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Sebastien Henry
Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

Our Ref: 02418-005947

9 February 2017

Dear Sebastien,

Re: RES submission to System Security Market Frameworks Review - Interim Report

We would like to thank you for the opportunity to submit to the AEMC's review. RES is active in markets that have significant depth of fast frequency assets and would like to present some views on the comparative technologies considered in the AEMC's review.

It is clear that a key report consideration is the initial rate of change of frequency (RoCoF). RES agrees and supports the intention to review market mechanisms from a technology neutral perspective. However, we believe that report presents a technology biased view which runs the risk of developing an inferior outcome for consumers. RES suggests a RoCoF Support Service mechanism which opens procurement to a broad range of technologies as they develop and mature as well as recognise the different contribution to supporting RoCoF levels of each technology. Please refer to the attached document supporting these views.

RES would be pleased to discuss any of the raised points further with the AEMC as it further considers its review.

Yours sincerely,

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Introduction

The following is in response to the AEMC System Security Market Frameworks Review Interim Report published 15th of December 2016.

RES submits the following points for consideration:

1. The interim report demonstrates a technology bias towards inertia. RES believes the current direction is not consistent with the objective of the AEMC System Security Market Frameworks Review to remain technology neutral.
2. RES believes and demonstrates below that Fast Frequency Response (FFR) is a very effective method providing RoCoF support and can provide a great breadth of associated benefits.
3. Any market or process designed to procure RoCoF Support Services must be technology neutral. RES believes the use of a performance factor for relevant plant will ensure such a RoCoF Support Service will remain relevant and effective in the future.
4. RES' view is that system strength is typically a localised issue that should be managed by Network Service Providers through existing frameworks such as the Regulatory Investment Test.

ROCOF Support Service

Central to the AEMC review is the management of various RoCoF scenarios. The description of RoCoF varies, so RES will use the definition of RoCoF as measured over 500ms. The empirical description broadly used to describe RoCoF, and that used in the interim report Box 2.1 is per below

$$ROCOF = \frac{Frequency\ (50Hz)}{2} \times \frac{\Delta P\ [contingency\ size\ (MW)]}{H\ [system\ inertia\ (MW.s)]}$$

This equation demonstrates that ROCOF is increased with larger sized contingency events and is reduced with increased levels of system inertia. The AEMC recognises that fast frequency response (FFR) acts to reduce the contingency size. The below figure illustrates the impact of FFR contribution to management of RoCoF.

