8 November 2017

Mr John Pierce
Chairman
Australian Energy Market Commission
Level 5, 201 Elizabeth St
Sydney, NSW 2000

Dear Mr Pierce

AEMO Rule Change Application - Generator Technical Performance Standards

I refer to the AEMC's current consultation on the Rule Change application made by the Australian Energy Market Operator.

Pacific Hydro does not support AEMO's application to change the rules as they relate to generator technical performance standards. At a high level, the proposed rule change does not appear to take into account the principles that apply to making technical standards, and aspects of the proposed rule change seem poorly constructed and technically flawed.

Pacific Hydro's submission is comprised of this covering letter, comments on the proposed rules, and a set of responses to the AEMC's consultation questions.

General Comments from Pacific Hydro

1. Transitional arrangements

AEMO proposes that the transitional arrangements applying the proposed changes to the performance standards should apply retrospectively to performance standards agreed on or after 11 August 2017. Pacific Hydro strongly objects to this proposal as it will significantly jeopardise the viability of new generation projects in respect of which performance standards have already been agreed. If this proposal was accepted, a project proponent that has achieved agreement on performance standards after 11 August 2017 could find itself in the position of needing to re-negotiate standards, include further capital items in the project budget and face project delays. This introduces an unacceptable level of regulatory risk, and does not meet the considerations of regulatory certainty and flexibility for parties involved in the connection process mentioned by the AEMC in its Consultation Paper.

Pacific Hydro acknowledges that the AEMC has indicated in public forums that retrospective application of rules is highly unlikely given the existing regulatory framework within which rules are made. It is an unprecedented request from AEMO, illustrating a high level of concern regarding the volume of new connections, however, Pacific Hydro considers that the existing rules are sufficient to manage reliable integration. Improvements are required to the rules that govern the performance and provision of frequency control, and a structure needs to be implemented to manage the concerns regarding fault level or "system strength" so as to ensure that power electronic devices can perform in a stable manner across a wide range of expected system conditions.

2. Principles for setting generator performance standards

The principles that governed setting generator performance standards (or the boundaries of access standards) were agreed by the industry through consultation and accepted by the Standing Committee of Officials (SCO) in 2004/5. The seven principles, set out below, govern how to set, alter and introduce new standards. This rule change proposal has been developed without following the established philosophy and principles.

Principle 1: The technical standard must provide for adequate security, quality of supply and reliability.

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.

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

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

Principle 5: Provide clear guidance on the basis for negotiation

Principle 6: Changes must include appropriate transitional arrangements

Principle 7: Changes must be technically justified

The existing access standards were developed by a consultative and collaborative group of power system engineers, planners and generators (engineers) in accordance with these principles. There are principles regarding clarity for when the standards refer to a generating unit or a generating system, these proposed changes muddle up the terminology without regard to the existing practise.

Pacific Hydro notes that several proposed rule change documents appear to be changed marked in a manner that makes it difficult to identify the underlying existing rule. This is concerning and time consuming to dissect exactly the intent of each rule change. We note that some changes alter significantly the clarity in the existing rules around the distinct between generating unit terminals and generating system (connection point), which is undesirable from an engineering point of view.

3. Application of the automatic standard

The proposed rule change appears to adopt a philosophy that only automatic access is the acceptable standard, regardless of the size, location within the network, and impact of the plant in question. No matter how “high” a performance standard for generators is set, if the power system is operated beyond reasonable limits it will collapse and no amount of capability in generators will stop issues that arise within networks. The higher a performance standard the less likely the physical plant is to meet or exceed the performance and if the network performance is outside the system standards the risk is increased. This is not a “safe harbour” and represents significant investment and compliance risk as generators that do not meet the enforced standard may be required to install excessive auxiliary plant that may or may not solve a perceived problem.

4. Tolerances required in the performance standards

The proposed rule change elevates and promotes the automatic standard as if it is the "safe harbour" for connection and will remove issues associated with system security. All dynamic models are an approximation and have a tolerance within which they can be considered accurate. If the mathematics is taken to be exactly how the plant is going to perform and the standard is written to precisely reflect the model, there is an increased risk that the plant will not meet that performance. This is because the design studies rely on, and are only as good as, the network model used for the studies. While AEMO are responsible to maintain the system model, in our experience the base cases that are provided, at cost to participants, come with a significant disclaimer, and have significant errors that require good network knowledge to fix prior to use. The network model itself is only an approximation of the system, and for this reason tolerances around the performance standards are necessary.

5. Balance between generator performance and network limitations

The proposed rule change ignores the balance between generator performance and network limitations, and places abnormal expectations on generators, diminishing the influence of the network. Setting all standards to the highest level possible without appropriate consideration of the network to which a generator is connected greatly increases the risk of failure. Some of the proposed rules have been drafted in a manner that disregards the system dynamics, assume a fault level in which all generators can control the local voltages and in places, ignores the physics that underpins the power system. It sets a future environment that would prosecute participants in the pursuit of every failure that may occur on the power system. This is not appropriate and ignores, or is in ignorance of, the collaborative manner which was used to establish the NEM.

6. Context of the System Black event of 28 September 2016

The proposed rule change relies heavily on the recommendations from the System Black Report prepared by AEMO following the events of 28 September 2016. Pacific Hydro submits that reliance on this report as a basis for a rule change is problematic for a number of reasons.

6.1 The analyses in the System Black Report focus on the sequence of events, and establish "what happened", but do not objectively question how the system was being operated, or whether there were underlying contributing factors and it accepts the operating conditions as if necessary because the market allows it. It did not assess the operation, or whether had different decisions been made on the day a different outcome may have occurred.

6.2 The rule change request states that the System Black event "demonstrated weaknesses in the existing generator performance standards" as if multiple generator contingencies were not possible at a time when multiple network failures were happening. This illustrates a failure to see the non-credible multiple contingencies that occurred in conjunction with an operating regime that was not adequately prepared for the forecast weather conditions. The rule change proposal justifies these proposed changes to the technical performance standards based on recommendations in X.4 of the System Black report. After concluding that the voltage disturbances that led to the collapse was a non-credible event, AEMO goes on to say that "in relation to generator performance standards, however, it is

irrelevant whether the event – or the resulting number of faults – were credible or not". This is a remarkable statement as credible or non-credible faults are always singular faults, where a single fault includes auto re-closure onto a persistent fault. Multiple faults and the consequential loss of multiple network elements is not a singular event. The report goes on to say that the performance standard S5.2.5.4 regarding "multiple successive voltage disturbances is uncertain". This is untrue as the voltage disturbance contemplated in S5.2.5.4 is caused by a credible contingency, and includes an auto reclosure onto a persistent fault. This is studied in the course of assessing the performance of plant. To go beyond an auto reclosure onto a fault, to an abnormal number of disturbances, is to broaden the interpretation of what is normally expected or planned for on a power system. The question of fault ride-through capability is discussed further below.

