POWER SYSTEM STABILITY GUIDELINES DETERMINATION AND REPORT

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1. Executive summary

1.1 Matter under consultation

Under clauses 4.3.4(h) and (i) of the National Electricity *Rules* (***Rules***)[1], *AEMO* is required to develop *power system* stability guidelines (**the Guidelines**) in accordance with the *Rules consultation procedures*. The Guidelines must detail the policies relating to *power system* stability to facilitate operation of the *power system* within stable limits.

1.2 Material Issues Raised in Submissions

Fourteen material issues were raised in response to the Issues Paper, and one further issue in the second round consultation.

Stability Criteria

The most significant issue, submitted by Transend *Network*s, was related to stability criteria, and whether the Guidelines should develop stability criteria beyond those in the *Rules*. This theme was developed further for various types of stability mechanisms, with the submission highlighting links between *generating system* performance and *power system* performance, for stability-related performance. A related issue was the extent to which the Guidelines can be prescriptive.

After considering the Transend submission, *AEMO* concluded that it was not appropriate for the Guidelines to extend the stability criteria in the *Rules*, and this would be better done by means of a *Rules* change. However, there is scope for the Guidelines to interpret the *Rules*, and to make the links between different parts of the *Rules* where these are pertinent. *AEMO* agreed with Transend that the Guidelines can be prescriptive, on those matters within its scope, and that discretion might be necessary about the application of some requirements.

AEMO rearranged the Guidelines to identify the stability criteria more clearly, and associate them with the relevant *Rules*. *AEMO* also added some new sections linking the stability criteria with other parts of the *Rules* that relate to stability, particularly the *generating system performance standards*.

Technical matters raised in submissions

A number of material technical issues were also raised including the following:

Definition of *Control system* stability: The Issues Paper proposed a new sub-classification of stability called "*control system* stability", to cover stability issues associated with some of the new technology *plant*, such as wind farms, for which definitions of stability definitions from classical control theory are not appropriate. The Issues Paper presented *control system*

[1] In this Determination Report, italicised words have the meaning defined in the *Rules*.

stability under transient and oscillatory stability categories, and invited submissions as to whether this was appropriate.

Two submissions commented on the issue and supported the need for a different definition. Transend further proposed that *control system* stability should be a separate category from transient and oscillatory stability. In its Draft Determination, *AEMO* changed the classification of stability to include a new category called "asynchronous machine and *control system* stability". Stability criteria already exist in the *Rules* that can be applied to this new category, for both large and small *power system* disturbances.

AEMO received another submission on this matter following the second round of consultation. This submission argued that asynchronous machine stability would be better combined with synchronous machine stability, rather than with *control system* stability.

After consideration of all the submissions, *AEMO* has added the asynchronous machine stability under the transient stability classification, and kept *control system* stability as a separate classification.

***Frequency* stability**: The Issues Paper also proposed classification of *frequency* stability as a category of stability, and asked for comment as to this proposal. Two submissions commented on the issue and supported the proposal. One *Registered Participant* also added that inclusion of frequency stability as a category should not result in any additional obligations for Participants. A further submission to the second round consultation also supported establishing this category.

After consideration of all the submissions, *AEMO* has included *frequency* stability as a category of stability in the Guidelines.

Oscillatory stability: One submission suggested that the Guidelines further elaborate on the types of oscillation modes that might be observed, and that torsional oscillation modes be covered under *control system* stability phenomena. The submission argued that sub-synchronous resonance, which is also a torsional mode phenomenon, should be excluded from the requirements for modes of oscillation to be *adequately damped*.

After consideration of the submission, *AEMO* concluded that sub-synchronous resonance was a specialist and relatively uncommon form of stability study that could not be accommodated in this *Rules* consultation. Instead, reference to the need to assess resonances (harmonic and sub-synchronous) would be included as a requirement under planning processes. To the extent that damping of shaft torsional modes are supported by *control systems*, these should be *adequately damped* and would be included in the Guidelines.

Fault Clearance Times: One submission proposed a more prescriptive approach to selection of fault clearance times for planning and negotiation of generating *plant performance standards*, than the approach contemplated in the *Rules*.

After consideration of the submission, *AEMO* concluded that this approach was unnecessarily restrictive, and might not lead to the most efficient *market* outcomes, especially considering, for example, the *Rules* already contemplate negotiation in fault clearance times in *Rules* clause S5.1.9.

Pole Slip Protection: One submission sought clarification around the necessity for stability analysis for setting of pole slip protection settings. The submission identified that established industry practice included methodologies that did not require stability studies.

In its Draft Determination, *AEMO* agreed that transient stability studies were not always necessary for setting pole slip protection, and proposed that studies confirm the settings if required by the *Network Service Provider* (**NSP**) and *AEMO*, on a case-by-case basis.

A submission to the second round consultation disagreed with this approach and argued that using a transient stability study was necessary for correct setting of pole slip protection.

After consideration of all the submissions, *AEMO* has confirmed its conclusion that stability studies might not always be required. A factor that might influence the need for studies, and should be a consideration for the relevant NSP, is adequacy of the *Connection Applicant's* commissioning test plan to confirm the appropriateness of the settings.

Studies to demonstrate compliance: The Issues Paper proposed that *Generators* confirm their stability-related *performance standards* by *power system* simulation at least every 5 years. Two submissions objected to this requirement, the first on the basis that it created unnecessary work, and the second on the basis that compliance was managed through the *Generator* compliance template. This second submission also suggested that a "grand-fathering principle" meant that there was no on-going obligation to meet *performance standards* when the *power system* changed. A subsequent submission from this Participant to the second round consultation re-iterated this position.

Another second-round consultation submission argued for the stability guidelines to provide guidance on what constituted compliance or what tolerances on responses would constitute non-compliance.

After consideration of all the submissions, *AEMO* has confirmed the position set out in the Draft Determination:

AEMO agrees that the *Generator* compliance template[2] outlines requirements for *Generators* to demonstrate compliance through tests, but considers that, except where relevant *contingency events* have been monitored, the only way to demonstrate compliance is by simulation with an appropriate model. *AEMO* finds no general "grandfathering principle" in the technical requirements of Schedule 5.2, except in regard to S5.2.5.12 "Impact on *network capability*". Therefore *AEMO* recommends that studies be carried out by the *Generator* to

[2] http://www.aemc.gov.au/Market-Reviews/Completed/Template-for-Generator-Compliance-Programs.html

satisfy itself about compliance with its *performance standards*. However, *AEMO* has removed the proposal for this to occur every 5 years, as formal compliance monitoring already exists, and the *Generator* is obliged to comply with its *performance standards* at all times.

Review of Stability Limits: One submission commented that a TNSP should not be required to recalculate stability limits every five years, but should only need to review whether a recalculation was required.

AEMO agreed with this proposal, and reworded the section to clarify its intent.

More detail on process for limit and *constraint* development: One proponent requested more information in the guidelines regarding the due diligence process, the processes for developing limit equations and the margins applied to limits and *constraints*. The proponent also suggested value in harmonising the limit development process.

While *AEMO* agrees that there would be value in harmonising the limits development process, *AEMO* considers it is not feasible to do so within the timeframe of a *Rules* Consultation on the Guidelines. Information regarding confidence intervals, margins and offsets is already published by *AEMO* on its website.

After consideration of the submission, *AEMO* included some additional information in the Guidelines around the due diligence process.

1.3 Conclusion

After consideration of all submissions, *AEMO* determines the *Power System* Stability Guidelines in the form on the AEMO website (on the same webpage as this Determination and Report), titled “Power System Stability Guidelines”, Version 1.0, Final, issue date 25 May 2012.

2. Background

2.1 Matter under consultation

Under clauses 4.3.4(h) and (i) of the *Rules*, *AEMO* is required to develop *power system* stability guidelines in accordance with the *Rules consultation procedures*. The *power system* stability guidelines must detail the policies relating to *power system* stability to facilitate operation of the *power system* within stable limits.

The Guidelines are for the purposes of clauses 4.3.4(g) and 4.7.1(a) in relation to *Network Service Providers* (NSPs) relating to:

- The planning and operation of their transmission and distribution systems; and

- The application of those guidelines to the conduct of all necessary calculations associated with the stable operation of the *power system*, and to support the coordination of the determination of the settings of equipment used to maintain *power system* stability.

The Guidelines are also for the purposes of clauses S5.2.5.10(a) and S5.2.5.13(k) in relation to applications to connect for *generating systems*. These clauses relate to:

- The *protection systems* to trip *plant* for unstable operation; and
- The assessment of impact of *generating units* on *power system* stability and damping of *power system* oscillations.

The objectives of this consultation are to:

- Provide *Consulted Persons* with an opportunity to contribute to the development of the *Power system* Stability Guidelines; and
- Ensure that *Consulted Persons* are properly informed about the proposed and final outcome.

2.2 The consultation and decision-making process

The following table provides an outline of the consultation process:

PROCESS	DATE
Notice of First Stage of *Rules* Consultation issued	16 January 2012
Closing date for submissions received in response to the Notice of First Stage of *Rules* Consultation	24 February 2012
Publication of the Draft Determination and issue of Notice Of Second Stage of *Rules* Consultation	23 March 2012
Closing date for submissions received in response to the Notice of Second Stage of *Rules* Consultation	13 April 2012
Publication of the Final Determination and Guidelines	25 May 2012

Documentation related to this consultation is published on *AEMO*'s website at:

http://www.aemo.com.au/planning/0220-0002.html

Six submissions were received and two meetings held in the first stage of consultation.

Two submissions were received in the second stage of consultation.

3. Consideration of Submissions

3.1 List of submissions received

AEMO received six submissions (five formal submissions, and one query) in response to the *First Stage Notice*.

The following table contains a list of respondents:

RESPONDENT	PARTICIPANT TYPE OR OTHER ROLE
Basslink Pty Ltd	*Market Network Service Provider* (MNSP)
Powerlink Queensland	*Transmission Network Service Provider* (TNSP)
Transend *Network*s	TNSP
TransGrid	TNSP
Stanwell Corporation	*Generator*
International Power GDF Suez Australia	*Generator*

All formal submissions[3] from the first round of consultation were published on *AEMO's* website on the same date that the Draft Determination and Report was released.

A further two submissions were received to the second round of consultation:

RESPONDENT	PARTICIPANT TYPE OR OTHER ROLE
Stanwell Corporation	*Generator*
WorleyParsons[4]	Consultant to the electricity industry

These submissions were published on *AEMO*'s website, along with the final Determination and Report.

