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Australian Energy Market Commission

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Dispatch limits for inverter-based resources consultation paper

Transgrid welcomes the opportunity to respond to the Australian Energy Market Commission's (**AEMC**) consultation paper on the dispatch limits for inverter-based resources rule change.

Transgrid supports the proposed rule change. As the jurisdictional planner, system strength service provider, and operator and manager of the transmission network in NSW and the ACT, Transgrid has direct operational experience with the increasing challenges associated with maintaining system security as inverter-based resources connect at scale. The growth of inverter-based generation and storage is essential to the energy transition, but it also requires fit-for-purpose operational tools that allow Australian Energy Market Operator (**AEMO**), network service providers and market participants to manage power system security efficiently, reliably and transparently.

We understand the rule change request submitted by AEMO seeks to amend the National Electricity Rules (**NER**) to expressly enable dispatch instructions to include limits on the number of inverters online at a connection point. The proposal would formalise AEMO's inverter dispatch initiative by allowing inverter-limit instructions to be communicated electronically and complied with through local control systems. It would also introduce new connection capability requirements for future connecting facilities, definitions of "inverter" and "online inverter", and transitional arrangements for existing facilities.

Transgrid considers that the proposed rule change is an important and practical reform to support secure operation of the power system during periods of low system strength, planned and unplanned outages, and other operational conditions where the number of inverters online at a connection point can materially affect system security. The current framework relies on a combination of constraint equations, manual communication with participants and, where necessary, clause 4.8.9 instructions to network service providers to disconnect facilities. These arrangements can be inefficient, time-sensitive and operationally complex. In practice, they can also result in more inverters being taken offline than necessary, generators experiencing delays in returning to service, and market constraints remaining in place longer than required. A direct, automated and enforceable dispatch mechanism for inverter limits would reduce reliance on manual interventions and emergency disconnection instructions, while improving the speed and reliability of operational response.

These reforms are in the long-term interests of consumers because they support secure and reliable power system operation while reducing the need for inefficient, manual or emergency interventions.

Transgrid supports the rule change for the following reasons:

- It would provide AEMO with a clearer and more effective tool to manage system security risks associated with inverter-based resources.
- It would reduce reliance on manual communication processes during time-critical operational conditions.
- It would reduce the need for AEMO to issue clause 4.8.9 instructions to network service providers to open circuit breakers and disconnect generating systems where participants do not respond sufficiently quickly.
- It would support more efficient network operation during planned and unplanned outages, including circumstances where inverter switching is required to maintain secure operating conditions.
- It would provide a clearer framework for future connecting inverter-based resources to have the capability to receive, monitor and respond to inverter-limit instructions through local control systems.
- It would support the delivery of operational technology improvements and market benefits by enabling more automated and coordinated management of inverter-based resources.
- Would be an opportunity to standardise the methodology and capability for reporting “online inverters”, which will help TNSPs monitor the availability of Grid-Forming Battery Energy Storage Systems (**GFM BESS**) it has contracted to provide system strength services.

Transgrid considers that the rule change is particularly important in the context of the scale and speed of the energy transition. The transmission network is increasingly required to accommodate large volumes of inverter-based generation and storage, including in renewable energy zones and other areas where system strength and network operability can be binding operational considerations. Ensuring AEMO has timely and enforceable tools to manage inverter numbers will be important to maintaining system security while maximising efficient utilisation of renewable generation and storage.

The rule change would also support more efficient outage management by enabling inverter numbers to be adjusted dynamically as operating conditions change. During planned outages, inverter dispatch could reduce delays where a generator does not respond in accordance with agreed schedules, helping to avoid Transgrid resources being left idle and market constraints remaining in place longer than necessary. During an outage, it could also allow available system strength to be allocated more efficiently across generators. For example, where a generator is temporarily unable to utilise its allocated share of system strength, such as where a solar farm is not generating after sunset or inverters are out of service for maintenance, that capacity could be reallocated to other generators that are able to make productive use of it. This would improve utilisation of system strength resources and maximise the value delivered to the market during outage conditions.

Transgrid also supports the proposal because it is consistent with the direction of operational technology upgrades required to manage a more complex and dynamic power system.

Automation of inverter-limit instructions can deliver benefits by improving the speed, consistency and reliability of operational response. It can also reduce the need for manual telephone calls, bespoke participant engagement and late-stage network disconnection actions. These benefits are likely to be particularly important during forced outages, planned outages and system security incidents where operating conditions can change quickly and require coordinated action across AEMO, network service providers and connected participants. Inverter dispatch would also improve the ability to allocate scarce system strength efficiently during outage conditions, including by allowing inverter numbers to reflect actual system conditions on the day rather than conservative worst-case assumptions.

While Transgrid supports the rule change, we recommend that the final rule and supporting implementation arrangements address several technical and implementation matters.

