363 Wellington Street Perth WA 6000
GPO Box L921 Perth WA 6842
T: (08) 9326 4911 F: (08) 9326 4595
www.westernpower.com.au
ABN 18 540 492 861

5th May 2006

Mr Robert Pullella
Executive Director
Economic Regulation Authority
6th Floor, Governor Stirling Tower
197 St Georges Terrace
Perth, Western Australia 6000

Dear Rob

ERA Decision and Explanatory Memorandum on the Draft Technical Rules dated 11 April 2006 for Western Power's South West Interconnected Network

Western Power is pleased to provide the enclosed submission on the issues raised in your memorandum.

In general we have restricted our response to the Memorandum to those issues where comments were invited. However, we have also taken the opportunity to provide comments on some other clauses of the draft Technical Rules and to propose some additional appendices. The additional comments are intended to provide clarification for users of the document.

Western Power considers that, of the issues raised in the Memorandum and addressed in our submission, the most critical areas are:

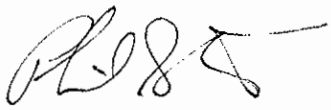
- Fault levels – User and NSP obligations to address rising fault levels;
- Credible Contingency Events – especially the issue of 3 phase fault events;
- Distribution System Design – remote monitoring and control;
- Computer Model – the importance of providing upgradeable dynamic models;
- Stability Assessment – selection of system states during contingency events; and
- System Studies – a pro-forma for performing system studies.

In addition, we request that you closely consider the changes we have proposed to individual clauses. We are, of course happy to provide additional supporting information as required on all issues.

DMS#: 3038017v1
File#: NAC/77/2(30)V1

Western Power believes that the collaborative process followed in developing the draft Technical Rules has been valuable and has resulted in a document that more closely meets the requirements of the Access Code, is more internally consistent, and minimises overlaps with the requirements of the WEM Rules.

Yours sincerely



PHIL SOUTHWELL
GENERAL MANAGER
STRATEGY AND CORPORATE AFFAIRS DIVISION

DMS#: 3038017v1
File#: NAC/77/2(30)V1

Western Power Response to the ERA Decision and Explanatory Memorandum on the Draft Technical Rules dated 11 April 2006 for Western Power's South West Interconnected Network

Table of Content:

Specific Issues

Submission on Specific Issue: *Fault Levels*

Purpose of this submission

This submission by Western Power relates to paragraphs 39 to 46 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South west Interconnected Network dated 11 April 2006. Western Power submits that the current provisions of the Draft Technical Rules that impact on the control of fault currents should stand unaltered or be qualified on account of the complexity of the issues involved.

Summary

In Western Power's submission:

(a) Clause 2.5.9 (a) places an absolute obligation on Western Power to "design and construct the *distribution system* so that the potential *maximum fault currents* do not exceed (specified) values.

(b) It is unlikely that Western Power would seek an exemption to exceed these levels despite the availability of higher rated equipment and some benefits of permitting higher currents.

(c) The new suggested clause 3.2.1 (f) that permits Western Power to allow Users to install lower rated equipment has a number of serious implications that should be considered, and possibly also included in the Rules.

(d) The application of the grandfather clause 1.9.4 also has implications when applied in respect of equipment fault ratings.

(e) The principle that the User that causes the problem should be responsible for its correction is supported, but where there are several options for correction with different consequences the current provisions may be difficult to apply in practice.

The ERA's observations

39. Clause 2.5.9 of the draft technical rules sets out the maximum allowable fault levels at the different voltage levels of the distribution system. Many parts of the distribution network currently have fault levels well below this. No maximum fault levels are prescribed for the transmission system, although clause 2.5.8 requires that the transmission and distribution systems be operated so that the calculated maximum fault level at any point does not exceed 95 per cent of the equipment fault rating at that point.

40. Fault levels on a network change over time. In particular, the connection of new rotating plant, including generators and large motors, is likely to increase the fault level on those parts of the network electrically close to the point of connection. This raises the issue of whether a user should be required to upgrade equipment connected to the network if fault levels increase to the point that its existing equipment is no longer suitable.

41. In respect of the distribution system the Authority has clarified this issue by inserting clause 3.2.1(f) in the draft technical rules. This provides that a user who connects to the distribution system must install equipment that is rated for the maximum fault levels specified in clause 2.5.9 unless granted an exemption by Western Power. It is expected that Western Power will grant exemptions for those parts of the distribution system where fault levels are low. However, it is likely that such an exemption would include a condition requiring the user to upgrade its equipment should this become necessary at a later date.

42. The situation becomes more difficult in respect of users connected to the distribution system at the rules commencement date. Their equipment is deemed to comply with the rules in accordance with the "grandfathering" provisions of clause 1.9.4 and the issue is whether such users should be liable for equipment upgrades. This is covered by clause 1.9.5, which requires users to monitor their equipment on an ongoing basis and to ensure its continued safety and suitability as conditions on the power system change. This clause would also apply to users connected to the transmission system at the rules commencement date.

43. In respect of the transmission system, fault levels are expected to gradually increase over time and a consequence of clause 2.5.8(a) is that equipment may need to be upgraded to accommodate this. Liability for such upgrades is not prescribed in the technical rules as it is a commercial issue and the Authority has inserted the following note to clause 3.2.1(f) of the rules to indicate this: Where a *User's equipment* increases the fault levels in the *transmission system* or *distribution system*, responsibility for the cost of any upgrades to the *equipment* required as a result of the *changed power system* conditions will be dealt with by commercial arrangements between the *Network Service Provider* and the *User*.

44. This note leaves open the question of liability when distribution or transmission system fault levels increase to a level in excess of the rating of existing Western Power or user equipment. It is anticipated that Western Power would seek to recover from the proponent the cost of any necessary upgrades required to its own equipment as a result of a new connection when negotiating the access contract. However, users connected to the transmission system at the rules commencement date would be liable for their own upgrades in accordance with clause 1.9.5 and Western Power has indicated that it will require a similar clause to be inserted into new access contracts negotiated after the rules commencement date.

45. Under the draft technical rules, if subsequent network changes required Western Power to increase fault levels above those specified for the distribution system in clause 2.5.9 it would need to seek an exemption from the Authority. Assuming the exemption was granted, users affected by the increased fault levels would need to ensure their equipment's fault level rating was adequate for the increased fault level and, if necessary, would need to upgrade the equipment affected.

46. The Authority invites comment from interested parties as to whether these arrangements are appropriate and also whether the question of liability for equipment upgrades as a result of increases in potential fault levels should be more explicitly prescribed in the final technical rules.

Western Power's submission

1. As the Network expands and more generation is installed fault levels will increase. Clause 2.5.9 (a) places an absolute obligation on Western Power to "design and construct the *distribution system* so that the potential *maximum fault currents* do not exceed (specified) values.

2. The effect of this clause would be to require that Western Power design the networks such that increases in fault level on the transmission network do not cause exceedance of the specified distribution fault levels.

3. It is currently unclear to whom Clause 2.5.9 (b) applies. This clause states that "equipment may be installed with a lower fault *current rating* in accordance with the *WA Electrical Requirements* where the fault level is unlikely to exceed the lower rating for *credible contingency event*". It is assumed that it applies only to Western Power, as does the companion clause 2.5.9 (a), and that the arrangements for Users that seek to install lower rated equipment is covered by clause 3.2.1 (f).

4. It is not appropriate that Western Power should bear liability for its actions in granting an exemption under clause 3.2.1 (f) because it has no control over future connections that may increase the fault currents. Accordingly it is appropriate that it should have the right to insert the condition suggested in paragraph 41. The ERA should consider whether this right should be explicitly covered in clause 3.2.1 (f).

5. Equipment ratings available on the market are now higher as a result of the upward trend in fault levels generally. Clause 2.5.9 (a) appears to remove the possibility of using such equipment to achieve benefits, such as those that follow:

6. The benefits of increased fault levels include increased system stability at transmission level and improvement in power quality at the distribution level.

7. Some reliability improvement measures such as parallel operation of zone substation transformers will result in increased fault levels.

8. Maximum fault level values are only likely near generation sources or near major nodes that are connected to several generation sources or where there are multiple parallel paths.

9. It is therefore likely that few customers would be affected by rising fault levels. The "W.A. Electrical Requirements" sets minimum standards for Users.

10. It is problematic whether Western Power would seek to increase the fault levels above those specified in clause 2.5.9 by seeking the exemption suggested in paragraph 45 because they would also have to consider the consequent impact of

higher fault currents on downstream Users.

11. In principle Users should be responsible for the management of their equipment to ensure that it meets required specifications according to current and foreseeable conditions. However clause 1.9.5 poses a compliance problem in respect of fault levels. This is because a fault level is not something that is directly observable by a User. The first manifestation of equipment rating being exceeded would be the catastrophic failure of that equipment during the occurrence of a fault. The User is obliged to diligently perform a regular review of fault levels at points of connection with reference to system data supplied by Western Power.

12. Western Power will periodically calculate fault currents at its own substations, and will particularly do so in response to an application to connect. However it would not normally be expected to extend such calculations to User premises. It is not feasible to regularly check the ratings of other User plant that is connected to the network and would be affected by a rise in fault levels. The question arises whether Western Power should have an obligation to inform Users to whom it has granted a fault current exemption about the changed circumstances. To impose this obligation would result in a considerable technical and administrative burden on Western Power to manage the fault current exemption process, and impose potential liability on it for failure to identify a potential problem.

13. Western Power has a similar problem in respect of the grandfather clause 1.9.4 if installations exist that do not meet the fault current standard. Historically network companies are entitled to manage the fault currents at their own substations, and assume that downstream User equipment will be compatible with the network company's equipment.

14. Where a User increases fault current contribution through the connection of assets with a step input, a commercial arrangement between the NSP and the User that is responsible for the changed circumstances is considered the fairest approach.

15. However such arrangements are unlikely to be clear-cut, as there are usually several options for controlling fault currents. Apart from the option of replacing equipment (as assumed by the Rules), there is usually the option of adding impedance to the supply path by installing reactors or neutral resistors, and the option of splitting the network into two or more parts, which will have the disadvantage of reducing the amount of supply redundancy, so affecting quality of supply.

16. The potential User would usually prefer that the last option be adopted because it will result in least cost for correction (unless he is concerned about the reduction in supply quality). However this option is clearly detrimental to other Users in a manner that is difficult to cost. If this latter option is proposed it should be considered whether Western Power and the User should have an obligation to disclose the plan and consider public submissions.

17. In view of the above it should also be considered whether Western Power should have the codified right to refuse access where the fault level consequences of the proposed connection would have an unacceptable impact on other Users. This would put in context the boxed proposal that "Where a *User's equipment* increases the fault levels in the *transmission system* or *distribution system*, responsibility for the cost of any upgrades to the *equipment* required as a result of the *changed power system* conditions will be dealt with by commercial arrangements between the *Network Service Provider* and the *User*."

Conclusion

The proposed provisions are reasonable, but they concentrate on some particular solutions to the possible exclusion of other options. The issue of fault level control is technically complex, and solutions involving negotiation where the rights of others are impacted by the solution are likely to be commercially complex and result in disputation.

Western Power submits that the current provisions of the Draft Technical Rules that impact on the control of fault currents should stand unaltered or be qualified on account of the complexity of the issues involved.

Submission on Specific Issue: *Requirements for connection of energy systems to the low voltage distribution system via inverters*

Purpose of this submission

This submission by Western Power relates to paragraphs 47 to 49 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. Western Power believes that the current provisions are satisfactory and should not be altered.

Summary

Western Power is of the view that clause 3.7 of the Draft Technical Rules provides a reasonable balance between network service provider and user requirements and obligations and should stand unaltered.

The ERA's observations

47 Clause 3.7 of the draft technical rules sets out the particular requirements for the connection by users of energy systems to the low voltage distribution system via inverters.

48 The clause is prescriptive compared to the requirements in the draft technical rules for generating units to the extent that the clause explicitly covers safety issues and includes detail such as a connection diagram and drawings of signage requirements. Western Power considers that, due to the nature of the installations and the potential hazards they can cause, this level of detail is required and appropriate.

49 The Authority has made no change to this clause. However, it invites comment from interested parties as to whether the detail included in clause 3.7 is appropriate in the final technical rules. The Authority draws stakeholder attention to the safety requirements included in clause 3.7 and invites comment from stakeholders as to whether such requirements should be included in the final technical rules.

Western Power's submission

Clause 3.7 provides a concise statement of Western Power technical requirements for small inverter connected energy systems, that does not depend on reference to other clauses within the Technical Rules. As such it is substantially a stand-alone statement of network service provider requirements that can be conveniently provided by retailers to proponents of inverter energy systems to facilitate energy buy-back arrangements.

