SMART GRID

Department of Electric Power Engineering, Mäsiarska 74, 042 01 Košice

Team members

Dr.h.c. prof. Ing. Michal Kolcun, PhD. is the head of the Department of Electric Power Engineering (EPE) at FEI TU of Košice. He deals with the management of EPS operation, using IT in the field of EPS and addressing technical problems in connection with the liberalization of the electricity market. He has been responsible researcher and principal investigator of various projects (VEGA, APVV, VaV). His experience in managing of scientists is used to manage research scientific team and it is the guarantee for a successful process and completion of the projects.

Assoc. prof. Ing. Ľubomír Beňa, PhD. is an associate professor at the Department of EPE FEI TU of Košice. He deals with computer analysis of electrical networks and optimization of EPS operation. In his habilitation thesis he solved issue of the using of specialized devices for the electric power flow regulation in EPS. Currently he deals with determining of the possibility of implementing control devices to improve the stability of operation and also in order to reduce power losses.

Assoc. prof. Ing. Alexander Mészáros, PhD. is an associate professor at the Department of Electric Power Engineering. He primarily deals with the research of problems from the area of economic and environmental aspects of electric power systems. Theme of his habilitation thesis was the evaluation of economic effectiveness of optimal voltage control in electric power system of the Slovak Republic.

Ing. Dušan Medveď, PhD. is an assistant professor at the Department of Electric Power Engineering. He deals with the computer modelling of thermal and electromagnetic fields using numerical methods and with the computer modelling of electrical system elements.

Ing. Martin Kanálik, PhD. is an assistant professor at the Department of Electric Power Engineering. He deals with the load flow and transient analysis of electrical power systems, with the computer modelling of electrical system elements and with the power system voltage quality.

Ing. Stanislav Ilenin, PhD. is an assistant professor at the Department of Electric Power Engineering. He deals with design of overhead power lines, electrical installations and intelligent design of power stations using software for design.

Ing. Marek Pavlík, PhD. is an assistant professor at Department of EPE at FEI TU of Košice. He is focused on the management model of renewable energy sources. Currently he deals with the deployment and cooperation of renewable energy sources.

Ing. Zsolt Čonka, PhD. is an assistant professor at Department of EPE at FEI TU of Košice. He specializes in the issue of the use of special equipment to control the power flow and increase the stability of electric power systems and protection systems of simple and robust electrical systems.

Research Direction

- Principles of electrical energy generation (conventional and unconventional sources of electricity)
- Transmission of Electricity (line parameters, calculation of steady-state and transient operating conditions)
- Management of the electricity system (automation systems, artificial intelligence)
- Protective elements in the power system (classical, digital)
- Power consumption (electro-thermal equipment, lighting systems)
- Economy of electricity and environmental issues
- Research of dynamic phenomena in the power system
- Research of the intelligent network to the distribution system
- Research of renewable energy sources cooperation and their implementation into the daily load curve
- Measurement and evaluation of electrical quantities in terms of power quality
- Measurements in power system for the safe operation
- The solution of mechanical phenomena of overhead power lines

The Importance and Benefits of Research

In term of technical-physical, power system is a single and complex which in the every instant of time conforms to the laws of physics. This system makes high demands on ensure safe, reliable and economic operation of power system as a whole.

The current global trends in the field of renewable energy sources are directed to continually increasing demands on their regulatory and economic use. Economical energy production from the quite difficult predicted renewables often leads to its using in the place of generation and at the time of peak energy demands, so it tends to utilizing of energy storage systems.

Smart metering systems are currently used primarily as the metering and billing equipment. This narrow view does not permit the use of the technological potential of smart metering

systems as the instrument for creating of smart distribution networks. The use of their features and functions, also at lower voltage, can help to reduce the losses of electricity distribution as well as the voltage regulation (also by keeping the quality of electricity).

To achieve these objectives, it is necessary to ensure the balances of local production and consumption of electricity (e.g. by reduction of short duration consumption and by accumulation of electrical or thermal energy to another form); regulation of overvoltage and undervoltage; identification of phase asymmetry, adverse powers and losses; deployment of distributed control algorithms (i.e. smart intelligence); use of energy storage and finally to bring an added value for the consumer in the form of price distribution fees reduction, increasing of the reliability and quality of electricity.

