In Celebration of the Auspicious Occasion of His Majesty the King's 7th Cycle Birthday Anniversary, 5th December 2011

2011 International Conference & Utility Exhibition on Power and Energy Systems: Issues and Prospects for Asia (ICUE)

ICUE 2011

28-30 September 2011

AMARI ORCHID PATTAYA HOTEL, Pattaya City, Thailand

ASIAN INSTITUTE OF TECHNOLOGY

(Empowering Asia through post-graduate education)

PROVINCIAL ELECTRICITY AUTHORITY

(Thailand's biggest power distributor)

2ND AIT-PEA COLLABORATION

CONFERENCE PROCEEDINGS

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RATIONALE OF THE CONFERENCE

Research and development on power and energy systems are extremely needed for the challenging era of energy crisis. With limited resources and environmental concerns, collaborations of stakeholders are required to reach a sustainable goal. Particularly in a new emerging economy region like Asia, cooperation among Asian countries is very crucial for success on technology development and effective adaption.

Thus, the 2nd AIT-PEA International Conference & Utility Exhibition on Power and Energy Systems: Issues and Prospects for Asia (ICUE 2011) can be viewed as a platform to help strengthen relations between energy and power sector, utility providers, research institutions, universities, government institutions and non-government organizations. Also, it is a stage to exchange research ideas, experiences, technical issues, and emerging technologies in power and energy areas. Moreover, the exhibition could get together industry, utility, and academic people to directly discuss needs and measures for development.

After the success of the first PEA-AIT International Conference on Energy and Sustainable Development in 2010, ICUE 2011 is the second collaboration between the Asian Institute of Technology (AIT) and the Provincial Electricity Authority (PEA), Thailand, the country's leading power distributor. It will focus on power and energy system topics with particular emphasis on issues and prospects for Asia.

ICUE 2011 will cover academic, technical, economic, social and political dimensions of electric energy utilization and management that aims for Asian sustainable development. It would cover specific areas such as emerging technologies and research on power and energy systems, regional interconnections of energy resources, and Asian power grid issues.

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Regional Energy Resources and Information Center (RERIC)

Energy Field of Study, Asian Institute of Technology (AIT)

Provincial Electricity Authority, Thailand (PEA)

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THE ASIAN INSTITUTE OF TECHNOLOGY (AIT)

The Asian Institute of Technology promotes technological change and sustainable development in the Asia-Pacific region through higher education, research and outreach. Established in Bangkok in 1959, AIT has become a leading regional postgraduate institution and is actively working with public and private sector partners throughout the region and with some of the top universities in the world. Recognized for its multinational, multi- cultural ethos, the Institute operates as a self-contained international community at its campus located 40 km (25 miles) north of Bangkok, Thailand.

Vision
AIT will strive to become a leading and a unique regional multicultural institution of higher learning, offering state of the art education, research and training in technology, management and societal development.

Mission
The mission of AIT in the context of the emerging environment is "to develop highly qualified and committed professionals who will play a leading role in the sustainable development of the region and its integration into the global economy"

Guided by the above clear, timeless vision and mission, the dedicated students, faculty and staff of AIT are set to steer the Institute along its path of becoming:

- A trailblazer in advanced education in the region, with leadership in IT and new types of multidisciplinary programs
- An exemplary institution, with an emphasis on academic quality in terms of courses and other aspects of operation
- A leader in professional development programs
- A hub for the implementation of regional and transnational research projects, and a research facility for academic professionals. A nexus for networking with other academic and research institutions in the region and the world
- A model international citizen
- A collaborator and partner of national postgraduate institutions
- A financially viable, self-sustaining institution, able to draw support from donors the private sector and individuals, with good governance and strong leadership
- A strong partner to its alumni, who are principal stakeholders through the AIT Alumni Association (AITAA)

Key Facts and Figures

- 2300+ Students from 50 + Countries/Territories
- 18000+ Alumni from 85 Countries/Territories
- 28000+ Short-term Trainees from 70+ Countries/Territories
- 120 World Class Faculty from 20+ Countries
- 1000+ Courses
- 32 Fields of Study
- 3 Schools
- 15 Research and Outreach Centers
- 100+ Research Staff and 500+ Support Staff from about 30 Countries
- 500+ Support Staff
- 400 Research & Outreach Projects
- 330 Partners
- 33 Board of Trustee members from 19 Countries

