 3.2.4.3 (b) of the proposed Technical Rules

b) **Immunity to voltage excursions.** A *generating unit*, and the *power station* in which the *generating unit* is located, must be capable of continuous uninterrupted operation for the range of *voltage* variation permitted by Clause 2.2.2 and Clause 2.3.3.2, and for *transmission or distribution network* faults which cause the *voltage* at the *connection point* to drop to between 0% and 80% of nominal voltage for a period of up to 450 milli second (based on 330kV CB fail protection time) in any one phase or combination of phases, followed by a period of ten seconds where *voltage* may vary in the range 80-110% of the nominal *voltage*, and a subsequent return of the *voltage* within the range 90-110% of the nominal *voltage*. See Figure 3.5 for details of the latter.

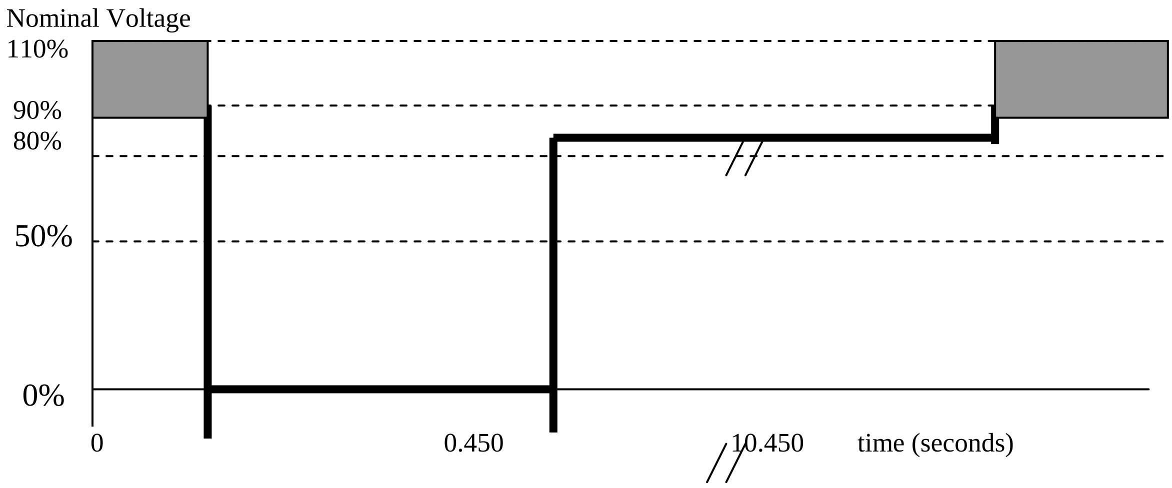


Figure 3.5 – Off Nominal Voltage Operation Capability Requirement for Generators that complement those of Figure 2.1

Appendix B
Comments received in relation to clause 3.2.4.3(b)

97	3.2.4.3 (b)	Generating Unit Responses to Disturbances in the Power System	H. Fernandez	Voltage Excursions – Users to ensure generating unit capable of continuous uninterrupted operation even while voltage at connection point is between 0-80% for 450ms !! (vs NEC of 175ms due to their faster clearance times) or up to 110% for 10 secs… **Amendment Suggested by Proponent** Too onerous.	**Discussion** • P. Southwell and Z. Bozic explained that the generator and the auxiliary equipment should be able to withstand the voltage drop. • M. Bastick informed that, in the case of International Power/Mitsui's plant in Kwinana, this would be impossible because the plant has a protection system that makes the generator trip automatically if the voltage drops to zero. Without that protection, the machine would be destroyed. He added that the auxiliaries could stay connected, but not the generator. Thus this requirement (or at least the way it is drafted) would not be complied with. • P. Southwell suggested reducing the time required for the generator to stay operational while a voltage drop occurs. • M. Bastick responded that reducing the time would not solve the problem. **Outcome** • Western Power to reconsider this section in light of the comments made by members. **ISSUE OPEN**	Western Power to reconsider this section in light of the comments made by members.
97	3.2.4.3 (b)	Generating Unit Responses to Disturbances in the Power System	H. Fernandez	Voltage Excursions – Users to ensure generating unit capable of continuous uninterrupted operation even while voltage at connection point is between 0-80% for 450ms !! (vs NEC of 175ms due to their faster clearance times) or up to 110% for 10 secs… **Amendment Suggested by Proponent** Too onerous.	**Discussion** • H. Fernandez queried whether Western Power's requirements were reasonable. • N. Liddelow noted that, according to this section, the machines would not be required to run for that time under those voltage conditions, but their specifications would be required to meet the requirement. • M. Bastick noted that the test is not realistic, particularly for light-weight machines. **Outcome** • Issue for further consideration. **ISSUE OPEN**	

SUBMISSION TO THE TECHNICAL RULES COMMITTEE

WESTERN POWER TECHNICAL RULES

FURTHER JUSTIFICATION FOR THE PROPOSED CLAUSE "3.2.4.1 *REACTIVE POWER* CAPABILITY"

1. BACKGROUND

The purpose of this document is to provide more detailed justification for the proposed reactive power requirements for synchronous generators, as agreed at the 5th meeting of the TRC on 27 May 2005 when comments on the Western Power's draft Chapter 3 were discussed.

