SYSTEM STRENGTH IMPACT ASSESSMENT GUIDELINES

DRAFT REPORT AND DETERMINATION

Published: **14 May 2018**

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

NOTICE OF SECOND STAGE CONSULTATION – SYSTEM STRENGTH IMPACT ASSESSMENT GUIDELINES

National Electricity Rules – Rule 8.9

Date of Notice: 14 May 2018

This notice informs all Registered Participants and interested parties (**Consulted Persons**) that AEMO is commencing the second stage of its consultation on the *system strength impact assessment guidelines*.

This consultation is being conducted under clause 4.6.6 of the National Electricity Rules (**NER**), in accordance with the Rules consultation requirements detailed in rule 8.9 of the NER.

Invitation to make Submissions

AEMO invites written submissions on this Draft Report and Determination (**Draft Report**).

Please identify any parts of your submission that you wish to remain confidential, and explain why. AEMO may still publish that information if it does not consider it to be confidential, but will consult with you before doing so.

Consulted Persons should note that material identified as confidential may be given less weight in the decision-making process than material that is published.

Closing Date and Time

Submissions in response to this Notice of Second Stage of Rules Consultation should be sent by email to SystemStrengthGuidelines@aemo.com.au, to reach AEMO by 5.00pm (Melbourne time) on **29 May 2018**.

All submissions must be forwarded in electronic format (both pdf and Word). Please send any queries about this consultation to the same email address.

Submissions received after the closing date and time will not be valid, and AEMO is not obliged to consider them. Any late submissions should explain the reason for lateness and the detriment to you if AEMO does not consider your submission.

Publication

All submissions will be published on AEMO's website, other than confidential content.

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EXECUTIVE SUMMARY

The publication of this Draft Report and Determination (**Draft Report**) commences the second stage of the consultation conducted by AEMO to develop the *system strength impact assessment guidelines* (**Guidelines**) under the National Electricity Rules (**NER**).

The National Electricity Amendment (Managing power system fault levels) Rule 2017 No.10 (**Amending Rule**) will commence on 1 July 2018. Clause 4.6.6 in the Amending Rule requires AEMO to *publish* the Guidelines in accordance with the *Rules consultation procedures*.

AEMO commenced the consultation on 5 March 2018 by *publishing* proposed Guidelines and calling for submissions. AEMO received ten submissions in response. The submissions expressed various concerns over the proposed Guidelines, but there were six issues that AEMO regarded as material. These are summarised in the table below, together with AEMO's response.

Issue	AEMO's response
Threshold for inclusion of other connection projects	Several submissions were concerned that AEMO's proposed threshold was too low. After further consideration, AEMO has determined that the threshold should be higher and has proposed amended criteria for further consideration.
Risk of delay if EMT models not available	Several submissions were concerned that delays in the availability of appropriate EMT models could halt the progress of *applications to connect*. AEMO considers that this can be managed by affected parties and a regulatory solution is not necessary. Accordingly, AEMO does not propose any changes to the proposed Guidelines to address this.
Establishment of a register of committed projects	*Network Service Providers* (NSPs) were concerned that there be a 'single source of truth' when it came to determining which projects should be considered to be 'committed'. AEMO was initially reluctant to assume responsibility for the establishment and management of such a register, but after further consideration, it is prepared to offer a platform for NSPs to manage their data and models.
Imposition of system strength performance requirements	NSPs were keen to see system strength performance requirements imposed on *Generators*. Given that the *AEMC* is consulting on AEMO's rule change request on Generator technical performance standards, AEMO does not consider it appropriate to include such requirements in the Guidelines. NSPs may wish to review and respond to the AEMC's draft determination when published.
Management of system strength risks	Various risks in the ongoing management of system strength were referred to in submissions, with many focusing on the extent of NSPs' responsibility for bad outcomes. AEMO does not consider the proposed Guidelines are an appropriate means to address these types of issues.
Optimising mitigation measures	Various submissions expressed concern over the need to ensure that mitigation measures were not over-sized. AEMO shares this concern and notes that the proposed Guidelines do not preclude the use of innovative solutions, whether customised or more centralised, but recognises that achieving the right-sized, least-cost solution is challenging and might require the co-operation of multiple parties.

In total, over thirty issues were raised, all of which are noted and addressed in section 4 and Appendix B.

AEMO's draft determination is to make the *system strength impact assessment guidelines* in the form published with this Draft Report.

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1. STAKEHOLDER CONSULTATION PROCESS

As required by clause 4.6.6 of the NER, AEMO is consulting on the *system strength impact assessment guidelines* in accordance with the Rules consultation process in rule 8.9.

AEMO's indicative timeline for this consultation is outlined below. Future dates may be adjusted depending on the number and complexity of issues raised in submissions, although the NER require AEMO to make the Guidelines by 1 July 2018.[1]

Deliverable	Indicative date
Notice of First Stage Consultation and Issues Paper published	5 March 2018
First Stage submissions closed	12 April 2018
Draft Report and Determination & Notice of Second Stage Consultation published	14 May 2018
Submissions due on Draft Report and Determination	29 May 2018
Final Report and Determination published	29 June 2018

The publication of this Draft Report marks the commencement of the second stage of consultation.

A glossary of terms used in this Draft Report can be found in **Appendix A**. Italicised terms are defined in the NER.

[1] NER clause 11.101.2(c)

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2. BACKGROUND

2.1 NER requirements

AEMO is required by clause 4.6.6 of the NER to develop and *publish* the *system strength impact assessment guidelines*.

The relevant requirements are detailed below for the sake of completeness:

(a) *AEMO* must make, *publish* and may amend *system strength impact assessment guidelines* that set out the methodology to be used by *Network Service Providers* when undertaking *system strength impact assessments* under clause 5.3.4B in relation to a proposed new *connection* of a *generating system* or *market network service facility* or an alteration to a *generating system* to which clause 5.3.9 applies.

(b) The *system strength impact assessment guidelines* must:

(1) provide for a two-stage assessment process comprising:

(i) a preliminary assessment to screen for the need for a full assessment; and

(ii) a full assessment;

(2) require the full assessment to be carried out using a *power system* model that is reasonably appropriate for conducting *system strength impact assessments* and applicable to the location the *transmission network* or *distribution network* at which the *facility* is or may be *connected* and specified by *AEMO* from time to time for this purpose;

(3) exclude from the assessment of an *adverse system strength impact* the impact on any *protection system* for a *transmission network* or *distribution network*;

(4) provide guidance about the different *network* conditions and *dispatch* patterns and other relevant matters that should be examined when undertaking a full assessment;

(5) specify the nature of the impacts that *AEMO* considers to be *adverse system strength impacts* and that must be avoided or overcome by undertaking *system strength connection works* or implementing a *system strength remediation scheme* in accordance with clause 5.3.4B;

(6) provide guidance about the matters that must be considered when determining whether a *connection* or alteration will result in an *adverse system strength impact*;

(7) include if applicable any thresholds below which an impact may be disregarded when determining the need for a *system strength remediation scheme* or *system strength connection works* under clause 5.3.4B; and

(8) provide general guidance about options for *system strength remediation schemes* and *system strength connection works*.

2.2 Context for this Consultation

Various schedules of the National Electricity Amendment (Managing power system fault levels) Rule 2017 No.10 (**Amending Rule**) will commence on 1 July 2018, but Schedule 1, requiring the development and publication of the *system strength impact assessment guidelines,* commenced on 17 November 2017.[2]

Clause 11.101.2(c) requires that AEMO *publish* the *system strength impact assessment guidelines* by 1 July 2018.

[2] The transitional provisions in Schedule 5 of the Amending Rule commenced on 19 September 2017.

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2.3 First Stage Consultation

AEMO issued a Notice of First Stage Consultation on 5 March 2018 along with a draft of the proposed *system strength impact assessment guidelines*.

AEMO received four valid written submissions in the first stage of consultation. Six late submissions were received, which AEMO has also considered.

All written submissions, minutes of meetings and issues raised in forums (excluding any confidential information) have been *published* on AEMO's website at: http://aemo.com.au/Stakeholder-Consultation/Consultations/Power-System-Model-Guidelines-and-System-Strength-Impact-Assessment-Guidelines.

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3. SUMMARY OF MATERIAL ISSUES

The key material issues arising from the proposal and raised by Consulted Persons are summarised in the following table:

No.	Issue	Raised by
1.	Threshold for Inclusion of Other Connection Projects	ElectraNet Energy Queensland Group Pacific Hydro Powerlink Queensland TransGrid
2.	Risk of Delay if EMT Models not provided	Pacific Hydro Reach Solar energy Terrain Solar
3.	Establishment of a Register of Committed Projects	ElectraNet Energy Queensland Group Powerlink Queensland TransGrid
4.	Imposition of System Strength Performance Requirements on Generators	Energy Queensland Group TransGrid
5.	Management of System Strength Risks	Energy Queensland Group Pacific Hydro Powerlink Queensland TransGrid
6.	Optimising Mitigation Measures	Pacific Hydro Powerlink Queensland Reach Solar energy

A detailed summary of issues raised by Consulted Persons in submissions, together with AEMO's responses, is contained in **Appendix B**.

AEMO also met with members of the Power System Modelling Reference Group (**PSMRG**) on 2 May 2018 to gain a better understanding of some of the issues that would directly impact on NSPs' ability to carry out *system strength impact assessments* in accordance with the NER. Minutes of that meeting have been published on AEMO's website at: http://aemo.com.au/Stakeholder-Consultation/Consultations/Power-System-Model-Guidelines-and-System-Strength-Impact-Assessment-Guidelines.

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4. DISCUSSION OF MATERIAL ISSUES

4.1 Threshold for inclusion of other connection projects

4.1.1 Issue and submissions

In section 4 of the proposed Guidelines, AEMO requires that NSPs undertaking *system strength impact assessments* consider all 'proposed' *generating units*, *generating systems* and *market network service facilities* for which an *application to connect* has been submitted.

Some submissions indicated that the inclusion of projects at the *application to connect* stage is premature. The issue is most relevant for proposed *generation connections* as they are more numerous and not all will come to fruition, but could also apply to proposed *market network service facility connections.*

Below are relevant extracts from submissions:

ElectraNet:

> In Section 4 it is stated that NSPs must take into account all proposed generating units or generating systems or proposed market network service facilities where an application to connect has been submitted. ElectraNet submits that this requirement is a notable shift from that published under the Interim Guidelines and considers that this presents a threshold that is too low with respect to which prospective projects must be included when conducting impact assessments.
>
> While the Guidelines require that such projects must have submitted proposed performance standards, it is noted that there are no requirements specified as to the validity or acceptability of these proposed performance standards. ElectraNet considers that it is more appropriate that a project achieve at least a provisional committed status, as defined by acceptance of proposed Generator Performance Standards by the NSP and AEMO, and for a Connection Agreement to be in place with the local NSP, before it is required to be included in the assumed projects for impact assessments of other newly proposed generators. It is also noted that the availability of a site specific and vendor specific EMT model is a key requirement to enable Full Impact Assessments to take into account any particular generator proposal.