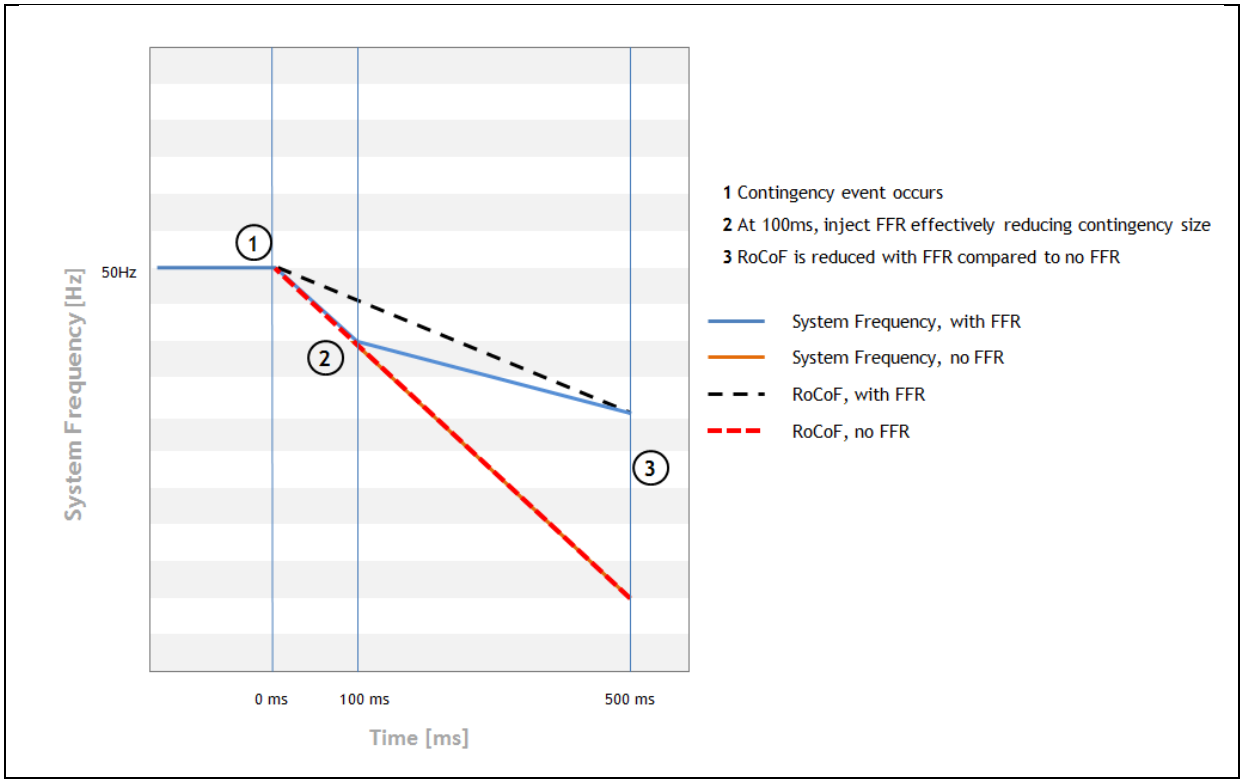


Figure 1. Illustration of FFR contribution to managing initial rate of change of frequency to a contingent event.

Figure 4 of the interim report partially recognises this point, and points to an initial delay for triggering the FFR response which is the case where FFR is looking to directly parallel the operation of inertia. Section 3.3.1 of the interim report suggests the time delay of FFR discounts its usefulness in addressing RoCoF. RES has looked at this relationship in the following analysis and we believe discounting of FFR to be technology biased rather than neutral.