AIT Offers

- Masters degrees: MBA, MEng, MSc
- Executive Master Degree Programs
- Doctoral Degrees: DEng, DTechSc, PhD
- Diploma and Certificate Programs
- An intensive English language and academic Bridging Program
- Non-degree continuing education courses for practicing professionals

THE PROVINCIAL ELECTRICITY AUTHORITY (PEA)

The Provincial Electricity Authority (PEA) is a government enterprise under the Ministry of Interior. It was established 51 years ago by a Royal Decree executed on September 20, 1960 and then published in the Government Gazette on September 27, 1960.

Objective

The PEA's three major objectives are:

1. To continue to improve its provision and distribution services of electric energy for customers: to achieve the highest possible level of sufficiency, efficiency and reliability in power distribution commensurate with safety practices; to meet the timely need of customers; and to keep pace with changing circumstances.
2. To optimize its business and operations in order to be more profitable and therby achieve sufficient revenues to facilitate further development.
3. To develop its organizational structure, man power and resource management in order to achieve the highest level of efficiency and effectiveness.

Service Area

The service area of the PEA is approximately 510,000 km^2, accounting 99 percent of the country. PEA has primary responsibilities in the provision and distribution of electricity and related services to the public, business and industrial sectors in 73 provinces (except Bangkok, Nonthaburi and Samut Prakarn provinces) and the neighboring countries. The PEA has grouped its service area into four (4) regions: North region, Northeast region, Central region, and South region.

There are over 900 PEA sub-offices scattered throughout the country, rendering services to more than 14 million customers through its nationawide electrical system network with state of the art and sophisticated equipment. PEA's service personnel comprise experienced and highly-skilled staff with expertise in both high-power network operation and organizational management.

PEA continues to make every effort for excellence to be at par with leading institutions of international standard in doing business in energy services and related services.

ABOUT RERIC

The Regional Energy Resources Information Center (RERIC) was established in 1978 as a result of recommendations made at various meetings held in Asia, and particularly those made at a meeting of experts in solar and wind energy utilization held in 1976 under the energy program of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).

RERIC collects, repackages, and disseminates information on energy and environmental issues related to energy. The Center's wide range of activities includes publishing, networking, consulting, and other information services for energy conservation and renewable energy promotion.

The current RERIC staffs are as follows:

Director:	Professor S. Kumar
Research/Information Professional:	Maria Kathrina B. Gratuito
Secretary:	Parichart Khammeerak

RERIC regularly publishes the International Energy Journal (IEJ) since 1979. It is a journal dedicated to the advancement of knowledge in energy by the vigorous examination and analysis of theories and good practices, and by encouraging innovations needed to establish a successful approach to solve identified problems. IEJ is a quarterly journal that publishes peer-reviewed papers on technical, socio-economic and environmental aspects of energy planning, energy conservation, renewable sources of energy, and electric power transmission, generation and management. The papers are reviewed by world renowned referees. IEJ also maintains an online journal system wherein not only current volumes are available but also archives containing past volumes and past special issues.

RERIC's occasional publications include conference/seminar/workshop proceedings, research reports, directories, environment systems reviewa, and do-it-yourself manuals. For more information about RERIC's publications, please visit www.serd.ait.ac.th/reric. Annual membership fees to RERIC entitle the members to hard copies of the International Energy Journal (IEJ) as well as access to the online journal system at www.rericjournal.ait.ac.th. Members also get 20% discount on other RERIC publications and a discounted rate to trainings/workshops/conference it organizes. Annual membership fees for year 2010 are as follows: USA, Canada, European countries, Australia, New Zealand, Japan, and Middle East *(Individual: US$ 130, Institutional: US$ 275)*; Thailand *(Individual: THB 1,500, Institutional: THB 5,000)*; all other countries not mentioned above *(Individual: US$ 85, Institutional: US$ 160).*

