

3 February 2023

Anna Collyer
Chair
Australian Energy Market Commission
Sydney South NSW 1235

By online submission

Dear Ms. Collyer,

AEMC Draft Rule Determination on “Efficient reactive current access standards for inverter-based resources” under clause S5.2.5.5 of the National Electricity Rules (NER) – your ref. ERC0272 & ERC0329

AEMO welcomes the opportunity to provide feedback on the above Draft Rule Determination published by the Commission on 15 December 2022.

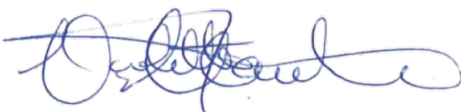
In essence, our feedback focuses on the following topics:

1. The % level of reactive current capability per % change in voltage
2. The definition of maximum continuous current
3. The definition of continuous uninterrupted operation (CUO)
4. Active power recovery following stable recovery of voltage, and frequency response
5. Reactive response times (rise time and initiate response).

Our submission is set out in the annexure to this letter.

Please contact Margarida Pimentel on margarida.pimentel@aemo.com.au should there be any enquiries on the matters outlined in this submission.

Yours sincerely,



Violette Mouchaileh

Executive General Manager – Reform Delivery



ANNEXURE – AEMO submission to AEMC Draft Rule Determination on “Efficient reactive current access standards for inverter-based resources” under NER clause S5.2.5.5

1. The % level of reactive current capability per % change in voltage

As correctly set out on page 16 of the Commission’s Draft Determination:

“AEMO’s submission, reflecting NSPs’ preferred position was to recommend a standard of 1% per % change in voltage. The CRI’s technical paper reflected a position closer to generators’ recommendation that the rules require that the reactive current capability be set at a level that NSPs and generators agree, but be greater than 0%.”

We acknowledge that the Commission has taken a “do no harm” approach with a more preferable draft Rule that seeks to “provide more flexibility for generators and Network Service Providers (NSPs) to negotiate an amount of reactive current capability that is aligned with the system security risk that the connection site and the connecting generator present, while providing a clear benchmark to support negotiations”.

In practical terms, we note the draft Rule is:

- intended to ensure “generators are neither absorbing, nor injecting reactive current during a disturbance by setting the minimum reactive current capability standard to maintain 0% of the maximum continuous current, in addition to the pre-disturbance level, for a 1% change in voltage at the connection point”
- lower than both that proposed by AEMO and Connections Reform Initiative (CRI).

In response, AEMO is of the view that a minimum reactive current capability level below 0% could present operational challenges since, at that level, the impact of the generating system on the network voltages is to reduce voltages at the connection point further during faults and increase them further during overvoltages.

AEMO therefore considers that a minimum reactive current capability level of 1% would instead provide reactive current capability to support fault recovery and secure operations of the system, while retaining scope for generators to negotiate with NSPs based on specific connection site conditions.

Further and in practical terms, AEMO does not consider that a standard of 1% per % change in voltage is difficult for most connecting generators to achieve, even without significant investment in additional equipment. It is also AEMO’s experience that generators who have difficulty meeting reactive current capability access standards often enter connection negotiations at the minimum access standards level (rather than the automatic access standard level).

AEMO recommends that a basis for negotiation below 1%/ % be established in the draft Rule (or below 0%/ % if that is retained as the AEMC’s position) by setting out the conditions under which AEMO and the NSP may accept a lower standard. In our view, the relaxation below 1%/ % should be to allow flexibility for outlier conditions and exceptional circumstances (provided that the secure and efficient power system operation is not compromised). AEMO’s position is that, establishing the basis for negotiation below 1%/ % could improve the efficiency of the negotiation process, because it creates more clarity around the minimum access standard level.



