



WOOLNORTH
WIND FARMS

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17th January 2019

Mr Brian Spalding
Reliability Panel Chairman and AEMC Commissioner
Australian Energy Market Commission (AEMC)
PO Box A2449
Sydney South NSW 1235

Via electronic submission – REL0065

Dear Mr Spalding,

Review of the Frequency Operating Standard – REL0065 Stage 2 review - Woolnorth Submission

Woolnorth Wind Farms appreciates the opportunity to provide comments on the *draft report – Review of the Frequency Operating Standards – Stage Two* published by the Reliability Panel on the 6th December 2018.

Woolnorth owns, operates and maintains three large scale wind farms in Tasmania at Bluff Point, Studland Bay (WNWF) and Musselroe (MRWF) with an installed capacity of 308 Mw. Annually the portfolio generates approximately 10 percent of Tasmania's electricity needs and up to 33 percent during peak wind generation across the state.

The proposed changes, specifically around the definition of a *generation event* poses a significant impact to the economic viability of our business and Woolnorth provides the following report to support further discussions on the issues identified.

As a stakeholder Woolnorth seeks to be included into any ongoing discussions related to changes in the operating environment.

If you require further information in relation to our submission, please contact Rick Haines (Engineering and Projects Manager) on 0429 320 240 or via email rick.haines@woolnorthwind.com.au

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Submission overview

Woolnorth Wind Farm Holdings Pty Ltd (Woolnorth), as owner and operator of the two largest windfarm systems in Tasmania (Musselroe, Bluff Point and Studland Bay Wind Farms), has a keen interest in the application and management of the Frequency Operating Standard in Tasmania (TFOS) and appreciates the opportunity to provide this report.

The proposed *generator event* definition amendment related to the 144 MW limit on the largest generator in the Tasmanian Power system has serious and substantial financial implications for Woolnorth that have prompted this submission.

Woolnorth is appreciative that the AEMC and TasNetworks have contemplated legacy considerations noting that Musselroe wind Farm (Musselroe) has not implemented a Generator Contingency Scheme (GCS) and to date has not been required to do so. Woolnorth does not support a retrospective application of the 144 MW limit being applied to Musselroe based on the in-service analysis of its performance and the frequency response to generator and network events since commissioning in 2013.

Highlighted in the following submission Woolnorth has also identified many other aspects that need further consideration in the application of the TFOS.

Woolnorth contends that while the inclusion of the dedicated connection asset (DCA) to the assessment and definition of a *generator event* is appropriate for new connections the existing limit of 144 MW is not appropriate under all circumstances. This view is based on the historical performance of the wind farms, network responses, changes in the raise services availability and contributing factors around existing management of the FCAS requirement.

This report is broken into three key elements:

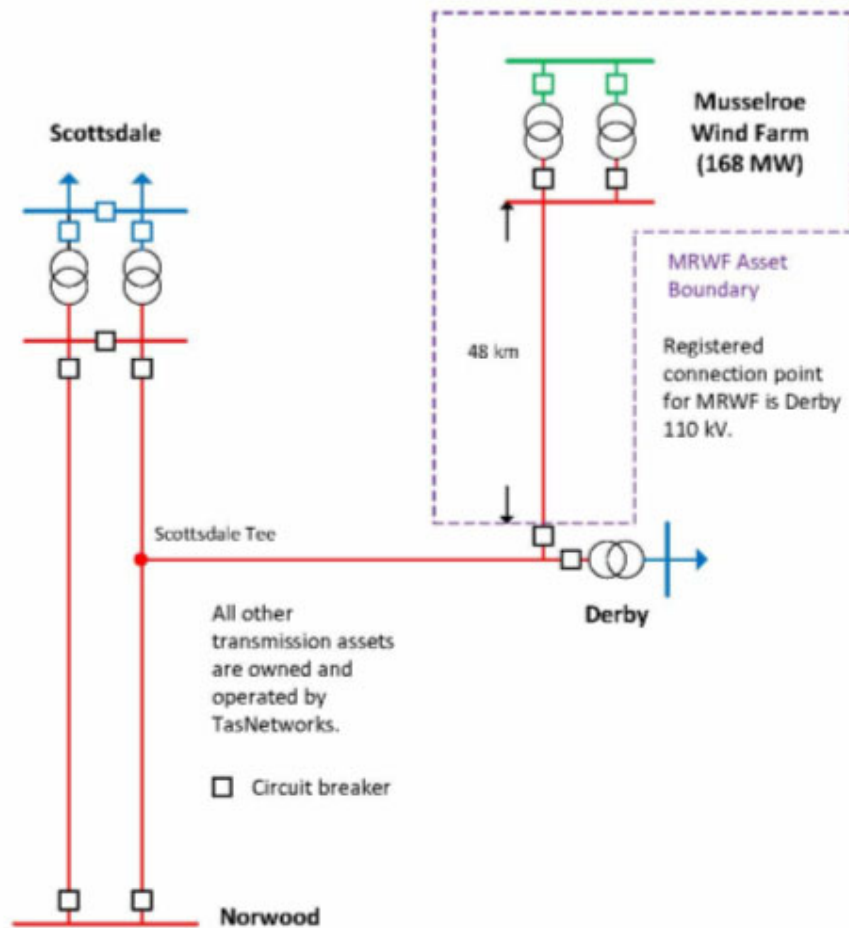
1. Impact
2. Historical system and market events and their impact;
3. Wider legacy and frequency control issues;

1. Impact

Woolnorth has reviewed and assessed the upper MW limit for the largest generation event and has the following information to support consideration of either rewording the term “generation event” or an exclusion to allow Musselroe to generate at its installed capacity under normal network configurations.

Up until 1 July 2018 the connection arrangement for Musselroe wind incorporates duplicate transformers to reduce the size of a credible contingency impacting the generating system to below 144MW.

Furthermore, under the current FOS, a trip of the Musselroe — Derby line is considered to be a *network event* not a *generation event* and the limit on the size of a generation event did not apply for the credible loss of this line.



Source: TasNetworks

The proposed rewording of a *generation event* effectively places a permanent restriction on the generation at Musselroe of 144 MW at its connection point.

A limit of 144 MW at the connection point represents up to 16 MW reduction to the peak metered generation capability. The estimated revenue loss has been calculated and coupled with costs associated with implementation of a GCS the future viability of the business is not sustainable¹. Equally the current FCAS enablement project at Musselroe would be impacted.

Woolnorth has undertaken a review of several events and provides the following observations.

¹ Every 5-minute interval since Musselroe was commissioned in 2013 was assessed for its total generation as measured by AEMO at the 110kV bus. Calculations include the average losses on the MRWF-DE Transmission Line. Confidential financial outcomes have not been included in this Report.



2. Historical events and their impact

System events

Musselroe was commissioned in 2013 with an installed capacity of 168 MW as measured at the generator terminals. A review of several contingency and market events demonstrates that the network, if appropriately configured, can cope with the loss of Musselroe during peak generation.

Where there was a loss of energy from full generation levels our analysis indicates that a *generation event* has not occurred rather the loss of generation was as a result of dispatch, shared *network events* and local control. However, the analysis of these events provides an indication of what a significant *generation event* at Musselroe would involve for the network noting that the frequency response was satisfactory with a recovery within acceptable time frames.

Market events and local control

Woolnorth understands that the desired FCAS enablement outcomes is a function of NEMDE based on accurate provision of availability bidding.

Hydro Tasmania also manages the FCAS requirement by remotely reducing generation at Musselroe and at times Bluff Point/Studland Bay to as low as 90 MW to meet the next largest generator requirements. This method of managing the contingency requirements in Tasmania is not reflected in the market dispatch tables or as an input to NEMDE.

Analysis indicates that at times, frequency deviations have occurred as a result of conflicting dispatch and local control hence the accuracy of NEMDE dispatch solution has been shown to be impacted. The local control at times results in a deviation from the target for our wind farms resulting in significant dispatch and scheduling errors that contribute to increased regulation requirements and corresponding FCAS costs.