The degree of detail is high, but requirements are substantially those of Australian Standard 4777 - 2005 so they should not impose an undue barrier to network access. Moreover, the most common use of an inverter energy system would be in a domestic dwelling for which the user would be unlikely to have the requisite engineering qualifications. Therefore prescribing in detail the performance and safety requirements and requiring certification by an NPER engineer provides certainty that the installation will be reliable and safe and also avoids the need for detailed and costly review of access applications by the NSP.

Conclusion

Clause 3.7 has been written to concisely express Western Power requirements for small inverter energy systems without reference to other parts of the Technical Rules. We believe the requirements of 3.7 are reasonable and the clause in its present form is clear and concise and will facilitate the entry of small inverter energy systems.

Submission on Specific Issue: *Ride-through*

Purpose of this submission

This submission by Western Power relates to paragraphs 50 to 52 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. We believe the requirement as stated should stand unchanged.

Summary

Western Power is of the view that clause 3.6.5 of the Draft Technical Rules, which specifies fault ride-through requirements for small generators, is necessary to preserve system reliability as the aggregate distributed generation grows to become a significant proportion of total generation capacity.

The ERA's observations

50. Clause 3.3.4.3 of the draft technical rules provides design requirements for generating units and their auxiliary systems for continuous uninterrupted operation while being subjected to off-nominal frequency and voltage excursions. The requirements in this clause generally apply to generating units with a rating of over 10 MW, which in most cases would be directly connected to the transmission system.

51. Clause 3.6.5 imposes the same ride-through requirements on smaller units connected to the distribution system. However, for smaller units it may be appropriate to relax the ride-through requirements, given that failure to comply would not normally have a material impact on system stability. The requirements of clause 3.6.5 of the draft technical rules for small generators are more onerous than required by the NER.

52. The Authority has not amended clause 3.6.5 of the draft technical rules. Nevertheless, the Authority invites comment from interested parties on whether the ride-through requirements for small generators are appropriate, or whether the final technical rules should require only larger generators or generators located on more critical parts of the network to be subject to the ride-through requirements.

Western Power's submission

1. Paragraph 51 notes that imposing ride-through requirements on smaller generating units connected to the distribution system may be too onerous, based on the assumption that failure of these units to comply would not have material impact on the overall system.
2. This assumption is not correct. While failure of a small generator to ride-through a local disturbance would not materially affect the system, failure of numerous small generating units to ride-through a system-wide disturbance would have a substantial system impacts.
3. The requirements of clause 3.3.4.3 have been imposed on small generators in anticipation that access to more liberal energy trading arrangements will encourage greater participation of small generators in which their collective response to a widespread system disturbance would have a significant impact on system frequency recovery. The importance of fault ride-though capability for small generators was demonstrated during an incident in Italy in 2003 in which widespread blackout resulted from the untimely disconnection of some 3400 MW of distributed generation capacity during a power system disturbance.
4. The ride-through requirements have in fact been relaxed somewhat for smaller generators - the ride-through requirement only applies to times related to transmission protection tripping times, not the time that would be required to ride through distribution system faults. Therefore, the small distribution generators are only expected to ride-through wide spread disturbances (reflected by transmission tripping times of 450 msec) where their loss would be material.
5. At the level of local distribution networks, network overload may occur should embedded generators used for demand management disconnect at times of high load in response to a system frequency deviation or a nearby fault. Avoidance or reduction of the need to re-synchronise embedded generation following a disturbance would also reduce potential hazards in operation of the distribution system.
6. Western Power believes that these performance requirements are necessary and should not be difficult to achieve for small generators, however there is likely to be scope to grant derogations for individual cases.

Conclusion

Clause 3.6.5 imposes the same fault ride-through requirements on small distribution connected generators as large generators. We believe that these requirements should not prove difficult to achieve in most cases and they will contribute to overall power system reliability as the proportion of distributed generation grows. Nevertheless there is scope to grant derogations for individual cases. Therefore the current requirements should remain unchanged.

Submission on Specific Issue: *Load Shedding*

Purpose of this submission

This submission by Western Power relates to paragraphs 53 to 57 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. Western Power believes that clause 2.2.1 (d)

should not impose an absolute performance requirement in which the network provider has little control of the outcome. The clause should be qualified to reflect this.

Summary

Western Power believes that although it will normally be possible to avoid load shedding, it is unrealistic to expect the network service provider to achieve performance outcomes over which it has little control.

The ERA's observations

53. The Authority has included Clause 2.2.1(d) in the draft technical rules. It states:

> Frequency tolerance limits must be satisfied, provided that there is no shortage of spinning reserve in accordance with clause 3.10.2 of the Wholesale Electricity Market Rules, without the use of load shedding under all credible power system load and generation patterns and the most severe credible contingency event.

54. Western Power has indicated that, under certain operating scenarios, it may not be able to comply with this obligation without load shedding. This situation could arise firstly from the loss of the largest connected generator under adverse system generation and load patterns and secondly from the loss of an interconnector. In either circumstance above, load shedding might be required if the system splits into "islands". Western Power sought to amend the standard to be conditional on sufficient spinning reserve being dispatched to enable compliance.

55. The Authority is reluctant to impose a technical rule or performance standard that is conditional on Western Power being in a position to comply. Furthermore, the frequency tolerance standards imposed by clause 2.2 of the technical rules are less onerous than those imposed by the NER, or indeed on most power systems operating in developed economies. The Authority understands that the probability of non-compliance arising through the loss of a generating unit is low and considers that Western Power should seek an exemption from the rules to cover such low probability scenarios.

56. The Authority accepts Western Power's position regarding the loss of an interconnector. It understands that the load shedding would be required only on the "islanded" part of the power system and so it has further included clause 2.2.1(e) in the draft technical rules to provide for this. This clause states:

> In the event of a loss of interconnecting equipment leading to the formation of an island separate from the rest of the power system, load shedding facilities within the island may be used to ensure that the frequency tolerance limits specified in Table 2.1 are satisfied within the islanded part of the power system. Once the power system within the island has returned to a steady state operating condition, the "island" frequency range in Table 2.1 will apply until the islanded power system is resynchronised to the main power system.

57. Comments are invited from interested parties as to whether the approach taken by the Authority to include clause 2.2.1(d) of the draft technical rules in respect of load shedding offers an appropriate solution or whether the standard should be amended to reflect Western Power's preferred position.

Western Power's submission

1. Clause 3.10.2 of the WEM Rules currently specifies spinning reserve cover for only 70% of the largest single generating unit. History demonstrates that load frequency relief and the governor response of remaining generators usually prevents the frequency lower limits from being exceeded without shedding load. Nevertheless the speed of

governor response of some market participants may at times be insufficient to achieve this and some load shedding may occur. Accordingly we believe that compliance with clause 2.2.1 (d), although achievable, will depend on plant performance which is beyond the control of the network service provider.

2. Similarly, whereas clause 3.10.2 of the WEM Rules currently nominates spinning reserve of 70% of the load supplied by the largest generator, a future rule change to a lower level of spinning reserve may make load shedding more likely. This also is a circumstance beyond the control of the network service provider.

3. We recommend that clause 2.2.1 (d) should refer to '*single contingency event*' for which avoidance of load shedding is achievable rather than 'credible contingency event' and should also be changed to reflect that circumstances beyond the control of the network service provider may result in some load shedding.

Conclusion

The clause 2.2.1 (d) should reflect that load shedding may occur due to circumstances beyond the control of the network service provider including a future WEM rule change. '*credible contingency event*' should be changed to '*single contingency event*'.

Submission on Issue: *Credible Contingency Events*

Purpose of this submission

This submission by Western Power relates to paragraphs 58 to 64 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. Western Power submits that clause 2.3.7.1(a) of the Draft Technical Rules should stand unaltered.

Summary

In Western Power's submission:

(a) clause 2.3.7.1 (a) defines five events that should be considered to be credible when assessing the technical envelope for the network: to adopt less severe events would increase the risk of experiencing catastrophic system failure;

(b) the inclusion of solid three phase faults cleared correctly by primary protection is consistent with the provisions of the NE Rules when the special circumstances of the SWIN are considered;

(c) the NE Rules are inconsistent, so that the requirement that the faster of two primary protections should be assumed out of service is consistent with one NE Rule, but is inconsistent with another;

(d) clearance of certain single phase faults by backup protection is credible.

The ERA's observations

58. Clause 2.3.7.1(a) of the draft technical rules states:

The Network Service Provider must plan, design and construct the transmission and distribution systems so that the short term power system stability and dynamic performance criteria specified in clauses 2.2.7 to 2.2.10 are met under the worst credible system load and generation patterns, and the most critical, for the particular location, of the following credible contingency events without exceeding the rating of any power system component or, where applicable, the allocated power transfer capacity:

(a) a three-phase to earth fault cleared by *disconnection* of the faulted component, with the fastest main protection out of service;

(b) a single-phase to earth fault cleared by the *disconnection* of the faulted component, with the fastest main protection out of service;

(c) a single-phase to earth fault cleared after unsuccessful high-speed single-phase auto-reclosure onto a persistent fault;

(d) a single-phase to earth fault cleared by the backup protection; or

(e) sudden *disconnection* of a system component, e.g. a *transmission line* or a *generation* unit.

59. Clause 2.3.7.1(a) of the draft technical rules defines the credible contingency events, which form the benchmark disturbances through which the power system must be able to remain stable and controllable without the use of load shedding. Accordingly, the definition of a credible contingency event is important not only for system design but also for defining the acceptable technical envelope for system operation. If the definition of credible contingency event is unduly onerous, certain generating patterns and operating configurations may not be permissible and this in turn may prevent available generation from being dispatched for certain network and load configurations.

60. The critical contingency events defined for the SWIN are more onerous than in the NEM in that:

a) three phase to earth faults are not considered credible on the NEM; and

b) on the SWIN it is assumed that for a credible contingency event the fastest main protection scheme can be considered to be out of service.

61. Western Power argues that three phase to earth faults do occur on the SWIN and must be taken into account in power system operational planning, particularly in view of the marginal stability of the Goldfields interconnector. The Authority accepts this position.

62. In respect of the fastest main protection scheme being out of service, clause 2.9 of the draft technical rules requires that duplicate main protection schemes be installed on the transmission system and on those parts of the distribution system subject to a critical fault clearance time. Western Power has indicated that this is current practice. Therefore, in undertaking critical stability assessments, the requirement that the fastest main protection be assumed to be out of service is unlikely to be onerous, because the fault clearing time of the second main protection is unlikely to be significantly slower than the fault clearing time of the first main protection. This would not be the case if duplicate main protection was not required since, in this event, it would be necessary to rely on slower backup protection should the main protection not be available.

63. The Authority has made some changes to the wording of clause 2.3.7.1(a) to increase clarity. These have not changed the effect of the clause. However, the Authority's technical advisers, PB Associates, have advised that clause 2.3.7.1(a)(4) of the draft technical rules defines a credible contingency event as existing when a single phase to earth fault is cleared by backup protection. This would require both duplicate protection schemes either to be out of service or to fail to operate correctly.

64. The Authority invites comments from interested parties as to whether the definition of credible contingency events contained in clause 2.3.7.1 of the draft technical rules is appropriate.

Western Power's submission

1. In paragraph 59 the ERA has identified the importance of the identifying those contingency events that are to be considered credible in respect of power system stability and dynamic performance. The system fault contingencies listed in clause 2.3.7.1(a), together with identified system operating conditions, define one part of the "technical envelope", within which the system must be operated in order to reduce the probability of system instability to a level that will be acceptable to the community.

2. System instability can be very destructive to electricity supply over wide areas of a power system. Inevitably the power system will split in an uncontrolled manner into two or more islands, which will not have the required balance between supply and demand. In the best case scenario some or all these islands may stabilise after shedding some load or backing off some generation output, but there are many documented cases around the world where a shutdown of the total system occurs. In this event it may take several hours to gradually restore normal supplies, and some industrial processes may suffer severe consequential damage. Such events have economic, social and political consequences.

3. The identification of a set of credible contingencies is not, therefore undertaken lightly. The aim should be to achieve an average time between such destructive events of several tens of years.

4. The most severe fault is always a "solid three phase fault", in which each of the three wires that form a circuit are inadvertently connected together by some highly conducting material. It should be noted that clause 2.3.7.1(a) does not assume this worst possible fault for all circumstances. Rather the less severe but more likely solid single phase fault is assumed for most cases.

5. Paragraph 60 compares the proposed clause with the National Electricity Rules, but does not fully appreciate some qualifying statements that are included in the Rules.

