Advisian Submission Regarding AEMO's proposed rule changes for the Generator technical performance standards

Level 13, 333 Collins Street
Melbourne VIC 3000
Australia

-

www.**advisian**.com

Advisian
WorleyParsons Group

Disclaimer

Advisian accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party.

Project No: - – Advisian Submission Regarding

AEMO's proposed rule changes for

the Generator technical performance standards:

Rev	Description	Author	Review	Advisian Approval	Date
A	Original	B Miller	Advisian	S. Porter	30 Oct 2017

Table of Contents

Appendix List

1 Introduction

Advisian acknowledges the challenges faced by AEMO in managing the changing power systems within Australian power networks, and supports the need to review the technical standards to ensure they are sufficient.

Advisian have prepared this overview of AEMO's proposed changes to the technical requirements that generating systems need to meet in Chapter 5 of the NER in response to a request from the AEMC.

2 Methodology

Advisian carried out the task of reviewing the proposed rule changes in the following simple manner:

- A working document was created that tabulated all the proposed rule changes contained in the document "Electricity Rule Change Proposal – Generator Technical Requirements – August 2017". This working document has been attached in Appendix A.
- Two subject matter experts reviewed the proposed rule changes against the previous rules to ensure clear understanding and clarity.
- Comments were written for each proposed rule change in a separate comments column.
- Feedback has been provided on specific proposed rule changes.

In addition, the AEMC has prepared a questionnaire which allows respondents of the proposed rule changes to make submissions based on principles used to govern the National Electricity Market. Advisian has completed this questionnaire which has been attached as Appendix B.

3 Key Findings

The key findings are as follows:

3.1 Summary

The rules proposed by AEMO appear to create several issues for the industry should they be implemented as drafted.

The issues that Advisian have identified are as follows:

- Advisian believes there appears to be a lack of alignment between the proposed changes to the rules and the national electricity objective potentially creating uncertainty as to the basis of the rules and therefore allowing greater interpretation around implementation. This could create disparity in relation to connection requirements across different NSPs.

- Some of the proposed rule changes appear to be impossible for generation plant to meet, or are more related to characteristics of the network than those of the generators. Advisian believe this is a very serious issue and not just because they cannot be physically achieved. There is the possibility of reputational damage to the Australian power industry that would arise if the rules were passed, and then found to be unworkable. This could have a negative impact on investment because investors would lose confidence in the ability of the industry to manage technical change.

- The principles for the rules regulating the connection of generators to the NEM have been well established by AEMO's former organisation NEMMCO - the proposed rules do not uniformly align with these established and industry agreed approaches. Advisian believe that this could also have a negative impact on investment because investors may perceive this as an unnecessary change in well-established prior practice within the industry, and radical changes will lead to investor uncertainty.

- If the rules were to be passed as drafted, Advisian believe they would place unusually onerous requirements on new and (if clauses were not grandfathered) existing generation. We believe some of the requirements are so onerous they could prevent many projects from being able to proceed, and add significant cost to any remaining. This approach would clearly not deliver power at a low cost and security of supply because it will severely limit the number of projects that will be financially viable.

- In Advisian' s opinion, the proposed rules present technical issues to particular forms of generation in many instances, although the types of generation that are disadvantaged are dependent on the rule in question. Some rules will prevent the connection of synchronous machines of all types; others prevent the connection of invertor connected plant. In combination as is discussed in this document, a literal interpretation of these proposed rules in their entirety would prevent the connection of all new generation plant.

3.2 Lack of Alignment with the National Electricity Objective

The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to—

(a) price, quality, safety, reliability and security of supply of electricity; and

(b) the reliability, safety and security of the national electricity system.

As an example where the National Electricity Objective (NEO) is not met, the proposed new clause 5.3.4A requires a generator proponent to meet automatic access unless it cannot be practically achieved.

Clause 5.3.4A Automatic access can always be achieved (if physically possible) if expensive resources are allocated; this clause seems to insist that these be instigated which is contrary to providing an installation which meets technical and cost requirements as is laid out in the NEO.

Specifically, the clause makes no allowance for price, quality, safety, reliability and security of supply of electricity produced by the generation plant, which is the first part of the NEO.

3.3 Physicality of proposed rules

Two specific rule changes, those for clause S5.2.5.1 and S5.2.5.5 put requirements on new generator connections which would typically be physically impossible to comply with.

S5.2.5.1 Reactive power capability – The new clause requires that the generator be able to control the voltage at the connection point and specifies a range. The minimum access requirement is likely to be physically impossible if the generation system is connected to a strong fault level point on the system which would mean it cannot affect system voltage to any significant degree.

The original intent of this clause may have been to describe how a generating system can control voltage under open circuit conditions, but the text of the proposed rule does not make this distinction.

S5.2.5.5 Generator response to disturbances following contingency events

This clause required generation to be able to stay on line for fifteen disturbances within five minutes in all of the possible combinations of scenarios.

Due mainly to system transient stability considerations, no known generation technology can possibly guarantee compliance with this clause for all possible combinations of scenarios. There is also the obvious practical consideration to consider which is that if fifteen faults occur within a five minute period then the transmission system will likely have several lines tripped and locked out. If this happened within a single region the transmission system could fail and a blackout ensue regardless of the response of generation plant simply because the transmission would be insufficient to supply the load.

This clause puts the onus for compliance wholly on the individual generator. In real world power systems the ability to ride through faults is shared between the network protection systems (fault clearing times), network impedances and the interactions with other generators. This must be modelled and analysed in order to determine what the most appropriate transient design should be, and what contingent conditions can be safely ridden through.

3.4 Lack of Alignment with previously agreed Principles

NEMMCO the antecedent organisation of AEMO engaged with industry in order to create general principles to guide the drafting of generator performance standards, these are listed below and the proposed rule changes are compared with the guiding principles.

The main issue to consider is that if the industry decides to deviate from these well-established principals and adopt an approach which differs significantly from past practices, there may be an adverse on attracting future investment for power system generation developments.

Principle 1 *Technical standards must provide for adequate*

a. Power system security;
b. Quality of supply; and
c. Reliability of supply.

This principle summarizes the second point of the NEO which has been discussed above.

Principle 2 *Minimum automatic and mandatory standards should be defined so that the performance requirements are consistent with the impact of the plant on the power system*

In Advisian's opinion, the proposed rule changes overturn the agreed approach which had three levels of compliance:

1. A generating unit or generating system complying with the automatic access standard cannot be required to provide a higher performance standard. The automatic standard represents the maximum level of performance that could reasonably be expected.

2. A unit or generating system complying with a minimum standard should, at least, "do no harm" to the performance of the power system as a whole, although a higher standard may be required to meet the specific technical requirements of the Network Service Provider (NSP) or NEMMCO, which may arise from considerations about the specific location of the generating system, and potential interactions with other plant.

3. By insisting on automatic access or by rewriting the minimum access requirements so they are almost identical to automatic access, the previously agreed approach has been ignored.

Principle 3 *Terminology used must support appropriate application. Where technically appropriate performance should be measured at the connection point*

Advisian believe this Principle has been ignored most specifically in the proposed clause **S5.2.6 Monitoring and control requirements.** In this clause AEMO is requesting monitoring well beyond the connection point.

Principle 4 *Avoid technology-specific terms, unless necessary to clarify requirements for particular technologies*

- *Where possible write clauses in terms of technology non-specific terms so applicable when new technologies emerge*
- *Aim to achieve equivalent requirements for different technologies*

In some cases the proposed rules attempt to apply a different technical requirement on synchronous vs asynchronous generation which is contrary to this well established principle.

Principle 5 *Provide clear guidance on the basis for negotiation*

- *Intent of clause*
- *Factors to be considered*

Advisian believe the new rules attempt to avoid negotiation altogether by insisting on automatic access standards.

Principle 6 *Changes must include appropriate transitional arrangements*

If the new rules were to be adopted, Advisian believe a two tier system of generation requirements would necessarily come into being as the generation on the system will not be compliant. Necessarily they would have to be grandfathered which would favour incumbents over new entrants which will have significant commercial implications.

Principle 7 *Changes must be technically justified*

- *Need to demonstrate adequate technical justification for change*

  Must consult with industry, power system experts and specialists from any new technology that the changes seek to incorporate

In the proposed rule changes, Advisian believe AEMO have not demonstrated technical justification for many of the proposed changes, specifically the clauses:

- S5.1a.4 Power Frequency voltage
- S5.2.5.1 Reactive Power Capability
- S5.2.5.3 Generating system response to frequency disturbances
- S5.2.5.4 Generating system response to voltage disturbances
- S5.2.5.5 Generating system response to disturbances following contingency events
- S5.2.5.11 frequency control
- S5.2.5.13 Voltage and reactive power control
- S5.2.5.14 Active power control
- S5.2.5.15 System Strength
- S5.2.6 Monitoring and control requirements

Advisian has provided a detailed commentary on each of these rule change clause proposals in Appendix A.

The initial proposed clause 5.3.4A in particular is of concern.

"A connection applicant submitting a proposal for a negotiated access standard under clause 5.3.4(e), clause 5.3A.9(f) or paragraph (h)(3) must provide with that proposal evidence (to AEMO and the Network Service Provider's reasonable satisfaction) that it is not practicable for the applicable plant to achieve the relevant automatic access standard (including where there is a material risk that the applicable plant will be damaged if the level is set higher than a specified level)."

Excluding physically impossible requirements automatic access can always be achieved if expensive resources are allocated however this clause seems to **insist** that these be instigated which is contrary to the principal of providing a fit for purpose cost effective installation which meets the necessary requirements of the power system and the market.

It is unclear whether this clause requires a generator to be prepared to accept damage from system operation or be allowed to trip to prevent damage. Other clauses discussed below seem to imply the former interpretation was meant.

Advisian recommend this clause be reworded to comply with the intent of the National Electricity Objective.

3.5 Impact on Generation Assets

Assuming the clauses which require non-physical capabilities are amended, the main impact the proposed rules will have will be to increase the costs associated with generation plant compliance.

A cause for concern is the disregard expressed for the possibility of equipment damage, and the non-acceptance of this as a reason not to set protection at a high level. This would force the generator into applying dangerous settings which could potentially have severe health and safety consequences in addition to the potential to permanently damage generation plant.

3.6 Discriminatory impacts

In an attempt to ensure a reliable and secure system the rule proposal put forward by AEMO discriminates in many ways against new technologies such as solar, wind and batteries by writing rules around the technical behaviour of synchronous generators.

In many cases the rules discriminate against new entrant synchronous generators. In particular, the voltage control and fault ride through and short circuit ratio provisions are impractical and, if implemented, would effectively prevent all new generation being connected to the system.

3.7 Specific Rule Commentary

In Advisian's opinion, significant issues of physicality, safety, consistency of treatment and unnecessary allocation of resources for different generation technologies have been identified in the analysis.

Specifically:

S5.3.4A

The proposed changes to **Clause 5.3.4A** require generators to meet automatic access unless there is a practical reason why they cannot be met. Excluding physically impossible requirements, Automatic access can always be achieved if expensive resources are allocated; this clause seems to insist that these be instigated which is contrary to the principal of providing a cost effective installation which meets the necessary requirements of the power system and the market.

Advisian recommend this clause be reworded to comply with the intent of the National Electricity Objective which is listed below for reference.

National Electricity Objective

The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to—

(a) price, quality, safety, reliability and security of supply of electricity; and

(b) the reliability, safety and security of the national electricity system.

5.3.4A Advisian Suggestion

Advisian propose this change be rejected as drafted because it is clearly in contradiction to the National Electricity Objective.

S5.8.4

Proposed changes to **Clause 5.8.4** draw a distinction between normal power flows and reversal of power flows. There appears to be an inconsistent approach to connections to a distribution network which cause export to the transmission network relative to connections which may have been prior but does not cause a reversal of power flow.

The key issue is not whether a power flow reversal occurs or not but whether a significant change to power flows on the distribution network is likely to cause a network operational management issue or not. By focusing on an arbitrary threshold of power reversal, the key issue is being missed.

5.8.4 Advisian Suggestion

Advisian suggest this proposed change be redrafted to better reflect the key issue which is whether substantial changes to power flows cause an issue on the network or not.

S5.1a.4

Proposed changes to **S5.1a.4** significantly raise the voltage levels that generators must remain connected. These power frequency overvoltage requirements appear to be very onerous and many generators currently connected to the system will not be able to meet these over voltage levels without sustaining damage.

No justification above a 115% level has been offered and there does not appear to have been any investigation of what the impact this change will have on generation plant. Advisian also note that the proposed changes to the voltage standards seem to exceed long established industry standards such as ANSI and IEC requirements.

S5.1a.4 Advisian Suggestion

Advisian counsel that this proposed change be rejected by because if adopted it would put plant at risk which could severely impact on power system reliability, and personnel safety.

S5.2.5.1

The proposed changes to **S5.2.5.1 Reactive power capability** require generators to be able to change the voltage levels in very prescriptive ways at the point of connection - The minimum and automatic access requirement is likely to be physically impossible if the generation system is connected to a strong fault level point on the system which would mean it cannot affect system voltage to any significant degree.

Potentially the minimum access standard could be more onerous than the automatic access standard which appears to be against the guiding principles previously understood for generator performance standards.

S5.2.5.1 Advisian Suggestion

Advisian recommend this proposed change be rejected by because it fails to take into consideration how power systems actually behave and is unphysical.

S5.2.5.3

Changes to the clause **S5.2.5.3 Generating system response to frequency disturbances** makes the clause confused. For the minimum access standard there appears to be an inconsistent treatment of synchronous vs asynchronous generators. The interpretation could mean that there is no minimum access requirement for non-synchronous generators.

The negotiated access clause is ill-defined and is more dependent on the system parameters than on the generator parameters and will be ineffective in practice.

S5.2.5.3 Advisian Suggestion

Advisian propose this change be rejected because it discriminates against asynchronous generation in removing the possibility of registering under minimum access requirements. This is contrary to the general principle that the rules be technology neutral as far as possible.

S5.2.5.4

Changes to the clause **S5.2.5.4 Generator response to voltage disturbances** – In Advisian's opinion, the proposed clause provides little difference between the minimum and automatic access standards.

This clause is already confused in its intent and the redrafting appears to have made the requirements less clear. One sentence in the clause seems to imply that generators cannot reduce their power output by more than 100 MW regardless of system voltage level. This is clearly a violation of basic physics and appears to have been mistakenly drafted.

Although not explicitly detailed in the text of the rules, the way AEMO and some NSP's have already been interpreting this clause (and the clause for automatic access) in practice is contrary to normal engineering design in that they require the generation plant to operate at rated output even if the connection point voltage is low – which would typically overload the current rating of most generation plant. (E.g. by requiring the generator to continuously output ~ 110 % of its current rating whenever the voltage falls to 90%).

S5.2.5.4 Advisian Suggestion

Advisian counsel that the proposed change to the minimum access standard be rejected by AEMC.

The changes to the negotiated access standard appear arbitrary and the clause should be redrafted to make it clearer.

S5.2.5.5

Changes to the clause **S5.2.5.5 Generator response to disturbances following contingency events** require generators to stay on line for 10 – 15 disturbances within a five minute period for all of the possible combinations of scenarios.

This is impractical, no known existing generator technology is able to stay on line for fifteen disturbances within five minutes in all of the possible combinations of scenarios, due to system transient stability considerations, and compliance with this clause depends more on the transmission system remaining intact than on generator response.

The obvious issue with this clause is that it puts the onus for compliance wholly on the generator and none on the network or market operators. In actual power systems the ability to ride through faults is dependent on the network protection systems (fault clearing times), network impedances, the interactions with other generators and the envelope of operation. This must be modelled and analysed in order to determine what the most appropriate transient design should be, and what contingent conditions can be safely ridden through.

Engineering practice has always been to design for ride through after one fault so long as the fault is cleared within a clearly defined period (normally the backup protection clearance time).

S5.2.5.5 Advisian Suggestion

Advisian counsel that the proposed change be rejected by AEMC for the reasons set out above. Specifically the clause imposes impractical requirements on all generating plant and fails to consider the actual technical behaviour of power systems during faults.

S5.2.5.7

The proposed change to **S5.2.5.7 Partial Load Rejection –** removes the requirement on the NSP's to consult with AEMO which seems to allow NSP's to avoid consultation with AEMO for Negotiated Access standards.

S5.2.5.7 Advisian Suggestion

Advisian question the proposed changes particularly the removal of the NSP's to consult with AEMO. The reasons for making this change are not clear and appear likely to cause issues.

S5.2.5.11

The clause **S5.2.5.11 Frequency Control** has been redrafted.

There is confusion about specific requirements in the redrafted clause which need to be clarified.

S5.2.5.11 Advisian Suggestion

Advisian believe the proposed changes should be redrafted to make the intent clearer in some areas as discussed above.

The industry as a whole has been struggling with the concept of system frequency control, not necessarily because it is technically difficult but because the FCAS market is ill-designed and being disrupted by new technologies. A root and branch reform of this part of the NEM is required to resolve the various issues.

S5.2.5.13

The clause **S5.2.5.13 Voltage and Reactive Power Control** has been redrafted to make it complex and unclear.

In Advisian's opinion, there is much confusion and duplication in this clause. Requirements that are physically impossible to meet have been repeated in this clause which will make it un-workable.

S5.2.5.13 Advisian Suggestion

Advisian counsel that the proposed change be rejected by AEMC for the reasons set out above. Specifically, the impractical requirements on all generating plant and the incorrect technical assumptions that have been made. Many subclauses are unclear with respect to their actual intent; the clause should be redrafted to make the intention clear.

S5.2.5.14

S5.2.5.14 Active Power Control - The 30 MW requirement has been removed and this could cause very small generators to be required to meet these requirements which is contrary to established practice, and would lead to increased costs being imposed on small generation systems.

S5.2.5.14 Advisian Suggestion

Advisian suggest the proposed change be rejected by AEMC for the reasons set out above. Specifically, the onerous requirements on small scale generating plant which would make small installations non-commercially viable.

S5.2.5.15

A new clause **S5.2.5.15 System Strength** has been added. The clauses requirements are not practical for any generation system connected to the system via an inverter. The clause requires a generation system to provide at least 3 times its rated current when supplying a system fault. This would require overrating inverter connected plant by a factor of nearly 3 which would greatly increase the cost of the installation.

The clause does not allow for an engineering assessment to be made to clarify if the network requirements are met or not, which would be a more cost effective approach.

S5.2.5.15 Advisian suggestion

Advisian counsel that the proposed change be rejected by AEMC for the reasons set out above. Specifically the impractical requirements on invertor based generating plant which would make the installations non-commercially viable or result in a misallocation of resources leading to an unnecessarily more expensive power system.

S5.2.6.1

S5.2.6.1 Remote Control and Monitoring

This clause seems to simplify existing requirements.

In Advisian's opinion, there is very little difference between Minimum access standards and automatic access standards. This appears to be an example of placing excessive and expensive technical constraints on generation requirements.