Energy Queensland Group:

> It would be beneficial for AEMO to provide guidance as to the stage at which NSPs need to inform one another about proponents to ensure a complete Preliminary Assessment can be undertaken.
>
> …
>
> A definition for the word "proposed" is necessary. We suggest:
>
> > *"Where a proponent has made an Application to Connect, but has not yet accepted an Offer".*
>
> Additionally, there are often many systems which are in the Application phase that will ultimately not proceed. Therefore, we recommend that point two is changed from "proposed" to "committed".
>
> …
>
> A definition for the word "committed" is required. Energex and Ergon Energy suggest the following:
>
> > *"A generation proponent is considered 'committed' when they have accepted an Offer to Connect, have an agreed GPS and / or 5.3.4A letter, and an accepted PSCAD/EMT model."*

Pacific Hydro:

> Furthermore, the language refers to "proposed" remediation schemes, not committed remediation schemes. Given the volume and number of connecting projects this has created an almost impossible set of constantly changing parameters.

Powerlink Queensland:

> The Draft Guidelines now include a requirement that the impact assessment considers all existing and proposed generating units or generating systems or proposed market network service facilities where an

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application to connect has been submitted. This is a significant shift from the first and second versions of the Interim Guidelines which referred to committed generation projects. The reference to 'committed generation projects' has been removed in the Draft Guidelines.

The Interim Guidelines, released in November 2017, specify that only committed changes to the network and existing and committed generation projects are to be taken into account in the impact assessment process. These Interim Guidelines defined 'committed generation projects' as those that had a connection agreement and agreed Generator Performance Standard (GPS).

Powerlink notes a second version of the Interim Guideline, released 26 March 2018, makes reference to 'financial close' as a measure of project commitment. Powerlink does not consider reference 'financial close' is an appropriate mechanism for assessment of commitment in the System Strength assessment for a number of reasons:

- Projects may not be subject to external financing and may proceed independently; and
- For projects subject to external financing, the term is not defined in the NER. The meaning and use of the term is dependent on how the term is practically agreed and applied between parties. From that perspective, it would be inappropriate and inefficient for NSPs to actively monitor the nontransparent activity of private companies in the NEM.

Powerlink does not support the inclusion of all existing and proposed generating units in the system strength assessment as Powerlink considers such inclusion will not deliver the best outcome for customers and consumers overall. Instead Powerlink proposes only committed generation should be included and provides a proposed definition later in this submission.

Powerlink is currently assessing 38 projects which have made an application to connect to the Queensland transmission network. Powerlink is aware that there are also significant numbers of projects which have made applications to connect to adjacent networks - either distribution in Queensland or transmission in New South Wales. A number of these projects are proposing to connect to similar locations which may not be feasible or commercial. It is therefore likely that a number of projects which have made application to connect will not proceed to commitment or the timing of their progress to commitment may be significantly different to currently proposed.

In the current environment specifying the system strength mitigation solutions based on all projects which have made an application to connect to a relevant network will not be meaningful nor efficient. The system strength mitigation solutions identified will not be of "right size", likely much larger, for the sub-set of connection applicants that do progress. There is a risk that higher cost may unnecessarily impact the individual proponent's commercial business cases and, if built too large, could result in costs being indirectly borne by consumers.

In the event that the final Guidelines specify the inclusion of all existing and proposed connection applicants, AEMO needs to consider:

- Inefficiency with repetition of system strength assessment when a new connection application is received, including by neighbouring NSPs; and
- System strength mitigation solutions are specified based on EMT-type models and associated plant settings that have not undergone detailed design and due diligence at the time the application to connect is made (this usually occurs during the application process).

Powerlink proposes the Guideline should revert to the standard in the Interim Guidelines and consider only existing and committed generation projects when assessing each individual connection application, but with a different definition as outlined below. This allows clear identification of the individual proponent that causes "harm" and individual mitigation measures can be identified…

In terms of what is a committed generation project, Powerlink suggests that 'committed generation projects' should more appropriately be linked to:

- an application to connect being in place with the NSP;

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- a NER clause 5.3.4A letter having been issued by AEMO; and
- proponent agreement to NER clause 5.3.4B work, if required.

Transition to the Final Guidelines

The Interim System Strength Guidelines (Interim Guidelines) were published 17 November following collaboration between AEMO and TNSP members of a technical Task Force coordinated by the Power System Modelling Reference Group (the PSMRG).

The Interim Guidelines specify the criterion below which connecting applicants have to complete a Full Impact Assessment (FIA) as a pre-requisite to a connection agreement. Although delivering more certainty on the technical viability of connections there were unintended consequences associated with implementation of the Interim Guidelines in regards to the commercial impact on applications to connect which were already in progress.

Subsequently, Powerlink, AEMO, the AEMC and other NSPs, developed some supporting transitional arrangements that assisted the management of commercial and technical risks by applicants. Powerlink appreciates the collaborative approach taken by AEMO in developing these transitional arrangements and wishes to ensure that the likelihood of unintended consequences when transitioning to the Final Guidelines are minimised.

With respect to this concern, Powerlink recommends AEMO and the technical Task Force give consideration to commercial impacts which may arise due to the currently agreed transitional arrangements ceasing on 1 July and the Power System Model Guidelines coming into effect I July. These impacts will be different depending on the stage of the connection process at which projects need to be included with much more significant impacts if all projects which have only made an application to connect are to be included in the assessments.

TransGrid:

The draft guidelines (section 4, pp. 13), recommend that NSPs take into consideration: "…all proposed generating units or generating systems or proposed market network service facilities where an application to connect has been submitted..."

TransGrid's experience to date suggests that there is considerable uncertainty associated with the performance of the proposed connections at the "application to connect" stage and will require significant further close scrutiny by the proponents, suppliers, NSPs and AEMO, prior to finalising the plant performance. Further, there is also a significant uncertainty associated with the commitment of the proposed connections and intended timeframes for their development. If all the proposed connections are to be taken into consideration in assessing the system strength impact of a particular connection, this uncertainty would be likely to negatively impact on the assessed ability of the proposed connection to connect. On the other hand, limiting the potential connections to be considered in the assessment only to committed plant, where they require a SCR above that required for commonly available technology, may ultimately result in limiting the quantity of generation connected to the network below the economically efficient level.

TransGrid requests that the guidelines be amended to reflect:

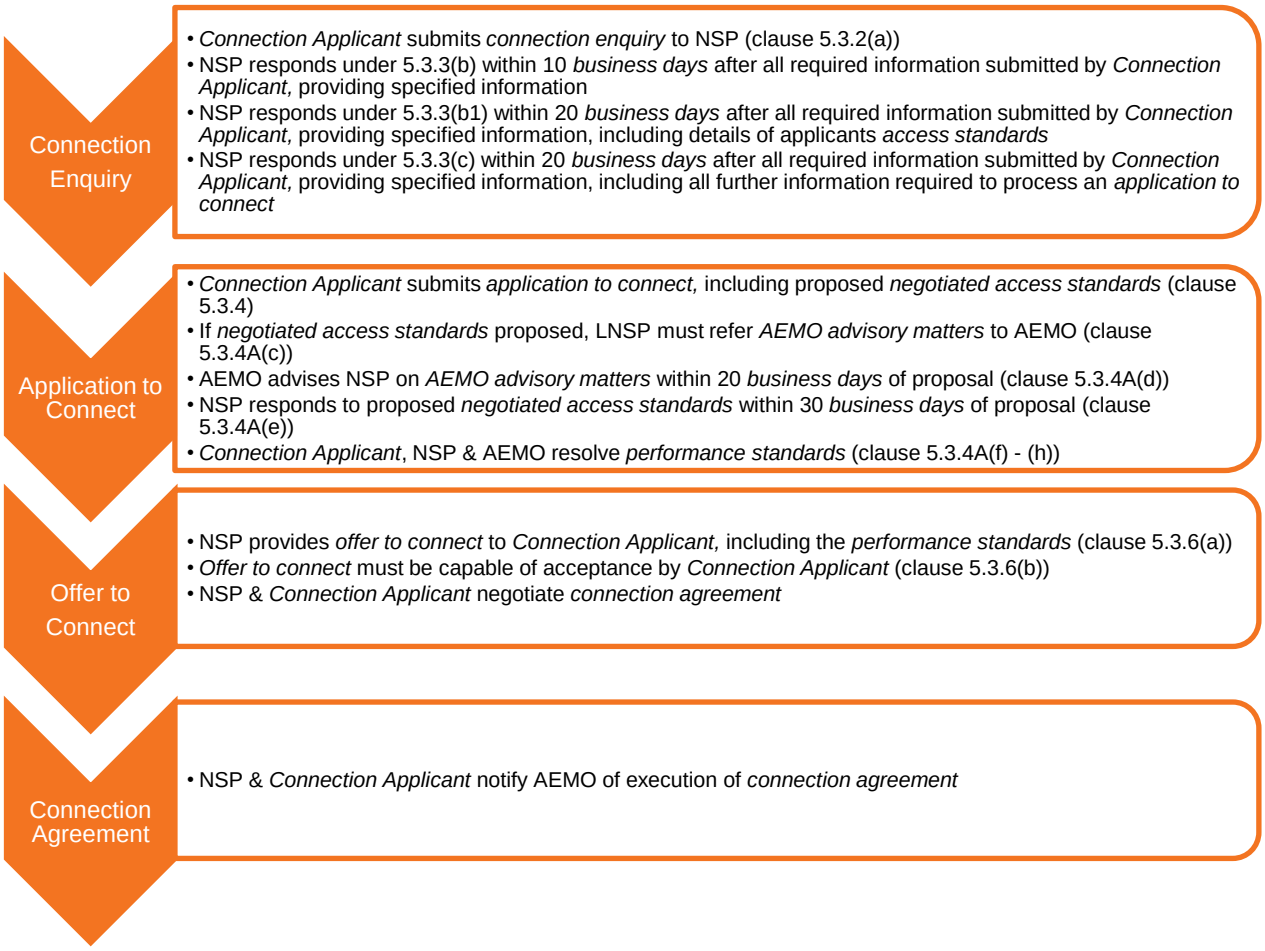
> The assessing NSP to consider the impacts of the connection proposal under assessment based only on existing and committed connections, rather than all proposed connections.
>
> …
>
> there is a reasonable likelihood that other generating units or generating systems or market network service facilities may connect to the same connection point or electrically close to the connection point in the future…

4.1.2 AEMO's assessment

The point at which a *connection* project is generally considered highly likely to proceed is commonly referred to as 'committed'. For the purposes of *system strength impact assessments*, in an environment

where proposed *generation* projects can move very quickly from proposal to construction, AEMO considers it appropriate that 'committed' need not necessarily be certain to proceed, but should be at an advanced stage. AEMO also recognises that there must be a consistent and easily identifiable threshold, or trigger, for a project to be considered 'committed'.