Refer to Appendix A for the draft requirements

Refer to Appendix B for the comments on clause 3.2.4.1, comments Nos. 90 to 92.

2. INTRODUCTION

2.1 Non-synchronous types of generation recognised

An important change in the Western Power's draft Technical Rules, relative to the old technical code, is recognition of non-synchronous types of generation. Apart from a few

European countries that have already done so, the work to address non-synchronous types of generation in the National Electricity Code (NEC) in Australia has also commenced.

The introduction of technology specific requirements is needed for fairness and as a prerequisite to facilitate sustained growth in wind and other types of non-conventional generation and to ensure that barriers to local or overall developments are not introduced. Failure to do so may place the SWIS at increased risk of operational difficulties and costly remedial measures.

The concessional reactive power requirements granted to non-synchronous generators does not diminish the capability requirements of existing generators necessary for the ability of the aggregate generation in a power system to meet the need for reactive power in long term.

2.2 Market perspective

Mandating minimal technical requirements for all generators is seen as a prerequisite for:

a) maintaining the power system security in the (relatively small) power system in WA,

b) providing equity among market participants

c) facilitating the establishment an effective ancillary services market, and

d) enabling generators to earn income from that market.

3 REQUIREMENTS FOR SYNCHRONOUS GENERATORS

3.1 NEC Requirements

Initially, the NEC power factor requirement was 0.9 inductive and 0.93 capacitive at the generator terminals and was changed after a few years of market operation.

Power factor of 0.93 (inductive and capacitive) at the connection point is required now in NEC for the automatic access standard (none for the minimum access standard).

3.2 SWIS Requirements

0.8 inductive and 0.9 capacitive at the generator terminals is required for SWIS, which is the capability requirement for existing generators. Refer to Appendix 1 for more details.

4 RELEVANT CONSIDERATIONS FOR SWIS

Inputs for decision making included:

a) The current reactive requirements for generators are appropriate for SWIS,

b) Reactive power is needed to maintain voltages and longer distance transmission increases the need for it.

c) Experience with deregulation of the electricity supply industry in other jurisdictions is that deregulation increases long distance transmission transfers.

d) Experience with large wind-generation projects is that they also increase long distance electricity transmission, because they are located far away from major load centres.

e) The deregulation of the industry for more competition and imminent development of large third party wind-generation projects in WA may increase the need for reactive power in SWIS, and this trend will be further compounded by the concessional reactive power requirements for non-synchronous types of generation.

f) Considerations *a)* to *e)* here suggest that the need for reactive power in SWIS will increase in the near future. It would not be therefore reasonable to reduce the reactive power requirements for generators, as that would likely erode the power system security in WA, which is not the intention of the Technical Rules.

g) In addition, we do not consider the reactive power capability as a stand-alone issue. It should be considered in conjunction with the contribution to stability margins it provides during major system disturbances and in the context of the long-term economical development of power systems.

For example, a generator becomes more stable by increasing its reactive capability, because the synchronising torque is proportional to the internal EMF (Electro Motive Force) - ie the reactive power capability.

h) Finally, uniform reactive power capability enables new generators to equally share VAr (voltage control) duty with the existing generators. This facilitates equality among market participants in WA.

5 NEED FOR REACTIVE POWER

Motors, neon and fluorescent lighting and power supplies are major loads in the power system that create the need for reactive power. Air-conditioners have emerged in the past few years as the most important category of household appliances that has a major impact on the power system as a whole.

Reactive power must be provided when it is needed, and we distinguish between the need for fast and slow reserve.

The need for slow reactive reserve typically arises as a result of the need to follow (slow) daily load changes. These processes are characterised by time constants of the order of minutes or tens of minutes.

The need for fast reactive reserve typically arises immediately after the loss of a heavily loaded infeed into a major load area. In case of Perth, it could be the loss of a 330kV line from Muja. Another typical situation is the loss of a generator that is located in the close proximity of a major load centre.

If the additional reactive power is not provided instantaneously after the incident, the system volts will drop, moving the system trajectory towards the point of voltage collapse and a possible major blackout.

The under voltage load shedding (UVLS) is the measure of the last resort to establish the balance between reactive consumption and generation and prevent blackouts. It sacrifices some loads in order to save the remaining.

6 SOURCES OF REACTIVE POWER

A distinction should be made between the sources of slow and fast reactive power.