6.3 Lastly the System Black Report provided little or no assessment as to whether the System Stability Guidelines were met. It dismissed of the performance of the synchronous units that were returning to their dispatch targets at the time the system was collapsing as this "was allowed under the market". Given that the synchronous unit behaviour is contradictory to past requirements for power system control and regional stability, it is questionable as to whether the report has assessed all factors that contributed to the failure.

7. Fault ride-through requirement

7.1 Broadening the interpretation of what is normally expected in terms of fault ride-through expands the planning criteria for reliability and infringes on International Standards for the manufacturer of synchronous plant, as there is no criteria to specify or require a synchronous unit to operate or tolerate more than a single fault. The fault criteria describe by AEMO fails to recognise that such a series of faults would remove network elements from service and alter significantly the system impedance that plant is connected to. These fundamental physical realities significantly affect plant performance. Accordingly, the proposal for so many faults in such a short period of time is unreasonable.

7.2 AEMO's claim that synchronous units can ride through multiple faults is based on observing only a few events and fails to appreciate the dynamics of what would happen under different event timing scenarios. It is an established fact that a synchronous machine can lose synchronism if an incorrectly timed auto reclosure occurs as the following Figure 12-10 from Elgerd (p 245) illustrates:

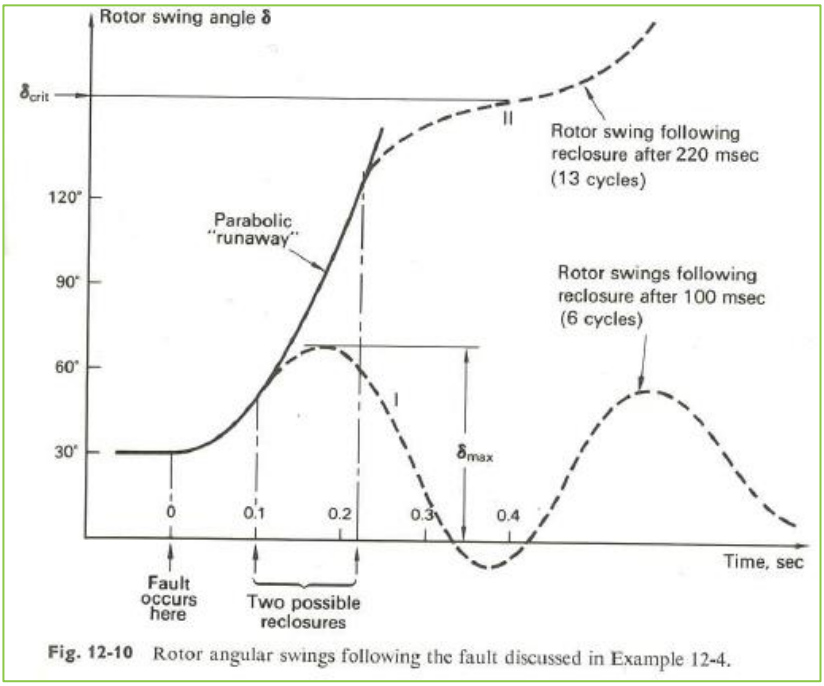

Fig. 12-10 Rotor angular swings following the fault discussed in Example 12-4.

7.3 Pacific Hydro understands that generators should be able to remain connected through an auto reclosure onto a persistent fault. However, as illustrated in the figure above, this depends entirely on the co-ordination of the NSP's protection timing to ensure that reclosure does not cause a unit to lose synchronism. Each fault creates torsional stresses on the drive shaft of a machine and an excessive number of faults lead to fatigue in the super bolts of the shaft coupling. The shaft of a gas turbine is likely to shatter if exposed to more than 6 faults in close succession. To this extent it is extraordinary that AEMO would create an expectation that the electrical infrastructure should expose itself to so much damage. All electrical equipment owners are entitled to protect their equipment from excessive damage that originates from faults within the power system network. Furthermore, if equipment is damaged and the power system collapses, the same equipment will be unavailable to restart the system.

7.4 The only way to protect a power system from significant abnormal conditions is to operate it with prudence, appropriate preparation and caution. No human action or even market dispatch action can correct a power system fast enough to avoid collapse if the wrong combination of conditions occur.

7.5 There is little or no justification to expect electrical equipment to remain connected (and produce at rated power) through abnormally high or low voltages, or an abnormal series of events, without expecting the system operator to prepare the power system for abnormal conditions and operate the power system with precaution.

8. Establishment of a technical advisory group

Pacific Hydro strongly recommends that the AEMC re-establish an appropriately qualified cross section of the industry to examine and develop an appropriate set of technical rules to address the concerns raised by AEMO. The qualifications of such a technical group must include power system control engineers, network planning engineers and have sufficient

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engineering representatives from the manufacturers or developers of generating equipment and renewable energy projects. The principles that were established for technical rule making require this type of cross industry collaboration. The industry, working together with AEMO would be capable of technically resolving the issues and setting appropriate standards. While this approach would take more time, it is likely to achieve an appropriate set of technical changes that address system security concerns in a manner that creates collective technical agreement.

Please find in the attached documents Pacific Hydro's response to each of the questions raised by the AEMC and the comments on the proposed rule changes.

Yours sincerely

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Pacific Hydro

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AEMC Rule Change Questions	Pacific Hydro'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?	We 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. In addition, Pacific Hydro requests that the rule change is assessed on the basis of the seven principles established by the industry for setting technical rules changes. In particular that the rules must be technically justifiable. If any of the rules fail to be technically possible or are inadequately justified then they must be rejected. An economic assessment alone is inefficient.
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. 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. Frequency control is critical to being able to dispatch the market in accordance with the security constraints. Sub-optimal primary frequency control and failing to maintain tight control of frequency on the eastern seaboard have the potential to undermine the control and operation of the power system. 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 maintaining power system security. Furthermore, the rule changes do not take into account issues that arise in networks placing the risk of network failures onto generation, this is an extraordinary approach that will increase the cost of generation investment. 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. Requiring generators to provide a technical capability while allowing the market to turn it on and off depending on the dispatch interval, removes control and certainty in the power system. Reliable control is an active control and must be enabled at all times and not subject to market dispatch. There is no action a human (or remote market dispatch) can do to correct an electrical force going in the wrong direction. Communications delays in control signalling of second order controls such as the AGC occur and cause unacceptable delays. Market dispatch for both energy and frequency regulation can and does contradict good control practice.