When determining the most appropriate point in the *connection* process at which a proposed *generation* or *market network service facility connection* project ought to be considered as 'committed', AEMO considered the steps in the NER. The process is detailed in Chapter 5. At a high level, and assuming no diversions, such as a requirement to involve another NSP, the process is depicted in the following flow diagram:



Some of these milestones are, by their nature, indicative of substantial expenditure (and therefore a reasonable level of commitment) on the part of the *Connection Applicant*. In proposing that the *application to connect* be the threshold for determining whether a *generation connection* project will proceed, AEMO considered that the requirement for an *application to connect* to be accompanied by proposed *negotiated access standards* was significant. The *Connection Applicant* will have undertaken significant technical studies to develop proposed standards, which tends to indicate that a project is likelier than not to proceed.

Several submissions challenged this assumption, but did not agree on what 'commitment' should mean:

- ElectraNet proposes that this be when:
  - proposed *performance standards* are accepted by the NSP and AEMO;
  - when a *connection agreement* has been executed; and

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  - a site specific and vendor specific EMT model has been provided.
- Energy Queensland Group proposes that this be when:
  - the Connection Applicant has accepted an offer to connect;
  - proposed performance standards are accepted by the NSP and AEMO, and/or a clause 5.3.4A letter has been issued by AEMO; and
  - the Connection Applicant has submitted an acceptable PSCAD™/EMTDC™ model to AEMO.
- Powerlink Queensland proposes that this be when:
  - an *application to connect* has been submitted to the NSP;
  - a clause 5.3.4A letter has been issued by AEMO; and
  - *Connection Applicant* agreement to clause 5.3.4B work, if required.
- TransGrid proposes that this be when the NSP considers that there is a reasonable likelihood that other proposed *connection* projects for *connection* the same *connection point* or electrically close to it are likely to proceed.

For the sake of completeness, AEMO notes that, for the purposes of the *statement of opportunities*, AEMO defines levels of commitment ('proposed', 'advanced' or 'committed') by reference to the following criteria:[3]

Category	Criteria
Site	The proponent has acquired (or commenced legal proceedings to acquire) land for the project.
Major components	Contracts for the supply of major plant or equipment (such as generating units, turbines, boilers, transmission towers, conductors and terminal station equipment) have been finalised and executed, including provisions for cancellation payments.
Planning consents/ construction & connection approvals	The proponent has obtained all required planning consents, construction approvals, connection contracts, and licences, including completion and acceptance of any necessary environmental impact statements, and AEMO has issued a clause 5.3.4A letter.
Finance	The financing arrangements for the project are concluded and contracts have been executed.
Construction date	Construction must have commenced or a firm commencement date has been set.

AEMO needs to define 'committed' so that there is consistency in how NSPs conduct their *system strength impact assessments*. A subjective definition, such as that proposed by TransGrid, will lead to inconsistent outcomes between *regions*.

It is important to ensure that *system strength impact assessments* make realistic assumptions about the number, location and type of *connections* in the foreseeable future.

AEMO accepts that its original proposal to include all projects that have reached the *application to connect* stage may capture a material number of projects that ultimately do not proceed, or are deferred for an extended period. It also recognises the challenges in modelling *connections* without sufficiently detailed or certain information. On the other hand, excluding projects that are highly likely to proceed (even if not yet fully 'signed up') carries a significant risk of under-estimating their collective impact on system strength and over-spending on ad hoc Mitigation Measures, not to mention exacerbating the conditions for future *connections* in the fairly short term.

[3] These criteria are found in the 'Background Information' tab in each regional generation information data file, accessed from AEMO's Generation Information webpage: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information

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The performance of a Full Assessment requires the use of a PSCAD™/EMTDC™ model that complies with the requirements detailed in the proposed *Power System Model Guidelines*, so it makes sense that this should be the key criterion for determining whether a *connection* project is 'committed'. Moreover, it would be of no assistance to the NSPs if the models obtained are flawed; the models needed for a Full Assessment must comply with the requirements detailed in the proposed *Power System Model Guidelines*.

Another key concern is that there must be a degree of certainty on the *performance standards* that will apply to the *connection*, so there can be some certainty as to *plant* performance, and therefore, confidence in the outcome of the studies.

Finally, to complete the assessment, NSPs will need to know the scope of any *system strength remediation schemes* or *system strength connection works* for other proposed *connections*.

4.1.3 AEMO's conclusion

Although submissions were focussed on the criteria in section 4 of the proposed Guidelines by which other proposed *connections* were to be considered as part of a *system strength impact assessment*, AEMO also considers it prudent to specify the commitment criteria for the subject Applicant.

To balance the needs discussed in section 4.1.2, AEMO considers that the following criteria appropriately determine whether a proposed *connection* is 'committed' for the purposes of carrying out *system strength impact assessments.*

In the case of the Applicant, when:

- AEMO's clause 5.3.4A letter has been provided to the *connecting* NSP; and
- AEMO and the *connecting* NSP have accepted that a detailed PSCAD™/EMTDC™ model of the proposed *connection* representing the proposed *connection* meets the requirements of the *Power System Model Guidelines*.

In determining whether to include another *connection* in the *system strength impact assessment* of an Applicant, the two criteria above will apply (with modifications) plus two further requirements, as follows:

- AEMO's clause 5.3.4A letter has been provided to the *connecting* NSP;
- AEMO and the *connecting* NSP have accepted that a detailed PSCAD™/EMTDC™ model of the proposed *connection* representing the proposed *connection* meets the requirements of the *Power System Model Guidelines*;
- any proposed *system strength remediation schemes* or *system strength connection works* in respect of that other *connection* have been agreed between the relevant parties, or determined by a *dispute resolution panel*; and
- there is no reasonable basis to conclude that the model previously provided and considered to be 'committed' is materially inaccurate following commissioning of the *connection*.

4.2 Risk of delay if EMT models not available

4.2.1 Issue and submissions

Some submissions have referred to concerns about the consequences of a delay in the provision of up-to-date PSCAD™/EMTDC™ models or, indeed, a failure to provide them, by other *connected parties*, or *Connection Applicants*.

Below are relevant extracts from submissions:

Pacific Hydro:

> Another factor is NSPs not yet having the required (EMT) models which are needed for the full assessment. The guideline, the rules and the requirement for detailed EMT models is already a problem and transitional

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arrangements regarding the lack of EMT full models must be considered. This leads to enormous risks and unacceptable delays for the connection of plant while waiting for the models to be developed.

Reach Solar energy:

The proposed wording is reliant on all generators, including existing generators, to provide up-to-date PS-CAD models each time a system strength assessment is undertaken. This means the Applicants process will stop if one generator does not provide an up-to-date EMT model of their plant in a timely manner.

Terrain Solar:

Terrain Solar does not support consideration of nearby asynchronous generators in the preliminary of (sic) full impact assessment where they are either not committed or do not have a releasable EMT model. Where this is the case the connection applicant should be allowed to progress through the GPS assessment at their own risk, acknowledging that if another generator is subsequently committed nearby and a releasable EMT model is available then system strength remediation may be required following a full impact assessment at that time. However, this should not be used as a blocking mechanism to stop connection applications being assessed.

4.2.2 AEMO's assessment

Risk of delay to application process

All the submissions on this issue assume that the *connection* application process will stop, or be unacceptably delayed, if an NSP does not have all necessary PSCAD™/EMTDC™ models to conduct a *system strength impact assessment*. AEMO does not agree that this is a foregone conclusion.

NSPs are required to take several matters into consideration when carrying out a Full Assessment, one of which is to use up-to-date PSCAD™/EMTDC™ models of all relevant *plant*. If models are not available for one or more *plant*, the proposed Guidelines do not preclude NSPs from proceeding with the assessment.

Time limit for provision of models

The proposed Guidelines do not need to introduce a time limit for the provision of up-to-date PSCAD™/EMTDC™ models from *Registered Participants* with *connected plant* because the NER will do this from 1 July 2018, following the commencement of the National Electricity Amendments (Generating System Model Guidelines) Rule 2017.[4]

Section 2 of the proposed Power System Model Guidelines summarises those requirements, which require the submission of models within 15-20 *business days* from the date of the request.

Managing the risk of delay in provision of models

As illustrated above, there are ways to manage the risk of delay in the provision of an up-to-date PSCAD™/EMTDC™ model by another *Registered Participant*, either through the use of assumptions that lead to conditional outcomes, or reopeners in *connection agreements*, something that already occurs to a certain extent.

Take an example: There are two solar farms, Solar Farm A and Solar Farm B, that have submitted *applications to connect* and they appear to be electrically close to each other:

- AEMO has forwarded a clause 5.3.4A letter to the *connecting* NSP for each of them.
- Solar Farm A submits its PSCAD™/EMTDC™ model to the *connecting* NSP, which is subsequently accepted, but Solar Farm B's PSCAD™/EMTDC™ model is delayed.
- This means that Solar Farm A is 'committed', but Solar Farm B is not.

[4] Noting that this is the commencement date of the proposed Guidelines, as well.

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The *connecting* NSP has two options:

- Option 1:
  - The NSP can conduct a Full Assessment of Solar Farm A on the assumption that Solar Farm B doesn't exist because it is not 'committed'.
  - When an acceptable Solar Farm B's PSCAD™/EMTDC™ model is available, the NSP can conduct a Full Assessment of Solar Farm B but on this occasion, the NSP will incorporate Solar Farm A in the assessment as a Committed project.

  The outcome is that if Solar Farm B's operation will degrade Solar Farm A's system strength performance, Solar Farm B's Mitigation Measure will have to include measures to address this additional impact.
- Option 2:
  - If the NSP considers it is likely that a more efficient Mitigation Measure could address the impact of Solar Farm A and Solar Farm B concurrently, the NSP can agree with Solar Farm A and Solar Farm B to carry out a joint Full Assessment. The parties can either:
    - wait until all acceptable PSCAD™/EMTDC™ models have been submitted; or
    - agree on assumptions over Solar Farm B's performance in the absence of a model.
  - The parties can agree to revisit the joint assessment once Solar Farm B's acceptable PSCAD™/EMTDC™ model is available, and agree on the allocation of costs caused by the delay.

  Solar Farm A and Solar Farm B have an incentive agree to a Mitigation Measure that addresses all impacts because their share in its cost should be materially less than the cost of independent Mitigation Measures to cover the impact of each Solar Farm.

  Solar Farm B has an additional incentive to not delay submission of its PSCAD™/EMTDC™ model because of the cost implications of causing a delay, both in terms of the need to reassess its impact and the lost opportunity in sharing in the cost of a joint Mitigation Measure.

The risks associated with delays in the provision of PSCAD™/EMTDC™ models can addressed. AEMO does not consider this is a matter to which a regulatory solution can, or should, be imposed.

Risk of delay caused by NSPs' not having full system models

In its submission, Pacific Hydro noted an additional cause of delay due to the lack of an EMT model for the entire *network* owned by an NSP. AEMO agrees that there is a risk that some NSPs might not have developed EMT models by 1 July 2018, and this could delay the performance of Full Assessments where required.

AEMO notes that NSPs have been aware of the need for system strength to be assessed and that obligations would be imposed on them in this regard for at least a year.[5] While the details of those obligations were not finalised until the final version of the Amending Rule, NSPs have been aware of the need to develop appropriate EMT models of their *networks* since the Amending Rule was published on 19 September 2017. In making the Amending Rule, the AEMC assessed that 1 July 2018 represented an appropriate commencement date for these requirements.

