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UNIVERSITI TEKNOLOGI MALAYSIA

Centre of Electrical Energy Systems (CEES)

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Innovative Research and Developments in Power and Energy Systems

February 2011 www.fke.utm.my/cees

Vision

To be an internationally renowned R&D Centre of Excellence

Mission

To provide innovative research and development ideas and solutions in electrical power and energy systems

This is the second newsletter published by the Centre of Electrical Energy Systems (CEES), Universiti Teknologi Malaysia (UTM). CEES is a centre of excellence established in March 2009 by the Universiti Teknologi Malaysia (UTM). Recently, under the Research University Grant, 10 members of CEES have been given research funding. In the last six months three Ph.D students and a research master student joined the University under CEES member supervision.

CEES has made steady progress in its development. Recently, the Deputy Vice Chancellor office audit team rated CEES 2010 performance as highly satisfactory. With the budget allocated by the University, the revenue to be earned from the Energy Commission Power Quality Baseline Study consultancy as well nearly one million ringgit in research funding, CEES looks forward to contributing to the nation technical and intellectual development and consequently, uplift UTM standing and achievement. This newsletter highlights some of 2010 CEES activities to interested readers and supporters.

The Centre of Electrical Energy Systems (CEES) has conducted a workshop in the period between 15 to 17 December 2010 in Melaka. In this workshop, all CEES academic staff and students had the opportunity to review the achievements made during 2010 and plans for 2011 were drafted.

CENTRE OF ELECTRICAL ENERGY SYSTEMS

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12 Ph.D Students
5 Master Students
3 Research Engineers

MESSAGE FROM THE DIRECTOR

Recent global development shows how delicate and important energy is to the human welfare. Unrests in the Middle-East push energy prices high. Nuclear accidents and create jitter in the energy markets, has turned off appetite of nuclear energy particularly for the fence sitters.

No matter what developments that are taking place, the world continues to require reliable, safe and economically sustainable energy supply. CEES mission of providing innovative research and development ideas and solutions in electrical power and energy systems is our major contribution towards meeting the energy requirements either nationally or globally.

In the last Newsletter, I mentioned about developments in distributed generation either based on conventional energy such co-generation or through renewable resources such as wind turbine as one of the most important answers to the challenges facing the energy industry today. Another interesting and attractive concept mentioned is the idea of smart grid, which is being actively studied world-wide.

CEES is undertaking some aspects of the Smart Grid concepts. Among our activities are the load flow and short circuit analysis of large scale the active grid. A short write up of the load flow analysis of large scale unbalanced network with distributed energy resources is presented in this newsletter.

CEES is also collaborating other academics nationally and internationally. Among area of interests are energy efficiency, cogeneration system and renewable energy. Last year we had two visitors, one from New Zealand and another from Egypt. Early this year Associate Professor Dr. Wu paid a visit to CEES to pave a beginning of a collaboration in renewable energy research, especially in wind energy.

The centre has two active industrial collaborators. They are the Dataran Berlian Sdn. Bhd., the power industry data logging specialist and the Advanced Power Solutions Sdn. Bhd., that specializes in power system studies. We are planning more collaborations with other engineering specialist firms this year.

This newsletter, a continuation of the last issue, is an update of our activities, and other information.

Prof. Dr. Khalid Mohamed Nor
Director

Research and Development Teams

CEES is organized into five research groups called research teams. The teams focuses on specific area of research but synergise with other teams whenever necessary. The current teams and leaders are:

Research Team	Team Leader
Power Systems Engineering - analysis, design, planning and optimisation	Prof. Dr. Khalid Mohamed Nor
Electrical Energy Markets and Generations Studies	Assc. Prof. Dr. Mohammad Yusri B. Hassan
Renewable Energy	Assc. Prof. Md. Shah B. Majid
Power Quality and Energy Supply Reliability Engineering	Dalila Bt. Mat Said/Prof. Dr. Khalid Mohamed Nor
End-user and Customer Side Energy Efficiency	Assc. Prof. Faridah Bt. Mohd Taha

Visiting Academic Researchers

CEES has hosted Dr. Mamdouh Abdel-Akher from South Valley University, Aswan, Egypt between 20 November to 5 December 2010. Dr. Mamdouh Abdel-Akher is an expert in the field of power system modeling and simulation and has earlier collaboration with members of the Power System Engineering Team in some publications.