Section 5 considers all material issues raised in both rounds of the consultation. **Appendix 1** details, for each submitting party, each issue raised and, for issues *AEMO* considers to be non-material, *AEMO's* response.

3.2 Meetings and forums

Two meetings were held, one prior to the close of submissions to the first stage of consultation, and the other following close of submissions. The table below lists the parties involved and the dates of the meetings:

[3] The query from Basslink Pty Ltd is summarised in Appendix 1, along with the other issues raised.
[4] Not a Consulted Person, but the submission includes relevant matters that AEMO has taken into consideration.

NAME OF PARTY	MEETING DATE
Plant Modelling Reference Group (PMRG), comprising: • Powerlink Queensland • TransGrid; • Transend Networks • Electranet SA	9 February 2012
Transend Networks	20 March 2012

The PMRG meeting was for clarification purposes, and parties were advised to raise all issues in their submissions to the Consultation.

The minutes of the Transend meeting are published along with the Draft Determination Report. No new issues were raised at the meeting.

4. Material issues raised in Submissions

Submissions raised the material issues detailed in the following table:

ISSUE NUMBER	ISSUE	RAISED BY
TN2	Acceptance criteria for all stability phenomena	Transend Networks
TN3	Level of prescription	Transend Networks
TN5, PQ2, WP1	*Control system* stability	Transend Networks, Powerlink Queensland, WorleyParsons
TN6, WP4	Fault clearance times for transient stability studies	Transend Networks, WorleyParsons
TN7, WP3	Oscillation modes and acceptability criteria	Transend Networks, WorleyParsons
TN9	Reference S5.2.5.4(a) as a default transient voltage recovery criterion for assessment of short-term voltage instabilities	Transend Networks
TN10, IP4, WP2	*Frequency* stability and inclusion of df/dt in acceptance criteria	Transend Networks, International Power GDF Suez Australia, WorleyParsons
TN12, WP7	NSP review of stability limits (five year cycle)	Transend Networks, WorleyParsons
PQ3	Additional analysis to confirm ongoing performance compliance if R2 data differs from R1 data	Powerlink Queensland
TG1, SCL4, WP6	Remove requirement for reviewing *performance standards* compliance after 5 years.	TransGrid, Stanwell Corporation Ltd, WorleyParsons
IP1	Describe Due Diligence on stability limits	International Power GDF Suez Australia
IP2	Define process for establishing stability limit safety margins	International Power GDF Suez Australia
IP3	Define approach for developing *network* limits and *constraints*	International Power GDF Suez Australia
SCL6	Clarity of the guidelines	Stanwell Corporation

4.1 Discussion of Material Issues

This section discusses material issues identified in the previous table. For a full list of issues identified in the submissions, see Appendix 1.

4.1.1 Material Issue TN2: Acceptance criteria for all stability phenomena

The *Rules* are not consistent in the way they describe acceptability criteria for different types of *power system* stability phenomena. Transend Networks proposes that the Guidelines should publish acceptance criteria for all stability mechanisms. The draft Guidelines, as published in the Issues Paper, included most of the relevant criteria from the *Rules*, but did

not explicitly refer to the *Rules* clauses, and did not propose any additional criteria outside of those in the *Rules*.

4.1.1.1 Summary of issue

Transend's submission includes the following:

> "Transend is of the view that the PSSG must be clear on what acceptability criteria apply to each stability mechanism. This view stems from (i) the Rule clauses which require the direct application of the PSSG, and (ii) inconsistencies in the Rules.
>
> Clauses requiring direct application of the PSSG:
>
> - The assessment of a generator against the automatic access standard of Schedule S5.2.5.10(a) requires a clear understanding of what is/is not unstable behaviour of the power system.
> - S5.2.5.10(a)(2) is of particular relevance given the increase in wind farm developments utilising non-synchronous generation. To assess these generators against S5.2.5.10(a)(2), the NSP must know the point at which the power system is considered sufficiently unstable that the generating system should be disconnected.
> - Clause 4.3.4(g), which carries civil penalty provisions, requires:
>
> "Each Network Service Provider must plan or operate its transmission system or distribution system in accordance with the power system stability guidelines described in clause 4.3.4(h)".
>
> A truly unstable power system would become self-evident. The point of contention is power system operation (whether actual or planned) in a manner which is less damped than normal but not actually unstable. What margin must be allowed? Given the economic consequences of increasing power system stability (e.g. constraints causing generation dispatch out of merit order so as to increase stability), plus the possibility of civil penalty provisions, Transend expects that the PSSG will clearly define stability limits.
>
> **Rule inconsistencies**
>
> The Rules are inconsistent in their requirements for the various stability phenomena:
>
> - there are explicit criteria in regard to oscillatory stability [S5.1a.3, S5.1.8 & S5.2.5.13(d)],
> - over-voltage limits and over-voltage recovery requirements [S5.1a.4];
> - minimum reactive margin is specified, although the Rules make allowance for the NSP to allocate a different reactive margin [S5.1.8];

- there are no under-voltage recovery requirements [S5.1a.4];
- other than the statement that the system must remain in synchronism following any credible contingency event, transient stability margins are not specified [S5.1a.3; S5.1.8];
- frequency stability is not mentioned in the Rules at all1 [S5.1a.2; S5.1.3].

It is reasonable to expect that the Rules should contain acceptance criteria for all stability phenomena, not just for a subset. The lack of acceptance criteria for some phenomena has proven problematic for Transend in the past. By specifying acceptance criteria for all forms of power system stability in the PSSG, the present inconsistency can be alleviated."

Transend provides some specific suggestions about criteria in Section 3 of their submission.

4.1.1.2 *AEMO* response

While *AEMO* agrees that acceptance criteria are not specified to the same extent for all *power system* stability phenomena, *AEMO* does not believe it is appropriate for the Guidelines to develop new criteria. This, *AEMO* believes, would go beyond scope of the Guidelines under the *Rules*. To add criteria for acceptable stability, *AEMO* believes it would be more appropriate to change the *Rules*.

4.1.1.3 Outcome

AEMO has reworded the Guidelines to describe clearly those criteria that do exist in the *Rules* and has further elaborated on where other parts of the *Rules* impact on application of those criteria (for example, in the interaction between the generator *performance standards* and *power system* performance). In some cases *AEMO* has included an interpretation of the criteria, where *AEMO* believes this necessary to improve clarity.

4.1.2 Material Issue TN3: Level of Prescription in Stability Guidelines

This issue concerns the extent to which the Guidelines can contain prescriptive requirements, and how the Guidelines should deal with providing strong direction while maintaining flexibility.

4.1.2.1 Summary of issue

Transend's submission contains the following:

"The issue in question is: should the PSSG contain prescriptive requirements additional to the existing Rules? This is obviously relevant to the stability criteria concept discussed above, but it is also applicable to other contents of the PSSG such as study assumptions and reporting. Transend acknowledges that Rule 4.3.4(h) requires AEMO to develop guidelines for power system stability, and, by definition, guidelines allow some discretion in their implementation. Rule 4.3.4(i) requires that the guidelines "...must detail the policies governing power system stability...". It is therefore arguable

that the Rules would allow the PSSG to be prescriptive if – via the current consultation process – the prescribed criteria become AEMO policy.

Transend also notes that the Generating system Model Guidelines, which NEMMCO was required to develop under the Rules, contain a number of prescriptive requirements despite being "guidelines". Transend therefore considers that the PSSG could contain prescriptive requirements.

However, adopting a prescriptive approach with any engineering issue typically becomes problematic.

Situations inevitably arise in which a deviation from the mandated practise would be justified or even essential. Transend recommends that a "middle ground" approach be adopted: the PSSG should define prescriptive criteria (e.g., for the various forms of power system stability, certain study assumptions), but allow the NSP to deviate from these criteria if it has a justifiable reason to do so and defines alternative criteria applicable to the situation in question. This removes the ambiguity that Transend perceives would otherwise exist in the application of Rule 4.3.4(g) and Schedule 5.2.5.10(a), whilst acknowledging that what is generally acceptable may not be technically appropriate for a particular region and/or situation."

4.1.2.2 *AEMO* response

While *AEMO* agrees that the Guidelines can be prescriptive in regard to policy, the focus of the Guidelines must be on policies, as described in clause 4.3.4(i). *AEMO* agrees that a middle ground approach can provide a degree of certainty, while maintaining some flexibility. However, *AEMO* believes that a decision to move away from Guidelines should be with agreement of both *AEMO* and the relevant TNSP, since *AEMO* has responsibility for maintaining both the Guidelines and *power system security*.

4.1.2.3 Outcome

AEMO has inserted wording to mandate or allow discretion where appropriate.

4.1.3 Material Issue TN5, PLQ2, WP1: *Control system* stability

The Issues Paper raised a question as to whether *control system* stability should be considered separately from rotor angle stability under transient stability and oscillatory stability categories. The Issues Paper proposed definitions for transient and oscillatory stability that include elements for *control system* stability. Transend supports the introduction of the term "*control system* stability", but suggests a category for *control system* stability that is separate from transient stability. Powerlink supports the distinction between transient and *control system* stability.

In a second round submission Worley Parsons argued that *AEMO* should not combine asynchronous stability and *control systems* stability in one category.

4.1.3.1 Summary of issue

Transend's submission contains the following:

> "Transend agrees that the increased use of advanced and typically non-linear controls, notably those based around power electronics devices, introduces new stability issues not covered under the traditional definitions of power system stability. Transend supports introduction of the term "Control system Stability".
>
> There are a number of drivers which justify the separation of control system stability from transient stability (as currently proposed in the draft PSSG):
>
> a) Not all control system instabilities will manifest into transient stability issues as traditionally defined. Transend believes that the term "transient stability" should be reserved for "rotor angle stability" and the risks associated with loss of synchronism.
> b) A separate classification would allow discussion and definition of acceptability criteria for instability mechanisms for which application of halving time or damping ratio type measures may not necessarily apply. An example may be limit cycle behaviour within a non-linear control such as an excitation limiter or switching controller.
> c) A separate classification provides scope for consideration of newer types of network connected equipment dominated by power electronic controls having non-linear performance characteristics.
>
> Wind turbines and HVDC are examples, with the stability of fault-ride-through controls being the specific issue of concern (and how to describe acceptable (stable) behaviour during the fault recovery period)."