6. In respect of paragraph 60 (a) the relevant NE Rule is S5.1.2.1 (a) which states (in part) that "*credible contingency events* must include the *disconnection* of any single *generating unit* or *transmission line*, with or without the application of a single circuit two-phase-to-ground solid fault on lines operating at or above 220 kV, and a single circuit three-phase solid fault on lines operating below 220 kV." However this is qualified by Rule S5.1.2.1 (b), which states that "for lines at any *voltage* above 66 kV which are not protected by an overhead earth wire and/or lines with tower footing resistances in excess of 10 ohms, the *Network Service Provider* may extend the criterion to include a single circuit three-phase solid fault to cover the increased risk of such a fault occurring. Such lines must be examined individually on their merits by the relevant *Network Service Provider*."

7. Western Power has examined the design and fault records for its 330 kV and 220 kV lines, and has concluded that to be compliant with the NE Rule it would have to use the three phase solid fault as is proposed for clause 2.3.7.1 (a) for the following reasons:

8. Low tower footing resistance is achieved by constructing a buried system of earthing wires at each tower. The aim is to form a path where an electric arc from one phase conductor to the tower can be dissipated to earth without involving the other phase conductors. While there was a general intention during line construction to achieve a tower footing resistance of around 10 ohms for these lines, this could not always be achieved. This is attributable to the geological conditions in Western Australia. It is not economically feasible to remedy this at this stage.

9. Western Power's fault records indicate that a small proportion of the faults that have occurred on these lines have involved all three phases. This indicates a real difference to the NEM networks, confirming the merits of the current proposal.

10. Western Power's objection to adopting wording similar to that of the NER, and using the terms of the qualification to still adopt the three phase solid fault, is that this would be a less transparent outcome.

11. In respect of paragraph 60 (b) there are conflicting provisions in the NER.

12. NE Rule S5.1.2.1 (a), which was quoted in part above, also states that: "The *Network Service Provider* must assume that the fault will be cleared in primary protection time by the faster of the duplicate protections with installed intertrips available."

13. However NE Rule S5.2.5.9 (a)(2), which concerns protection aspects of the automatic access standard for generators states that "Each primary *protection system* must have sufficient redundancy to ensure that a faulted element within its protection zone is *disconnected* from the *power system* within the applicable *fault clearance time* with any single protection element (including any communications facility upon which that *protection system* depends) out of service." This can only be interpreted as meaning that the faster protection should be assumed to be out of service, contrary to S5.1.2.1 (a).

14. Western Power submits that, in principle, it is not logical to assume that only the slower of two protections should be assumed out of service, because there is an equal probability that the faster protection might be out of service.

15. Whereas in the NEM a protection may be out of service no more than 8 hours, in the SWIN 48 hours is permitted. This significantly increases the probability that one protection will be out of service.

16. In paragraph 62 the ERA notes that the proposed rule is unlikely to be onerous in practice because the speeds of the two protections of the primary system are likely to be very similar. It should be noted that clause 2.9.2 requires that the two protections must operate according to different principles, so that small differences in timing may be expected. Never-the-less Western Power agrees with the ERA's position.

17. In paragraph 63 the ERA quotes its consultants PB Associates as having advised "that clause 2.3.7.1(a)(4) of the draft technical rules defines a credible contingency event as existing when a single phase to earth fault is cleared by backup protection. This would require both duplicate protection schemes either to be out of service or to fail to operate correctly." Western Power advises that the last sentence of this statement is incorrect. Two types of fault are only cleared by backup protection as follows:

18. A "small zone fault", which is a fault between a circuit breaker and its associated current transformer is not cleared when the primary protection opens that circuit breaker. This fault is cleared by the backup protection, when it initiates a trip of all circuit breakers of the adjacent protection zone.

19. The failure of a circuit breaker to open in an attempt to clear a fault will result in fault clearance by the backup protection of the adjacent zone.

20. Western Power submits that these events are credible, and that the relevant provision should therefore remain.

Conclusion

The current provisions are a reasonable compromise between the need to manage the possibility of occurrence of a catastrophic system failure caused by instability, against the need to maximise power transfer capability so as to minimise constraints on generator operation. Western Power believes they should remain unchanged.

Submission on Specific Issue: *Protection requirements for small generating units*

Purpose of this submission

This submission by Western Power relates to paragraphs 65 to 67 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. Western Power believes that the requirements of clause 3.6 should remain unchanged.

Summary

Distribution systems have in general not been designed to accommodate embedded generation. Consequently connection of generators to the distribution network generally poses several safety and reliability concerns. Western Power is of the view that clause 3.6 and Table 3.6 in particular of the Draft Technical Rules, which specify connection and protection requirements for small generators, benefit users by providing certainty of Western Power requirements and by providing differentiation between types of access to the network. We believe that with integrated protection equipment now widely available, meeting the protection requirements of Table 3.6 should not prove costly or difficult and the process of reviewing applications for access will be expedited. We believe that the degree of prescription in clause 3.6 is not uncommon for distribution systems and is justified. Therefore the requirements of clause 3.6 should stand unchanged.

The ERA's observations

65. The protection requirements for small generating units are contained in section 3.6 of the draft technical rules. Table 3.6 in the draft technical rules sets out a detailed summary of those protection requirements, which is significantly more prescriptive than the requirements in clause 3.5.2 for the connection of large generators to the transmission system.

66. Western Power accepts that the requirements in clause 3.6 are more prescriptive than other requirements in the draft technical rules but notes the particular problems it faces in connecting embedded generation to a distribution feeder. It stated that the amount of prescription provides a degree of certainty to smaller users in regard to Western

Power's expectations and notes that Table 6.1 of the draft technical rules is based on Table 8-2 of a much more comprehensive technical guide published by the Australian Business Council for Sustainable Energy.

67. The Authority invites comment from interested parties on whether clause 3.6 in the draft technical rules, and in particular, the detailed protection requirements specified in Table 3.6, are appropriate.

Western Power's submission

1. Clause 3.6 was developed with reference to industry guidelines for connection of generation to distribution networks and codes obtained from other network service providers. We believe that the requirements of this clause are balanced and reasonable. The clause addresses the particular hazards posed by embedding generators in a distribution system that was not originally intended for this purpose.

2. Some of the issues that require special consideration when connecting generators to the distribution system and which are addressed by clause 3.6 are:

   a) Network operators need to be absolutely certain of the status of embedded generation when performing switching and maintenance. Depending on the degree of risk posed by facilities, this will require varying combinations of automatic protections, interlocks, inter-tripping, and remote indication, control and interlocking from the network control centre.

   b) Embedded generators exporting to the network may create switching hazards for network operators by causing switch ratings to be exceeded.

   c) Embedded generation is not common in the network at present and distribution switchgear is generally not equipped with synchronizing and check facilities

   d) Inadvertent islanding of an embedded generator on to part of the distribution network may create operator safety and quality of supply problems. The generator protection may be unable to detect certain network faults. Inadvertent reclosing of a switch on to an undetected island may result in severe plant damage.

   e) An embedded generator may substantially increase distribution network fault levels and thermal loadings so that plant ratings may be exceeded in the network and at other customer facilities.

   f) The connection and disconnection of a generator will cause disturbing voltage transients and step voltage changes to the extent that the voltage limits at the point of connection and other customer connections on the same feeder may be exceeded.

   g) Inverter connected and wind generation will contribute to network harmonics and flicker at other customer installations.

   h) Distribution connected generators are more likely to become unstable during power system disturbances due to high interconnecting impedances and slow fault clearing times on the distribution system

3. Whereas the degree of prescription in 3.6 is higher than the Technical Rules requirements for other generators, we believe this degree of detail does, as stated in the Memorandum, provide greater certainty for proponents of Western Power's

requirements and it also reduces the costs and time for evaluation of applications for access for a large range of generator sizes and connection situations.

4. We believe that a higher degree of prescription for distribution connection generation is not uncommon for distribution providers. Examples of such documents are: "ESB Networks Distribution Code" May 2005, issued by the Distribution System Operator, ESB Networks (Ireland) and, "Rule 21 –Generating Facility Interconnections" Pacific Gas and Electric Company, San Francisco California, August 2005.

5. The Table 3.6 is, as mentioned in the Memorandum, similar to that provided in a BCSE document "Technical Guide for Connection of Renewable Generators to the Local Electricity Network". Rather than adopting a one-size-fits-all approach, the table in its current form identifies reduced protection equipment requirements for small generators and those connected to the network for small periods of time. Nevertheless with the integrated protection equipment currently available, we believe that providing additional protection functions where required should not involve large additional expenditure by the proponent, if any.

6. Where access situations arise that are not adequately addressed by clause 3.6 in its current form we believe that clause 3.6 provides for requirements to be varied to achieve efficient outcomes.

Conclusion

Western Power believes that the detailed requirements of clause 3.6 as a whole and Table 3.6 in particular are necessary for dealing expeditiously and efficiently with the many difficult issues faced in connecting generation to a distribution system. We believe they are in the best interests of generation proponents and other users of the distribution systems and that clause 3.6 and Table 3.6 as presented should remain unchanged.

In clause 3.6 we have attempted to differentiate between the various distribution access situations in order to provide concessional terms of access for smaller generators and those connected for only short periods of time. Where access situations arise that are not adequately addressed by clause 3.6 in its current form we believe that clause 3.6 provides for requirements to be varied to achieve efficient outcomes.

Submission on Specific Issue: *Service Standards*

Purpose of this submission

This submission by Western Power relates to paragraphs 68 to 71 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. Western Power is of the opinion that the service standards in respect of reliability should not become part of Technical Rules.

Summary

Western Power is of the opinion that the service standards in respect of reliability are adequately and more appropriately addressed elsewhere and should not become part of Technical Rules

The ERA's observations

68. Section 12.32 of the Access Code provides that, unless a different form of technical rules will better achieve the Code objective or the objectives set out in section 12.1 of the Access Code, the technical rules must address the matters listed in Appendix 6 of the Access Code.

69. Section A6.1(a) of Appendix 6 of the Access Code states that the technical rules must address, among other things, performance standards in respect of service standard parameters. Service standards are defined as being *either or both of the technical standard, and reliability, of delivered electricity.*

70. The draft technical rules contain performance standards in respect of the technical standard of delivered electricity but not in respect of reliability. In the Authority's view, the reliability benchmarks required in the Authority's draft decision on Western Power's proposed Access Arrangement for the SWIN address this requirement for the technical rules.

71. Therefore, the Authority is satisfied that the draft technical rules, together with the amendments required in the Authority's draft decision on Western Power's proposed Access Arrangement for the SWIN will better achieve the Code objective and the objectives set out in section 12.1 of the Access Code. However, the Authority invites comments from interested parties on whether the technical rules should contain performance standards in respect of reliability.

Western Power's submission

Western Power is of the view that performance standards in respect of reliability should not be included in Technical Rules for the following reasons:

1. The inclusion of performance standards in respect of reliability would not be consistent with the intent of the Technical Rules and their objectives set out in clause 1.1(b);

2. The service standards are dynamic indicators that are strongly correlated to expenditure outcomes, and as such they are not suitable for Technical Rules. The Australian and international practice shows that such parameters that change rather regularly are best managed outside Technical Rules or similar documents the changes of which require considerable administration and public consultation;

3. The minimum standards are set out in the Network Reliability and Quality of Supply Code, administered by the Office of Energy, WA;

4. Reporting is effectively covered by monitoring and licensing requirements of the Electricity Industry Act and Access Code; and

5. The service standards, which include performance standards in respect of reliability, are explicitly taken into consideration as part of the Access Determination.

Conclusion

For the reasons explained here Western Power is of the opinion that the Technical Rules should not include performance standards in respect of reliability, and therefore proposes that the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006 should stand unaltered in that respect.

Submission on Specific Issue: *Distribution System Design*

Purpose of this submission

This submission by Western Power relates to paragraphs 72 to 79 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. Western Power believes that the present provisions of the Draft Technical Rules that impact distribution system design are satisfactory and should not be changed, other than clarification that clause 2.5.7(a) applies to high voltage switches only.

Summary

In regard to clause 2.5.4.3 Western Power believes that with the understanding, as stated in the accompanying box, that 100% peak load transfer will only be achievable in the long term, this clause is satisfactory as presented.

In regard to clause 2.5.7 Western Power believes that the progressive introduction of remote control of high voltage switches, local monitoring of transformers and provision for remote monitoring is viable.

The ERA's observations

72. Clauses 2.5.4.3 of the draft technical rules provides design criteria for urban high voltage distribution feeders. Essentially the criteria provide that, should a fault occur at the zone substation or on the feeder exit cable so that the feeder cannot be energised from the zone substation, it must be possible to transfer the feeder loads to adjacent feeders, using spare capacity kept available for this purpose. This is a reasonable requirement consistent with good electricity industry practice.