With NEMDE attempting to find the least cost dispatch outcomes, application of local controls in Tasmania suggest either a) NEMDE is not able to optimise Tasmania to the degree required (hence the need for remote local controls), or b) existing NEMDE co-optimisation is finding alternate solutions that are reflective of the limited contingency resources available in Tasmania. Either way, continuing to run the wind farms back outside of the semi schedule dispatch control should be the last resort except in the case of power system security. AEMO has not directed Musselroe wind farm off due to power system security other than via application of a semi dispatch control via NEMDE.

The central and local duplication of managing the FCAS requirements is unlikely a viable solution as the energy market in Tasmania continues to change over the coming years.

At times (see Figure 3), contingency-linked events are as a result of some form of shortfall in FCAS provision amongst large generators and Basslink (particularly moving through its no-go zone) rather than Musselroe or Woolnorth setting a requirement in the region.



System Events

1. 18 October 2016 15:55

Musselroe was at near full generation of 163 MW as measured at the generator terminals. A lightning strike on the TNSP Transmission Line resulted in a Musselroe-Derby Transmission line trip. Frequency observed at Studland Bay fell from 49.94 to 49.35 Hz before restoring to pre-event levels within 6 sec.

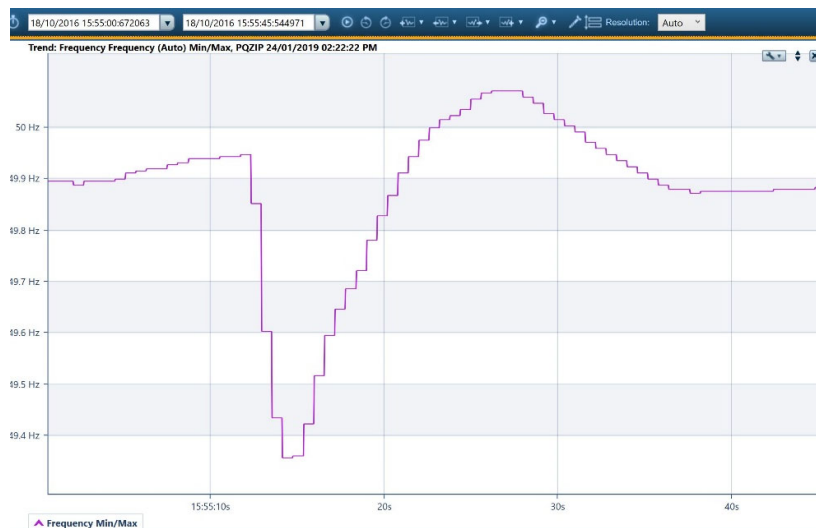


Figure 1 : 18 October 2016 Frequency Trace

2. 11 August 2017 21:48

Musselroe was at near full generation of 166 MW as measured at the generator terminals. A lightning strike on TNSP Transmission Line resulted in Musselroe-Derby Transmission line trip. Tasmanian Frequency fell from 49.89 to 48.53 Hz before restoring to pre-event levels in 28 sec.