Slow reserve

Slow voltage reserve can be provided by mechanically switched capacitor banks, which are manually or automatically controlled. They are the cheapest sources of reactive power that provide coarse control. A deficiency of capacitor banks as a reactive power source is that their output diminishes when it is needed most, ie when the volts are low. The reactive output is proportional to the square of the volts, and if, for example, the volts decrease by 10% (from 100% to 90%), their output will decrease by nearly 20% (0.90^2=0.81≈80%). This reduction would aggravate the initial disturbance by increasing the initial deficit of reactive power, that would further reduce volts and shift the system one step closer to the point of voltage collapse. Mechanically switched capacitor banks are therefore unsuitable to safeguard the power system against major disturbances that cause large voltage excursions.

Fast reserve

Fast reactive reserve is typically provided by synchronous generators, which are the cheapest and most beneficial source of dynamic reactive reserve. The reactive power is provided by the exciter of a synchronous machine and controlled by its excitation system. It provides full control over the whole range. An advantage of synchronous machines as the source of reactive power is that their output is highest when it is needed the most, when the volts are low or zero, and the capability is independent of the machine's terminal voltage. Synchronous generators provide full control over the whole reactive range.

Fast reactive reserve can also be provided by synchronous compensators. Synchronous compensators are specially designed synchronous generators that provide only reactive power. They have no turbine and cannot generate MW. In all other technical aspects they are equivalent to synchronous generators. Due to high maintenance costs associated with rotating parts, fast static reactive sources are generally cheaper nowadays.

Fast static reactive sources include thyristor switched capacitor banks, static VAr compensators (SVCs) and STATCOMs.

Thyristor switched capacitor banks are classified as a fast reactive source because they can be rapidly switched. However, other than switching, they provide no reactive control. Their output is voltage dependant, and it decreases with the square of the volts.

Static VAr compensators are a combination of capacitors and inductors which provides fast control over a limited control range. Their output is also voltage dependant, and it also decreases with the square of the volts. The high cost of SVCs is proportional to the control range, and they generate harmonics.

The reactive output of STATCOMs is less sensitive to the terminal volts variations than that of SVCs, which is achieved at a higher cost. In all other technical aspects they can be considered equivalent to SVCs.

7 CONSEQUENCES OF NOT HAVING SUFFICIENT REACTIVE CAPACITY IN GENERATORS

The fundamental principle is the need to maintain balance between the reactive consumption and reactive generation in a power system at all times.

If generators do not provide enough VAr (reactive power), then the following issues need to be addressed:
- balancing reactive demand by other sources of reactive power,
- ensuring adequate voltage control,
- instability of generators,
- equity between market participants, and
- market drivers.

7.1 Balancing of MVAr and voltage control

The lack of reactive support by generators can be overcome by alternative sources of reactive power, typically installed by the network service provider (NSP). This is usually technically feasible but not always cost effective.

The best location for reactive compensation is at the source of the demand, ie at the customers' premises or at the major load centres.

Legislative requirements for mandatory power factor and electricity tariffs have a significant long-term impact on the need for reactive compensation. They will not be discussed here, though the current arrangement offers a room for improvement.

However, the suggested consideration of capacitor banks only in comment No. 91 of Appendix B is not appropriate replacement for the reactive capacity of generators as it excludes the cost of the equivalent amount of fast reactive reserve that provides equivalent voltage control.

These additional reactive sources would probably include a mix of capacitor banks and fast static compensation.

The need to provide fast voltage control means a significant portion of these new sources would have to be provided in the form of SVCs and STATCOMs.

Cost

The cost of these new reactive sources to provide balance and voltage control would have to be recuperated by Western Power through higher network charges and ultimately passed on to the consumers.

The cost of capacitor banks appears to be marginally cheaper that the cost of providing an equivalent amount of reactive power in generators, provided free space is available.

The cost to install SVCs and STATCOMs may be significantly higher than the marginal cost of providing an equivalent amount of additional reactive power in generators.

In case of generators, the additional cost stems from a more powerful exciter that increases the MVA rating of the synchronous machine. No additional hardware (for example, circuit breakers), control, or space is needed.

In case of SVC and STATCOM plant, the additional cost includes that of the land, switchgear, harmonics filtering equipment (SVCs and STATCOMs generate harmonics), and dedicated power system studies, in addition to the cost the SVC/STATCOM itself. Further, if limited substation space is available, then more costly gas insulated switchgear may be required.

Similar considerations would apply in case synchronous compensators are used, plus, perhaps, additional cost to upgrade protection due to their typical low inertia.

7.2 Instability of generators

Reducing reactive capability of generators will make them less able to withstand disturbances in the system.

Explanation for reduced stability

The synchronising torque is a measure of stability of synchronous machines, and the higher torque values mean that the machine is more stable.

The synchronising torque is proportional to the internal EMF, the later of which is a measure of the reactive capability. In other words, machines with higher reactive capability (to generate VArs) are more stable than those with lesser reactive capability.

Under-excited operation of synchronous machines (with low excitation levels and a leading power factor) is unfavourable for stability reasons, so the manufacturers limit the maximum permissible leading power factor (reactive absorption).

