Young Researcher Symposium IEEE Benelux Chapter IAS/PES/PESC,
April 24 – 25, 2014, Ghent, Belgium

DYNAMIC OPTIMISATION FOR POWER DISPATCH IN MICROGRIDS

Christof DECKMYN*, Tine VANDOORN*, Mohammad MORADZADEH* and Lieven VANDEVELDE*

*Ghent University, Department of Electrical Energy, Systems and Automation, B-9000, Ghent, Belgium
E-mail: christof.deckmyn@ugent.be

Abstract. The increasing growth of non-dispatchable renewable energy sources (RES) such as solar and wind and the upcoming plug-in electric vehicles (PEVs) makes the secure power supply and power dispatch optimisation very challenging. In this paper, a coordinated power dispatch approach in microgrids is proposed using multi-objective optimisation. The application dynamically fits the power production to the power demand by appropriately dispatching the controllable distributed energy resources (DER).

Keywords: Microgrid, power dispatch, multi-objective optimisation, energy management

Distributed generation (DG) and storage become part of the modern energy structure. Unfortunately, conventional energy grids are not designed for the subsequent bidirectional power flows in the distribution networks. Moreover, the aging electrical distribution networks are not actively managed, i.e., they are conceived as passive facilities of the transmission network in which the control and stability is achieved. The challenge of ensuring a reliable and sustainable electricity supply is driving the need for technology improvements in electricity networks. Besides, the enormous efforts in the pursuit of low-carbon economy have led to a huge boom in the use of intermittent renewable energy sources (RES). The increasing growth of distributed electricity production and the unpredictability of electricity consumption could lead to grid congestion problems. As these techniques grow in popularity, so do the challenges. Control strategies for the coordinated power dispatch of distributed energy resources (DER) gain importance [1]. The microgrid concept, with a more reliable and more sustainable framework, is a promising approach and forms a solution to this challenge. A microgrid is an active distribution network defined as an integrated power delivery system. It consists of a low-voltage (LV) network including DG units, storage devices and (controllable) loads and behaves as a single controllable entity. A microgrid can provide both power and heat and may be operated to achieve several objectives, such as market participation, reducing the electricity cost through flattening of the load profile, and CO_2 reduction by maximising the use of RES. The priority goals of a microgrid are to provide a coordinated integration of DG in the electric power system, to improve the reliability and, to allow a more efficient use of energy. Due to the dynamics of RES, different generator power dispatch levels and external grid characteristics, a microgrid can be characterised by specific operations and limitations [2]. Taking into account these criteria, the microgrid needs a flexible energy management system (EMS) [3]. In this paper, a coordinated power dispatch approach in microgrids is proposed using multi-objective optimisation. The aims is to fulfill the time-varying energy demand while minimising the costs and emissions of the internal production and imported energy from the utility grid. The microgrid concept, used in this work, is presented in Fig. 1.

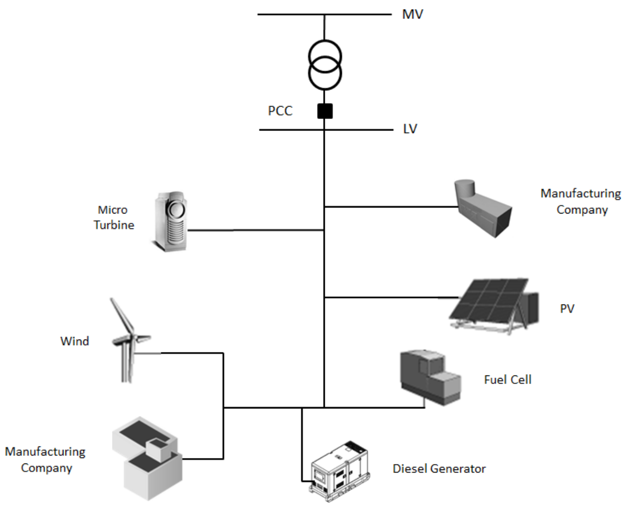

Figure 1 Microgrid architecture

It consists of an industrial park including fuel-based thermal generators (micro turbine, diesel generator and fuel cell), renewable energy production by wind turbines and photovoltaics, and two manufacturing companies with a varying demand profile. To improve the matching performance of the power generation and consumption in the microgrid, the power dispatch application dynamically fits the power production to the power demand by appropriately dispatching the controllable DER.

In this work, the focus is on the dynamic response of the microgrid in terms of dispatching the power among different DER in an economically and environmentally sound way. Due to the intermittency of the RES involved and the multiple objectives that need to be satisfied, the power dispatch system needs to find generator setpoints quickly and continuously. Therefore, it is essential that the dispatch system works fast and flexible. Operational constraints such as generator limits and operation and maintenance are to be satisfied. A representative microgrid structure will be studied as an example and simulation results will be presented to demonstrate the performance of the coordinated power dispatch approach.

REFERENCES

[1] Abido, M.A., "Multiobjective evolutionary algorithms for electric power dispatch problem," Evolutionary Computation, IEEE Transactions on , vol.10, no.3, pp.315,329, June 2006

[2] F. Katiraei, "Microgrids management - controls and operation aspects of microgrids," in IEEE power and energy magazine.

[3] Deckmyn, C., Vandoorn, T., Vandevelde, L., Desmet, J., Van Eetvelde, G., & Timmerman, J. (2013). Energy management and dynamic optimisation of eco-industrial parks. 48th Universities' Power Engineering Conference, Proceedings (pp. 1–5).