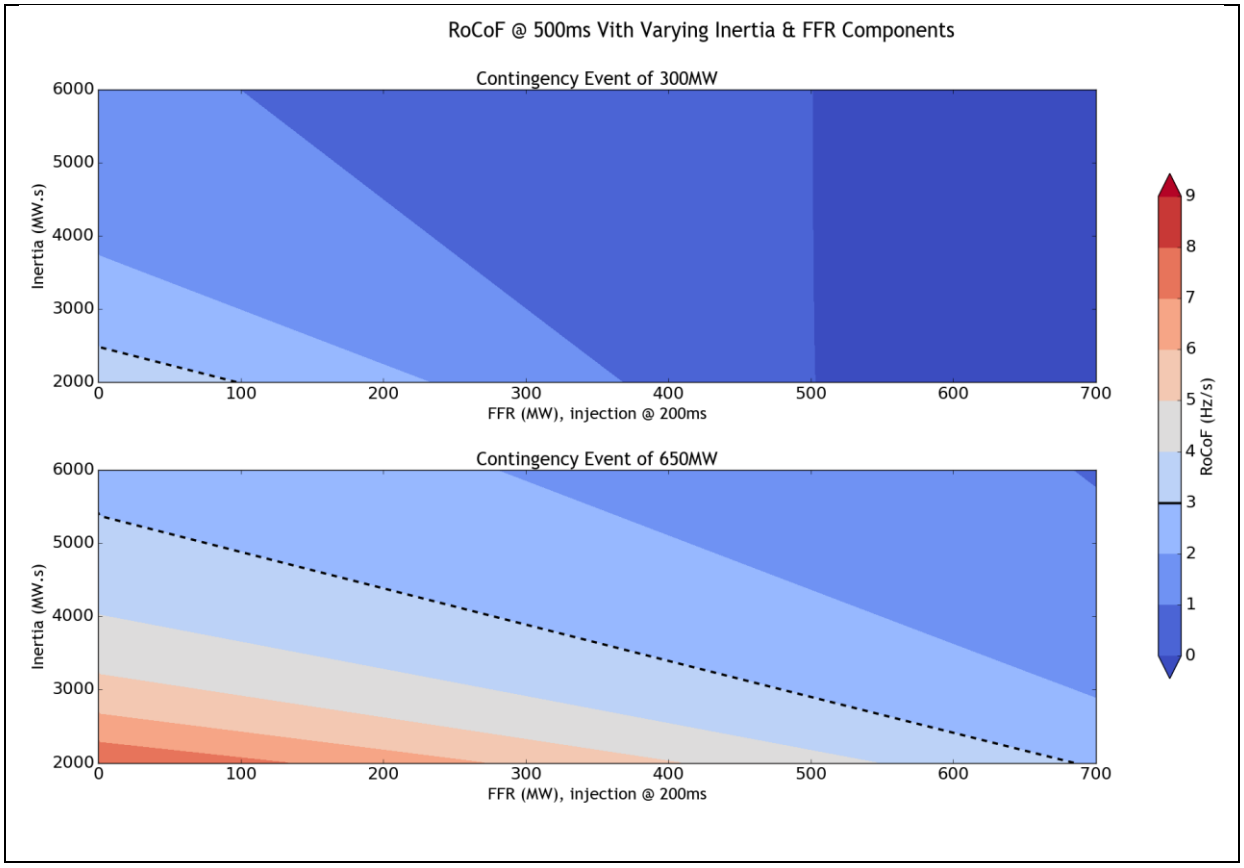


Figure 2. Comparison of different RoCoF levels at varying quantities of inertia and FFR for contingency sizes of 300MW and 650MW.

In the above Figure 2, the interplay between FFR and inertia for a relatively long frequency detection delay time of 200ms is examined. As the FFR compensates for the RoCoF equation ΔP term, it can be seen to have demonstrated impacts on RoCoF outcomes. RES's work in this area to date shows us that response times of less than 100ms are achievable with existing commonly utilised network hardware and communications. To understand the impacts of reducing the response times, Figure 3 below looks at a very significant contingency event size of 650MW (larger than Victoria's 600MW largest credible contingency) and the reduced requirement of FFR to achieve reasonable RoCoF outcomes. This shows that targeting the delay times can drastically reduce the level of FFR required for similar RoCoF outcomes.