A requirement for interim *system strength impact assessments guidelines* was included in the transitional provisions of the Amending Rule at the suggestion of NSPs. AEMO *published* these interim guidelines on 17 November 2017, with extensive input from NSPs.

Since the Amending Rule commences on 1 July 2018, AEMO has no power to defer the application of these requirements in the Guidelines.

[5] AEMC 2017, System Security Market Frameworks Review, Directions Paper, 23 March 2017, Sydney.

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4.2.3 AEMO's conclusion

From 1 July 2018, the NER will require *Registered Participants* to provide up-to-date PSCAD™/EMTDC™ models of their plant upon request from AEMO in certain circumstances, one of which is the need for NSPs to carry out *system strength impact assessments*. AEMO intends to make such requests, and any failure to meet an obligation to provide those models in due course would be a breach of the NER, to be addressed by the *AER*.

In the case of NSPs, AEMO cannot address any delay caused by an NSP's failure to have complete system models of their *networks* and suggests that affected parties direct their concerns to the *AER*. Nevertheless, AEMO notes it is possible for *Connection Applicants* and NSPs to manage the risk of delay to a *connection* application process caused by a failure, or delay, in the availability of up-to-date PSCAD™/EMTDC™ models contractually. Therefore, AEMO does not consider that a regulated solution is warranted.

4.3 Establishment of a register of committed projects

4.3.1 Issue and submissions

To facilitate a more efficient implementation of the Guidelines, several submissions requested that AEMO establish and maintain a register of 'committed' projects that should be included in NSP studies.

Below are relevant extracts from submissions:

ElectraNet:

> To enable NSPs to conduct the required system strength impact assessments for proposed non synchronous generation projects, records of projects to be included in these studies must be maintained to ensure that the assumptions feeding these studies are appropriate. Given the high level of activity on generation connection projects currently in the NEM and the importance of maintaining the sequence at which projects are required to be considered in impact assessments for other proposals, the importance of such information cannot be overstated. This information would also be highly useful to proponents in considering the relative complexity of a particular region for further non-synchronous generation development.
>
> Given the numerous interfaces between NSPs and the potential for projects to cause adverse system impacts across NEM jurisdictional borders, we consider that a single register should be maintained. It would be more efficient for a single organisation to maintain such a register instead of the alternative where all NSPs would be required to develop new processes and coordinate and maintain their own records. We note that the NER already requires NSPs to advise AEMO when a project achieves committed status and, in its role in managing the OPDMS and providing models and information to participants for committed projects, AEMO already performs a similar role. Therefore, it is considered that there would be minimal additional activities required for AEMO to maintain such a single register. While noting that this does not detract from NSPs' obligations to conduct joint planning, ElectraNet submit that a register should be created that lists projects required to be included in system strength impact assessments and that AEMO would be in the best position to maintain such a register.

Energy Queensland Group:

> We also recommend that AEMO should retain a database or register of committed generators across all NSPs so that all parties are aware of committed projects and the factors that must be taken into account.

Powerlink Queensland:

> The right balance needs to be reached of the generators to be included in system strength assessments to ensure investments in system strength mitigation measures are fit for purpose, ensuring unnecessary costs are not indirectly passed on to consumers. Since system strength spans across NSP boundaries, it is important that process and criteria is followed consistently by all NSPs. To assist with ensuring all NSPs and proponents are aware of the projects to be included and their timing, Powerlink recommends the establishment of a register to inform NSPs of the generators (and corresponding models) to be assumed in

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system strength assessments. NSPs should be responsible for providing updates as proponents meet the generator inclusion criteria. Consideration should be given to how such information could be made available all relevant parties in a timely and transparent manner.

TransGrid:

> In order for efficient identification and use of the committed generating units, generating systems, or market network service facilities, in the system strength impact assessment:
>
> a. AEMO should maintain a central and up to date register of all the committed generating units, generating systems, or market network service facilities, in the NEM
>
> b. NSPs should advise AEMO in a timely manner of the committed applications to connect, to be included in the above register
>
> c. AEMO to provide access to the above register to all NSPs undertaking system strength impact assessments
>
> In considering the system strength impact of connections in close proximity but to different NSPs, it is critical that all of their performance standards are adequately considered, modelled and evaluated, both for preliminary assessment as well as for detailed assessment. In order for this process to work efficiently, existing and committed connections need to be transparent for the assessing NSPs. Maintenance of a central register of connections by AEMO (together with corresponding plant models and parameters, SCR capability and connection arrangements) would be an efficient means of achieving this outcome.

4.3.2 AEMO's assessment

While the concept of a single register of committed projects is sensible, AEMO has reservations about undertaking this responsibility without an enforceable legal obligation on NSPs to provide and update the required information.

While the NER already imposes a clear obligation on AEMO to provide models and other information in clause 3.13.3, the NER do not require AEMO to provide models of 'committed' projects for the purposes of *system strength impact assessments*. The only information that AEMO is required to provide *Connection Applicants* under clause 4.6.6(f) is the model referred to in clause 4.6.6(b)(2).

If the NSPs wish AEMO to establish a single register of committed projects for the NEM, AEMO would only do so on the basis that content risk remains with the NSPs. AEMO could provide a database that NSPs could access remotely and update the details of committed *connection* projects affecting their *network*. Queries about the content of the database would be addressed by the owner of the data.

In this way, AEMO merely provides a platform for the database while the NSPs provide, and are accountable for, the database's content.

In addressing concerns over the timeliness of updates to the register, AEMO proposes that NSPs be required to update the register of its own 'committed' projects within 48 hours of any change and will provide for this in the proposed Guidelines.

4.3.3 AEMO's conclusion

AEMO will establish and make available a secure database to NSPs to facilitate their management of information. The NSPs will be responsible for the content of the database by:

- Providing specified details of each committed *connection* project affecting their *network*.
- Ensuring that the content they upload remains up to date.
- Responding to queries from other NSPs as to the content they upload.
- Updating the register with changes to the status of the *connection* projects affecting their *network* within 48 hours of the change.

The database will only be made available to NSPs.

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The specifications for the register will be addressed outside of the Guidelines.

4.4 Imposition of system strength performance requirements on generators

4.4.1 Issue and submissions

Two submissions suggested a need for some form of performance requirement on *Generators* with respect to their contribution to system strength.

Below are relevant extracts from submissions:

Energy Queensland Group:

> Further clarity is required as to whether a standard requirement, e.g. ESCOSA minimum SCR of 1.5 and ratio of system inductive to resistive impedance of 2.0 at the high voltage inverter terminals, will be enforced by AEMO or, alternatively, whether there will be a requirement for NSPs to develop an industry standard.

TransGrid:

> TransGrid requests that the guidelines be amended to reflect:
>
> …
>
> > The assessing NSP to require the proposed connection to be able to perform at a system strength that corresponds to a short circuit ratio (SCR) at the connection point as low as reasonably practical, if in its opinion the NSP considers:
> >
> > a. there is a reasonable likelihood that other generating units or generating systems or market network service facilities may connect to the same connection point or electrically close to the connection point in the future
> >
> > b. inferior performance of the proposed connection (e.g. proposed connection requiring a SCR higher than commonly available technology to perform satisfactorily) is likely to reduce the generation capacity that can be connected to the network below the maximum capacity the network can accommodate efficiently and effectively. In TransGrid's experience, with presently available technology, some wind turbine generators are capable of operating under SCR of 1.2 and solar farm generators are capable of operating under SCR of 1.5. TransGrid considers that this approach will further encourage equipment suppliers to improve equipment capability through implementation of more robust controls.

4.4.2 AEMO's assessment

The subject matter for the Guidelines, as set out in the NER, is not broad enough to include the imposition of system strength performance requirements on *Generators*. AEMO considers this should be achieved by amendments to the *performance standards* for *Generators* in the NER.

In August 2017, AEMO submitted a rule change request to the AEMC addressing the technical performance requirements applicable to *generation*.[6] One of the changes proposed by AEMO was the creation of a new technical performance requirement on system strength.

The rule change request proposed that *generating systems* exhibit a minimum SCR withstand capability of 3. This contrasts with the submissions on the proposed Guidelines by NSPs suggesting a minimum SCR withstand capability of 1.5, a more demanding requirement.

A draft determination has yet to be published by the *AEMC* on this rule change request, although the AEMC's Consultation Paper raised a number of issues with regard to the application of the proposed SCR withstand requirement.[7] AEMO encourages any concerned parties to review and respond to the AEMC's draft determination when it is published if they have concerns in this regard.

[6] https://www.aemc.gov.au/rule-changes/generator-technical-performance-standards
[7] AEMC, Generator Technical Performance Standards, Consultation Paper, 19 September 2017, Sydney, at section 5.2.1. Available at above link.

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4.4.3 AEMO's conclusion

AEMO does not consider that the imposition of performance requirements on *generation* meet the requirements of clause 4.6.6 of the NER and, as such, is not appropriate subject matter for the Guidelines.

Even if clause 4.6.6 could be more broadly interpreted, it is not appropriate for the Guidelines to impose a performance requirement on *generation* where an explicit request to include such a requirement in the NER remains under consultation and might not be accepted by the AEMC.

4.5 Management of system strength risks

4.5.1 Issue and submissions

There were several submissions on risk, but they cover a range of issues. It appears the underlying concerns relate to the risks associated with the management of system strength as between an NSP and its *Network Users*.

Below are relevant extracts from submissions:

Energy Queensland Group:

> The Guidelines should also make clear that where screening methods indicate a Full Assessment is not required, the risk / obligation for correction remains with the proponent.
>
> …
>
> At the Application stage, there are still uncertainties with respect to control systems, harmonic interactions and changes in the model. The S5.2.5.13 and S5.2.5.5 model validation may not happen until well after Hold Point Commissioning and the NSP cannot be held accountable for such unknowns / model variations when undertaking system strength assessments.

Pacific Hydro:

> The NSP must accept a small amount of risk and accept that there may be a need for some network support if there are projects that have parallel time frames. It is inevitable that something will be under or overestimated and that generators cannot always carry the cost of what ultimately becomes a network problem. Studies must be agreed and limited, they cannot become open ended and endless as discussed at the start of this submission.

Powerlink Queensland:

> The objective of system strength assessments is to identify the likelihood of an adverse system strength impact caused by a new connection or change to existing connection based on proponent supplied mathematical models which aim to replicate the physical system. However, if during the connection and commissioning process the generating system is found to cause 'harm', the Guidelines should clarify that the risk for remediation expenditure still lies with the proponent who is causing 'harm'.
>
> Powerlink does not consider it appropriate for this risk to be passed on directly to consumers through minimum fault level obligations.

4.5.2 AEMO's assessment

Risk of adverse system strength if Preliminary Assessment indicates no adverse system strength impact

AEMO considers it is reasonable to expect NSPs to stand by the results of their *system strength impact assessments*. If the result of a Preliminary Assessment is that there will be no *adverse system strength impact*, the NSP is required to assume the risk that its conclusion might be wrong.