Powerlink Queensland supports introduction of the concept of *control system* stability, in as a component of transient stability. With reference to Section 4.1 of the Issues Paper version of the Draft Stability Guidelines, Powerlink states:

> "This section includes two aspects of transient stability, "Large disturbance rotor angle stability", and "Large disturbance control system stability". Both topics are significant and should be presented in the document separately. The associated acceptance criteria would then be articulated more directly and clearly to the relevant transient stability issue."

WorleyParsons, in the second round submission states:

> "The proposed guidelines propose to change the definition of stability to include a new category called "asynchronous machine and control system stability". WorleyParsons is of the view that this approach will lead to possible confusion because the proposed definition combines two unrelated concepts, specifically:
>
> • Asynchronous machine instability – which may occur as a result of induction generator stalling or runaway behaviour.
>
> • and control system instability – which can occur as a result of inadequate control system design or inappropriate control system parameter settings.

Due to the fact that control system instability behaviour can occur for synchronous and asynchronous machines alike and also on devices as prosaic as transformer tap change controllers and switched capacitor banks; WorleyParsons proposes that the new category be named simply “control system stability”.

Issues specific to asynchronous generation may be treated similarly to stability issues associated with synchronous machines because the mathematical models associated with each category of machine have many similarities.”

4.1.3.2 *AEMO* response

AEMO agrees there are *power system* stability phenomena that are separate from the rotor angle stability mechanisms of classical control theory. These are typically seen for asynchronous machines such as wind farms. *AEMO* also notes that the acceptance criteria for oscillatory stability, in Clause S5.1.8, refer to electro-mechanical modes of oscillation, which is clearly a reference to the classical behaviours of synchronous machines. The references to “*adequately damped*” in the *generating system access standards* on the other hand are not specific to synchronous machines. In the Draft Determination, *AEMO* proposed to create a new definition for “asynchronous machine and *control system* stability” which included *control system* stability.

On consideration of the additional WorleyParsons submission, in conjunction with earlier submissions, *AEMO* has rearranged the definitions to include large disturbance behaviour of asynchronous plant with transient stability, and *control system* stability separately.

4.1.3.3 Outcome

The Guidelines define “*control system* stability” separately from transient and oscillatory stability, and provide relevant acceptance criteria for these categories. The transient stability category includes definitions for both rotor angle stability (associated with synchronous machines) and asynchronous machine stability.

4.1.4 Material Issue TN6, WP4: Fault clearance times for transient stability studies

The *Rules* specify maximum clearance times for breakers for various voltages and configurations in Table S5.1a.2. Transend Networks proposes that these maximum values be used for planning and for *connection* studies as fault clearance times rather than actual values.

4.1.4.1 Summary of issue

Transend’s submission states:

"Transend proposes that the PSSG clearly define what fault clearance times should be applied depending on the purpose of the study. This proposal is designed to ensure consistency of approach across AEMO, NSPs and external consultants acting on behalf of Registered Participants.

Transend proposes that the PSSG include commentary along the following lines:

a) For planning related studies, including connection application assessments undertaken in accordance with Rules Chapter 5, the fault clearance times to be assumed are those defined by Rules Table S5.1a.2, with the following considerations to apply:

- Where differential, permissive inter-tripping (PIT), or similar protection schemes are installed and duplicate (redundant) communication paths exist, the assumed fault clearance time at the remote end of a given circuit can be assumed equal to the value in Rules Table S5.1a.2 Column 2.
- Where differential, permissive inter-tripping (PIT), or similar protection schemes are installed and a communication system is not duplicated:
  - the remote end fault clearance time to be applied when communications are assumed to be in service should be equal to the value in Table S5.1a.2 Column 2.
  - the remote end fault clearance time to be applied when communications are assumed out of service should be equal to the value in Table S5.1a.2 Column 3 or other clearance time as advised by the NSP.

b) For operational studies of the existing network, where the status and performance of all installed protection equipment is known (i.e. protection audit information is available for equipment currently in service), the use of "actual" fault clearance times is acceptable for the assessment of system stability.

c) Advice provided to the NSP or AEMO must include a description of all assumptions and considerations made in regard to selection of fault clearance times and the impact of varying those assumptions where such considerations are necessary."

In its submission to the second round of consultation, WorleyParsons:

"… agrees that the fault clearance times should be in accordance with the rules except where specific network conditions require a more flexible approach to ensure efficient market outcomes."

4.1.4.2 *AEMO* response

The *Rules* requirements around applicable fault clearance times are extremely complex and not amenable to a "one size fits all" approach, even with the apparent complexity proposed by Transend. Setting the fault clearance time might affect efficient investment by:

- Reducing a *Connection Applicant*'s ability to negotiate a *performance standard*; and
- Forcing an NSP to use fault clearance times that might not be the most appropriate values for efficient *network* investment.

Attempting to interpret and recast the *Rules* requirements would only cause inconsistencies where the *Rules* are already quite specific. Given the transient stability criteria already describe rotor angle instability, there appears no apparent need to provide further clarity.

Transend's proposed guideline is already very similar to the requirements in *Rules* clause S5.1a.8(b), (c) and (d), which already include the specific purposes for columns 2, 3 and 4 for Table S5.1a.2:

> **S5.1a.8 Fault clearance times**
>
> (b) The *fault clearance time* of a primary *protection system* for a *short circuit fault* of any *fault type* anywhere:
>
> (1) within a *substation*;
>
> (2) within *connected plant*; or
>
> (3) on at least the half of a power line nearer to the *protection system*,
>
> should not exceed the relevant time in column 2 of Table S5.1a.2 for the nominal *voltage* that applies at the fault location.
>
> (c) The *fault clearance time* of a primary *protection system* for a *short circuit fault* of any *fault type* anywhere on the remote portion of a power line for which the near portion is protected by a primary *protection system* under clause S5.1a8(b) should not exceed the relevant time in column 3 of Table S5.1a.2 for the nominal *voltage* that applies at the fault location.
>
> (d) The *fault clearance time* of a *breaker fail protection system* or similar back-up *protection system* for a *short circuit fault* of any *fault type* should not exceed the relevant time in column 4 of Table S5.1a.2 for the nominal *voltage* that applies at the fault location.

Similarly, for *connection applications*, *Rules* clause S5.2.5.5(b)(1)(iii)(B) refers to the table recommended by Transend in its *automatic access standard*:

> **S5.2.5.5 *Generating system* response to disturbances following *contingency events***
>
> ...
>
> **Automatic *access standard***
>
> (b) The *automatic access standard* is:
>
> (1) a *generating system* and each of its *generating units* must remain in *continuous uninterrupted operation* for a disturbance caused by an event that is:
>
> ...

(iii) a two phase to ground, phase to phase or phase to ground fault in a *transmission system* cleared in:

(A) the longest time expected to be taken for a relevant *breaker fail protection system* to clear the fault; or

(B) if a *protection system* referred to in subparagraph (A) is not installed, the greater of the time specified in column 4 of Table S5.1a.2 (or if none is specified, 430 milliseconds) and the longest time expected to be taken for all relevant primary *protection systems* to clear the fault; and

...

provided that the event is not one that would *disconnect* the *generating unit* from the *power system* by removing *network elements* from service; and ...

It is agreed that there are specific circumstances where the use of the fault clearance times in Table S5.1a.2 would apply. However, there are many circumstances where other fault clearance times must also be considered:

For example:

- There are transient stability studies where the fault clearance times in the Table do not apply. These should not be overlooked in an effort to be specific about the fault clearance times to be used in transient stability studies.

  For example, clause S5.2.5.5(b)(1)(i)(ii) and (iv) and (c) include a range of specific requirements that must be taken into account by a person carrying out the *performance standard* assessment. For example, not all *protection systems* meet the *system standards* specified under S5.1a.8 and Table S5.1a.2. In some cases these might be longer and should be used in clause S5.2.5.5(b)(1)(i) and (c)(1)(i).

  Being specific and limited would exclude a range of studies that ought to be undertaken and might omit more onerous transient stability events or, conversely, preclude the ability of a *Connection Applicant* to apply for a standard below the *automatic access standard*:

  S5.2.5.5 *Generating system* response to disturbances following *contingency events*

  ...

  Automatic *access standard*

  (b) The *automatic access standard* is:

  (1) a *generating system* and each of its *generating units* must remain in *continuous uninterrupted operation* for a disturbance caused by an event that is:

  (i) a *credible contingency event* other than a fault referred to in subparagraph (iv);

  (ii) a three phase fault in a *transmission system* cleared by all relevant primary *protection systems*;

(iii) a two phase to ground, phase to phase or phase to ground fault in a *transmission system* cleared in:

(A) the longest time expected to be taken for a relevant *breaker fail protection system* to clear the fault; or

...

(iv) a three phase, two phase to ground, phase to phase or phase to ground fault in a *distribution network* cleared in:

(A) the longest time expected to be taken for the *breaker fail protection system* to clear the fault; or

(B) if a *protection system* referred to in subparagraph (A) is not installed, the greater of 430 milliseconds and the longest time expected to be taken for all relevant primary *protection systems* to clear the fault,

provided that the event is not one that would *disconnect* the *generating unit* from the *power system* by removing *network elements* from service; and ...

...

Minimum *access standard*

(c) The *minimum access standard* is:

(1) a *generating system* and each of its *generating units* must remain in *continuous uninterrupted operation* for the disturbance caused by an event that is:

(i) a *credible contingency event* other than a fault referred to in subparagraph (iii);

(ii) a single phase to ground, phase to phase or two phase to ground fault in a *transmission system* cleared in the longest time expected to be taken for all relevant primary *protection systems* to clear the fault unless *AEMO* and the *Network Service Provider* agree that:

... ; and

(iii) a single phase to ground, phase to phase or two phase to ground fault in a *distribution network*, cleared in the longest time expected to be taken for all relevant primary *protection systems* to clear the fault, unless *AEMO* and the *Network Service Provider* agree that:

...

provided that the event is not one that would *disconnect* the *generating unit* from the *power system* by removing *network elements* from service; and

- The *Rules* allow for extenuating circumstances and for other processes relating to *protection system* requirements for *network users*:
    - Clause S5.1a.8(a), for example, requires that *power system* stability be maintained, power transfers not be unduly constrained or *plant* to be damaged. Fault clearance time shorter than those in Table S5.1a.2 might be required for *plant* installed by an NSP to achieve these requirements.

