Inertial Response by Type IV Wind Turbines Experiences in Canada and in Ireland

Mr Konstantinos Pierros[1], Mr Patrice Godin[1], Mr David McMullin[1]
[1]*Enercon Gmbh*

Motivation

The SA power system is changing due to the increase in installed non-synchronous (inverter-connected) renewable generation and to changes in the patterns of demand. Therefore the challenges for Eskom, the System Operator (SO), in terms of managing an increased capacity of this new type of generation are new and significant.

Problem Statement

Conventional synchronous units are increasingly being displaced by non-synchronous technologies. The resulting reduction in available system inertia may lead to frequency control challenges, with steeper Rates of Change of Frequency (RoCoF) and lower frequency nadirs occurring. For this reason, several SOs have looked into requiring from Wind Turbines (WTs) to provide a form of synthetic inertial response for under-frequency events. The two most notable examples are Hydro-Québec in Canada and Eirgrid in Ireland, although the approach they have followed differs (Grid Code requirement vs System Service). Eskom may well face similar challenges in the near future.

Methodology

Due to their electrical design, modern WTs do not inherently increase their output in response to under-frequency events without additional controls. In response to the requirements introduced by Hydro-Québec in 2006, ENERCON developed the Inertia Emulation (IE) feature. With it, WTs become capable of responding to a drop in grid frequency by temporarily and rapidly increasing active power beyond the available power from the wind. Previous publications have shared the positive operational experiences with inertial response provided by Type IV WTs. They have also highlighted two main challenges associated with it. Firstly, the active power performance during the recovery period following activation of the inertial response must be controlled, so as not to bring about a secondary frequency dip in the electric network. Secondly, it might not always be accurate enough to assess the inertial response behaviour of a whole WF based on measurements performed on a single WT.

Results

The present paper will introduce the reader into the history of the development of requirements with respect to synthetic inertial response in Canada and in Ireland, and will also touch upon the noted differences between Grid Code requirements and System Services. This publication will also describe and show measurement results of a new version of the IE control system that enables the provision of this short-term frequency support with a more controllable recovery period. This paper will furthermore present the results of a recent field test performed in a WF connected to the transmission system in Québec.

Conclusions

The proposed publication will give an insight at the current capabilities of Type IV WTs to provide inertial response in the context of the Canadian and Irish requirements. The measurement results shown will also serve to enhance understanding of the IE system with a more controllable recovery period.

Key words: synthetic inertia, inertia emulation, inertial response, type IV wind turbines, system services