

Frequency Control in the NEM: issues and opportunities

Workshop Outcomes Melbourne, 19 April 2017

Overview

On 19 April 2017 the Clean Energy Council (CEC) held a workshop with 55 Corporate and Sponsoring CEC members and observers from key government and industry organisations. The workshop attendees and speakers consisted of leading local and international experts on frequency control. It took a deep dive into the frequency control regime in the National Electricity Market (NEM), examined the pros and cons of the current arrangements, and explored major flaws and opportunities for improvement that encompass the latest and emerging technologies.

The workshop invitation, agenda and registered attendees list is in the Appendices of this note for reference.

The presentations and discussion highlighted that CEC members have little faith in the existing frequency control regime and are concerned that it is not delivering appropriate technical or economic outcomes for electricity consumers. Workshop attendees also raised a significant concern that the existing regime provides an unsound footing to develop new markets and introduce new fast-acting frequency control measures from new technologies, such as battery storage.

The objective of the workshop included:

- Listen, learn, understand and discuss the current regime design and challenges it presents.
- Challenge the existing regime in its treatment of new technologies.
- Consider opportunities for improvement to embrace new technologies and solutions.
- Decide upon a preferred path forwards for a frequency control regime that addresses the issues and encourages new technologies to participate.
- Consider the avenues for the CEC and members to pursue this outcome.

The main highlights from the discussion are listed below.

FCAS market design has undermined system security

The most significant concern raised by members relates to the design of the current FCAS regime which embodies incentives for operators of conventional synchronous generators to disable the primary governor control. The outcome is a relaxation of governor deadband settings which has led to undesirable operating conditions that threaten energy security.

It is becoming increasingly evident that FCAS alone cannot support frequency within the normal operating frequency band. However, the current framework would also penalise any new entrant technology that attempted to operate within the normal operating frequency band, when not enabled for frequency raise or lower services.

One of the implications of these settings is that the system security modelling and planning studies that AEMO undertakes do not consider governor deadband settings, despite these settings potentially changing with every dispatch interval. This undermines the accuracy of the planning studies.

Solution needed: The key action to address this issue was to ensure that governor settings on synchronous generators around the NEM are regulated to some level consistent with good electricity industry practice. This is a fundamental issue, and needs to be addressed prior to the introduction of new markets for faster responses.

Actions: AEMO is looking to understand this issue in more detail before committing to move it forward.

Mandatory frequency control capability for new entrants

Overseas markets and recent movements from AEMO indicate that mandatory capability for frequency control will soon be considered in the NEM. This capability would require reconsideration of the operational and contractual positions of new generation projects which are required to incorporate the capability. Even if a generator has the *capability*, the market is expected to remain the driver for enabling this function.

Serious consideration should be given to the level of inefficiency in the operation of the FCAS market at present and the potential implications for new entrants to this market. These inefficiencies should be addressed as a matter of priority.

Solutions needed: Retrofitting this capability is technically and contractually problematic, high cost and undesirable. However, new developments should be encouraged to consider this capability.

Actions: Project developers need to consider the costs, risks and opportunities of implementing this change including from an operational and power purchase agreement perspective. CEC members should continue to advise the CEC on areas where major challenges arise such that they can be addressed.

Renewable energy generation developers need to be proactive

To date, there have not been strong incentives to participate in the NEM's eight frequency control markets, and technical barriers to entry for participation have existed. However, these conditions are changing, with small changes to the technical requirements and economic drivers, and increased capability of generation and storage capability.

Solution needed: Renewable energy developers need to ensure that they are prepared to incorporate the technical capability into their operational and contractual positions going forward.

Actions: In order to be proactive, renewable energy developers should consider the following:

- Analysis of Causer Pays Factors in their project economic modelling
- Install adequate control systems and capability
- Be prepared to capture, interrogate and understand market data
- Implement the new 'expected power' function that can override AEMO's wind and solar forecasting, placing an operational focus on the generator rather than a set and forget focus
- Participate in FCAS as far as possible

In progressing these actions, CEC members are encouraged to identify and report on any barriers or challenges to AEMO and the CEC, so that we can advocate on behalf of the industry.

Fast Frequency Response needs to be part of the NEM's frequency control regime

Although there is not a great deal of knowledge about this technology in the NEM, the technology is capable and there is a significant and growing body of experience in overseas markets. The NEM needs to adopt appropriate requirements and standards for fast frequency response from renewable energy and energy storage equipment. Diversity in system security services will be a necessary part of a resilient future NEM.

In making progress on this issue, it is critical that the market recognises that potential requirements for minimum levels of inertia must remain adaptable. It is also critical to ensure that new technologies are not locked out of these solutions by standards that limit the scope for future capabilities. For example, if a standard focusses on a fixed response time then this will dictate the technology capability, rather than creating opportunities for new technologies to support the system in new and more effective ways.

Solutions needed: The AEMC and AEMO need to ensure that new system standards or performance standards are flexible and reward actions based on meeting the needs of the power system, not specific thresholds or levels.

Actions: CEC to continue to promote these approaches to standards, especially in the context of the AEMC's System Security Market Frameworks Review and other reviews.