- Subclause (e) allows the owner of the faulted element to specify a shorter fault clearance time to minimise *plant* damage.
- Subclause (f) indicates that Table S5.1a.2 applies in accordance with clause S5.1.9. Clause S5.1.9 is used to define fault clearance times for *Generators*, *Customers* and MNSPs, linked to *performance standard* requirements under clauses S5.2.5.9, S5.3.3 and S5.3a.6, respectively, which might allow longer fault clearance times under *negotiated access standards*.

In response to the WorleyParsons submission, *AEMO* notes that the *Rules* allow for flexibility – *AEMO* is not proposing an approach outside of the *Rules*.

4.1.4.3 Outcome

For the reasons outlined above, *AEMO* has not adopted the proposed change outlined in this section. Where possible, actual fault clearance times should be used, and expected values for *network* augmentations that are committed, where designs are probably well progressed. For longer term planning assessments, there is a reasonable case to use the fault clearance times in the *System standards*, where the designs are likely to be notional.

4.1.5 Material Issue TN7, WP3: Oscillation modes and acceptability criteria

The Issues Paper version of the draft Guidelines proposed that the oscillatory stability must "meet the particular damping requirements specified in the *Rules* for that application or at the agreed *performance standard*, for the relevant modes of *power system* oscillations, unless agreed with the relevant NSP and *AEMO* for a particular application". Transend's submission asks for more detail of the types of oscillatory stability modes and the stability criteria for each. It also proposes that torsional oscillations be required to be *adequately damped*, for some *frequencies*.

4.1.5.1 Summary of issue

Transend's submission contains the following:

> "The PSSG should attempt to define all oscillation modes that may be observable in the power system in more detail, and then link to the appropriate acceptability criteria defined by the Rules (where these exist). As an indication of what might be considered as part of this consultation:
>
> (a) Electromechanical oscillation modes (local and inter-area) – oscillations observed in synchronous machine rotor angles and active power outputs which may subsequently propagate through the network as active power oscillations across transmission corridors.
>
> Acceptability criteria:
>
> - Rules S5.2.5.13(d) which requires power system oscillations of a generating unit against any other generating unit to be adequately damped in accordance with the Rules definition (Chapter 10).
> - 5-second halving time for power system oscillations as defined by S5.1.8.

As the Rules definition of adequately damped inherently includes the five second halving time criteria, isolated application of S5.1.8 is only envisaged where a generating unit has a Generator Performance standard (GPS) pre-dating the inclusion of adequately damped as a Rule term.

(b) Control system oscillation modes – oscillations observed in a control system output signal following the application of a step change in any input or feedback signal. This also applies to control system oscillation modes that fall within the range of sub-synchronous resonant frequencies as well as induced oscillations caused by control system response behaviour (e.g. oscillation modes in hydro water columns that manifest as oscillations in active power output).

Acceptability criteria:

Satisfaction of "adequately damped" as defined by Rules Chapter 10.

(c) Torsional oscillation modes – oscillations observed in generator active power outputs as a result of the interaction of rotating masses through shafts and couplings of finite stiffness.

Acceptability criteria:

While S5.2.5.13 is non-descript, it is generally accepted that the provisions of the automatic and minimum access standard do not apply to torsional oscillation modes. This is on the basis that active damping of such modes is difficult (if not impossible) to achieve in some types of generators.

It is however generally accepted that observable torsional modes that have frequencies of oscillation which overlap with typical electromechanical modes, should attempt to meet the 5-second halving time criteria. This is especially so where controls capable of providing a mitigating action exist within the generators overall design. The requirement is applied on the basis that impacts to the power system are directly comparable in the low frequency ranges. An indicative oscillation frequency limit for application of this criterion is ≤ 2.5 Hz based on the typical upper limit of local mode oscillations observed in synchronous machines.

(d) Advice provided to the NSP or AEMO must include a description of all assessed oscillation modes, the basis for their classification as an electromechanical, control or torsional mode of oscillation, the acceptability criteria therefore applied, and any other considerations made in undertaking the oscillatory stability assessment.

Transend also recommends that the PSSG more clearly define the term "power system oscillations" in terms of the types of signals that would typically be assessed during a power system stability study. Stability investigations should not only assess rotor angle and active power oscillations, but also reactive power and voltage.

Furthermore, Transend would recommend that the figure provided in Appendix C of this submission be included in the PSSG to clarify the various damping criteria.

This figure illustrates the combined requirements of the Rules term adequately damped."

WorleyParsons' submission to the second round of consultation supports the separation of oscillatory stability from sub-synchronous resonance behaviour, but offers a different view about including specific acceptance criteria:

"WorleyParsons supports the separation of oscillatory stability from sub-synchronous resonance behaviour. However the requirements of the damping of oscillatory stability modes currently defined in the rules are unclear and often mathematically ill defined. It would be clearer to remove references (in the rules) to damping ratios, define what specific variables should be measured (i.e. power output) and confine oscillatory stability to small signal analysis rather than to also attempt to define requirements for non-linear large scale analysis (which is really better categorized under transient stability). This will require changes to the rules rather than the guidelines discussed herein – but in the meantime the power system stability guidelines should not be unduly prescriptive in order to avoid the possibility of contradicting a future revision of the rules."

4.1.5.2 *AEMO* response

AEMO substantially agrees with the definitions of oscillatory modes and *control system* modes as outlined in Transend's submission above. However, it is not clear that torsional modes, whether at *frequencies* that would affect large synchronous modes or at *frequencies* that affect wind farms, are associated with instability of the *power system*, although its impact could be severe for individual *generating units*. Sub-synchronous resonance (SSR) analysis is a specialist and relatively uncommon study. While this could be classified as a form of stability, *AEMO* prefers not to include requirements for this in the initial version of the Guidelines. It is recognised that resonance issues can damage *plant*, if not properly managed, and that sub-synchronous resonance is typically associated with *network* augmentations that include either series capacitors or HVDC devices. Since these devices are often associated with augmentations that increase stability limits, *AEMO* proposes to comment about the need to avoid *plant* damage from sub-synchronous resonance when designing this type of augmentation.

In relation to the shaft torsional modes for wind turbines, the damping of these modes are typically supported through some form of damping mechanism (e.g. a *control system*). To that extent, therefore, the performance of that *control system* in damping the shaft torsional mode would need to be *adequately damped*, which is a requirement ion the *Rules* and within the scope of the Guidelines.

AEMO acknowledges that any changes to the Rules around oscillatory stability might necessitate changes to the Guidelines. Potential inconsistencies with oscillatory stability and the requirement for *generating system control systems* to be "*adequately damped*" have been identified for a possible future Rule change (see section 5 of this Determination).

4.1.5.3 Outcome

AEMO has excluded sub-synchronous resonance and harmonic resonance from the Guidelines, and included a reference to avoiding *plant* damage from these types of resonance conditions in the Process section, for planning processes.

Where appropriate, requirements relating to *control systems* being *adequately damped* have been inserted.

4.1.6 Material Issue TN9: Reference S5.2.5.4(a) as a default transient voltage recovery criterion for assessment of short-term voltage instabilities

There are no voltage recovery criteria generally applicable in the *Rules*. The *automatic access standard* for S5.2.5.4 "*Generating system* response to voltage disturbances", however, does have some values of voltages and times for which the *generating unit* must remain in operation. If the *power system* performs worse in a voltage disturbance than defined by these levels, then any *generating unit* could disconnect during the voltage disturbance and still meet its *performance standards*, as a *generating system* is not required to exceed the *automatic access standard*. This in turn might result in a *power system security* issue that would need to be managed.

4.1.6.1 Summary of issue

Transend's submission states:

> "Transend would like AEMO to consider referencing S5.2.5.4(a) as a default transient voltage recovery criteria for assessment of short term voltage instabilities. The Rules are silent on the requirements to recover depressed network voltages following a contingency event.
>
> In practice, an inability to satisfy the voltage profile outlined by the automatic access standard of S5.2.5.4 introduces the risk of generator tripping and is therefore something of a pseudo limit that can be legitimately considered during voltage stability assessments.
>
> The PSSG should only recommend consideration of this limit, and not dictate that the voltage/time characteristic be explicitly satisfied. The requirements to do so should be part of NSP and AEMO risk assessments which would need to consider the probability of impacts on nearby generators."

4.1.6.2 *AEMO* response

AEMO agrees with Transend that there is an effective linkage between the voltage recovery profile and the *generating unit* response to a voltage disturbance. However, *AEMO* considers that, rather than specifying a pseudo-acceptance criterion under the voltage stability classification, the Guidelines should refer to a need to consider the impact of *generating system performance standards* on *power system security* when undertaking

stability analyses. Likewise, when negotiating *performance standards* with *Generators*, the NSP must take account of the potential implications of those *performance standards*.

4.1.6.3 Outcome

The Guidelines include a section that discusses the interaction between generating *plant* performance and *power system* performance, and which covers this issue.

4.1.7 Material Issue TN10, IP4, WP2: *Frequency* stability and inclusion of df/dt in acceptance criteria

Transend maintains that reference to the *frequency* standards is not a sufficient definition for the criterion for *frequency* stability, and proposes that a df/dt criterion be included in the definition. International Power agrees with the proposed inclusion of *frequency* stability in the guidelines, provided this doesn't impose further obligations on Participants.

In its submission to the second round of consultation WorleyParsons supports inclusion of *frequency* stability but says it needs to be treated differently because it is covered by FCAS provisions.

4.1.7.1 Summary of issue

Transend's submission states:

> "**Appropriateness of *frequency* operating standards as a criteria for *frequency* stability**
>
> Whilst the statement in the proposed PSSG,
>
> "Frequency stability is maintained if the frequency operating standards are met"
>
> is true, Transend considers that the frequency standards alone inadequately specify an acceptable level of frequency stability, especially in the Tasmanian jurisdiction. Following a credible contingency event, the frequency standards specify:
>
> (a) frequency limits which apply for a given time after the contingency, and
>
> (b) the time by which frequency must recover to the normal frequency operating band, e.g. in the Tasmanian region, frequency may vary between 48 Hz and 52 Hz for up to 10 minutes following a generation event or load event and must recover to within the range 49.85 to 50.15 Hz after that.
>
> Although frequency typically "stabilises" within 60 seconds following such a contingency event, there is nothing in the frequency operating standards mandating that this be the case. It would be acceptable under the frequency standards for system frequency to oscillate within the range 48 Hz to 52 Hz for up to 10 minutes after a load or generation event, but this is poor engineering practise and would be considered a most undesirable outcome.
>
> Note also that the requirements of Schedule S5.1a.3, "System stability" do not apply to frequency stability issues. Schedule S5.1.8(b) states that "damping of power system oscillations will be adequate" but then goes on to define

adequate damping of power system oscillations in terms of electromechanical oscillation modes, a different phenomenon from frequency stability. Transend therefore considers that the Rules do not address frequency stability in explicit enough terms.