S5.2.6.1 Advisian Suggestion

Advisian counsel that the Minimum access requirements be rejected by AEMC because if this clause were to be mandated in the NEM it would lead to an over investment in new generation assets or would make them uncompetitive with existing assets already registered (and presumably grand fathered from the effects of this clause). This would lead either to a gold plated fleet of generation assets, or prevent any further generation developments being implemented, ultimately causing the system to be run down with old assets and eventual failure.

The Negotiated access standard for this clause is superfluous given that Minimum access and automatic access requirements are virtually the same.

3.8 Simplification of existing generator performance requirements

In direct discussions with the AMEC, Advisian stated that we believe the generator connection schedules of the rules could be much simplified if a root and branch reform were to occur and the relevant clauses were rearranged in a more logical format. A brief outline of how this could be implemented is presented in **Appendix D** of this submission.

3.9 Concluding remarks

The rules proposed by AEMO appear to create several issues for the industry should they be implemented as drafted.

The issues that Advisian have identified are as follows:

- Advisian believes there appears to be a lack of alignment between the proposed changes to the rules and the national electricity objective potentially creating uncertainty as to the basis of the rules and therefore allowing greater interpretation around implementation. This could create disparity in relation to connection requirements across different NSPs.
- Some of the proposed rule changes appear to be impossible for generation plant to meet, or are more related to characteristics of the network than those of the generators. Advisian believe this is a very serious issue and not just as they cannot be physically achieved. There is the possibility of reputational damage to the Australian power industry that would arise if the rules were passed, and then found to be unworkable. This could have a negative impact on future investment as investors lose confidence in the ability of the industry to manage technical change.
- The principles for the rules regulating the connection of generators to the NEM have been well established by AEMO's former organisation NEMMCO - the proposed rules do not uniformly align with these established and industry agreed approaches. Advisian believe that this could also have a negative impact on investment because investors may perceive this as an unnecessary change in well-established prior practice within the industry, and radical changes will lead to investor uncertainty.
- If the rules were to be passed as drafted, Advisian believe they would place unusually onerous requirements on new and (if clauses were not grandfathered) existing generation. We believe some of the requirements are so onerous they could prevent many projects from being able to proceed, and add significant cost to any remaining. This approach would clearly not deliver power at a lower cost and higher security of supply because it will severely limit the number of projects that will be financially viable.
- In Advisian's opinion, the proposed rules present technical issues to particular forms of generation in many instances, although the types of generation that are disadvantaged are dependent on the rule in question. Some rules will prevent the connection of synchronous machines of all types; others prevent the connection of invertor connected plant. In combination as is discussed in this document, a literal interpretation of these proposed rules in their entirety would prevent the connection of all new generation plant.

Moreover, Security, Reliability, Affordability and Sustainability of the National Electricity Market were the key aims defined by COAG and investigated in the Finkel review going forward for the NEM. In this regard:

- **Security and Reliability** – Advisian believe that the proposed rule changes will have a negative impact on security and reliability for AEMC simply because many of the requirements are impractical and betray an alarming lack of understanding of power system behaviour.
- **Affordability** – Advisian believe the proposed rule changes will have a negative impact on affordability because many of the new requirements impose unnecessary costs on generation plant.
- **Sustainability** - Advisian believe the proposed rule changes will have a negative impact on sustainability for AEMC because many of the new requirements impose unnecessary limits on

convertor connected plant which is usually the way new energy technologies of wind, solar and battery technologies are interfaced to the power system.

Appendix A Working Document

AEMO's proposed Rule Changes	Comments by Advisian
5.3.4A Negotiated access standards (b) A *negotiated access standard* must: (1) be ~~no less onerous than the corresponding *minimum access standard* provided by the *Network Service Provider* under clauses 5.3.3(b1)(4) or S5.4B(e)~~ as close as practicable to the *automatic access standard* and no less than the corresponding *minimum access standard*; (2) be set at a level that will not adversely affect *power system security*; (3) be set at a level that will not adversely affect the quality of *supply* for other *Network Users*; and (4) in respect of *generating plant*, meet the requirements applicable to a *negotiated access standard* in clauses S5.2.5, S5.2.6, S5.2.7 and S5.2.8. (c1) A *Connection Applicant* submitting a proposal for a *negotiated access standard* under clause 5.3.4(e), clause 5.3A.9(f) or paragraph (h)(3), must provide with that proposal evidence (to *AEMO* and the *Network Service Provider's* reasonable satisfaction) that it is not practicable for the applicable *plant* to achieve the relevant *automatic access standard* (including where there is a material risk that the applicable *plant* will be damaged if the level is set any higher than a specified level). (c2) A *Network Service Provider* must following the receipt of a proposed *negotiated access standard* under clause 5.3.4(e), clause 5.3A.9(f) or paragraph (h)(3), consult with *AEMO* as soon as practicable in relation to *AEMO advisory matters* for that proposed standard. **Note** This clause is classified as a civil penalty provision under the National Electricity (South Australia) Regulations. (See clause 6(1) and Schedule 1 of the National Electricity (South Australia) Regulations.) (d) *AEMO* must within 20 *business days* following the submission of a proposed *negotiated access standard* under clause 5.3.4(e), clause 5.3A.9(f) or paragraph (h)(3), respond to the *Network Service Provider* in writing in respect of any *AEMO advisory matters*. (e) A *Network Service Provider* must within 30 *business days* following the receipt of a proposed *negotiated access standard* in accordance with clause 5.3.4(e), clause 5.3A.9(f) or paragraph (h)(3), accept or reject a proposed *negotiated access standard*. **Note** This clause is classified as a civil penalty provision under the National Electricity (South Australia) Regulations. (See clause 6(1) and Schedule 1 of the National Electricity (South Australia) Regulations.) (f) The *Network Service Provider* must reject the proposed *negotiated access standard* if that *connection*, or alteration of the *generating plant* (as the case may be), at the *negotiated access standard* proposed by the *Connection Applicant* would: (1) on *AEMO's* reasonable advice, adversely affect *power system security*; (2) in the *Network Service Provider's* reasonable opinion, adversely affect quality of *supply* for other *Network Users*; ~~(3) in the reasonable opinion of *AEMO* or the *Network Service Provider*, in respect of a *AEMO* advisory matter or a matter allocated to the *Network Service Provider*, respectively, be lower than the corresponding *minimum access standard*;~~ (3) in the *Network Service Provider's* reasonable opinion, or *AEMO's* reasonable advice given under paragraph (d) in respect of an *AEMO advisory matter*, the performance of that *connection* or alteration would be lower than the corresponding *minimum access standard*; or	**5.3.4A Negotiated access standards** Tidying up text – intent appears unchanged Automatic access can usually always be achieved if expensive resources are allocated to it; this clause seems to insist that that be instigated which is contrary to providing a fit for purpose installation. If this clause were to be included in the NER it would lead to an over investment in new generation assets or would make them uncompetitive with existing assets already registered (and presumably grand fathered from the effects of this clause). This would lead either to a gold plated fleet of generation assets, or worse prevent any further generation developments being implemented, ultimately causing the system to be run down with old assets and eventual failure. This appears to be just a rewording of the existing arrangements, placing slightly more onus on the Network service provider.

AEMO's proposed Rule Changes	Comments by Advisian
(4) in respect of *generating plant*, in *AEMO's* reasonable opinion, not satisfy paragraph (b)(4). **Note** This clause is classified as a civil penalty provision under the National Electricity (South Australia) Regulations. (See clause 6(1) and Schedule 1 of the National Electricity (South Australia) Regulations.) (g) If a *Network Service Provider* rejects a proposed *negotiated access standard*, the *Network Service Provider* must when rejecting the proposed *negotiated access standard*, advise the *Connection Applicant* of a *negotiated access standard* that the *Network Service Provider* will accept. **Note** This clause is classified as a civil penalty provision under the National Electricity (South Australia) Regulations. (See clause 6(1) and Schedule 1 of the National Electricity (South Australia) Regulations.) (h) The *Connection Applicant* may in relation to a proposed *negotiated access standard* advised by a *Network Service Provider* in accordance with paragraph (g): (1) accept the proposed *negotiated access standard*; (2) reject the proposed *negotiated access standard*; (3) propose an alternative *negotiated access standard* to be further evaluated in accordance with the criteria in paragraph (b); or (4) elect to adopt the relevant *automatic access standard* or a corresponding *plant standard*. (i) An *automatic access standard* or if the procedures in this clause 5.3.4A have been followed a *negotiated access standard*, that forms part of the terms and conditions of a *connection agreement*, is taken to be the *performance standard* applicable to the *connected plant* for the relevant technical requirement.	No change to existing clauses. **5.3.4A Recommendation** Advisian recommend this proposed change be rejected for the reasons set out above.

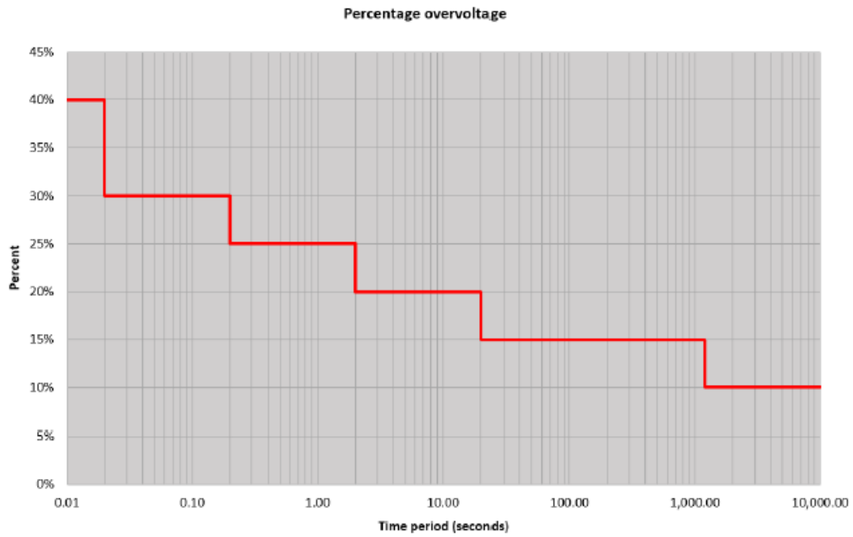
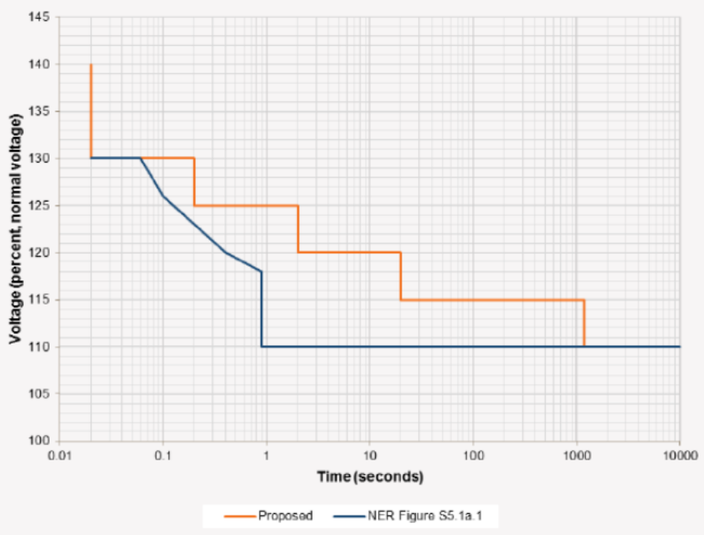
AEMO's proposed Rule Changes	Comments by Advisian
5.3.9 Procedure to be followed by a Generator proposing to alter a generating system [The only changes proposed by AEMO are to the table]	**5.3.9 Procedure to be followed by a Generator proposing to alter a generating system** Noted changes only to Voltage control system and protection system adding clauses S5.2.5.7 and S5.2.5.10, which requires a generator to undergo a formal process to make changes. **5.3.9 Recommendation** Advisian recommend the proposed change be accepted.

Column 1 (altered equipment)	Column 2 (clause)
machine windings	S5.2.5.1, S5.2.5.2, S5.2.8
power converter	S5.2.5.1, S5.2.5.2, S5.2.5.5, S5.2.5.12, S5.2.5.13, S5.2.8
reactive compensation plant	S5.2.5.1, S5.2.5.2, S5.2.5.5, S5.2.5.12, S5.2.5.13
excitation control system	S5.2.5.5, S5.2.5.7, S5.2.5.12, S5.2.5.13
voltage control system	S5.2.5.5, S5.2.5.7, S5.2.5.12, S5.2.5.13
governor *control system*	S5.2.5.7, S5.2.5.11, S5.2.5.14
power *control system*	S5.2.5.11, S5.2.5.14
protection system	S5.2.5.3, S5.2.5.4, S5.2.5.5, S5.2.5.7, S5.2.5.8, S5.2.5.9, S5.2.5.10
auxiliary supplies	S5.2.5.1, S5.2.5.2, S5.2.78

Page 2

Column 1 (altered equipment)	Column 2 (clause)
remote control and monitoring system	S5.2.5.14, S5.2.6.1, S5.2.6.2

AEMO's proposed Rule Changes	Comments by Advisian
5.8.4 Commissioning program (a) Prior to the proposed commencement of commissioning by a *Registered Participant* of any new or replacement equipment that could reasonably be expected to alter performance of the *power system*, the *Registered Participant* must advise the relevant *Network Service Provider* and *AEMO* in writing of the commissioning program including test procedures and proposed test equipment to be used in the commissioning. (b) Notice under clause 5.8.4(a) must be given not less than: (1) 3 months prior to commencement of commissioning for a *connection* to a *transmission network* or for a *connection* to a *distribution network* for a *facility* that exceeds 30MW capacity or causes export of *power* to a *transmission network*; or (2) ~~and not less than~~1 month prior to commencement of commissioning for any other *connection* to a *distribution network*. (c) The relevant *Network Service Provider* and *AEMO* must, within 15 *business days* of receipt of such advice under clause 5.8.4(a), notify the *Registered Participant* either that they: (1) agree with the proposed commissioning program; or (2) require changes to it in the interest of maintaining *power system security*, safety or quality of *supply*. (d) If the relevant *Network Service Provider* or *AEMO* require changes to the proposed commissioning program, then the parties must co-operate to reach agreement and finalise the commissioning program within a reasonable period. (e) A *Registered Participant* must not commence the commissioning until the commissioning program has been finalised and the relevant *Network Service Provider* and *AEMO* must not unreasonably delay finalising a commissioning program.	**5.8.4 Commissioning program** There appears to be an inconsistent approach to connections to a distribution network which cause export to the transmission network relative to connections which may have been prior but does not cause a reversal of power flow. The practical problem with this clause is that it requires the connecting generator to have knowledge of the network flows whereas it is the DNSP who monitors network flows – not the intending generator. A preferable approach would be to put the onus on the DNSP (who has access to the power and reactive power flow data and is responsible for planning the network) to ensure that if reversed power flows are likely, and if this causes a technical issue, that sufficient time is allowed in the commissioning program to address the necessary technical requirements. The main issue that should be under consideration is whether the change in load profile causes a technical issue or not, drawing an arbitrary line at the power reversal point does not aid good technical management of the network. **5.8.4 Recommendation** Advisian recommend this proposed change be rejected for the reasons set out above.

AEMO's proposed Rule Changes	Comments by Advisian
S5.1a.4 Power frequency voltage [The only changes proposed by AEMO are to replace Figure S5.1a.1. with the following]  **Figure 5 Proposed *system standard* for power frequency over voltage**  	**S5.1a.4 Power Frequency voltage** These requirements appear to be very onerous and many generators currently connected to the system will not be able to meet these over voltage levels without sustaining damage or significant loss of life for insulation componentry. AEMO have not provided any justification above the 115% level (which is currently the highest power frequency overvoltage allowed) and do not appear to have investigated what the possible impact of this change is on new and existing generation plant. Whilst new generation plant can be built to comply, this would result in an over investment in electrical insulation and voltage rating of equipment. Existing plant, in particular synchronous and asynchronous generators, transformers, capacitor banks, cables, power electronics and other electrical components would be at risk of significant damage if exposed to high over voltages for the time periods being proposed. **S5.1a.4 Recommendation** Advisian recommend this proposed change be rejected for the reasons set out above.

AEMO's proposed Rule Changes	Comments by Advisian
S5.2.5 Technical requirements **S5.2.5.1 Reactive power capability** **Automatic access standard** (a) The *automatic access standard* is a *generating system* operating at: (1) any level of *active power* output greater than 10% of its *maximum operating level*; and (2) any *voltage* at the *connection point* within the limits established under clause S5.1a.4 without a *contingency event*, must be capable of supplying and absorbing continuously at its *connection point* an amount of *reactive power* of at least the amount equal to the product of the *rated active power* of the *generating system* and 0.395. **Minimum access standard** (b) The *minimum access standard* is a *generating system* operating at: (1) any level of *active power* output; and (2) any *voltage* at the *connection point* within the limits established under clause S5.1a.4 without a *contingency event*, must be capable of supplying and absorbing continuously at its *connection point* an amount of *reactive power* of at least the amount required to enable the *generating system* to achieve	**S5.2.5 Technical requirements** **S5.2.5.1 Reactive Power Capability** It is existing practice to rate the generator power output to a specific value and consider reactive power requirements relative to the generator rating. To define reactive power ratings at levels 10% above the generator power rating will effectively make proponents over build their generating plant in order to comply. This will either cause proponents to build elsewhere or build overly expensive plant. Both scenarios will be undesirable for consumers of electrical power because it will lead to a misallocation of resources. "Any level of active power output" is ill-defined. Limits should be defined. This requirement is physically impossible if the generation system is connected to a strong fault level point on the system which would mean it cannot affect system voltage to any significant degree. In practice the generator cannot control system voltage over its fully defined range if the system has a high fault level and is set at a specific voltage level.

AEMO's proposed Rule Changes	Comments by Advisian
the continuously controllable *voltage* setpoint range specified in the *performance standard* agreed under clause S5.2.5.13. ~~no capability is required to supply or absorb *reactive power* at the *connection point*.~~ **Negotiated access standard** (c) When negotiating a *negotiated access standard*, the *Generator* and the *Network Service Provider*: (1) must subject to any agreement under paragraph (d)(4), ensure that the *reactive power capability* of the *generating system* is sufficient to ensure that all relevant *system standards* are met before and after *credible contingency events* under normal and planned *outage* operating conditions of the *power system*, taking into account at least existing projects and *considered projects*; (2) may negotiate either a range of *reactive power* absorption and supply, or a range of *power factor*, at the *connection point*, within which the *plant* must be operated; and (3) may negotiate a limit that describes how the *reactive power capability* varies as a function of *active power* output due to a design characteristic of the *plant*. (d) If the *generating system* is not capable of the level of performance established under paragraph (c)(1) the *Generator*, depending on what is reasonable in the circumstances, must: (1) pay compensation to the *Network Service Provider* for the provision of the deficit of *reactive power* (supply and absorption) from within the *network*; (2) install additional equipment *connecting* at the *generating system's connection point* or another location, to provide the deficit of *reactive power* (supply and absorption), and such equipment is deemed to be part of the *generating system*; (3) reach a commercial arrangement with a *Registered Participant* to provide the deficit of *reactive power* (supply and absorption); or (4) if the inability to meet the performance level only occurs for particular operating conditions, agree to and document as part of the proposed *negotiated access standard*, operational arrangements by which the *plant* can achieve an agreed level of performance for those operating conditions. (e) The *Generator* may select one or more options referred to in paragraph (d). **General requirements** (f) An *access standard* must record the agreed value for *rated active power* and where relevant the method of determining the value. (g) An *access standard* for consumption of *energy* by a *generating system* when not supplying or absorbing *reactive power* under an *ancillary services agreement* is to be established under clause S5.3.5 as if the *Generator* were a *Market Customer*.	Potentially the minimum access standard could be more onerous than the automatic access standard which defeats the purpose and is contrary to the principle of having a minimum access standard. **S5.2.5.1 Recommendation** Advisian recommend this proposed change be rejected for the reasons set out above.