In view of this, AEMO proposes clause S5.2.5.5(n)(1) be amended¹ as follows:

(i) capacitive reactive current in addition to its pre-disturbance level of:

(A) ~~0~~1%; or

(B) a lower percentage or percentages agreed to by AEMO and the *Network Service Provider*, [under clause \[X\]](#)

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* below the relevant point at which a reactive current response must commence, as identified in or agreed under paragraph (o)(1); and

(ii) inductive reactive current in addition to its pre-disturbance level of:

(A) ~~0~~1%; or

(B) a lower percentage or percentages agreed to by AEMO and the *Network Service Provider*, [under clause \[X\]](#)

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* above the relevant point at which a reactive current response must commence, as identified in or agreed under paragraph (o)(1);

where clause [X] should read:

For the purposes of clause S5.2.5.5(n)(1)(i)(B) and (n)(1)(ii)(B), AEMO and the *Network Service Provider* may agree to a reactive current injection or absorption below 1% if it does not reduce the ability of the *generating system* to remain in *continuous uninterrupted operation* for faults defined in clause S5.2.5.5, when compared with reactive current injection or absorption at 1% and:

- (a) the reactive current injection or absorption below 1% only occurs for limited operating conditions so that likelihood of occurrence is low and does not adversely impact *power system security or transmission network power transfer capability*; or
- (b) there is benefit to the *power system* from reactive current injection or absorption below 1%, compared with injection or absorption, as relevant, at 1%; or
- (c) considering the dynamic reactive current capability from existing sources and *committed projects* and considering the impact of *plant retirements and network changes*, the *Network Service Provider* and AEMO agree that additional reactive current absorption or injection, as relevant, is not required at the relevant *connection point*.

AEMO further considers that lowering the minimum reactive current capability level below 0%/1% at the connection point has the potential to increase uncertainty between the responsibility for NSPs to invest in network and network assets to maintain reactive power, and the generator connection process. We note that the draft Rule seeks to “not require significant investments from generators that crowd out NSP investment when the latter offers the potential to achieve economies of scale and scope”, however, the opposite can also be true. That is, the marginal cost of a generator

¹ In this annexure, text in struck-out red font is deleted and text in blue font is substituted or new text.

providing additional reactive capability during faults might be less than the cost of the NSP providing additional dynamic reactive capability at that location, considering that voltage tends to be a local rather than a network-wide condition.

To assist with achieving a net benefit to the consumer, consistent with efficient investment under the National Electricity Objective, we have proposed condition (c) above so that an NSP may agree to injection or absorption lower than 1%/ % where a higher level is otherwise not necessary in the circumstances.

In view of this, AEMO also recommends that the AEMC works to ensure that NSPs and the AER (as the approver of regulated expenditure) are aligned on process and the role of NSPs in providing potential additional reactive support. Given the likelihood of timing mismatches between the connection of new generation and NSP investment (particularly through a RIT-T process), AEMO is of the view that, without proper coordination or assurances that NSPs will be able to procure additional voltage support in a timely manner, risk to overall system operations may arise.

The AEMC might therefore wish to consider whether further regulatory change is required via transitional Rules for NSPs to ensure that with the commencement of this revised Rule, sufficient dynamic reactive capability is retained throughout their networks.

2. Changes to the definition of maximum continuous current

NER clause S5.2.5.5 still provides for reactive current injection to be measured at a location other than the connection point, but maximum continuous current remains defined as the current at the connection point.

AEMO considers that, if the measurement point is not at the connection point, then maximum continuous current might need to be defined as the equivalent current at the agreed measurement location that would give the defined current at the connection point.

In view of this, AEMO proposes that the definition of maximum continuous current be amended as follows:

Maximum continuous current

In respect of a *generating system*

- (a) where the reactive current injection is measured at the *connection point*, the current at the *connection point* corresponding to the largest amount of *apparent power* required by the *generating system's performance standard* under S5.2.5.1, at the *normal voltage*, *or*
- (b) where the reactive current injection is measured at an alternative measurement location agreed under paragraph (u)(2), the equivalent current at that measurement location that would provide the current as calculated in (a) at the *connection point*.