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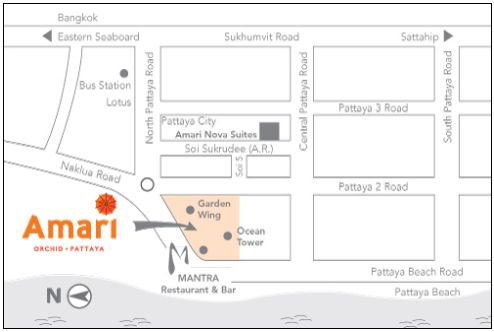
VENUE

Pattaya is a city in the province of Chonburi, Thailand. It is located on the east coast of the Gulf of Thailand, about 165 km southeast of Bangkok. Pattaya city is an internationally well-known seaside place. It is also a vibrant city by night and by day and offers a colorful potpourri of mixed nationalities from near and far. The city has a vast range of tourism-related activities. Pleasures of Pattaya are from relaxing on the beach, sea-based sports and local attractions in and around the city.

A beach lifestyle hotspot on the picturesque northern crescent of vibrant Pattaya Bay, Amari Orchid offers an array of seaside experiences from an idyllic Thai beach holiday, to destination dining among the fashionable crowd, to a laid-back barbecue party on the beach. The hotel's oceanfront location is five minutes away from the city's throbbing entertainment zone as well as museums, golf courses and other recreational activities.

OCEAN TOWER

GARDEN WING



SUMMARY OF ROOM ASSIGNMENTS

Bardolino (Ocean Tower)

Aranda Ballroom

Pathway to Garden Wing (Rimsuan and Cattleya)

Aranda Ballroom

Venue for:

= Opening Ceremony, Plenary Speech, Keynote Adresses, Closing Ceromony
= Session 1: Power System Simulation and Optimization
= Session 5: Artificial Intelligence Application to Power System
= Session 9: Energy Conversion and Thermodynamic Systems
= Session 12: FACT Devices and Power System Dynamics
= Session 15: Energy Security and Assessment

Rimsuan (near Garden Wing Lobby)

Venue for:

= Session 2: Smart Grids and Active Distribution Networks
= Session 6: Renewable Energy Technology and Management
= Session 10: Electrical Energy Deregulation and Management
= Session 13: Renewable Energy Development and Integration
= Session 16: Power Electronics and Energy System Equipments

Cattleya (near Garden Wing Lobby)

Venue for:

= Session 3: Machinery and Energy System Components
= Session 7: Energy Conservation and Management
= Session 11: Biofuel and Biogas Technologies
= Session 14: Energy and Environment
= Session 17: Solar Power and Dryer Technology

Bardolino (Ocean Tower)

Venue for:

= Sessions 4 and 8: Special Track on Smart Grid Development: Experiences and Benefits
(Sponsored by: Smart Thai Project with Funding from EU)

Plenary Speaker

Dr. Sumet Tantivejakul*
Secretary-General
Chaipattana Foundation
Sri Ayuttaya Road, Dusit, Bangkok, Thailand

* **Dr. Sumet Tantivejkul** was born in Petchaburi Province of Thailand in 1939. He obtained his Baccalaureat Philosophie from the Academie de Montpelier, France in 1962 and quickly backed it up with Diploma in Political Science from Grenoble University, France in 1966, and a PhD also in Political Science from the Montpelier University, France in 1969. He is also holder of Certificates in Economic Planning as well as in Economic Development Institute awarded by International Publique Administration Institute, Paris (1973) and World Bank (1982), respectively.

In his official capacity, he served as the Secretary-General of the Royal Development Projects Board of the Royal Kingdom of Thailand bfrom 1993-1999. He was also the Secretary-General of the National Economic and Social Development Board from 1994-1996. He also held several key positions as President of Petchaburi Rajabhat Institute Council, Chairman of the Clean, Open and Transparent Thailand Project, Chairman of the Thai Rice Foundation, Chairman of Sirindhorn International Environment Park Foundation, and President Thammasat University Council.

Due to his remarkable achievements he received several honors, some of them are: "Role Person of the Year 1994", Award for Oustanding Civil Affairs Adminiostrator 1995, Plaque of Honour for Excellence in Loyalty and Honesty from the Office of the Commission of Counter Corruption in 1997. His recent awards include: Oustanding National Figure in Economic Development in 1998, Father of the Year 2008, as well as the Award for "Best Human Relationships of the Year 2010" from the Human Relation Society.