73. Western Power's proposed technical rules stated that this load transfer capability should be applied only "where technically and economically feasible". The Authority has deleted this proviso on the basis that it is too subjective. This does not prevent Western Power from applying for an exemption where it is not feasible or economic to meet this requirement. Alternatively, the technical rules could contain a more specific definition of "urban distribution feeder" or specify where the requirement would not apply. The Authority invites interested party comments on whether this position is appropriate.

74. Clause 2.5.7(a) of the draft technical rules requires that all new and replacement high voltage switches, including ring main units, must be remotely operable and controlled from the distribution control centre. Clause 2.5.7(b) further requires that all new and replacement distribution transformers be fitted with load monitoring facilities which are capable of being modified for monitoring from the distribution system control centre.

75. The use of network automation and remote control is becoming increasingly common in the electricity distribution industry. However, most utilities limit the installation of remote control to selected switches on strategic parts of the network where such installation could be expected to have a measurable impact on supply reliability. Installation of remote control facilities as a matter of course on all field located high voltage switches is relatively uncommon.

76. While remote control on switches in rural areas may result in a significant improvement in supply reliability due to the travelling times required when manual switching is necessary, the justification for all switches in urban areas served by underground

distribution to be remotely controlled is not so obvious. Due to the large number of switches in such areas, the cost of implementation is greater than in rural areas, but arguably, given the reduced travelling times, the benefits are less. The proposal also requires developing and maintaining, on an ongoing basis, a much expanded SCADA system with a very large number of remote terminal units spread throughout the SWIS supply area. The costs of maintaining such an extensive system in an operational condition would be significant.

77. In respect of clause 2.5.7(b) of the draft technical rules, Western Power has provided no information of the potential benefits foreseen from remotely monitoring the load at all distribution transformers.

78. These are new requirements that do not reflect Western Power's current practice, nor is it standard practice in the electricity supply industry. The Authority notes that the capital costs involved in meeting these requirements may be significant.

79. The Authority has not, at this point, made any changes to the remote control requirements proposed by Western Power. Nevertheless, it has reservations regarding the technical and economic benefits of the proposals submitted by Western Power and therefore invites comment from interested parties before making final technical rules.

Western Power's submissions to:

ERA paragraphs 72 to 73 re clause 2.5.4.3

In regard to clause 2.5.4.3 (a) Western Power believes that with the understanding, as stated in the accompanying box, that 100% peak load transfer will only be achievable in the long term, this clause is satisfactory as presented.

ERA paragraphs 74 to 79 re clause 2.5.7

1. Clause 2.5.7(a) is not intended to apply to low voltage switches and we propose a qualification to that effect by replacing, in the first sentence, word "switches" with "*high voltage* switches".

2. The basis for Clause 2.5.7(a) is to improve reliability performance following a fault by the provision of remote control facilities. This is likely to have a positive effect on CAIDI (Customer Average Interruption Duration Index) and generally to response times.

3. The intention is to introduce these remote control switches progressively in new developments. As this likely to be random and not entirely sequential, the net result over short to medium term is likely to be a sporadic introduction and distribution of remotely controlled switches.

4. This Clause specifically states, "Switches in key position will need to be controlled from the distribution system control centre". Although it is noted that the more obvious reduction in restoration times will be achieved in remote areas, the benefit of remote controllable switches in more densely populated areas is achieved through the fact that feeders usually have many thousands of customers. The ability to restore these feeders, even partially, will reduce CAIDI (& SAIDI) minutes considerably due to the large numbers of customers restored quickly. These measures are to be operated in conjunction with fault passage indicators.

5. Clause 2.5.7 (b) states that transformers must be fitted with load monitoring facilities. This is necessary to enable logging of maximum demands and their trends. This type of information is critical to prudent asset management and network management. Overloading of distribution transformers through ignorance of loading conditions is not good practice and failures can take many hours resulting in considerable public backlash.

6. This clause also makes provision for remote monitoring capability. Initially high risk areas would be converted to remote monitoring to allow information to be sent, even if not in real time, to a central logging or monitoring system.

Western Power's distribution SCADA (ENMAC) system has been designed to allow for considerable expansion through monitoring of transformers and other loads including power quality. The unique design allows the possibility of control of all distribution switches.

Conclusions

Clause 2.5.4.3 as stated and qualified does not require change.

Western Power believes that the specified remote control and monitoring facilities of clause 2.5.7, as they are progressively introduced, will measurably improve system reliability and introduce economies through better and safer utilisation of plant through knowledge of actual loadings. Conversely, the incidence of plant failure due to overload will be reduced.

Clause 2.5.7(a) should be qualified to apply to high voltage switches only. The reminder of Clause 2.5.7 as currently stated is satisfactory and does not require change.

Submission on Specific Issue: *Provision of Primary Speech Equipment*

Purpose of this submission

This submission by Western Power relates to paragraphs 80 to 83 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006.

Western Power seeks to modify its position in light of information received on practices followed by market participants in the Eastern States and New Zealand. Western Power now holds the view that the User should be responsible for the Primary Speech Equipment and the NSP (Network Service Provider) should be responsible for the Backup Speech Equipment if deemed necessary. Western Power is of the view that clause 3.3.5.3 (d) of the draft Technical Rules should be altered to the effect that the NSP should be responsible for the provision of backup speech equipment and that clause 3.3.5.3 (c) should stand unaltered.

Summary

The NER Schedule S5.2 does require the relevant Network Service Provider to provide and maintain a Primary and Back-up Speech Facility. Prior to market commencement in the Eastern states, dedicated, direct lines or "Hot Lines" were provided by some NSP's. These were typically proprietary to the NSP Network and could not be accessed by the PSTN (Public Switched Telephone Network). This is no longer a current NEMMCO requirement. In practice, the Eastern States and NZ electricity market participants install a PSTN (Public Switched Telephone Network) line as the Primary and the Back-up is provided by the NSP. The Back-up operates as an ordinary dial telephone but is carried separately from the PSTN

over the NSP's private dial telephone network.

The ERA's observations

80. Clause 3.3.5(c) of the draft technical rules makes a user responsible for the provision of the primary speech communication channels used to dispatch generation to support the operation of the WEM. This is different from the corresponding NER requirement which mandates that such communication channels be provided by the network service provider.

81. A consequence of the NER requirement is that the network service provider must establish and maintain a secure and dedicated telephone network to support the operation of the power system. This network is designed and constructed to ensure a high level of communication security and is not reliant on any public telephone network. In order to participate in the market, all generators must connect to this telephone network.

82. While acknowledging that clause 3.3.5(c) requires that all speech communication channels must meet specifications provided by Western Power, the Authority is nevertheless concerned that the proposed requirement could potentially result in a proliferation of independent speech channels and could undermine the successful operation of the WEM.

83. At this point the Authority has not changed the requirement proposed by Western Power. However, interested parties are invited to comment on this issue.

Western Power's submission

In response to the Specific Observations above:

80. The agreement with NEMMCO for the initial operation of the market in the Eastern States was that the primary path for communication between NEMMCO and the generators was a Telstra provided line. A second line was provided by the NSP's private dial telephone network. Dedicated, Direct or "Hot lines" are not currently required by NEMMCO.

    The current NZ rules allow each asset owner to use any means of communications to meet their obligations. In practice, most generators use the PSTN as their primary means of voice communication.

81. Eastern states and NZ market participants have moved away from Dedicated, Direct or "Hot Line" telephone system. Reliability is ensured by having two physically separate and diverse telephone networks, the PSTN and NSP private dial telephone network.

82. Proliferation of independent speech channels is a concern with Dedicated, Direct or "Hot Line" phones where each User phone must have a corresponding phone on the same system at the other end of the line. In practice, dial telephones have replaced the "Hot Lines" using the PSTN or the NSP private dial telephone network. The dial telephones, whether provided using the PSTN or the NSP's private dial telephone network are transparently interconnectable.

83. Western Power now holds the view the NSP should provide the Back-up Facility. This is to ensure the reliability of the speech communications is maintained by providing a physically diverse path from the PSTN Primary Speech Equipment.

Reasons why the NSP does not need to provide the Primary Speech Equipment

There are no access, technology or reliability/availability barriers to prevent the User from supplying the Primary Speech Equipment. There is no benefit to the User in having the NSP provide the Primary Speech Equipment and adding the cost to the connection charges.

1. **Access**. Access to the PSTN (Public Switched Telephone Network) is likely to be available anywhere in WA where a generator is sited.

2. **Technology.** Dedicated, Direct, or "Hot Line" telephones are no longer used. The PSTN telephone is universally compatible with the System Operator's and NSP's phone systems. There is no technical disadvantage to the User arranging the PSTN Primary phone equipment.

3. **Reliability/Availability:** There is no control of outages on leased circuit facilities, including the PSTN. However, the Back-up Speech Equipment on a different bearer under the NSP's control overcomes this uncertainty for the speech equipment.

Conclusion

Eastern states and NZ market participants have moved away from Dedicated, Direct or "Hot Line" telephone system. Reliability is ensured by having two physically separate and diverse telephone networks, the PSTN and NSP private dial telephone network. Under these circumstances there is no additional reliability benefit of the NSP providing Primary Speech Equipment because the hot line is not required. There is no barrier to the User supplying and maintaining the Primary Speech Equipment from an access, technology and reliability/availability standpoint.

Since the NSP should provide the Back-up telephone equipment, clause 3.3.5.3(d) should be altered to allocate the responsibility for Back-up Speech Equipment to Western Power, whereas clause 3.3.5.3 (c) should remain unaltered.

Submission on Specific Issue: *Computer Model*

Purpose of this submission

This submission by Western Power relates to paragraphs 84 to 88 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. Western Power submits that the current provisions of the Draft Technical Rules are inadequate to deal with the circumstance that a user fails to submit a computer model that is fully compliant with the rules. The requirement for ongoing User support of the model should be reinstated with the qualification that it does not apply to those that have fully complied with clause 3.3.10

Summary

In Western Power's submission:

(a) Some existing users have managed to connect to the SWIN without fully complying with clause 3.3.10 in respect of computer models of plant, and it is probable that in the future others will seek to do the same.

(b) The models provided by these users are in a form that is not upgradeable by

Western Power.

(b) This has very serious implications because if Western Power is technically unable to support a model it will be unable to fulfil its planning and security obligations

(c) If data is not provided in the required form, then the user must be given the obligation to update it on an ongoing basis, and this requirement to update the model expeditiously must be enforceable.

(d) The other alternative is to permit Western Power to refuse access in such cases.

The ERA's observations

84. Clause 3.3.10 requires a large generator to provide a computer model of the dynamic behaviour of its plant to the network service provider, suitable for use in the network service provider's nominated software package, currently PSS/E. The model is required to allow the network service provider to accurately simulate the dynamic behaviour of the power system. The provision of this model in PSS/E format was the subject of extensive debate within the Committee. However, agreement was reached to the extent that it was not formally raised as a deadlock issue.

85. One of the requirements proposed by Western Power in relation to the provision of this computer model in clause 3.3.10 was that: The User must support the model for changes and updates in the nominated software for the duration of connection to the transmission or distribution system.

86. In the Authority's view, a user entering into an access contract in full compliance with the technical rules should not be put at risk of having to incur future costs as a result of actions taken unilaterally by the network service provider, when that user is not in a position to influence these actions or negotiate alternative outcomes. That is, if the network service provider chooses to change or upgrade its existing software, for whatever reason, it is reasonable for the network service provider to bear all the consequential costs of this action.

87. The Authority has deleted this requirement from the draft technical rules.

88. The Authority invites comment from interested parties on whether this position is appropriate.

Western Power's submission

1. If the requirement to support the model for the life of the plant is deleted then the user will have to supply sufficient information to enable Western Power to rewrite the model as necessary. This will require source code and full block diagrams describing the functionality of the model, as currently required by clause 3.3.10

2. Western Power does not have sufficient information to be able to develop a suitable dynamic model for some of the existing wind turbines. The wind turbine manufacturer has provided a model in object code but was not prepared to provide detailed block diagrams or source code, claiming this to have commercial value.

3. This information would have to be provided if the model was to be supported by Western Power.

4. Given the format of the current model for these generators Western Power would be unable to change software package without the cooperation of the subject generator to provide suitable object code. This affects Western Power's ability to manage its planning and security obligations.

5. In respect of paragraph 86 Western Power does not currently have the information that would be needed if it was to change software.

6. The changing of software is not always under the control of Western Power. For example Siemens-PTI (the owner of the PSS/E software) has withdrawn its support of the Unix platform which will require the models to be transferred to the PC version of PSS/E. This will require the models to at least be recompiled. To perform the recompilation the source code of the models is required. This is not available for the wind turbine models.