Dr. Mamdouh Abdel-Akher

CEES has also invited Dr. Wu Yuan Kang from Penghu National University, Taiwan from 17 to 28 January 2011. Dr. Wu was the international speaker at the RE and Systems Management short course held by the RE team in the same month. He is now collaborating with the RE team in a number of projects.

Dr. Wu Yuan Kang

Power Systems Engineering

The Power System Engineering Team, CEES, has currently 3 members and 6 Ph.D students. Prof. Dr. Khalid Mohamed Nor is the leader of the team. Dr. Mohamed Shaaban is the senior research staff and Dr. Mamdouh Aldel-Akher from the University of South Valley, Egypt is an associate research member. Research activities of the team include power system analysis, design, planning and optimizations. The team is actively involved in exploring opportunities for cooperation with global and local electrical power industries and participation in national and international scientific events and associations.

The Power System Engineering Team, CEES has obtained two FRGS research projects from MOHE with the total RM 60,800. The first project title is "A Study of Parallel Programming Algorithms for Large Scale Non-Linear Equations Solutions" has been running for nearly thirteen months. The project has completed the literature review phase and the first version of parallel non-linear equation solution class library. The class library has been used to solve load flow problems. Results from the power flow solution show that the parallel version computation has significant speed-up as compared with the serial version. The second project title is "Multi-Core Parallel Programming Algorithms for Large Scale Differential–Algebraic Equation System". The project aims to decompose differential-algebraic equation system solver, run the solver under multi-core PC platform and investigate the accuracy and efficiency of parallel DAEs solver in transient stability solutions. This project kicked off on April 2010 and to be completed by March 2012.

The team will soon undertake another significant project with a budget of RM 300,000. The project is dedicated to develop a power quality analysis and simulation tool, which is a part of the "Power Quality Baseline Study for Peninsular Malaysia" consultancy project, currently undertaken by Prof. Dr. Khalid Mohamed Nor. Under this project, the team will build a Visual Power System (VPS) software using our own power system analysis engines. The software will be used to analyse power quality problems. Collaboration is sought with Advanced Power Solutions Sdn. Bhd. (APS) and with Dr. Mamdouh Abdel-Akher to execute this project.

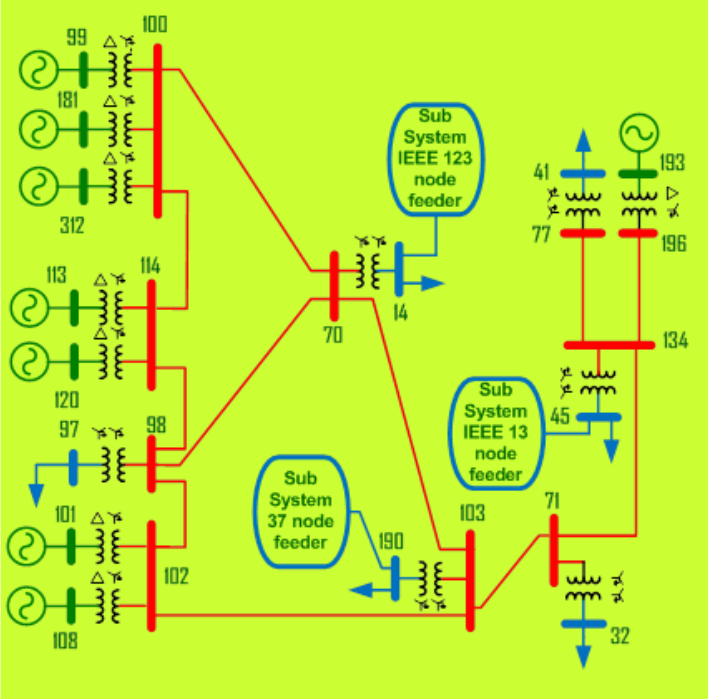
The team has published three international journal papers in 2010 and presented seven papers in the IEEE International Conferences, including Power and Energy Conference (PECon' 2010), CIRED Asia Pasific Conference and Exhibition on Energy Efficiency (APACEEE' 2010) and Asia Pasific Conference Circuits and Systems (APCCAS' 2010) all held in Malaysia.

