AEMO SSRM, SSISG & PSSG - SMA Consultation Report

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Abbreviations & Definitions

Abbreviations

Term	Definition
AG	Aktiengesellschaft (translation: public limited company)
AU	Australia
GW	Gigawatt
IBR	Inverter Based Resources
NEM	National Electricity Market
R&D	Research and Development
SRC	Short Circuit Ratio

1 Introduction

Inverter based generation is rapidly evolving to support grid stability. This is due to extensive R&D by organisations such as SMA, and continuous improvement guided by experience in deploying and operating a substantial fleet of IBR in advanced sparce power systems such as the Australian NEM.

Over the past 5 years, inverter technology has evolved from a position where it often needed auxiliary equipment such as synchronous condensers in weak grid situations, to now being able to connect and operate without auxiliary plant at short circuit ratios of 1.6 and below at the point of connection.

Looking to the immediate future, extensive investment and effort has been directed towards maturing grid forming technologies which will allow serial, large scale deployment of inverters with the ability to operate in the complete absence of grid stability services from conventional rotating machines.

It is anticipated that initial deployment of large-scale grid forming inverters could occur within 18 months or less, with widespread adoption rapidly following.

Considering this, it is proposed that relevant methodologies for managing "system strength" need to carefully allocate cost and responsibility for "system strength services" requirements to the true causer or user of these services. In this way, correct price signals will incentivise generation and storage developers to deploy equipment that minimises the overall cost of achieving system stability and hence cost to the NEM as a whole.

1.1 Purpose

This document provides an overview of SMA as well as feedback and observations regarding the System Strength Requirements Methodology, System Strength Impact Assessment Guidelines and the Power System Stability Guidelines in accordance with clauses 5.20.6, 4.6.6, 4.3.4 and the Rules consultation procedures in rule 8.9 of the National Electricity Rules (NER).

2 SMA comments and feedback

2.1 P. 8 Paragraph 4:

"Declining minimum operational demand, changing patterns of synchronous generator operation, and rapid uptake of inverter-based resources (IBR) have combined to reduce the levels of system strength required to support stable operation of existing equipment and to host further IBR as the transition to net zero policy objectives continues"

SMA comment: It is the uptake of IBR that utilises grid following, or immature grid forming control algorithms that can cause adverse impacts, not the fundamental characteristics of IBR technology itself. In theory it is mathematically possible to identically replicate the response of a synchronous machine using advanced IBR technology. However, in practice a more efficient solution is likely to differ somewhat from one to one representation, in order to minimise the cost of short term current capability and provide improved transient stability relative to equivalent synchronous machines. Nonetheless, it is important to note that the reliance on external system strength sources is not a fundamental requirement of IBR per-se, rather it is a consequence of using control algorithms other than mature "grid forming" algorithms.

2.2 AEMC rule determination on efficient provision of system strength

This section can be summarised as creating enhanced power system standards aimed at increasing system strength, a minimum access standard for operability of generation of SCR 3.0 and mechanism for centralised planning and charging for "system strength".

It is suggested that the following aspects require careful consideration to ensure that this framework delivers efficient outcomes to the market:

1. The operability of generation of SCR 3.0 is a lax standard and much higher than the capability of mainstream grid following IBR currently under serial deployment in the NEM. This creates a risk of low grade technology being able to connect inefficiently consuming available system strength and so reducing the overall hosting capability of the transmission network. This increases cost for subsequent connection of grid following IBR and hence the NEM as a whole. In the absence of suitable mechanisms to tighten this standard, this risk can be partially mitigated through careful application of the guideline to ensure the cost of connecting equipment with high system strength consumption is efficiently allocated to the relevant generator.

2. The opportunity for monopoly network service providers to market system strength service to connecting parties potentially creates a perverse incentive against working constructively with connecting parties to arrive at efficient, low cost solutions. Likewise, it would appear that network companies are indeed incentivised to progress inefficient central solutions in order to maximise revenue, rather than being motivated to enthusiastically work with connecting parties to find efficient solutions, either self-remediation or avoiding the need for remediation entirely.

In order to mitigate this risk somewhat, it is suggested that the guideline should create a reverse onus of proof on the monopoly network service provider to demonstrate the detailed technical requirement for any "remediation" they identify. Use of coarse approximations such as three phase fault level and "available fault level" methodologies should be explicitly prohibited. The guideline should also ensure that the monopoly network service providers are required to work in good faith, providing a high level of transparency and timely support in progressing and optimising proposals for "self-remediation" or removing the need for remediation entirely.

3. With the emergence of large scale inverter connected storage, the potential for the transmission network to host inverter based technology could increase by multiples of 2-3, as it allows additional renewable energy generators to be matched with IBR storage of a similar capacity. This increase could be much greater if new energy intensive load such as hydrogen production or other industry types locate in the same resource rich areas. If grid following IBR fault level is compensated for with synchronous plant, the fault level is further increased by the contribution of the synchronous plant.

   It is therefore easy to envisage that parts of the transmission network which are currently considered "saturated" from a thermal rating perspective could experience fault levels of over 300% of current levels as capacity opens up by storage installations and load. This creates the risk that generation hosting capability of the network could actually be constrained by fault level rating of equipment.

   As such, close scrutiny would need to be applied to centralised or "self-remediation" proposals involving auxiliary plant, synchronous or otherwise, to ensure that it does not degrade ultimate hosting capacity of the existing transmission network by un-necessarily or inefficiently consuming fault level headroom, or indeed degrading as transient stability modes, as observed already in some areas of the NEM.

3 Conclusion

SMA proposes the use of advanced IBR technology and well developed and robust grid forming control algorithms as a more efficient alternative to increase and guarantee system stability as more IBR are connected to the NEM.

The current maturity level of technology and the ongoing developments that will be ready in the next year, allow for the use of IBR in improving system stability through the provision of system strength to the required levels according to the characteristics of the point of interconnection.