AEMC Rule Change Questions	Pacific Hydro'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?	Pacific Hydro has provided a detailed analysis of the proposed rule changes provided by AEMO, and where possible the modified rules have been included. This has been included in this submission. A. In summary, Pacific Hydro 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 • Are not technology neutral • Are 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. The rule changes are drafted as if all issues can be resolved by increasing the standards on generators. This fails to balance the risk and assumes that issues arising in the network can be fully resolved by generators . The power system has to be viewed as a whole and operated appropriately, it will obey the laws of physics regardless of what rules are written. B. In general, 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. Until there is a deeper understanding of the loss of control that has occurred due to the FCAS market the power system will continue to be poorly controlled and at risk of failure. Evidence shows that the market cannot be dispatched in accordance with the "security constrained dispatch" without tight control of frequency. Hence there is a significant energy market failure due to the framework of the FCAS market. 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. The change to the definition of Continuous Uninterrupted Operation (CUO) is significant and unnecessary – it fails to understand simple mathematics (let alone physics. If P = V*I and V is disturbed how can you maintain a constant P?) The new definition appears to pursue perfection rather than accepting the physical reality. D. For many of the proposed changes 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. Taking into account the proposed CUO definition a solar farm would be expected to ride through 0.7 pu voltage for 2 seconds maintaining its full active power output. This would require up to 50% more inverters to provide for the rare event that the system was being operated for 70% volts for 2 seconds. Meanwhile the participant would be unable to use that capacity as it would not be able to bid above its "maximum allowable capacity" defined by AEMO. This is not economic, reasonable or logical.

AEMC Rule Change Questions	Pacific Hydro'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. Pacific Hydro has reviewed the proposed rule changes and considered the brief discussion provided by AEMO on system strength. AEMO has also produced some "fact sheets" on the issue which contain technical errors. Pacific Hydro sought advice from Advisian who has consulted widely with inverter suppliers, manufacturers and developers of utility scale batteries, wind and solar farms and experts in power electronics. There is a prevailing view that many of the issues on system strength being discussed in the industry require further work and thorough investigation and that more work on this issue should be carried out. Pacific Hydro is concerned with AEMO's general analysis of the issue. This issue has not been transparently presented. It is fraught with technical questions that have been inadequately addressed by AEMO. The change to a PSCAD model is driving secrecy into the formulation of constraints in an unprecedented manner and is detrimental to the economic outcomes of the NEM. B. The proposed rule changes do not address the issue of system strength; in effect the rule changes rule out all inverter connected generation, unless the inverters were to be oversized by a factor of approximately 2.7. This would make inverter 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. Taking the new definition of continuous uninterrupted operation into account with the requirements of S5.2.5.4 increases the amount of additional inverters required to meet the standard to 50%. This is unreasonable, unnecessary and does not lead to an economic result. Should the network operate at 0.7 pu voltage the active power of all generating units will be affected. Furthermore it should be incumbent on the system operator to avoid significant periods of voltage depression and work with the network owners to ensure sufficient voltage support is provided in the network where it is required. C. All inverter 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.

AEMC Rule Change Questions	Pacific Hydro's Comments
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. Pacific Hydro has studied this issue and considers that the rules must establish a priority in the hierarchy of control. Frequency control should take precedence over market dispatch ramping, otherwise the market dispatch can and does compound the lack of frequency control. All active power control should be done with respect to frequency control not in contradiction to it. 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. The rules should be clear, primary frequency is required for system reliability, setting "ramp rates" on active power will conflict with frequency control unless carefully co-ordinated. Evidence shows that the energy dispatch can and does contradict frequency control requirements. The market dispatch cannot replace the primary control due to the time delays. Control of frequency equates to active power control just as control of reactive power equates to voltage control these are two fundamental characteristics of AC power. B. The proposed changes should be redrafted, as the new rule proposal is unclear. Ramp rates under the control of market dispatch do not resolve frequency control issues and will compound the confusion. A control hierarchy is required for the energy market as it affects frequency control active power ramping directly affects frequency control. Any rule changes here should set a priority with respect to the control expectations. C. The active power provisions would not 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 inverter plant the change is likely to be achievable in software. The actual cost of frequency control is immaterial compared to the energy market. The speed control on rotating machines is not adequate under the current market mechanisms. E. The 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. The FCAS markets are not controlling frequency efficiently or securely and the reliability of the power system is compromised by the current loss of primary control.
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 be expended 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. The smaller units need right sized connection costs. There are more significant issues in the NEM regarding the control of large units than an issue with small units. This is an ideological approach and will inhibit small projects.

AEMC Rule Change Questions	Pacific Hydro's Comments
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. This approach should be maintained as a general principal which attempts to understand accurately a complex system of many interacting parts. The proposed change is literally not technically possible, even the modified version as the existing definition was adequate and understood. B. No. In many cases system security can be enhanced by generation plant responding to system transients, however, 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. System security and reliability are best addressed via appropriate operating constraints based on a good understanding of power system behaviour when it is under stress. The current control practises on synchronous units in accordance with the energy dispatch and the FCAS market are removing capability from the power system to respond to system events. This is what the real problem is. 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. Inverter connected plant may be able to meet the requirement but will likely have to install additional inverters to ensure capability. This will add unnecessary cost to projects. DFIG generation would not meet this definition either, as it must control the torsional damping on the drive shaft and therefore it will have an amount of active power variation in the recovery period following an event. It is unrealistic to think that a unit would not have some variation in active power.
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. Should this proposed rule change go through it would strongly discourage generation investment in the NEM. B. No. Pacific Hydro does 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. 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.

AEMC Rule Change Questions	Pacific Hydro's Comments
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" Pacific Hydro 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. Pacific Hydro 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, however, retrofits will be very expensive, the costs of compliance would ultimately be passed onto the market. The reapplication of this rule to asynchronous fleet appears to be confused. Partial Load Rejection was always related to the trip to house load control of large thermal plant.
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. Pacific Hydro operates in a number of states and 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. Pacific Hydro does not agree with rolling out the technical standards as imposed in South Australia. B. The existing generator access requirements are sufficient to manage system security. The proposed changes are unphysical in many cases and should be rejected. Improvements can be made to frequency control as noted in other places in this submission. Further work should be undertaken to address the issues of weak network. C. It is time for a review of the conflicts that are created between technical requirements and the market rules. Clearly a unit following a dispatch or AGC in contradiction to frequency is not desirable The structure and obligations on units within the market should not interfere with power system control.

