Prof. István Erlich
Head of the Institute of Electrical Power Systems, Department of Electrical Engineering and Information Technologies, University of Duisburg-Essen, Duisburg, Germany

The German Energy Transition Need for a Comprehensive Basic Research

The German government, in line with the general public opinion, decided to introduce a fundamental change in the energy policy, to phase-out the nuclear energy and move to a renewable based sustainable landscape of power generation and consumption. The German power supply system in the future will be characterized by a large portion of renewable and distributed sources such as wind, solar and biomass combined with backup generation units preferably based on natural gas. The policy also envisages lower energy consumption through higher efficiency of units and energy conservation in production processes as well as in homes and buildings. This vision of Energy Transition represents a fundamental paradigm change and presupposes a new regulatory framework and operational strategies embedded in a competitive European electricity market.

For maintaining the high reliability of supply, the operation of the system requires new intelligent approaches backed up by large-scaleintelligent communication infrastructure and powerful software tools. This will be accomplished over an extended period of time with the addition of successive layers of functionality and capability to the existing systems. To perform the increased power transmission demand from the North to the South on account of the fact that most of the large wind farms are in the north and major load centers are in the south the German transmission utilities are planning to build major new Direct Current (DC) links based on the latest Voltage Source Converter technology parallel to the existing alternating current (AC) lines, in addition to the large offshore wind farms which will also be connected to the grid via DC links. Obviously there are no experiences with the operation of such mixed AC/DC systems as of now. Besides, there are also a large number of renewable generation units locatedin the distribution network, which will now perform not only power distribution as in the past but will also collect the power from a large number of small units such as PV panels. This will obviously change the character of the distribution network with part of the controllability and flexibility features necessary for secure system operation being shifted to the distributed units.In the future consumers will become active as well by responding to different incentives and thus contributing to the power balance in the whole system on the one side and help to avoid grid congestions on the other.In other words, customer-owned renewable and other distributed resources will in the future have the possibility to add value to their services through the provision of ancillary services and by supporting the efficient and secure operation of the system.

The immediate objective of the energy transition is managing the complex dynamic relationships between distribute resources and the legacy grid. It will also set the stage for a more intelligent system, capable of efficiently managing the increasingly complex functions by integrating information and communications technology (ICT) with the electricity infrastructure – thus the smart grid.The development of new operational methods and tools for real-time process control, adaptive protection, portfolio management, etc. for the anticipated power system requires the involvement of different disciplines: communication, control andpower engineers, among others. The ultimate goal is to build and operate a sustainable power system, which is reliable, fault tolerant, self-healing, stable and environmentally friendly. This is a monumental challenge over a long haul.