AEMO's proposed Rule Changes	Comments by Advisian
S5.2.5.3 Generating ~~unit~~ system response to frequency disturbances (a) For the purposes of this clause S5.2.5.3: **normal operating frequency band**, **operational frequency tolerance band**, or **extreme frequency excursion tolerance limits** are references to the widest range specified for those terms for any condition (including an "island" condition) in the *frequency operating standards* that apply to the *region* in which the *generating unit* is located. **stabilisation time** and **recovery time** mean the longest times allowable for *power system frequency* ~~system frequency~~ at the *connection point* to remain outside the operational frequency tolerance band and the normal operating frequency band, respectively, for any condition (including an "island" condition) in the *frequency operating standards* that apply to the region in which the *generating unit* is located. **transient frequency limit** and **transient frequency time** mean the values of 47.5 Hz and 9 seconds respectively, or such other values determined by the *Reliability Panel*.	**S5.2.5.3 Generating system response to frequency disturbances** This appears an attempt to clarify the terminology used for frequency disturbances.

AEMO's proposed Rule Changes	Comments by Advisian
Automatic access standard (b) The *automatic access standard* is a *generating system* and each of its *generating units* must be capable of *continuous uninterrupted operation* for *frequencies* in the following ranges: (1) the lower bound of the extreme frequency excursion tolerance limits to the lower bound of the operational frequency tolerance band for at least the stabilisation time; (2) the lower bound of the operational frequency tolerance band to the lower bound of the normal operating frequency band, for at least the recovery time including any time spent in the range under subparagraph (1); (3) the normal operating frequency band for an indefinite period; (4) the upper bound of the normal operating frequency band to the upper bound of the operational frequency tolerance band, for at least the recovery time including any time spent in the range under subparagraph (5); and (5) the upper bound of the operational frequency tolerance band to the upper bound of the extreme frequency excursion tolerance limits for at least the stabilisation time, unless the rate of change of *frequency* is outside the range of –4 Hz to 4 Hz per second for more than 0.25 seconds, –3Hz to 3Hz per second for more than one second, or such other range as determined by the *Reliability Panel* from time to time. **Note:** The automatic access standard is illustrated in the following diagram. To the extent of any inconsistency between the diagram and paragraph (b), paragraph (b) prevails. [Figure not included]	This appears to be generally less onerous than was previously the case. However gas turbine and some synchronous generation plant may struggle to meet the 3 Hz per second for one second requirement because this implies operation at 47 Hz or 53 Hz. Some Gas turbines will trip when frequency goes down to 47 Hz (often on over firing temperature – not necessarily a specific speed related protection setting). Synchronous generators can experience over fluxing at 53 Hz which will result in damage to the plant if sustained too long.
Minimum access standard (c) The *minimum access standard* is a synchronous *generating system* and each of its *generating units* must be capable of *continuous uninterrupted operation* for *frequencies* in the following ranges: (1) the lower bound of the extreme frequency excursion tolerance limits to the transient frequency limit for at least the transient frequency time; (2) the transient frequency limit to the lower bound of the operational frequency tolerance band for at least the stabilisation time; (3) the lower bound of the operational frequency tolerance band to the lower bound of the normal operating frequency band for at least the recovery time including any time spent in the ranges under subparagraphs (1) and (2); (4) the normal operating frequency band for an indefinite period; (5) the upper bound of the normal operating frequency band to the upper bound of the operational frequency tolerance band for at least the recovery time including any time spent in the ranges under subparagraph (6) unless the *generating system* has a *protection system* to trip a *generating unit* if the *frequency* exceeds a level agreed with *AEMO*; and (6) in respect of a *generating system*: (i) of 30 MW or more; and (ii) that does not have a *protection system* to trip the *generating unit* if the *frequency* exceeds a level agreed with *AEMO*, unless the rate of change of *frequency* is outside the range of -2Hz to 2Hz per second for more than 0.25 seconds, -1 Hz to 1 Hz per second for more than one second or such other range as determined by the *Reliability Panel* from time to time.	There is an inconsistent treatment of synchronous vs non-synchronous generators. The interpretation means that there is no minimum access requirement for non-synchronous generators. This is contrary to the general principal that the rules be technology neutral as far as possible. **S5.2.5.3 Recommendation** Advisian recommend this proposed change be rejected for the reasons set out above.

AEMO's proposed Rule Changes	Comments by Advisian
S5.2.5.4 Generating system response to voltage disturbances **Automatic access standard** (a) The *automatic access standard* is a *generating system* and each of its *generating units* must be capable of *continuous uninterrupted operation* where a *power system* disturbance causes the *voltage* at the *connection point* to vary within the following ranges: (1) *voltages* over 110% for the durations permitted under clause S5.1a.4; (2) 90% to 110% of *normal voltage* continuously; (3) 80% to 90% of *normal voltage* for a period of at least 10 seconds; and (4) 70% to 80% of *normal voltage* for a period of at least 2 seconds. **Minimum access standard** (b) The *minimum access standard* is a *generating system* including all operating *generating units* must be capable of *continuous uninterrupted operation* where a *power system* disturbance causes the *voltage* at the *connection point* to vary within the following ranges: (1) *voltages* over 110% for the durations permitted under clause S5.1a.4; and (2) in the range of: (i) 90% to 110% of *normal voltage*, provided that the ratio of *voltage* to *frequency* (as measured at the *connection point* and expressed as percentage of *normal voltage* and a percentage of 50 Hz) does not exceed: (A~~1~~) a value of 1.15 for more than two minutes; or (B2) a value of 1.10 for more than 10 minutes~~.~~; (3) 80% to 90% of *normal voltage* for a period of at least 5 seconds; and (4) 70% to 80% of *normal voltage* for a period of at least 2 seconds. **Negotiated access standard** (c) In negotiating a *negotiated access standard*, a *generating system* and each of its operating *generating units* must be capable of *continuous uninterrupted operation* for the range of *voltages* specified in the *automatic access standard* except where *AEMO* and the *Network Service Provider* agree that~~:~~	**S5.2.5.4 Generating system response to voltage disturbances** There is now little difference between the minimum and automatic access standards which is contrary to the principles set out in 2005 which established the system of graded access. The way AEMO and some NSP's have been interpreting this clause (and the clause for automatic access) in practice is contrary to normal engineering design in that they require the generation plant to operate at rated power and reactive power output even though reactive power is not mentioned in the clause. This leads to plant needing to being built over its nominal rated capacity which leads to an overinvestment in generation assets with little or no benefit to the power system. Although the first clause of the negotiated access standard clause has not changed – the voltages referred to in the automatic access standard have making it more onerous than before. If implemented this will lead to an over investment in voltage insulation or prevent projects from being built.

AEMO's proposed Rule Changes	Comments by Advisian
~~(1) the *negotiated access standard* is as close as practicable to the *automatic access standard* while respecting the need to protect the *plant* from damage;~~ ~~(2) the *generating plant* that would be trippedtotal reduction of *generation* in the *power system* as a result of any *voltage* excursion within levels specified by the *automatic access standard*, is not more thanwould not exceed 100 MW. or a greater limit based on what *AEMO* and the *Network Service Provider* both consider to be reasonable in the circumstances; and~~ ~~(3) there would be no material adverse impact on the quality of *supply* to other *Network Users* or *power system security*.~~ (d) In carrying out assessments of proposed *negotiated access standards* under this clause S5.2.5.4, *AEMO* and the *Network Service Provider* must at a minimum, take into account: (1) the expected performance of existing *networks* and *considered projects*; (2) the expected performance of existing *generating plant* and other relevant projects; and ~~(3) any corresponding *performance standard* (or where no *performance standard* has been registered, the *access standard*) that allows *generating plant* to trip for *voltage* excursions in ranges specified under the *automatic access standards*.~~ (e) *AEMO* must advise on matters relating to *negotiated access standards* under this clause S5.2.5.4. **General requirement** (f) The *access standard* must include any operational arrangements necessary to ensure the *generating system* and each of its *generating units* will meet its agreed performance levels under abnormal *network* or *generating system* conditions.	**S5.2.5.4 Generating system response to voltage disturbances** The removal of the words "*respecting the need to protect the plant from damage*" appears to trivialise the effect that equipment damage can have on an investment, hazard to personnel and system security. Accordingly we believe these words should be retained. The 100 MW figure has now been made mandatory which is an arbitrary value which may not be of relevance depending on the connection point being considered. The removal of the phrase "*no material impact on quality of supply to other Network users ..etc*" appears to remove a difficult to define concept which tidy's up the clause. This appears to simplify the requirement in that item 3 is already captured under item 2. **S5.2.5.4 Recommendation** Advisian recommend the proposed change to the minimum access standard be rejected for the reasons set out above. The changes to the negotiated access standard appear arbitrary and the clause should be redrafted to make it clearer.

AEMO's proposed Rule Changes	Comments by Advisian
S5.2.5.5 Generating system response to disturbances following contingency events (a) In this clause S5.2.5.5 a fault includes: (1) a fault of the relevant type having a metallic conducting path; and (2) a fault of the relevant type resulting from reclosure onto a fault by the operation of *automatic reclose equipment*. **Automatic access standard** (b) The *automatic access standard* is: (1) a *generating system* and each of its *generating units* must remain in *continuous uninterrupted operation* for up to fifteen ~~a~~ disturbances within any five-minute period caused by any combination of the following events ~~that is~~: (i) a *credible contingency event* other than a fault referred to in subparagraph (iv); (ii) a three phase fault in a *transmission system* cleared by all relevant primary *protection systems*; (iii) a two phase to ground, phase to phase or phase to ground fault in a *transmission system* cleared in: (A) the longest time expected to be taken for a relevant *breaker fail protection system* to clear the fault; or (B) if a *protection system* referred to in subparagraph (A) is not installed, the greater of the time specified in column 4 of Table S5.1a.2 (or if none is specified, 430 milliseconds) and the longest time expected to be taken for all relevant primary *protection systems* to clear the fault; and (iv) a three phase, two phase to ground, phase to phase or phase to ground fault in a *distribution network* cleared in: (A) the longest time expected to be taken for the *breaker fail protection system* to clear the fault; or	**S5.2.5.5 Generating system response to disturbances following contingency events** No known existing generator technology is able to achieve this in all of the possible combinations of scenarios, mainly due to system transient stability considerations. The clause indicates that the generator should be able to ride through fifteen disturbances within a five minute period but does not define when those disturbances take place relative to each other. If they were to occur one after the other, from a transient stability viewpoint this would be roughly equivalent to a fault that lasts 15 x 100 ms = 1500 ms, which is more than three times the length typically seen for the critical clearing times. Another obvious flaw with this clause is that it puts the onus for compliance on the generator. In actual power systems the ability to ride through faults is mainly dependent on the network protection systems (fault clearing times), network impedances and the complex interactions with other generators. This must be modelled and analysed in order to determine what the most appropriate transient design should be, and what contingent conditions can be safely ridden through. In effect this clause puts a requirement on the generation plant that no traditional synchronous generator would be able to meet, and generation connected via power electronics could only achieve if the system around it remains stable, (which existing systems currently cannot). The situation if rotating machines were to be subjected to this sort of event would be very severe. Rotating machines would be required to accelerate or decelerate at extreme torque depending on the timing of the faults. Most machines, including robust induction motors would suffer mechanical damage, e.g. shaft breakages. In effect, this clause attempts to impose requirements on new entrant generation having little or no regard for the laws of physics, or good engineering practice. The practical effect of this clause were it to be implemented would be to prevent new entrant generation – particularly synchronous machines from connecting to the system.

AEMO's proposed Rule Changes	Comments by Advisian
(B) if a *protection system* referred to in subparagraph (A) is not installed, the greater of 430 milliseconds and the longest time expected to be taken for all relevant primary *protection systems* to clear the fault, provided that none of the events ~~is not one that~~ would *disconnect* the *generating unit* from the *power system* by removing *network elements* from service and that the total time that the *voltage* at the *connection point* is less than 90% of *normal voltage* for 1,800 milliseconds; and (2) subject to any changed *power system* conditions or energy source availability beyond the *Generator's* reasonable control, a *generating system* and each of its *generating units*, in respect of the types of fault described in subparagraphs (1)(ii) to (iv), must supply to or absorb from the *network*: (i) to assist the maintenance of *power system voltages* during the application of the fault~~.~~: (A) capacitive reactive current ~~of at least the greater of~~ in addition to its pre-disturbance ~~reactive current and~~ level of 4% of the maximum continuous current of the *generating system* including all operating *generating units* (in the absence of a disturbance) for each 1% reduction ~~(from its pre-fault level)~~ of *connection point voltage* below 90% of *normal voltage*~~during the fault~~; (B) inductive reactive current in addition to its pre-disturbance reactive current and 6% of the maximum continuous current of the *generating system* including all operating *generating units* (in the absence of a disturbance) for each 1% increase of *connection point voltage* above 110% of *normal voltage*; during the disturbance and maintained until the *connection point voltage* recovers to between 90% and 110% of *normal voltage*, (ii) after *disconnection* of the faulted element, *reactive power* sufficient to ensure that the *connection point voltage* is within the range for *continuous uninterrupted operation* under clause S5.2.5.4; and (iii) from 100 milliseconds after *disconnection* of the faulted element, *active power* of at least 95% of the level existing just prior to the fault. **Minimum access standard** (c) The *minimum access standard* is: (1) a *generating system* and each of its *generating units* must remain in *continuous uninterrupted operation* for ~~the~~ up to fifteen disturbances within any five-minute period caused by any combination of the following events~~ that is~~: (i) a *credible contingency event* other than a fault referred to in subparagraph (iii); (ii) a single phase to ground, phase to phase or two phase to ground fault in a *transmission system*, or *distribution network*, cleared in the longest time expected to be taken for all relevant primary *protection systems* to clear the fault unless *AEMO* and the *Network Service Provider* agree that~~:~~ ~~(A) the total reduction of *generation* in the *power system* due to that fault would not exceed 100 MW;~~ ~~(B) there is unlikely to be an adverse impact on quality of *supply* to other *Network Users*; and~~ ~~(C) there is unlikely to be a material adverse impact on *power system security*; and~~ ~~(iii) a single phase to ground, phase to phase or two phase to ground fault in a *distribution network*, cleared in the longest time expected to be taken for all relevant primary *protection systems* to clear the fault, unless *AEMO* and the	**S5.2.5.5 Generating system response to disturbances following contingency events** This latter point mitigates the intent of the clause only slightly – no known generation technology can meet the requirements of this clause due to transient stability considerations. The intent of this clause appears to be to require a 4% droop characteristic on reactive power and system voltage, this is high for reactive power droop but not difficult to achieve. However there has been no wording to suggest what the limit to output should apply. If you were to reduce the voltage by 90%, according to the wording, the reactive power output should increase by 90 x 4 = 360 %. This is not possible for invertor based technologies to achieve and is unlikely even for synchronous generators (they need a SCR of at least 3.6 which implies a transient impedance plus transformer impedance of < 28%). Similar remarks apply to the inductive situation except a 6% droop characteristic is implied, and no limit has been defined for the overvoltage situation. As stated above, no known existing generator technology is able to achieve this in all of the possible combinations of scenarios, in part due to system transient stability considerations; it is also a system issue, not a generator issue per se. **S5.2.5.5 Recommendation**

AEMO's proposed Rule Changes	Comments by Advisian
S5.2.5.7 Partial load rejection ~~(a)~~ For the purposes of this clause S5.2.5.7 **minimum load** means minimum *sent out generation* for continuous stable operation. ~~(b) This clause S5.2.5.7 does not apply to an *asynchronous generating unit*.~~ **Automatic access standard** (c) The *automatic access standard* is a *generating system* ~~*unit*~~ must be capable of *continuous uninterrupted operation* during and following a *power system load* reduction of 30% from its predisturbance level or equivalent impact from separation of part of the *power system* in less than 10 seconds, provided that the *loading level* remains above minimum load. **Minimum access standard** (d) The *minimum access standard* is a *generating system* ~~*unit*~~ must be capable of *continuous uninterrupted operation* during and following a *power system load* reduction of 5% or equivalent impact from separation of part of the *power system* in less than 10 seconds provided that the *loading level* remains above minimum load. **Negotiated access standard** ~~(e) If in accordance with clause 5.3.4A the *Generator* and the *Network Service Provider* determine a *negotiated access standard* is to apply, the *Network Service Provider* must consult *AEMO* to ensure that the *negotiated access standard* does not materially adversely affect *power system security*.~~ (f) *AEMO* must advise on matters relating to *negotiated access standards* under this clause S5.2.5.7. **General requirements** (g) The actual partial load rejection performance must be recorded in the ~~*access*~~ *performance standards*.	**S5.2.5.7 Partial load rejection** Noted Noted. Asynchronous generating plant is now required to operate for a partial load rejection. Noted drafting change. The requirement on the NSP's to consult with AEMO has been removed which seems to allow NSP's to avoid consultation with AEMO for Negotiated Access standards. **S5.2.5.7 Recommendation** Advisian question the proposed changes particularly the removal of the NSP's to consult with AEMO.