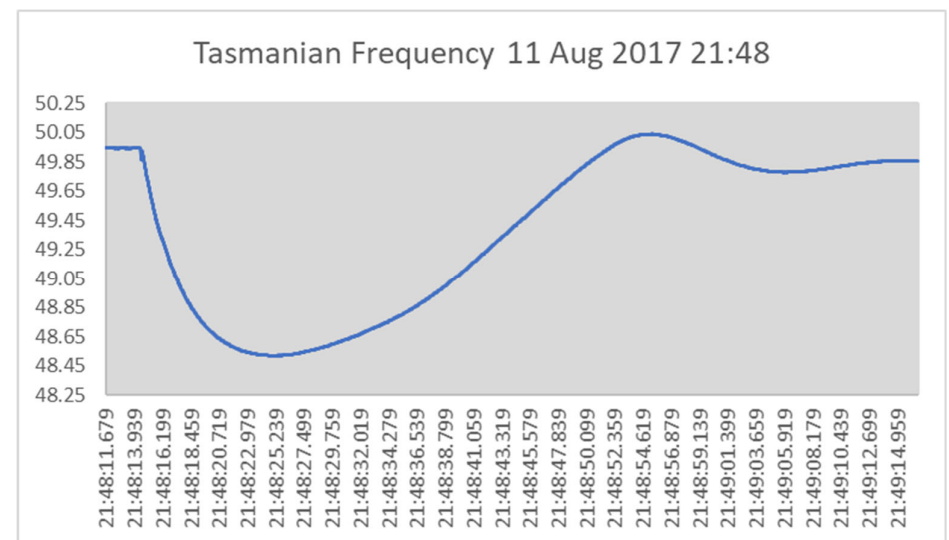


Figure 2 : 11 Aug 2017 - Frequency Trace



The below tables show Tasmanian Raise FCAS and Basslink configuration, although it is unclear how the Raise 6 second dispatch was being managed to account for a contingency event in Tasmania, noting that the system events resulted in a satisfactory FCAS response.

SETTLEMENTDATE	RAISE6SEC ACTUALAVAILABILITY	RAISE6SEC LOCALDISPATCH	RAISE60SEC ACTUALAVAILABILITY	RAISE60SEC LOCALDISPATCH	RAISE5MIN ACTUALAVAILABILITY	RAISE5MIN LOCALDISPATCH
18/10/2016 15:45	50.71053	0	202.3245	10.89	154.0391	0
18/10/2016 15:50	50.71053	0	202.3245	14.5	154.0391	0
18/10/2016 15:55	50.71053	0	202.3245	9.3	153.0391	0
18/10/2016 16:00	49.26803	0	197.1727	4.67	150.1315	0
11/08/2017 21:45	18.05317	18.05	106.4062	39.44	168.3321	30.19
11/08/2017 21:50	18.24236	18.24	109.754	49.09	157.9786	26.75
11/08/2017 21:55	41.50196	41.5	195.7352	63	160.4131	9.41
11/08/2017 22:00	51.64507	51.65	317.4973	64.56	348.8409	59.01
11/08/2017 22:05	65.99104	65.99	402.156	82.49	403.4861	73.46
11/08/2017 22:10	75.00165	75	342.0021	93.75	399.456	43.36

SETTLEMENTDATE	METEREDMWFLOW	MWFLOW	EXPORTLIMIT	IMPORTLIMIT	Effective Headroom for Raise Service in Tas
18/10/2016 15:45	310.1	300.3621	398.2694	175.6995	124.6626
18/10/2016 15:50	305.2	300.2659	397.3324	173.4249	126.8411
18/10/2016 15:55	309.5	316.1951	387.1648	178.8364	137.3587
18/10/2016 16:00	304.6	303.2151	386.6349	184.6248	118.5903
11/08/2017 21:45	115.9	130.5866	315.9	130.5907	-0.00404
11/08/2017 21:50	105	134.0383	305	134.0424	70.1406
11/08/2017 21:55	44.5	-85.3594	244.5	-155.5	33.00619
11/08/2017 22:00	-53.7	-169.226	-169.222	-202.232	32.21122
11/08/2017 22:05	-123.9	-169.993	-169.99	-202.204	135.4609
11/08/2017 22:10	-177.6	-64.4373	-64.44	-199.898	124.6626



Market Events

1. 1 Dec 2016: Run Back of Musselroe from 20MW

- Between 03:05 and 03:25, the RRP in all 3 Raise FCAS prices went to \$14,000
- Enablement levels had been approx. 20MW with Gordon at very low levels (trapped outside its FCAS trapezium) in the affected intervals.
- Musselroe was remotely runback at 03:06 from 20MW when the Tasmanian system frequency was already low (around 49.90Hz)
- Basslink was at full import into Tasmania and violated import limit constraints, thus providing an indication of the lack of generation in the Tasmanian system at the time.