Given the shortage of fast FCAS in the Tasmanian region, Transend has in recent years received a number of proposals from proponents wishing to alter the governor settings on generating units so as to increase the quantity of fast FCAS services those generating units can provide. Increasing the governors' speeds of response will decrease their stability[5]. Decrease of governor stability across multiple generating units will lead to a degradation of system-wide frequency stability. That is, system frequency will be more oscillatory following a contingency event, with greater overshoot upon recovery. As discussed above, provided the absolute frequency limits are not breached, it appears that there are few, if any, mechanisms within the Rules to prevent degradation of system frequency stability.

Transend considers the PSSG to be the most appropriate mechanism to address the lack of frequency stability criteria elsewhere in the Rules or in the frequency standards themselves. As previously discussed, defining a suitable measure of system frequency stability and numerical limits may require considerable effort. At the present time, Transend is unable to offer any proposed alternative measures of frequency stability, but it is willing to assist AEMO in developing such measures.

Inclusion of df/dt acceptability criteria

Transend recommends the inclusion of maximum rates of change of frequency (df/dt) as part of the acceptability criteria for assessing frequency stability. The existing Tasmanian Frequency Operating Standard is silent on this issue and is therefore not an applicable reference document. Frequency rate of change will become a significant issue for Tasmania in the future as wind penetration levels continue to increase.

As the acceptable rates of change of frequency are likely to be NEM region dependant, it may be suitable in the PSSG to simply highlight the need for consideration of df/dt as part of acceptability criteria, with specific values to be made available from the relevant NSP."

International Power also comments on this issue:

> "IPRA agrees with the inclusion of frequency stability in the Guidelines, along with transient, oscillatory and voltage stability. However the inclusion of frequency stability in the Guidelines should not impose any new obligations on participants that are not

[5] Note that it is possible in many cases to decrease a governor's stability whilst still meeting the requirements of S5.2.5.11(g) that the control system be *adequately damped*.

already contained in the NEM Rules or the Reliability Panel Frequency Operating Standards."

WorleyParsons, in a submission to the second round of consultation states:

> "WorleyParsons notes that the guidelines have also included frequency stability as a new category. Whilst the clear designation of frequency stability is supported in general, it should also be noted that system frequency stability is covered in the provisions of the FCAS market and as a consequence must be treated differently to other stability issues because it depends on market bidding behaviour, which is covered elsewhere in the rules."

4.1.7.2 *AEMO* response

As previously indicated, *AEMO* does not believe it is appropriate to introduce new acceptance criteria that are not in the *Rules*. *AEMO*, instead, proposes to include this issue in the general discussion around the interaction between *generating system* performance and *power system* performance.

AEMO believes issues around the performance of the *power system,* in response to a *frequency* disturbance, should be addressed by changes to the *frequency operating standards* or by adding appropriate *Rules* requirements.

AEMO acknowledges that one mechanism for managing *frequency* stability is through the FCAS market.

4.1.7.3 Outcome

The Guidelines include a section that discusses the interaction between *generating plant* performance and *power system* performance, and which covers this issue.

AEMO has added to the Guidelines a reference to the potential need to take into account the operation of the FCAS markets, when carrying out stability studies and analysis.

4.1.8 Material Issue TN12, WP7: NSP review of stability limits (five year cycle)

The process of developing stability limits is generally labour intensive. Transend suggests that the requirement to review stability limits on a cycle not exceeding 5 years is too prescriptive and could result in excessive workload.

4.1.8.1 Summary of issue

Transend's submission contains the following:

"In section 6.1.3 of the PSSG issued for consultation, it is stated that "Each stability limit must be reviewed by the NSP…In any event, after a period not exceeding 5 years".

Transend would like AEMO to consider the practical implications of this general statement (from a potential ongoing work commitment perspective) and consider a more descriptive approach to achieve the same objective (which is understood to be an ongoing compliance culture around the management of power system stability).

On a cycle not exceeding 5 years:

(a) Consider changes in system operating conditions which could have a material impact on an existing stability limit (significant changes in generation dispatch outcomes due to market, hydrological or other environmental conditions, natural load growth etc).

(b) Identify which stability limits may be affected by the identified changes in system conditions.

(c) Undertake sensitivity analysis on the existing limit advice, i.e. how material is the change in system operating conditions with respect to the stability limit and is the existing stability limit still robust for the new conditions?

(d) If stability limit is found to be impacted significantly by the observed changes in system operating conditions (a decision which may involve AEMO), only then undertake detailed review and revision of the limit advice.

Transend accepts that any change in the power system that would likely have an abrupt material effect on stability limits would need to invoke a more immediate review."

In its submission to the second round of consultation Worley Parsons:

"…agrees with the approach that stability limits need only be reviewed if required by a change in the system (for example by a new generation connection, construction of a new transmission line or significant change in system loading."

4.1.8.2 *AEMO* response

AEMO's intention was not that the limits need to be recalculated, but that the need to recalculate them is reviewed at least every five years. This appears to be consistent with the intent of Transend's proposal.

4.1.8.3 Outcome

AEMO has clarified the wording around this issue in the Guidelines.

4.1.9 Material Issue PQ3: Additional analysis to confirm ongoing performance compliance if R2 data differs from R1 data

R2 data refers to data about a *plant* model that is obtained from test, typically during commissioning. R1 data is the best model data available prior to commissioning of the *plant*, and is generally provided by the *plant* manufacturer. Sometimes the R2 data differs substantially from the R1 data. Since some *performance standards* are based on modelling, a change in model data might call into question whether the *plant* can meet its *performance standards*. It is the responsibility of the *Generator* to ensure the *plant* is compliant with its *performance standards*.

4.1.9.1 Summary of issue

Powerlink Queensland's submission contains the following:

> "It would be useful to include a dot point in this section that requires consideration of additional analysis to confirm ongoing performance compliance when plant R2 data is derived that is different to the R1 Data on which the performance standards are based. Section 5.5 Review cycle references a consideration be included to reassess performance standards, but in terms of plant upgrades, new plant or network operation changes. It would be more clear to make a direct reference to re-evaluation of performance standards with R2 data."

4.1.9.2 *AEMO* response

AEMO agrees that there are situations in which a change in model between R1 and R2 data could be sufficiently material that the *plant* might need to reconsider its *performance standards*.

The *Rules* do not explicitly identify the link between the test parameters and compliance with the *performance standards*, but compliance with some *performance standards* (particularly *performance standards* related to stability) can only be assessed by application of the model in a simulation, unless the conditions for testing the *performance standard* arise on the *power system*. Therefore, *AEMO* considers it reasonable to make the link in the processes described in the Guidelines.

4.1.9.3 Outcome

AEMO has, in the Guidelines:

- modified the description of high level processes to include a change of model data as a possible trigger for a reassessment of study outcomes; and
- added a reference in the *connection application* and *plant* alteration processes to a possible need to reassess compliance with *performance standards* if model changes.

4.1.10 Material Issue TG1, SCL4, WP6: Remove requirement for reviewing *performance standards* compliance after 5 years.

The Issues Paper version of the draft Stability Guidelines contained a requirement for review of *performance standards* that would require stability calculation. TransGrid argues against this on the basis that it is not necessary to recalculate *performance standards* unless the *plant* is altered, and therefore the requirement represents an unnecessary burden on them. Stanwell Corporation argues that any such requirement should be in the Compliance template, not in the Stability Guidelines.

Stanwell Corporation, in its subsequent submission to the second round of consultation argues against a requirement for *Generators* to routinely perform stability studies to demonstrate on-going compliance.

4.1.10.1 Summary of issue

Transgrid's submission to the first round of consultation stated:

"...the draft Stability Guidelines contain requirements that will be difficult for TransGrid to meet. In particular, the following requirement (from bottom of page 19):

"In order to confirm continued compliance with its performance standards, a Registered Participant must review its performance standards that would require stability calculation:

- Prior to a change to the power system that is likely to have material effect on the relevant performance standard; or
- In any event after a period not exceeding 5 years"

At present the need for studies to assess the ability of a generating system to meet its performance standards arises when it is first installed or when existing excitation systems are to be replaced. For generators in NSW, these studies always require a considerable effort by TransGrid.

If the Generator's compliance Monitoring system is functioning well, and there are no major changes to the system in the vicinity of the generating system, there should be no requirement for performance standards studies to be re-done, until a new excitation system (or other major plant augmentation) is planned.

Therefore it is recommended that the second dot point at the bottom of page 19 of the draft Stability Guidelines be removed."

Stanwell Corporation's submission to the first round of consultation also covers this issue:

"The last paragraph on page 19 rightly identifies that a registered participant has a responsibility to ensure ongoing compliance with its performance standards.

> However, it is not clear that generators are required to routinely assess compliance as a result of, and if necessary change settings or plant due to, system changes external to the generator which impact the generator's performance. The grandfathering principle would exclude outcomes that require a generator to change plant to maintain compliance. Hence SCL submits that this section of the Guidelines can be read as attempting to apply requirements on generators that are beyond those required under the NER. SCL suggests that the template for generator compliance programs is a more appropriate location for commentary regarding the requirements for routine compliance assessment.
>
> The exception to this is S5.2.2 where the Rules make provision for AEMO and NSP's to initiate setting changes in generator control system settings in response to system changes (S5.2.2 third paragraph). However this applies only where the NSP or AEMO has assessed that the change is necessary in order for the generator to maintain compliance with its performance standards. This implies that the NSP or AEMO should assess the impact of proposed network changes on generators compliance with their performance standards."

In its submission to the second round consultation, Stanwell states:

> "In the context of Appendix 2, Item 2 of the Guidelines, SCL submits that generator performance standards are negotiated based on the plant performance. The requirement for generators to routinely perform stability studies to demonstrate on-going compliance carries with it the implication that, if found to be non-compliant, generators could be required to alter plant in order to maintain compliance (at significant cost if compliance requires anything beyond application of settings or renegotiation of the standard). Stanwell submits that the rules do not support this outcome and that the ongoing review requirements in the guideline should be amended accordingly."