The installation of the smart metering systems, which also serves as a self-regulating devices, requires a review of current approaches to predicting consumption and supply of electricity. Prediction software based on accurate data from the smart metering systems may bring reducing of the final price of electricity.

With the development of renewable energy sources, there is still the question of energy accumulation, management, storage and subsequent use. Due to aging of distribution networks and increasing of the contribution of difficult predictable renewable energy sources (with the rapid change of output power to electricity) it is increasingly difficult to ensure the network stability and the necessary quality of electricity, which is guaranteed through the Decree on the quality of electricity supply. In towns and cities with sparse distribution network is ensuring of the necessary quality parameters of energy very difficult and the situation is getting worse because the distribution lines work for many times at the limit of their technical capabilities, especially in terms of providing quality electricity. Connecting of new resources to these networks, could greatly deteriorate this quality and the distribution network will be unable to provide the required quality.

One way to improve the quality of network parameters (with the high penetration of renewables in the distribution network) is ensuring the electricity storage at the place of production and subsequent consumption. Energy source in the place of local or regional consumption will lighten the distribution network, and electricity storage (when it is properly integrated into the system) will allow to adjust the daily load diagram in a given place or region, and it also provide the neutral behavior of the source to the distribution network.

Therefore, the issue of ensuring stable and reliable operation of the distribution system is very actual in terms of market liberalization, reducing the share of traditional energy sources and deployment of renewable sources (that are difficult to predict) and ensuring the quality indicators of electric energy.

Solving Current problems

- Operation optimizing of the renewable energy sources in power system
- The optimal voltage regulation in distribution systems
- Research on the impact of smart grid to distribution system
- The impact of FACTS devices for adjusting the switching characteristics of distance relays
- Research on renewable energy sources cooperation in the distribution system
- Impact of harmonics influence on the power losses of lines and transformers

- Research of devices that improve the dynamic stability of the power system
- Technical problems solving in the liberalized electricity market
- Research on the use of FACTS devices to minimize losses in power system
- Modelling of electricity generation from the wind power farms for power system planning
- Research on the impact of renewable energy sources on support services in electric power systems
- Evaluating of the reliability of high voltage electric power stations and their own consumption
- Research on methods of electricity pricing
- Analysis and forecast of electricity prices on commodity exchanges
- Ampacity of overhead transmission lines
- The implementation of Smart Grid technology and determine its impact on security and stability of the power system

Current Projects

1. ***Utilisation of FACTS devices in electric power system***, APVV (bilateral project) No. SK-BG-0010-08, solved in 2009/2010.
2. ***Research of the possibilities of critical states elimination in the electrical power system of the Slovak republic***, VEGA 1/0166/10.
3. ***Research centre for performance of the renewable energy resources integration (VUKONZE)***, project from EU funds OPVaV-2009/2.2/02-SORO (ITMS code 26220220064) (activity 2.3. Intelligent control systems for production and consumption of electricity from renewable energy resources)
4. ***Research of characteristics of effective components for photovoltaic solar systems design***, project from EU funds OPVaV-2009/2.2/03-SORO (ITMS code 26220220080)
5. ***Protecting the population of SR against the electromagnetic fields effects***, project from EU funds OPVaV-2009/2.2/05-SORO (ITMS code 26220220145).
6. ***Research of dynamic processes in the electric power system of the Slovak republic***, VEGA 1/0388/13.
7. ***Research of the penetrating of high frequency electromagnetic waves through ecological building materials***, VEGA 1/0132/15.