Dr. Sumet holds Honary Doctorate Degrees in Liberal Arts, Rural Planning and Development, Community Development, Agricultural Resources, Economics, Philosophy and Political Science from several universities all over Thailand. He is also highly decorated with Royal Awards, the latest of which is the Knight Grand Cross (First Class) of the Most Illustious Order of Chula Chom Klao.

He is currently serving as the Secretary-General of The Chaipattana Foundation.

KEYNOTE ADDRESS 1

Smart Grid as an Enabler for Distributed Generation

Professor Saifur Rahman[†]
Joseph R. Loring Professor & Director
Virginia Tech Advanced Res. Inst.
Arlington, VA 22203, USA

Abstract:

While central station electric power plants have long provided the bulk of electricity in all industrialized and most developing countries, the traditional need for reliability of electricity supply is now being supplemented by the need for security and environmental sustainability. As many developing countries begin to industrialize to provide jobs and better living conditions to its citizens, the requirements for reliable, secure and environmentally sustainable supply of electricity becomes paramount. While fossil fuels have been the primary sources of electricity for the last one hundred years, their cost, uneven global distribution and global warming potential are encouraging world leaders to look for alternatives in renewable solar resources, which are distributed. But distributed generation sources have their own challenges - primarily intermittency. Many believe that the smart grid – due to its inherent communication, sensing and control capabilities – will have the ability to manage the load, storage and generation assets in the power grid to enable a large scale integration of distributed generation.

A smart grid will look more like the Internet, where information about the state of the grid and its components can be exchanged quickly over long distances and diverse networks. This will allow the grid integration of sustainable energy sources, such as wind, solar, off-shore electricity, etc. for smoother system operation. But in order for this to be possible, the electric utility will have to evolve and change their ways of operation to become an intelligent provider of these services. This lecture introduces the operational characteristics of renewable energy sources, and various aspects of the smart grid - technology, standards, regulations and data security – which are needed to effectively integrate these sources of electricity into the grid. This lecture also addresses the interplay among distributed generation and storage, conventional generation and demand response to provide an efficient operational strategy in the context of the smart grid.

[†]**Prof. Saifur Rahman** is the director of the Advanced Research Institute at Virginia Tech where he is the Joseph Loring Professor of electrical and computer engineering. He also directs the Center for Energy and the Global Environment at the University. He is a Fellow of the IEEE and the editor-in-chief of the IEEE Transactions on Sustainable Energy. In 2010 he is serving as the vice president for New Intiatives and Outreach for the IEEE Power & Energy Society and a member of its governing board. In 2006 he served as the vice president of the IEEE Publications Board, and a member of the IEEE Board of Directors. He is a distinguished lecturer of IEEE.

KEYNOTE ADDRESS 2

Strong and Smart Grid Drives Shanghai

Mr. Chen Fangzeng[‡]
Executive Vice President
Shanghai Municipal Electric Power Company (SMEPC)
State Grid Corporation of China
Shanghai, China

In this presentation, Mr. Chen Fangzeng first gives a brief introduction of Shanghai Municipal Electric Power Company, SGCC (State Grid Corporation of China), and then shares with ICUE 2011 participants the knowledge of the government and SGCC policies, plans, technologies and the latest developments of Strong and Smart grid and renewable energy in Shanghai.

Keywords: SGCC (State Grid Corporation of China), Shanghai, SMEPC, Strong and Smart Grid, Renewable Energy.

With nearly 40 years work experience in power industries, **Mr. Chen Fangzeng** is not only regarded as a respected leader, but also a faithful senior and friend by his colleagues in SMEPC. An expert in Management, especially in corporate governance and human resource management, Mr. Chen is a successful leader and has accomplished many management innovation projects in his presidency.

Besides his career life, Mr. Chen is also a delightful gentleman with many hobbies and roles. He is well known athlete, photographer, and most of all, the beloved husband and awesome father for his family.

He has a Bachelor of Science in Thermal Energy and Power Engineering as well as a Masters in Business Administration.