It is noted that the proposed Guidelines do not prevent NSPs from performing a Full Assessment if the results of a Preliminary Assessment are inconclusive.

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Fault levels

Once fault levels and Mitigation Measures are agreed, they would be documented in a *connection agreement*.

Over- and under-estimations of system strength

AEMO agrees that NSPs need to assume the risk that their *system strength impact assessments* are incorrect, for reasons other than inaccurate data and models provided by Applicants, and take appropriate measures to any *fault level shortfalls* in accordance with the NER.

Adverse impact on existing generation

An *adverse system strength impact* can manifest into unacceptable performance in one or more of an existing *generating system's performance standards*. Should this occur, the *connecting* NSP and the Applicant need to mitigate that impact either through the negotiation of the Applicant's proposed *performance standards* or through Mitigation Measures.

Post-commissioning impacts

AEMO understands that the use of models, regardless of type, to carry out *system strength impact assessments* is expected to provide an accurate, but not exact, approximation of how proposed *plant* is likely to perform once connected to a *network*.

Assessments are likely to be carried out at the design stage, which means that many variables can alter the performance of *plant* once it is installed, including a change to the *plant* models, *plant* size, or configuration or *connection* arrangement. Moreover, once installed, *plant* might not perform as expected, which might indicate that the models on which the assessments were based were flawed. It is also not unusual for models to require updating post-commissioning.

None of these risks is new. They are currently being managed in the context of a host of other requirements, including the ability of newly-installed *plant* to meet its *performance standards*.

AEMO considers all these risks can be appropriately managed contractually between NSPs and *Connection Applicants*.

4.5.3 AEMO's conclusion

The underlying theme of these submissions is the extent to which an NSP can be liable for poor system strength outcomes. AEMO considers this, along with other risks referred to in submissions, can be managed by the NSPs, in many cases contractually with Applicants.

Moreover, if an NSP has made a bad decision based on good information, it is inappropriate for the Guidelines to provide any way of shifting that risk onto Applicants.

Therefore, AEMO sees no need to make any changes to the proposed Guidelines to address any of the issues raised in section 4.5.1.

4.6 Optimising Mitigation Measures

4.6.1 Issue and submissions

Three submissions referred to the efficiency of selecting Mitigation Measures on an ad hoc basis, compared with an aggregated solution that would address the adverse system strength impact caused by more than one 'committed' project.

Below are relevant extracts from submissions:

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Pacific Hydro:

> The obligation for applicants to pay for system strength connection works is likely to lead to other stability issues as each project will wind up with small synchronous condensers. Larger centralised properly located units would be more efficient and cost effective. A network based solution is really what is needed with appropriate planning studies to identify the location.

Powerlink Queensland:

> The approach does not exclude the possibility of a shared mitigation solution being investigated with more than one proponent. Under the current NER arrangements regarding confidentiality, the individual proponents would need to initiate this co-ordination but changes to these requirements could be considered through another mechanism to assist in facilitating economies of scale and efficient outcomes.

Reach Solar energy:

> The AEMO guideline does not consider the mitigation will only be required at certain times of the day or year and not 24/7. This infrequent requirement would be addressed in a market-based mechanism and the AEMO guidelines provide no consideration that it may not be required for the life of the project ie. the mitigation may only be required for 5 years as a new synchronous generator or a mitigation described in 4.2(a) may connect addressing the low strength at some point in the future.

4.6.2 AEMO's assessment

AEMO notes that its responsibility in relation to Mitigation Measures is to provide guidance on the available options, not to evaluate them.

NSPs are best placed to determine whether ad hoc Mitigation Measures or aggregated/centralised solutions would be more efficient and expects them to exercise their judgement accordingly.

NSPs will have access to information about every existing and possible *connection* that is likely to affect system strength in its *network*. Therefore, it will be able to make informed judgements about where and how Mitigation Measures can be implemented in a more efficient and effective manner.

Applicants have every incentive to negotiate the most cost-effective Mitigation Measure and, on that basis, can be expected to consider any NSP proposal for an efficient aggregated or centralised solution, where the costs can be shared with other Applicants.

AEMO notes that the proposed Guidelines apply in parallel to the other aspect of the Amending Rule requiring AEMO to determine the minimum *three phase fault level* at a number of *fault level nodes* in each *region* to be maintained by the relevant TNSP at all times. One of the criteria AEMO will take into consideration in determining *fault level nodes* is areas electrically remote from *synchronous generation*, where there is a large amount of committed and prospective *asynchronous generation*. This aims to provide a baseline of system strength in such concentrated areas, but it does not substitute the need for *system strength connection works* or *system strength remediation schemes*.

In addition to this, and in reference to Pacific Hydro's comment, AEMO notes that an approach where several Applicants contribute to a larger centralised solution is already permitted under the proposed Guidelines, either by collectively proposing a *system strength remediation scheme*, or by contributing to *system strength connection works* that address their combined impact on system strength.

It is unclear what Reach Solar means by a 'market-based mechanism'. AEMO considers that contracting with *Generators* for the provision of *system strength services* is a feasible short-term commercial solution, subject to the usual procurement arrangements.

4.6.3 AEMO's conclusion

AEMO expects that NSPs and Applicants to explore appropriate Mitigation Measures and select the most efficient one in each case.

AEMO does not propose to amend the proposed Guidelines in this regard.

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5. OTHER MATTERS

5.1 Responsibility for assessments

While not considered to be a material issue, AEMO was concerned that several submissions indicated a misunderstanding about where the responsibility to carry out *system strength impact assessments* lies. The obligation clearly rests with the NSPs.

5.2 Relationship between the Guidelines and system strength requirements

Some submissions also appeared to confuse the relationship between the proposed Guidelines and other obligations in the Amending Rule concerning system strength.

AEMO included section 2 of the proposed Guidelines to explain that relationship at a very high level. It was not considered appropriate that the proposed Guidelines go into any detail about the *system strength requirements methodology* and *system strength requirements* that flow from that.

AEMO understands that there is a timing issue between the requirement on NSPs to carry out *system strength impact assessments* and AEMO's obligation to specify the *system strength requirements* for each *region*. To mitigate this, AEMO has engaged with the PSMRG to ensure that the considerations applied by AEMO in developing the *system strength requirements*, and determining the minimum number of *synchronous* machines in each *region*, are understood by TNSPs and consistently used for the NSPs' *system strength impact assessments*.

AEMO has provided more detailed responses on this matter in response to issues 16 and 30 in Appendix B.

5.3 Corrections

AEMO has made several corrections to the proposed Guidelines as follows:

- Sections 4.1.3 and 4.1.4, which apply to Preliminary Assessments, should have been repeated, to the extent necessary, in section 4.2, which deals with Full Assessments. A new section 4.2.3 has addressed this.
- When used with '4.6.6 Connection', the word 'proposed' is redundant because the definition of '4.6.6 Connection' means that it is proposed.
- Improvements to express some concepts more clearly.
- Cross-referencing errors.

For ease of reading, typographical, formatting, and italicisation corrections are not change-marked.

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6. DRAFT DETERMINATION

Having considered the matters raised in submissions, AEMO's draft determination is to make the *system strength impact assessment guidelines* in the form published with this Draft Report in accordance with clause 4.6.6 of the NER.

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APPENDIX A - GLOSSARY

Term or acronym	Meaning
Amending Rule	National Electricity Amendment (Managing power system fault levels) Rule 2017 No.10
CIGRE TB 671	CIGRE Technical Brochure TB 671 entitled “Connection of Wind Farms to Weak AC Networks”
DNSP	*Distribution Network Service Provider*
Draft Report	This document
EMT	Electromagnetic transient
ESCOSA	Essential Services Commission of South Australia
Full Assessment	The assessment referred to in clause 4.6.6(b)(2) of the NER
Guidelines	*system strength impact assessment guidelines*
Mitigation Measure	Either or both of the following (as the context requires): • system strength connection works • system strength remediation scheme
MNSP	*Market Network Service Provider*
NER	National Electricity Rules
NSP	*Network Service Provider*
Preliminary Assessment	The assessment referred to in clause 4.6.6(b)(1) of the NER
PSMRG	Power System Modelling Reference Group
SCR	Short circuit ratio
TNSP	*Transmission Network Service Provider*
WSCR	Weighted short circuit ratio

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APPENDIX B - SUMMARY OF SUBMISSIONS AND AEMO RESPONSES

No.	Consulted person	Issue	AEMO response
1.	ElectraNet, Energy Queensland Group, Powerlink Queensland, TransGrid	**Threshold for inclusion of other generator proposals** See section 4.1.1.	See sections 4.1.2 & 4.1.3.
2.	Pacific Hydro, Reach Solar energy, Terrain Solar	**Risk of Delay if EMT Models not provided** See section 4.2.1.	See sections 4.2.2 & 4.2.3.
3.	ElectraNet, Energy Queensland Group, Powerlink Queensland, TransGrid	**Establishment of a Register of Included Projects** See section 4.3.1.	See sections 4.3.2 & 4.3.3.
4.	Energy Queensland Group, TransGrid	**Imposition of System Strength Performance Requirements on Generators** See section 4.4.1.	See sections 4.4.2 & 4.4.3.
5.	Energy Queensland Group, Pacific Hydro, Powerlink Queensland, TransGrid	**Management of System Strength Risks** See section 4.5.1.	See sections 4.5.2 & 4.5.3.
6.	Pacific Hydro, Powerlink Queensland, Reach Solar energy	**Optimising Mitigation Measures** See section 4.6.1.	See sections 4.6.2 & 4.6.3.
7.	Energy Queensland Group	**Section 1.2.1: Definitions** "Synchronous fault level" is a term already widely used to denote a fault level calculated using synchronous impedances. However, it has been defined differently in the Guideline. In order to avoid confusion, Energex and Ergon Energy recommend that the term should be amended to "synchronous generation three phase transient fault level" (which may be abbreviated to "synchronous generation fault level").	AEMO has amended this to refer to the three-phase fault level comprising synchronous machines only.