In its second round consultation submission WorleyParsons states:

> "WorleyParsons notes that AEMO has dropped the requirement for 5 yearly checks on control systems on the basis that the generators must always be compliant. This issue currently suffers from ill-defined requirements in the rules and the associated guidelines. Specifically, it is not clear what responses of various control systems (AVR's, PSS, Governors, and limits on these systems) constitute compliance or what tolerance on responses would constitute non-compliance. WorleyParsons recommends this issue be examined more carefully because currently the onus is on the generators to comply but it appears that compliance cannot be clearly defined."

4.1.10.2 *AEMO* response

AEMO agrees that the *Generator* Compliance Template specifies the measures to demonstrate compliance that the *Generator* is required to take. However, *AEMO* does not find any general grandfathering principle in the *Rules*.

AEMO considers that it is the *Generator*'s responsibility to demonstrate compliance with the *performance standards*, and that simulating the *power system* with an appropriately validated model for the *power system* conditions for which it is required to remain stable is a valid way to check its compliance.

In response to Stanwell's second round submission, it should be noted that secure operation of the *power system* relies on *generating systems* complying with their *performance standards*, and operating consistent with their dynamic models. Clause 4.15 of the *Rules* indicates clearly the responsibility for a *Registered Participant* to continuously meet its *performance standards* and notify AEMO of, and rectify, any non-conformance. Nevertheless, AEMO agrees that an unnecessary requirement to alter plant would be contrary to an efficient market and the *Rules* allows for the re-negotiation of *performance standards* in some circumstances.

It is also noted that many of the *performance standards* contain requirements not to adversely affect the quality of supply to other Participants. This provides a basis in the negotiation of the *performance standards* of one *plant,* to take into account the performance of and impact on other *plant*, and means that *connection* of a *generating system* should not adversely affect the ability of another *Generator* to meet the *performance standards* for its *generating system*.

There may, however, be a risk that a *network* augmentation might affect a *Registered Participant's performance standards.*

In response to WorleyParsons' submission to the second round of consultation, *AEMO* has taken the view that compliance measures should be detailed in the Reliability Panel's *Generator* Compliance Template.

4.1.10.3 Outcome

AEMO included a recommendation in the Guidelines for the review of compliance against *performance standards* every 5 years, rather than a mandatory requirement.

In order to address Stanwell's concern, only in relation to risks associated with *network* augmentations affecting a *Registered Participant's performance standards*, an additional requirement has been placed in the Guidelines for a person planning a *network* to consider any potential detrimental impact on a *Registered Participant* in relation to its *performance standards*.

4.1.11 Material Issue SCL2, WP5: Are stability studies required for pole slip settings?

S5.2.5.10 refers to the Guidelines regarding the definition of unstable. Stanwell Corporation requests clarification on when (or if) stability studies need to be undertaken to assist with setting of pole slip relays.

4.1.11.1 Summary of issue

Stanwell Corporation's submission contains the following:

> "For synchronous generators, all relay manufacturers publish guidelines for selecting the settings for impedance based pole slip protection. Industry practice has been to select the pole slip settings based on these impedances without a stability study being performed. Given the costs of performing a stability study, the Guideline should differentiate and recommend when stability studies should be performed to assist with the setting of pole slip relays for the various types of generator technologies."

WorleyParsons provides a counter view:

> " WorleyParsons believes that setting pole slip protection without conducting transient stability studies is problematic because reliance is placed on subjective assessments which may be mistaken. Transient stability studies will provide information on the rate of generator acceleration during a fault, the point on the system at which de-synchronisatin occurs and consequently define the time delays and reach settings that should be applied to a pole slip relay. Whilst experienced engineering assessments may be accurate enough for this purpose in some cases – transient studies provide an objective measure which can be documented which is not possible by other means."

4.1.11.2 *AEMO* response

While transient stability studies are an effective way of checking pole slip protection settings, a study is not always necessary. As discussed by Stanwell Corporation, there are established methods of setting pole slip protection that might not require a study. *AEMO* proposes it be left to the discretion of the NSP and *AEMO* as to whether a study is required, on a case by case basis. A factor that might influence the decision is the adequacy of the proponent's commissioning test plans to confirm the protection settings, and should be considered by the NSP.

4.1.11.3 Outcome

AEMO has included commentary around this issue in the process for *connection application* and *plant* alterations in the Guidelines.

4.1.12 Material Issue IP1: Describe Due Diligence on stability limits

International Power proposes that the Stability Guidelines should prescribe the process for undertaking due diligence studies for stability limits.

4.1.12.1 Summary of issue

International Power's submission contains:

> "The Issues Paper makes reference to the current "due diligence" process in which the Transmission Network Service Providers (TNSP's) determine the transmission network limits, and AEMO then perform a due diligence check. The Issues Paper also notes that the AEMO due diligence check considers both whether the limit is sufficient to preserve power system security, as well as whether the limit is overly conservative.
> It is important that the due diligence process is applied consistently and transparently. Given that the due diligence process is not described in the Rules, IPRA suggest that the Power system Stability Guidelines (Guidelines) include a section that describes the due diligence process in full, including the responsibilities of the TNSPs and AEMO. The description should include what steps are taken by AEMO when it's due diligence analysis identifies that a limit is either too onerous or too lax."

4.1.12.2 *AEMO* response

The due diligence process tests a small subset of *power system* conditions, in order to check the validity of the advice. It does sometimes result in *AEMO* requesting the TNSP to revise its limit advice. The due diligence process is not amenable to a fixed procedure, as the choice of checks will vary from one case to another, and relies on engineering judgement as to selection of test conditions.

4.1.12.3 Outcome

AEMO has included some additional detail on the due diligence process in the process for development of stability limits in the Guidelines, including reference to a possible revision of a stability limit. However, for the reasons outlined, *AEMO* has not made this highly detailed.

4.1.13 Material Issue IP2: Define process for establishing stability limit safety margins

International Power proposes that the Guidelines should prescribe the process for application of safety margins.

4.1.13.1 Summary of issue

International Power 's submission contains:

> "In determining transmission limit advice, IPRA understand that TNSPs will usually apply a safety margin to their calculated limit. Furthermore, IPRA understand that when AEMO then convert the limit advice into a constraint equation, a further safety margin can be applied.
> As efficient utilisation of network capability is of critical importance, it is highly desirable that the processes used to establish and define the network capability are clearly understood and transparent to market participants. For this reason, IPRA urges AEMO to include a section in the Guidelines which sets out a consistent process for the application of safety margins by all TNSPs as well as AEMO."

4.1.13.2 *AEMO* response

AEMO publishes a separate policy document on confidence levels, and operating margins which may be found at the following address:

http://www.*AEMO*.com.au/electricityops/170-0051.html

As this document is likely to be updated more often than the Guidelines, *AEMO* does not propose to prescribe these matters. *AEMO* considers the publication of the document is sufficient to provide a reasonable level of transparency as to the processes adopted.

4.1.13.3 Outcome

A reference to the published document is included in the Guidelines for information.

4.1.14 Material Issue IP3: Define approach for developing *network* limits and *constraints*

International Power proposes that the Guidelines should prescribe the process for developing *network* limits and *constraints*.

4.1.14.1 Summary of issue

International Power's submission contains:

> "The Issues Paper states that as the Guidelines are intended for skilled power system analysts, there is no need to describe the processes in detail. IPRA accept that power system stability analysis is a highly specialised area in which only suitably skilled people could determine stability limits. However it is also true that there a number of different methods and processes that could legitimately be applied by power system specialists in calculating power system stability limits.
>
> The Guidelines provide a good opportunity to establish an agreed approach for calculating network limits and constraints, which would then be applied consistently across all regions of the NEM.
> IPRA therefore recommend that the Guidelines include a description of the approach to be adopted in determining network limits and constraints."

4.1.14.2 *AEMO* response

As part of the Congestion Information Resource, *AEMO* publishes a number of documents that describe processes around *constraint* development and implementation. These may be found at:

http://www.*AEMO*.com.au/electricityops/congestion.html

As these documents are likely to be updated more often than the Guidelines, *AEMO* does not propose to prescribe these matters directly in the Guidelines. There is already a *Rules* obligation to publish this information.

While *AEMO* agrees there is potentially some value in harmonising the processes for development of stability limit equations, this is not feasible in the timeframe allowed for a *Rules* consultation.

4.1.14.3 Outcome

For the reasons outlined, *AEMO* has not made any change to the draft Guidelines in response to this issue.

4.1.15 Material Issue SC6: Clarity of the Guideline

Stanwell identifies that the Guidelines will be provided to external service providers to specify study requirements. They identify some specific issues that they would like to see addressed to improve the clarity of the Guidelines.

4.1.15.1 Summary of issue

Stanwell states:

> "**Clarity of the Guideline**
>
> Generators generally engage external "expert" service providers to undertake stability studies in order to assess their compliance with the Performance Standards, be it for conformation of compliance with existing performance standards or for the review of performance standards in the context of a plant alteration. Following the release of the Guidelines, SCL will refer to the guidelines in specifying its study requirements.
>
> The difference in approach to undertaking stability studies between NSP's and AEMO mentioned in SCL's initial submission, demonstrates a difference in approach between experts. The Guidelines offer some assistance in sections 4.1 through to 4.3 in nominating the issues that should be considered. SCL's concerns are as follows:
>
> 1. Reference to the Guidelines in the specification for a study will still rely on interpretation of the Guidelines by the expert. If the expert is not familiar with the approach adopted by the NSP and AEMO for their due diligence check of the study, there is a significant risk that rework will be required. This issue was raised in the Issues Paper and SCL's initial submission, and has not been adequately addressed in the Guidelines in SCL's opinion.
> 2. Section 4.3 should include consideration of post contingency conditions (e.g. transmission lines out of service after a fault.
> 3. When performing studies it is usual practice to introduce a degree of conservatism into the results via the selection of the study cases. For example, conservative fault ride through studies are performed with the generator at maximum generator output and leading power factor. In the context of the Guidelines, would this case be considered a "practicable" operating condition? It could be interpreted as implausible on a real power system (which would disallow the case) or plausible in that "the performance standard would permit this plant condition" (which would

allow this case). The guideline should address wheat degree of conservatism is appropriate for stability studies and clarify what is intended by the term "practicable".

4. Interpretation and application of the Guidelines conceivably results in a multiplicity of cases to be studied. The guideline is silent however in terms of suggested techniques to limit the number of cases."