This is in contrast to over-excited operation of synchronous machines (with high excitation levels and a lagging power factor) which is beneficial for stability. The higher the lagging power factor (reactive generation) is, the better.

These considerations also explain the asymmetrical power factor requirements (0.8 lagging and 0.9 leading) for synchronous machines.

Remedial measures

Proliferation of new generators with reduced stability performance due to less powerful excitation systems and reactive capability can be managed by reducing fault clearing times. Technically this is possible.

Faster fault clearing times should reduce, at least in theory, de-synchronising forces to the level these new generators can tolerate.

This would require installation of faster circuit breakers and other equipment, including faster and dedicated communication channels.

Cost

Unfortunately, no limit can be established to which lines would require faster clearing times without carrying out detailed computer simulations at the time.

It is intuitively clear that faster clearing times would be required for nearby lines and for those along major transmission/export paths.

New generators in the metropolitan area and fringe metropolitan areas are likely to require protection upgrade on the largest number of transmission lines because of highly meshed transmission system there.

The 50 km rule to attract generation to the Perth metropolitan area will aggravate the potential problem because of the highly meshed network requiring protection upgrade on a large number of lines.

It will probably take just a few new generators before transmission lines in the SWIS will need to be upgraded, the cost of which is likely to run in to millions of dollars. This financial exposure appears to be too high and unnecessary.

7.3 Equity among market participants

Maintaining uniform reactive power factor requirements for all synchronous generators in the power system will provide equity among market participants.

7.4 Market drivers

There is no reactive power ancillary services market in the proposed electricity market model for WA. This means that there are no driver or market incentives for participants to invest in reactive plant.

Mandating minimal technical requirements for all generators is essential for maintaining power system security in the relatively small power system in WA.

The original mandatory reactive power requirements in the National Electricity Market (NEM) have changes after five years of market operation and confidence of its effective operation.

WA could adopt a similar path sometime in the future by changing the market model to one that recognises reactive power as an ancillary service. In that respect, mandating minimal technical requirements for all generators can be seen as a prerequisite to: *a)* establish an effective ancillary services market in the future, and *b)* enable generators to earn income from that market.

In any case, the currently proposed market arrangement for WA does not justify relaxation of the mandatory requirements for reactive capability of clause 3.2.4.1.

8 CONCLUSION

We trust that this submission explains our reasons for proposing mandatory reactive capability requirements for synchronous generators and the likely consequences of having no mandatory requirements. Technically, both alternatives can be managed and the ultimate decision should be based on economic and other considerations. The proposed alternative is superior in economic terms and provides equity among market participants. The adoption of no mandatory requirements at this stage is likely to result in millions of dollars of unnecessary capital expenditures in dynamic reactive support and upgrading of power system protection.

Appendix A - Proposed reactive power requirements

3.2.4.1 *Reactive power* capability

Each generating unit, and the power station in which the generating unit is located, must be capable of continuously providing its full reactive power output within the full range of steady state voltages at the *connection point* permitted under clause 2.2.2.

(a) Unless otherwise agreed by *Western Power*:

(1) Each *synchronous generating unit* must be capable of *supplying* a *reactive power* output coincident with rated real power output such that at the *generating unit's* terminals at nominal *voltage* the lagging *power factor* is less than or equal to 0.8 and at the same power output the *generating unit* must be capable of absorbing *reactive power* at a leading *power factor* less than or equal to 0.9. Refer to Figure 3.1 for details.