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No.	Consulted person	Issue	AEMO response
8.	Energy Queensland Group	**Section 2.1: AEMO Obligations** With respect to the first dot point, further clarity is required as to what is meant by "fault levels at all busbars of the power system". Currently, we have an obligation to report on and maintain our maximum fault levels and it is unclear whether there will be a requirement for AEMO and NSPs to determine minimum fault levels for embedded generation on their networks.	The expression comes from clause 4.6.1 of the Amending Rule. The obligation is on AEMO to consult with NSPs when determining the fault levels at *busbars*. Any issues over the impact of *embedded generation* will be discussed at the appropriate time with affected NSPs.
9.	Energy Queensland Group	**Section 2.3: NSP Obligations** The third dot point requires NSPs to consult with AEMO before providing the Connection Applicant with the results of the Preliminary Assessment and the Full Assessment. However, it should be noted that NSPs have specific timeframes within which to provide a response to the proponent. It will therefore be necessary for AEMO to commit to providing timely responses to NSPs to enable those timeframes to be achieved. Energex and Ergon Energy recommend that a one to two week timeframe would be reasonable.	Section 2.3 merely outlines the new NER obligations on affected parties. The consultations that NSPs are required to undertake, and AEMO's obligations during those consultations, are addressed in new sections 4.1.3 and 4.2.3 of the proposed Guidelines.
10.	TransGrid	**Role and limitation of responsibilities of the NSPs** The objective of the system strength impact assessment by NSPs is to ensure that the proposed generating plant will not adversely impact on stable operation of the power system, a generating system or market network service facility. In assessing the impact of a proposed connection, NSPs rely on: a. the performance of the proposed plant specified via the plant's performance standards and models b. the performance of the existing and committed plants and transmission networks, based on the information available to the TNSP at the time TransGrid notes that the system strength impact assessment is not meant to: a. provide a guarantee in any form on the physical performance of the proposed plant when connected to the transmission system. In TransGrid's experience to date, significant discrepancies between model performance and physical performance can exist b. perform as a tool for tuning and coordination of the controllers and parameters of the plant associated with the proposed connection Therefore, TransGrid recommends AEMO to revise section 2 of the draft guidelines: > to very clearly outline the obligations of each of the parties involved as well as limitations of their responsibilities > to recommend the proponents to carry out their own assessment of the performance of the plant and be satisfied that the plant will perform adequately as per the owners expectations and can be operated in compliance with the NER and the Generator Performance Standards.	Section 2 of the proposed Guidelines merely summarises the new obligations imposed on relevant parties by the Amending Rule. Therefore, it is not appropriate for AEMO to extrapolate on the implications of those obligations. That is a matter that each party with concerns about the limits of those obligations should seek its own advice about. See also the discussion in sections 4.4.2 & 4.4.3.

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No.	Consulted person	Issue	AEMO response
11.	Energy Queensland Group	**Section 2.4.1: Applicant Obligations** This clause should be amended to read as follows: *"An Applicant will be required to provide up-to-date EMT models if required by the NSP undertaking a Full Assessment as these are the only types of models that will result in an accurate assessment. These models are to be provided within 20 business days. When such a model is not readily available, the NSP will not commence the Full Assessment until the Applicant provides the required updated model."* The NSP cannot bear responsibility for design or tuning advice and should only be providing performance feedback during the Full Assessment. Further clarity will therefore be required as to how proponents will adjust their tuning without access to the full models.	AEMO cannot make the requested amendment to the first sentence. Please refer to clause 5.2.5(e) of the NER (in the case of *Generators*), clause 5.2.3(k) (in the case of other NSPs), clause 5.2.4(d) (in the case of *Network Users*) and clause 5.2.3A(b) (in the case of MNSPs). In each of those cases, whether an up-to-date EMT model is required is a matter for AEMO's reasonable opinion. Tuning of the model is expected to have been carried out by, or on behalf of, the Applicant. AEMO agrees that this is not an NSP responsibility.
12.	Reach Solar energy	**Clause 2.5.4: System Strength and Inertia Methodologies and Implementation** The proposed wording does not exclude a retrospective application of the rule to a project where the *system strength requirements methodology* determines a *fault level shortfall* exists. The guidelines should make clear the rule will not be applied retrospectively to projects which have received GPS approval.	The Amending Rule does not apply retrospectively. It was made on 19 September 2017 and the relevant parts of the Amending Rule commenced on 17 November 2017. *System strength impact assessments* are required on the occurrence of one of the following: • A *connection* enquiry from a *Connection Applicant* proposing to *connect* new *generation*, or a *new market network service facility.* • An *application to connect* from a *Connection Applicant* proposing to *connect* new *generation*, or a new *market network service facility*. • A proposal to alter a *connected generating system* for which *performance standards* have previously been accepted.
13.	Energy Queensland Group	**Section 2.5.4: System Strength and Inertia Methodologies and Implementation** The Guideline specifically states that the remediation of a fault level shortfall is a TNSP obligation. Consequently, further guidance is required as to how this obligation will be applied when the fault level shortfall exists at sub-transmission or distribution level.	Section 2.5 as a whole, not just section 2.5.4, merely highlights that there is a relationship between the proposed Guidelines and other guidelines and parallel developments, such as AEMO's *system strength requirements methodology*. The guidance requested is outside the scope of the proposed Guidelines.
14.	Reach Solar energy	**Cost allocation of TNSP system strength obligation** Reach consider the TNSP and/ or AEMO should procure the required service/solution via a least-cost market-based mechanism, and it be treated as network services. The costs should be charged to the users through the network connection charges.	The allocation of costs associated with system strength remediation has been addressed by the Amending Rule and discussed extensively by the AEMC in its Determination. In summary, remediation can be effected by: • *system strength connection works* carried out by the NSP; or • a *system strength remediation scheme* behind the *connection point,* and, regardless of which option is adopted, the cost of the mitigation is to be funded by the *Generator* or MNSP whose new *connection* is found to have an *adverse system strength impact*. Where *system strength connection works* are required because there is more than one new *connection* impacting system

No.	Consulted person	Issue	AEMO response
			strength, the costs can be shared between the relevant *Generators* or MNSPs, or both, as noted in section 5.1 of the proposed Guideline. There is no scope for AEMO to address this issue any further in these Guidelines.
15.	Reach Solar energy	The guideline remains too biased to traditional generation. Reach considers: (a) The need for system inertia (sic) remains important and will be provided by synchronous generation in the near-term, but it will be increasingly provided from other sources including fast-acting asynchronous inverter technologies and/or aggregated consumer generation, controlled load shedding (financial options paid to willing consumers), installation of frequency control on Murraylink, and energy storage. The AEMO guidelines are too focused on traditional generation. (b) See section 4.5.1. (c) The proposed AEMO guidelines do not envisage or cater for a better technological solution to be developed in the future. The AEMO guideline is therefore not future-proof and instead locks in the cost of the solution for the consumer to fund the life of the project, approximately 30 years. It is possible a better technological solution is developed within solar inverter themselves well within this timeframe. (d) AEMO is able to constrain certain generation and/ or transmission lines in response to system disturbances i.e. avoiding or reducing the additional capital cost required for what are likely to be infrequent events. There is no mention of this in the AEMO guidelines.	In response to each of these points: (a) As Reach correctly points out, system strength will be provided largely by *synchronous generation* for the foreseeable future. AEMO has amended the new section 5.1 to include the use of *asynchronous plant* based on grid forming converter technologies allowing the *plant* to stably operate at an SCR level of down to zero. AEMO intends to update the Guidelines from time to time, especially if it becomes apparent that system strength can be enhanced by other types of *plant*. (b) See sections 4.5.2 & 4.5.3. (c) Section 5.1 of the proposed Guidelines has been amended to include grid forming converters. The solutions referred to in the submission are primarily for *frequency* control and *inertia* provision rather than providing a solution for an adverse impact on system strength caused by new or modified *generation*. Moreover, the list of Mitigation Measures is merely a suggested list and the introductory sentence in section 5.1 clearly states that the list is not exhaustive. (d) AEMO presumes that Reach is referring to the use of *dispatch constraint* equations, which are referred to in section 5.2 of the proposed Guidelines and discussed extensively in section 5.3. In addition to the technical issues raised in the proposed Guidelines, and to respond directly to the issue raised by the submission, it should be noted that the use of *dispatch constraint* equations to control the flow of electricity on the *network* will usually result in an increase in *spot prices* and should neither be seen as a solution to a *network* problem caused by the *connection* of new *generation*, nor as a means of avoiding the capital expense of new *plant* to address those issues. These *market* costs would need to be quantified and assessed against the capital cost of a *plant*-based solution for its full economic life before it can be determined whether the use of *dispatch constraint* equations will result in the avoidance, reduction or merely a reallocation of cost from NSP regulated revenue to *market* costs. The economics of each new *connection* would need to be assessed before a decision as to the most efficient option could be made. Since the *Generator*/MNSP who is causing the *adverse system strength impact* must fund the

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			mitigation, it would be in their best interests to seek the most cost-effective solution regardless of whether it takes the form of *system strength connection works* or a *system strength remediation scheme*.
16.	Clean Energy Council	**Calculations of system strength impact must be clear and justified** The calculation of system strength impacts by connecting parties must be clearly defined. AEMO has presented the SSIAG within the context of System Security Market Framework Review requirements, specifically the Fault Level rule which requires NSPs to procure a minimum level of system strength. However, it is not clearly stated how the SSIAG is linked to the Fault Level rule and what minimum levels of fault level will be required as part of the application process for the guidelines. Without a definition of this minimum level within the SSIAG, the definition of the level is at the discretion of the NSP which could produce varied or unreasonable outcomes. It is suggested that the SSIAG focus on compliance with S5.2.5.5 (fault ride through performance). Attention should be exercised when specifying calculations of system strength. It is not clear that the SCR is the most appropriate metric to use in calculations of system strength. If used, transparency must be provided in the SCR calculation in the SSIAG and the basis for the calculation approach must be justified. It is understood that the final system strength guidelines may specify the use of transient reactance. The need for the use of this variable is unclear, and requires justification considering its impact on the SCR value.	It appears that the Council is concerned about the lack of a determination on the *system strength requirements* for each *region*, but that is not a matter that the Guidelines can address. This is addressed in clause 11.101.4(a) in the Amending Rule. AEMO is required to make these determinations by 30 June 2018 by reference to a methodology that, likewise, must be *published* by that date (under clause 11.101.3(a)). AEMO intends to fulfil these requirements by that date. For completeness, it should be noted that to determine the *system strength requirements* under clause 5.20C.1 in the Amending Rule, AEMO is required to determine the *three phase fault level* at *fault level nodes* and the minimum *three phase fault level* at those *fault level nodes*, all of which are to be determined in accordance with the *system strength requirements methodology* under clause 5.20.7(b). The calculation is specified in the definition of *three phase fault level.* The content of the Guidelines is clearly prescribed by clause 4.6.6 in the Amending Rule. The Council's suggestions on the focus of the Guidelines is misconceived, as the processes underpinning those matters are outside the scope of the Guidelines. In specifying the use of CIGRE TB 671 as the reference point for the choice of calculation method, AEMO considers that the calculation is sufficiently transparent. CIGRE TB 671 also permits the use of transient reactance. Focussing on compliance with the clause S5.2.5.5 technical requirements is inappropriate and could result in not identifying an adverse system strength impact at early stage. Figure 11 of the proposed Guidelines demonstrates how a system with a low fault level can be exposed to steady state instability. When AG2 is connected, it affects AG1's performance. This phenomenon appears even before the *power system* is subjected to a fault. Hence, compliance with clause S5.2.5.5 would not be a good indicator of system strength. AEMO notes that the SCR is used for the Preliminary Assessment only. Appendix B of the proposed Guidelines includes results obtained from detailed simulation studies conducted on a number of actual wind and solar farm projects. This corroborates the appropriateness of using SCR as a screening threshold for issues related to lack of system strength.