2. 8 Feb 2018: Run back of non-scheduled Woolnorth to 100MW

- Between 01:00 to 01:10, Woolnorth was manually run back to reduce its output below 100MW (the next largest single generation unit)
- At the time, all R6, R60 and R5Min was being supplied by Gordon (which was progressively being curtailed in the energy market to provide additional FCAS) until, for the 01:05 interval, it became trapped
- Basslink was moving through the 'no-go' zone, with R6 constraints violating in various dispatch intervals

3. 16 May 2016: Tribute Unit Trip

- Basslink was out of service at the time a Tribute unit tripped from 65MW at approx. 1:26, resulting in frequency dropping to as low as 49.3Hz, before a subsequent over-frequency event. This event was a serious incident.
- At the time, there was 20MW of R6 and R60 available, which appeared to be very low given Basslink was out of service.
- Musselroe was locally run back approx. 23 minutes after the event from 153MW, thereby causing another major frequency drop.



3. Wider legacy and frequency control issues

National Electricity Objective (NEO)

Woolnorth appreciates and understands that the NEO mandates an objective to manage the system safely and securely while doing so at an affordable cost, as well as seeking to promote efficient investment. Woolnorth understands that it may be an option to regulate frequency requirement limits, but question is this a blunt and simple solution to a more complex issue and one that risks stifling innovation and investment.

During peak wind generation conditions within the state, up to 33% of Tasmania's energy requirements can be provided from the existing Woolnorth Wind Farm Portfolio. It is understood that an additional 240 MW of wind generation will soon come online in Tasmania raising the potential peak transmission connected wind generation contribution above 50%.

The Ancillary services requirements for the network as it transitions to an increased penetration from intermittent asynchronous generation will obviously need to be reliable and maintain safe operating conditions whilst being transparent and ensuring a truly competitive market exists that ensures participants, large or small have an opportunity to participate and invest in the market.

Additional fast raise availability

Woolnorth question the view that there is a shortage of raise service availability in the state. With the addition of 105 MW of switch controlled fast raise via Hydro Tasmania's Adaptive Under Frequency Load Shedding Scheme (AUFLS) in 2018 this has increased the availability of raise services that was not previously available. Whilst the AUFLS operates differently to that of a traditional generator providing continuously variable responses the inclusion of this technology provides additional network support.

Musselroe is in the process of testing its ability to provide Regulation and Contingency raise and lower services. A Regulatory rule, local control or restriction applied to the wind farm upper limit will impact this project and reduce the likely contribution capability further, undermining the investment opportunities. New entrants would need to also aim to contribute to providing network support assuming the market drivers provide the incentive to do so.

With Basslink contribution, the new and existing Hydro Tasmania services and the FCAS trial being undertaken at Musselroe it seems that the findings of the 2008 review require revisiting. As noted previously the market and NEMDE may not be able to operate effectively if local control obscures the operating environment.

The below chart shows the monthly average R6 Actual Availability of Tasmanian generation increasing from May 2018.