Cooperation with business practice:

- Optimal Voltage Regulation in the Slovak transmission system (SEPS, a.s., 2008)
- Possibilities to power flow control in the power system of the Slovak republic (SEPS, a.s., 2008)
- Proposal consideration of interphase separators design in the field of double 110 kV overhead line M. Třebová – Svitavy (Phase II), September 2006
- Real exams of start from black-out in 2014 (SEPS, a.s., 2014)
- Calculation of electrical parameters in steady-state and dynamic stability analysis in order to start from the black-out of TEKO source (SEPS, a.s., 2014)
- Evaluation of real exams of start from black-out of PVE Ružín DG and Moldava in power system completed on 18.6.2014 (SEPS, a.s., 2014)
- In-depth analysis of measured data during real tests of start from the black-out of PVE Ružín-TEKO and DG Moldava-TEKO on 18.6.2014 (SEPS, a.s., 2014)

- Transmission capacity increasing of Slovakia-Hungarian border section (SEPS, a.s., 2014)
- Study – Database of attributes of the transmission system (SEPS, a.s, 2015)
- Study – Utilizing of WAMS to create alarms for supervisory control (SEPS, a.s., 2014)
- Measurement of transients during 3-phase short circuit in high voltage system of electric station Bardejov (VSD, a.s., 2015)
- Preparing of input data to perform the real exam of start from black-out DG Moldava or PVE Ružín–EVO in the period 10/11–2015, evaluation of tests and suggestion of measures (SEPS, a.s., 2015)
- Laboratory preparation for testing of hybrid photovoltaic systems (VSD, a.s., 2016)

Cooperation with Academic Institutions and Industry

- Czestochowa University of Technology, PCz, Poland
- Department of Electrical Power Engineering of Faculty of Electrical Engineering and Computer Science VŠB – TU Ostrava, Czech republic
- Institute of Electrical Power Engineering and Applied Electrical Engineering FEI STU Bratislava
- Department of Electric power engineering and Ecology, WBU Pilsen, Czech republic
- Politechnika Rzeszowska, Poland
- Kálmán Kandó Faculty of Electrical Engineering, Óbuda University, Budapest, Hungary
- Slovenské elektrárne, a.s.
- Východoslovenská energetika, a.s. Košice (VSE)
- Elektrárne Nováky, (ENO)
- Elektrárne Vojany, (EVO)
- Vodné elektrárne Trenčín
- Atómové elektrárne Bohunice
- Tepláreň Košice, TEKO
- Slovenská elektrizačná prenosová sústava, a.s. (SEPS)
- Stredoslovenská energetika, a.s. Žilina (SSE)
- ABB ELEKTRO, s.r.o. Bratislava
- Výskumný ústav jadrových elektrární a.s., Trnava (VUJE)
- Železnice Slovenskej republiky, Košice (ŽSR)
- ELEKTROVOD, s.r.o. Bratislava
- U.S. Steel Košice, s.r.o.
- Chemko, a.s. Strážske
- Chemes, a.s. Humenné
- Slovalco, a.s. Žiar nad Hronom

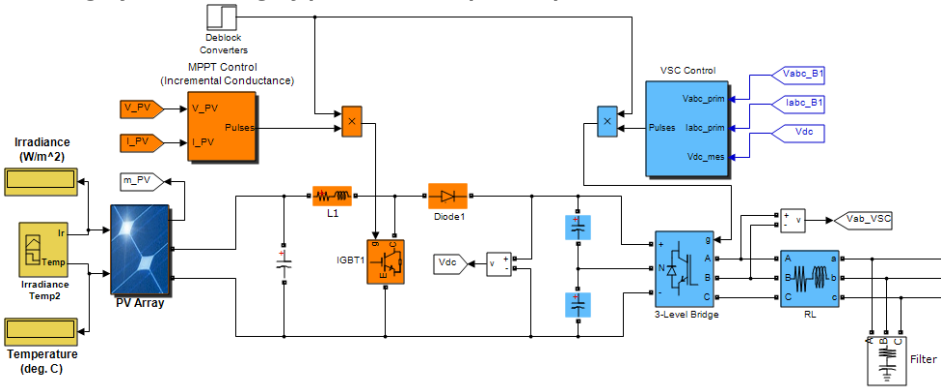
Selected Publication

The research team published their work in academic and professional journals, in proceedings of scientific conferences and scientific monographs, including:

