Wind power plant system services

Traditionally, conventional power plants have the task to support the power system, by supplying power balancing services. These services are required by the power system operators in order to secure a safe and reliable operation of the power system. However, as in the future the wind power is going more and more to replace conventional power plants, the sources of conventional reserve available to the system will be reduced and fewer conventional plants will be available on-line to share the regulation burden. The reliable operation of highly wind power integrated power system might then beat risk unless the wind power plants (WPPs) are able to support and participate in power balancing services. The objective of this PhD project is to develop and analyse control strategies which can increase the WPPs capability to provide system services, such as active power balancing control, in a modern power system with large scale integration wind power. This study presents the investigation of the real-time balance control in a modern Danish power system, where WPPs can actively contribute to active power balance control. New solutions for the automatic generation control (AGC) dealing with the compensation of the power imbalances between demand and generation in real time, caused by wind power forecast errors, to enhance the security and the reliability of a power system operation with large wind power penetration with the coordination between combined heat and power plants (CHPs) and WPPs are developed and analysed. The main results of this research work show that the WPPs can actively contribute to power balance control through primary and secondary response. The integration of WPPs control into the AGC is of high relevance, particularly in situations when wind power is contributing highly to the total electricity production and conventional power plants are operating on the minimum level. The grid support services from WPPs improve the active power balance control and make power system operation more reliable.