Connections Reform Initiative (CRI)

Proposed wording changes to S5.2.5.5 Minimum Access Standards

Working papers

Presented to CRI Working Group December 2021

Background to the proposed changes

The following proposed changes have been developed by a dedicated Technical Subgroup of the CRI. It was formed to review the original intent of the S5.2.5.5 Minimum Access Standards and propose wording changes as appropriate.

The Subgroup comprised a total of 21 representatives that included Network Service Providers (transmission and distribution), AEMO, Original Equipment Manufacturers (OEMs) and consultants. A list of Subgroup members is included on the following page.

The proposed changes were developed through an extensive process of collaboration, largely via technical workshops held over several months. As a result, the proposed changes are well supported. Consistent with the CRI collaboration, the proposed changes do not represent the views of any particular individual or organisation, nor purport to, and are non-binding on any person or any organisation involved in the Technical Subgroup or the CRI.

About the Connections Reform Initiative (CRI)

The CRI is jointly sponsored by the Australian Energy Market Operator (AEMO) and the Clean Energy Council (CEC). It was created to make the connections process one that is consistent, predictable, efficient and collaborative while Australia undergoes the fastest clean energy system transition in the world.

Context

The changes proposed in this document were presented to CRI Working Group in December 2021. Technologies such as grid forming inverters were excluded from the Subgroup's scope because they were not considered sufficiently mature at the time of this review.

It is noted that there are a number of consultations now underway which can expand on the work of the CRI as the understanding of these technologies evolves. These include AEMO's *Technical Access Standards Review* (which includes appropriate standards for grid forming inverters and industrial load, including hydrogen) and the *Streamlined Connections Process* being advanced by the Energy Corporation of NSW (EnergyCo) as part of the NSW Electricity Infrastructure Roadmap.

CRI Technical Subgroup Members

Type	Organisation	Name
Network Service Providers	AEMO (VIC TNSP)	Erika Twining
	AEMO (VIC TNSP)	Logan Peters
	AEMO (VIC TNSP)	Michael Redpath
	AEMO	Navid Aghanoori
	Energy Queensland	Anthony Cran
	Essential Energy	Hadi Lomei
	Powercor	Hieu Nguyen
	Powerlink	Kevin Paice
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	TasNetworks	George Ivkovic
	Transgrid	Shilpa Kala
	Transgrid	Malithi Gundawarda
OEMs	Fluence Energy	Syed Rizvi
	Goldwind	Sam Fyfield
	Siemens Gamesa	Amir Baf
	Tesla	Josef Tadich
	Vestas	Janakiraman Sivasankaran
Consultants	Jacobs	Keith Frearson
	Vysus Group	Tony Morton
Facilitators	Online Power	Neil Gibbs
	Venturi Group	Nick Barr

Proposed wording changes to S5.2.5.5 Minimum Access Standards

Developed by CRI Technical Subgroup (late-2021)

Clause S5.2.5.5 Minimum Access Standard – Asynchronous generating systems [Clause S5.2.5.5(n)]

n) Subject to any changed *power system* conditions or energy source availability beyond the *Generator's* reasonable control, a *generating system* comprised of *asynchronous generating units* must:

1) for the types of fault described in subparagraph (k)(2), and to assist the maintenance of *power system voltages* during the fault, have *facilities* capable of supplying to or absorbing from the *network*:

   i. capacitive reactive current in addition to its pre-disturbance level of at least ~~2%~~ a nominated percentage (to be not less than zero) of the *maximum continuous current* of the *generating system* ~~including all operating *asynchronous generating units* (in the absence of a disturbance)~~ for each 1% reduction of *voltage* at the *connection point* (as qualified by subclause (u)) below the relevant ~~range in~~ threshold at which a reactive current response must commence, as identified in paragraph (o)(1), with the *performance standards* to record the required response agreed with *AEMO* and the *Network Service Provider*; and

   ii. inductive reactive current in addition to its pre-disturbance level of at least ~~2%~~ a nominated percentage (to be not less than zero) of the *maximum continuous current* of the *generating system* ~~including all operating *asynchronous generating units* (in the absence of a disturbance)~~ for each 1% increase of *voltage* at the *connection point* (as qualified by subclause (u)) above the relevant ~~range in~~ threshold at which a reactive current response must commence, as identified in paragraph (o)(1), with the *performance standards* to record the required response agreed with *AEMO* and the *Network Service Provider*,

   during the disturbance and maintained until *connection point* voltage recovers to between 90% and 110% of *normal voltage*, or such other range agreed with the Network Service Provider and AEMO, except for voltages below the relevant threshold identified in paragraph (p); and

2) return to at least 95% of: ~~the pre-fault active power output, after clearance of the fault, within a period of time agreed by the Connection Applicant, AEMO and the Network Service Provider.~~

i. the pre-fault active power output, or
ii. during a frequency disturbance, a level of active power output consistent with the *generating system*'s *performance standard* under clause S5.2.5.11,

after clearance of the fault and recovery of positive sequence *voltage* at the *connection point* to settle between 90% and 110% of *normal voltage* (or such other range agreed with the Network Service Provider and AEMO), within a period of time agreed by the Connection Applicant, AEMO and the Network Service Provider and recorded in the *performance standard* under this clause S5.2.5.5. This period of time may differ according to the type of fault, in which case the differing values are to be recorded as such.~~; and~~