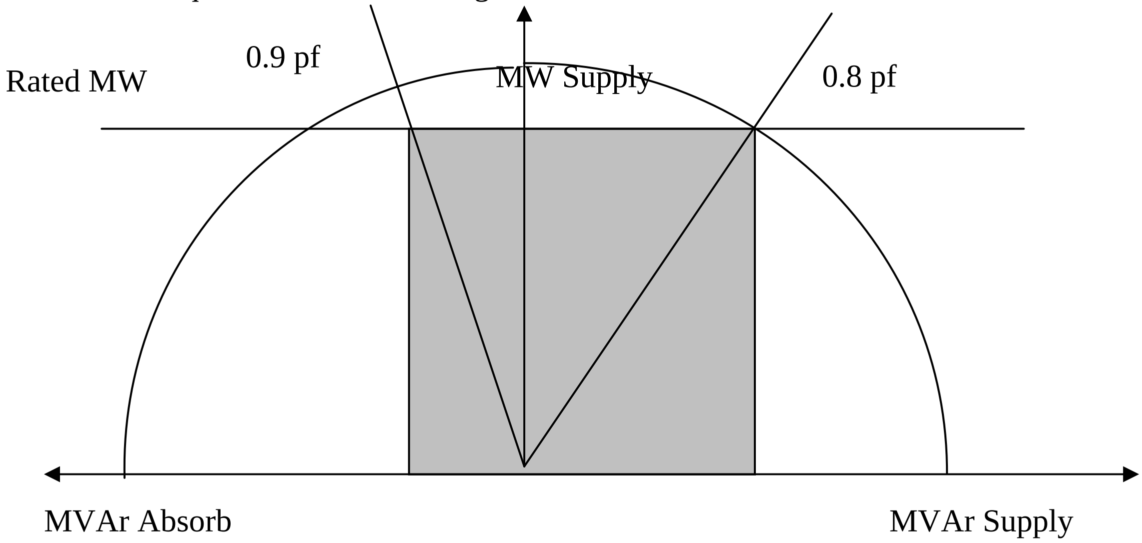


Figure 3.3 Inverter Coupled or Converter Coupled Generating Unit Reactive Capability Requirements at Point of Common Coupling shown Shaded

(2) Each *induction generating unit* must be capable of *supplying a reactive power* output coincident with rated real power output such that at the *connection point* to the *network* at *nominal voltage* the lagging *power factor* is less than or equal to 0.95 and at the same power output the *generating unit* must be capable of absorbing *reactive power* at a leading *power factor* less than or equal to 0.95.

In some circumstances, a larger *power factor* range may be required. This will be determined by *power system* simulation studies. *Users* will be advised accordingly of any additional requirements. Refer to Figure 3.2 for details.

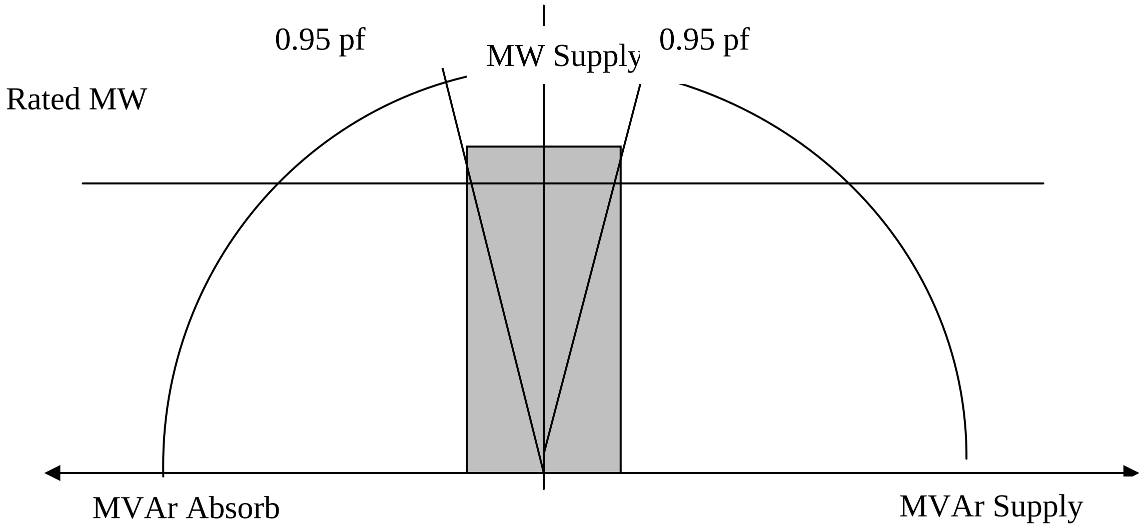


Figure 3.2 Induction Generating Unit Reactive Capability Requirements at Point of Common Coupling shown Shaded

(3) Each *inverter or converter coupled generating unit* shall be capable of supplying a reactive power such that at the inverter or converter connection point to the network at nominal voltage the lagging power factor is less than or equal to 0.95 and shall be capable of absorbing reactive power at a leading power factor less than or equal to 0.95.

In some circumstances, a larger power factor range may be required. This will be determined by power system simulation studies. Users will be advised accordingly of any additional requirements. Refer to Figure 3.3 for details.

(4) For generators for not described by susbsections (1), (2) or (3), the power factor requirements shall be as advised by Western Power.