Current Research by a PhD Student

In every newsletter, an abstract of a graduating Ph.D student will be presented. In this edition Syafii Ghazali, presents his work entitled 'Parallel Three-phase Power-Flow Analysis including Distributed Energy Resources (DER) Models.' He is supervised by Prof. Dr. Khalid Mohamed Nor.

The main objective of the research is to develop parallel three-phase power flow algorithm including DER models for large scale balanced/unbalanced mesh and radial system. The significant contributions of this research are listed as follows:

- *Novel parallel algorithm for sequence decoupled three-phase load flow analysis (Multi-core PC based parallel programming).*
- *Development of DER models, including co-generation (Cogen), induction and synchronous wind turbine generation and three phase and single phase photovoltaic (PV) , fuel cells as well as Centre Tapped LV Transformer model.*
- *Testing the algorithm and analyse the impacts of DERs penetration using the IEEE test system. The test systems used are from practical systems that are the available in public domain.*
- *1)Taiwan Power Company 24 bus + IEEE 13 node + IEEE 123 node + practical California system 37 node feeder.*
  2) IEEE 8500 node feeder.
- *Consistently faster by at least 200% when compared to earlier algorithms.*



The combination of TCP 24 bus mesh and radial unbalanced systems

Renewable Energy

The Renewable Energy Team, CEES, currently has 6 members with 2 Ph.D and 3 master students. Assoc. Prof. Md. Shah Majid is the team leader with Assoc. Prof Dr. Mohammad Yusri Hassan, Dr. Md. Afendi M. Yusof, Mr. Wan Zaidi Wan Omar, Assoc. Prof. Faridah Taha and Ms. Hasimah Abdul Rahman are the senior research staffs. Research activities of the team include solar photovoltaic technology study, design of horizontal axis winds turbines for low wind speed and design of low wind speed wind turbine. The team is in negotiation with NGO for Rural Electrification Project and also cooperation with local government bodies and participating in national and international scientific events and associations.

The Renewable Energy Team, CEES has obtained two FRGS research projects from MOHE with the total amount of RM 119,500. The first project title is "Development of Mathematical Model for Different PV Modules Technologies and Topologies" and the second project title is "Study of Macro Level Capillary Flow in Fibre Based Porous Medium".

The team has published one international journal paper, one in The Monthly Bulletin of the Institution of Engineers, Malaysia in 2010 and presented one paper in the IEEE International Conferences, including Power and Energy Conference (PECon' 2010) and one International Conference on Business and Management, Bangkok.

Renewable Energy and Systems Management Short Course

The RE and Systems Management Short Course was successfully held on 26 and 27 January 2011. The course mainly discussed the impact of implementation of RE generation projects connected to the National Grid. The main speaker was Assoc. Prof. Dr. Wu from Penghu National University, Taiwan, Ms. Hafiza Yob from the Energy Commission and Dr. Affendi Yusuf from CEES.

Ms. Hafiza gave the history and experiences of the Energy Commission (EC) in RE, especially certain specific legislations to encourage RE implementation in Malaysia. According to her, the next legislation that would give a big impact would be the Feed-in Tariff legislation (FIT). She also related the EC experience with the Energy Education Program, where EC attempted to inculcate consciousness about energy savings to the Malaysian general public.

