Meeting System Strength Requirements in NSW

30 March 2023

Smart Wires Response

Introduction

Smart Wires are pleased to provide a response to the Transgrid *"Meeting System Strength Requirements in NSW"* RIT-T Project Specification Consultation Report (PSCR).

Smart Wires is a global power technology company enabling the connection and delivery of renewable energy resources worldwide. As the leading provider of modular power flow control solutions in Australia, we are positioned to provide a unique perspective on the ongoing development and optimisation of the grid as the energy transition occurs. Our innovative technology has the potential to improve the network's generator connection capacity while at the same time optimising its thermal transfer capacity. This means enabling greater quantities of renewable generator connections, at a lower cost and with less disruption to communities and the environment.

The nature of system strength in allowing renewable generation to connect to the grid

The PSCR describes the need for additional 'system strength' services required to allow the connection of the large quantity of inverter-based renewable (IBR) generation necessary to maintain generator supply reliability. It is foreseen that a significant number of synchronous condensers (SYNCONs) is expected to be required to provide the necessary levels of system strength to support the generator connections.

As system strength is a network attribute that varies geographically, the locations selected for siting the equipment that will provide system strength services become relevant. The effectiveness of various locations is dependent on their proximity to the main transmission system, in turn relying on the network topology, namely the number and length of connected circuits, to extend the impact and benefits of system strength services to the wider transmission network.

As the PSCR acknowledges, placing all system strength related equipment and services in one single location is not considered optimal, as network impedances reduce the level of system strength over distance and the related benefits subsequently decline. It is, therefore, advantageous to provide system strength at key nodes around the grid that are strategically chosen to optimally support the development of renewable generation.

The establishment of renewable energy zones (REZs) provides suitable locations for siting the equipment that will provide the system strength services that will support the establishment of IBR generation in that area. The development of new lines to strengthen ties between the REZs and the greater transmission network further improves the suitability of these sites for the provision of system strength services.

Extending the reach of system strength to enable increased renewable generator connection

While the responsibility of alleviating forecast shortfalls in system strength has been assigned to the TNSPs, achieving efficiencies of scale through an aggregated and coordinated approach to addressing the system strength shortfall, it is still likely that some IBR generation projects will be limited in the level of MW they can generate due to system strength related constraints defining their connection point

capacity. This could occur where suitable sites for wind or solar generation are located remotely from a REZ or 'strong' point on the network, possibly connected by a weak sub-transmission network or long radial line, so that despite the main backbone of the transmission network having sufficient available system strength, the renewable generator is curtailed due to localised system strength based stability concerns. In such a scenario, by reducing the 'electrical distance' of the connecting network by series compensating the lines with an appropriate technology, the concerns of voltage magnitude regulation, voltage phase angle variation, voltage waveform distortion, and voltage oscillations could be addressed, allowing the MW output of the connecting IBR generator to increase. In essence, this approach would extend the reach of system strength services to a wider geographic area, increasing the potential to harness renewable energy resources at the most viable locations in rural NSW.

Series compensating with SmartValve

While there are concerns with the traditional approach of using fixed series capacitors to provide series compensation in the vicinity of IBR generation due to the potential for various subsynchronous resonant phenomena occurring, the same risks do not present themselves with Smart Wires' modular power flow control (MPFC) technology. As Smart Wires' SmartValve is a FACTS-based solution, based on static series synchronous compensator (SSSC) topology, it can provide the functionality of a series capacitor to reduce series line reactance and decrease system source impedance, but without placing a physical series capacitor on the line the potential for subsynchronous resonance and control interactions to occur is practically eliminated.

The use of the suggested form of series compensation could provide an economic means for a proposed renewable generator to increase the size of a wind or solar farm proposal, eliminating the need for providing their own system strength remediation in the form of a prohibitively expensive local SYNCON, and instead leveraging the more efficient provision of network strength by the TNSP.

We hope that our submission has provided new ideas and insight into how the attributes of FACTS-based series compensation with modular SSSC technology could be employed to provide improved and extended benefits from centralised sources of system strength.

We would welcome the opportunity to meet with you to discuss these opportunities in further detail.

Regards,

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