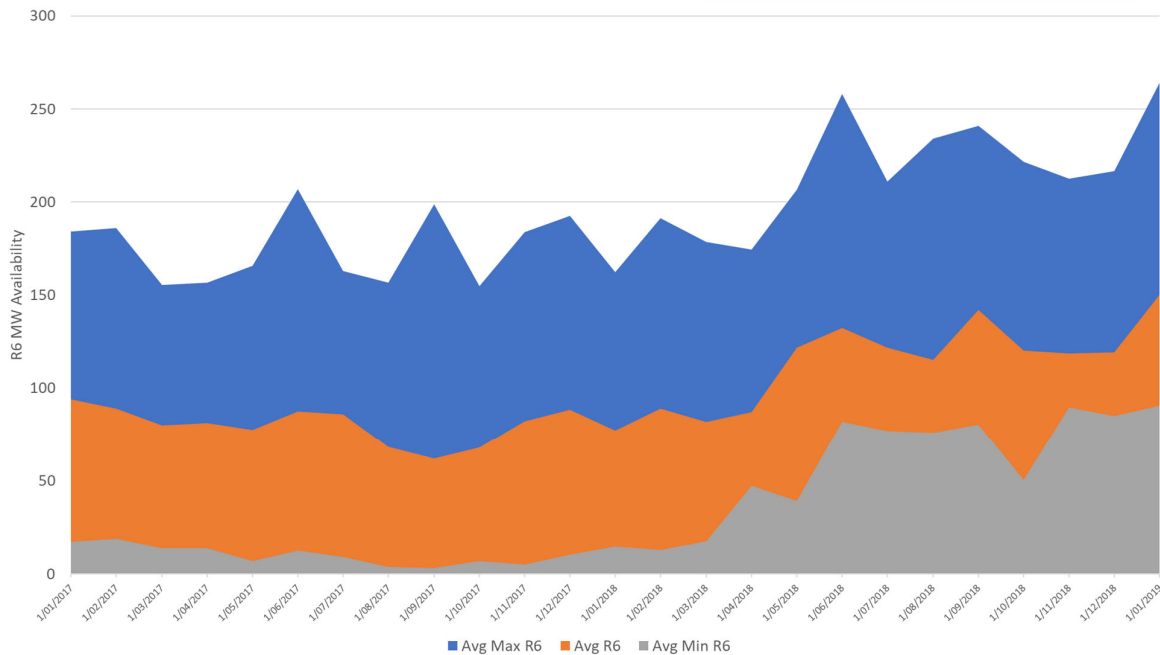


Figure 3: Tasmanian R6 Availability excluding Basslink

Dynamic Requirement and Generator Contribution

The largest *generator event* limitations on generation should be a dynamic value based on actual raise services available at the time rather than a fixed generation limit to enable optimisation of the energy markets.

Under FCAS violation or credible contingency scenarios constraining off generation is an acceptable outcome to ensure a safe operating state is maintained.

Woolnorth suggests that the *generator event* contingency size should be measured and calculated based on the actual MW contribution to the network requirements. This can be determined by the Regional reference node contribution.

NEMDE already includes MLF information as part of the current dispatch processes, so allowing for the type of node-based consideration should not be onerous for AEMO.

At full generation, the Musselroe MW contribution to the network at the Regional Reference Node in Georgetown is approx. 144 MW. Assessments for other large units in Tasmania that provide a frequency response are shown in (Figure 4).

When all the electrical losses between the initial source of the generation and the delivery to the node are taken in consideration, there is very little difference in the MW contribution between Musselroe and Gordon in terms of size. Interestingly within AEMO's infoserver², individual Gordon units can be run up to 150MW (although this is invisible to the market and NEMDE).

² AEMO table: genunits_unit



Therefore, in the event of the loss of 168 MW of generation at Musselroe (as measured at the 110kV dispatch point, the effective raise requirement (assuming equivalent response rates from an existing FCAS provider) will be somewhat less than the full 168 MW that is currently setting the requirement due to the losses that occur along the path to the RRN, noting that the load contribution at Derby is minor.

NEMDE’s calculation for the FCAS requirement based on the measured value at terminals of the generator system it is likely that with the Transmission loss factors the required raise services being provided by generators with a minimal loss factor would be somewhat less.

Woolnorth suggests the procurement requirements maybe overstated in the order of 22-25MW.

The following table represents the Transmission loss factors that apply to Musselroe noting that unlike scheduled generators Wind Farms are not able to adjust the calculation of its transmission loss factors.

Table 1: MLF Impacts at the RRN

	Registration	Unit Size	Connection Point	TLF	MW At Node
MUSSELROE	168	-	158.84	0.9105	144.6
GORDON	432	150#	150	0.9868	148.0
POATINA	100	50	50	0.9799	49.0