He started his engineering career as engineer of Shanghai Electric Power Authority in 1973-1984. After that he was involve in several electric companies such as Shanghai Electric Power Industrial Authority, Shanghai Shidongkou Power Plant. He also served as Vice President of the Northwest Electric Power Generation Company, China Guodian Corporation in 2000-2002.

KEYNOTE ADDRESS 3

Integrating Wind Generations to a Smart Grid Environment

Professor Sri Niwas Singh[§]
Department of Electrical Engineering
Indian Institute of Technology Kanpur
Kanpur, India

Abstract:

Due to the increased interconnections and loading of the network with liberization and environmental pressure, the power systems have become complex and facing many challenges in their optimal, secure and efficient operation. Smart grid initiatives seem to provide remedial measured to these problems by computational intelligence, automation, advanced measurements, and application of information and communication technology (ICT). Several countries have already taken the first step in the direction of smart grid by unbundling the power system to bring competition with the introduction of renewable energy sources. Future power system structure, operation, control and management will be quite different from the existing one as it will foresee large market players with direct involvement of consumers, more renewable energy sources and trading of electricity.

Wind power generation is emerging as one of the most successful programs in renewable energy sector, and has started making meaningful contributions to the overall power requirements in India and worldwide. Harnessing wind energy for electric power generation is an important area of research due to irreversible changes in the power system structure, operation, management and ownership. Wind power integration in the existing grid is one of the major concerns in the recent years due to increased penetration level of wind power generation which will have a significant influence on the operation and control of power systems. New grid codes are being set up by several countries to specify the relevant requirements to integrate the wind power generation in the existing electric power system. The grid connection regulations are to be developed in a more consistent and internationally harmonized manner to bring the accelerated growth, maximum efficiency and to reduce the cost.

The main objective of this talk is to discuss the major challenges in integrating the wind power generation in the smart grid environment. The talk provides a platform to an in-depth discussion on the various challenges and their possible remedies in smart grid initiatives which will benefit participants from academic and R&D institutions, engineers of utilities and policy makers.

[§]**Prof S. N. Singh**, who was born on 5th September 1966, obtained his M. Tech. and Ph. D. in Electrical Engineering from Indian Institute of Technology Kanpur, in 1989 and 1995, respectively. Presently, he is a Professor in the Department of Electrical Engineering, Indian Institute of Technology Kanpur, India. Before joining IIT Kanpur as Associate Professor, Dr Singh worked with UP State Electricity Board as Assistant Engineer from 8-8-1988 to 13-6-1996, with Rookree University (Now IIT Rookree) as Assistant Professor from 14-6-1996 to 1-1-2001 and with Asian Institute of Technology, Bangkok, Thailand as Assistant Professor from 2-1-2001 to 4-4-2003. Dr Singh received several awards including Young Engineer Award 2000 of Indian National Academy of Engineering, Khosla Research Award of IIT Roorkee, and Young Engineer Award of CBIP New Delhi (India), 1996. Prof Singh is receipt of Humboldt Fellowship of Germany (2005, 2007) and Otto-Monsted Fellowship of Denmark (2009-10).

His research interests include power system restructuring, FACTS, power system optimization & control, security analysis, wind power, etc. Prof Singh is a Fellow of Institution of Electronics and Telecommunication Engineers (IETE) India, a Senior Member of IEEE, USA, a Fellow of the Institution of Engineering & Technology (UK) and a Fellow of the Institution of Engineers (India).

Prof Singh has published more than 320 papers in International/national journals/conferences. He has also written two books one on Electric Power Generation, Transmission and Distribution and second is Basic Electrical Engineering, published by PHI, India.