~~3) to limit the risk to power system security, not inject current that contributes disproportionately to voltage rise in any phase (considering the range for *contingency events* under clause S5.1a.4):~~

~~i. on un-faulted phases during an unbalanced fault; or~~
~~ii. on any network element upon clearance of the fault.~~

[Clause S5.2.5.5(o)]

o) For the purpose of paragraph (n):

1) the *generating system* and its *generating units* must commence a response when the corresponding *voltage* falls below a nominated under-voltage threshold ~~is in an under-voltage range of~~ in the range of 80% to 90%, or rises above a nominated over-voltage threshold ~~an over-voltage~~ in the range of 110% to 120%, of:
   i. in relation to the *connection point*, *normal voltage*; or
   ii. in relation to the terminals of a *generating unit*, *nominal voltage*.

   ~~These ranges may be varied~~ These voltage thresholds may be placed outside the ranges above with the agreement of the Network Service Provider and AEMO ~~(provided the magnitude of the range between the upper and lower bounds remains at Δ10%)~~. The nominated under-voltage and over-voltage thresholds must be recorded in the *performance standard* under this clause S5.2.5.5 and may take different values at the *connection point* and at the terminals of a *generating unit*;

~~OR alternative wording:~~

~~1) the *generating system* must commence a response when the *voltage* in any phase is below a threshold level specified by *AEMO* and the *Network Service Provider* within a range of 80% to 90% or above a threshold level specified by *AEMO* and the *Network Service Provider* within a range of 110% to 120% of *normal voltage*. The under-voltage and over-voltage threshold levels may be set outside the specified ranges with the agreement of the *Network Service Provider* and *AEMO*;~~

2) ~~where *AEMO* and the *Network Service Provider* require the generating system to sustain a response duration of 2 seconds or less,~~ the reactive current response at the *connection point*

must have a *rise time* of no greater than ~~80 milliseconds~~ the fastest applicable primary protection clearance time as determined by the Network Service Provider, and must be damped. ~~not be underdamped~~;

~~3) where *AEMO* and the *Network Service Provider* require the *generating system* to sustain a response duration of greater than 2 seconds, the reactive current response at the *connection point* must have a *rise time* as short as practicable and must not be underdamped;~~

4) ~~Irrespective of the required response duration,~~ The reactive current response at the *generating unit* ~~*connection point*~~ to under-voltage must not be less than the pre-disturbance level of reactive current from 40 ms after any phase of the *connection point* voltage drops below the under-voltage threshold level specified in S5.2.5.5(o)(1); and

5) ~~Irrespective of the required response duration,~~ The reactive current response at the *generating unit* ~~*connection point*~~ to over-voltage must not be greater than the pre-disturbance level of reactive current from 40 ms after any phase of the *connection point* voltage rises above the over-voltage threshold level specified in S5.2.5.5(o)(1).

Clause S5.2.5.5 General requirement

[Clause S5.2.5.5(u)]

u) For the purpose of paragraphs (f) and (n):

1) the reactive current contribution may be limited to the maximum continuous current of a *generating system*, including its operating *asynchronous generating units*;

2) the reactive current contribution and *voltage* deviation described may be measured at a location other than the *connection point* (including within the relevant *generating system*) where agreed with *AEMO* and the *Network Service Provider*, in which case the level of injection and absorption will be assessed at that agreed location;

3) the reactive current contribution required may be calculated using phase to phase, phase to ground or sequence components, as appropriate, of the root-mean-square amplitudes of measured ~~of~~ *voltages*. The choice of *voltage* used for calculation purposes must be recorded in the performance standard. The ratio of the negative sequence to positive sequence components of the reactive current contribution must be agreed with *AEMO* and the *Network Service Provider* for the types of disturbances listed in this clause S5.2.5.5; and

4) to limit the risk to power system security, the *generating system* must not inject current that contributes ~~disproportionately~~ excessively to voltage rise in any phase (considering the range for *contingency events* under clause S5.1a.4):

   i. on un-faulted phases during an unbalanced fault; or

ii. on any network element upon clearance of the fault.

5) the *performance standards* must record all conditions (which may include temperature) considered relevant by *AEMO* and the *Network Service Provider* under which the reactive current response is required.

Glossary

maximum continuous current

(1) In relation to a *generating system*, the amount of current calculated to correspond at the *connection point* to the largest *apparent power* required by the *generating system*'s *performance standard* under clause S5.2.5.1, and with the *connection point* at [its *nominal voltage* ~~/ the lowest *voltage* within the limits established under clause S5.1a.4~~ without a *contingency event*].

(2) In relation to a *generating unit*, the maximum magnitude of current that the *generating unit* can continuously deliver at its terminals, defined by reference to its *nameplate rating*, its *apparent power* rating, and the permitted range of terminal *voltage* for continuous operation.