1. **Reporting of “online inverters” should also consider generators providing a system strength service** - AEMO’s rule change proposal is designed to enable AEMO to issue inverter-limit dispatch instructions to generators that consume system strength. However, we think the rule should also consider requirements to monitor “online inverters” for generators that are providing a system strength service. As such, the definitions of “inverter” and “online inverter” and supporting implementation arrangements (i.e. AEMO guidelines/procedures) would support all of these use cases:

1. Issuing inverter-limit dispatch instructions
2. Monitoring compliance with inverter-limit dispatch instructions
3. Implementation of “online inverters” in limit/constraint equations, for both LHS (generators that consume system strength) and RHS (generators that provide a system strength service)
4. Monitoring compliance with system strength service enablement instructions, which require a generator to maintain a minimum number of inverters online during the enablement period
5. Monitoring compliance with availability obligations in system strength service agreements, which will require a generator to maintain a minimum number of inverters online for their system strength service to be considered “available”

The key requirements are to ensure that the reporting of “online inverters” is as precise and accurate as possible. For generators that consume system strength, imprecision or inaccuracy is acceptable if it errs towards over-estimating. But for a system strength service, over-estimating the number of “online inverters” puts power system security at risk; and under-estimating may result in unnecessary constraints on the other generators that depend on the system strength service.

2. **Modular inverters** - Where the inverter comprises multiple modules that may each be individually controlled, blocked, or removed from service, we think that generators should be required to report the number of individual modules, rather than the number of inverters. This could be achieved by amending the definition of “inverter” to reflect the smallest such device or circuit within the plant that can be individually controlled or

disabled. Alternatively, AEMO could clarify in a guideline/procedure how “inverter” should be interpreted for modular inverters.

3. **Online inverters should be directly counted, not estimated** - We believe generators should be required to report a direct count of the number of “online inverters”. We do not believe they should be allowed to provide an estimate/calculation based on the total available power reported by the PPC (power plant controller), to ensure there is no error or uncertainty due to other operational limitations that may affect the total available power. This could be achieved by amending proposed clause S5.2.6.1(b1)(1)(iii) to “(iii) a count of the number of online inverters”. Alternatively, AEMO could set out this requirement in a guideline/procedure. Some generators may need a firmware update to implement this capability, which should be considered and allowed for in the implementation period.
4. **Transition arrangements** - We consider the transition arrangements would benefit from providing sufficient time and clarity for existing facilities to assess, design and implement any required plant modifications. Transgrid understands that AEMO has proposed an 18-month implementation period before the new dispatch instruction provisions apply to existing facilities. Transgrid supports timely implementation given the system security issues the rule change is intended to address. To support efficient implementation, we encourage the AEMC to provide clarity in the final rule on capability requirements, compliance expectations and any supporting procedure changes so that existing participants can implement the requirements efficiently and with greater certainty.
5. **Operational coordination** - We consider the implementation process would benefit from maintaining close coordination between AEMO, network service providers and market participants. Network service providers will continue to have an important role in advising AEMO on inverter limits under particular network, outage and system strength conditions. In this context, the rule change could preserve effective operational coordination and information sharing between AEMO and network service providers, while shifting the direct dispatch obligation for inverter-limit compliance to the relevant participants. The final framework should clearly distinguish between AEMO’s role in issuing dispatch instructions, participants’ responsibility for compliance, and network service providers’ role in providing technical advice on network limits, outage conditions and system strength constraints. This will be particularly important during forced outages, where a contingency event may result in a non-secure state that requires inverter numbers to be reduced quickly to restore security. If inverter dispatch is available, security could be restored through the dispatch process, reducing reliance on manual communications with generators or last-resort action to open breakers at the connection point.
6. **Regulatory interactions** - We encourage the AEMC to consider how the proposed rule will interact with other reforms and operational frameworks relating to system strength, access standards, power system security and the integration of inverter-based resources. In our view, the final framework would benefit from avoiding duplication or inconsistency with existing obligations, while ensuring AEMO has the necessary authority to issue inverter-limit instructions, and monitoring, in a way that is operationally effective and enforceable.

Transgrid considers that implementation should, where possible, build on existing dispatch, connection and operational coordination frameworks rather than create duplicative processes. Where implementation requires participants to provide plant configuration, inverter status or control system information, the framework should ensure that information sharing is limited to what is reasonably required for system security purposes and supported by appropriate confidentiality, data governance and cybersecurity protections.

Transgrid supports the AEMC's consideration of this rule change as a priority reform. The proposed amendments would provide a clearer and more efficient mechanism for managing inverter limits, reduce reliance on manual and emergency operational interventions, support more efficient outage coordination and improve the allocation of scarce system strength resources during constrained operating conditions. These outcomes would support the secure integration of renewable generation and storage and are in the long-term interests of consumers because they support a secure and reliable power system while enabling higher levels of inverter-based resources to connect and operate efficiently.

Transgrid appreciates the opportunity to provide this submission and looks forward to continuing to engage with the AEMC, AEMO, other transmission network service providers and market participants as the rule change progresses. If you would like to discuss this submission, please contact Zainab Dirani, Policy and Advocacy Manager, at zainab.dirani@transgrid.com.au.

Yours sincerely

A handwritten signature in black ink that reads "david hughes" in a cursive, lowercase style.

David Hughes
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