KEYNOTE ADDRESS 4

KEPCO's Efforts Towards Realization of a Low-Carbon Society

Mr. Michiaki Uriu[**]
Executive Vice President, and
General Manager of Thermal Power Generation Division
Kyushu Electric Power Co., Inc.
Japan

Global warming issues have been growing in importance as a problem shared by all humankind. This trend calls for emission reductions of greenhouse gases, which are considered to be the cause of global warming. Kyushu Electric Power's keynote speech at the conference is entitled "Kyushu Electric Power's Efforts towards Realization of a Low-carbon Society" and introduces our approaches to "Efficient Use of Energy," "Proactive Development and Introduction of Renewable Energy" and "Technological Development," all of which are main pillars towards the actualization of a low-carbon society. "Efficient Use of Energy" focuses on our company's enhanced efficiency of thermal power generation. "Proactive Development and Introduction of Renewable Energy" deals with our efforts towards wind and photovoltaic power, biomass and geothermal power generation, while introducing our biomass power generation project overseas and geothermal binary power generation development. Finally, "Technological Development" focuses on our small isolated island microgrid verification testing, and smart grid verification testing, as well as our Intelligent House project, which is our customer-side scheme. In this connection, the challenge we have set towards the development of lithium-ion batteries which are essential to the development of EV quick charging and regular charging infrastructure as well as carbon reduction, is also introduced.

[**] **Mr. Michiaki Uriu** has been serving as Executive Vice President and General Manager of Thermal Power Generation Division in Kyushu Electric Power Company, Incorporated, as well as President and Representative Director in two subsidiaries, including KYUDEN ECOSOL CO., LTD., since June 2011. He joined the Company in April 1975 and used to serve as Managing Executive Officer, Manager of New Business Development Group, Manager of Energy Market Strategy Group, Manager of Power Trading Management Group, General Manager of Environmental Affairs Department, Executive Officer, and General Manager of Corporate Planning Department. He obtained his Master's degree in Industrial Mechanical Engineering from Osaka University in March 1975.

PRESENTATION SCHEDULES

Day 2: 29 September 2011

S 01: Power System Simulation and Optimization
Time: 13:00 – 14:30
Room Assignment: Aranda Ballroom

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 01.1	**Using a PSCAD Simulation Software in Calculating the Probability of Surge Protective Devices Failure in an Installation Served by Overhead Lines** *I. Hamzah[1] and A. Qisti Ramli[2]* [1]Public Works Department [2]College of Graduate Studies, Universiti Tenaga Nasional	Malaysia
S 01.2	**Optimization of Distribution Transformers Maintenance using the Ranking Method** *[1]M. E. Honarmand, [2]M. R. Haghifam, [1]H. Dousti Barhagh and [1]R. Pormoozeh Noveiri* [1]Guilan Electrical Power Distribution Company [2]Power Systems Department of Electrical Engineering, Tarbiat Modarres University	Iran
S 01.3	**Allocation Planning Tool for Determining the Optimal Location and Sizing of Distributed Generations in Provincial Electricity Authority of Thailand** *P. Saraisuwan, P. Jirapong, A. Kalankul and S. Premrudeepreechacharn* Department of Electrical Engineering, Faculty of Engineering, Chiang Mai University	Thailand
S 01.4	**Optimal Placement of UPFC for Maximizing System Loadability and Minimize Active Power Losses by NSGA-II** *[1]I Made Wartana[*], Student Member, IEEE, [2]Jai Govind Singh, Member, IEEE, [2]Weerakorn Ongsakul, Member, IEEE, [2]Kittavit Buayai, and Sasidharan Sreedharan* [1]National Institute of Technology (ITN), Indonesia. [2]Energy field of Study, SERD, Asian Institute of Technology, Pathumthani 12120, Thailand.	Indonesia and Thailand

S 02: Smart Grids and Active Distribution Networks
Time: 13:00 – 14:30
Room Assignment: Rimsuan (near Garden Wing Lobby)

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 02.1	**Development of Distributed Generation Assessment Tool Considering Multi-System Constraints for Evaluating Initial Grid Connection** *A. Kalankul, P. Jirapong, P. Saraisuwan and S. Premrudeepreechacharn* Department of Electrical Engineering, Faculty of Engineering, Chiang Mai University	Thailand
S 02.2	**An Overview of Smart Grid Technology in Bangladesh: Development and Opportunities**	Bangladesh