4.1.15.2 *AEMO* response

The text in sections 4.1 to 4.3 of the Guidelines and the more detailed process sections in Appendix 2 of the Guidelines, attempt to strike a balance between covering a wide range of situations and providing extensive detail. The risk in becoming too prescriptive is that such a description might not cover unusual situations sufficiently well. Also, the studies carried out for an *application to connect* are an investigation and may lead to the need for further, more detailed studies, in some aspects of *plant* or *power system* performance.

AEMO welcomes the specific suggestions put forward by Stanwell regarding improvements to section 4 or Appendix 2. *AEMO* agrees that the range of studies should include extreme situations that might not arise under normal operation of the *power system* such as a *generating unit* operating at full output and leading power factor. Such conditions will test the correct operation of *plant*, including limiters, and other parts of the *control systems* that might not be exercised under normal *power system* conditions. However, such *control systems* are installed for unusual operation and are important considerations for *performance standards*.

AEMO considers that Stanwell's comment on post-contingent conditions is reasonable.

AEMO agrees that there ought to be some way of reasonably managing the number of studies required, and, in principle, this should be related to the size of the *plant* relative to the *power system* in which it is connected. The number of studies can also be managed by selecting appropriate worst case boundary conditions to study. It should be emphasised that the obligation to carry out sufficient studies is on the *Connection Applicant*. For example, detailed studies to assess the impact on the *network* close to the proposed *connection point* must be carried out and, if there is any opportunity to minimise study effort then this would be for remote impacts – e.g. a small embedded *generating system* might be unlikely to affect *interconnector* capability, however some analytical demonstration of this should be provided.

4.1.15.3 Outcome

Under section 4.3, the Guideline has been updated to:

- Elaborate on the need to set up specific conditions to test particular aspects of *control systems* and *protection systems*.
- Elaborate that the range and depth of studies should depend on the extent to which the *generating system* impacts the *power system* and the extent to which the *power system* affects the *plant*.
- Add a consideration relating to post-contingency conditions.

5. Potential *Rule* changes

During the course of this consultation, it was considered that changes to the *Rules* might be necessary to clarify assessment criteria around *power system* stability. This was highlighted by some of the submissions. These related primarily to:

- A lack of clear *voltage* stability criteria
- No *frequency* stability criteria other than the bounds detailed in the *frequency standards*
- Potential inconsistencies with oscillatory stability and the requirement for *generating system control systems* to be "*adequately damped*"
- Complex requirements around fault clearance times
- The imbalance of information between NSPs/*AEMO* and other *registered participants* who might need to carry out their own stability calculations

Following completion of this consultation, *AEMO* will review the potential for Rule changes to deliver improved clarity around stability criteria.

6. Determination

After consideration of all submissions, *AEMO* determines the *Power System* Stability Guidelines in the form on the AEMO website (on the same webpage as this Determination and Report), titled "Power System Stability Guidelines", Version 1.0, issue date 25 May 2012.

Appendix 1 – Submissions received

Transend Networks

ISSUE	TOPIC	ISSUE	*AEMO* RESPONSE	OUTCOME
TN1 – Minor	Define stable and unstable	This issue was raised by Transend Networks. Transend's submission proposes "Provide descriptions of what is interpreted as stable and unstable behaviour, especially for (i) circumstances where application of "classical" mathematical and control theory techniques may not be entirely appropriate or may not apply at all, and (ii) for areas where the *Rules* do not mandate stability criteria."	*AEMO* agrees that it is relevant and important to describe the types of *power system* stability that will be covered by the Guidelines. See Section 4.1.1, for further discussion about acceptance criterion.	Reword descriptions of the types of stability to improve clarity, where appropriate.
TN2 – Material	Acceptance criteria for all stability phenomena	See section 4.1.1.	See section 4.1.1.2.	See section 4.1.1.3.
TN3 – Material	Level of prescription	See section 4.1.3.	See section 4.1.3.2.	See section 4.1.3.3.
TN4 – Minor	Structure of document	Transend would like to offer an alternative document structure to that proposed in the PSSG issued for consultation. While the existing document provided a great deal of useful information, restructuring of some sections is likely to aid readability and practical application. An alternative Table of Contents is provided in Appendix B, with significant alterations being:	Section 6 (in Issues Paper draft Guideline) details the processes around applications of the stability guidelines. *AEMO* agrees with Transend that there needs to be a section on application of this guideline upfront. AEMO agrees with	Add some words in section 2 about the purpose and application of the document. Re-structure the document to bring the general process section upfront. Make corrections to the structure in

		a) Bring forward the intended application of the document from Section 6 to Section 2. This will assist users to understand the intent of the PSSG earlier in the document. b) Bring forward the process map so that these concepts are "in-mind" when the reader arrives at the technical discussions. c) Consider adding a separate section for "general technical issues" that are relevant to most of the stability issues addressed by the PSSG. By doing this, it will avoid the need to address discussions such as "credible and non-credible events" in every section thereafter. d) Consider adding a separate section for "management of *power system* stability". Issues pertaining to NSP and *AEMO* obligations for review and approval can be logically grouped under this type of heading (NSP review of stability limits is an example). In Transend's proposed document structure, Section 7 (Assessment Principles) is sub-divided	bringing the process diagram earlier, however, our preference is to move definitions and specific processes into Appendices. "Applicability" could be changed to "Intended audience". Transend has suggested some amendments to the process map, which look reasonable, except that a couple of dot points have been omit, which *AEMO* prefers to keep (with additional explanation). The changes result in some changes to the structure of section 5. *AEMO* agrees the structure around the 6.1 Credible *contingency events* and 6.2 Non-credible *contingency events* needs some work. Transend's proposed section 7 seems to cover material that is	(the previous) section 6 regarding *contingency events*. Some additional structural changes arise from changes that address other issues.

		into each of the stability phenomena. For each stability type, Transend suggests the following sub-structure: 7.x.1 Typical study expectations 7.x.2 Standard assumptions 7.x.3 Acceptability criteria 7.x.4 Reporting of results	already covered in general terms in section 5, and section 4. It would be difficult to be more specific, but remain sufficiently flexible to allow for the range of studies that could be undertaken for each stability type.	
TN5 – Material	*Control system* stability	See section 4.1.3.	See section 4.1.3.2.	See section 4.1.3.3.
TN6 – Material	Fault clearance times for transient stability studies	See section 4.1.4	See section 4.1.4.2.	See section 0.
TN7 – Material	Oscillation modes and acceptability criteria	See section 4.1.5.	See section 4.1.5.2.	See section 4.1.5.3.
TN8 – Minor	Segregating short and long term voltage stability and clearer linkages to voltage stability references	• Transend considers there to be value in segregating voltage stability discussion in the PSSG into two time frames (consistent with IEEE and other literature available on this topic). • Transend recommends clearer linkage to S5.1.8 in relation to acceptability criteria (provision of adequate reactive margin as determined from steady state QV analysis). • Transend recommends clearer linkage to S5.1.8 in relation to acceptability criteria (provision of adequate reactive margin as determined from steady state QV analysis).	*AEMO* agrees that voltage stability is typically described in terms of short and long term phenomena. There appears to be only one criterion for acceptability listed in the *Rules*.	Elaborate the definition to include reference to short and long term voltage stability.

TN9 – Material	Reference S5.2.5.4(a) as a default transient recovery criterion for assessment of short-term voltage instabilities	See section 4.1.6.	See section 4.1.6.2.	See section 4.1.6.3
TN10 –Material	*Frequency* stability and inclusion of df/dt in acceptance criteria	See section 4.1.7.	See section 4.1.8.2.	See section 4.1.8.3
TN11 – Minor	New stability phenomena	Transend recommends that the PSSG acknowledge the potential for new stability phenomena – that cannot presently be envisaged – to arise as new technologies evolve. Their inclusion into the PSSG would need to be considered once identified and an understanding of their impacts on the *power system* performance has developed.	This is covered by the *Rules* allowance for the PSSG to be updated from time to time.	Leave as is.
TN12 –Material	NSP review of stability limits (5 year cycle)	See section 4.1.8.	See section 4.1.8.2.	See section 4.1.8.3.
TN13 – Minor	Proposed modification of process chart	Transend would like to offer a slightly modified version of the proposed process map provided in Figure 1 of the PSSG. The alternative version provided in Appendix A refines what was already a very reasonable sequence of events. The modifications capture the experience of personnel within Transend who undertake such work on a regular basis.	Changes proposed by Transend are reasonable. Comments suggest Transend might have misunderstood the intent of the review cycle block. *AEMO* proposes to clarify this section	Adapt the process diagram to cover Transend's additions where relevant. Modify the review cycle block to clarify its intent.
TN14 –Minor	Additional description of	Transend suggests that the following two points	The proposed changes are	Merge with existing wording.

	target audience under Section 2	be added to the list describing skilled *power system* analysts in Section 2 “Applicability”: (a) Able to envisage valid scenarios outside the present range of NEM operating practise (sic). (b) Familiar with operating procedures or practises (sic) within a particular region of the NEM.	reasonable.	
TN15 –Minor	Include statement in section 5 about using engineering judgement	Although Transend generally agrees with the material presented in Section 5, there is the possibility parties using the PSSG may (possibly unintentionally) rely on Section 5 as an exhaustive list of considerations. Transend recommends that *AEMO* include a clear statement in the introduction that the reader is expected to use engineering judgement to determine additional relevant considerations to the issues in question.	There are already some words to this effect, The proposed changes are reasonable.	Add a reference to engineering judgement and *good electricity industry practice* to existing wording.
TN16 – Minor	Establishing valid load flow solution for stability analysis	Transend’s submission contains the following: “The [Issues paper] draft guideline states that considerations must include the requirement that each *network* solution has an operationally acceptable voltage profile. Transend considers that this is only part of establishing a valid load flow solution. Other aspects include ensuring no *constraints* are binding; sufficient FCAS is dispatched; generator reactive outputs are within limits etc. Transend considers it worthwhile to expand the list of considerations in this section of	*Network* conditions following a stability study may not conform to operationally acceptable voltage profile, but starting conditions for a study should generally do so. *AEMO* agrees, that it is normally the case that for a stability analysis one would start with a *network* solution that is consistent, not only with operationally acceptable	*AEMO* will include reference to initial *network* solution being in a secure operating state where appropriate in the process description.