AEMO's proposed Rule Changes	Comments by Advisian
S5.2.5.11 Frequency control (a) For the purpose of this clause S5.2.5.11: ~~**maximum operating level** means in relation to:~~ ~~(1) a *non-scheduled generating unit*, the maximum *sent out generation* consistent with its *nameplate rating*;~~ ~~(2) a *scheduled generating unit* or *semi-scheduled generating unit*, the maximum *sent out generation*;~~ ~~(3) a *non-scheduled generating system*, the combined maximum *sent out generation* consistent with the *nameplate ratings* of its in-service *generating units*; and~~ ~~(4) a *scheduled generating system* or *semi-scheduled generating system*, the combined maximum *sent out generation* of its in-service *generating units*.~~ **minimum operating level** means in relation to: (1) a *non-scheduled generating unit*, its minimum *sent out generation* for continuous stable operation; (2) a *scheduled generating unit* or *semi-scheduled generating unit*, its minimum *sent out generation* for continuous stable operation; (3) a *non-scheduled generating system*, the combined *minimum operating level* of its in-service *generating units*; and (4) a *scheduled generating system* or *semi-scheduled generating system*, the combined minimum *sent out generation* of its in-service *generating units*. ~~**pre-disturbance level** means in relation to a *generating unit* and a *frequency* disturbance, the *generating unit's* level of output just before the *system frequency* first exceeds the upper or lower limit of the *normal operating frequency band* during the *frequency* disturbance.~~ ~~**system frequency** means the *frequency* of the *transmission system* or *distribution system* to which the *generating unit* or *generating system* is *connected*.~~ **droop** means in relation to *frequency response mode*, the percentage change in *power system frequency* at the *connection point* required to produce a change in *power transfer* equal to the *maximum operating level* of the *generating system*. **Automatic access standard** (b) The *automatic access standard* is: (1) a *generating system's power transfer* ~~*active power* transfer~~ to the *power system* must not: (i) increase in response to a rise in *power system frequency* at the *connection point* ~~system frequency~~; or	**S5.2.5.11 frequency control** The definitions of maximum operating level has been removed, whereas the minimum operating level has been retained – this appears to be an inconsistent approach. Two definitions have been removed and one added. For reasons of consistency Advisian believe all definitions in the rules should be located at a single location in the overall document. This clause makes it clearer where the frequency is to be measured – system frequency is a nebulous term because it can be different at different locations on the system for short periods of time.

AEMO's proposed Rule Changes	Comments by Advisian
(ii) decrease in response to a fall in *power system frequency* at the *connection point* ~~system frequency~~; (2) a *generating system* must be capable of automatically providing a proportional: (i) decrease in *power transfer* to the *power system* in response to a rise in *power system frequency* at the *connection point*; and~~reducing its *active power* transfer to the *power system*~~: ~~(i) whenever the system frequency exceeds the upper limit of the *normal operating frequency band*;~~ (ii) increase in *power transfer* to the *power system* in response to a fall in *power system frequency* at the *connection point*; and ~~by an amount that equals or exceeds the least of:~~ ~~(A) 20% of its maximum operating level times the percentage *frequency* difference between system frequency and the upper limit of the *normal operating frequency band*;~~ ~~(B) 10% of its maximum operating level; and~~ ~~(C) the difference between the *generating unit's* pre-disturbance level and minimum operating level, but zero if the difference is negative; and~~ ~~(iii) sufficiently rapidly for the *Generator* to be in a position to offer measurable amounts of lower services to the *spot market* for *market ancillary services*; and~~ ~~(3) a *generating system* must be capable of automatically increasing its *active power* transfer to the *power system*:~~ ~~(i) whenever the system frequency falls below the lower limit of the *normal operating frequency band*;~~ ~~(ii) by the amount that equals or exceeds the least of:~~ ~~(A) 20% of its maximum operating level times the percentage *frequency* difference between the lower limit of the *normal operating frequency band* and system frequency;~~ ~~(B) 5% of its maximum operating level; and~~ ~~(C) one third of the difference between the *generating unit's* maximum operating level and pre-disturbance level, but zero if the difference is negative; and~~ ~~(iii)~~ sufficiently rapidly and sustained for a sufficient period for the *Generator* to be in a position to offer measurable amounts of *market ancillary services* ~~raise services~~ to the *spot market* for each of the *market ancillary services*.	**S5.2.5.11 frequency control** This clause also makes it clearer where the frequency is to be measured. This clause requires generating systems to provide a proportional response to frequency changes as is traditional for speed droop governing, the change from "active power" to "power" is unnecessary. The speed of response of the generating system is tied to the ancillary services market, which includes all markets. Existing large scale thermal generation which have slow governing responses may not be able to contribute to FFR or 6 second markets (this was the reason why 1 minute and 5 minute markets were introduced). Small energy rated battery systems may struggle to contribute to 5 minute markets. The phrase "relatively stable" is present whereas it is absent for the automatic access standard. Some wording should be added to include the intent of "relatively stable" in both sections to avoid generators being non-compliant during power swing conditions. A clear definition of what "relatively stable" means should be provided.

AEMO's proposed Rule Changes	Comments by Advisian
Minimum access standard (c) The *minimum access standard* is: (1) a *generating system* under relatively stable input energy, *power transfer* ~~*active power transfer*~~ to the *power system* must not: (i~~1~~) increase in response to a rise in *power system frequency* at the *connection point* ~~system frequency~~; or ~~and~~ (ii~~2~~) decrease more than 2% per Hz in response to a fall in *power system frequency* at the *connection point* ~~system frequency.~~; (2) a *generating system* with a *nameplate rating* of 30MW or more must be capable of automatically providing a proportional: (i) decrease in *power transfer* to the *power system* in response to a rise in *power system frequency* at the *connection point*; and (ii) subject to paragraph (c)(i)(ii), increase in *power transfer* to the *power system* in response to a fall in *power system frequency* at the *connection point*.	**S5.2.5.11 frequency control**

AEMO's proposed Rule Changes	Comments by Advisian
sufficiently rapidly and sustained for a sufficient period for the *Generator* to be in a potion to offer measurable amounts of *market ancillary services* to each of the *spot market* for at least one of the *market ancillary services*. **Negotiated access standard** (d) A *Generator* proposing a *negotiated access standard* in respect of paragraph (c)(2)(1)(ii) must satisfy ~~demonstrate to~~ *AEMO* and the *Network Service Provider* that the proposed ~~increase and~~ decrease in *power transfer* ~~active power transfer~~ to the *power system* is ~~are~~ as close as practicable to the *automatic access standard* ~~for that plant~~. ~~(e) The *negotiated access standard* must record the agreed values for maximum operating level and minimum operating level, and where relevant the method of determining the values and the values for a *generating system* must take into account its in-service *generating units*.~~ (f) *AEMO* must advise on matters relating to *negotiated access standards* under this clause S5.2.5.11. **General requirements** (g) Each *control system* used to satisfy this clause S5.2.5.11 must be *adequately damped*. (h) The amount of a relevant *market ancillary service* for which the *plant* may be registered must not exceed the amount that would be consistent with the *performance standard* registered in respect of this requirement. (i) For the purposes of paragraphs (b)(2) and (c)(2): (1) the change in *power transfer* to the *power system* must occur with no delay beyond that required for stable operation, or inherent in the *plant* controls, once *power system frequency* at the *connection point* leaves a dead-band around 50 Hz; (2) This dead-band must be set within the range 0 to ±1.0 Hz. Different dead-band settings may be applied for a rise or fall in *power system frequency* at the *connection point*; (3) The *frequency* droop must be set within the range of 2% to 10%; and (4) A *generating system* is not required to operate below its minimum operating level in response to a rise in *power system frequency* at the *connection point*, or above its *maximum operating level* in response to a fall in *power system frequency* at the *connection point*. (e) The *performance standard* must record: (1) the agreed values for *maximum operating level* and minimum operating level and, where relevant, the method of determining the values and the values for a *generating system* must take into account its in-service *generating units*; (2) the dead-band and droop settings applied; and (3) the agreed time for sustained response in *power transfer* to a rise or fall in *power system frequency* at the *connection point*.	**S5.2.5.11 frequency control** The speed of response of the generating system is tied to the ancillary services market, which includes all markets. Existing large scale thermal generation which have slow governing responses may not be able to contribute to FFR or 6 second markets (this was the reason why 1 minute and 5 minute markets were introduced). Small energy rated battery systems may struggle to contribute to 5 minute markets. Noted Noted Noted Noted Noted Rather than a specified time, the actual response to a step change in frequency should probably be agreed. **S5.2.5.11 Recommendation** Advisian believe the proposed changes should be redrafted to make the intent clearer in some areas as discussed above.

AEMO's proposed Rule Changes	Comments by Advisian
S5.2.5.13 Voltage and reactive power control (a) For the purpose of this clause S5.2.5.13: ~~**rise time** means in relation to a step response test or simulation of a *control system*, the time taken for an output quantity to rise from 10% to 90% of the maximum change induced in that quantity by a step change of an input quantity.~~ ~~**settling time** means in relation to a step response test or simulation of a *control system*, the time measured from initiation of a step change in an input quantity to the time when the magnitude of error between the output quantity and its final settling value remains less than 10% of:~~ ~~(1) if the sustained change in the quantity is less than half of the maximum change in that output quantity, the maximum change induced in that output quantity; or~~	**S5.2.5.13 Voltage and reactive power control** Two definitions have been removed and one added. For reasons of consistency Advisian believe all definitions in the rules should be located at a single location in the overall document.

AEMO's proposed Rule Changes	Comments by Advisian
~~(2) the sustained change induced in that output quantity.~~ **static excitation system** means in relation to a *synchronous generating unit*, an *excitation control system* that does not use rotating machinery to produce the field current. **Automatic access standard** (b) The *automatic access standard* is: (1) a *generating system* must have *plant* capabilities and *control systems* sufficient to ensure that: (i) *power system* oscillations, for the frequencies of oscillation of the *generating unit* against any other *generating unit*, are *adequately damped*; (ii) operation of the *generating system* does not degrade the damping of any critical mode of oscillation of the *power system*; and (iii) operation of the *generating system* does not cause instability (including hunting of *tap-changing transformer control systems*) that would adversely impact other *Registered Participants*; (2) a *control system* must have: (i) for the purposes of disturbance monitoring and testing, permanently installed and operational, monitoring and recording *facilities* for key variables including each input and output; and (ii) *facilities* for testing the *control system* sufficient to establish its dynamic operational characteristics;	**S5.2.5.13 Voltage and reactive power control**
(2A) all *generating systems* must have a *voltage control system* that: (i) regulates *voltage* at the *connection point* or another agreed location in the *power system* (including within the *generating system*) to within 0.5% of the setpoint; (ii) regulates *voltage* in a manner that helps to support *network voltages* during faults and does not prevent the *Network Service Provider* from achieving the requirements of clause S5.1a.3 and S5.1a.4; (iii) allows the *voltage* setpoint to be continuously controllable in the range of at least 95% to 105% of *normal voltage* at the *connection point* or agreed location on the power system, without reliance on a *tap-changing transformer*; and (iv) has limiting devices to ensure that a *voltage* disturbance does not cause the *system* or any of its *generating units* to trip at the limits of its operating capability;	This is physically impossible on high fault level systems. The system will dictate the voltage level not the generator. Noted This is physically impossible on high fault level systems. The exclusion of transformer tap changing from voltage regulation duty is contrary to normal power engineering practice. Noted
(3) each ~~a~~ *synchronous generating ~~system~~ unit* must have an *excitation control system* that: ~~(i) regulates *voltage* at the *connection point* or another agreed location in the *power system* (including within the *generating system*) to within 0.5% of the setpoint;~~ (ii) is able to operate the stator continuously at 105% of *nominal voltage* with *rated active power* output; ~~(iii) regulates *voltage* in a manner that helps to support *network voltages* during faults and does not prevent the *Network Service Provider* from achieving the requirements of clause S5.1a.3 and S5.1a.4;~~	Noted Noted

AEMO's proposed Rule Changes	Comments by Advisian
~~(iv) allows the *voltage* setpoint to be continuously controllable in the range of at least 95% to 105% of *normal voltage* at the *connection point* or the agreed location, without reliance on a *tap changing transformer*;~~ ~~(v) has limiting devices to ensure that a *voltage* disturbance does not cause the *generating unit* to trip at the limits of its operating capability;~~ (vi) has an excitation ceiling *voltage* of at least: (A) for a static excitation system, 2.3 times; or (B) for other *excitation control systems*, 1.5 times, the excitation required to achieve *generation* at the *nameplate rating* for rated *power factor*, rated speed and *nominal voltage*; (vii) has *settling times* for a step change of *voltage* setpoint or *voltage* at the location agreed under subparagraph (2A)(i) of: (A) generated *voltage* less than 2.5 seconds for a 5% *voltage* disturbance with the *generating unit* not *synchronised*; (B) *active power*, *reactive power* and *voltage* less than 5.0 seconds for a 5% *voltage* disturbance with the *generating unit synchronised*, from an operating point where the *voltage* disturbance would not cause any limiting device to operate; and (C) in respect of each limiting device, *active power*, *reactive power* and *voltage* less than 7.5 seconds for a 5% *voltage* disturbance with the *generating unit synchronised*, when operating into a limiting device from an operating point where a *voltage* disturbance of 2.5% would just cause the limiting device to operate; (viii) is able to increase field *voltage* from rated field *voltage* to the excitation ceiling *voltage* in less than: (A) 0.05 second for a static excitation system; or (B) 0.5 second for other *excitation control systems*; and (ix) has a *power system* stabiliser with sufficient flexibility to enable damping performance to be maximised, with characteristics as described in paragraph (c); and (x) has reactive current compensation settable for boost or droop; and	**S5.2.5.13 Voltage and reactive power control** Noted Noted

AEMO's proposed Rule Changes	Comments by Advisian
(4) the *voltage control system* for a *generating system*~~, other than one~~ comprised of *asynchronous generating units*~~,~~ must have ~~a *voltage control system* that~~: ~~(i) regulates *voltage* at the *connection point* or an agreed location in the *power system* (including within the *generating system*) to within 0.5% of its setpoint;~~ ~~(ii) regulates *voltage* in a manner that helps to support *network voltages* during faults and does not prevent the *Network Service Provider* from achieving the requirements of clauses S5.1a.3 and S5.1a.4;~~ ~~(iii) allows the *voltage* setpoint to be continuously controllable in the range of at least 95% to 105% of *normal voltage* at the *connection point* or agreed location in the *power system*, without reliance on a *tap changing transformer*;~~ ~~(iv) has limiting devices to ensure that a *voltage* disturbance does not cause the *generating unit* to trip at the limits of its operating capability;~~ (v) with the *generating system connected* to the *power system*, ~~has~~ *settling times* for *active power*, *reactive power* and *voltage* due to a step change of *voltage* setpoint or *voltage* at the location agreed under clause subparagraph (2A)(i), of less than: (A) 5.0 seconds for a 5% *voltage* disturbance with the *generating system connected* to the *power system*, from an operating point where the *voltage* disturbance would not cause any limiting device to operate; and (B) 7.5 seconds for a 5% *voltage* disturbance with the *generating system connected* to the *power system*, when operating into any limiting device from an operating point where a *voltage* disturbance of 2.5% would just cause the limiting device to operate; (vi) ~~has~~ *reactive power rise time*, for a 5% step change in the *voltage* setpoint, of less than 2 seconds; and	**S5.2.5.13 Voltage and reactive power control** Noted Noted Noted Noted
Page 16	
~~(vii) has a *power system* stabiliser with sufficient flexibility to enable damping performance to be maximised, with characteristics as described in paragraph (c); and~~ (viii) ~~has~~ reactive current compensation. (c) A *power system* stabiliser provided under paragraph (b) must have: (1) for a *synchronous generating unit*, measurements of rotor speed and *active power* output of the *generating unit* as inputs, and otherwise, measurements of *power system frequency* at the *connection point* and *active power* output of the *generating unit* as inputs;	Noted This is a minor point, but almost all PSS measure frequency at the generator terminals, and some do not measure frequency at all but rather use generator shaft speed. Advisian recommends the words "at the connection point" be removed.

AEMO's proposed Rule Changes	Comments by Advisian
(2) two washout filters for each input, with ability to bypass one of them if necessary; (3) sufficient (and not less than two) lead-lag transfer function blocks (or equivalent number of complex poles and zeros) with adjustable gain and time-constants, to compensate fully for the phase lags due to the *generating plant*; (4) an output limiter, which for a *synchronous generating unit* is continually adjustable over the range of –10% to +10% of stator *voltage*; (5) monitoring and recording *facilities* for key variables including inputs, output and the inputs to the lead-lag transfer function blocks; and (6) *facilities* to permit testing of the *power system* stabiliser in isolation from the *power system* by injection of test signals, sufficient to establish the transfer function of the *power system* stabiliser. **Minimum access standard** (d) The *minimum access standard* is: (1) a *generating system* must have *plant* capabilities and *control systems*, including, if appropriate, a *power system* stabiliser, sufficient to ensure that: (i) *power system* oscillations, for the frequencies of oscillation of the *generating unit* against any other *generating unit*, are *adequately damped*; (ii) operation of the *generating unit* does not degrade: (A) any mode of oscillation that is within 0.3 nepers per second of being unstable, by more than 0.01 nepers per second; and (B) any other mode of oscillation to within 0.29 nepers per second of being unstable; and (iii) operation of the *generating unit* does not cause instability (including hunting of *tap-changing transformer control systems*) that would adversely impact other *Registered Participants*; (2) a *generating system* comprised of *generating units* with a combined *nameplate rating* of 30 MW or more must have *facilities* for testing its *control systems* sufficient to establish their dynamic operational characteristics; (3) the *voltage control system* for a ~~*generating unit* or~~ *generating system* ~~and each of its *generating units*~~ must ~~have~~ ~~*facilities*~~: (i) regulates ~~*voltage*~~ at the *connection point*, or at another agreed location on the *power system* or within the *generating system*, to within 2% of the setpoint~~, *power factor* or *reactive power* as agreed with the *Network Service Provider* and *AEMO*~~; (ii) regulate *voltage* in a manner that helps to support *network voltages* during faults and does not prevent the *Network Service Provider* from achieving the requirements of clause S5.1a.3 and S5.1a.4;	**S5.2.5.13 Voltage and reactive power control**

AEMO's proposed Rule Changes	Comments by Advisian
(iii) allow the *voltage* setpoint to be continuously controllable in the range of at least 98% to 102% of *normal voltage* at the *connection point* or the agreed location, without reliance on a *tap-changing transformer*;	**S5.2.5.13 Voltage and reactive power control** This is physically impossible for high fault level systems.
(iv) have limiting devices to ensure that a *voltage* disturbance does not cause the *generating unit* to trip at the limits of its operating capability; ~~where the *connection point nominal voltage* is 100 kV or more, must have *facilities* to regulate *voltage* in a manner that does not prevent the *Network Service Provider* from achieving the requirements of clauses S5.1a.3 and S5.1a.4; or~~ and	Noted
(v) where the *generating units* are *embedded generating units* ~~*connection point nominal voltage* is less than 100 kV~~, may have *facilities* to regulate ~~*voltage* or~~ *reactive power* or *power factor* in a manner that does not prevent the *Network Service Provider* from achieving the requirements of clauses S5.1a.3 and S5.1a.4, and sufficient to achieve the performance agreed in respect of clauses S5.2.5.1, S5.2.5.2, S5.2.5.3, S5.2.5.4, S5.2.5.5, S5.2.5.6 and S5.2.5.12;	Noted
(4) an *excitation control system* for a *synchronous generating unit*~~,~~ that is part of a *generating system* ~~comprised of *generating units*~~ with a ~~combined~~ *nameplate rating* of 30 MW or more~~,~~ must ~~have an *excitation control system* that~~:	
~~(i) regulates *voltage* at the *connection point*, or at another agreed location on the *power system* or within the *generating system*, to within 2% of the setpoint, *power factor* or *reactive power* as agreed with the *Network Service Provider* and *AEMO*;~~	
(ii) operate the stator continuously at 102% of *nominal voltage* with *rated active power* output;	This requirement appears to be overly prescriptive (why 102%? – there is no technical reason for this value)
~~(iii) regulates *voltage* in a manner that helps to support *network voltages* during faults and does not prevent the *Network Service Provider* from achieving the requirements of clause S5.1a.3 and S5.1a.4;~~	Noted
~~(iv) allows the *voltage* setpoint to be continuously controllable in the range of at least 98% to 102% of *normal voltage* at the *connection point* or the agreed location, without reliance on a *tap-changing transformer*;~~	Noted
~~(v) has limiting devices to ensure that a *voltage* disturbance does not cause the *generating unit* to trip at the limits of its operating capability;~~	Noted

