Managing low inertia in Australian grids

Dr Jenny Riesz[1]
[1]*Australian Energy Market Operator, Brisbane, Australia*

Motivation

Low inertia, related to displacement of synchronous generation by wind and photovoltaics, is now a real and present issue in the Australian National Electricity Market (NEM). A comprehensive work program is underway to address this challenge, including exploring Fast Frequency Response ("synthetic inertia"), and procurement of inertia services.

Problem Statement

The South Australian region, with ~42% of energy now provided by wind and photovoltaics, is now facing a real and present challenge with managing low inertia, related to synchronous plant displacement. If the single AC interconnector fails, and South Australia becomes separated, the Rate of Change of Frequency (RoCoF) can exceed 4Hz/s. This is extreme, and likely beyond the withstand capabilities of many synchronous generators. This means that a stable island cannot be formed, and a separation event leads to cascading failure, and a black system. This creates a real and present risk associated with low system inertia.

Methodology

The Australian Energy Market Operator (AEMO) is addressing this risk in a number of work streams:

- Investigating the RoCoF withstand capabilities of the generators in South Australia, through modelling and analysis.
- Implementing system constraints to limit interconnector flows, and therefore limit RoCoF in the event of separation.
- Exploring the potential for Fast Frequency Response (FFR), also termed "synthetic inertia", to mitigate high RoCoF in future. This will include trials of these services from wind farms, and possibly batteries.
- Investigating international experiences, including establishing collaboration with EirGrid in Ireland (managing similar issues with RoCoF).
- Calculating future RoCoF exposure, to screen for potential emerging risks
- Developing a Special Protection Scheme to prevent the separation of the South Australian system, by rapidly tripping load to correct a large system imbalance.
- Reviewing and updating frequency control frameworks.
- Reviewing and updating generator technical standards for connections.

Results

Work programs are ongoing. To date, it has been shown that RoCoF withstand capabilities may be lower than expected, and may be as low as 0.5Hz/s in some cases. There are many issues that require further exploration, and this work is progressing. Fast Frequency Response may offer a valuable solution in future, contributing to faster frequency control, and providing a more efficient method for meeting the Frequency Operating Standards in future. However, there are many nuances that will need to be addressed. For example, the "recovery period" from wind generation will need to be carefully managed, to ensure sufficient frequency response from other providers in those timeframes. The control methodologies will also need to be carefully specified, to ensure an adequately rapid response, but also a robust and stable recovery. AEMO is working with the Australian Energy Market Commission to define frameworks for procurement of these services in future.

Conclusions

Low inertia systems (due to displacement of synchronous generation by wind and PV) create new challenges related to high Rate of Change of Frequency (RoCoF). These challenges will require innovative approaches, which are now being explored in a small number of power systems internationally, such as the Australian NEM.