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			See also the discussion in section 5.2 on the timing issue between the proposed Guidelines and other requirements on system strength imposed by the Amending Rule. Lastly, AEMO has conducted benchmarking studies between full-scale PSS®E and PSCAD™/EMTDC™ models of South Australia and Tasmania as part of developing the *system strength requirements methodology*. These studies demonstrate the highest accuracy in the PSS®E fault current calculations when the sub-transient impedance is used. This will result in a higher fault current than that estimated by the transient impedance, providing less conservative results from a *Generator's* perspective.
17.	Clean Energy Council	**Processes must be clearly defined within the SSIAG** The SSIAG must inform clear processes for involved parties, particularly in terms of requirements, modelling methods and responsibilities. For instance, although the SSIAG references system strength remediation schemes, it does not identify a transparent process by which a connecting proponent can assess the impact of their project on system strength in the presence of other connecting parties. It is unclear how a connecting party can demonstrate compliance with a 'do not harm' requirement in the absence of a defined process. This must be considered in order to ensure the usability of the guidelines. In terms of process, the current power system model guidelines also do not address the commercial sensitivities of requiring PSCAD models to be shared between third parties. The competitive nature of the connection process causes difficulties around sharing models and has the potential to cause confidentiality issues for manufacturers. This issue must be considered by AEMO.	If an Applicant wishes to review an NSP's *system strength impact assessment,* the following requirements apply: • The NSP is required to provide the Applicant with the information specified in section 4.1.4 of the proposed Guidelines (following a Preliminary Assessment) and section 4.2.3 (following a Full Assessment). • Subject to the conditions specified in clause 4.6.6(f) in the Amending Rule, Applicants are entitled to receive a copy of the model used by the NSP to carry out a Full Assessment, being the model referred to in clause 4.6.6(b)(2). Confidentiality is addressed as follows: • In the context of *system strength impact assessments,* in clause 4.6.6(f) in the Amending Rule. • In the context of the provision of models, in section 7 of the proposed *Power System Model Guidelines*.[8] As noted in section 4.3.2, the only information that AEMO is required to provide *Connection Applicants* under clause 4.6.6(f) is the model referred to in clause 4.6.6(b)(2). This will not necessarily involve disclosure of the model related to each *plant* that was included in a Full Assessment and if it did, provision of the model is subject to the confidentiality requirements in the NER, and subject to request from impacted Applicants who indicate that the reason for seeking the model is to determine whether to instigate a dispute under clause 5.3.4B(c) of the NER.
18.	Clean Energy Council	**The SSIAG must work within the capabilities of proponents** It is essential that requirements made in the SSIAG allow parties to meet their performance standards. The full assessment requires connecting parties to assess the impact of new or modified generation connection on the ability of existing or other committed generating systems to meet their GPS. This is beyond the reasonable requirements of the connecting party.	AEMO requires NSPs to provide detailed information to Applicants, including their assumptions, with the results of a Preliminary Assessment (section 4.1.4) and a Full Assessment (section 4.2.3). See also AEMO's response to issue 17 on the information an Applicant is entitled to receive following the conclusion of a Preliminary Assessment or a Full Assessment, noting that the

[8] See http://aemo.com.au/Stakeholder-Consultation/Consultations/Power-System-Model-Guidelines-and-System-Strength-Impact-Assessment-Guidelines.

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		The transparent provision of information is also essential. It is critical to appreciate the importance of information provision for connecting parties. Where a full system strength impact assessment is required, there should be a mechanism to allow all information required for the connecting party to carry out a full assessment to be made available. Without full information, there is significant uncertainty for proponents to undertake EMT-type modelling. It is important that the SSIAG incorporate practical assumptions, and does not include results that reflect non-physical assumptions (eg. infinite source impedance or no fault contribution at a connection point). It is likely that incorrect assumptions will result in high equipment costs for proponents and inefficient outcomes.	model will only be provided if the Applicant indicates that the reason for seeking the model is to determine whether to instigate a dispute under clause 5.3.4B(c) of the NER.
19.	Energy Queensland Group	**Section 4.1.1: Overview** A definition for the term "withstand capacity" (sic) is required. We suggest: *"The 3-second fault current withstand capability of the plant".*	
20.	Energy Queensland Group	**Section 4.1.2: Impact Assessment** Energex and Ergon Energy will require detailed information from the TNSP on fault levels. Therefore, we recommend that additional information regarding the exact network state / conditions should be included in the fault level information provided by the TNSP or AEMO, including, for example, items of plant and / or generators that are out of service. With respect to WSCR calculations, clarification is required as to whether SVCs and STATCOMS should be included. Energex and Ergon Energy request that it is clearly defined that: - SVCs and STATCOMs are not to be considered in the WSCR calculation; and - If an SVC or STATCOM changes the voltage at the busbar of interest by more than three per cent (or as agreed by the NSP), a Full Assessment should be carried out to study the possible interactions. An agreed definition of "electrically close" is required. Both 100km and five busbars away have been put forward previously, but no consensus has yet been reached. We recommend that AEMO should lead the discussion on this issue.	AEMO and the relevant TNSP can provide a PSS®E case corresponding to the minimum three-phase fault level requirements. DNSPs are responsible for making further changes in terms of *network outages* and *contingencies* that need to be applied for *distribution connected plant*. AEMO has clarified the relevance of FACTS devices at the end of section 4.1.2. AEMO considers that a single definition of 'electrically close' is impractical. There are vast geographical and *network* topological differences between *regions* with the two extremes being Queensland and Tasmania. Moreover, not all calculation methods require consideration of this issue. For example, the use of MSCR method (referred to as Available Fault Level method in CIGRE TB 671 obviates the need for either considerations suggested by Energy Queensland.
21.	Tilt Renewables	In **section 4.1.2**, there is a statement that reads: *"An Applicant should obtain clarification from the NSP as to what method has been used by the NSP for the Preliminary Assessment."*	AEMO agrees and will make the appropriate amendment.

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		Tilt Renewables recommends that this wording be altered to: *"Prior to undertaking the Preliminary Assessment, the NSP is required to notify the Applicant of the method to be used for the Preliminary Assessment. As part of that notification, the NSP is required to provide details of how the method is implemented."* Such a change will ensure transparency of the process without the need to request it.	
22.	Terrain Solar	**Section 4.1.2: Requirement for headroom (or margin) between network capacity verses connection requirements** Terrain Solar does not support additional headroom (or margin) being imposed between network capacity and connection requirements given the preliminary assessment is normally undertaken using an extreme operating condition (generally the lowest fault current level) with asynchronous generators operating at 100% dispatch. Given the extreme unlikelihood that minimum fault current levels would coincide with maximum dispatch of asynchronous machines such as solar or wind generators, there is already a significant degree of conservatism in the preliminary assessment, therefore additional margins are not appropriate.	AEMO disagrees that minimum fault current levels are extremely unlikely to coincide with maximum *dispatch* of *asynchronous generation*. This coincidence is, in fact, highly likely and it is part of the problem in South Australia, and will be in other *regions*. Very few *synchronous generating systems* are *dispatched* in very windy or sunny conditions due to their relative marginal costs. There is a high level of correlation and coincidence between the two.
23.	Pacific Hydro	Of further concern is the additional 10% deduction from the SCR outcome obtained from the preliminary assessment. Being too conservative with these SCR values will ultimately result in greatly increased costs for mitigation methods which may in fact not be needed.	The Preliminary Assessment acts as a screening process to determine whether a Full Assessment is to be carried out. Mitigation Measures will not be determined based on the outcomes of a Preliminary Assessment. If an *adverse system strength impact* is found in the Preliminary Assessment; the Applicant will need to submit a proposed *system strength remediation scheme* with its *application to connect*. It will then be assessed as part of a Full Assessment, which is based on better data, and no headroom, before determining whether mitigation is required.
24.	General Electric	**Section 4.1.3: Results of Preliminary Assessment** The NSP will undertake an initial assessment of the system strength impact, however a timeline should be imposed on the NSP to provide the results of such assessment.	The results of the Preliminary Assessment must be provided to a *Connection Applicant* with the NSP's response to the *connection* enquiry (see clause 5.3.3(b4) in the Amending Rule), which must be provided within the time specified in clause 5.3.3(a1) of the NER. The only deadline not specified in the NER is where an NSP must carry out a Preliminary Assessment following a request under clause 5.3.9(c1). AEMO proposes to amend the proposed Guidelines to include deadlines in those cases, consistent with those that apply to *connection* enquiries.

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25.	General Electric	**Section 4.2: Full Assessment** The Generator makes a significant investment to put together the *application to connect*, therefore the Full Assessment should be carried out prior to submission of the *application to connect* since the Full Assessment may invalidate the studies carried out to prepare the *application to connect*.	The NER require a Full Assessment to be carried out only after an NSP receives an *application to connect* – see clause 5.3.4B(a) in the Amending Rule. A further requirement on *Connection Applicants* is to submit a *system strength remediation scheme* with their *application to connect*, presumably because a Preliminary Assessment indicates that their proposed *connection* is likely to have an *adverse system strength impact* (see clause 5.3.4(g) in the Amending Rule). In light of those requirements, AEMO is not in a position to require an earlier assessment.
26.	Energy Queensland Group	The wording of this clause places responsibility for completing the Full Assessment on the NSP. Further clarification is required to ensure that there is no expectation that the NSP will be providing specific tuning or system design advice and that general advice only regarding system performance will be provided. Guidance is also required on how a proponent will tune their model without access to all the other models.	It is the NSPs' responsibility to carry out the *system strength impact assessments*, regardless of whether they are carrying out a Preliminary Assessment or Full Assessment. NSPs should resolve gaps in the information required to draw conclusions from these assessments contractually with Applicants as mentioned in sections 4.5.2 & 4.5.3.
27.	Energy Queensland Group	**Section 4.3: Scenario Selection** It will be necessary for NSPs to know the minimum generation dispatch profiles to accurately conduct stability studies. Further clarity is required as to which party will be calculating those profiles, when they will be calculated, and how NSPs will be able to obtain this information.	AEMO understands that TNSPs will be providing the relevant data to DNSPs.
28.	Energy Queensland Group	**Section 5.1: System Strength Connection Works** Some discussion on the long-term implications of maintaining system stability would be appreciated. Where a generator is connecting into aged network, the NSP should be able to nominate plant retirement outside the five year window (for example, the retirement of a sub-transmission line leading to a change in system strength) to ensure future system stability.	The long-term implications of maintaining system stability is a matter that NSPs need to consider when agreeing on *system strength connection works*, or when reviewing proposed *system strength remediation schemes*. There is nothing in the proposed Guidelines to prevent an NSP from nominating *plant* retirement as part of a longer-term plan to ensure system stability. See also section 5.2 on the linkage between the proposed Guidelines and *system strength requirement*s. *Network plant* retirements can be considered in the latter.
29.	General Electric	**Section 5.1: System Strength Connection Works** Modifications to control systems belonging to the NSP or other Network Users – It is not clear under which Rules' provision the NSP could demand an existing Network User to adjust their control settings to facilitate say a new generator connection. However, such an avenue would lead to efficient investment since new generators may not require system strength reinforcing solutions to process their connection	Footnote 43 clearly references clause S5.2.2 of the NER in the case of *Generators*. The footnote will be amended to include a reference to clause S5.3a.2 in the case of MNSPs.
30.	Pacific Hydro	There is a drafting approach that places an imperative on the connecting party to provide solutions that solve all possible problems. This has the effect of making it the generators task and responsibility to solve all risks and unidentified problems. Any assumption that presumes that all risks and problems can be solved is highly problematic. Power systems are	AEMO must also *publish* the *system strength requirements methodology* under clause 5.20.7(b) in the Amending Rule and *system strength requirements* under clause 5.20C.1 in the Amending Rule, both by 30 June 2018.