1. MÁSLO, K., KOLCUN, M.: *Load–frequency control management in island operation*. In: Electric Power Systems Research. Vol. 114 (2014), p. 10-20. - ISSN 0378-7796 - ISI Current Contents Journal, IF=1.749.
2. KOLCUN, M., BEŇA, Ľ., MÉSZÁROS, A.: *Optimalizácia prevádzky elektrizačnej sústavy*. Košice: TU 2009. 265 s. ISBN 978-80-553-0323-9.
3. FECKO, Š., REVÁKOVÁ, D., VARGA, L., LAGO, J., ILENIN, S.: *Vonkajšie elektrické vedenia*. Bratislava: Renesans - 2010. - 600 s.. - ISBN 80-89402-35-9.
4. MÉSZÁROS, A.: *Metodika hodnotenia ekonomického prínosu optimálnej regulácie napätia*. Košice: TU 2011. 125 s. ISBN 978-80-553-0756-5.
5. MÉSZÁROS, A.: *Ekonomika v elektroenergetike*. Košice: Technická univerzita - 2015. 229 s. ISBN 978-80-553-2146-2.
6. KOLCUN, M., BEŇA, Ľ.: *Využitie špecializovaných zariadení na reguláciu tokov výkonov v elektrizačných sústavách*. Košice : TU - 2011. - 128 s.. - ISBN 978-80-553-0767-1.
7. GRABARA, J., KOLCUN, M., KOT, S.: *The role of information systems in transport logistics*. In: International Journal of Education and Research. Vol. 2, no. 2 (2014), p. 1-8. ISSN 2201-6740 Spôsob prístupu: http://www.ijern.com/journal/February-2014/25.pdf.
8. KOVALČÍK, M., FECIĽAK, P., JAKAB, F. DUDIAK, J., KOLCUN, M.: *Cost-Effective Smart Metering System for the Power Consumption Analysis of Household*. In: International Journal of Advanced Computer Science and Applications (IJACSA). Vol. 5, no. 8 (2014), p. 135-144. - ISSN 2156-5570 Spôsob prístupu: http://thesai.org/ PdfFileHandler.ashx?filen =IJACSA_Volume5No8.
9. MÉSZÁROS, A.: *Analýza výroby elektriny v podmienkach SR z hľadiska trvalej udržateľnosti*. In: Elektroenergetika. Roč. 4, č. 1 (2011), s. 5-9. ISSN 1337-6756.
10. NOVÁK, M., KOLCUN, M.: *Riešenie technických problémov v liberalizovanom trhu s elektrinou*. Košice : TU - 2014. - 125 s. ISBN 978-80-553-1880-6.
11. KOLCUN, M., BEŇA, Ľ., KOŠICKÝ, T.: *Using of Voltage Regulation in Distribution Networks for System Balancing of Transmission System*. In: Power and Electrical Engineering. No. 32 (2014), p. 55-58. - ISBN 978-9934-10-627-9 - ISSN 2256-0238.
12. KOLCUN, M., DUDIAK, J.: *Analýza komunikačných technológií pre inteligentné meracie systémy*. In: EE časopis. Roč. 20, č. 2 (2014), s. 42-44. - ISSN 1335-2547.
13. NOVÁK, M., KRAVEC, R., KANÁLIK, M., ČONKA, Zs., KOLCUN, M.: *UPFC influence to transient stability of power system*. In: Elektro 2014: 10th international conference: proceedings: Rajecké Teplice, May 19-20, 2014. Žilina: ŽU, 2014 s. 343-346. ISBN 978-1-4799-3720-2.