AEMO's proposed Rule Changes	Comments by Advisian
~~(vi) has limiting devices to ensure that a *voltage* disturbance does not cause the *generating unit* to trip at the limits of its operating capability;~~ (~~v~~ii) haves an excitation ceiling *voltage* of at least 1.5 times the excitation required to achieve *generation* at the *nameplate rating* for rated *power factor*, rated speed and *nominal voltage*; (~~v~~iii) subject to co-ordination under paragraph (~~i~~i), haves a *settling* time for a step change of *voltage* setpoint or *voltage* at the location agreed under subparagraph (3)(i): (A) for *active power*, *reactive power* and *voltage* ~~*time*~~ of less than 5.0 seconds for a 5% *voltage* disturbance with the *generating unit* synchronised, from an operating point where such a *voltage* disturbance would not cause any limiting device to operate; and (B) in respect of each limiting device, *active power*, *reactive power* and *voltage* less than 25 seconds for a 5% *voltage* disturbance with the *generating unit synchronised*, when operating into a limiting device from an operating point where a *voltage* disturbance of 2.5% would just cause the limiting device to operate; (i~~x~~v) haves over- and under-excitation limiting devices sufficient to ensure that a *voltage* disturbance does not cause the *generating unit* to trip at the limits of its operating capability; and (5) the *voltage control system* for a *generating system* comprised of *asynchronous generating units* with a ~~combined~~ *nameplate rating* of 30 MW or more ~~and which are asynchronous generating units~~, must ~~have a *control system* that~~:	**S5.2.5.13 Voltage and reactive power control** Noted Noted Voltage settling times are system dependent as well as generator dependent, accordingly this clause should be reworded to clarify this issue. Both the A and B clauses are unclear with respect to their actual intent, the clause should be redrafted to make the intention clear. Noted Noted
Page 18	
~~(i) regulates *voltage* at the *connection point*, or at another agreed location on the *power system* or within the *generating system*, to within 2% of the setpoint*power factor* or *reactive power* as agreed with the *Network Service Provider* and *AEMO*;~~ ~~(ii) regulates *voltage* in a manner that helps to support *network voltages* during faults and does not prevent the *Network Service Provider* from achieving the requirements of clauses S5.1a.3 and S5.1a.4;~~ ~~(iii) allows the *voltage* setpoint to be continuously controllable in the range of at least 98% to 102% of *normal voltage* at the *connection point* or agreed location in the *power system*, without reliance on a *tap changing transformer*;~~	

AEMO's proposed Rule Changes	Comments by Advisian
~~(iv) has limit control to ensure that a *voltage* disturbance does not cause the *generating system* or any of its *generating units* to trip at the limits of its operating capability.~~ (~~iv~~) subject to co-ordination under subparagraph (~~ii~~), haves a *settling times* for *active power*, *reactive power* and *voltage* due to a step change of *voltage* setpoint or *voltage* at the location agreed under clause subparagraph (3)(i), of less than: (A) ~~7~~.5.0 seconds for a 5% *voltage* disturbance with the *generating unit* ~~electrically~~ connected to the *power system* from an operating point where such a *voltage* disturbance would not cause any limiting device to operate; and (B) 25 seconds for a 5% *voltage* disturbance with the *generating unit connected* to the *power system*, when operating into any limiting device from an operating point where a *voltage* disturbance of 2.5% would just cause the limiting device to operate; and ~~(iii) has limiting devices to ensure that a *voltage* disturbance would not cause the *generating unit* to trip at the limits of its operating capability.~~ (~~v~~ii) have *reactive power rise time*, for a 5% step change in the *voltage* setpoint, of less than 5 seconds. **Negotiated access standard** (e) If a *generating system* cannot meet the *automatic access standard*, the *Generator* must demonstrate to the *Network Service Provider* why that standard could not be reasonably achieved and propose a *negotiated access standard*. (f) The *negotiated access standard* proposed by the *Generator* under paragraph (e) must be the highest level that the *generating system* can reasonably achieve, including by installation of additional dynamic *reactive power* equipment, and through optimising its *control systems*. (g) Where *power factor* or *reactive power* regulation modes are included, these are in addition to *voltage* control or excitation control. The *generating system* may operate in any control mode as agreed with the *Network Service Provider* and *AEMO* and must be able to be switched to *voltage* control or excitation control at any time. *Remote control equipment* to change the setpoint and mode of regulation must be provided. (h~~g~~) *AEMO* must advise on matters relating to *negotiated access standards* under this clause S5.2.5.13. **General requirements** (i~~h~~) A limiting device provided under paragraphs (b), ~~and~~ (c) or (d) must: (1) not detract from the performance of any *power system* stabiliser; and (2) be co-ordinated with all *protection systems*. (j~~i~~) The *Network Service Provider* may require that the design and operation of the *control systems* of a *generating unit* or *generating system* be coordinated with the existing *voltage control systems* of the *Network Service Provider* and of other *Network Users*, in order to	**S5.2.5.13 Voltage and reactive power control** Same comments apply for asynchronous and synchronous generation Duplication should be removed and the clause apply to both synchronous and asynchronous generation. There is no system reason why this requirement for asynchronous generation could not also be applied to synchronous. Extending it would make the clause technology neutral In some situations constant PF or reactive power control is preferable. As this equipment is standard Advisian recommend it also be included in the Automatic Access requirements

AEMO's proposed Rule Changes	Comments by Advisian
avoid or manage interactions that would adversely impact on the *Network Service Provider* and other *Network Users*. (~~k~~j) Any requirements imposed by the *Network Service Provider* under paragraph (~~j~~i) must be recorded in the *access standard*. (~~l~~k) The assessment of impact of the *generating units* on *power system* stability and damping of *power system* oscillations shall be in accordance with the guidelines for *power system* stability established under clause 4.3.4(h).	**S5.2.5.13 Recommendation** Advisian recommend the proposed change be rejected for the reasons set out above. Specifically the impractical requirements on all generating plant and the incorrect technical assumptions that have been made. Many subclauses are unclear with respect to their actual intent, the clause should be redrafted to make the intention clear.
S5.2.5.14 Active power control (a) The *automatic access standard* is a *generating system* ~~comprised of *generating units* with a combined *nameplate rating* of 30 MW or more~~ must have an *active power control system* capable of: (1) for a *scheduled generating unit* or a *scheduled generating system*: (i) maintaining and changing its *active power* output in accordance with its *dispatch instructions*; ~~and~~ (ii) ramping its *active power* output linearly from one level of *dispatch* to another; and (iii) receiving and automatically responding to signals delivered from the *AGC*, as updated at a rate of once every four seconds; (2) subject to energy source availability, for a *non-scheduled generating unit* or *non-scheduled generating system*: (i) automatically reducing or increasing its *active power* output within 5 minutes, at a constant rate, to or below the level specified in an instruction electronically issued by a *control centre*, subject to subparagraph (iii); (ii) automatically limiting its *active power* output, to below the level specified in subparagraph (i); and (iii) not changing its *active power* output within 5 minutes by more than the raise and lower amounts specified in an instruction electronically issued by a *control centre*; and (3) subject to energy source availability, for a *semi-scheduled generating unit* or a *semi-scheduled generating system*: (i) automatically reducing or increasing its *active power* output within 5 minutes at a constant rate, to or below the level specified in an instruction electronically issued by a *control centre*; (ii) automatically limiting its *active power* output, to or below the level specified in subparagraph (i); (iii) not changing its *active power* output within 5 minutes by more than the raise and lower amounts specified in an instruction electronically issued by a *control centre*; ~~and~~ (iv) ramping its *active power* output linearly from one level of *dispatch* to another~~.~~; and (v) receiving and automatically responding to signals delivered from the *AGC*, as updated at a rate of once every four seconds.	**S5.2.5.14 Active power control** The 30 MW requirement has been removed this could cause very small generators to be required to meet these requirements which is contrary to established practice, and would lead to excessive costs being imposed on small generation systems. Noted Noted

AEMO's proposed Rule Changes	Comments by Advisian
Minimum access standard (b) The *minimum access standard* is a *generating system* ~~comprised of *generating units* with a combined *nameplate rating* of 30 MW or more~~ must have an *active power control system* capable of: (1) for a *scheduled generating unit* or a *scheduled generating system*; Page 20 (i) ~~,~~ maintaining and changing its *active power* output in accordance with its *dispatch instructions*; and (ii) receiving and automatically responding to signals delivered from the *AGC*, as updated at a rate of once every four seconds (2) for a *non-scheduled generating system*: (i) reducing its *active power* output, within 5 minutes, to or below the level required to manage *network* flows that is specified in a verbal instruction issued by the *control centre*; (ii) limiting its *active power* output, to or below the level specified in subparagraph (i); and (iii) subject to energy source availability, ensuring that the change of *active power* output in a 5 minute period does not exceed a value specified in a verbal instruction issued by the *control centre*; and ~~(iv) being upgraded to receive electronic instructions from the *control centre* and fully implement them within 5 minutes; and~~ (3) subject to energy source availability, for a *semi-scheduled generating unit* or a *semi-scheduled generating system*: (i) ~~,~~ maintaining and changing its *active power* output in accordance with its *dispatch instructions*~~.~~; (ii) not changing its *active power* output within five minutes by more than the raise and lower amounts specified in an instruction electronically issued by a *control centre*; and (iii) receiving and automatically responding to signals delivered from the *AGC*, as updated at a rate of once every four seconds.	**S5.2.5.13 Voltage and reactive power control** The 30 MW requirement has been removed this could cause very small generators to be required to meet these requirements which is contrary to established practice, and would lead to excessive costs being imposed on small generation systems. This is an onerous requirement for small units Noted – onerous requirement for small units

AEMO's proposed Rule Changes	Comments by Advisian
Negotiated access standard (c) A *negotiated access standard* may provide that if the number or frequency of verbal instructions becomes difficult for a *control centre* to manage, *AEMO* may require the *Generator* to upgrade its *facilities* to receive electronic instructions and fully implement them within 5 minutes. (d) The *negotiated access standard* must document to *AEMO's* satisfaction any operational arrangements necessary to manage *network* flows that may include a requirement for the *non-scheduled generating system* to be operated in a manner that prevents its output changing within 5 minutes by more than an amount specified by a *control centre*. (e) *AEMO* must advise on matters relating to *negotiated access standards* under this clause S5.2.5.14. **General requirements** (f) Each *control system* used to satisfy the requirements of paragraphs (a) and (b) must be *adequately damped*.	**S5.2.5.14 Recommendation** Advisian recommend the proposed change be rejected for the reasons set out above. Specifically the impractical requirements on small scale generating plant which would make the installations non commercially viable.
S5.2.5.15 System Strength **Minimum access standard** (a) The *minimum access standard* is a *generating system* and each of its *generating units* must be capable of *continuous uninterrupted operation* for any *short circuit ratio* to a minimum of 3.0 at the *connection point*.	**S5.2.5.15 System Strength** This is not practical for any generation system connected to the system via an inverter and difficult to achieve for a synchronous machine. The whole issue of "system strength" needs to be critically examined. As many invertor systems can be shown to operate stably on open circuit systems (very low loads), the necessary requirement for system strength as promulgated by various authorities needs to be clarified and the recent statements debunked if necessary. **S5.2.5.15 Recommendation** Advisian recommend the proposed change be rejected for the reasons set out above. Specifically the impractical requirements on invertor based generating plant which would make the installations non-commercially viable or result in a misallocation of resources leading to a unnecessarily more expensive power system.

AEMO's proposed Rule Changes	Comments by Advisian
S5.2.6 Monitoring and control requirements **S5.2.6.1 Remote Control and Monitoring** **Automatic access standard** (a) The *automatic access standard* is a *generating system*~~:~~ ~~(1) *scheduled generating unit*;~~ ~~(2) *scheduled generating system*;~~ ~~(3) *non-scheduled generating unit* with a *nameplate rating* of 30 MW or more;~~ ~~(4) *non-scheduled generating system* with a combined *nameplate rating* of 30 MW or more;~~ ~~(5) *semi-scheduled generating unit*; or~~ ~~(6) *semi-scheduled generating system*,~~ must have *remote monitoring equipment* and control equipment to transmit to, and receive from, *AEMO's control centres* in real-time in accordance with rule 4.11 the quantities that *AEMO* reasonably requires to discharge its *market* and *power system security* functions set out in Chapters 3 and 4. (b) The quantities referred to under paragraph (a) that *AEMO* may request include: (1) in respect of a *generating system*: (i) the status of all switching devices that carry the *generation*; (ii) *tap-changing transformer* tap position(s) and *voltages*; (iii) *active power* and *reactive power* aggregated for groups of identical *generating units*; (iv) either the number of identical *generating units* operating or the operating status of each non-identical *generating unit*; (v) *active power* and *reactive power* for the *generating system*; (vi) *voltage control* setpoint and mode (where applicable); (2~~1~~) in respect of a *generating unit* with a *nameplate rating* of 30 MW or more: (i) current, *voltage*, *active power* and *reactive power* in respect of *generating unit* stators or power conversion systems (as applicable); ~~(ii) the status of all switching devices that carry the *generation*; and~~ ~~(iii) *tap-changing transformer* tap position;~~ ~~(2) in respect of a *generating system* that includes a *generating unit* with a *nameplate rating* of less than 30 MW:~~ ~~(i) its connected status, *tap-changing transformer* tap position and *voltages*;~~ ~~(ii) *active power* and *reactive power* aggregated for groups of identical *generating units*;~~ ~~(iii) either the number of identical *generating units* operating or the operating status of each non-identical *generating unit*; and~~	**S5.2.6 Monitoring and control requirements** The clauses in this section effectively require a generation plant to monitor almost all electrical and process quantities that are relevant to the operation of the plant and send them via communication link to AEMO. This will result in extensive communication costs which the generator would have to recoup through higher power charges. Beyond quantities measured at the connection point, there is no reason for AEMO to concern itself with the operational details of the generator installation. To do so will incur additional costs and effectively amounts to gold plating the fleet of generation assets for no conceivable benefit to the market. **S5.2.6.1 Remote Control and Monitoring** Noted – this seems to simplify existing requirements Noted – this clarifies want quantities should be monitored Noted – already covered by subclause (1)

AEMO's proposed Rule Changes	Comments by Advisian
~~(iv) *active power* and *reactive power* for the *generating system*;~~ (3) in respect of an auxiliary supply system with a capacity of 30 MW or more associated with a *generating unit* or *generating system*, *active power* and *reactive power*; (4) in respect of *reactive power* equipment that is part of a *generating system* but not part of a particular *generating unit*, its *reactive power*; Page 22 (5) in respect of a ~~wind farm type of~~ *semi-scheduled generating system* all data specified as mandatory in the relevant *energy conversion model* applicable to that type of *semi-scheduled generating system*;~~:~~ ~~(i) wind speed;~~ ~~(ii) wind direction;~~ ~~(iii) ambient temperature; and~~ (6) in respect of a *scheduled generating system* or *semi-scheduled generating system*: (i) maximum *active power* limit; (ii) minimum *active power* limit; (iii) maximum *active power* raise ramp rate; and (iv) maximum *active power* lower ramp rate; (7) in respect of a energy storage system, the available energy (in MWh); (8) in respect of a run-back scheme agreed with the *Network Service Provider*: (i) run-back scheme status; and (ii) *active power*, *reactive power* or other control limit, as applicable; (9) the mode of operation of the *generating unit*, turbine control limits, or other information required to reasonably predict the *active power* response of the *generating system* to a change in *power system frequency* at the *connection point*; and (10~~6~~) any other quantity that *AEMO* reasonably requires to discharge its *market* and *power system security* functions as set out in Chapters 3 and 4.	**S5.2.6 Monitoring and control requirements** Noted Noted Noted – although dam levels are currently provided for pumped storage systems Noted Noted

AEMO's proposed Rule Changes	Comments by Advisian
(c) The remote control quantities referred to under paragraph (a) that *AEMO* may request include: (1) in respect of a *generating system*: (i) *voltage control* setpoint; (ii) *voltage control* mode (where applicable); and (2) in respect of a *scheduled generating system* or *semi-scheduled generating system*: (i) *AGC* control; and (3) in respect of a *non-scheduled generating system*: (i) *active power* limit; and (ii) *active power* ramp limit. **Minimum access standard** (de) The *minimum access standard* is a *generating system* must have *remote monitoring equipment* and control equipment to transmit to *AEMO's control centres* in real-time in accordance with rule 4.11 the quantities that *AEMO* reasonably requires to discharge its *market* and *power system security* functions set out in Chapters 3 and 4.~~:~~ ~~(1) *scheduled generating unit*;~~ ~~(2) *scheduled generating system*;~~ ~~(3) *non-scheduled generating system* with a combined *nameplate rating* of 30 MW or more;~~ ~~(4) *semi-scheduled generating unit*; or~~ ~~(5) *semi-scheduled generating system*,~~ ~~must have *remote monitoring equipment* to transmit to *AEMO's control centres* in real time:~~ ~~(6) the *active power* output of the *generating unit* or *generating system* (as applicable);~~	**S5.2.6 Monitoring and control requirements** Noted Noted below – there is very little difference between Minimum access standards and automatic access standards. This appears to be an example of "gold plating the generation requirements".

