WIND AND SOLAR FARMS TESTING REQUIREMENTS FOR CONTINGENCY FCAS REGISTRATION

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1. INTRODUCTION AND PURPOSE

The current Frequency Control Ancillary Services (FCAS) testing requirements for a synchronous generator can include a frequency injection test using the standard frequency ramp rate or a simulation of a frequency disturbance up to the raise and lower reference frequency.

In order to allow market semi-scheduled units to participate in the Contingency FCAS market under the Market Ancillary Service Specification (MASS), AEMO has developed additional testing requirements for operators to classify wind and solar generation as ancillary services generating units for contingency FCAS.

The tests that were carried out to demonstrate a wind farm's ability to follow AEMO's Automatic Generation Control (AGC) dispatch signal in order to register for regulation FCAS can be found under Chapter 8 of the Hornsdale Wind Farm 2 detailed test plan report[1].

2. CONTINGENCY FCAS REGISTRATION REQUIREMENTS FOR WIND FARMS AND SOLAR FARMS

An operator seeking to provide contingency FCAS will be required to account for the following:

1. A single droop setting is to be chosen if the control system to provide FCAS is a variable controller.

2. Demonstrate the active power response to a frequency disturbance coinciding with a voltage disturbance causing the voltage to dip down to 0.2 p.u at the connection point; simulations using a sufficiently accurate model should be submitted with the FCAS classification application.

3. Provide data from a frequency injection test to demonstrate the FCAS capability for standard and non-credible under-frequency and over-frequency events. The data from the test will be used to conduct the technical assessment of FCAS, and the metering facilities to comply with the MASS requirements will also be verified when the test results are provided. Tests are to be conducted at different hold points according to the ascending section of the turbine power curve or the number of solar panels installed and results for the following frequency injection profiles are required prior to classification:

   i. Standard frequency ramp rate test profile for an under-frequency event when the frequency reaches the raise reference frequency and an over-frequency event when the frequency reaches the lower reference frequency.
   ii. 3 Hz/s profile for non-credible over-frequency and under-frequency events.
   iii. 1 Hz/s profile for credible over-frequency and under-frequency events.

   Data from a suitable power system simulation package may also be required if injection testing will not deliver results representative of actual operation during a contingency event.

4. Provide data to verify the active power response following a frequency deviation as per Table 7 of the MASS[2].

[1] http://aemo.com.au/-/media/Files/Electricity/NEM/Strategic-Partnerships/2018/HWF2_Detailed_test_plan_Final.pdf
[2] https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/primary-freq-resp-norm-op-conditions/market-ancillary-services-specification-v70.pdf?la=en

5. Demonstrate how the headroom is calculated for raise and lower services. AEMO requires a minimum baseline % (based on a 3 standard deviation error in its 5-minute ahead generation forecast) of raise and lower headroom to cover forecast uncertainty over the next 5 minutes. Management of headroom for contingency response and compliance with FCAS offers is the responsibility of each FCAS market participant. If forecast data is not yet available, the minimum headroom is 10% of registered capacity. The baseline factor used for the headroom can be reviewed after six months based on actual forecast performance. The importance of the headroom is explained in Appendix A.