Attentive participants at the RE and Systems Management Short Course

The committee members for RE and Systems Management Short Course held at Universiti Teknologi Malaysia, Kuala Lumpur

Dr. Wu gave an overview on current RE technologies and their system management, as well as the RE potential and their impact. He also presented his experience with the wind energy harvesting and wind turbine testing program in National Taiwan Penghu University.

Dr. Affendi gave a narrative of CEES and his own experiences in the implementation of isolated RE projects, especially those involving the Orang Asli (aboriginal) communities.

School gets excited about Solar Cooking

The CEES RE Team was invited as facilitator under "Excellence Academic Program 2010" at Sekolah Tun Fatimah, JB on 24 Dec 2010. Title of this program is "Unleash the Potential – Cooking with Nature for a Healthy Living". In this program, the school girls were introduced to basic solar photovoltaic energy conversion as well as the application in day life. Later they were asked to participate in making their own and trying out their Solar Oven. In that event, three CEES RE Team members were involved headed by Ms. Hasimah as a speaker as well as a facilitator together with Ms. Faridah and Ms. Siti Maherah.

RE Team members and form 2 students with cheerful and smiling faces with their innovative invention - Solar oven.

Creating awareness among the population, especially the young generation, to the environmental impact is becoming more important as the world is now experiencing the effects of unsustainable practices.

At the end of the program, the team seized the opportunity to remind the students about the importance of inculcating energy efficiency practices.

Wind Anemometer

Mounted Anemometer

Wireless data logger with Davis Pro2 Console Display

Wireless Data Repeater

Hendry , a Ph.D student, adjusting the data logger setup

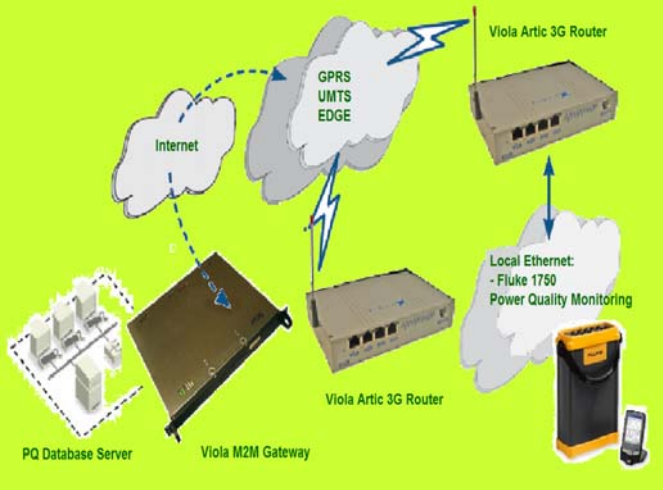
CEES currently, have one Ph.D candidate and a research master student carrying research projects on wind turbines.

To enhance research capability on wind energy, CEES has purchased a wind measuring system. The anemometer is NIST certified and has a maximum wind measuring capability of up to a speed of 30 m/s.

The wireless data logging facility enables remote data collection. CEES will be purchasing a few of these wind measuring systems to seek out potential wind turbine sites in Malaysia.

Power Quality and Energy Supply Reliability Engineering

In April 2010, the Power Quality and Energy Supply Reliability Engineering Team, CEES through the consultant arm of UTM, Global Technology Innovation Management Sdn. Bhd. (GTIM) has been awarded a RM 3.4 million project to carry out a 30-month consultancy on the Power Quality Baseline Study for Peninsular Malaysia. This 30-month project is to help the Malaysian Energy Commission (EC) to develop power quality baseline for the Malaysian environment. The objective of this project is to obtain the baseline data on power quality events and sources of events through power quality monitoring programs. From the monitored data, analysis will be carried out to determine the Malaysian power quality limits and the suitable period of implementation and enforcement of the Malaysian Standards and Regulations regarding to power quality. This project will be carried out on industrial, commercial and residential sites, covering the northern, eastern, central and southern regions of Peninsular Malaysia.