AEMC Rule Change Questions	Pacific Hydro'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. Pacific Hydro is 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 delays and 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. Pacific Hydro has never aimed for minimum access standards only. C. 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. Recent projects have received GPS approval with a caveat that the standards have to be proven that they are met using a PSCAD model. This completely undermines months of negotiation and sets a project back at the start and creates a significant additional set of costs. Recent projects have been delayed on the abnormal interpretation of the rules and application a philosophy aimed at making every project meet the automatic standards. There is significant cost and delay in the delivery of generation to the power system at a time when there is a perceived short fall.

AEMC Rule Change Questions	Pacific Hydro'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. 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 The 7 principles for setting technical standards appear to have been ignored in this round of rule changes. The has been a lack of appropriate industry engagement in this proposal, it is driven by the "findings" from the System Black report which in essence appears to condone the lack of action taken to prepare the power system for the forecast weather. No amount of lifting generator performance standards will avoid a collapse if the system operator fails to prepare and operate the power system in a manner that is precautionary for abnormal conditions.

AEMC Rule Change Questions	Pacific Hydro'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. AEMO needs to explain in detail what the perceived system security issues are through transparent system study results, it is rare to find a report with such results, the problems are vague and generalised. B. Yes, particularly for in places for small generation projects. 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. We 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. Pacific Hydro recommends that the existing rules be retained in the short to medium term and that better 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 existing generation is grandfathered and new generation is prevented from connecting, it condemns the system to eventual failure as old plant becomes unmaintainable.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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 (4) in respect of *generating plant*, in *AEMO's* reasonable opinion, not satisfy paragraph (b)(4). **Note**	**5.3.4A Negotiated access standards** This is usually what is undertaken in the studies within reason of the tolerances of the accuracy of studies. 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. The evidence relies on the accuracy of the network model provided to the participant by AEMO. Will AEMO remove its disclaimer regarding the model data? Is it not reasonable to expect a level of reciprocal engineering responsibility? It is unreasonable remove the ability to negotiate and design the performance of plant relevant to the network location. This appears to be just a rewording of the existing arrangements, placing slightly more onus on the Network service provider. Pacific Hydro requests that this rule change be rejected for the reasons outlined above.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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.	

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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. This change is acceptable if AEMO recognise that protection system upgrades are required at or about the 10 year mark for plant and that this should not open up the entire technical standards in a manner that risks financial support for contracts. This change is acceptable on the above criteria, protection for stability is important and AEMO should have knowledge of it.

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
remote control and monitoring system	S5.2.5.14, S5.2.6.1, S5.2.6.2

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.	**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 pre-existing connections which may 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. Pacific Hydro rejects this rule change for the points outlined. A minor transient reversal of a network point would be hard to allocate to an individual project. In assessing the application to connect, the NSP could provide a requirement to the generator that they need 3 months for consideration of the commissioning plan if they identify that they need time to co-ordinate other network issues.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
(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.	

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
S5.1a.4 Power frequency voltage [The only changes proposed by AEMO are to replace Figure S5.1a.1. with the following]	**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** Pacific Hydro recommends that this change to the TOV be rejected as this significant change to the transient over voltage "ride through" requirement appears to fail to consider the existing plant that is unlikely to operate through such over voltages. Many existing power electronic devices cannot sustain this level of voltage and protect themselves from it. There does not appear to be sufficient technical justification provided in the rule change proposal. The events that have occurred should be examined to see whether the NSP has planned the network requirements and whether there is a need for a broad network solution to the temporary over voltages that have occurred.
S5.2.5 Technical requirements **S5.2.5.1 Reactive power capability** **Automatic access standard**	**S5.2.5 Technical requirements** **S5.2.5.1 Reactive Power Capability**

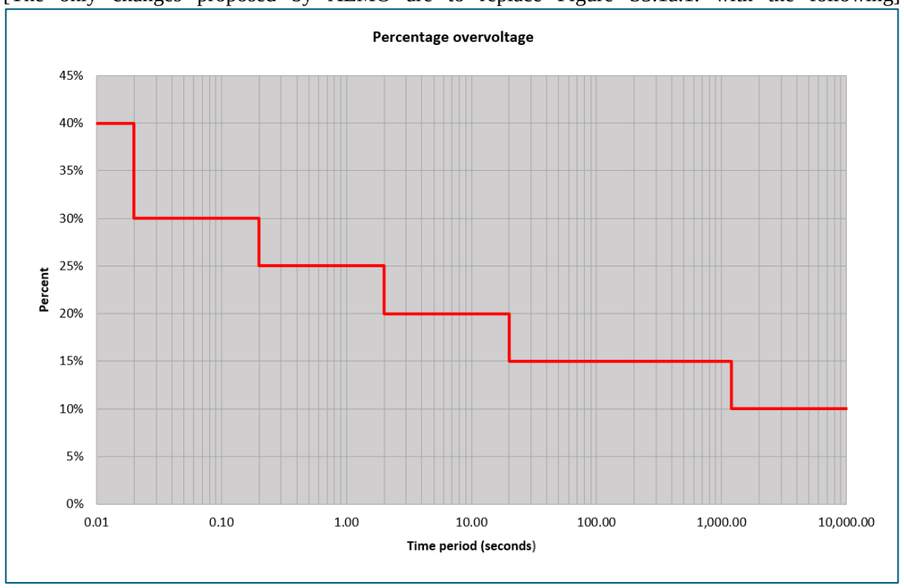
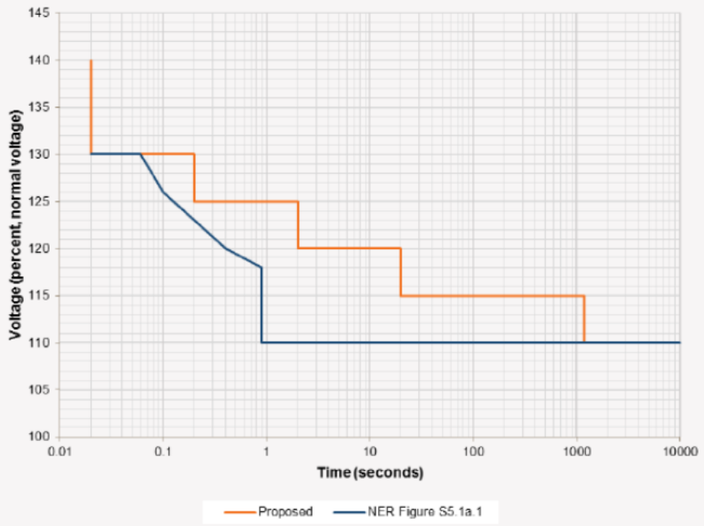