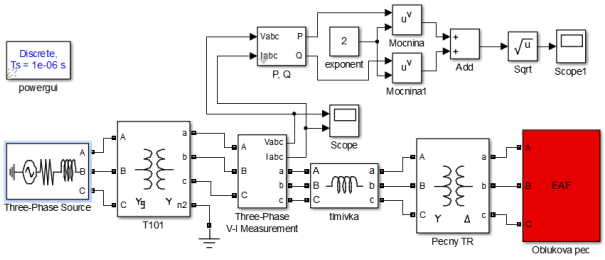
Photos

1. *Modelling of connecting of photovoltaic power plant*

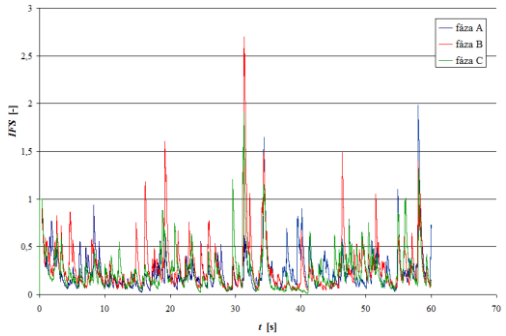


Modelling of 999 kW photovoltaic power plant

2. *Modeling of dynamic compensation of arc furnace*

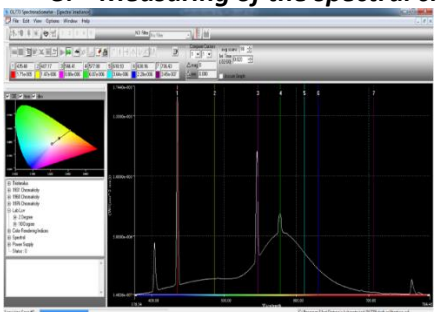


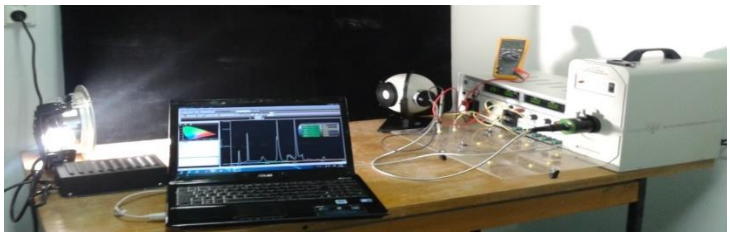
Block diagram for control of the apparent power consumption of the arc furnace



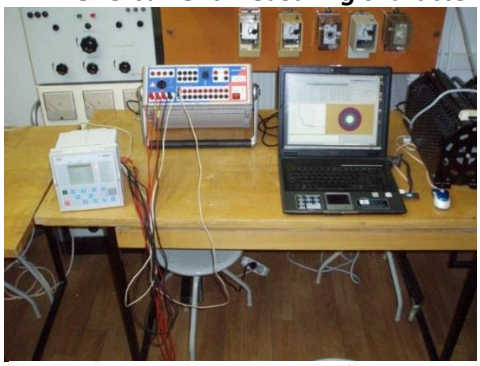
The characteristics of instantaneous flicker sensation (IFS) in network using of arc furnace of 1 MVA

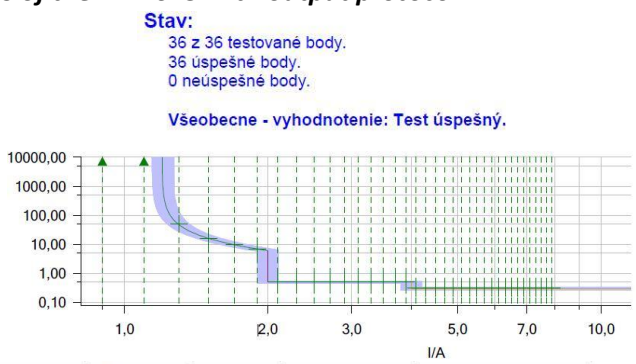
3. *Measuring of the spectral characteristics of light sources*





4. *Overcurrent measuring characteristics of the RED 615 with output protocol*





Aktív.	Názov	Vypínacia charakteristika	I príťahový	Čas	Prídržný pomer	Smer
Áno	I #1 Fáza	IEC Very Inverse	1,20 Iref	0,30	0,95	Nesmerové
Áno	I #2 Fáza	Určitý čas IEC	2,00 Iref	0,50 s	0,95	Nesmerové
Áno	I #3 Fáza	Určitý čas IEC	4,00 Iref	0,30 s	0,95	Nesmerové