The Virtual Private Network (VPN) Configuration of Power Quality Monitoring System

Power Quality Monitor with Modem at Elektrisola, a manufacturer of enameled copper wire and fine magnet wire at Janda Baik, Pahang.

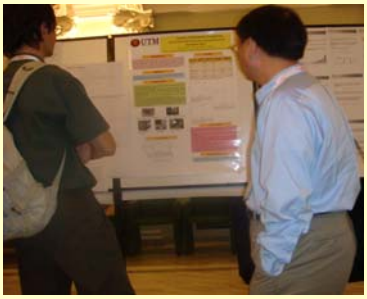
This project has been running for nearly eleven months. The first seminar was held on 12 July 2010 at the Energy Commission, Putrajaya. As part of the first seminar, the Power Quality Symposium was held on 13 and 14 July 2010 at the Putra World Trade Centre (PWTC), Kuala Lumpur. During the first year of this project, logging activities will cover 250 sites from the northern and eastern regions of Peninsular Malaysia

PQ Monitor Installation at Huntsman Tioxide, a petrochemical manufacturer of paint pigments, Teluk Kalung, Terengganu. In the picture are Dr. Pauzi and Mr. Lutfi, CEES engineer.

and another 250 sites at the southern and central regions for the second year. The logging activities have already started on November 2010 at a few areas in the northern region of Peninsular Malaysia. PQ monitoring activities started on January 2011 at 25 sites of the northern and eastern regions of Peninsular Malaysia and another 25 sites at the southern and central regions will be installed next year.

The team has published five papers in national and international conferences in 2010. In addition, two journal papers are in preparation.

Prof. Khalid presenting a paper at the IEEE International Conference on Harmonics and Quality of Power, ICHQP 2010, Bergamo, Italy.



Participants of the ICHQP 2010, reading a poster paper of the Power Quality and Reliability research team.

Energy Audit

- A preliminary energy audit was conducted by CEES in Faculty of Electrical Engineering (FKE) blocks from 26 April to 10 May 2010. The objective of this exercise is to identify the current status of electricity consumption and performances, including illumination, temperature and humidity level. These are some of the observations:
- Some rooms are very cold such as rooms in Block P08, while some are hot, e.g. Block P05. When the rooms are very clod, occupants tend to open their windows and doors. This contributed towards energy loss, thus should be properly addressed.
- Humidity level in most areas is within the acceptable level for comfort, i.e. between 30 to 60%.
- Lighting levels for working areas are adequate, i.e. within 300-500 lux. However, some of the lecturer rooms are poorly lighted.
- Some light fittings can be reduced, e.g. laboratory in Block P04.

Assoc. Prof Dr. Mohammad Yusri bin Hassan was appointed as the Energy Manager for the FKE effective from February 2011. His first initiatives as an Energy Manager is the launching of "EE Month" in March by the Faculty of Electrical Engineering Dean, Prof. Dr. Ir. Abdul Halim Bin Mohd Yatim. He was asked by the Director of Pejabat Harta Bina (Asset and Development Office), to present actions taken by the FKE at the University Management Group meeting on 7 March 2011.

Assoc. Prof Dr. Mohammad Yusri bin Hassan has been nominated by the Faculty of Electrical Engineering to attend an in-house Energy Management Training Course (EMTC) from 24-28 January 2011. The course was conducted by Green Tech (formerly known as Pusat Tenaga Malaysia). This workshop was organized to reduce the energy consumption in the campus. Since UTM is among the biggest consumer in Johor Bahru, it is incumbent that UTM has to appoint a certified energy manager as stipulated by the law.

Electrical Energy Markets and Generations Studies

The Electrical Energy Markets and Generations Studies (EEMGS) group of CEES conducts research relating to the electricity market models, electricity market deregulation issues, energy policy and generation studies. The group is currently doing research on finding the suitable locations for generation expansion (in terms of technical and economic aspects) for electricity system, which may later be applied for Malaysia Electricity Supply Industry. This research is funded by FRGS grant. Another ongoing research is on developing the competitive electricity market model for Malaysia. In many parts of the world, competitions have been introduced in electricity industry through different market models. As a response to this, the EEMGS group has to initiate studies in the electricity market related issues with regard to Malaysia's electricity supply industry.