7. During the life of a generator it would reasonably be expected that the software used in performing studies change. This is as a result of changing hardware, changing operating systems and product enhancements. Past experience indicates that backward compatibility is unlikely to be maintained during that time.

8. Requiring Western Power to support computer models will have cost implications for Western Power. In particular there will be drivers for Western Power to select software that will reduce modeling costs, rather than that which will provide more suitable modelling.

9. If the user is not required to support the models then the cost for the support will be borne by Western Power. These costs will be passed to all users rather than the users whose plant is represented by the models.

10. Western Power submits that the rules should reflect the reality that some users will not comply with clause 3.3.10 in its present form. This should take one of two forms.

11. Either the deleted provision that requires that the user support the model of the life of the plant should be re-inserted, with the qualification that this does not apply to a user that has fully complied with clause 3.3.10, This clause would have to be enforceable, or

12. Western Power should be given the right to refuse access to a user that does not supply a fully compliant model, on the grounds that Western Power would otherwise be unable to fulfill its own obligations under the rules.

13. Western Power notes that there is an incorrect cross reference in Appendix 2, Schedule S2 to clause 3.3.9 instead of to clause 3.3.10

Conclusion

The fact that some users have managed to connect without fully complying with rule 3.3.10, and that others will in the future seek to do the same has very serious implications for planning and security. If Western Power is technically unable to support a model, due to non-provision of data in the required form, then the user must be given the obligation to do so

expeditiously on an ongoing basis, and this requirement to update the model must be enforceable. The other alternative is to permit Western Power to refuse access in such cases. A new clause should be inserted to require a user that does not fully comply with 3.3.10 to provide expeditious ongoing support.

Submission on Specific Issue: *Section 5 requirements and the Market Rules*

Purpose of this submission

This submission by Western Power relates to paragraphs 89 to 93 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for the Western Power South West Interconnected Network dated 11 April 2006. Western Power believes that the current provisions of section 5 of the Technical Rules are adequate and no change is required.

Summary

Western Power concurs with the observations of ERA in paragraphs 89, 90, and 92, however in regard to paragraph 91 Western Power is of the view that the boundary between coverage for the Technical rules and the Market rules is adequately defined by clause 5.1.

The ERA's observations

89. Section 5 of the draft technical rules concerns the obligations of the network service provider and users in respect of power system operation and coordination. However, it does not bind system management, which is responsible for the dispatch of market generators and for ensuring the real time security of the power system, and which must perform these tasks in accordance with the Market Rules.

90. The boundary between the real time operation functions of system management and the network service provider does not appear to be well defined. Firstly, it is not clear at this stage exactly which parts of the transmission system will be "registered facilities" under the Market Rules and hence under the real time control of system management. Secondly, the extent of the effect to which those parts of the power system that do not form part of market operations, and which therefore will remain under the real time control of the network service provider, will have on power system security is unclear. Thirdly, the network service provider will advise system management on power system security related issues, particularly in respect of power system analysis and planning.

91. Section 5 of the draft technical rules does not define the boundary but imposes requirements on the network service provider in respect of the performance of those operational duties for which the network service provider is responsible.

92. The Authority has worked with Western Power to improve the clarity of the requirements in section 5 and to minimise ambiguity.

93. The Authority invites comments from interested parties on whether the requirements of section 5 are appropriate given the need to be consistent and avoid overlaps with the Market Rules. It also invites comment on the extent to which the requirements of section 5 of the technical rules support the efficient operation of the SWIN as a whole.

Western Power's submission

Clause 5.1 states simply that those facilities not covered under the Market Rules are covered by the Technical rules. Western Power agrees that Users may not be clear as to which facilities are covered under the Market Rules as they are defined by the "equipment list" which is defined under the Market Rules 3.18.2.(c) as follows:

"The list described in paragraph (a) must include:

i. all transmission network Registered Facilities;

ii. all Registered Facilities holding Capacity Credits, except those to which clause 3.18.2A applies;

iiA. all generation systems to which clause 2.30B.2(a) relates, except those to which clause 3.18.2A applies;

iii. all Registered Facilities subject to an Ancillary Services Contract; and

iv. any other equipment that System Management determines must be subject to outage scheduling to maintain Power System Security and Power System Reliability."

The boundary will become clear when System Management has, in accordance with this market rule, determined what other equipment is covered.

Conclusion

The boundary between coverage by the WEM Rules and Technical Rules will become clearer when the 'equipment list' as defined by the Market Rules clause 3.18.2 (c) has been completed. Western Power believes that there is no issue of clarity in the Technical Rules with respect to boundaries and overlap with the Market Rules and no change is therefore required.

Deadlock Issues

Submission on Deadlock Issue 2: *Stability Assessment*

Purpose of this submission

This submission by Western Power relates to paragraphs 106 to 114 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. Western Power submits that the clauses of the Draft Technical Rules that describe the methodology for stability assessment for planning, design and construction, and the determination of power transfer limits for operational purposes should stand unaltered.

Summary

In Western Power's submission:

(a) clause 2.3.8 places obligations on Western Power in respect of the determination of power transfer limits, and these are consistent with the requirements of NEM Rule S5.1.2.3 which describes a framework for determining power transfer capability between regions.

(a) clause 2.3.7.1(a) describes practices applicable to planning, design and construction, including the determination of capability of proposed network configurations under worst-case conditions. This clause is not relevant to the concerns of Users;

(b) the alternative suggested by Users of using a probability-based approach to define operational constraints is not practical, and in any event would unnecessarily compromise security;

(c) this alternative is not consistent with operational practice in the NEM networks;

(d) a precondition for fully adopting the NEM approach to power transfer capability would be to use more sophisticated operational software and hardware than is currently available.

The ERA's observations

106. Users on the Committee contended that Western Power's approach to stability assessment is too conservative and restrains their capacity to transfer power.

107. Users asserted that, using a combination of critical contingencies with worst case system operating conditions, the acceptable stability envelope is determined by scenarios with an extremely low probability of occurring. A higher probability threshold should therefore be used for the selection of stability scenarios used to determine the acceptable operating envelope of the power system. This would permit a less conservative operating policy that would increase the network capacity available to users for power transfer.

108. Western Power argued that a credible trigger event will often escalate into a more serious situation and that it is therefore prudent to take a conservative approach to specifying an acceptable operating envelope. It also stated that probability criteria

would be difficult to apply and would require a vast amount of data. Western Power also noted that although stability related events have a very low probability of occurrence, they are also very high impact events that will not only result in the lights going off but can also cause plant damage with significant financial consequences.

109. The Authority notes that the reserves policy discussed in Issue 1 above also means that the SWIS is likely to be more prone to transient and voltage instability which arise following the occurrence of a "trigger event" due to the lower inertia of the system relative to the total load and the consequent lower levels of dynamic reactive support likely to be available.

110. Further, it is noted that this issue is exacerbated by the topography of the SWIS, as the limited capacity of the long 220 kV line to Kalgoorlie restricts the ability of generators located in the Goldfields region to support the system voltage in the event of a fault in the vicinity of the Perth metropolitan area.

111. The Authority understands that the use of a less conservative operating policy could increase the capacity of the SWIN, and in particular the Goldfields interconnection, for power transfer purposes. However, the consequences following an extreme trigger event may be more serious as a result. System studies would be needed to quantify these impacts but the overall benefits to generators could be marginal, given the structural nature of the problems resulting from the existing operating policy and transmission system topography.

112. For these reasons the Authority's view is that no amendment should be made to the planning criteria proposed by Western Power for stability assessment.

Authority's view on Deadlock Issue 2

113. The Authority's view on Deadlock Issue 2 is that no change should be made to the planning criteria for stability assessment proposed by Western Power.

114. The Authority's view is reflected in the draft technical rules.

Western Power's submission

1. In these paragraphs the ERA has not mentioned specific clauses that are of concern. Western Power considers that clauses 2.3.7.1 (a) and 2.3.8 are relevant to this matter.

2. Western Power has made a separate submission in respect of the ERA's comments in paragraphs 58 to 64. In paragraph 59 the ERA identified the importance of the identifying those contingency events that are to be considered credible in respect of power system stability and dynamic performance. It is noted that the system fault contingencies listed in clause 2.3.7.1(a), together with identified system operating conditions, define one part of a "technical envelope", within which the system must operate in order to reduce the probability of system instability to a level that will be acceptable to the community.

3. System instability can be very destructive to electricity supply over wide areas of a power system. Inevitably the power system will split in an uncontrolled manner into two or more islands, which will not have the required balance between supply and demand. In the best case scenario some or all these islands may stabilise after

shedding some load or backing off some generation output, but there are many documented cases around the world where a shutdown of the total system occurs. In this event it may take several hours to gradually restore normal supplies, and some industrial processes may suffer severe consequential damage. Such events have economic, social and political consequences.

4. Clause 2.3.8 states, in respect of the determination of power transfer limits, that:

   (a) The *Network Service Provider* must assign, on a request by a *User* or *System Management*, *power transfer* limits to *equipment* forming part of the *transmission and distribution systems*. The assigned *power transfer* limits must ensure that the system performance criteria specified in clause 2.2 are met and may be lower than the equipment thermal ratings. Further, the assigned *power transfer* limits may vary in accordance with different *power system* operating conditions.

   (b) The *power transfer* assessed in accordance with clause 2.3.8(a) must not exceed 95% of the relevant *rotor angle* or other *stability* limit as may be applicable, whichever is the lowest.

5. Western Power interprets clause 2.3.8 as requiring it to consider actual power system operating conditions when determining power transfer limits. The worst case conditions are just one of several sets of conditions that would need to be considered when determining a need to vary the limits to take account of different power system operating conditions.

6. It is possible that Users may be unnecessarily influenced in their opinions by clause 2.3.7.1 (a).

7. It should be noted that clause 2.3.7.1 (a) refers to the requirement that the "Network Service Provider must plan, design and construct the transmission and distribution systems so that the short term power system stability and dynamic performance criteria specified in clauses 2.2.7 to 2.2.10 are met under the worst credible system load and generation patterns...." Of special importance is that the reference in this clause is to "plan, design and construct" and that the clause does not, therefore, refer to "operation". This clause is not therefore relevant to the concerns of Users.

8. It is necessary and appropriate that planning and design should consider the worst combination of system conditions that are likely to prevail at the time of the selected credible contingency. If, at the planning stage, and having regard for the economics of alternative options or design features, the proposed network configuration is such as to maximise power transfer under the worst-case conditions, then the best result is likely to be achieved under less onerous conditions as well.

9. Paragraph 107 suggests the option of undertaking some form of probability analysis, and that the technical envelope should be determined on the basis of conditions that have a higher probability of occurring than the does the worst-case.

10. While it may be superficially appealing this approach is impossible to apply in practice for operation, and would in any event compromise system security. Reasons for this assessment follow:

11. The approach would require that the probability that various combinations of system conditions will occur should be determined in advance, and that the portion of the full technical envelope applicable to each condition should be determined. In a network that is subject to market-driven dispatch it is not practical to determine such probabilities, and the task of describing the technical envelope in this way would be arduous and time-consuming.

12. It would be necessary to determine a threshold probability against which to set the network constraint. This means that there would also be a probability that the system would be knowingly operated in an insecure condition for significant time durations. Having regard for the consequences of instability this is unacceptable.

13. Clause 2.3.8 is consistent with NEM Rule S5.1.2.3, which sets out a framework within which *Network Service Providers* must describe to *NEMMCO* the levels of *network service* that apply for *power transfer* between *regions*. Part (a) of this Rule states that "in the *satisfactory operating state* the *power transfer capability* between *regions* is defined by a multi-term equation for each *connection* between *regions* which takes account of all *power system* operating conditions which can significantly impact on performance. The majority of these operating conditions is the result of *market* operation and are outside the control of the *Network Service Provider*. In the *satisfactory operating state* the *network* must be planned by the *Network Service Provider* and operated by *NEMMCO* to withstand the impact of any *single contingency* with severity less than the *credible contingency events* stated in clause S5.1.2.1."

14. In the NEM networks operation in an insecure state (i.e. in which a credible contingency would cause loss of stability) is not permitted to occur for more than 30 minutes on any occasion, and in practice such operation is corrected by the dispatch software system within less than 3 dispatch intervals, or 15 minutes. The proposal by Users would result in much longer periods of operation in an insecure state.

15. In accordance with this framework the network service providers define most critical network constraints in terms of aspects of the actual system operating state that are directly measurable in real time. Thus the level of some constraints, usually those determined by stability, are continuously reassessed and adjusted by the dispatch software, and appropriate adjustments are made to the dispatch. The constraint level determined by the worst-case conditions is thereby relaxed under less onerous conditions.