AEMO's proposed Rule Changes	Comments by Advisian
~~(7) if *connected* to a *transmission system*, the *reactive power* output of the *generating unit* or *generating system* (as applicable); and~~ ~~(8) if a wind farm type of *generating system*:~~ ~~(i) number of units operating;~~ ~~(ii) wind speed; and~~ ~~(iii) wind direction,~~ ~~in accordance with rule 4.11.~~ (e) The remote monitoring quantities referred to under paragraph (d) that *AEMO* may request include: (1) in respect of a *generating system connected* to a *transmission system*, or *connected* to a *distribution system* with a *nameplate rating* of 30 MW or more: (i) the status of all switching devices that carry the *generation*; (ii) *tap-changing transformer* tap position(s) and *voltages*; (iii) *active power* and *reactive power* for the *generating system*; (iv) *voltage control* setpoint and mode (where applicable); and (v) in respect of *reactive power* equipment that is part of the *generating system* but not part of a particular *generating unit*, its *reactive power*; (2) in respect of a *generating unit* with a *nameplate rating* of 30 MW or more, current, *voltage*, *active power* and *reactive power* in respect of *generating unit* stators or power conversion systems (as applicable); (3) in respect of an auxiliary supply system with a capacity of 30 MW or more associated with a *generating unit* or *generating system*, *active power* and *reactive power*; (5) in respect of a *semi-scheduled generating system* all data as specified in the relevant *energy conversion model* applicable to that type of *semi-scheduled generating system*; (5) in respect of a *scheduled generating system* or *semi-scheduled generating system*: (i) maximum *active power* limit; (ii) minimum *active power* limit; (iii) maximum *active power* raise ramp rate; (iv) maximum *active power* lower ramp rate; (v) *AGC*; (7) in respect of an energy storage system, the available energy (in MWh); (8) in respect of a run-back scheme agreed with the *Network Service Provider*: (i) run-back scheme status; and (ii) *active power*, *reactive power* or other control limit as applicable; (9) the mode of operation of the *generating unit*, turbine control limits, or other information required to reasonably predict the *active power response* of the *generating system* to a change in *power system frequency* at the *connection point*; and	**S5.2.6 Monitoring and control requirements** Noted Noted Noted

AEMO's proposed Rule Changes	Comments by Advisian
(10) any other quantity that *AEMO* reasonably requires to discharge its *market* and *power system security* functions as set out in Chapters 3 and 4. (f) The *remote control* quantities referred to in paragraph (e) that *AEMO* may request include: (1) in respect of a *generating system*: (i) *voltage control* setpoint; (ii) *voltage control* mode (where applicable); and (2) in respect of a *scheduled generating system* or *semi-scheduled generating system*: Page 24 (i) *AGC* controls; and (3) in respect of a *non-scheduled generating system*: (iv) *active power* limit; and (v) *active power* ramp limit. **Negotiated access standard** (~~g~~d) *AEMO* must~~may~~ advise on matters relating to *negotiated access standards* under this clause S5.2.6.1.	**S5.2.6 Monitoring and control requirements** **S5.2.6 Recommendation** Advisian recommend the Automatic and Minimum access requirements be rejected because if these clauses were to be included in the NER it would lead to an over investment in new generation assets or would make them uncompetitive with existing assets already registered (and presumably grand fathered from the effects of this clause). This would lead either to a gold plated fleet of generation assets, or prevent any further generation developments being implemented, ultimately causing the system to be run down with old assets and eventual failure. The Negotiated access standard for this clause is superfluous given that Minimum access and automatic access requirements are virtually the same.

AEMO's proposed Rule Changes	Comments by Advisian
GLOSSARY **Amended Definitions** *continuous uninterrupted operation* In respect of a *generating system* or operating *generating unit* operating immediately prior to a *power system* disturbance, not *disconnecting* from the *power system* except under its *performance standards* established under clauses S5.2.5.8 and S5.2.5.9 and, during the disturbance and after clearance of any electrical fault that caused the disturbance, not ~~only substantially~~ varying ~~its~~ *active power* or ~~and~~ *reactive power* unless required by its *performance standards* established under clauses S5.2.5.5, S5.2.5.11, S5.2.5.13 and S5.2.5.14, with all essential auxiliary and *reactive plant* remaining in service, and responding so as not to exacerbate or prolong the disturbance or cause a subsequent disturbance for other *connected plant*.	**Glossary** **Amended Definitions** The word "not varying" has been inserted which is impractical for most generators. The previous definition reflected the actual situation better.
New Definitions *maximum operating level* In relation to: (1) a *non-scheduled generating unit*, the maximum *sent out generation* consistent with its *nameplate rating*; (2) a *scheduled generating unit* or *semi-scheduled generating unit*, the maximum *generation* to which it may be *dispatched* and as provided to *AEMO* in the most recent *bid and offer validation data*; (3) a *non-scheduled generating system*, the combined maximum *sent out generation* consistent with the *nameplate ratings* of its in-service *generating units*; and (4) a *scheduled generating system* or *semi-scheduled generating system*, the combined maximum *generation* of its in-service *generating units* to which it may be *dispatched* and as provided to *AEMO* in the most recent *bid and offer validation data*.	**New definitions** Noted
rise time In relation to a *control system*, the time taken for an output quantity to rise from 10% to 90% of the maximum change induced in that quantity by a step change of an input quantity.	Noted
settling time In relation to a *control system*, the time measured from initiation of a step change in an input quantity to the time when the magnitude of error between the output quantity and its final settling value remains less than 10% of: (1) if the sustained change in the quantity is less than half of the maximum change in that output quantity, the maximum change induced in that output quantity; or (2) the sustained change induced in that output quantity.	Noted Noted

AEMO's proposed Rule Changes	Comments by Advisian
TRANSITIONAL RULES **11.X Rules Consequential on the making of the National Electricity Amendment (Generator Technical Requirements) Rule 201X** **11.X.1 Definitions** **Amending Rule** means the XYZ Rule. **commencement date** means the date on which the Amending Rule commences operation. **transition date** means the date *AEMO* request that the *AEMC* make the Amending Rule was submitted to the *AEMC*. **11.X.1.1 Application of Amending Rule to connection agreements** (a) The Amending Rule applies from the transition date in respect of all *connection applications* for new or altered *generating systems* or *generating units* made before the commencement date where the *performance standards* have not yet been finalised as at the transition date. (b) If a *performance standard* agreed on or after the transition date is below the level of the applicable *minimum access standard* specified in the Amending Rule: (i) for the purposes of the *Rules* and unless, in *AEMO's* reasonable opinion, there are extenuating circumstances, from the commencement date, the applicable *minimum access standard* applies to the exclusion of the relevant *performance standard*; and (ii) the *Connection Applicant* and *Network Service Provider* must negotiate an amendment to the *performance standard* to ensure it is consistent with the Amending Rule and, where the relevant *minimum access standard* is an *AEMO advisory matter*, the *Network Service Provider* must first consult with, and have received advice from, *AEMO*. (c) *AEMO* may exempt a *performance standard* from the application of paragraph (b) where AEMO considers that the *performance standard* will not adversely affect *power system security*. (d) Any action taken by *AEMO* or a *Network Service Provider* prior to the commencement date in anticipation of the commencement of the Amending Rule is deemed to have been taken for the purpose of the Amending Rule and continues to have effect for that purpose.	**Transitional Rules** Noted Noted Noted Noted

Advisian
WorleyParsons Group

Appendix B Responses to AEMC Questionnaire

AEMC Rule Change Questions	Advisian's Comments
Question 1 Assessment framework Do you agree with the Commission's proposed approach to assessing whether the rule change request will, or is likely to, contribute to the achievement of the national electricity objective? If not, how should it be assessed?	Advisian understand from the AEMC Consultation paper that the rule change request is to be assessed based on the NEO with due regard to: • Maintaining system security at the lowest costs to consumers • Appropriate allocation of costs and risks • Regulatory certainty and flexibility • Technology neutrality This would seem to be an appropriate way to assess the proposed rule change.
Question 2 Role of access standards A. Do the current generator access standards require changes to help maintain power system security? B. Would making changes to generator access standards represent the lowest cost approach to maintaining system security relative to other options? C. • Will mandating certain capabilities in generator access standards enable and support the establishment of ancillary services in future?	A. Advisian is of the view that except for minor housekeeping and better provisions for frequency and voltage control the existing rules covering generator performance standards are adequate to help maintain power system security. B. The proposed changes to the generator access standards will either result in very expensive generation plant or a complete prohibition of new generation connections. Neither represents the lowest cost approach for maintain power system security. C. Generator access standards already mandate some ancillary services (e.g. voltage control and reactive power), a similar approach could be instigated to system frequency control.

AEMC Rule Change Questions	Advisian's Comments
Question 3 Proposed changes to generator access standards For each of AEMO's technical recommendations set out in Appendix B: A. Do you agree with AEMO's analysis of the issue in relation to the proposed change to the access standard? B. Would the proposed change address the issue raised by AEMO? If not, what alternative solutions are there? C. Does the proposed change represent an unnecessary barrier to entry, having regard to the costs imposed by the change and the technical capabilities of different technologies? D. • Can you provide an indication of the costs associated with the proposed change?	A. In summary, Advisian does not agree with many of the proposed changes because they: • Attempt to contradict the laws of physics with respect to system voltage control provisions. • Have wholly unrealistic requirements with respect to fault ride through capabilities of generation plant • Is not technology neutral • Is discriminatory against new entrant generation of all technology types • Would require very expensive plant to be installed which would not be fit for purpose leading to an over investment in the generation sector of the NEM. B. In general, Advisian advises that the proposed changes do not address the various issues raised by AEMO, the alternative solutions are to maintain the existing rules with the exception of the provisions for FCAS which require redrafting to fix the damaging effects of the FCAS markets on the power system frequency control. C. Some of the specific changes that are being proposed (if interpreted literally) will prevent any further generator connections from taking place. This is obviously an unnecessary barrier to entry. D. For many of the proposed changes Advisian advises that the costs are obviously excessive but it would take much effort to quantify the costs in every case. As an example, to meet the voltage requirements may require providing switchgear which is rated for a much higher voltage than necessary. This could easily double the cost of the switchgear, adding about 20 -30% to a typical project cost.

AEMC Rule Change Questions	Advisian's Comments
Question 4 System strength access standard A. Do you agree with AEMO's analysis of the issue related to system strength? B. Would the proposed changes address these issues, particularly in light of the Commission's *Managing system fault levels rule change final determination*? If not, what alternative solutions are there? **C.** • Would the proposed changes relating to system strength represent an unnecessary barrier to entry, having regard to the costs imposed by the change and the technical capabilities of different technologies?	A. Advisian has reviewed the proposed rule changes and the brief discussion provided by AEMO on system strength. AEMO has also produced some "fact sheets" on the issue which contain technical errors. Advisian has consulted widely with invertor suppliers, manufacturers and developers of utility scale batteries, wind and solar farms and experts in power electronics. From this we are of the view that many of the issues on system strength being discussed in the industry are often demonstrably incorrect and misleading. Advisian advises that whilst more work on this issue should be carried out, AEMO's general analysis of the issue can be shown to be incorrect. B. The proposed rule changes do not address the issue of system strength; in effect the rule changes rule out all invertor connected generation, unless the inverters were to be oversized by a factor of approximately 2.7. This would make invertor connected generation cost prohibitive. Insisting on a SCR of 3 in the generator performance standards is arbitrary and does not reflect that different parts of the system may require differing amounts of support. C. All invertor connected plant such as solar farms and battery installations would be ruled out by the requirements of this clause. This represents an unnecessary barrier to entry.
Question 5 Mandating active power control A. Do you agree with AEMO's analysis of the issue related to active power control? B. Would the proposed changes address these issues? If not, what alternative solutions are there? C. Would the proposed changes relating to active power control represent an unnecessary barrier to entry, having regard to the costs imposed by the change and the technical capabilities of different technologies? D. What are the risks associated with mandating active power control capabilities? E. What impacts would a mandated active power control capability have on competition in FCAS markets, and therefore FCAS prices?	A. Advisian has studied this issue and agree that mandating that generation plant be capable of active power control in response to changes in system frequency and in some cases response to AGC signalling is necessary to ensure system security and reliability. This area has been the subject of much misunderstanding and misinformation in recent times, particularly with regard to the role played by inertia. Many of the misrepresentations of the role of inertia have been repeated by AEMO in their submission. B. Advisian believe the proposed changes should be redrafted, as the new rule proposal is unclear. C. Advisian does not believe that active power provisions would create an unnecessary barrier to entry. D. It is standard practice for all rotating generation plant to have speed control systems which translates directly into active power control. For invertor plant the change is likely to be achievable in software. The actual cost of frequency control is immaterial compared to the energy market. E. Advisian is of the view that FCAS spot markets should be eliminated and replaced by a scheme which funds frequency control in a similar manner to the way reactive power and voltage control is currently provisioned. The prices paid on FCAS markets appear to have no relationship to the quality of frequency control.

AEMC Rule Change Questions	Advisian's Comments
Question 6 Reduction in system size thresholds A. Do you agree with AEMO's view that standards should not consider generating system size in their application appropriate? If not, what alternatives are there? B. Would the proposed changes to the thresholds for certain generator access standards represent an unnecessary barrier to entry, having regard to the costs imposed by the change and the technical capabilities of different technologies? C. • Can you provide an indication of the costs associated with the proposed changes?	If the requirements placed on generators were easily defined and able to be easily assessed there would be no reason to distinguish between generators of different sizes. However, in practice substantial effort has to expend to model and study various technical aspects of a generator connection. For small generators it is a large financial cost to impose to require them to go through a complex registration process. By dint of their size, small generators cannot substantially affect the behaviour of a power system in steady state or during system transient conditions so the necessity for detailed analysis of behaviour is less. The costs for small generators are likely to be prohibitive and if this rule is enacted will prevent projects from going ahead. This represents an unnecessary barrier to entry.
Question 7 Definition of continuous uninterrupted operation A. Do you think the current definition of continuous uninterrupted operation raises issues for maintaining power system security? B. Would the proposed change to the definition of continuous uninterrupted operation address the issues raised by AEMO? If not, what alternatives are there, for example what materiality thresholds should apply? C. Would the proposed change to the definition of continuous uninterrupted operation represent an unnecessary barrier to entry, having regard to the costs imposed by the change and the technical capabilities of different technologies?	A. No. The maintenance of power system security is addressed by considering contingent and non-contingent events and modelling the system behaviour during and immediately after such events. Advisian believe this approach should be maintained as a general principal which attempts to understand accurately a complex system of many interacting parts. B. No. In many cases system security can be enhanced by generation plant responding to system transients, the approach being suggested by AEMO would act to prevent generation systems responding to system transients. This is likely to result in power system failures. As an example, one of the contributing factors to the SA blackout was non responsiveness of governor control systems. This proposed rule change will effectively mandate such an approach which may be exactly the wrong response to a specific system incident. Advisian advises that system security and reliability is best addressed via appropriate operating constraints based on a good understanding of power system behaviour when it is under stress. C. Yes the proposed changes do represent an unnecessary barrier to entry. Virtually all synchronous generators directly connected to the grid will be unable to meet this requirement due to their design. Invertor connected plant may be able to meet the requirement but will likely have to install additional inverters to ensure capability. Advisian advises that this will add unnecessary cost to projects.

AEMC Rule Change Questions	Advisian's Comments
Question 8 Negotiated access standard requirements under specific clauses A. Do you agree with AEMO's analysis of the issues in relation to negotiated access standard requirements? B. Would the proposed changes address the issues raised by AEMO? If not, what alternatives are there? C. Would the proposed changes represent an unnecessary barrier to entry, having regard to the costs imposed by the change and the technical capabilities of different technologies?	A. No. The proposed rule changes in many cases effectively make automatic access requirements mandatory and make minimum and negotiated access standards redundant. This is contrary to the principals that guide the structures of the national electricity rule and is an indication of a radical departure from normal practice. In Advisian's view if this proposed rule change were to go through it would strongly discourage generation investment in the NEM. B. No. Advisian do not believe that the issues raised by AEMO are valid, and if passed would effectively give AEMO too much negotiating power without any associated responsibility for an event were it to occur. Advisian advises that the current system is adequate with appropriate minor changes (specifically with regard to frequency) to address specific issues. C. Yes the proposed changes do represent an unnecessary barrier to entry. Virtually mandating automatic access in all cases would effectively add a huge cost to generation projects. Projects that went ahead would be "gold plated" for no significant benefit to the system but most projects would not go ahead.
Question 9 Technical standards relevant to the alteration of generating plant/system A. Do you agree with AEMO's analysis of the issues related to the technical standards for alteration of generating plants or system? B. Would the proposed change address the issues identified by AEMO? If not, what alternatives are there? C. Would the proposed changes to standards relevant to the alteration of generating systems or plant represent an unnecessary barrier to investment, having regard to the costs imposed by the change and the technical capabilities of different technologies?	A. With respect to "partial load rejection in **response to a disturbance**" and "protection to trip plant for unstable operation" Advisian is in general agreement with AEMO's analysis; however we note that the former point is in direct conflict with other rule proposals in their submission. B. No. Advisian would recommend the partial load rejection issue be dealt with in conjunction with the control of system frequency issue. The "protection to trip plant due to unstable operation" is already covered in the existing rules. C. For new plant the proposed changes do not represent a major impost on existing plant design, however for many existing plants retrofits will be very expensive, the costs of compliance would ultimately be passed onto the market.
Question 10 Jurisdictional issues and harmonisation A. How important is a consistent approach to generator access standards across regions? B. Are AEMO's proposed changes sufficient to manage system security across all areas of the power system so that jurisdictional arrangements (such as ESCOSA's licensing conditions for connecting generators in South Australia) are not required? C. Are there changes in addition to those proposed by AEMO that stakeholders consider necessary to avoid the need for jurisdictional specific arrangements?	A. Advisian is of the view that generator access standards should be the same as far as practical across the network, but that obviously some parts of the network will be subject to constraints more than others. The guiding principle should be that access should not be prevented for connection, but that the ability to generate is not guaranteed if a system security or reliability issue is identified. B. Advisian believe the existing generator access requirements are sufficient for this purpose. The proposed changes are unphysical in many cases and should be rejected. C. No comment.

AEMC Rule Change Questions	Advisian's Comments
Question 11 Issues with the current negotiating framework A. Do AEMO and NSPs have adequate powers under the NER to require connection applicants to set performance standards at levels that do not negatively impact power system security? Are there other factors that may impact the effectiveness of the negotiating process? B. How does the negotiating process operate in practice for participants? Is AEMO's view that connection applicants generally aim for the minimum access standards, and negotiate away from that position, an accurate representation of most negotiations? C. What are the costs of the current negotiating framework for market participants and AEMO?	A. Advisian are of the view that AEMO and the NSP's have too much power to frustrate and prevent projects from being registered. This has led to gold plating of generation assets for little or no discernible benefit to the network or other market participants. B. AEMO's view that connection applicants aim for minimum access standards is not correct. Most applicants aim for automatic if there is no major financial penalty to do so, and will aim for negotiated if there is a large financial justification. None of our clients have ever aimed for minimum access standards. C. Advisian advises that there are substantial costs involved in negotiations, studies and design of plant to comply with the NER. Most of these costs are associated with project delays.