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		complex machines, and there is an extremely high or an infinite number of problems that could occur in a system. Tackling a system problem in a manner that expects perfection will lead to a situation in which nothing can be solved. Engineering requires refining extremely complex problems down to the fundamental issue/s and then addressing those through first principles and dealing with the worst cases that can be reasonably expected. This set of guidelines often uses all-encompassing language which grossly increases the burden of proof onto the connecting party who may or may not have access to any of the information that would enable these studies. An example of this language is given below: *"Power system modelling and simulation studies are required to demonstrate that the application of all proposed system strength remediation schemes can mitigate all identified adverse system strength impacts." (page 22, emphasis added)*	The *system strength requirements*, to be determined in accordance with the *system strength requirements methodology*, will specify the system strength to be maintained by TNSPs in each *region* in the absence of impacts caused by new *connections* of *generation* and *market network service facilities*. The relationship between these processes and the *system strength impact assessment guidelines* is depicted in section 2 of the proposed Guidelines. AEMO's approach does not have the effect of making it the *Generators'* task and responsibility to solve all risks and unidentified problems, as explained below. The language referred to in Pacific Hydro's example is used in two instances: 1. When referring to *system strength connection works* (section 5.1) 2. When referring to *system strength remediation schemes* (section 5.2) The context in which they appear is that modelling and studies are required to demonstrate whether the proposed *system strength connection works* or *system strength remediation schemes* can mitigate identified *adverse system strength impacts*. The only imperative is that modelling and studies be carried out. The initial proposed Guidelines did not specify who should carry out the modelling and studies and this has now been rectified. It is the NSPs who should carry out the necessary modelling and studies. The reference to 'proposed' in the context of *system strength remediation schemes* is required because of the timing of the assessment, namely, that it must be carried out upon receipt of an *application to connect* and Connection Applicants are required to submit proposed *system strength remediation schemes* with their *applications to connect* (see clause 5.3.4(g) of the NER). Consideration of the Amending Rule in conjunction with the relevant parts of Chapter 5 of the NER leads to the conclusion that, if it appears the parties agree that a **proposed** *system strength remediation scheme* will mitigate the identified *adverse system strength impact,* it must be included as an obligation on the *Connection Applicant* in their *connection agreement* (see clause 5.2.5(c) in the Amending Rule.
31.	Pacific Hydro	**Define Short Circuit Ratio (SCR)** More clarity is required on the methodology used to calculate SCR, and the application of the calculation at the time of the enquiry and the connection application. A single methodology must be provided for consistency. Adequate justification also needs to be provided for the	The proposed Guidelines permit NSPs to use one of four methods of calculating the SCR, all of which are based on the CIGRE TB 671. Considering vast differences between the *regions* in terms of geographical distribution of the *network* and

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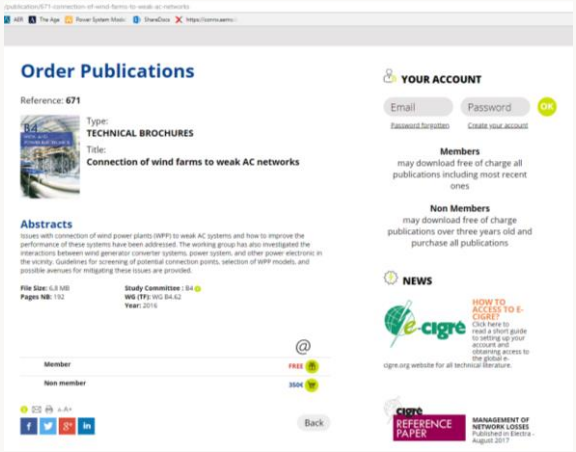
		chosen methodology. The guideline does not provide sufficient justification and the assumptions adopted can lead in some cases to unsolvable problems where the source impedance can become infinite. The methodology should never result in a grid fault contribution of zero. It would also provide more clarity if the methodology used in the system strength impact assessment was required to be provided to applicants. Not all participants have access to CIGRE papers. Secondly, the methods used for estimating SCRs appear to be overly conservative, leading to unnecessary costs for mitigation methods. The obligation on a connecting party should be limited to ensuring that the inverters within their plant are stable, and they ought not be obligated to resolve a legacy issue caused by existing plant without mitigation measures or correctly tuned inverters for low SCR conditions. It should be a requirement that all plant can be retuned when the power system changes. In the draft guidelines, the absolute worst case scenarios are taken into account when calculating the SCR. Modelling is performed in a network with the minimum number of synchronous generators online under the most severe contingency, likely a two phase to ground fault in the most onerous network location. … Not only this, but protected events, which are considered non-credible contingences (according to 4.2.3 (f) of the NER), may also be included in the assessment. More clarity is needed as to what these "protected events" are and the justification for their inclusion. The requirement to study an unknown number of multiple contingencies including "protected events", greatly increases the volume, the cost and time associated with achieving a set of performance standards, and leaves open the possibility to find an event that has not been covered. This is neither practical nor efficient, it fails to achieve the NEO and will lead to an unacceptable arrangement in which any failure of generation on the power system will be blamed on generators, regardless of the network conditions. This guideline and the proposed approach is creating a potentially impossible situation, in which connecting parties may never be able to pin down the requirement for connection. Such situations are unworkable and a more pragmatic approach is required. … FACTs devices are also not included in the preliminary assessment modelling, yet at the same time these devices are given as an option for mitigation while being at risk of underperforming in extreme low SCR conditions.	*generation dispatch* patterns, the specification of one method will not result in the best outcomes. All participants can access this brochure, which is accessible online. Below is a screenshot from the CIGRE website indicating that members can access CIGRE TB 671 for free and that non-members can get a copy for € 350. No explanation is provided for the view that the methods used for estimating SCRs appear overly conservative. In response to the 'second' issue, AEMO notes that the obligation is that new generation not exacerbate an existing system strength condition either by degrading *network* or existing *generation* performance.  *Credible contingency events* and *protected events* are included because they are required to be studied – see the definition of *system strength impact assessment* and *adverse system strength impact* in the Amending Rule. *System strength impact assessments* must assess, amongst other things, the impact of a relevant *connection* on its ability to maintain stable operation following any *credible contingency event* or *protected event.* As to what a *protected event* is, Pacific Hydro should refer to the National Electricity Amendment (Emergency frequency control schemes) Rule 2017 No. 2. At this stage, the *Reliability Panel* has not declared any *protected events*.

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			The updated Guidelines do not include FACTS devices as a solution. Instead, they include grid forming converters that could be in the form of *asynchronous generating units* or FACTS devices.
32.	Pacific Hydro	**Assessment of Multiple Contingency Events** Power system studies and engineering calls for narrowing the size of the problem to whittle it down to identify a range of worst cases that are still reasonable operating scenarios and to study the responses of control systems and the physics to achieve stability and manage the system. The inclusion of multiple contingency responses triggers further complications and creates criteria that sets the scene for all possible problems in the future grid to be placed on generators. This approach is unacceptable and unworkable as a power system is highly non-linear and requires co-ordination of generation, network and operation management to ensure it works. It is always possible to operate the system beyond reasonable limits, it is unreasonable to think that all connected plant will keep operating in all circumstances. … The guidelines also state that in some parts of the network multiple contingency events can also be temporarily assessed as credible contingency events (multiple line trips due to lightning being the example given).	AEMO refers to section 5.2 of the proposed Guidelines. Whether multiple *contingency events* should be classified as credible is dependent largely on historical events that have required AEMO to reclassify them as credible. In case this was unclear, AEMO has amended section 4.3.2 of the proposed Guidelines. AEMO notes that, typically, the reclassified events number around 10 per *region*. There also is a need to ensure that a *generating system's* inability to ride-through multiple faults does not adversely impact a second *generating system's* capability where the second one can meet such a requirement where it not for the first *generating system's* trip. Hence, at the time a *system strength impact assessment* is undertaken, NSPs need to take into consideration any events that have tended to be reclassified as credible either depending on the existence of extraneous matters, such as lightning, or the co-incidence of *network* events arising from the co-dependence of *network plant* for sustained operation. This does not extend the scope of studies to be done infinitesimally, but by reference to known risks.
33.	Terrain Solar	**No Transition Period or Guidance on Implementation for New Connections** The Interim Guidelines were released on 17 November 2017 with no transition period applying to existing connection enquiries or connection applications. There was also very little guidance provided to connection proponents about how existing connection enquiries and connection applications would be assessed following release of the Interim Guidelines. In some cases connection proponents were informed that a Full Impact Assessment was required in order to begin assessing the connection application just after the release of the Interim Guidelines, however, EMT models of nearby generators were not available to allow a Full Impact Assessment to be undertaken, therefore, connection applications were blocked from progressing. Terrain Solar recommend practical and pragmatic transitional arrangements to be put in place to prevent connection applications being blocked with the introduction of the Interim Guidelines as there are material commercial consequences being caused by projects being delayed. Further guidance needs to be provided by AEMO and NSPs to support these transitional arrangements in a timely manner.	The Interim System Strength Assessment Guidelines are not the subject of this consultation. On the issue of delay caused by a failure of required EMT models to be provided, see section 4.2.

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34.	Pacific Hydro	**Agreed Grid Contribution** Once the NSP has provided the agreed fault level contribution from the grid to the point of connection it should not change. Given the 10% deduction, the conservative assumptions and the assumed allocation of existing fault level to connected AG plant, there is existing margin in these conservative assumptions. The inclusion of committed plant only brings with it the risk that another connecting party can become "committed" in between the completion of studies and the signing of a connection agreement, which has the potential to create an endless loop for connecting parties.	AEMO agrees that once set, the grid fault level contribution should not change and the responsibility for maintaining it will rest with the TNSPs, as mentioned in section 2 of the proposed Guidelines. The *system strength requirements methodology* and *system strength requirements* will be addressed outside of this consultation, as noted in response to issues 16 & 30. See also section 4.2.2.
35.	Reach Solar energy	Reach consider the proposed guidelines do not include appropriate feedback and/ or lessons-learned from Hornsdale 3 and/ or the Power Reserve trials on renewable generators and/or Li-ion energy storage providing FCAS, frequency control and adequately addressing low system strength. Please include the same.	The proposed Guidelines represent the learnings from various projects across the *NEM* and are not an appropriate vehicle for AEMO to reveal detailed learnings about individual projects. The impact of Hornsdale Power Reserve on South Australian system strength has been assessed, and AEMO determined that it had no positive or negative impacts. See AEMO's Transfer Limit Advice – South Australia System Strength[9] on this issue.

[9] http://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Congestion-Information/2018/Transfer-Limit-Advice---South-Australian-System-Strength.pdf

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