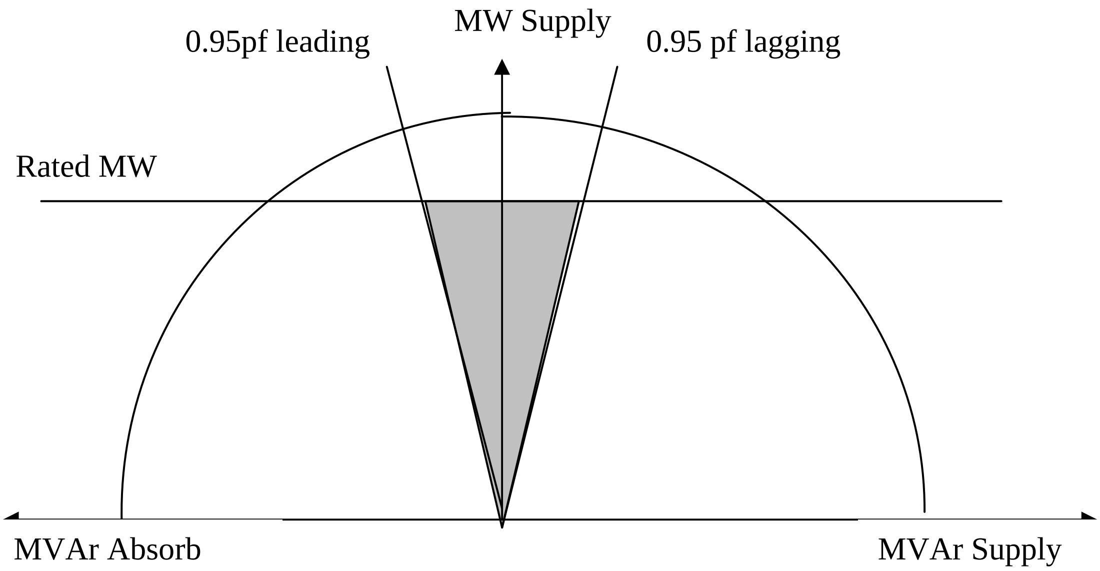


Figure 3.3 Inverter Coupled or Converter Coupled Generating Unit Reactive Capability Requirements at Point of Common Coupling shown Shaded

(b) In the event that the *power factor* capabilities specified in (a)(1), (a)(2) and (a)(3), as applicable, cannot be provided, the *User* must reach a commercial arrangement under the *access agreement* with *Western Power* for the *supply* of the deficit in *reactive power* as measured at the *generating unit's* terminals.

(c) The *Generator connection* must be designed to permit the *dispatch* of the full *active power* and *reactive power capability* of the installation as specified in the *access agreement* under all *power system* conditions contained in Section 2 of this *Code*.

Appendix B - Comments received

No	Sec.	Section Title	Proponent	Issue
90	3.2.4.1	Reactive Power Capability See arguments in the list of differences The existing generators meet this requirement and its retention provides an equal playing field for all market participants Does not understand I2X losses Disagree	K. MacCormick	The power factor performance range of alternators connected to the transmission system of 0.8 lag to 0.9 lead is excessive. The 66/132/330 systems operate at greater than 0.9 lagging. Within other sections of the code users must provide a load with power factors in the range of >0.95 lagging. Requiring generators to supply down as low as 0.8 into the transmission system is unreasonable and significantly increases the cost of the equipment, which in turn will be passed onto the ultimate users. For connections in the distribution system at 33kV and below this power factor range may be acceptable. **Amendment Suggested by Proponent** Respecify power factor performance range to 0.9 lag to 0.9 lead.
91	3.2.4.1	Reactive Power Capability	H. Fernandez	Is this a requirement of an individual generator unit or combined generation facility (i.e. can reactive requirements be satisfied by installation of capacitors instead of by alternator design?). **Amendment Suggested by Proponent** Clarify.
92	3.2.4.1 (4)(c)	Reactive Power Capability The full machine capability is required for all permissible network conditions (voltage and frequency). Reactive power capability should not be considered as a stand-alone issue. It should be considered in conjunction with the stability margins it provides during major system disturbances and in the context of the long-term economical development of the power system. Disagree	H. Fernandez	(4) (c) – Generator connection must be designed to permit the dispatch of the full active and reactive power capability of the installation. Sometimes, network conditions or access agreement conditions preclude dispatch at full machine capability so why design for max. when in actuality, could be less. **Amendment Suggested by Proponent** Limit to access agreement as minimum, max. limit at user discretion.

Western Australia

Economic Regulation Authority

TECHNICAL RULES COMMITTEE

TERMS OF REFERENCE

This Terms of Reference provides guidance to the Technical Rules Committee (**Committee**), established pursuant to chapter 12 of the *Electricity Networks Access Code 2004* (**Access Code**) for the parts of the South West Interconnected System (**SWIS**) owned by Western Power Corporation (**Western Power**).

Technical Rules consist of the standards, procedures and planning criteria governing the construction and operation of an electricity network, and deal with all the matters listed in Appendix 6 of the Access Code. The objectives for Technical Rules are set out in section 12.1 of the Access Code.

- Section 12.6(a) of the Access Code requires the Service Provider of a covered network to submit proposed Technical Rules for that network at the time it submits a proposed Access Arrangement

- Section 12.11 of the Access Code provides the Economic Regulation Authority (**Authority**) with the power to approve the proposed Technical Rules. The assessment process for the Technical Rules, to the extent possible, is to be conducted concurrent with the assessment process for a proposed Access Arrangement by the Authority.

- Section 12.17 requires the Authority to establish a Committee for the first Technical Rules for a covered network which is part of an interconnected system, to provide specialist knowledge and advice to assist the Authority in the performance of its technical regulatory functions.