16. Because this approach requires a great deal of computation it is applied most often to constraints that are likely to be important in determining dispatch. Other constraints are defined as a single worst-case value, as implied by the planning criterion described in clause 2.3.7.1 (a).

17. To justify the definition of constraints in this way requires that software capability must also exist to assess the constraint in real time and take appropriate dispatch action. This exists in the NEM but does not exist to the same degree of sophistication in the SWIN. However it is a possible option for the future in the event that constraints severely limit dispatch.

18. In respect of its current approach to operation (as distinct from planning) Western Power does not apply the theoretical worst case to the determination of constraints, but makes an engineering judgment of those system conditions that represent the reasonable bounds of operation. For example for the Eastern Goldfields Western Power no longer considers minimum generation, but looks more at medium because this is a more likely at load levels that represent a worse case for the goldfields. The saturated reactors are no longer assumed to be forced to the minimum of dead band but are operated at normal expected levels. It is no longer assumed that the saturated reactors become desaturated, but instead it is assumed that there is normal voltage performance of the network. Further the coincident outage of a capacitor bank is no longer considered because this seemed too conservative.

19. Western Power submits that its obligations under clause 2.3.8 are consistent with those of network service providers in the NEM, and do not constitute an inappropriate "stacking" of contingencies for the purpose of reducing power transfer capability. It also submits that its current approach to planning, design and construction as described in clause 2.3.7.1 (a) is appropriate.

Conclusion

Western Power concurs with the Authority's conclusions. The current provisions are consistent with the NEM and are a reasonable compromise between the need to manage the possibility of occurrence of a catastrophic system failure caused by instability, against the need to maximise power transfer capability so as to minimise constraints on generator operation.

Submission on Deadlock Issue 9: *Reasonable endeavours*

Purpose of this submission

This submission by Western Power relates to paragraphs 165 to 169 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. Western Power is of the view that clauses 1.8.1(b) and 1.8.1(c) of the Draft Technical Rules should stand unaltered.

Summary

In Western Power's submission:

(a) clauses 1.8.1(b) and 1.8.1(c) have the support of long standing public policy, the benefit of precedent to assist in their interpretation, the characteristic of symmetry and fairness and the advantage of controlled flexibility. There is no need to clarify them and no good reason to change the policy on which they are based; and

(b) their inclusion is warranted despite the fact that the Rules are technical in nature, in order to ensure consistency of treatment and fairness among users.

The ERA's observations

165. It was argued by users on the Committee that proposed clause 5.3.2(b) and 5.3.2(c) of the proposed technical rules were of a legal nature and should not be included in the draft technical rules. These clauses limited Western Power's obligations to use reasonable endeavours to comply with the requirement. These clauses have now been deleted from section 5 of the draft technical rules and substantially incorporated as clauses 1.8.1(b) and 1.8.1(c) of the draft technical rules.

166. Western Power argued that, according to legal advice received, the clauses were appropriately incorporated into the technical rules. The Authority received alternate advice on this point.

167. Western Power also argued that the clauses were necessary in order to have a consistent standard of conduct applying across the SWIN. Section 12.5 of the Access Code provides that the technical rules will prevail over a contract. As such, the standard will be the standard imported into all access contracts for the SWIN. Western Power noted that if the standard was not incorporated into the technical rules, then there was a real possibility that some users

would be held to a stricter standard than others. In particular, smaller users with less bargaining power may not be able to negotiate the same standard as larger users. Western Power also argued that the clauses were reasonable as they were symmetrical in that they applied the same standard to users and Western Power.

168. The Authority considers that the clauses may be characterised as being more of a legal obligation than a technical one. However, the Authority accepts that such clauses may be ancillary to technical rules. Further, the Authority can see merit in Western Power's arguments. Accordingly, the Authority's view on Deadlock Issue 9 is that the clauses should not be deleted from the proposed technical rules. The Authority invites submissions on this point.

169. The Authority's view is reflected in the draft technical rules by the redrafted clauses 1.8.1(b) and 1.8.1(c) of the draft technical rules.

Western Power's submission

1. The concept of the obligation of the Network Services Provider having an overriding obligation to use all reasonable endeavours to provide services, and to comply with the Transmission Technical Code, comes from the *Electricity Transmission Regulations 1996* (regs 26(4) and 34) and the *Electricity Transmission Regulations 1997* (regs 28(5) and 35). Note that regulation 28(5) of the *Electricity Transmission Regulations 1997* also required only an "all reasonable endeavours" compliance with the Distribution Technical Code by users.

2. These regulations in turn appear to have had their genesis in section 58 of the *State Energy Commission Act 1979*, under which it was provided that SECWA was not bound to supply energy to anyone, and even when it contracted to do so, it had no obligation to maintain supply in the circumstances set out in section 58(2).

3. SECWA was an agent of the Crown, but the Electricity Corporation, although State owned, was expressed not to be (section 5 of its constituting Act). However, the public policy reason for not holding them to a strict standard of compliance with their relevant obligations could not have just been their State ownership, because the standard also applied to users of the distribution system after the disaggregation of SECWA. Presumably, advantage was seen in maintaining a flexible, cooperative approach between the Electricity Corporation and users. Unless a new public policy reason has emerged that dictates a new approach, there is no reason to remove the inherent flexibility maintained by clauses 1.8.1(b) and 1.8.1(c) of the Rules, especially when they are read with the rest of section 1 of the Rules.

4. Clauses 1.8.1(b) and 1.8.1(c) of the Rules operate symmetrically - that is, they apply to both the Network Services Provider and Users in relation to both the transmission system and the distribution system. In that sense, the risks they pose are not weighted either way. The risk allocation is inherently fair.

5. The notion of the due performance of obligations being judged by a standard of reasonableness is used extensively in the Access Code, where the definition of "good electricity industry practice" is "the exercise of that degree of skill, diligence, prudence and foresight that a skilled and experienced person would reasonably and ordinarily exercise under comparable conditions and circumstances consistent with applicable written laws and statutory instruments and applicable recognised codes, standards and guidelines." The expression "reasonable and prudent person" is defined as "a person acting in good faith and in accordance with good electricity industry practice".

6. The Market Rules use the expression "reasonable endeavours" extensively as well as expressions such as "reasonable expectation", "reasonable allowance", and contain a number of references to the IMO or others having powers or obligations to be exercised or undertaken in a manner they consider "reasonable". They also employ the concept of a "reasonable and prudent person".

7. The expression "all reasonable endeavours" is familiar to people of commerce and to the courts. It is capable of being construed by courts, arbitrators and referees with the support of precedent. Because the concept is used so widely throughout the new market and industry rules and regulations, industry standards of reasonableness and fairness will develop, especially having regard for the supervisory role of the ERA.

8. Best endeavours and reasonable endeavours clauses are both taken by the Australian courts to prescribe a standard or reasonableness. What is reasonable in the circumstances is to be determined with regard to the nature, capacity, qualifications and responsibilities of the person who has the obligation, but (unlike the position in England, where an obligation to use best endeavours may require a person to disregard self interest), neither an obligation to use best endeavours nor an obligation to use reasonable endeavours requires the abandonment of self interest.

9. Under Australian law, even an obligation to act in good faith does not normally require the abandonment of self interest, but at the least it requires an obligation to achieve the goals of the contract (or, in this case, the Rules), and compliance with standards of conduct that are reasonable and honest. These obligations are already clearly set out in clause 1.6.2 of the Rules.

10. If any further emphasis were to be added to clauses 1.8.1(b) and 1.8.1(c) of the Rules, one might add "as a reasonable and prudent person" after "reasonable endeavours" where it appears, but this is unnecessary, because the concept of "reasonable endeavours" already incorporates the notions of reasonableness and clause 1.8.1(a) already requires a standard of prudence through the obligation to observe good electricity industry practice.

11. The Rules are binding between the Network Services Provider and Users because they are incorporated by reference in access contracts. It is important from the viewpoint of both the Network Services Provider and Users that technical obligations and standards are imposed and enforced in as consistent a manner as possible. It is entirely appropriate that the status of those obligations be described in the Rules. That status could, of course, be described in each access contract, but that may well favour Users with strong negotiating positions over Users who are less able to negotiate terms, which the Network Services Provider sees as undesirable.

Conclusion

The obligations of the stakeholders to comply with the Rules will, in most foreseeable cases, be both reasonable and practicable. However, where a requirement for strict compliance would be unreasonable, clauses 1.8.1(b) and 1.8.1(c) of the Rules offer necessary flexibility. By including clauses 1.8.1(b) and 1.8.1(c) in the Rules rather than in access contracts, all Users and the Network Services Provider operate under the same required legal standard of performance.

Recommendations from the Committee

Submission on: *Recommendation 3 (system studies)*

Purpose of this submission

This submission by Western Power relates to paragraph 191 of the ERA's Decision and Explanatory Memorandum on the Draft Technical Rules for Western Power's South West Interconnected Network dated 11 April 2006. Western Power believes that in many cases, the process will not be straightforward and to obtain the optimum solution, interaction with the User and repetition of studies will be required.

Summary

Power system simulation studies are performed by Western Power to check compliance with the Technical Rules. Dynamic studies for generator access are usually quite complex and time consuming and depend on obtaining accurate and timely User data. Where studies identify the need for network reinforcement, multiple further studies may be required. This aspect may require substantial interaction with the User to optimise plant parameters and to identify the most cost effective option. Rather than being straightforward, the process is likely to be iterative.

The ERA's observations

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

191. The Authority invites submissions from industry on this issue.

Western Power's submission

1. Western Power performs system studies to check conformity with the Technical Rules. The criteria are therefore the Technical Rules.

2. To determine the compliance with the Technical Rules we perform the following studies:

    a. **Loadflow** studies ensure that with all network equipment in service and under the outage conditions defined in the Technical Rules, no equipment is overloaded. This is done using a number of credible generation and load conditions. Load flow studies are also performed to ensure that the voltage step change requirements of the Technical Rules are met as well as the long term voltage stability requirements.

    b. **Fault level** studies are performed with all generation and equipment in service to determine whether the fault rating of equipment will be exceeded.

    c. **Power quality** studies are only performed where the connected equipment may cause an issue. Depending on the technology used for generation it may be necessary to examine the impact in terms of harmonics and flicker.

d. **Dynamic** studies are performed for the connection of new generators and are used to ensure rotor angle stability as well as to examine the voltage recovery profile for faults on the network. The accuracy of dynamic studies is dependent on the supply of accurate dynamic models by the User. Historically this has often been difficult to achieve.

3. Although the information above indicates the type of studies, the cost and length of time required for the studies is very dependent upon the type and size of the load or generator and the point of connection to the network.

4. Where it is evident that connection of a new customer would be likely to cause some aspect of network capacity to be exceeded, Western Power would provide an estimate on the length of time required for the further studies.

5. Where the time taken for studies can be an issue is when an unforeseen problem is discovered during the studies and the solution is not clear. In this case multiple alternatives for reinforcements may have to be examined to determine the most cost effective solution for the customer.

6. We would normally avoid over-complicating the study proposal by covering all possible outcomes, but at the same time it should be recognised that resolving some of the issues that are discovered can be time consuming and that these issues are not always foreseen.

Conclusion

The duration and cost of studies is not always apparent until initial studies have been completed. Where the need for network reinforcement is identified multiple options may need to be examined. Dynamic studies are particularly time consuming and complex. The accuracy of dynamic studies is dependent on obtaining accurate data and models from the User in a timely manner, and this has not always been forthcoming.

It is important to recognise therefore that for the efficient conduct of the studies, the User has a responsibility to supply quality data in a timely manner. The duration and cost of studies will be heavily dependent on customer cooperation in this issue.

Where initial studies indicate that the ability of the system to accept the new facility is marginal or that network reinforcements will be required, additional time will be necessary for a series of further studies to identify the best options.

Western Power believes there would be some value in cooperative development of a pro-forma for studies provided the issues discussed above are recognised. The criteria would be the Technical Rules.

Western Power would initially identify the factors that are most likely to be the determinants as the basis for initial studies. Following initial studies there may be a need for substantial interaction with the User in determining the course of further studies.