Figure 5 Proposed *system standard* for power frequency over voltage



AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
(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 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.*~~	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. 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. Pacific Hydro reads this change to the standard as setting the minimum standard above the automatic. **S5.2.5.1 Recommendation** Pacific Hydro recommends that this rule change be rejected for the reasons outlined above. AEMO are expecting full voltage control through the full range established under S5.1a.4 at any level of active power, there are limits to the physical equipment.
MODIFIED Rule Change – AEMO **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	**Modified rule change** This still requires the voltage control throughout the entire range of S5.1a.4 and fails to appreciate that different parts of the network have different strengths – small units in strong parts of the network cannot control the voltages. The economic impact for this rule change is excessive and unjustified. Pacific Hydro requests that this rule change be rejected, and a suitable minimum standard be retained.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
under clause S5.2.5.13, and within the limits in the *automatic access standard*. **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 Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
S5.2.5.3 Generating ~~unit~~ system response to frequency disturbances	**S5.2.5.3 Generating UNIT ~~system~~ response to frequency disturbances**

AEMO's proposed Rule Changes –modified comments have been added but may not be complete

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*.

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, –~~3~~1Hz to ~~3~~1Hz 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]

Comments by Pacific Hydro

S5.2.5.3 Generating UNIT ~~system~~ response to frequency disturbances

Pacific Hydro disagrees with the change to the title of this standard. EACH generating unit must be able to stabilise itself, especially when it is within a "system". Within a wind farm or solar farm the "unit" is the inverter or wind turbine – this is how the standards are drafted.

From a control point of view it is understood that system frequency is measured by generators at their terminals and that there are minor differences in frequency at connection points during disturbances.

Paragraph (b) 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.

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.

Modified Rule changes the +/- 3 Hz/s to +/- 1 Hz/s for one second, this is an improvement but illustrates that there is a need for a minimum and an automatic set of standards as there is a range of performance that is acceptable.

Pacific Hydro disagrees with drafting a minimum standard as if it applies to synchronous units only. This is contrary to the general principal that the rules be technology neutral as far as possible.

If such high rates of change of frequency occur and the synchronous fleet trips off, it is not clear how the system frequency will be controlled, or to which reference the inverter controlled fleet will be operating.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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*, the upper bound of the operational frequency tolerance band to the upper bound of the extreme frequency excursion tolerance limits (including an "island" condition) for at least the transient frequency time, 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. **Note:** The minimum access standard is illustrated in the following diagram. To the extent of any inconsistency between the diagram and paragraph (c), paragraph (c) prevails. [Figure not included] **Negotiated access standard** (d) A *negotiated access standard* ~~can be accepted by the *Network Service Provider* provided that *AEMO* and the *Network Service Provider* agree that:~~ ~~(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)~~ must require that the *frequency* would be unlikely to fall below the lower bound of the operational frequency tolerance band as a result of over-frequency tripping of *generating units*.~~; and~~ ~~(3) there would be no material adverse impact on quality of *supply* to other *Network Users* or *power system security*.~~ (e) *AEMO* must advise on matters relating to *negotiated access standards* under this clause S5.2.5.3.	In the negotiated standard WHO is controlling the frequency, is this requiring a limit on the size of the generation that can be connected at one location? AEMO set the settings for the tripping of units for over frequency, how can they write this into a generator's performance standard? This illustrates the confused nature of this set of rules. This clause is ill-defined and is more dependent on the system parameters than on the generator parameters. This is more onerous than prior requirements which had only the 1 Hz per second for one second requirement generally most equipment should be able to ride through 2 Hz/s. **S5.2.5.3 Recommendation** Pacific Hydro recommends that this proposed rule change should be rejected for all the reasons outlined.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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) a value of 1.15 for more than two minutes; or (B) 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: (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 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*.	**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 made it more onerous than before. If implemented this will lead to an over investment in voltage insulation or prevent projects from being built. In practise the interpretation of how to assess plant against this performance standard has been changed to include full active power response at the limits of the voltage range. This is expensive and unnecessary and the justification that full rated reactive and active is required to 0.7 pu voltage has not been technically justified. Pacific Hydro has experienced the application of this altered interpretation and the consequential delays and commercial implications. The removal of the words "*respecting the need to protect the plant from damage*" in S5.2.5.4(c)(1) 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. Yellow highlight has been reinstated in the modified advice. The removal of the phrase "*no material impact on quality of supply to other Network users ..etc*" appears to remove a concept which is difficult to define, which tidies up the clause. (d) (3) This appears to simplify the requirement in that item 3 is already captured under item 2. The assessment must include conditions for which the generating plant is allowed to trip the loss of (3) sets no boundary on the assessment. Conditions for which you are allowed to trip should remain. Item (2) is written in consideration of other relevant projects. In (d), if removing (3) the "and" needs to move from (2) to (1). Pacific Hydro disagrees with the removal of (3) as it clarifies a particular requirement in the assessment. Pacific Hydro recommends rejecting the change to the minimum standard. The changes to the negotiating requirements are unnecessary, and clarification may be required as there appears to some confusion. The changes to the negotiated access standard appear arbitrary and the clause should be redrafted to make it less arbitrary.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
(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 Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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~~ disturbance<u>s within any five-minute period</u> caused by an<u>y combination of the following</u> event<u>s</u> ~~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 (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 <u>none of</u> the events ~~is not one that~~ would *disconnect* the *generating unit* from the *power system* by removing *network elements* from service <u>and that the total time that the *voltage* at the *connection point* is less than 90% of *normal voltage* for 1,800 milliseconds</u>; 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~~,~~<u>:</u> <u>(A)</u> capacitive reactive current ~~of at least the greater of~~ <u>in addition to</u> its pre-disturbance ~~reactive current and~~ <u>level of</u> 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* <u>below 90% of *normal voltage*</u>~~during the fault~~;	**S5.2.5.5 Generating system response to disturbances following contingency events** S5.2.5.5 (b) No known existing generator technology is able to achieve continuous uninterrupted operation for up to fifteen disturbances within any five-minute period 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. The practical effect of this clause would be to prevent new entrant generation, particularly synchronous machines, from connecting to the system. (b) (1) This latter point commencing "provided that" 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 (b)(2) (i)(A) 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