- Section 12.28 of the Access Code requires the Authority to have regard to advice provided by the Committee in deciding whether to approve proposed Technical Rules for a network.

As the Western Power network in the SWIS is interconnected with another network, namely Southern Cross Energy's 132kV transmission network between Boulder and Kambalda, Western Power is required to have Technical Rules for its network within the SWIS. The Authority is obligated to establish a Committee to provide advice on the first Technical Rules proposed for Western Power's network within the SWIS.

Section 12.27(a) of the Access Code allows for the Authority to provide directions to a Committee in relation to the procedures it must follow, and the manner in which it must perform its functions. Accordingly, the following represents the Terms of Reference for the Committee established pursuant to chapter 12 of the Access Code for the parts of the SWIS owned by Western Power.

This Terms of Reference is to be read subject to the provisions of the Access Code.

1. Purpose of the Committee

(a) The Committee is established for the purpose of providing specialist knowledge and advising the Authority on the approval of proposed Technical Rules relating to the parts of the SWIS owned by Western Power.

(b) The Committee:

(i) may develop model Technical Rules;

(ii) must advise the Authority on the approval of proposed Technical Rules;

(iii) must, when requested by the Authority, advise the Authority on any matter connected with Technical Rules; and

(iv) must, when requested by the Authority, conduct a review of the operation of:

a. Technical Rules or a part of Technical Rules; or

b. chapter 12 of the Access Code, or a part of chapter 12,

and advise the Authority on the outcome of the review. [*cf. s.12.23*]

(c) The Committee is to provide the Authority with a preliminary report and final report on the proposed Technical Rules, in accordance with the reporting timeframe outlined in clause 7 of this Terms of Reference.

2. Commencement of the Committee

(a) The Committee is established under section 12.17(a) of the Access Code and by this Terms of Reference.

(b) The Committee shall be convened by way of written invitation from the Authority or its delegate.

(c) The Committee shall meet as frequently as the Chair, or the Authority or its delegate, determines.

3. Membership of the Committee

(a) Upon commencement, the members of the Committee are:

(i) a representative of Western Power (the service provider);

(ii) persons representing other service providers of networks interconnected with Western Power's network within the SWIS, comprising:

a. a representative of Southern Cross Energy; and

b. a representative of International Power Mitsui Consortium (Kwinana Cogeneration Plant);

[*clause 3(a)(ii) revised 19 April 2005*]

(iii) persons representing users of the network, comprising:

a. a representative of Alinta Limited;

b. a representative of Perth Energy Pty Ltd;

c. a representative of Tiwest Pty Ltd;

d. a representative of Wesfarmers Energy Limited; and

(iv) a representative of the Coordinator of Energy. [*cf. s.12.19(a)(i)*]

(b) The representative of the Coordinator of Energy will Chair the Committee. [*cf. s.12.20*]

(c) The Committee may, if considered necessary, recommend to the Authority the appointment of any other person as a representative of users of the network, or any other person that the Committee considers appropriate. This clause does not limit the Authority in appointing any other party to the Committee.

(d) The Authority may appoint a representative to observe any aspect of the operation of the Committee, including attending meetings of the Committee. [*cf. s.12.30*]

(i) The representative of the Authority must not participate in any decision making process of the Committee. [*cf. s.12.31*]

4. Duration of Membership

(a) The Authority will review the Committee's membership, operation and procedures (including the continuation of the Committee) after the first Technical Rules have been approved.

(b) The Authority may, by writing to members of the Committee, dissolve the Committee after the first Technical Rules have been approved. [*cf. s.12.27(b)*]

5. Funding and Resources of the Committee

(a) Each member organisation shall be responsible for their individual participation costs on the Committee.

(b) The Chair is responsible for providing secretariat services to the Committee, including minuting the activities of the Committee.

6. Meeting Governance

(a) A quorum shall comprise:

(i) the member representing the Coordinator of Energy (Chair);

(ii) the member representing Western Power (the service provider);

(iii) the members representing Southern Cross Energy and International Power Mitsui Consortium (Kwinana Cogeneration Plant) (the other service providers of networks interconnected with Western Power's network within the SWIS); and

[*clause 6(a)(iii) revised 19 April 2005*]

(iv) at least one member representing users of the networks.

(b) The Committee's recommendations to the Authority are to be formulated on the basis of consensus.

(i) In the event of deadlock the Chair of the Committee must advise the Authority of the details of the deadlock and the position held by each member of the Committee on the matter the subject of the deadlock. [*cf. s.12.25*]

(ii) The Authority must form a view on the matter the subject of the deadlock and advise the Committee of its view. The Committee is required to proceed on the basis of the view advised to it. [*cf. s.12.36*]

(c) Apart from that which is provided for within the Access Code, this Terms of Reference or any other direction provided by the Authority under section 12.27(a) of the Access Code, the Committee is to determine the policies of, control the affairs of, and otherwise perform the functions of, the Committee.