AEMC Rule Change Questions	Advisian's Comments
Question 12 Rationale for a negotiating framework A. Given the changing nature of connections to the power system, does the rational for a negotiating framework governing the connection process remain appropriate? Do you value the ability to negotiate and why? B. What are the appropriate respective roles of the automatic, minimum and negotiated access standards?	A. Negotiation of access to the network remains necessary because there are always at least two parties involved – the owner of the network and the owner of the generation asset. AEMO also needs to be involved due to its responsibilities as the market operator. B. The following points were produced by NEMMCO with respect to technical standards. Advisian believe these general principals should still be respected. Technical standards must provide to adequate a. Power system security; b. Quality of supply; and c. Reliability of supply. Minimum automatic and mandatory standards should be defined so that the performance requirements are consistent with the impact of the plant on the power system Terminology used must support appropriate application. Where technically appropriate performance should be measured at the connection point • Avoid technology-specific terms, unless necessary to clarify requirements for particular technologies • Where possible write clauses in terms of technology non-specific terms so applicable when new technologies emerge • Aim to achieve equivalent requirements for different technologies Provide clear guidance on the basis for negotiation • Intent of clause • Factors to to considered Changes must include appropriate transitional arrangements Changes must be technically justified • Need to demonstrate adequate technical justification for change • Must consult with industry, power system experts and specialists from any new technology that the changes seek to incorporate

AEMC Rule Change Questions	Advisian's Comments
Question 13 AEMO's proposed changes to the negotiating framework A. AEMO proposes changing the negotiations so that the onus is on the connection applicant to prove that they cannot practicably meet an automatic access standard. Does this change strike the appropriate balance between security and costs? B. Would the proposed changes present unnecessary barriers to entry for particular technologies, scales or locations? C. Would the proposed changes have any unintended adverse consequences for connecting MNSPs or large customers?	A. No. This would lead to higher than necessary costs and effectively "gold plate" the generation assets. B. Yes. C. Yes. If the new rules are interpreted literally they will stop the development of all new generation projects and this will lead to higher electricity prices for consumers and reduced reliability.
Question 14 Nature of the issues raised A. What are the potential negative impacts on system security that could arise from the connection of new equipment under existing arrangements? B. What other options may be available to address the issues raised, taking into account the limitations set out in section 6.2.1 below?	A. Advisian can foresee many negative impacts to the system if these proposals were to be successful: a. No new significant generation projects may go ahead b. Projects that do go ahead will have unnecessary costs which will have to be passed on c. Australia's international standing in the power industry will suffer reputational damage because of some of the non-physically tenable requirements. d. There will be a loss of investor confidence in the industry because these changes are so radical as to cause investors to invest outside the industry. e. System security will deteriorate because there will be less generation connected leading to lower capacity (reduced spinning reserve) to support high system peaks, or loss of generation due to system events. B. Advisian recommend that the existing rules be retained in the short to medium term and that industry consultation take place to address some of the issues that need reform –e.g. the provisions for control of system frequency.
Question 15 AEMO's proposed transitional arrangements A. What is the nature of the system security implications of an immediate transition to a new rule, as against a grandfathered transition? B. What is the nature of the cost implications of an immediate transition to a new rule, as against a grandfathered transition, and could this vary for different technology types, or depending on the stage a project has reached?	A. The new rules cannot be made retrospective in some instances because this would contravene the laws of physics and would also do irreparable harm to the reputation of Australia as a leader in power systems engineering. B. In theory if you were to make these rules retrospective you would make all power generation in Australia illegal because it is technically impossible to meet all of the requirements. If you grandfather existing generation you would prevent new generation from connecting and thus condemn the system to eventual failure as old plant becomes unmaintainable.

AEMC Rule Change Questions	Advisian's Comments

Advisian
WorleyParsons Group

Appendix C Response to Redrafting of Rules advised 24/10/2017

AEMO have clarified and made some changes to the drafting of the rules. The changes are listed below for reference. Advisian is of the view that the clarifications make little change to the original submissions and suggest they should be treated in accordance with our original analysis.

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
3.1 S5.2.5.1 AEMO notes a drafting error in the proposed draft Rule and proposes to add a clarifying note that the *automatic access standard* represents the upper bound for any negotiated standard. The revised draft rule is as follows: **Automatic access standard** (a) The *automatic access standard* is a *generating system* operating at: (1) any level of *active power* output ~~greater than 10% of its maximum operating level~~; and (2) any *voltage* at the *connection point* within the limits established under clause S5.1a.4 without a *contingency event*, must be capable of supplying and absorbing continuously at its *connection point* an amount of *reactive power* of at least the amount equal to the product of the *rated active power* of the *generating system* and 0.395. **Minimum access standard** (b) The *minimum access standard* is a *generating system* operating at: (1) any level of *active power* output greater than 10% of its maximum operating level; and (2) any *voltage* at the *connection point* within the limit established under clause S5.1a.4 without a *contingency event*, must be capable of supplying and absorbing continuously at its *connection point* an amount of *reactive power* of at least the amount required to enable the *generating system* to achieve the continuously controllable *voltage* setpoint range specified in the *performance standard* agreed under clause S5.2.5.13, and within the limits in the *automatic access standard*.	**3.1 S5.2.5.1** **From proposed AEMO rule changes** **S5.2.5 Technical requirements** **S5.2.5.1 Reactive power capability** **Automatic access standard** (a) The *automatic access standard* is a *generating system* operating at: (1) any level of *active power* output greater than 10% of its *maximum operating level*; and (2) any *voltage* at the *connection point* within the limits established under clause S5.1a.4 without a *contingency event*, must be capable of supplying and absorbing continuously at its *connection point* an amount of *reactive power* of at least the amount equal to the product of the *rated active power* of the *generating system* and 0.395. **Minimum access standard** (b) The *minimum access standard* is a *generating system* operating at: (1) any level of *active power* output; and (2) any *voltage* at the *connection point* within the limits established under clause S5.1a.4 without a *contingency event*, must be capable of supplying and absorbing continuously at its *connection point* an amount of *reactive power* of at least the amount required to enable the *generating system* to achieve

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
	the continuously controllable *voltage* setpoint range specified in the *performance standard* agreed under clause S5.2.5.13. ~~no capability is required to supply or absorb *reactive power* at the *connection point*.~~ **Negotiated access standard** (c) When negotiating a *negotiated access standard*, the *Generator* and the *Network Service Provider*: (1) must subject to any agreement under paragraph (d)(4), ensure that the *reactive power capability* of the *generating system* is sufficient to ensure that all relevant *system standards* are met before and after *credible contingency events* under normal and planned *outage* operating conditions of the *power system*, taking into account at least existing projects and *considered projects*; (2) may negotiate either a range of *reactive power* absorption and supply, or a range of *power factor*, at the *connection point*, within which the *plant* must be operated; and (3) may negotiate a limit that describes how the *reactive power capability* varies as a function of *active power* output due to a design characteristic of the *plant*. (d) If the *generating system* is not capable of the level of performance established under paragraph (c)(1) the *Generator*, depending on what is reasonable in the circumstances, must: (1) pay compensation to the *Network Service Provider* for the provision of the deficit of *reactive power* (supply and absorption) from within the *network*; (2) install additional equipment *connecting* at the *generating system's connection point* or another location, to provide the deficit of *reactive power* (supply and absorption), and such equipment is deemed to be part of the *generating system*; (3) reach a commercial arrangement with a *Registered Participant* to provide the deficit of *reactive power* (supply and absorption); or (4) if the inability to meet the performance level only occurs for particular operating conditions, agree to and document as part of the proposed *negotiated access standard*, operational arrangements by which the *plant* can achieve an agreed level of performance for those operating conditions. (e) The *Generator* may select one or more options referred to in paragraph (d). **General requirements** (f) An *access standard* must record the agreed value for *rated active power* and where relevant the method of determining the value. (g) An *access standard* for consumption of *energy* by a *generating system* when not supplying or absorbing *reactive power* under an *ancillary services agreement* is to be established under clause S5.3.5 as if the *Generator* were a *Market Customer*.

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
3.2 S5.2.5.3 In section 5.9.3 of AEMO's Rule change proposal, a withstand requirement for *synchronous generating systems* under the *minimum access* standard of ±1 Hz/s for 1 second is noted. This was a drafting error. The correct recommendation is detailed in AEMO's draft clause S5.2.5.3. The correct recommendation is that a *synchronous generating system* and each of its *generating units* must be capable of *continuous uninterrupted operation* for *frequencies* in a number of ranges listed under sub-paragraphs (1) to (6), unless the rate of change of *frequency* is outside the **range of -2 Hz to 2 Hz per second for more than 0.25 seconds, -1Hz to 1Hz per second for more than one second** or such range as determined by the *Reliability Panel* from time to time.	**3.2 S5.2.5.3** **From proposed AEMO rule changes** **S5.2.5.3 Generating ~~unit~~ system response to frequency disturbances** (a) For the purposes of this clause S5.2.5.3: **normal operating frequency band**, **operational frequency tolerance band**, or **extreme frequency excursion tolerance limits** are references to the widest range specified for those terms for any condition (including an "island" condition) in the *frequency operating standards* that apply to the *region* in which the *generating unit* is located. **stabilisation time** and **recovery time** mean the longest times allowable for *power system frequency* ~~system frequency~~ at the *connection point* to remain outside the operational frequency tolerance band and the normal operating frequency band, respectively, for any condition (including an "island" condition) in the *frequency operating standards* that apply to the region in which the *generating unit* is located. **transient frequency limit** and **transient frequency time** mean the values of 47.5 Hz and 9 seconds respectively, or such other values determined by the *Reliability Panel*.

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal

Automatic access standard

(b) The *automatic access standard* is a *generating system* and each of its *generating units* must be capable of *continuous uninterrupted operation* for *frequencies* in the following ranges:

(1) the lower bound of the extreme frequency excursion tolerance limits to the lower bound of the operational frequency tolerance band for at least the stabilisation time;

(2) the lower bound of the operational frequency tolerance band to the lower bound of the normal operating frequency band, for at least the recovery time including any time spent in the range under subparagraph (1);

(3) the normal operating frequency band for an indefinite period;

(4) the upper bound of the normal operating frequency band to the upper bound of the operational frequency tolerance band, for at least the recovery time including any time spent in the range under subparagraph (5); and

(5) the upper bound of the operational frequency tolerance band to the upper bound of the extreme frequency excursion tolerance limits for at least the stabilisation time,

unless the rate of change of *frequency* is outside the range of –4 Hz to 4 Hz per second for more than 0.25 seconds, –3Hz to 3Hz per second for more than one second, or such other range as determined by the *Reliability Panel* from time to time.

Note:

The automatic access standard is illustrated in the following diagram. To the extent of any inconsistency between the diagram and paragraph (b), paragraph (b) prevails.

[Figure not included]

Minimum access standard

(c) The *minimum access standard* is a synchronous *generating system* and each of its *generating units* must be capable of *continuous uninterrupted operation* for *frequencies* in the following ranges:

(1) the lower bound of the extreme frequency excursion tolerance limits to the transient frequency limit for at least the transient frequency time;

(2) the transient frequency limit to the lower bound of the operational frequency tolerance band for at least the stabilisation time;

(3) the lower bound of the operational frequency tolerance band to the lower bound of the normal operating frequency band for at least the recovery time including any time spent in the ranges under subparagraphs (1) and (2);

(4) the normal operating frequency band for an indefinite period;

(5) the upper bound of the normal operating frequency band to the upper bound of the operational frequency tolerance band for at least the recovery time including any time spent in the ranges under subparagraph (6) unless the *generating system* has a *protection system* to trip a *generating unit* if the *frequency* exceeds a level agreed with *AEMO*; and

(6) in respect of a *generating system*:

(i) of 30 MW or more; and

(ii) that does not have a *protection system* to trip the *generating unit* if the *frequency* exceeds a level agreed with *AEMO*,

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
3.3 S5.2.5.4 and S5.2.5.5 AEMO notes that in aligning the negotiation principles specified under clauses S5.2.5.4 and S5.2.5.5 some previous flexibility within clause S5.4.5.4 has been lost. AEMO proposes to restore this flexibility to clause S5.2.5.4 and add it to clause S5.2.5.5 by making the following amendments to draft clauses S5.2.5.4(c) and S5.2.5.5(c)(1)(ii): S5.2.5.4 (c) In negotiating a *negotiated access standard*, a *generating system* and each of its operating *generating units* must be capable of *continuous uninterrupted operation* for the range of *voltages* specified in the *automatic access standard* except where *AEMO* and the *Network Service Provider* agree that the total reduction of *generation* in the *power system* as a result of any *voltage* excursion within levels specified by the *automatic access standard*, would not exceed 100 MW, or a greater limit based on what *AEMO* and the *Network Service Provider* both consider to be reasonable in the circumstances. S5.2.5.5(c)(1)(ii) a single phase to ground, phase to phase or two phase to ground fault in a *transmission system*, or *distribution network*, cleared in the longest time expected to be taken for all relevant primary *protection systems* to clear the fault unless *AEMO* and the *Network Service Provider* agree that the total reduction of *generation* in the *power system* due to that fault would not exceed 100 MW, or a greater limit based on what *AEMO* and the *Network Service Provider* both consider to be reasonable in the circumstances.	**3.3 S5.2.5.4 and S5.2.5.5** **From proposed AEMO rule changes** **S5.2.5.4 Generating system response to voltage disturbances** **Automatic access standard** (a) The *automatic access standard* is a *generating system* and each of its *generating units* must be capable of *continuous uninterrupted operation* where a *power system* disturbance causes the *voltage* at the *connection point* to vary within the following ranges: (1) *voltages* over 110% for the durations permitted under clause S5.1a.4; (2) 90% to 110% of *normal voltage* continuously; (3) 80% to 90% of *normal voltage* for a period of at least 10 seconds; and (4) 70% to 80% of *normal voltage* for a period of at least 2 seconds. **Minimum access standard** (b) The *minimum access standard* is a *generating system* including all operating *generating units* must be capable of *continuous uninterrupted operation* where a *power system* disturbance causes the *voltage* at the *connection point* to vary within the following ranges: (1) *voltages* over 110% for the durations permitted under clause S5.1a.4; and (2) in the range of: (i) 90% to 110% of *normal voltage*, provided that the ratio of *voltage* to *frequency* (as measured at the *connection point* and expressed as percentage of *normal voltage* and a percentage of 50 Hz) does not exceed: (A~~1~~) a value of 1.15 for more than two minutes; or (B~~2~~) a value of 1.10 for more than 10 minutes~~.~~; (3) 80% to 90% of *normal voltage* for a period of at least 5 seconds; and (4) 70% to 80% of *normal voltage* for a period of at least 2 seconds. **Negotiated access standard** (c) In negotiating a *negotiated access standard*, a *generating system* and each of its operating *generating units* must be capable of *continuous uninterrupted operation* for the range of *voltages* specified in the *automatic access standard* except where *AEMO* and the *Network Service Provider* agree that~~:~~

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
	~~(1) the *negotiated access standard* is as close as practicable to the *automatic access standard* while respecting the need to protect the *plant* from damage;~~ ~~(2) the *generating plant* that would be tripped~~total reduction of *generation* in the *power system* as a result of any *voltage* excursion within levels specified by the *automatic access standard*, ~~is not more than~~would not exceed 100 MW~~, or a greater limit based on what *AEMO* and the *Network Service Provider* both consider to be reasonable in the circumstances; and~~ ~~(3) there would be no material adverse impact on the quality of *supply* to other *Network Users* or *power system security*.~~ (d) In carrying out assessments of proposed *negotiated access standards* under this clause S5.2.5.4, *AEMO* and the *Network Service Provider* must at a minimum, take into account: (1) the expected performance of existing *networks* and *considered projects*; (2) the expected performance of existing *generating plant* and other relevant projects; and ~~(3) any corresponding *performance standard* (or where no *performance standard* has been registered, the *access standard*) that allows *generating plant* to trip for *voltage* excursions in ranges specified under the *automatic access standards*.~~ (e) *AEMO* must advise on matters relating to *negotiated access standards* under this clause S5.2.5.4. **General requirement** (f) The *access standard* must include any operational arrangements necessary to ensure the *generating system* and each of its *generating units* will meet its agreed performance levels under abnormal *network* or *generating system* conditions.

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
	S5.2.5.5 Generating system response to disturbances following contingency events (a) In this clause S5.2.5.5 a fault includes: (1) a fault of the relevant type having a metallic conducting path; and (2) a fault of the relevant type resulting from reclosure onto a fault by the operation of *automatic reclose equipment*. **Automatic access standard** (b) The *automatic access standard* is: (1) a *generating system* and each of its *generating units* must remain in *continuous uninterrupted operation* for up to fifteen ~~a~~ disturbances within any five-minute period caused by any combination of the following events ~~that is~~: (i) a *credible contingency event* other than a fault referred to in subparagraph (iv); (ii) a three phase fault in a *transmission system* cleared by all relevant primary *protection systems*; (iii) a two phase to ground, phase to phase or phase to ground fault in a *transmission system* cleared in: (A) the longest time expected to be taken for a relevant *breaker fail protection system* to clear the fault; or (B) if a *protection system* referred to in subparagraph (A) is not installed, the greater of the time specified in column 4 of Table S5.1a.2 (or if none is specified, 430 milliseconds) and the longest time expected to be taken for all relevant primary *protection systems* to clear the fault; and (iv) a three phase, two phase to ground, phase to phase or phase to ground fault in a *distribution network* cleared in: (A) the longest time expected to be taken for the *breaker fail protection system* to clear the fault; or

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
	(B) if a *protection system* referred to in subparagraph (A) is not installed, the greater of 430 milliseconds and the longest time expected to be taken for all relevant primary *protection systems* to clear the fault, provided that none of the events ~~is not one that~~ would *disconnect* the *generating unit* from the *power system* by removing *network elements* from service and that the total time that the *voltage* at the *connection point* is less than 90% of *normal voltage* for 1,800 milliseconds; and (2) subject to any changed *power system* conditions or energy source availability beyond the *Generator's* reasonable control, a *generating system* and each of its *generating units*, in respect of the types of fault described in subparagraphs (1)(ii) to (iv), must supply to or absorb from the *network*: (i) to assist the maintenance of *power system voltages* during the application of the fault~~.~~; (A) capacitive reactive current ~~of at least the greater of~~ in addition to its pre-disturbance ~~reactive current and~~ level of 4% of the maximum continuous current of the *generating system* including all operating *generating units* (in the absence of a disturbance) for each 1% reduction ~~(from its pre-fault level)~~ of *connection point voltage* below 90% of *normal voltage*~~during the fault~~; (B) inductive reactive current in addition to its pre-disturbance reactive current and 6% of the maximum continuous current of the *generating system* including all operating *generating units* (in the absence of a disturbance) for each 1% increase of *connection point voltage* above 110% of *normal voltage*; during the disturbance and maintained until the *connection point voltage* recovers to between 90% and 110% of *normal voltage*, (ii) after *disconnection* of the faulted element, *reactive power* sufficient to ensure that the *connection point voltage* is within the range for *continuous uninterrupted operation* under clause S5.2.5.4; and (iii) from 100 milliseconds after *disconnection* of the faulted element, *active power* of at least 95% of the level existing just prior to the fault. **Minimum access standard** (c) The *minimum access standard* is: (1) a *generating system* and each of its *generating units* must remain in *continuous uninterrupted operation* for ~~the~~ up to fifteen disturbances within any five-minute period caused by any combination of the following events ~~that is~~: (i) a *credible contingency event* other than a fault referred to in subparagraph (iii); (ii) a single phase to ground, phase to phase or two phase to ground fault in a *transmission system*, or *distribution network*, cleared in the longest time expected to be taken for all relevant primary *protection systems* to clear the fault unless *AEMO* and the *Network Service Provider* agree that~~:~~ ~~(A) the total reduction of *generation* in the *power system* due to that fault would not exceed 100 MW;~~ ~~(B) there is unlikely to be an adverse impact on quality of *supply* to other *Network Users*; and~~