International practices should be considered

The workshop heard from Nick Miller (GE consulting) with regards to the frequency control regimes in North America. These markets offer a good insight into practices in place to control frequency and to manage power system security across regions. They show how generator governors are used as the primary frequency control unit and how the incentive regime for frequency control offers the secondary control mechanism through automatic generator control (AGC). These control mechanisms go hand in hand to keep frequency within the normal operating range. The primary response is mandatory and automatic. Capability for secondary response is mandatory however, a market provides the economic incentive to bring the right volume online at the right times.

North American frequency control markets are now also incentivising faster and more accurate responses from any technologies, in recognition that new technologies such as energy storage or demand response can respond faster and with improved accuracy over conventional generation responses.

North American markets also interrogate every generator for performance following a system event (like a major fault or disturbance). The market operator has to ensure that the frequency is returned to the normal operating range within a designated time. Measurement of performance avoids the frequency nadir because this varies across the grid.

Solutions needed: The CEC needs to ensure that these solutions are considered in light of the changes going on the NEM.

Actions: CEC recommends a continued open dialogue on options that may be adopted in the NEM.

The Australian Wind Energy Forecasting System should be revised

AWEFS was designed to forecast wind resources on diurnal and weekly timescales. The system has since been adapted by AEMO to estimate generation at wind farm sites in the dispatch timeframe (5 minutes ahead). Errors in AWEFS flow through to increased frequency regulation requirements. While the current approach may have been adequate with low wind penetrations and low FCAS costs current market conditions mean errors introduced by AWEFS now have significant consequences on the market.

Solution needed: The AWEFS scheme needs to be reviewed and brought into line with international best practices of mesoscale wind forecasting in the dispatch timeframe at wind farm sites.

Actions: CEC to advocate for this review to take place. In lieu of this review taking place, CEC members should consider implementing the new 'expected power' function in order to override the AWEFS' generated set points as this is the most immediately accessible option for generator operators to manage risk.

The 35 MW FCAS regulation constraint in South Australia needs to be reviewed

This 35 MW regulation FCAS constraint has been invoked during periods of credible contingency for the loss of the Heywood interconnector. Since then, other constraints have been introduced that reduce the potential impact of the loss of the interconnector. These include the requirement to have at least two synchronous units online and the reduction of flows on Heywood to 50 MW in the case of a credible contingency.

However, the 35 MW FCAS constraint has not been revised, despite it having a significant impact on the South Australian economy and forcing dramatic increases in FCAS regulation costs.

Solution needed: AEMO needs to revise its assessment of the level of FCAS needed in SA. Should this not happen, AEMO should be releasing its studies to show that this level is still required following the creation of the additional constraints.

Actions: CEC to advocate for a revision / justification of this requirement going forward.

Ancillary Services unbundling will drive opportunities for innovation

From 1 July 2017 the coupling of ancillary services with electricity retailers will be removed. This change will enable storage and demand response providers to aggregate and offer frequency services to AEMO. It will remove barriers to aggregated energy storage and electric vehicle control amongst other innovative and independently operated solutions into the frequency control market.

Solutions needed: CEC members should consider how this change will enable their business model to play a more active role in participating in the NEM's ancillary services markets.

Actions: CEC members to review business models in light of this reform following 1 July 2017.

Virtual Power Plants should be promoted in the NEM

Significant growth is anticipated in the small scale generation and energy storage. Although small in individual size it is no longer possible to consider these systems as low-impact, passive technologies in this way because the aggregated capacity can be significant.

As these systems continue to grow in number it becomes increasingly important to encourage them to operate in ways that support the broader power system. While the concept of a virtual power plant is one way to do this the FCAS regime currently discourages small capacity participants such as these from contributing. This is largely due to a registration threshold that is based on FCAS bid capacities arbitrarily set to integers of 1 MW.

Since small-scale technologies are usually deployed for other motives these solutions would be able to provide low cost ancillary services. Yet, the threshold means that a virtual power plant operator would require a very large volume of generation or storage before registering this capacity for FCAS. A more efficient approach would encourage participation from earlier on the development of the virtual power plant. This would lead to a more competitive FCAS market and more efficient use of electricity infrastructure.

Solutions needed: The market rules that set the registration threshold to 1 MW need to be revisited to encourage participants to register battery capacities that provide essential system support services.

Actions: CEC to advocate for changes to the National Electricity Rules to reform the registration threshold for virtual power plants to provide ancillary services.

Appendix 1: Workshop invitation

The CEC is inviting members, key local and international experts and representatives from electricity market institutions to attend a workshop on frequency control in the National Electricity Market (NEM).

Thank you to those who have already registered to attend this event. The event will now be taking place at AECOM, Collins Square, Level 10, Tower Two, 727 Collins Street, Melbourne.

The workshop will look closely at the pros and cons of the current Frequency Control Ancillary Services (FCAS) arrangements, highlighting major flaws and opportunities for improvement in order to incorporate the latest and emerging technologies. It will take a deep dive into the NEM's frequency control regime in order to inform the objectives of key reforms needed to enable the integration of new technologies such as fast frequency response from battery storage or wind turbines.