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
(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 *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 material adverse impact on quality of *supply* to other *Network Users* or *power system security*; and,~~ ~~(C) there is unlikely to be a material adverse impact on *power system security*,~~ 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 1,000 milliseconds; and (2) subject to any changed *power system* conditions or energy source availability beyond the *Generator's* reasonable control ~~after *disconnection* of the faulted element, each~~a *generating system* and each of its *generating units* must, in respect of the types of fault described in subparagraphs (1)(ii) and (iii), supply to, or absorb from, the *network*: (i) to assist the maintenance of *power system voltages* during the fault: (A) capacitive reactive current in addition to its pre-disturbance level of 2% of the maximum continuous current of the *generating system*	increase by 90 x 4 = 360 %. This is not possible for inverter based technologies to achieve and is unlikely even for synchronous generators (they need a SCR of at least 3.6 which implies a transient plus transformer impedance of < 28%). (b)(2) (i)(B) Similar remarks apply to the inductive situation except a 6% droop characteristic is implied, and no limit has been defined for the overvoltage situation. The range of disturbances specified in the negotiated access standard clause is the same as the automatic access clause which cannot be met in practice by any generation technology. S5.2.5.5 (c)(1) 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. The manufacturers of "modern" asynchronous plant may have modelled "voltage dip" only in respect of the effect on the power electronic devices. The ability to ride through multiple contingencies that remove multiple network elements is unlikely to have been appropriately assessed. The probability and combination of scenarios described in this requirement make dynamic studies impossible. There are 50,625 fault scenarios which would need to be multiplied by the various case studies. This is not a condition that any generator could reasonably guarantee. (c)(1)(ii)Taken to its logical conclusion, the 100 MW limit would seem to imply that no generation plant greater than 100 MW can be built to comply with the negotiated access standard. The intent of this clause (c) (2) (i)(A) 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 inverter based technologies to achieve and is unlikely even for synchronous generators (they need a SCR of at least 3.6 which implies a transient plus transformer impedance of < 28%).

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and each of its operating *generating units* (in the absence of a disturbance) for each 1% reduction 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* and each of its 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; during the disturbance and maintained until *connection point voltage* recovers to between 90% and 110% of *normal voltage;* (ii) after *disconnection* of the faulted element, ~~deliver to the *network, active power* and supply or absorb leading or lagging~~ *reactive power*, sufficient to ensure that the *connection point voltage* is within the range for *continuous uninterrupted operation* agreed under clause S5.2.5.4.~~;~~ and (iii) from 1,000 milliseconds after *disconnection* of the faulted element, *active power* of at least 95% of the level existing immediately prior to the fault. **Negotiated access standard** (d) A *generating system* and each of its operating *generating units* must be capable of: (1) *continuous uninterrupted operation* for the range of disturbances; and (2) supplying and absorbing the *active power, reactive power* and reactive current, 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* due to that fault would not exceed 100 MW. (e~~d~~) In carrying out assessments of proposed *negotiated access standards* under this clause S5.2.5.5, the *Network Service Provider* and *AEMO* must take into account, without limitation: (1) the expected performance of: (i) existing *networks* and *considered projects*; (ii) existing *generating plant* and other relevant projects; and (iii) *control systems* and *protection systems*, including auxiliary systems and *automatic reclose equipment*; and (2) the expected range of *power system* operating conditions. (f~~e~~) A proposed *negotiated access standard* may be accepted if the *connection* of the *plant* at the proposed access level would not cause other *generating* ~~generating~~ *plant* or *loads* to trip as a result of an event, when they would otherwise not have tripped for the same event. (g~~f~~) *AEMO* must advise on matters relating to *negotiated access standards* under this clause S5.2.5.5. **General requirement** (h~~g~~) The *access standard* must include any operational arrangements to ensure the *generating system* including all operating *generating units* will meet its agreed performance levels under abnormal *network* or *generating system* conditions. (i) For the purposes of paragraphs (b)(2)(i) and (c)(2)(i): (i) the reactive current contribution may be limited to:	(c)(2) (i)(B) Similar remarks apply to the inductive situation except a 6% droop characteristic is implied, and no limit has been defined for the overvoltage situation. S5.2.5.5 (c)(2)(ii) Noted – there may be an issue with inverter connected devices for unbalanced faults Dividing generating units or systems into synchronous and asynchronous fails to appreciate that inverter connected plant is not "asynchronous" the existing rules used "synchronous" and for not synchronous "units other than synchronous" to capture inverter connected PV for example.

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(A) the maximum continuous current of an *asynchronous generating system* including all operating *generating units*; or (B) 250% of the maximum continuous current of a *synchronous generating system* including all operating *generating units*; (ii) the reactive current contribution and *voltage* deviation described may be measured at the applicable low *voltage* terminals of the *generating units* or *reactive plant* within a *generating system*; (iii) the reactive current contribution required may be calculated using phase to phase, phase to ground, or sequence components of *voltage*. When using sequence components, the ratio of negative-sequence to positive-sequence current injection must be agreed with *AEMO* and the *Network Service Provider* for various types of *voltage* disturbances; and (iv) the reactive current response must have a *rise time* of no greater than 30 milliseconds, a *settling time* of no greater than 60 milliseconds and must be *adequately damped*; (v) any *reactive power* consumption immediately upon the occurrence of a fault must not exceed 5% of the maximum continuous current of the *generating system* and is limited to the duration of *rise time*; and (vi) any *active power* consumption immediately upon the occurrence of a fault must not exceed 5% of the maximum continuous current of the *generating system* and is limited to 20 milliseconds. (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*.	The amendment proposed in S5.2.5.5(i)(iv) is not physically possible for most synchronous generators which typically have a transient time constant greater than 5 seconds and hence would have to be driven very hard by the AVR to achieve a response of 30 ms. The amendment proposed in S5.2.5.5(i)(v) is dependent on the starting point prior to the fault and seems to prevent the generating system operating in a leading power factor mode before the fault. This may not be appropriate depending on the local system conditions. The amendment proposed in S5.2.5.5(i)(vi) appears to limit auxiliary power supplies to 5% which is not achievable for existing conventional plant (e.g. coal fired units, gas turbines etc) and some asynchronous plant. The 20 ms limit for switch off is also unachievable for almost all plant in clause (i)(vi). Pacific Hydro recommends that 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. Furthermore, it is technically unjustified, careful consideration should be given to addressing the concerns that AEMO have, but this drafting is problematic.