Max individual unit size

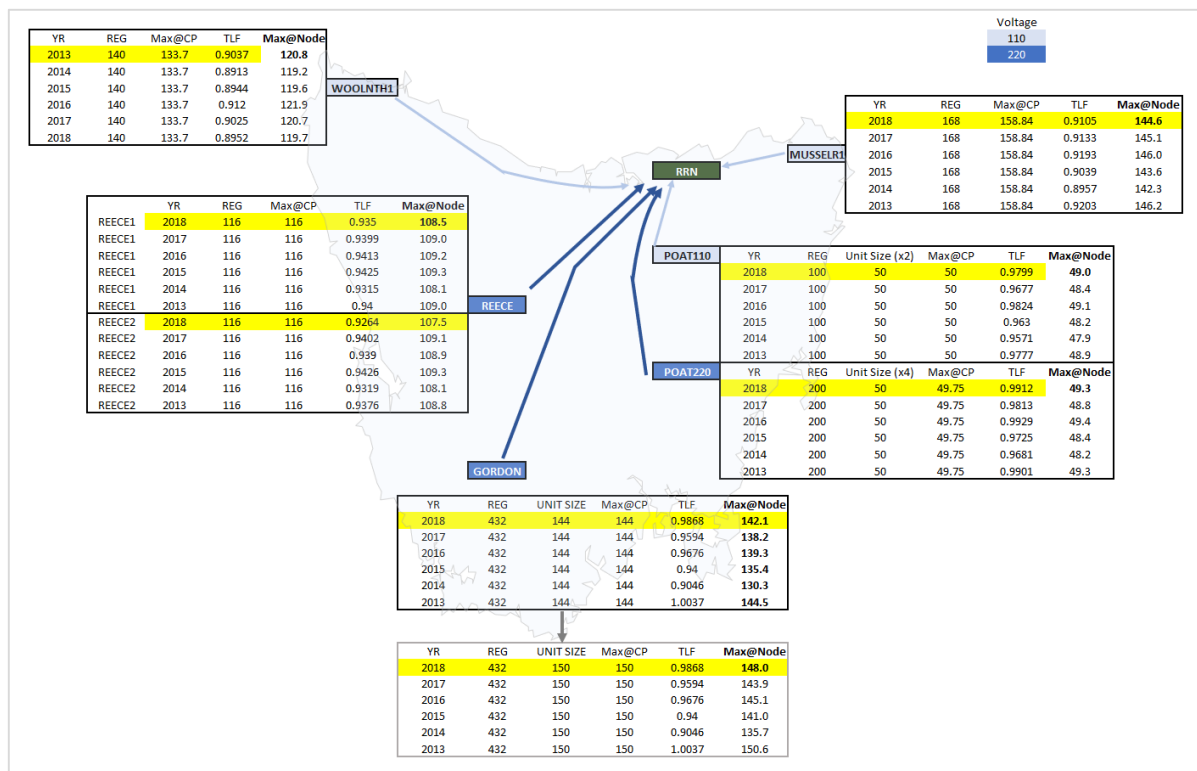


Figure 4: Major Tasmanian Generator - TLF History and Nodal Impact



Frequency deviation distribution

Woolnorth appreciates the Tasmanian frequency trials relating to the governor settings undertaken in May 2018 and the resultant reduction in costs incurred demonstrating the importance of governor dead band settings management.

We acknowledge that generation variability associated with wind farms is an issue that needs to be managed and dealt with, as it does with any generation technology. Whilst we are yet to see any of the intricate detail on how the variability of the wind contributes to frequency deviations observed in Tasmania, we would like to highlight that there are several compounding factors that contribute to frequency management.

Woolnorth has been active in discussions and implemented several AEMO recommendations with respect to local limits, possible power and is further investigating ultra-high forecasting based on actual local conditions (also known as self-forecasting by AEMO), thereby removing some of the forecasting noise and dispatch errors that is contributing to wider frequency management, not just in Tasmania but around the NEM and Internationally.

Also, a recent review of the NEMDE application of dispatch limits for transmission line overloading constraint solutions has identified the fast unloading of Musselroe has a resultant frequency deviation.

Conclusion

Woolnorth again appreciates the opportunity to provide input into the works being undertaken on the TFOS changes. We are committed to the safe and reliable operating state of the wider network and have a keen interest around the application of the generator limitations within the wider management of Network dispatch in the market.

We look forward to providing further information in relation to our submission