AKE 12: Implications of Fluctuating Electricity Generation

Time: Wednesday 11:15–12:15 Location: A 151

Invited Talk AKE 12.1 Wed 11:15 A 151

Electricity by Intermittent Sources — •Friedrich Wagner — Max-Planck-Institut für Plasmaphysik, Greifswald, Germany

We describe the major characteristics of an electricity supply system being predominantly composed of the scalable renewable energy (RE) forms wind and photovoltaic power. The analysis is mostly based on the actual production data of 2013 from the German electricity system. The 2013 data will be scaled to larger shares of RES in the electricity production up to the 100% case where RES integrally generate as much electricity as consumed during a year. The 100% case is then analysed according to the proper mix of wind and PV power, the extent of installed power, the remaining residual back-up power, the dynamics of the back-up system, the size of storage, the conditions for demand-side-management, the CO2-reduction in comparison to other supply forms and finally with regard to some cost issues. Similar analyses are carried out for some European countries using only their national RE-power field. A rough picture emerges on the viability of using RES in Europe. Finally, an EU-wide RE power field is constructed from the superposition of the national contributions. This allows to assess the reduction of the degree of intermittency and the necessary interconnection capacity to benefit from this effect.

AKE 12.2 Wed 11:45 A 151

Transient stability of conventional power generating stations during times of high wind penetration — •Marios Zarifakis[1] and William T. Coffey[2] — [1]Electricity Supply Board, Generation, Asset Management, Dublin, Ireland — [2]Department of Electronic and Electrical Engineering, Trinity College, Dublin, Ireland

The requirement to increase the level of energy produced from sustainable sources resulted in wind turbine generators and solar photo voltaic installations becoming major contributors into the energy pool. However, studies, recent measurements and experience in the island of Ireland show that the increase of these generation sources influences the ability of the frequency in the transmission and distribution system to remain stable after a transient disturbance. This weakening of the grid frequency strength is observed by an increase of the Rate of Change of Frequency (ROCOF). Furthermore, the frequency of the transmission system oscillates in a higher frequency range which triggers further oscillations in transmission connected synchronous generators. The development of an understanding of the behaviour of synchronous generators, connected to such a system with high wind penetration during transient disturbances, required a new modelling technique. A mechanical analogy and model was developed and verified using electromagnetic models in MATLAB and proven by comparing it with actual measurements on various generators. It highlights limitations to the operational range of synchronous generators and also limits to the amount of grid connected non synchronous generators used in wind turbine and solar PV installations.

AKE 12.3 Wed 12:00 A 151

On the Improvement of Numerical Weather Prediction by Assimilation of Wind Power Data — •Stefan Declair, Klaus Stephan, and Roland Potthast — Deutscher Wetterdienst, Frankfurter Straße 135, 63067 Offenbach, Germany

It is a demanding task for the transmission system operators (TSOs) to predict the amount of weather dependent renewabe energy in terms of net stability and power supply safety. In the BMBI funded project EWeLiNE, the German Weather Service and the Fraunhofer Institute on Wind Energy and Energy System Technology strongly support the TSOs by developing innovative weather- and power forecasting models and tools for grid integration.

With focus on wind energy, this contribution sketches the way of using wind power data from the growing amount of wind farms in Germany to improve the wind forecast in the planetary boundary layer via data assimilation (DA). This part of the atmosphere is important to observe, since it is heavily underobserved by conventional observation networks. Additionally, it is difficult to describe the strong spatiotemporal fluctuations in the numerical weather prediction (NWP) model properly. The concept of DA provides an improved initial atmospheric state for the subsequent NWP model integration in terms of a best-fit according to observations and model background and is a crucial part in NWP.

After a short introduction, the DA system is shortly introduced and first results of improved wind forecasts from impact experiments are discussed.