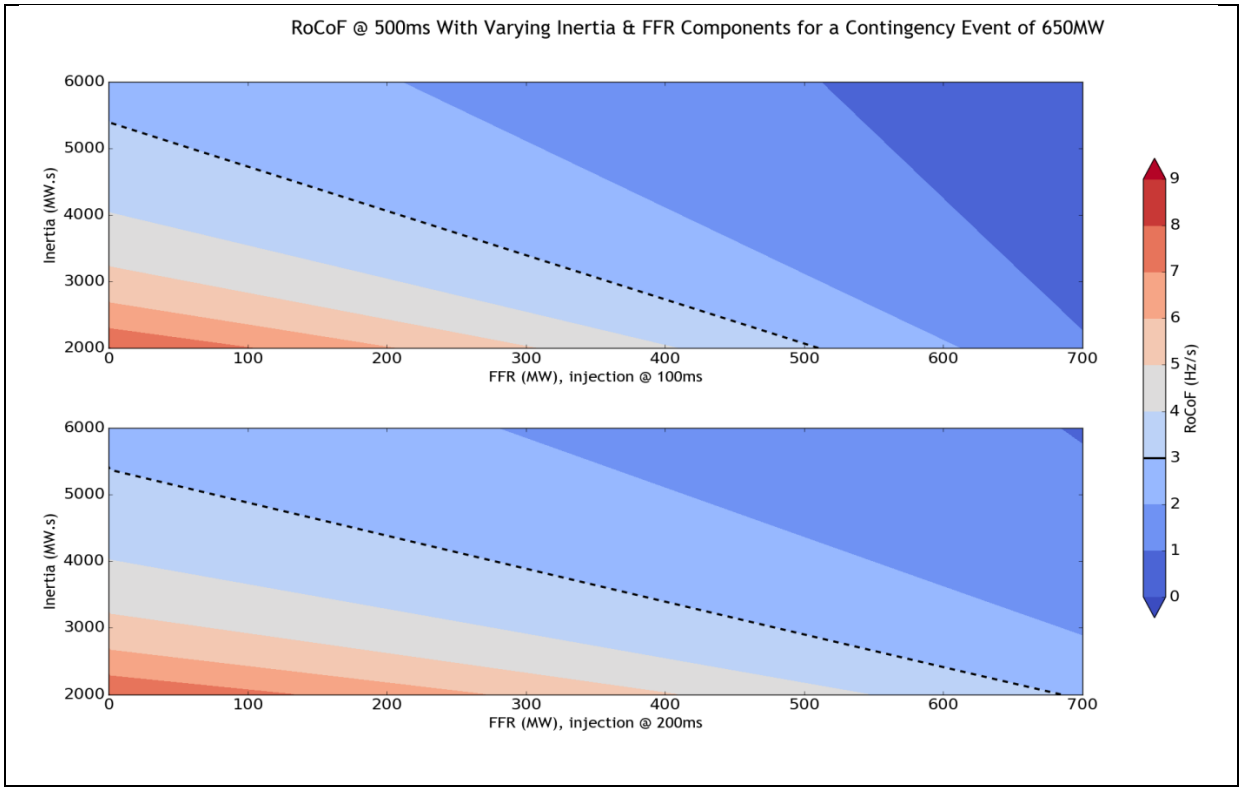


Figure 3. Comparison of relative impact of response times on RoCoF for a significant contingency event of 650MW.

To put the above analyses into some form of context, RES has examined the implications of managing a 3 Hz/s RoCoF with varying levels of inertia (synchronous condensers) and FFR (battery based energy storage). Indicative capital cost costs for synchronous condensers ('syncons') have been derived from the AusNet Transmission Revenue Review 2017-2022[1] as $70million for replacement of 225MVA of syncons, which equates to a per unit cost of $311k/MW.s. RES has used internal benchmarking on 2018 FFR delivery of $300k/MW. The results of this analysis, in Figure 4 below, shows that there are significantly higher cost implications for favouring inertia which are ultimately borne by consumers.

[1] Transmission Revenue Review 2017-2022 – October 2015, AusNet Transmission Group

