AEMC

INFORMATION

Draft rule for efficient reactive current access standards for inverter-based resources

Draft determination to support more efficient and flexible reactive current capability from inverter-based resources such as renewable generators and batteries

The Australian Energy Market Commission (AEMC) has made a more preferable draft rule that would facilitate greater efficiency in the connection requirements of inverter-connected technologies, such as batteries, wind and solar, while maintaining a secure power system. The draft rule would support more flexible reactive current capability to ensure inverter-based generators continue to support voltage stability at least cost.

Alternating current power comprises two components - active and reactive power:

- **active power** is the form of electrical current that does actual work - i.e. provides light, heat and motion, whereas
- **reactive power** helps facilitate the transport of electrical current by maintaining stable voltages in electrical circuits.

This draft determination responds to two rule change requests that recommended the Commission lower the minimum amount of reactive current injection or absorption capability that inverter-based (or asynchronous) generators need to provide after a voltage disturbance.

Voltages can be disturbed or be faulted for a variety of reasons but such changes often follow a lightning, animal or vegetation strike on power lines, which leads to a sudden voltage disturbance. Typically, these disturbances lead to generators either injecting reactive current to lift voltages back to an acceptable proportion of normal voltages or absorbing reactive current to lower voltages back into the normal range. If voltage disturbances are not arrested by the rapid injection or absorption of reactive current, voltages may deviate further from their normal levels, which in turn affects the capacity of nearby generators and loads to remain connected to the power system.

The Commission's draft rule recognises the importance of requiring inverter-based resources to provide reactive current to arrest these voltage deviations, because inverters are typically able to provide some capability at a fairly low marginal cost. However, the current standard is resulting in some systems, especially wind farms, to invest in auxiliary dynamic reactive plant to satisfy the existing minimum access standard capability requirement. This investment in auxiliary equipment is not always likely to support the achievement of system security outcomes at least cost and the Commission considers that there should be more flexibility to agree to a more efficient level of reactive current provision by connecting resources.

The Commission has made this determination because the minimum reactive current capability access standard is not calibrated to specific system security needs, and investment in auxiliary equipment may often lead to poorer voltage control outcomes especially in low system strength parts of the power system. For these reasons, the Commission's draft rule would propose to establish a 'do no harm' requirement. This would require inverter-connected resources to ensure that they do not absorb reactive current at the connection point during under-voltage faults and do not inject reactive current during over-voltage faults. The draft determination also provides additional flexibility to agree to a lower level of reactive current provision, than that prescribed numerically in the rules.

Over time, the Commission expects that the more preferable draft rule would lead to NSPs having to be more proactive in planning for and investing in dynamic reactive plant to ensure stable voltage levels during steady-state conditions and maintain adequate reactive power reserve margins to respond to faults. Meeting these obligations would require NSPs

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to establish the need for such investments as part of regulatory investment tests for transmission and distribution.

Draft rule would facilitate more pragmatic negotiations on the design of reactive current responses to support both a fast and stable response

A further issue identified through the rule change requests was that responses from inverter-based resources often trade off the stability of a reactive current response to ensure that the response is provided quickly. Stakeholders also noted that current definitions for the adequacy of a reactive current response in the rules are appropriate for controlled test conditions but are less relevant when assessing the adequacy of reactive current response to more complex, unbalanced faults that are the most onerous type of fault condition seen in practice.

To ensure that reactive current responses are both fast and stable, the Commission's draft rule would:

- introduce a new standard that would require reactive current responses to start within 40 milliseconds (ms) of a fault-initiating condition agreed upon by all connecting parties
- increase the requirement for the response to ris from 10% to 90% of its maximum level from 40 ms to 80 ms
- delete the settling time requirement from the rules as it is a success criterion that is only applicable to certain, simple faults with step characteristics that are rarely seen in practice. For more complex voltage faults, the settling time requirement is not relevant to an assessment of the adequacy of a reactive current response.

The draft rule determination has proposed the reformulation of the success criteria that would define the characteristics of an adequate reactive current response to a fault that would be seen in practice. This reformulation would also provide connecting parties, NSPs and AEMO with some rules-based guidance on how devices should be tuned and the numeric response characteristics that control systems should aim to achieve, while balancing flexibility to agree to a slightly different standard if local conditions demand it.

Draft rules provide clarity on several other elements of the rules to assist connection negotiations

The Commission's draft rule also provides clarity on three other elements of the rules to:

- Reflect the practical experience that voltages often remain depressed outside the normal operating range after fault clearance, which means that active power cannot recover to its pre-fault level. The draft rule would address this by requiring that negotiation of the timing of active power recovery to its pre-fault level also consider whether voltages have recovered to a stable level between 90% and 110% of the connection point normal voltage.
- Provide a definition of 'maximum continuous current' that would be calculated as the ratio of the rated apparent power of the generating system and the connection point normal voltage.
- Clarify the definition of 'continuous uninterrupted operation' to recognise that a new connecting generator should not materially exacerbate disturbances other generators may face.

Implementation

The amended provisions in the draft rule are proposed to come into effect 10 weeks from the publication of the final rule and determination, for those who have submitted a connection enquiry or an application to connect, but have not received an offer to connect. This 10 week timeframe is being proposed to allow NSPs and AEMO time to amend their processes and consider how the proposed rule would impact the connections they are currently assessing.

The proposed amendments would then come into effect for all connecting parties six months from the publication of the final rule.

Consultation

Submissions on this draft determination and draft rule are due by **3 February 2023**.

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