

Advanced technologies for measurement, control, and communication on the electric grid

This project is conceived as a continuation of the research of projects previously financed by the Serbian Ministry of Science:

1. EE-232014Б, A system for measurement and correction of the power and distortion factor of electronic equipment.
2. TP 11007, Design of integrated circuits for measurement and data protection within the system of control of consumption of electricity.

Now we conceive a change in the perception of the role of the measurement and control system within the grid. It is viewed as a complex telecommunication system that, in the future, should perform two fundamental tasks:

a) enable measurement of all quantities related to the consumption taking into account the modern conditions characterized by nonlinear loads and being able to control the consumption within a two-way encrypted communication including prediction of the consumption and

b) to become a communication system that will utilize the existing infrastructure of power lines and transformer stations, making it an alternative to the stationary telephone communication system.

Following are the new developments of the grid:

- In the production of electricity: the problem of adjustment of the amplitude, phase, and frequency, as well as control aiming optimal exploitation of the available diversified resources.
- In the communications on the grid, by use of the grid, and for the grid.
- In the consumption represented by the appearance of nonlinear loads especially electronic transducers of all sizes.
- In the needs for short- (real time) and long-term forecasting of the loads.
- In the understanding of the electrical quantities related to the nonlinear dynamic loads.

Accordingly the following are the research tasks that will dominate:

- New way of characterization (definition) of the measured quantities and redefinition of the electronic power meters as a measuring unit
- New set of measured quantities that, besides the usual, include the ones related to the network frequency and the nonlinearity of the loads.
- New role of the electronic power meter in the global communication system having in mind the ubiquitous availability of the power meter and the existence of the communication lines that are used for electricity distribution.
- New concept of communication within the power grid with respect to the data protection on the grid.
- New specialized instrument implementing the innovated approaches to the characterization of the properties and quality of small electrical loads.
- New methods for short (real time)-, medium- and long-term prediction of the electricity consumption at different levels.

Exceptional attention was devoted to this subject both in the world and in Europe.

The share of electricity in the overall energy consumption is permanently rising. While in the year 1973 the share of the electrical energy consumption was 9%, in the year 2009 it rose to 16%. It is predicted that by the year 2030 the global investments in the electric energy sector will approach 16 trillion US dollars. This trend is followed by the rise of the efficiency of the grid that rose from 33% for the old network to 60% for the new built grid. In addition 8% of the electricity in the EU is spent by ICT equipment and components. That emphasizes the problem of harmonics and distortion power.

In the last fifty years the grid development was not following the modern challenges such as:

- Security threats from both the (downstream) supplier side and the (upstream) side of possible terrorist or criminal attack.
- National goals of introduction of alternative sources of electricity
- Energy saving that targets reduction of the daily consumption
- Providing conditions for uninterrupted supply of large number of consumers
- Providing digitally controlled components that will allow to change the nature of the load at the consumer side.

A good example of developments in the world is the Smart Grid paradigm. A smart grid delivers electricity from suppliers to consumers using two-way digital technology to control appliances at consumers' homes to save energy, reduce cost and increase reliability and transparency. It overlays the electricity distribution grid with an information and net metering system. One US Dep. of Energy study calculated that internal modernization of US grids with smart grid capabilities would save between 46 and 117 billion dollars over the next 20 years.

The EU via the „Commission Recommendation of 9.10.2009 on mobilising Information and communications Technologies to facilitate the transition to an energy-efficient, low-carbon economy“ urges the member states

- a) by the end of 2010 at the latest, to agree on a common minimum functional specification for smart metering
- b) by the end of 2012 at the latest, to set up a coherent timeframe for the rollout of smart metering.

In addition within the Framework Program 7 the EC started several research projects such as the „OPEN meter“ (2009-2010). The main objective of the OPEN meter project is to specify a comprehensive set of open and public standards for AMI, supporting electricity, gas, water and heat metering.

The state owned company “Elektroprivreda Srbije” takes steps toward the introduction of AMI system. According to the 2008 Annual Report, a “Centre for Control of the Telecommunication Traffic” was put in work at the national level. In April 2010 the “Specifications and Technical Requirements of the AMI/AMD system” were published. Several small installations were built implementing the AMI concept.