3. CACULATION OF FCAS TRAPEZIUM AND MAXIMUM UPPER ANGLE

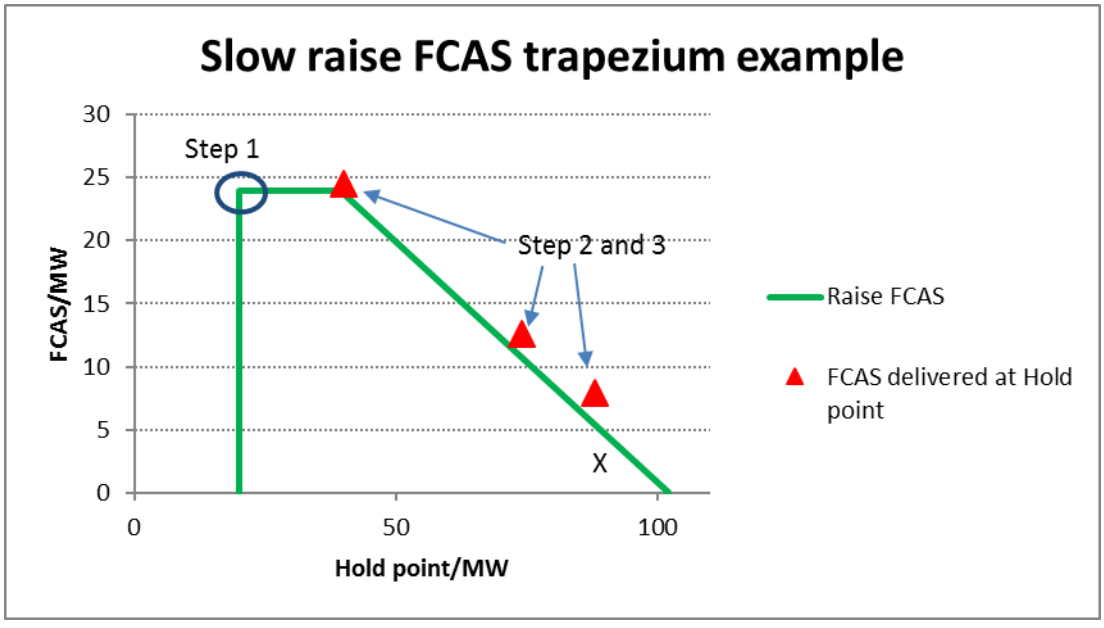
The steps below are followed to determine the maximum upper angle of the FCAS trapezium for contingency FCAS:

1. The minimum enablement level for a service is plotted against the maximum market ancillary service capacity for that service.

2. The results from the frequency injection test with the standard frequency ramp profile and at different hold points are plotted on a graph.

3. The amount of FCAS delivered from the three frequency injection tests at different hold points are added to the graph.

4. The maximum upper angle, X is calculated to match the results from the frequency injection test.



APPENDIX A

The section below is an extract from the HWF2 FCAS trial report[3] and Section A3 of this trial report contains more information on the calculation of headroom.

The need for headroom

During the pre-classification technical assessment process, AEMO must consider whether an intending FCAS provider can operate in energy and FCAS markets according to their proposed FCAS trapezium. If the power system is relying on enabled ancillary services being available to the grid following occurrence of a fault, the system operator will need to be confident that these services can be provided accurately and precisely as expected. In the case of wind and solar plant, the ability of the plant operator to provide an acceptable forecast of generation in the coming dispatch interval as part of their FCAS offers (bids) becomes particularly important.

To provide AEMO with confidence in the forecasting capability, an FCAS parameter was developed to reflect a minimum headroom (or pre-curtailment) requirement for both the raise and lower services. This minimum headroom approximates a 3-standard deviation error in its 5-minute ahead generation forecast (that is, an error not exceeded for 99.7% of the time). This ensures that generator output can be steadily controlled over the 5-minute interval over which it may be enabled to provide the service. Failing to provide the service could have an adverse impact on frequency.

For HWF2, this calculation resulted in a minimum of around 10 MW of headroom to manage the risk of forecasting error (or 10% of registered capacity) across all operating conditions, measured over the period from 21 February to 18 July 2017. It is noted that this period was during the commissioning phase of the HWF2 wind farm, for which forecasting performance data was available – this minimum level of 10 MW of headroom resulted from benchmarking against actual forecast data from this period.

[3] http://aemo.com.au/-/media/Files/Electricity/NEM/Strategic-Partnerships/2018/HWF2-FCAS-trial-paper.pdf

VERSION RELEASE HISTORY

Version	Effective Date	Summary of Changes
1.0	5 October 2018	First Issue of the wind and solar farms testing requirements for Contingency FCAS registration.
2.0	16 February 2022	Update references to the Market Ancillary Services Specification to be consistent with version 7.0 effective from 1 February 2022.