		the PSSG, albeit noting the discussions just above." .	voltages but for other conditions consistent with a *secure operating state*.	
TN17 – Minor	Allow for NSP and *AEMO* to undertake calculation of impact on *network* limits	The first paragraph under section 6.1.1 states that: "The Connection Applicant must address the assessment of *access standards* ... in relation to: • ... • Calculation of the impact of the application to connect on *network* limits relating to *power system* stability." Calculation of *network* limits in Tasmania typically requires detailed knowledge of the operation and characteristics of the *power system* which (i) may be unreasonable to expect the proponent to assimilate; (ii) may not be able to be disclosed by the NSP due to confidentiality provisions. Transend recommends that this requirement be reworded to allow for situations where it is not reasonably possible for a proponent to carry out this analysis. Under such situations, the default outcome is that the NSP and *AEMO* will be required to undertake the analysis and perform appropriate due diligence.	It is possible that there may be confidential information that is necessary for calculation of limit impacts. This is a fundamental issue in the *Rules* relating to the balance between protecting *confidential information* and transparency. There are already requirements in the *Rules* (clause S5.2.5.12(c)) for the NSP and *AEMO* to take into account a range of potentially *confidential information*. This should not preclude the *Connection Applicant* from carrying out its own studies, to the extent of information available to it, however, the NSP and *AEMO* would be able to provide more accurate assessments. It is not appropriate for the Guidelines to recommend who is required to to carry out studies, and is more a matter for the *Rules* and a	Add a footnote in the relevant section – connection application and *plant* alteration process.

			possible *Rules* change.	
TN18 – Minor	Statement about NSP and *AEMO* providing required information	Section 6.1.1 also contains the statement: "The NSP and *AEMO* must cooperate with the Connection Applicant to supply the required information available to it, subject to any confidentiality requirements under the *Rules*." This requirement is adequately covered in the *Rules* and therefore adds no further value in the PSSG	The proposed changes are reasonable.	Remove statement from document.
TN19 – Minor	Refer to Clause 4.15 to justify statements about compliance	Section 6.1.1 concludes with the statements: " In order to confirm continued compliance with its *performance standards* a Registered Participant must review its *performance standards* that would require a stability calculation." ... Transend recommends that *AEMO* provide references to applicable *Rules*, ie Clause 4.15, to justify the inclusion of such requirements in the PSSG.	This issue is affected by the response to another Issue	See response for material issue TG1, SCL4.
TN20 – Minor	Form of stability limit advice	The PSSG does not define what is a suitable form to *AEMO*. Additional clarification of this point would be welcomed and promote consistency of approach.	This is likely to be of value, but too detailed for the Guideline. *AEMO* suggests it should be pursued outside of this consultation	Leave as is.

Powerlink Queensland

ISSUE	TOPIC	ISSUE	*AEMO* RESPONSE	OUTCOME
PQ1 – Minor	Assist practitioners to gain access to appropriate information	(Referring to Section 2 Applicability) The last dot point "Familiar with the operating procedures and practices of the NEM". While this is an essential requirement for competent analysis of the Australian *power system*, not all analyst practitioners have a comprehensive understanding of the operation of the NEM. Some direction in the document to assist practitioners to gain access to appropriate information relevant to their analysis should be included here.	While *AEMO* agrees in principle with this statement, and could point to relevant information available from our website, *AEMO* wishes to avoid triggering a need for a further *Rules* consultation, which might arise from direct reference to other documents that might need to be updated more often than this Guideline. Notwithstanding this position, this does not preclude either the NSP or *AEMO* from publishing further general information about aspects of operation of the NEM. There are already obligations on *AEMO* to provide information to *registered participants* for planning and operational purposes.	Leave as is.
PQ2 – Material	Separate "Large Disturbance Rotor Angle Stability" and "Large Disturbance *Control system*	See section 4.1.3.	See section 4.1.3.2.	See section 4.1.3.3.

	Stability"			
PQ3 – Minor	*Plant* model calibration is responsibility of *AEMO* and TNSPs not connection applicant	(Referring to Section 5.2) In general, stability studies undertaken with 5-state *network* and *plant* dynamic models provided to Registered or Intending Participants is provided by *AEMO* and is confidential information. As such any information provided by *AEMO* includes validated and encrypted R2 *plant* data. Any *plant* model calibration will be included in the issue of the encrypted data to proponents, and in itself will be confidential. Our understanding is that the issue of model calibration is for *AEMO* and the relevant TNSPs, not for connection applicants, and this should be made clear in the document.	The Guideline does not specify who is undertaking the calibration, nor is it specific about the type of study. However, it is agreed that it would be difficult for a *Registered Participant* to calibrate a model with access only to encrypted models.	Add a footnote in the section that deals with calibration of models.
PQ3 – Material	Additional analysis to confirm ongoing performance compliance if R2 data differs from R1 data	See section 4.1.9.	See section 4.1.9.2.	See section 4.1.9.3.

TransGrid

ISSUE	TOPIC	ISSUE	*AEMO* RESPONSE	OUTCOME
TG1 – Material	Remove requirement for reviewing *performance standards* compliance after 5 years.	See Section 4.1.10	See section 4.1.10.2	See section 4.1.10.3.

Stanwell Corporation Limited

ISSUE	TOPIC	ISSUE	*AEMO* RESPONSE	OUTCOME
SCL1 – Minor	Link Section 2 "Interpretation of the *Rules*" to *Rules* clauses S5.2.5.5 and S5.2.5.12	SCL notes in the Paper, Section 2 "Interpretation of the *Rules*", NER clauses S5.2.5.10(a) and S5.2.5.13(k) are specifically referenced with respect to generators. For some *plant* alterations (5.3.9), transient stability studies are required to assess fault ride through capability (S5.2.5.5) and transient, oscillatory and/or voltage stability studies are required to assess the impact on *network capability* (S5.2.5.12). These studies should be referenced in the Paper.	*AEMO* intends to add a new section that deals with the relationship between *power system* performance and *generating system performance standards*. This will deal in general terms with these *access standards*.	Discuss links with *performance standards* in new section 5.2 of the Guidelines
SCL2 – Material	Are stability studies required for pole slip settings	See Section 4.1.11	See section 4.1.11.2.	See Section 4.1.11.3.
SCL3 – Minor	Separate connection application and *plant* upgrade processes in Stability Guidelines	Section 6.1.1 (Connection application and upgrade process): This section addresses both the connection application and *plant* upgrade processes in a joint fashion. SCL submits that the connection application process is sufficiently different to both the generating *plant* alteration process (5.3.9) and the *performance standard* compliance requirements (4.15) that these differences should be adequately dealt with in the Guidelines.	The *connection* and alteration processes reference the same technical requirements, and therefore have the same sorts of requirements. Likewise, compliance is referenced to the same technical requirements. For these reasons, and because the Guidelines are only high level	Insert some section labels within this section to make it clearer where there is a reference to *connection* and alteration or compliance.

			requirements, *AEMO* prefers to keep this as a single section	
SCL4 – Material	The Stability Guidelines should not require *Generator*s to assess *performance standards* routinely.	See section 4.1.10	See section 4.1.10.2	See section 4.1.10.3
SCL5 – Minor	Change wording "*plant* upgrade processes" to "*plant* alteration processes" for consistency with *Rules*	The Paper generally refers to "*plant* upgrade processes". SCL submits that a more appropriate term might be "*plant* alteration processes" in keeping with NER 5.3.9.	Agreed	Update wording in the Guidelines to refer to *Plant* Upgrade.
SCL6 – Material	Clarity of the Guideline (from second stage consultation)	See section 4.1.15	See section 4.1.15.2	See section4.1.15.3

International Power – GDF Suez Australia

ISSUE	TOPIC	ISSUE	*AEMO* RESPONSE	OUTCOME
IP1 – Material	Describe Due Diligence on stability limits	See section 4.1.12	See section 4.1.12.2	See section 4.1.12.3
IP2 – Material	Define process for establishing stability limit safety margins	See section 4.1.13.	See section 4.1.13.2.	See section 4.1.13.3.
IP3 – Material	Define approach for developing *network* limits and *constraints*	See section 4.1.14	See Section 4.1.14.2	See Section 4.1.14.3
IP4 – Material	*Frequency* Stability	See section 4.1.7	See section 4.1.8.2.	See section 4.1.8.3

Basslink Pty Ltd

ISSUE	TOPIC	ISSUE	*AEMO* RESPONSE	OUTCOME
BL1 – Minor	Responsibilities of MNSPs for planning	Basslink would like to see clarity regarding obligations specific to regulated *network*s, differentiated to unregulated *network*s where there is a difference in requirements. To be clear on the question there are obligations that are clearly NSP related (being non-specific to the *network* type and ownership) there are however obligations that are questionable in an MSNP linear *network* context. For example 6.1.1 connection application and *plant* upgrade of the interpretation document, when using Basslink in this context we are the connection applicant and it is relation to the TNSP we must comply, we will not have a 3rd party apply for interconnection.	In respect of clause 4.3.4 of the *Rules*, which states "Each *Network Service Provider* must plan or operate its *transmission system* or *distribution system* in accordance with the *power system* stability guidelines described in clause 4.3.4(h).", *AEMO*'s understanding is that this provision applies to NSPs generally, including MNSPs. In regard to the Section 6.1.1 of the Issues Paper Draft Stability Guidelines, the requirements described were written for *generating system connections*, but some aspects could also be applied to MNSPs.	Amend the Guidelines wordings to make these clarifications.

ISSUE	TOPIC	ISSUE	*AEMO* RESPONSE	OUTCOME
WP1 – Material	Asynchronous machine and control system stability	See Section 4.1.3	See Section 4.1.3.2	See Section 4.1.3.3
WP2 – Material	Frequency Stability	See Section 4.1.7	See Section 4.1.7.2	See Section 4.1.7.3
WP3 – Material	Oscillatory stability	See Section 4.1.5	See Section 4.1.5.2	See Section 4.1.5.3
WP4 – Material	Fault Clearance times	See Section 4.1.4	See Section 4.1.4.2	See Section 4.1.4.3
WP5 – Material	Pole Slip Protection	See Section 4.1.11	See Section 4.1.11.2	See Section 4.1.11.3
WP6 – Material	Studies to demonstrate compliance	See Section 4.1.10	See Section 4.1.10.2	See Section 4.1.10.3
WP7 – Material	Review of stability limits	See Section 4.1.8	See Section 4.1.8.2	See Section 4.1.8.3