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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** Asynchronous plant can do this – it should be noted that the intent of this clause is to cover "trip to house" for synchronous thermal plant. This is why it was agreed to remove it from being mandatory in the last round of rule changes. The change to the automatic and the minimum standard would appear to remove the obligation to trip to house load on large generating units. This should not be changed. Pacific Hydro disagrees with the change from "unit" to "system". Alternatively, add "or generating system" after generating unit. Asynchronous generating plant is now required to operate for a partial load rejection. It is not clear why this is necessary, and under what system conditions. "Actual" load rejection performance cannot be recorded in the standard that is negotiated prior to commissioning. This should read "expected" Pacific Hydro disagrees with removing the obligation of NSPs to consult on this clause (e). The intention of this clause needs to be re-examined and clarified.
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-	**S5.2.5.11 frequency control** Pacific Hydro disagrees with the removal of the maximum operating level in relation to this clause. The removal of this definition to the glossary and not the minimum is inconsistent – also the change marking on the definition is incorrect. The definition 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 all definitions in the rules should be located at a single location in the overall document.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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 (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~~	The removal of the word "active" reduces the clarity of the clause. The change to (2) (i) 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. Clause (2) 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 opening statement in (b) and (c) is not possible if a unit (or system) has no active primary control enabled. The Commission must decide whether it requires a unit to control frequency appropriately or to obey dispatch and the regulation services – both dispatch targets and AGC regulation services can and do control units in manner that contradicts these clauses.

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~~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*. **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*, 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% or as agreed with the *Network Service Provider* and *AEMO* and must be recorded in the *performance standard*; and	The change to the automatic to require a unit to provide "each" ancillary service illustrates a significant lack of understanding that not all plant can offer "all" of the services. They were designed to pick up the variations in performance between different plant. 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. Relatively stable was inserted to ensure that wind farms would only be measured when energy input was stable, if generating systems (wind farms or solar farms) are obligated to meet the automatic standard it would be unreasonable to expect frequency control without "relatively stable input energy" – this covers off the problem when the wind is dying down or there is cloud cover. 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 removal of (e) appears to remove a clarification for negotiation. This assumes no negotiation. Pacific Hydro suggests that clarifying the maximum and minimum levels is necessary. From modified document. – it must still be limited to between 2 to 10 % .. so the comment places no limits on AEMO and the NSP – it should read "…10% and agreed with the NSP & AEMO and recorded in the GPS."

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(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*.	Should (e) be labelled (j)? (e)(1) This statement is illogical – at the time the GPS is recorded it should read "nameplate" of all its units.. – "in service" refers to operating and therefore bid data which is not possible at the time the GPS are negotiated. .. (3)This should be a record of any time delays associated with the frequency control loop. Rather than a specified time, the actual response to a step change in frequency should be agreed. The automatic standard mandates "each" ancillary service – this is unreasonable and fails to understand the various services. **S5.2.5.11 Recommendation** Pacific Hydro believes that the intent needs to be clearer. The requirement for frequency control is fundamental to the reliable operation of the NEM and the ability to dispatch the market within the technical envelope. To this effect the opening statement (a) and (c) cannot be met if units are participating in the FCAS market, nor if dispatch and AGC targets take priority over frequency control. There exists a fundament conflict in the control philosophy of the NEM. Limiting a generating unit's response to a bid removes capability out of the power system to respond to contingent events. This is not desirable.

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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~~ ~~(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; (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; (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*	Removal of the words "step response test or a simulation" from rise time definition and settling time is unwarranted and would appear to be an error caused by moving the changed marked text. Two definitions have been removed and one added. For reasons of consistency all definitions in the rules should be located at a single location in the overall document. Why is Static excitation system left here if all other definitions go to the glossary? 2A is physically impossible on high fault level systems. The system will dictate the voltage level not the generator. This is structural change for the sake of change – it reorders what was succinct criteria. 2A (iii)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.

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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;~~ ~~(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 (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;~~	The change to (vii) relates this clause to (2A) something that is physically impossible in high fault level systems. (x) does not need the "and" Dividing generating units or systems into synchronous and asynchronous fails to appreciate that inverter connected plant is not "asynchronous" the original rules used "synchronous" and for not synchronous "units other than synchronous" to capture inverter connected PV for example. Clause (4) appears to not apply to inverter controlled PV plant as they are not comprised of "asynchronous" units. These changes are not technology neutral, and could be better expressed if common voltage control requirements are grouped.

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(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 ~~(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; (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	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. The words "at the connection point" in (c)(1) should be removed.

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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) regulate~~s~~ *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; (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*; (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 (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; (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*;~~ (~~i~~ii) operate the stator continuously at 102% 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;~~ ~~(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*;~~ ~~(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 limiting devices to ensure that a *voltage* disturbance does not cause the *generating unit* to trip at the limits of its operating capability;~~ (~~v~~iii) haves ~~a~~n 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~~j), haves ~~a~~ *settling* time for a step change of *voltage* setpoint or *voltage* at the location agreed under subparagraph	(A) A generating unit that is not synchronised is not operational. (even asynchronous units "synchronise"). (3) This is physically impossible for high fault level systems. The criteria for excitation systems appears to be poorly constructed for example (4)(i) so have the words "is able to" inserted prior to the word operate. The drafter has tried to take the Automatic and just make the criteria not as high, yet some wording has been lost in the translation. This requirement appears to be overly prescriptive (why 102%? – there is no technical reason for this value) it would appear to be a copy of the automatic with the numbers reduced.