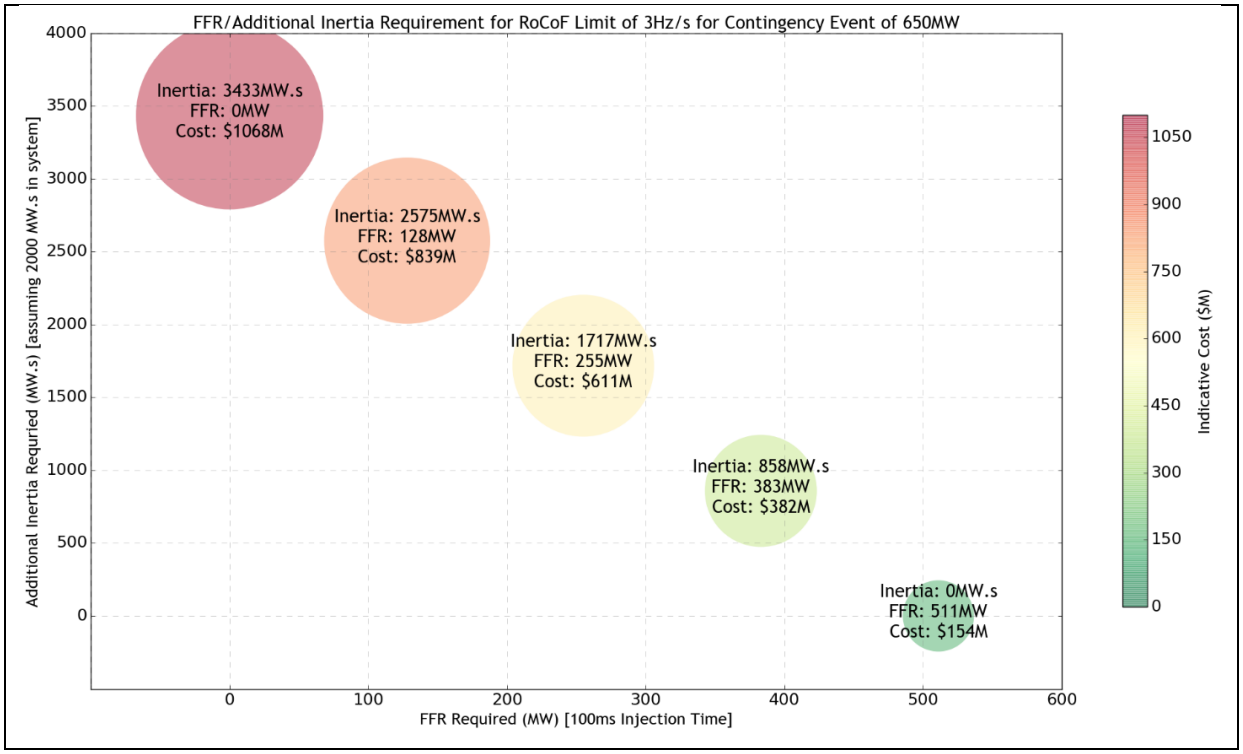


Figure 4. CAPEX comparison for varying blends of additional inertia and FFR to maintaining a 3 Hz/s RoCoF. (Note: Base inertia of 2000 MW.s)

What is not shown in the above analysis is the flexibility of energy storage as an FFR source where the RoCoF related service may be only one of many revenue streams (e.g. regulation and contingency FCAS and arbitrage). To illustrate this, the energy content requirement for responding to a RoCoF for 2 seconds at 100MW is only 56kWh. As such, the required buffer to the energy storage is very low and allows the batteries to be used in providing other services. Therefore, the CAPEX comparison above potentially underplays the cost difference for service. Additionally, the ability of FFR technology to provide multiple services will increase the depth of competition in other markets such as FCAS and SRAS, lowering costs to consumers.

To limit the conversation to inertia risks locking in future cost commitments which ultimately offer very narrow benefits. RES believes there is a significant level of interplay between inertia and FFR and accordingly any services procured should reflect the intended purpose - managing RoCoF. We believe such a service should enable any relevant technologies to participate and provide a method of ranking/factoring the relative merits of each technology into the payment mechanism. This could include a multiplier based on actual performance, and parallels the thinking behind the PJM performance score which has been successfully implemented for regulation services. The design and implementation of a RoCoF support service in this way would be technology neutral and the ranking factors can be tailored with time as the composition of the national generation fleet evolves.

System Strength

Combining system strength with inertia significantly constrains the market for any potential services and again becomes technology biased. System strength issues arise locally and are more appropriately managed by the network planner. Attributing the responsibility of system strength to new connecting

parties is an inferior outcome due to the ability of other parties to impact the system strength going forward – such as the AEMC example of retiring generators.

It is RES' view that management of system strength best sits with the network planner, as it would with any of its other planning responsibilities, and be subject to the RIT-T or RIT-D process.

Acquisition of services and cost recovery

The previous analysis, particularly Figure 4, illustrates that the volume of RoCoF Support Service capacity (referencing FFR) required would be similar to that which is currently procured through the ancillary services markets. It is RES' view that procurement of such services through an open market would serve consumers well. However, and as stated in the interim report, investors would look for a level of revenue certainty prior to investment. RES supports the view of a staged initial procurement program of limited tenor (e.g. 5 years) contracts be undertaken by AEMO of a RoCoF Support Service to assist in developing the market, transitioning to a 5 minute market. This would ensure services are efficiently procured both in terms of volume and price after the initial procurement rounds expire.

RES OVERVIEW

BACKGROUND

RES is owned by the Sir Robert McAlpine family company that has been in continuous operation since 1869.

Key characteristics:

- RES Limited established in the early 1980s.
- RES has developed and/or built over **12,000MW** of renewable generation capacity worldwide.
- RES Australia Pty Ltd is a wholly owned subsidiary of RES Limited and has been operating in Australia since 2003 with a focus on wind, solar and energy storage.
- RES Australia has developed the **107MW** Taralga Wind Farm, the **242MW** Ararat Wind Farm to financial close.
- RES Australia is significantly advanced in the development of the **116 turbine** Murra Warra wind farm in Victoria and the **175MW**+ Twin Creek wind farm and energy park in South Australia.
- Over **1GW** of other wind, solar and energy storage projects in development in Australia.