See below for event details or visit our website for full details including the agenda and speakers.

Date: Thursday, 20 April

Time: 8.45am for 9.00am start. Conclude by 2.30pm (lunch included)

Venue: AECOM, Collins Square, Level 10, Tower Two, 727 Collins Street, Melbourne

Cost: FREE for Sponsoring and Corporate CEC members (limit 2 per company)

Note: Places are limited so register early.

Some of the issues to be discussed at the workshop will include:

- Market signals that have not delivered new frequency control capability, but have led to an intervention from the Australian Energy Market Operator.
- Causer-pays factors that are not representative of the actual impact that generators have on frequency.
- The impact of significant long-term errors in the integration of wind energy forecasts into the frequency control regime.
- The identification of and solutions to potential threats to power system security due to incentives created for relaxed frequency control parameters in synchronous generators.
- The source and impact of dramatic cost increases for market participants over the last year.

Join us for an opportunity to hear from local and international experts on the major flaws and opportunities for improvement needed to remove barriers to new technologies providing frequency services in the NEM.

Appendix 2: Agenda

Workshop: Frequency control in the NEM

Agenda

9:00am – 2:30 pm Thursday 20th April 2017
 AECOM, Collins Square, Level 10, Tower Two, 727 Collins
 Street, Melbourne



	Presentation topic	Start	Speaker
1.	Welcome and introduction	9.00am	Tom Butler (Clean Energy Council)
2.	Frequency control philosophy and outcomes	9.15am	Kate Summers (Pacific Hydro)
	Morning tea	10.00am	
3.	Global perspective of frequency control practices and view of the NEM (via webinar)	10.15am	Nick Millar (GE Consulting)
4.	Causer pays and the integration of renewable energy and frequency control in the NEM	11.00am	Jonathan Dyson (Greenview Consulting)
5.	New technology capabilities and opportunities	12.00pm	Josef Tadich (Tesla)
	Lunch	12.30pm	
6.	Discussion: Opportunities and actions for the CEC and industry	1.15pm	All
	Workshop close	2.30pm	

Appendix 3: Registered attendees

Company	Invitee
ABB Australia	Juergen Zimmermann
ABB Australia	Craig Blizard
ABB Australia	Simon de Bell
Acciona	Bryan McCarthy
Acciona	Peter Veljkovic
AECOM Australia Pty Ltd	Rajesh Arora
AEMC (observer)	Julian Eggleston
AEMC (observer)	Andrew Truswell
AEMC (observer)	Suzanne Falvi
AEMO (observer)	Michael Bagot
AEMO (observer)	James Lindley
AGL Energy Ltd	Liz Gharghori
AGL Energy Ltd	Luke Shortal
APA	paul wheelodn
AusNet Services	Jacqueline Bridge
Canadian Solar (Australia) Inc.	Yu Chan
Clean Energy Council	Tom Butler
Clean Energy Council	Emma White
Clean Energy Regulator	Geoff Houen
Clean Energy Regulator	Gurdip Sahota
Commonwealth Bank	Charles Davis
CWP Renewables Pty Ltd	Mike Middleton
CWPR	Rowan Rogers
Downer	Himanshu Upadhyay
Downer Utilities Pty Ltd	Dev Randhawa
EA	Victor Petrovski
Eclectic.Engineering	Michael Hayes
ElectraNet	Chris Tansell
ElectraNet	Wen-Cheng Huang
Energy Australia	Leila Ngadi
Energy Australia	Barend Van Der Poll
Energy Australia	Naresh David
Energy Power Systems Australia	Phil Canning
Enphase Energy	Piers Morton
Enphase Energy	Andrew Mitchell
Fronius Australia	Rod Dewar
Fronius Australia	Marcus Funken
GE International Inc.	Peter Cowling
GE International Inc.	Ragu Balanathan
GHD Pty Ltd	Chandra Kumble

Herbert Smith Freehills	Daniel Lau
Herbert Smith Freehills	Stephanie Garnham
Hydro Tasmania	Marian Piekutowski
Individual	Killian Wentrup
Jemena Limited	Erika Twining
Jemena Limited	Nicole Walker
Kawa Australia Pty Limited T/a Conergy	Inka Heile
Monash University	Behrooz Bahrani
NAB	Andrew W. Smith
NEOEN Australia Pty Ltd	Louis Blateau
NEOEN Australia Pty Ltd	Alexander Craw
Pacific Hydro Limited	Darren Sexton
Pacific Hydro Limited	Meredith Anderson
Pacific Hydro Limited	Ryan Jennings
Pacific Hydro Limited	Rachael Cox
PwC	Charlie Grover
RES Australia Pty Ltd	Justin Howes
S&C Electric Company	Jill Caine
Snowy Hydro Limited	Kevin Ly
South Australian Government (observer)	Abe Abdallah
Suzlon Energy Australia	venkatesh madaswamy
Suzlon Energy Australia	M Umair Habib
Tesla Motors Australia Pty Ltd	Emma Fagan
Windlab Limited	Dave Osmond
Windlab Limited	Shaun Blackie