Other comments

Table of Content

Changes to Clause 2.9 and associated clauses

Clause	Change	Explanation
2.5.2.4	If a *circuit breaker failure* occurs and, as a result, a single phase to earth fault within a *transmission system* sub-network designed to the N-1-1 criterion is not cleared by a ~~main protection scheme~~ *main protection scheme*	Spelling error in word "result". *main protection scheme* is a defined term and so should be in *italics*.
2.9.1 (c) Line 1	~~Protection schemes~~ *Protection schemes* must be designed, installed and maintained in accordance	This is a defined term therefore it should be in *italics*
2.9.2 (a) (1) Line 6	the ~~main~~ *main protection system* must ~~include duplicate main protection schemes, each of which must be fully independent and of differing principle~~ comprise *two fully independent protection schemes of differing principle*	With the new definition of *protection scheme* the previous defined term has been changed to reflect this. Ie *two fully independent protection* ***schemes*** *of differing principle.* Therefore it is correct to use this defined term rather than the weaker one which it was changed to. It is also consistent with what has been kept in clause 2.9.2 (a) (2). There is no need for the word "duplicate" in this case.
2.9.2 (a) (2) Line 4	if a ~~main~~ *main protection scheme* fails to operate, or a *small zone* fault occurs, or a *circuit breaker failure* condition occurs.	"Main" needs to be in *italics*. New definition means that *scheme* needs to be added. The word *circuit* needs be added to make correct defined term.
2.9.2 (a) (2) Line 11	….by a single *backup protection scheme,* ~~except that~~ except that *small zone faults* must be included…	The words "except that" should not be in *italics*.
2.9.2 (a) (3) Line 1	~~A d~~Duplicate *protection schemes* must incorporate full redundancy	Editorial, consistent with the new definitions ("scheme" became "system" and "protection" became "protection scheme").
2.9.2 (a) (4) Line 1	The design of ~~a~~ duplicate *protection schemes* must make it possible to test and maintain either ~~protection~~ *protection scheme* without interfering with the other.	Wording slightly modified due to new definitions.
2.9.3 (b) Line 1	Should any of the *protection schemes* required	This does not only apply to duplicate schemes. For example, if a single local

	by clause 2.9.2 ~~either of the *protection schemes* forming part of the duplicate *protection system* protecting a part of the *transmission system*~~ be out of service	backup (132kV) is out of service this would also apply.
2.9.4 (b)	For *primary equipment* operating at a nominal *voltage* of 220 kV and above, both *main protection schemes* of a ~~duplicate~~ *protection system*	The duplicate is not necessary here as it is already stated in clause 2.9.2. To be consistent our preference is to refer to **duplicate *protection schemes*** rather than a **duplicate *protection system***. A *protection system* includes *primary equipment* used to effect the disconnection. Therefore it is not correct to talk about a duplicate *protection system*.
2.9.5 (a)	The *critical fault clearance time* may be lower than the standard maximum ~~fault clearance time~~ *total fault clearance time* set out in Table 2.11.	The correct defined term should be used.
2.9.5 (b)	All *primary equipment* that is subject to a *critical fault clearance time* must be protected by a ~~*duplicate*~~ *protection system* comprising of duplicate *protection schemes* that meet~~s~~ all relevant requirements of clause 2.9.2(a). Both *protection schemes* ~~of the duplicate *protection system*~~ must operate within a time no greater than the *critical fault clearance time* specified by the *Network Service Provider*.	A *protection system* includes *primary equipment* used to effect the disconnection. Therefore it is not correct to talk about a duplicate *protection system*. Wording changed accordingly. No need to mention *protection system* in second sentence.
2.9.6 (c) Line 3	....cleared by at least one *protection scheme*. *Backup protection schemes* may be relied on for this purpose.	*Scheme* should be added according to the new definition.
2.9.7 Line 2	... all *protection scheme* secondary circuits	This is being consistent with the use of this term in clause 2.9.8
Glossary ***back-up protection scheme or back up protection system***	A *protection* ~~scheme~~ *scheme* or *protection system* intended to supplement the ~~main~~ *main protection system* in the case of the latter ~~must~~ being ineffective, or to deal with faults in those parts of the *power system* that are not readily included in the operating zone of the	Some defined terms need to be in italics. There is a section that does not make sense. The word ***back-up (back up, backup)*** is not consistent, even in the definition. A protection manual indicates that ***back-up*** should be used.

	~~main~~ *main protection system.*	
Glossary definition	*two fully independent protection~~s~~ schemes of differing principle.*	Typographic error. Should be *protection schemes*.
Glossary ***two fully independent protection schemes of differing principle***	Therefore, to satisfy the redundancy requirements, each *protection scheme* would need to have its own independent battery and battery charger system *supplying* all that *protection~~'s~~ scheme's* trip functions.	In two instances the word *scheme* should be added.
Glossary ***trip circuit supervision***	Replace the word *protection* with *protection scheme (3 instances).*	Due to new definition of *protection scheme*
Glossary ***trip supply supervision***	Replace the word *protection* with *protection scheme.*	Due to new definition of *protection scheme*
Glossary defined term	Delete ***differing principle*** from glossary.	Due to change specified above for 2.9.2 (a) (1) Line 6 this defined term can be deleted.
Glossary defined term	Delete ***breaker fail*** from glossary	This is no longer used in the document. The definition of ***breaker fail*** may be added to the definition of ***circuit breaker failure*** but this may not be deemed necessary.
Glossary definition	Add definition of ***breaker fail*** to the definition of ***circuit breaker failure***	This may not be deemed necessary but will make the term more relevant when used in clause 2.9 and 3.5 etc.

Changes to Clause 3.5 and associated clauses

Clause	Change	Explanation / Comment
3.5	Streamline and use consistently terms User, Consumer and Generator	The title of Clause 3.5, and many references throughout this clause, has been changed from "Users"' Protection Requirements to "Consumer's" Protection Requirements. Further to this, a new glossary term has been added to define "Consumer" as "A User who consumes electricity supplied through a connection point.". We interpret this definition to mean that the new definition of "Consumer's" is very similar to a "Load" type of "User", and not a "Generator" type of user who supplies rather than consumes electricity. The requirements of Clause 3.5, however, apply to both "Load" and "Generator" types "Users"'. This is verified by the two subclauses "Specific Protection Requirements for Generator Facilities" and "Specific Protection Requirements for Consumer Facilities". As such, the term "User" should be re-instated, or some other means of clarification inserted. It is important that Clause 3.5, and 3.5.1 apply to both Consumers and Generators.
3.5.1(b), explanatory note in the box	Review the content to include situations with Generators and multiple User's lines behind the connection point or delete the note (our preference)	Clause 3.5.1 (b) applies to loads and users, as well as all plant connected to the network. An example is a step-up transformer for a generator connection. There are many situations where Clause 3.5.1 (b) would apply, not only for the example given in the box. It appears that the note could be interpreted as if it narrows the application of the clause to that specific case.
3.5.1(e) new clause, which is 3.5.1(f) related	For consistency with Clause 3.5.1(f), put back the equivalent requirement for distribution connected generators, by inserting a new clause 3.5.1(e): "Except in an emergency, a *User* must notify the *Network Service Provider* at least 5 *business days* prior to taking a *protection* of any *User's distribution system equipment* out of service if this *protection* is required to meet a *critical fault clearance time*."	This clause has been removed in the latest technical code. However, we believe it to be relevant due to the serious consequences of not meeting a critical fault clearance time. Hence the clause should be reinstated.

3.4.6(d)	Move Clause 3.4.6(d) to Clause 3.4.8 and reword as follows, for consistency with the relevant Australian Standards: "For the *transformer* that connects the *User's* facilities to the *transmission or distribution system*, the *transformer connection symbol* must be agreed with the *Network Service Provider*. Preference is given to transformers with a zero sequence opening between the high-*voltage* and low-*voltage* windings and a *transformer* connection type (vector group) that is compatible with the system at the connection point."	This requirement is for users and generators, hence it should be moved to the more relevant Clause 3.4.8 "Design Requirements for User's Substations". This will also cover generators, as Clause 3.4.8 is referenced by Clause 3.6.7.1. Consequently, add to the glossary the term ***"transformer connection symbol"***
Glossary	Add and define ***transformer connection symbol as*** "a conventional notation indicating the connections of the high-voltage, intermediate-voltage (if any), and low-voltage windings and their relative phase displacement(s) expressed as a combination of letters and clock-hour figure(s)"	Follow up of the previous comment on Clause 3.4.6(d)
3.5.1(h)	Delete the first sentence	The first part of this clause "*Users* must ensure that their *protection* settings coordinate with the *Network Service Provider's protection"* is already covered by new clause 3.5.1 e), and should be deleted. The second part of this clause "and must provide their protection data to the Network Service Provider." would be covered by addressing our two comments on Clause 3.5.4 and Clause 3.5.5 that follow. The final part of this clause "A *User* must not adjust its protection settings without the *Network Service Provider's* approval." should be retained.
3.5.2 (d) (4)	Change reference 3.3.4.10 to 3.5.1 (d)	Editorial
3.5.4 new clause	Put back clause 3.5.4 titled "Protection Design Philosophy Document" and worded as follows: "Unless otherwise	Clause 3.5.4 has been deleted in this document, however it is our understanding that it was agreed to modify it slightly, and include a new attachment. We therefore suggest to re-insert modified Clause 3.5.4 and

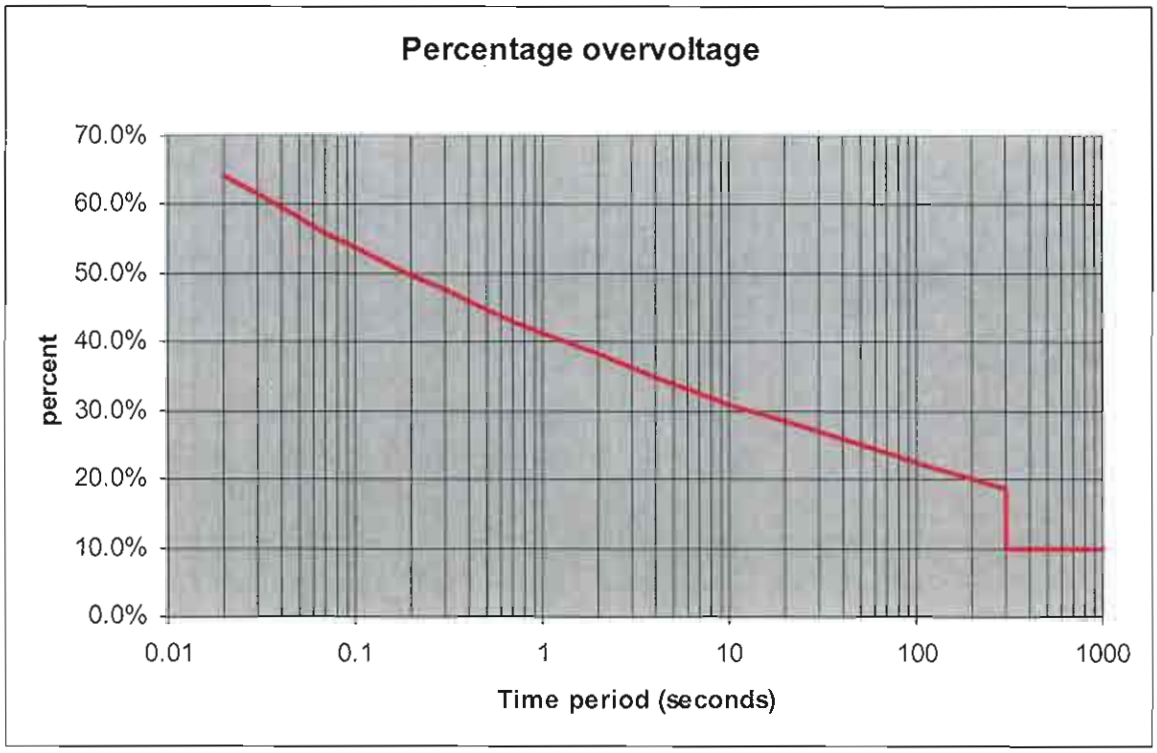
	agreed by the *Network Service Provider*, a *User* must provide the *Network Service Provider* with sufficient details of the proposed *protection* designs, together with all relevant *equipment* parameters for the *Network Service Provider's* review. Refer to Attachment 11 for specific document submittal requirements. The timeline for provision of these documents is to be detailed in the *access contract*."	Attachment 11 (provided separately).
Attachment 11, new	Add Attachment 11 (provided separately)	Follow up of our previous comment on Clause 3.5.4.
3.5.5 new clause	Put back Clause 3.5.5 titled: "Protection Settings Philosophy Document" and worded as follows: "Unless agreed otherwise, *Users* must provide the *Network Service Provider* with full details of proposed *protection* settings on all *equipment* that may have an impact on the *transmission system* or the *distribution system*. Refer to Attachment 12 for specific document submittal requirements. The timeline for provision of these documents is to be detailed in the *access contract*."	Clause 3.5.4 has been deleted in this document, however it is our understanding that it was agreed to modify it slightly, and include a new attachment. We therefore suggest to re-insert modified Clause 3.5.5 and Attachment 12 (provided separately).
Attachment 12, new	Add Attachment 12 (provided separately)	Follow up of our previous comment on Clause 3.5.5.
Attachment 3, section A3.4	Expand section A3.4 to include reference to newly inserted Attachments 11 and 12. In addition, consider discontinuing use of word "schedule" by simply referring to the relevant attachment.	Expansion of section A3.4 is a follow up of inclusion of new Attachments 11 and 12. Suggestion not to use word "schedule" is an editorial, which, if accepted, would also require removal of the same word from the title of Attachments 4 to 9.