3. Changes to the definition of continuous uninterrupted operation (CUO)

AEMO is of the view that, as currently drafted, the revised CUO definition does not fully clarify related requirements and obligations. Moreover, AEMO reminds the Commission that, pursuant to NER clause 5.2.6A, AEMO is conducting a review of the technical requirements for connection, which will also consider CUO more broadly.

In view of this, AEMO proposes that the CUO definition be amended, at paragraph (d), as follows:

Continuous uninterrupted operation:

not exacerbating or prolonging the disturbance **or causing a subsequent disturbance** such that it would ~~result in a subsequent disturbance for other~~ **adversely impact the stability of another generating systems**, except as required or permitted by its *performance standards*.

4. Active power recovery following stable recovery of voltage, and frequency response

The preferable draft Rule S5.2.5.5(n)(2) allows a return to 95% of active power output only “after clearance of the fault and recovery of positive sequence *voltage* at the *connection point* to be stable between 90% and 110% of *normal voltage*”.

We acknowledge this draft Rule is intended clarify that active power only must recover when voltages have. However, AEMO is of the view that the use of “stable” retains ambiguity relating to the level of voltage required and that the tightening of language may provide for a clearer starting point in assessing recovery time.

In view of this, AEMO proposes that the following drafting of NER clause S5.2.5.5(n)(2) “after clearance of the fault and recovery of positive sequence *voltage* at the *connection point* to be stable between 90% and 110% of *normal voltage*” be amended to:

after clearance of the fault and recovery of positive sequence *voltage* at the *connection point* ~~to be stable~~ **to remain** between 90% and 110% of *normal voltage*

The AEMC’s preferable draft Rule also includes in (u)(2)(ii) a new reference to frequency response under S5.2.5.11. It is unlikely that a fault which clears in a way that causes a supply-demand imbalance would lead to a significant difference in frequency within the recovery time of the fault. However, we acknowledge that it is technically possible to have a frequency disturbance occurring at the time of a fault. More likely in the fault recovery timeframe, for grid forming inverters especially, is that an active power response opposing a phase angle change occurs when a line is tripped to clear the fault, and there may also be an inertial response, opposing the rate of change of frequency if there is an associated supply-demand imbalance.

We therefore suggest that this reference to frequency be removed. If, however, the AEMC determines to continue to refer to frequency response under S5.2.5.11, it should also allow for:

- a response opposing a phase angle change on fault clearance
- an inertial response to a supply-demand imbalance, occurring as a result of the fault clearance, from a plant with synthetic inertia enabled
- primary frequency response to frequency deviation, in accordance with NER clause 4.4.2(c1).

5. Reactive response times (rise time and initial response)

AEMO considers that the inclusion of NER clauses that state “as agreed to by *AEMO* and the *Network Service Provider*” have the potential to allow a lower than minimum requirement under special network circumstances and should thus be more specific.

NER clauses S5.2.5.5(o)(3) and S5.2.5.5(o)(5) specify the reactive rise time and the reactive current response commencement must be no longer than 80ms and 40ms respectively or “a longer time agreed by the NSP and AEMO”. As proposed in relation to CUO for issue 1 above, AEMO is of the

view that greater specificity of the certain conditions that may be required to agree a lower than minimum requirement, would provide both clarity to proponents and reduce risk to the system.

In view of this AEMO proposes that NER clause S5.2.5.5(o)(3) to be amended as follows:

the reactive current *rise time* must be no longer than 80 milliseconds or a longer time agreed by the *Network Service Provider* and AEMO under clause [Y];

and that NER clause S5.2.5.5(o)(5) to be amended as follows:

the reactive current response must commence within a period after the response initiating condition of:

- (i) 40 milliseconds; or
- (ii) a longer time agreed by the *Network Service Provider* and AEMO under clause [Y]:

where clause [Y] should read:

For the purposes of clause S5.2.5.5(o)(3) and (o)(5), AEMO and the *Network Service Provider* may agree to a longer reactive current *rise time* or reactive current response commencement if the nature of the response provides benefit to *power system* operation or is otherwise acceptable to AEMO and the *Network Service Provider*.