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Reliability Panel
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(Lodged electronically) 17 January 2019

Reliability Panel – Review of the Frequency Operating Standard (Ref. REL0065)
Draft Determination (6 December 2018)

Delta Electricity operates the Vales Point Power Station situated at the southern end of Lake Macquarie in NSW. The power station consists of two 660MW conventional coal-fired steam turbo-generators. Delta Electricity appreciates the opportunity to comment on the draft revision.

The Frequency Operating Standards (FOS) are considered an essential foundation for successful operation of the power system.

To support the National Electricity Objective, the Frequency Operating Standards should be:

- clearly linked to detailed technical reasoning for the frequency bands;
- not open to misinterpretation and descriptive of the key operating parameters relevant to controlling frequency;
- supported by technical standards and the frequency control design specifications; and
- maintained by effective operational control systems, protection and procedures.

Technical Reasoning for the FOS band limits

The NEM is currently a collection of new and old machinery. The older machines were designed, constructed, installed and commissioned prior to the conception of the National Electricity Market and the subsequent Laws and Regulations.

It cannot be understated just how fundamental to the design of AC electrical machinery and networks the FOS is. The impacts of changing the band levels, as was done in 2001, upon NEM-wide clusters of generators and motors designed under standards and specifications of past generations and decades will not be immediately apparent or predictable. What are the implications of such changes upon such machines?

Whilst the draft revision to the FOS largely maintains existing settings in relation to the requirements for frequency performance in the NEM, what has not been illuminated in the standards are the potential impacts upon machinery not specifically designed to withstand adjusted FOS limits. Many electrical engineering calculations for AC networks and machinery assume system frequency to be 50Hz relying on the accurate approximations that result. If the Normal Operating Frequency Band (NOFB) is widened as occurred in 2001, the assumptions of a nominal 50Hz frequency level and the impacts on calculated expectations of electrical equivalent capacitance and inductance may need to be reassessed on all affected equipment. It is suggested that for future reviews, the AEMC/RP document the likely impacts of FOS limits on electrical machinery. Without clarity of the possible impacts, the assigned limits of the FOS may not be either appropriate for equipment not designed for them nor representative of the economic best fit.

However, a suggestion, perhaps of worth, is that the limits of the NOFB be set such that controllers not designed to control frequency do not detect changes to their control parameters caused by frequency movements permitted inside the NOFB. A wide NOFB can mean 'normal' frequency variations are detected by secondary systems controlling other parameters such as voltage or the steam pressure of coal fired boilers. A wider NOFB with the resultant possibilities potentially makes too complex a task of design, modelling and testing of each affected system. As each system detects a change and makes a controlled response, the subsequent levels of system response increase in complexity. As an example, testing generator automatic voltage regulators (AVR) in recent years during times of frequency fluctuations with larger rates of change inside the NOFB has been found to be a more difficult task because larger more erratic frequency changes can impact on the steadiness of voltage and make more difficult and expensive the testing work. A NOFB band with limits that, in the absence of contingency events, results in negligible subsequent impact on voltage would overcome such difficulties and improve testing outcomes.

Interpretation

As with all written standards, the words of the standard must be carefully chosen to avoid confusion, misinterpretation and the resultant errors in application and expectation.

Possibly as remnants from previous revisions or the original standards, the draft standards retain wording that provides the reader with interpretative questions such as:

1. Is the NOFB describing system frequency as detected/measured to be 99% of the time inside extremes of 49.85 to 50.15Hz? Measured using what accuracy of instrument, measurement methodology and at what resolution and settling time of the detection method?

   For example, if frequency is sampled at only a 4s rate by an operator, each detected '4s' period outside the NOFB could be in error by up to 3.9s if the frequency (nominally defined by sinusoidal waveform with a period of 0.02s) leaves the NOFB just after one 4s sample and returns just before the next sample after the sample detected to be outside the NOFB. The resolution of measurement is recommended to be stated in the FOS.

2. The use of the word "exceed" under the Required Frequency Outcomes point 2 could be interpreted as meaning only detected frequencies above 50.15Hz. A frequency of 49.83 is outside the NOFB but does not 'exceed' 50.15Hz under some definitions of the word. Dictionary definitions can differ for the word 'exceed' and it can be interpreted as meaning outside the bounds of the NOFB but better wording could be selected to avoid misinterpretation. e.g. "…. System frequency shall be maintained within the applicable normal operating frequency band…"

3. Inclusive or exclusive of contingency event conditions? – The wording under Table A.2 point 2 can be interpreted such that the exception for contingencies applies only to the recovery within 5 minutes for each contingency and does not apply to the requirement for the frequency to not be detected outside the NOFB more than 1% of the time. AEMO interpret it to mean that the frequency remains within the NOFB 99% of the time exclusive of contingency events which may be what the FOS intends but the current wording does not precisely convey such a meaning.

4. Related to 3. above, when assessing whether an event recovers in 5 minutes, AEMO in some reports disregards the time during a contingency event when the frequency wavers inside before returning outside the defined limits of the NOFB. In contrast, the AEMO Market Ancillary

Services Specification (MASS) defines frequency recovery[1]. Clarity on this point is recommended to be included in the FOS.

Frequency Control Design

Ambiguities with interpretation of the FOS and the AEMO MASS lead to a more variations and assumptions to be made in the design and testing of new control systems and can mean more expense for AEMO and participants.

The FOS should heavily influence and be guaranteed by a participant's registered technical standards and compliance program and, with reference to AEMOs MASS, by registered frequency control services. During discussions at AEMOs initial briefings for a 2019 MASS review, it was suggested that the MASS needs to either become a precise design specification document defining the control block diagram for expected FCAS services or the MASS should become a specification of the process participants should follow to achieve an AEMO-approved design for frequency control. In consideration of this point, the FOS may benefit from a further review following a future revision to AEMOs MASS.

Effective in Application

The effectiveness of aspects of the FOS only becomes observable in times of extreme system stress.

For example, as an extract from the executive summary (page 6) of the recently published AEMO[2] report into the 25 August 2018 QNI and V-SA separation event:

"Approximately 15% of sampled (Rooftop PV) systems installed before October 2016 dropped out during the event.".

To maintain secure operation of the NEM, it would seem to be an urgent action that any Rooftop solar system that does not have frequency interruption settings that support the FOS are inspected, tested and adjusted. This point is clearly outside the scope of the AEMC/RP FOS review but perhaps the future FOS could benefit from consideration of the revelations that some roof top inverters pose a potential risk to NEM security should the FOS limits not be installed in them and/or not be tested at installation.

Good system frequency control depends upon concise design specifications and effective operational processes developed by the operator and adhered to by all relevant participants.

Delta Electricity would be happy to participate further with regards to the determination and if the AEMC wishes to discuss this submission please contact Simon Bolt on (02) 4352 6315 or simon.bolt@de.com.au.

Yours sincerely

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[1] 1. Excerpt from the AEMO MASS: "Frequency Recovery means the first change in Local Frequency from above 50.15 Hz to below 50.1 Hz or below 49.85 Hz to above 49.9 Hz, to occur after a Frequency Disturbance"

[2] AEMOs Qld---SA-Separation-25-August-2018-Incident-Report