Other suggested changes

Clause	Change	Explanation / Comment
2.2.1(f)	*Load shedding facilities* (described in clause 2.4) may be used to ensure ~~that the frequency recovers to the normal voltage range within the time frames~~ compliance with the frequency performance prescribed in Table 2.1 following a multiple contingency event.	Editorial. Load shedding is only used to aid frequency recovery. Would be more appropriate to use load shedding to meet the requirements of table 2.1 for multiple contingency events. Load shedding is used to limit the fall in frequency as well as aiding recovery.
2.2.2(a), Table 2.2, 1st column, last row.	Infrequent Switching ~~or~~ Events(2)	Clarification. Switching due to a fault is not a controllable event. Delete "or"
2.2.2(a), Table 2.2, End Note 2.	For example, tripping of *generating units*, *loads*, lines and other components, not ~~typically~~ as a result of faults...	Clarification. Switching due to a fault is not a controllable event. Replace word "typically" with "not"
2.2.2(a), Table 2.2	Add Note 3 as follows: "Pre-tap-changing is before any tap changer action but after the operation of automatic control systems to manage voltage levels. This can include the automated switching of capacitors and reactors and the operation of SVCs and statcoms."	Editorial. As this is currently written it does not allow a voltage to increase by more than 6%. Suggest that a note be added to define more clearly what is meant by quasi steady state. This will then allow the voltage to reach the levels defined in Figure 2.2 as long as they automatically achieve the levels of Table 2.2.
2.2.10	Replace Figure 2.2 with the new one (provided separately)	New figure defines the maximum time for over-voltage to reach the upper steady state limit for continuous operation to 300 seconds. Otherwise, the figure is unchanged.
2.5.1(b)	Consider the appropriate change to Market Rules	The explanatory note in the text box requires Western Power to ensure there is adequate generation to supply local residents. This seems to be more of an IMO responsibility as network does not own generation.
2.5.2.3(a)(2)	All 132 kV *terminal* ~~sub~~*stations* in the Perth metropolitan area, and Muja *power station* 132 kV *substation.*	The current wording seems to be asking for all substations to meet the N-1-1 criterion. This would require at least 3 lines into all metro zone substations. This is wrong, as the criterion applies to *terminal stations*, which is now a defined term. Replace "All 132 kV *substations*" with "All 132 kV *terminal stations*"

2.5.7(a)	All new and replacement *high voltage* switches …	Clarification that the clause does not apply to low voltage switches. Insert "high voltage" after "All new and replacement".
2.6(a)	The minimum ~~maximum~~ reasonably foreseeable *load* for the subdivision shall be provided ~~agreed~~ by the *Network Services Provider* ~~and the developer~~ and must be determined by estimating the *peak load* of the subdivision after it has been fully developed, assuming the current electricity consumption patterns, however the developer may use a higher value.	Simplification which describes better our current practice. The essence of the change is to replace "The maximum reasonably foreseeable load for the subdivision shall be agreed by the Network Services Provider and the developer" with "The minimum reasonably foreseeable load for the subdivision shall be provided by the Network Services Provider however the developer may use a higher value"
2.6(c)	The *Network Service Provider* may require a developer to provide ducts for *high voltage distribution system* cables to supply future neighbouring subdivisions but and may ~~must not~~ require developers to provide *high voltage distribution system* cables if these are not required to supply the developer's own subdivision.	The current wording is inconsistent with the existing practice and with the Energy Operators (Powers) Act 1979, which states that the customer pays the energy operator the cost of accommodating future demands whether or not they are demands of the customer. 3rd row, Replace "must not" with "and may"
2.9.4(f), Table 2.12, Title	Table 2.12 Alternative ~~**Alternate**~~ Maximum *Total Fault Clearance Times* (msec) for 132 kV and 66 kV lines.	Editorial, typo. Replace "Alternate" with "Alternative"
3.2.4(b)	Change to the effect that the information should be supplied to any User, their agent or appointed reputable consultants.	Practice shows that the users themselves will normally not be performing the studies.
Attachment 10	Update Attachment 10 as per the attached.	The process of ongoing improvements. Table A10.1 remains unchanged. New Attachment 10 provided separately.
3.3.5.5	Change to the effect that, where small generators operate on power factor control, their response times should be in accordance with Table 3.2	Clarification. This clause specifies the voltage control requirements for synchronous and non-synchronous generators. On some parts of the system small generators or generators with small capacity will be required to operate on power factor control. In those circumstances their response times should be in accordance with Table 3.2.

Figure 2.2 – Highest Acceptable Level and Duration of AC temporary Overvoltages



Schedule 10 - TEST SCHEDULE FOR SPECIFIC PERFORMANCE VERIFICATION AND MODEL VALIDATION

A10.1 General

(a) Recorders must be calibrated/checked prior to use.

(b) Recorders must not interact with any equipment control functions.

(c) One chart recorder must be used to provide on site monitoring and rapid evaluation of key quantities during tests or a digital recorder with a real time display facility may be used.

A10.2 Recorder *Equipment*

Digital Recorder

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 (i.e. 3kHz) for up to 10 seconds unless specified otherwise.

(c) departure from linearity of no more than 0.1% in the slope of normalised output versus input. Normalised means value/full range value.

(d) DC offset errors not greater than 0.05% of full scale in the analogue circuitry.

A10.3 *Frequency* response

(a) Where digital or chart recordings of power frequency waveforms are to be made a minimum bandwidth of DC - 10kHz is required (0dB at DC, -3dB at 10kHz).Suitable filtering is required to eliminate aliasing errors.

(b) For relatively slowly changing signals (such as main exciter quantities, transducers for MW output etc) a recording device bandwidth of DC - 100Hz is required.

(c) All test results required in rms values are to be derived at a minimum rate of 100 samples per second.

A10.4 Signal Requirements and Conditioning

(a) Suitable input signal level must be used and allowance must be made for excursions during transients

(b) Subtraction of an appropriate amount of floating DC from input signals such as stator voltage must be provided so that any perturbations are clearly observable on an on site chart recorder

(c) Galvanic isolation and filtering of input signals must be provided whenever necessary.

A10.5 Form of Test Results

These must consist of:

(a) a brief log showing when tests were done (time, date, test alphanumeric identification).

(b) chart recordings appropriately annotated.

(c) relevant schematics of equipment and the local transmission system configuration.

(d) lists of data collected manually (eg meter readings).

(e) data in Microsoft Excell.

(f) SCADA type printout showing the users 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).

A10.6 Test Preparation And Presentation of Test Results

Information/data prior to tests

(a) a detailed schedule of tests agreed by the *Network Service Provider*. The schedule must list the tests, when each test is to occur and whose responsibility it will be to perform the test.

(b) Schematics of *equipment* and subnetworks plus descriptive material necessary to draw up/agree upon a schedule of tests

(c) Most up to date relevant technical data and parameter settings of *equipment* as specified in Attachment 4 to Attachment 9.

(d) All information / data mentioned above is to be provided at least 30 business days prior to the test.

Test Notification

(a) A minimum of 15 *business day* prior notice of test commencement must be given to the *Network Service Provider* for the purpose of arranging witnessing of tests.

(b) the *Network Service Provider's representative* must be consulted about proposed test schedules, be kept informed about the current state of the testing program, and give permission to proceed before each test is carried out.

(c) Unless agreed otherwise, tests must be conducted consecutively.

Test Results

(a) Test result data must be presented to the *Network Service Provider* within 10 *business days* of completion of each test or test series.

(b) Where test results show that generator performance does not comply with the requirements of the Technical Rules it will be necessary to rectify problem(s) and repeat tests.

A10.7 Quantities to be Measured

(a) Wherever appropriate and applicable for the tests, the following quantities must be measured on the machine under test using the same recorder or recorders with their time scales synchronised to within 1ms:

Generating unit and Excitation System

- 3 stator L-N terminal *voltages* (rms values)
- 3 stator terminal currents (rms values)
- Active power MW (rms values)
- Reactive power MVar (rms values)
- Generating unit rotor field voltage
- Generating unit rotor field current
- Main exciter field voltage
- Main exciter field current
- AVR reference voltage (rms values)
- 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 generating unit
- Engine speed control output
- Free turbine speed control output
- Generating unit-compressor speed control output
- Ambient/turbine air inlet temperature

- Exhaust gas temperature control output
- Exhaust temperature
- Fuel flow
- Turbine control /*load* reference set point

Hydro

- Shaft speed
- Gate position
- Turbine control /*load* reference set point

(b) the *Network Service Provider* will specify test quantities for power *equipment* other than those listed above, such as those consisting of wind, solar and fuel cell *generating units* which may also involve AC/DC/AC power conversion or DC/AC power inverters.

(c) Additional test quantities may be requested and advised by the *Network Service Provider* if other special tests are necessary.

(d) Key quantities such as stator terminal *voltages*, currents, *active power* and *reactive power* of other *generating units connected* on site and also *interconnection* lines with the *Network Service Provider transmission system* (from control room readings) before and after each test must also be provided.

ATTACHMENT 11 - DOCUMENT SUBMITTAL REQUIREMENTS FOR PROTECTION DESIGN PHILOSOPHY DOCUMENT

SUBMITTAL CODES (dates to be agreed in the *access contract*):

D	Detailed Planning Data
R1	Registered data, pre-*connection*
R2	Registered data, post-*connection*

PROTECTION DESIGN PHILOSOPHY DOCUMENT:

ITEM	DESCRIPTION	SUBMITTAL CODE
1	Documentation explaining the general protection philosophy. To include: - Present and design minimum and maximum fault levels. - Present and design minimum and maximum fault contributions to the network from the user, at the point of connection. - Details of required critical fault clearance times, and which protections will be employed to meet these times. - Local Backup (circuit breaker fail) philosophy. - Special scheme philosophy (ie islanding or load shedding schemes. - Protection number 1 philosophy. - Protection number 2 philosophy.	D, R1 and R2
2	Power single line diagram, down to and including the low voltage (greater than 50V AC) bus(s). To include: - Voltage levels. - Transformer ratings, winding configurations and earthing connections - Generator ratings and earthing connections - Operating status of switching devices - Earthing configuration - Primary plant interlocks	D, R1 and R2
3	Details of protection interfaces between the Transmission Network and the User.	D, R1 and R2
4	Protection single line diagram, down to and including the low voltage (greater than 50V AC) bus(s). To include: - Current transformer locations, rated primary and secondary current, rated short-time thermal current, rated output, accuracy class and designation. - Voltage Transformer locations, winding connections, rated primary and secondary voltages, rated output and accuracy class. - Relay make and model number - Relay functions employed - Primary plant mechanical protections - Trip details (diagramatic or by trip matrix)	R1 and R2
5	Impedance diagram of the system, showing for each item of primary plant details of the positive, negative and zero sequence series and shunt impedances, including mutual coupling between physically adjacent elements. Impedances to be in per unit, referred to a 100MVA base. Final	R1 & R2

	submission (R2) to include tested values of generator and transformer impedances (ie from manufacturers test certificates).	
6	Tripping and control power supply (eg DC system) single line diagram	R1 & R2
7	Power flow details at point of connection as per the data requested in Schedule S5.	R1 & R2
8	HV circuit breaker details: - A control and protection schematic diagram of the circuit breaker(s) at the user connection to the transmission network. - Type, rated current and rated fault MVA or rated breaking current of all HV circuit breakers	R1 & R2
9	HV switch fuse details: - Rated current of fuse - Rated breaking current of fuse - Type of fuse - Current-time characteristic curves	R1 & R2

ATTACHMENT 12 - DOCUMENT SUBMITTAL REQUIREMENTS FOR PROTECTION SETTINGS PHILOSOPHY DOCUMENT

SUBMITTAL CODES (dates to be agreed in the *access contract*):

D	Detailed Planning Data
R1	Registered data, pre-*connection*
R2	Registered data, post-*connection*

PROTECTION SETTINGS PHILOSOPHY DOCUMENT:

ITEM	DESCRIPTION	SUBMITTAL CODE
1	Documentation explaining the general settings philosophy.	R1 & R2
2	Calculated *total fault clearance times*.	R1 & R2
3	Protection function settings to be employed and reasons for selecting these settings. Diagrams are to be submitted where applicable.	R1 & R2
4	Overcurrent grading curves for phase faults.	R1 & R2
5	Overcurrent grading curves for earth faults.	R1 & R2