7. Reporting

(a) Any communication to the Authority from the Committee must be provided to the Authority by the Chair and not by any other member. [*cf. s.12.21*]

(i) This does not preclude a person who is a member of the Committee from making submissions to the Authority in relation to proposed Technical Rules in any capacity other than as a member of the Committee. [*cf. s.12.22*]

(b) The Committee is required to provide a preliminary report on the proposed Technical Rules to the Authority within 20 business days of the last day by which the Authority is required to make its draft decision on the Access Arrangement under section 4.12 of the Access Code. [*cf. s.12.11(b)(i)*]

(c) The Committee is required to provide a final report on the proposed Technical Rules to the Authority within 30 business days of the last day by which the Authority is required to make its final decision on the Access Arrangement under section 4.17 of the Access Code. [*cf. s.12.11(b)(ii)*]

8. Procedures for undertaking review of the operation of Technical Rules and/or chapter 12 of the Access Code

(a) If requested by the Authority the Committee must conduct a review of the operation of the Technical Rules (or part thereof) or chapter 12 of the Access Code (or part thereof), and advise the Authority of the outcome of the review, including any recommendations for amendment of the Technical Rules and/or chapter 12 of the Access Code. [*cf. s.12.23(d)*]

(b) The purpose of any such review is to determine whether the Technical Rules and/or chapter 12 of the Access Code continue to efficiently and effectively deliver the objectives of the Committee, the Technical Rules and/or the Access Code.

(c) Following a request from the Authority, the Committee must undertake a review that is consistent with the timeframes and objectives set out within the Access Code.

(d) This clause does not limit the Authority in the performance of its review role under sections 12.56, 12.57 and 12.58 of the Access Code.

9. Procedures for recommending an amendment to Technical Rules

(a) In addition to clause 8 above, the Committee, through the Chair, may recommend to the Authority an amendment to the Technical Rules at any time. [*cf. s.12.50*]

(b) The Authority is to consider any such proposed amendment in accordance with the procedures set out in sections 12.50, 12.51, 12.52, 12.53 and 12.54 of the Access Code.

(c) This clause does not limit the Authority in the performance of its Technical Rules amendment functions under the aforementioned sections of the Access Code.

10. Jurisdictional consistency

(a) The Committee shall keep informed of developments in other Australian states with respect to technical standards, procedures and planning criteria governing the construction and operation of an electricity network.

(b) The Committee will, when appropriate, liaise with other relevant Australian state organisations responsible for technical matters in order to achieve a national consistency of approach, wherever practicable, taking into account the circumstances of Western Australia.

Notes:

17 January 2005: Terms of Reference issued

19 April 2005: First revision [*clauses 3(a)(ii) and 6(a)(iii) amended*]

APPENDIX 6: MEMBERSHIP OF THE TECHNICAL RULES COMMITTEE

Technical Rules Committee

Name	First Name	Position	Company	TRC Role
Bozic	Zoran	Access Development Engineer	Western Power Corporation	Observer
Bitney	Dave	Manager - WA Power Plant Operations	Alinta	Member
Butcher	Alistair	A/Director - Electricity Access	Economic Regulation Authority	Member
Fernandez	Harry	Principal Engineer	TransAlta	Member
Gould	Steve	Director	Perth Energy Pty Ltd	Member
Liddelow	Neil	Manager Commercial & Logistics Services	Tiwest Joint Venture	Member
MacCormick	Ken	Project Manager	Wesfarmers Energy	Member
Shales	Greg		Economic Regulation Authority	Member
Southwell	Phil	Manager - Networks, Customer Services & Business Development	Western Power Corporation	Member
White	Gavin	Principal Project Officer	ERIU	Chair
Ottey	Danielle	Graduate Officer	ERIU	Executive Officer

Small Generators Working Group

Name	First	Position	Company
Bird	Richard		Greenbird Technology P/L
Forth	Shayne	Managing Director	Landfill Gas and Power
Fulford	Bonnie	Consultant (CRA International)	Western Power Retail Business Unit
Gordon	John	Operations Manager	Landfill Gas and Power
Gould	Steve	Director	Perth Energy
McLean	Steven	Senior Energy Analyst - Energy Trading	Western Power Retail Business Unit
Offszanka	Jon	Supervising Electrical Engineer, M & E Services Branch	Water Corporation
Ottey	Danielle	Graduate Officer	Office of Energy
Ryan	John	Peoject & Contract Manager	Western Power Networks Business Unit
Southwell	Phil	Manager - Networks, Customer Services & Business Development	Western Power
Schubert	Noel	Senior Renewable Energy Engineer	Western Power Corporation (incorporating Diesel
White	Gavin	Principal Project Officer	Office of Energy
Yuncken	Andrew		Andrew Yuncken Consulting Engineers

TRC Role
Member
Member
Member
Member
Member
Member
Member
Executive Officer
Member
Member
Member
Chair
Member