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
3.4 S5.2.5.5 AEMO has noted stakeholder concerns raised regarding establishing acceptable levels of reactive current injection and active power recovery for various connection points and proposes to amend the proposed Rule such that the required reactive current injection levels and active power recovery must be coordinated with the NSP. Insert paragraphs (j) and (k) to draft Rule S5.2.5.5 as follows: (j) The *Network Service Provider* may require that the actual reactive current contribution under subparagraphs (b)(2)(i)(A) and (b)(2)(i)(B) and/or the active power recovery time under subparagraph (b)(2)(iii) be agreed with the *Network Service Provider* in order to manage any potential adverse impacts on the *Network Service Provider* and other *Network Users*. (k) The actual reactive current contribution settings and *active power* recovery time agreed with the *Network Service Provider* under paragraph (j) must be recorded in the *performance standard*.	**3.4 S5.2.5.5** **From proposed AEMO rule changes** **S5.2.5.5 Generating system response to disturbances following contingency events** (a) In this clause S5.2.5.5 a fault includes: (1) a fault of the relevant type having a metallic conducting path; and (2) a fault of the relevant type resulting from reclosure onto a fault by the operation of *automatic reclose equipment*. **Automatic access standard** (b) The *automatic access standard* is: (1) a *generating system* and each of its *generating units* must remain in *continuous uninterrupted operation* for up to fifteen ~~a~~ disturbances within any five-minute period caused by any combination of the following events ~~that is~~: (i) a *credible contingency event* other than a fault referred to in subparagraph (iv); (ii) a three phase fault in a *transmission system* cleared by all relevant primary *protection systems*; (iii) a two phase to ground, phase to phase or phase to ground fault in a *transmission system* cleared in: (A) the longest time expected to be taken for a relevant *breaker fail protection system* to clear the fault; or (B) if a *protection system* referred to in subparagraph (A) is not installed, the greater of the time specified in column 4 of Table S5.1a.2 (or if none is specified, 430 milliseconds) and the longest time expected to be taken for all relevant primary *protection systems* to clear the fault; and (iv) a three phase, two phase to ground, phase to phase or phase to ground fault in a *distribution network* cleared in: (A) the longest time expected to be taken for the *breaker fail protection system* to clear the fault; or
3.5 S5.2.5.11 AEMO acknowledges there will be benefit in clarifying the necessity to coordinate droop[1] settings for frequency response and propose to amend the subparagraph (i)(3) as follows: (3) The *frequency* droop must be set within the range of 2% to 10% or as agreed with the *Network Service Provider* and *AEMO* and must be recorded in the *performance standard*; and	**3.5 S5.2.5.11** **From proposed AEMO rule changes**

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
	S5.2.5.11 Frequency control (a) For the purpose of this clause S5.2.5.11: ~~**maximum operating level** means in relation to:~~ ~~(1) a *non-scheduled generating unit*, the maximum *sent out generation* consistent with its *nameplate rating*;~~ ~~(2) a *scheduled generating unit* or *semi-scheduled generating unit*, the maximum *sent out generation*;~~ ~~(3) a *non-scheduled generating system*, the combined maximum *sent out generation* consistent with the *nameplate ratings* of its in-service *generating units*; and~~ ~~(4) a *scheduled generating system* or *semi-scheduled generating system*, the combined maximum *sent out generation* of its in-service *generating units*.~~ **minimum operating level** means in relation to: (1) a *non-scheduled generating unit*, its minimum *sent out generation* for continuous stable operation; (2) a *scheduled generating unit* or *semi-scheduled generating unit*, its minimum *sent out generation* for continuous stable operation; (3) a *non-scheduled generating system*, the combined *minimum operating level* of its in-service *generating units*; and (4) a *scheduled generating system* or *semi-scheduled generating system*, the combined minimum *sent out generation* of its in-service *generating units*. ~~**pre-disturbance level** means in relation to a *generating unit* and a *frequency* disturbance, the *generating unit's* level of output just before the *system frequency* first exceeds the upper or lower limit of the *normal operating frequency band* during the *frequency* disturbance.~~ ~~**system frequency** means the *frequency* of the *transmission system* or *distribution system* to which the *generating unit* or *generating system* is *connected*.~~ **droop** means in relation to *frequency response mode*, the percentage change in *power system frequency* at the *connection point* required to produce a change in *power transfer* equal to the *maximum operating level* of the *generating system*. **Automatic access standard** (b) The *automatic access standard* is: (1) a *generating system's* *power transfer* ~~*active power* transfer~~ to the *power system* must not: (i) increase in response to a rise in *power system frequency* at the *connection point* ~~system frequency~~; or

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
	(ii) decrease in response to a fall in *power system frequency* at the *connection point* ~~system frequency~~; (2) a *generating system* must be capable of automatically providing a proportional: (i) decrease in *power transfer* to the *power system* in response to a rise in *power system frequency* at the *connection point*; and~~reducing its *active power* transfer to the *power system*:~~ ~~(i) whenever the system frequency exceeds the upper limit of the *normal operating frequency band*;~~ (ii) increase in *power transfer* to the *power system* in response to a fall in *power system frequency* at the *connection point*; and ~~by an amount that equals or exceeds the least of:~~ ~~(A) 20% of its maximum operating level times the percentage *frequency* difference between system frequency and the upper limit of the *normal operating frequency band*;~~ ~~(B) 10% of its maximum operating level; and~~ ~~(C) the difference between the *generating unit's* pre-disturbance level and minimum operating level, but zero if the difference is negative; and~~ ~~(iii) sufficiently rapidly for the *Generator* to be in a position to offer measurable amounts of lower services to the *spot market* for *market ancillary services*; and~~ ~~(3) a *generating system* must be capable of automatically increasing its *active power* transfer to the *power system*:~~ ~~(i) whenever the system frequency falls below the lower limit of the *normal operating frequency band*;~~ ~~(ii) by the amount that equals or exceeds the least of:~~ ~~(A) 20% of its maximum operating level times the percentage *frequency* difference between the lower limit of the *normal operating frequency band* and system frequency;~~ ~~(B) 5% of its maximum operating level; and~~ ~~(C) one third of the difference between the *generating unit's* maximum operating level and pre-disturbance level, but zero if the difference is negative; and~~ ~~(iii)~~ sufficiently rapidly and sustained for a sufficient period for the *Generator* to be in a position to offer measurable amounts of *market ancillary services* ~~raise services~~ to the *spot market* for each of the *market ancillary services*.

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
	Minimum access standard (c) The *minimum access standard* is: (1) a *generating system* under relatively stable input energy, *power transfer* ~~*active power transfer*~~ to the *power system* must not: (i~~1~~) increase in response to a rise in *power system frequency* at the *connection point* ~~system frequency~~; or ~~and~~ (ii~~2~~) decrease more than 2% per Hz in response to a fall in *power system frequency* at the *connection point* ~~system frequency~~.; (2) a *generating system* with a *nameplate rating* of 30MW or more must be capable of automatically providing a proportional: (i) decrease in *power transfer* to the *power system* in response to a rise in *power system frequency* at the *connection point*; and (ii) subject to paragraph (c)(i)(ii), increase in *power transfer* to the *power system* in response to a fall in *power system frequency* at the *connection point*.

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
	sufficiently rapidly and sustained for a sufficient period for the *Generator* to be in a potion to offer measurable amounts of *market ancillary services* to each of the *spot market* for at least one of the *market ancillary services*. **Negotiated access standard** (d) A *Generator* proposing a *negotiated access standard* in respect of paragraph (c)(2)(1)(ii) must satisfy ~~demonstrate to~~ *AEMO* and the *Network Service Provider* that the proposed ~~increase and~~ decrease in *power transfer* ~~*active power* transfer~~ to the *power system* is ~~are~~ as close as practicable to the *automatic access standard* ~~for that *plant*~~. ~~(e) The *negotiated access standard* must record the agreed values for maximum operating level and minimum operating level, and where relevant the method of determining the values and the values for a *generating system* must take into account its in-service *generating units*.~~ (f) *AEMO* must advise on matters relating to *negotiated access standards* under this clause S5.2.5.11. **General requirements** (g) Each *control system* used to satisfy this clause S5.2.5.11 must be *adequately damped*. (h) The amount of a relevant *market ancillary service* for which the *plant* may be registered must not exceed the amount that would be consistent with the *performance standard* registered in respect of this requirement. (i) For the purposes of paragraphs (b)(2) and (c)(2): (1) the change in *power transfer* to the *power system* must occur with no delay beyond that required for stable operation, or inherent in the *plant* controls, once *power system frequency* at the *connection point* leaves a dead-band around 50 Hz; (2) This dead-band must be set within the range 0 to ±1.0 Hz. Different dead-band settings may be applied for a rise or fall in *power system frequency* at the *connection point*; (3) The *frequency* droop must be set within the range of 2% to 10%; and (4) A *generating system* is not required to operate below its minimum operating level in response to a rise in *power system frequency* at the *connection point*, or above its *maximum operating level* in response to a fall in *power system frequency* at the *connection point*. (e) The *performance standard* must record: (1) the agreed values for *maximum operating level* and minimum operating level and, where relevant, the method of determining the values and the values for a *generating system* must take into account its in-service *generating units*; (2) the dead-band and droop settings applied; and (3) the agreed time for sustained response in *power transfer* to a rise or fall in *power system frequency* at the *connection point*.

AEMO's proposed Rule drafting clarifications	AEMO's initial draft proposal
3.6 Continuous uninterrupted operation definition AEMO notes concerns raised regarding lack of clarity in the proposed amendments to the definition of *continuous uninterrupted operation*. AEMO therefore proposes a revision to clarify that the required performance during a disturbance only applies to reactive power requirements, specifically the requirements under clause S5.2.5.5. The revised definition is as follows: In respect of a *generating system* or operating *generating unit* operating immediately prior to a *power system* disturbance: (a) not *disconnecting* from the *power system* except under its *performance standards* established under clauses S5.2.5.8 and S5.2.5.9 ~~and~~; (b) during the disturbance contributing reactive current as required by its *performance standards* established under clause S5.2.5.5; and (c) after clearance of any electrical fault that caused the disturbance, not ~~only substantially~~ varying ~~its~~ *active power* or ~~and~~ *reactive power* unless required by its *performance standards* established under clauses ~~S5.2.5.5,~~ S5.2.5.11, S5.2.5.13 and S5.2.5.14, with all essential auxiliary and *reactive plant* remaining in service, and responding so as not to exacerbate or prolong the disturbance or cause a subsequent disturbance for other *connected plant*.	**3.6 Continuous uninterrupted operation definition**

Advisian
WorleyParsons Group

Appendix D Proposed approach for a revised Draft of the Generation Connection Requirements

In direct discussions with the AEMC (18th October 2017), Advisian indicated that a root and branch reform of the generator connection requirements could be implemented which would greatly simplify the existing rules and address many of the issues of the proposed rules addressed herein. This appendix briefly sketches out how such an approach can be realised.

For NER version 99, the table of contents of the conditions for connection of generators is as follows:

Schedule 5.2 Conditions for Connection of Generators

S5.2.1 Outline of requirements

S5.2.2 Application of Settings

S5.2.3 Technical matters to be coordinated

S5.2.4 Provision of information

S5.2.5 Technical requirements

S5.2.5.1 Reactive power capability

S5.2.5.2 Quality of electricity generated .

S5.2.5.3 Generating unit response to frequency disturbances

S5.2.5.4 Generating system response to voltage disturbances

S5.2.5.5 Generating system response to disturbances following contingency events

S5.2.5.6 Quality of electricity generated and continuous uninterrupted operation

S5.2.5.7 Partial load rejection

S5.2.5.8 Protection of generating systems from power system disturbances

S5.2.5.9 Protection systems that impact on power system security

S5.2.5.10 Protection to trip plant for unstable operation

S5.2.5.11 Frequency control.

S5.2.5.12 Impact on network capability

S5.2.5.13 Voltage and reactive power control

S5.2.5.14 Active power control

S5.2.6 Monitoring and control requirements

S5.2.6.1 Remote Monitoring

S5.2.6.2 Communications equipment.

S5.2.7 Power station auxiliary supplies

S5.2.8 Fault current

There is a lot of duplication inherent in these sections of the rules which have developed over several years due to various revisions applied to address various issues. This has resulted in needlessly complex arrangements for the analysis and negotiation of generator connections.

When the table of contents shown above is examined from a systems perspective it can be seen that many of the separate headings can easily be consolidated. A suggested approach is given below which if adopted would effectively consolidate approximately 15 rules into 5, significantly increasing opportunities for clarity and decreasing the possibility of internal contradictions.

Rule A – Generation system or energy storage device rating.

This issue is currently dealt with in several sections of the rules which leads to much confusion and is often a difficulty in negotiations between the generator proponent, the NSP's and AEMO. It is common for plant to be overrated in terms of reactive power and power capability because the current rule provisions have been poorly drafted with little or no consideration of the actual needs of the network, and do not take account of recent changes in technology, e.g. inverter connected plant, battery systems or reactive plant.

We propose the following approach to redrafting the rule be applied:

- The *steady state* P-Q generator capability curve at nominal voltage and +/- 10% voltage at the connection point be proposed by the generator, and agreed to or not by the NSP's and AEMO. If the proposal by the generator is deemed insufficient, by either AEMO or the NSP than they must provide a valid technical reason for rejecting the proposed capability curve.
- The generation system shall be able to operate anywhere within the nominated P-Q capability curve if sufficient power or energy is available. The rating is the rating, the rules should prevent "rating creep" which currently occurs due to poorly defined or interpreted rulings about power and reactive power capabilities under different system voltage or ambient temperature conditions.
- The generator may offer to provide some funding of additional reactive plant on the network in order to support the transmission network in facilitating additional power transfer across the network if it is needed for the proposed generator connection.
- Currently the rules covering power and reactive power allow for Automatic, Negotiated and Minimum access levels. Advisian suggest the Automatic and Minimum access levels be removed and replaced with a single negotiated access approach. This reflects the fact that power and reactive power capability is linked and is network connection point dependent. We believe arbitrary limits are not appropriate in such circumstances.

Following on from the basic design parameters of the generation plant defined by the P-Q capability diagram, the control of the generation plant under normal operating conditions must be defined and agreed to by the affected parties.

Advisian recommend splitting the steady state power and reactive power control features, and avoid discussion of response to transients until rule 3. As power, reactive power, frequency and voltage transients cannot be physically separated from each other, we suggest they be treated together in one rule.

Rule 1 – Control and Capability of power output under normal operating conditions

In this rule we propose discussion and definition of the following issues:

- Control modes (constant power, constant speed, constant inverter frequency)
- Control to nominated set points **– dispatch ability of the generating system**
- Steady state response to changes in power system frequency

The current scheme of applying minimum, negotiated and automatic access requirements should be maintained for this rule.

Rule 2 – Control and Capability of reactive power output under normal operating conditions

In this rule we proposed discussion and definition of the following issues:

- Control modes, constant voltage, power factor and constant Var
- Steady state Control to nominated set point
- Reactive power sharing and applied limits, e.g. AVR droop
- Transformer tap changing controls
- Steady state Control of any static reactive plant, e.g. synchronous condensers, capacitor banks, SVCs or Statcoms.

The current scheme of applying minimum, negotiated and automatic access requirements should be maintained for this rule.

Rule 3 – Response of generation system to power system transients and disturbances

Currently this issue is covered by several rules, e.g.:

S5.2.5.3 Generating unit response to frequency disturbances

S5.2.5.4 Generating system response to voltage disturbances

S5.2.5.5 Generating system response to disturbances following contingency events

S5.2.5.7 Partial load rejection

S5.2.5.8 Protection of generating systems from power system disturbances

S5.2.5.9 Protection systems that impact on power system security

S5.2.5.10 Protection to trip plant for unstable operation

S5.2.5.11 Frequency control.

S5.2.5.12 Impact on network capability

S5.2.8 Fault current

From the physical viewpoint of the generator, there is no *conceptual* difference between a system disturbance caused by switching or by the application of a system fault. The rules currently create such distinctions which may be known about after an event, but during an event all that is known is

that there is some sort of system disturbance which the generator is reacting to. Dividing the required generator response into several different categories (as is currently done) creates the risk of contradictions arising in the rules which then form a potential to cause confusion during connection negotiations.

Accordingly, it is suggested that all of the rules listed above be consolidated into one simplified approach.

The considerations covered by this rule should include:

- The amount and duration of fault contribution of the generating system to an external system fault. (This also addresses some of the issues associated with system strength).
- The response of the generation system to voltage disturbances caused by credible and non-credible contingencies
- The response of the generation system to system frequency disturbances caused by credible and non-credible contingencies
- The ability of the generation system to reject load and regulate system frequency and voltage in the event of a system islanding situation.

It is common to apply prescriptive requirements to each of these considerations, which are often derived from typical responses produced by synchronous generators. Advisian suggest that rather than applying approaches which are often ad-hoc, or based around behaviour of synchronous generators the requirements be drafted around what the network requirements actually are.

Suggested guiding principles being:

a. Fault level contribution to be sufficient to operate power system protection systems but not so much as to cause existing switchgear rupture ratings to be exceeded.

b. Reactive power injection sufficient to help support the network for remote faults (to be defined) or network switching events but not so much as to cause excessive over voltages after removal of the disturbance.

c. Power and energy injection (rejection) during under (over) frequency events sufficient to provide *proportionate* support the network so that combined with other generation, the system security provisions are met, but not so much as to cause excessive frequency control over shoot.

d. The generation system able to supply a portion of the network if it is islanded from the main network and the remaining load is less than the capacity of the generation plant to supply.

e. The stability of the generating plant after a disturbance, and the ability of the plant to detect unstable operation and take corrective action or trip as required.

f. The generation plant to remain stable and respond appropriately during power swings caused by events external to the generating plant.

Various generation systems will be able to address these issues to a greater of lesser degree depending on the details of the technologies used. Accordingly we suggest for this rule that the current approach of applying minimum, negotiated or automatic access requirements be retained.

Rule 4 – Power Quality

This rule will cover power quality issues such as voltage flicker, harmonics etc. as currently covered by:

S5.2.5.2 Quality of electricity generated.

S5.2.5.6 Quality of electricity generated and continuous uninterrupted operation

It is suggested that the provisions currently discussed in S5.2.5.6 relating to power output be moved to Rule 1 or Rule 3 as appropriate.