Retirement

Thank you and congratulations to Assoc. Prof. Faridah bt. Mohd. Taha, Research Fellows of Centre of Electrical Energy Systems (CEES), who retired at the end of 2010. Upon her retirements, CEES organized retirement ceremony in gratitude and appreciation for her dedication and contribution since joining CEES on 1st March 2009. CEES looks forward to Assoc. Prof. Faridah support in the future as a consultant researcher.

Assoc. Prof. Faridah Taha receiving a momento from the CEES Director, watched by the Deputy Director, Dr. Mohammad Yusri

Journals Publications 2010

1. M.A. Almaktar, M. Y. Hassan, F. Hussein, Md. Shah Majid & M.P.Abdullah, "Equitable Allocation of Transmission Usage and Losses in Competitive Electricity Market", IST Transactions of Electrical Electronic Systems – Theory & Applications, Vol 1 (2), pp. 5-12, July 2010.
2. M.Y. Hassan, M.A. Almaktar, M.P.Abdullah , F. Hussein , Md. Shah Majid & H.A Rahman,"The Impact of Transmission Loss Component on Transmission Cost Recovery in Pool Electricity Markets", International Review of Electrical Engineering (I.R.E.E), Vol.5 , No.4 , pp. 1736-1746, August 2010.
3. H. Zeynal, A.K. Zadeh, K.M. Nor, M. Eidiani, "Locational Marginal Price (LMP) Assessment Using Hybrid Active and Reactive Cost Minimization", International Review of Electrical Engineering (I.R.E.E), Vol.5, No.5, pp. 2413-2418, October 2010.
4. Z.A. Muis, H.Hashim, Z.A.Manan & F.Taha, "Optimal Planning of renewable Energy Integrated electricity generation Scheme with CO2 Reduction target", Renewable Energy Vol.35, No.11, pp.2562-2570, October 2010.
5. M. Abdel-Akher, K. M. Nor, Fault Analysis of Multiphase Distribution Systems Using Symmetrical Components , *IEEE Transaction*, on *Power Delivery* vol. 25, no. 4, October 2010.
6. M. Shaaban, A Visual Simulation Environment for Teaching Power System Stability, *Int. Journal of Elect. Engineering Education*, vol. 47, no. 4, October 2010.
7. Wan Omar, W.Z. and Mansor, S. (2010) Current Human Capital Requirement of Aircraft Engineering in Malaysia. Jurutera, The Monthly Bulletin of The Institution of Engineers, Malaysia, Bil. 2010 No. 11, November 2010. Pp.10-15. The Institution of Engineers Malaysia and Dimension Publishing Sdn. Bhd., Petaling Jaya.

Research Opportunities for Postgraduate Student

Currently, CEES has received nearly RM250,000 FRGS grants from Ministry of Higher Education, MOHE, in various fields of research. In addition, CEES has received RM510,000 RU grants from UTM that will give the great opportunity for local students to pursue their postgraduate studies in various fields of interest. Besides, CEES members also applying grants from MOSTI to create more opportunities for international students. We are currently applying for a few more ERGS and FRGS.

CEES can also supervise research students under a MOHE program call 'MyBrain15' for the sponsorship of postgraduate study at the Masters & PhD levels. The objectives of the programs is to simulate and encourage graduate with a calibre to pursue their studies at the higher levels in key areas in line with the country's development plan. This will be simultaneous develop and maintain/retain human capital and catapult the transformation of Malaysia to a high income country.

Postgraduate research opportunities in the fields of:

Power System Engineering

Electrical Energy Markets and Generations Studies

Renewable Energy

Power Quality Engineering

End-user and Customer Side Energy Efficiency

Grid-Connected Cogeneration Systems

Join CEES to share our experience and enhance your knowledge from our expertise. Visit us www.fke.utm/cees

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