ENERGY STORAGE EXPERIENCE AND CAPABILITY

RES has taken an early leadership position in the industry and we have purposefully developed and/or won a broad range of reference energy storage projects that we can now point to:

> 16 energy storage projects

> Over 147MW completed or contracted worldwide

> 10+ storage functions demonstrated with resolve

> 6 different battery vendors

> Experience with 4 PCS suppliers

> 8 different electricity markets and system operators

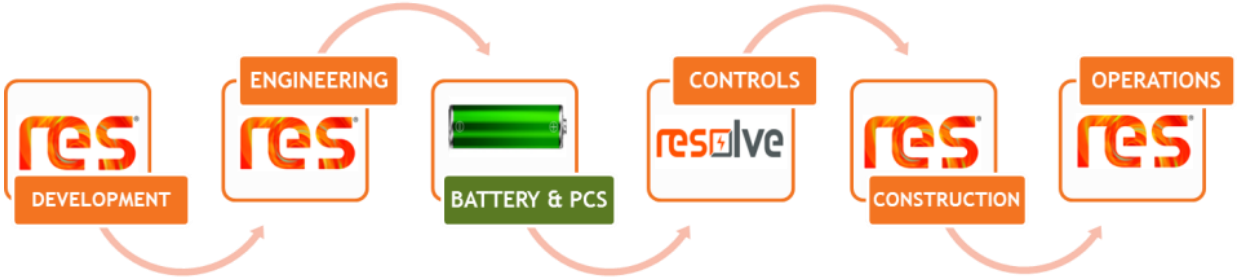
> Due diligence by 3 utilities and 5 financial investors

> First non-recourse debt financing of energy storage

> Named as Top 2 global player by Navigant

> 31% US market share of constructed MW's in 2015

> Winner of 25% of UK National Grid EFR tender



The following projects demonstrate RES' capability and experience:

NAME	FUNCTION	MARKET	MW	MWh	OWNER(S)	OWNER TYPE	RES ROLE	resolve	COD
BUO	Freq. Reg.	PJM	4.0	2.6	RES	IPP	Dev, EPC, Own, Asset Manage	Yes	2014 Q1
Amphora	Freq. Reg.	IESO	4.0	2.6	RES	IPP	Dev, EPC, Own, Asset Manage	Yes	2014 Q3
Jake	Freq. Reg.	PJM	19.8	7.9	RES + Prudential	IPP/Investor	EPC, Own, Asset Manage	Yes	2015 Q3
Elwood	Freq. Reg.	PJM	19.8	7.9	RES + Prudential	IPP/Investor	EPC, Own, Asset Manage	Yes	2015 Q4
Willey	Freq. Reg.	PJM	6.0	2.0	Sumitomo Corp.	Investor	Dev, BOP, Asset Manage	Yes	2015 Q4
McHenry	Freq. Reg.	PJM	19.8	7.9	EDF	IPP	EPC	No	2016 Q1
Glacier	Microgrid +	WECC	2.0	4.4	Puget Sound Energy	Utility	EPC	No	2016 Q3
Higher Hill	9 grid/solar apps.	Great Britain	0.3	0.6	WPD	Utility	EPC	Yes	2016 Q3
Clinton	Freq. Reg.	PJM	10.0	4.1	Exelon	IPP	Dev, EPC, Asset Manage	Yes	2016 Q3
M5Bat	Multiple	Germany	0.7	0.7	RWTH	Research	EPC	No	2016 Q3
Technocentre	Multiple	Hydro-Québec	0.2	0.3	TechnoCentre éolien	Research	EPC	No	2016 Q4
Campo 1	Solar shifting	CAISO	2.0	4.0	Southern Company	IPP	EPC, Asset Manage	Yes	2017 Q2
BQDM	T&D Deferral	NYISO	2.0	12.0	Consolidated Edison	Utility	EPC	Yes	2017 Q3
Broxburn	Freq. Response	Great Britain	20.0	(16.0)	TBD	TBD	Dev, EPC, Asset Manage	Yes	2017 Q3
Port of Tyne	Freq. Response	Great Britain	35.0	(23.0)	TBD	TBD	Dev, EPC, Asset Manage	Yes	2018 Q1
NREL	Multiple	WECC	1.0	1.0	NREL	Research	EPC	Yes	2017 Q2
		TOTAL:	**147**	**97**				**12**