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(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;	(B) Does not make sense. The restructure of (iii) opening statement make (B) illogical see highlight.
(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~~:	Voltage settling times are system dependent as well as generator dependent, accordingly this clause should be reworded to clarify this issue.
~~(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*;~~	Both the A and B clauses are unclear with respect to their actual intent, the clause should be redrafted to make the intention clear.
~~(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;*~~	The drafting in this section is failing technology neutrality, it should be possible to draft this clause with control criteria that covers all technology. It would appear that there is confusion about the control systems being described.
~~(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;~~	
(i~~v~~) subject to co-ordination under subparagraph (j~~i~~), 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:	Same comments apply for asynchronous and synchronous generation Duplication should be removed and the clause apply to both synchronous and asynchronous generation.
(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	25 seconds settling time for a 5% voltage step change, that is insufficiently damped and would fail the "adequately damped criteria"
(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.~~	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
(~~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	We note that the proposed rule change is the result of edit markings overlaid on earlier edit markings, which makes it very difficult to compare to the current rule.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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 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).	This implies regulating a remote voltage, to a setpoint that is under AEMO's control to within 2%. It appears that the consequence of this proposed change is that generators are being asked to take over the management and control of voltages across the network. This ignores the obligation on Networks to manage their voltages. This deletion appears to be a change marked deletion, or the inserts have shifted everything around significantly. It is hard to discern the original rule. Check original: under Minimum - the order and structure has been completely altered: (d) (3) a *generating unit* or *generating system* must have *facilities*: (i) where the *connection point nominal voltage* is 100 kV or more, 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 (ii) where the *connection point nominal voltage* is less than 100 kV, 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, The section from "and sufficient to achieve…S5.2.5.12" applies to the whole of the clause. Pacific Hydro recommends 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.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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. **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*: (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*:	**S5.2.5.14 Active power control** The 30 MW requirement has been removed which could cause very small generators to be required to meet these requirements. This is contrary to established practice, and would lead to excessive costs being imposed on small generation systems. Similar changes were made in SA licencing rules in 2004/5 and the result is that no small generating systems have connected in that state. AGC will and cannot provide sufficient frequency control. Primary control both units and systems will correct the problem and be cheaper and easier to implement than remote AGC signalling. Please note that ACTIVE POWER control affects the control of frequency – the rules are technically conflicted in this area. Pacific Hydro recommends that PRIORITY in interpretation should be given to the control of frequency – that is if a unit is acting to control frequency it must not be penalised and there must be an understanding that without good frequency control the system security is undermined. It can be shown that the AGC is not adequately controlling frequency in the Normal Operating Band. In many cases the AGC is contributing to the instability on the eastern seaboard. Putting more units into this control system will increase the problem not decrease it. It would be more logical to apply appropriate governing responses on all units. All units should have the right to receive their dispatch targets and AGC signals via SCADA, there needs to be consistent treatment of generators in the NEM.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
(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. **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*.	This is an onerous requirement for small units The proposed change should 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. Furthermore, this rule change it appears to be confused between FCAS market requirements and active power control requirements – for example it is not clear in (3)(ii) what is the dispatch instruction that is going to contain "raise and lower amounts" and what is "a control centre". It should be clear that it is AEMO's control centre and not an NSP's control room. The change to the minimum standard implies that very small units down to 5 MW must participate in the AGC – this is implementing the same philosophy as that adopted in SA which has created a barrier to small units connecting in that region.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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 inverter 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. Further collective work needs to be undertaken prior to setting a fixed figure and there is no definition provided for "short circuit ratio" in the rule change or the existing Glossary.. Pacific Hydro recommends the proposed change be rejected for the reasons set out above. Specifically the impractical requirements on inverter 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 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*	This is a reorganisation of the existing rule but applying to everything – (ie: less than 30 MW) appears excessive and expensive. Smaller generating systems are distribution connected, communications are not at the same standard as transmission-connected assets and voltage control requirements are negotiated with the NSP to suit local conditions. AEMO should not be requiring control of voltage setpoints into distribution areas. 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. This is an excessive amount of information to be transmitting – bearing in mind that communications congestion is getting worse and it is an extremely expensive facility to upgrade in the power system. It would appear that AMEO expect to receive all information – but the question is whether or not that information is being correctly interpreted and used. What is the "and control equipment" in light of communications? Some wind farms have non-identical units on the same feeder.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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~~ ~~(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*; (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. (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*:	Given the forecasting of the AWEFS system is not as accurate as forecasts produced by wind farm operators, wind farm owners should be able to provide their own forecast which would remove this requirement. Active signalling a change in a control mode to "predict" what units might do to a change of frequency will always be reactive in the power system. This is an inappropriate way to control the power system it will always be in "hindsight". This does not fit with the opening statement in S5.2.5.11 Noted – although dam levels are currently provided for pumped storage systems

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
(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);~~ ~~(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;	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. The Negotiated access standard for this clause is superfluous given that Minimum access and automatic access requirements are virtually the same. The change to the minimum standard will be an excessive burden on small generating units or systems. The approach taken here is similar that adopted by ESCOSA in 2004 in SA. The result is there are NO small generating units connected in SA. The cost of receiving AGC signals to small generating is unreasonable and again illustrates a misplaced expectation that small units can influence the big system. It is time that the big system (and the large units connected to it) were correctly controlled rather than placing an unrealistic cost burden onto small units in this space. There must be a distinction between automatic and minimum in this area. AEMO does not need to know everything about a small embedded unit within a distribution system the fundamental active. The ECM must be superseded by participants providing their own forecast this would greatly reduce the number of tags being transmitted.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
(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 (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*: (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** (gd) *AEMO* must~~may~~ advise on matters relating to *negotiated access standards* under this clause S5.2.6.1.	Pacific Hydro recommends 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.
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.* Modified version: In respect of a *generating system* or operating *generating unit* operating immediately prior to a *power system* disturbance:	The change to CUO significantly affects the technical standards, and fails to appreciate that all generation is affected during a disturbance. This change must be rejected as it is technically not justifiable. The word "not varying" has been inserted which is impractical for most generators. The previous definition reflected the actual situation better. These are not new definitions but moved old definitions and poorly change marked. It is the active power and reactive that belongs to the unit that is the subject of this clause. Deleting "its" makes the intent unclear.

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
(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, ***Proposed:*** ***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*. ***Correctly change marked*** **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* 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 *sent out 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*.	Pacific Hydro agrees with the removal of this clause(S5.2.5.5). There is a misunderstanding regarding "sent out generation" it should be in each of (1) to (4). This brings market into the technical – it should be the other way around. The market should conform to the technical requirements. Altering the maximum operating level to conform to a bid enables the removal of capability from the power system that is normally used in dynamic studies. Similar change marking issues in the rise time and settling times etc.
Original **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. ***Proposed*** ***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. ***Correctly change marked:*** **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.	The rise time is measured in a step response test or simulation, removing these words is unnecessary and reduces clarity

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Existing: **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 (2) the sustained change induced in that output quantity. ***Proposed:*** ***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. **Correctly change marked:** **settling time** 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 (2) the sustained change induced in that output quantity.	
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.	Pacific Hydro rejects these transitional rules as unworkable and a significant risk to investment. Pacific Hydro requests that the AEMC prepare an appropriate set of transitional arrangements that meet the regulatory framework and a suitable timeframe to introduce technical requirements

AEMO's proposed Rule Changes –modified comments have been added but may not be complete	Comments by Pacific Hydro
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.	