	[1]Tausif Ali, Ahmed Al Mansur[2], Zubaeer Bin Shams[2], S.M. Ferdous[2], Md. Ashraful Hoque[2] [1]Department of Electrical and Electronics Engineering (EEE), American International University of Bangladesh (AIUB) [2]EEE Department, Islamic University of Technology (IUT, OIC)	
S 02.3	**Design and Simulation of Active Antenna for Communication in Smart Grids** *[1]V. K. Sharma, [1]Harish Kumar, [2]Manish Sharma* [1]Department of Electronics & Electical Enginnering, Bhagwant Institute of Technology [2]Department of Electronics & Communication, Anand Engineering College	India
S 02.4	**A Multi-Agent Based Power System Restoration Approach in Distributed Smart Grid** *Warodom Khamphanchai, Songkran Pisanupoj, Weerakorn Ongsakul, Member, IEEE and Manisa Pipattanasomporn, Member, IEEE* Energy Field of Study, SERD, Asian Institute of Technology	Thailand

S 03: Machinery and Energy System Components
Time: 13:00 – 14:30
Room Assignment: Cattleya (near Garden Wing Lobby)

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 03.1	**Performance of a Quarter-Pitch Twisted Savonius Turbine** *Md. Imtiaj Hassan, Nahidul Khan* Faculty of Engineering, Memorial University	Canada
S 03.2	**Operational Experience of the Polygeneration Plant in Parc de l'Alba (Spain): Start-up and First Results** *J. Ortiga, J. C. Bruno and A. Coronas* Department of Mechanical Engineering, Universitat Rovira I Virgili	Spain
S 03.3	**A New Method for Balancing a Three-phase Induction Motor Supplied by a Single-phase Source** *Yaw-Juen Wang, Senior Member, IEEE, and Hong-Cheng Zhou* Department of Electrical Engineering, National Yunlin University of Science and Technology	Taiwan
S 03.4	**Analytical Modeling of Pulsating Torques of Induction Motors Caused by Supply Voltage Unbalance** *[1]Yaw-Juen Wang, Senior Member, IEEE, [2]Ming-Hsueh Lee, and [1]Sheng-Wen Sung* [1]Department of Electrical Engineering, National Yunlin University of Science and Technology [2]Graduate School of Engineering Science and Technology, National Yunlin University of Science & Technology	Taiwan
S 03.5	**The Optimal Energy and Environmental Management Criteria of Used Induction Motor in Thailand to Enhance Economic Value** *[1]Arnon Poungching-ngam, [1]Bunchar Hongpeechar, [1]Wichit Krueasuk, [1]Kitti Tirawannawit, [1]Pornrapeepat Bhasaputra and [2]Woraratana Pattaraprakorn* [1]Department of Electrical and Computer Engineering, Faculty of Engineering, Thammasat University [2]Department of Chemical Engineering, Faculty of Engineering, Thammasat University	Thailand

S 04 and S 08: Special track on "Smart Grid Development: Experiences and Benefits"
Time: 14:30 – 17:45
Room Assignment: Bardolino (Ocean Tower)
Moderator: Alan Dale Gonzales, Chairman, WADE Thai

14:30 – 14:45	Welcome Remarks: EC Representative
14:45 – 15:30	Smart Grid Fundamental and Benefits (Speaker: Mr. Sridhar Samudrala, Director for Asia - WADE)
15:30 – 16:15	EU and Global Experiences in Smart Grid (Speaker: Mr. Sridhar Samudrala, Director for Asia - WADE)
16:15 – 16:30	*Coffee Break*
16:30 – 17:30	Brief Presentations and Panel Discussion (Representatives from EGAT, PEA, MEA, ERC, EPPO and DEDE)
15:30 – 16:15	Wrap up and Closing

S 05: Artificial Intelligence Application to Power System
Time: 14:30 – 16:00
Room Assignment: Aranda Ballroom

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 05.1	**Transmission Line Faults Detection, Classification and Location using Artificial Neural Network** *Eisa Bashier M. Tayeb and Omer A/Aziz A/Rhim* Electrical Engineering Department, College of Engineering, Sudan University of Science and Technology	Sudan
S 05.2	**Automation of Interconnected Power System using Fuzzy Controller** *Eisa Bashier M. Tayeb* Sudan University of Science and Technology, College of Engineering	Sudan
S 05.3	**A Hybrid Approach Based on PSO and EP for Proficient Solving of Unit Commitment Problem** *[1]R. Lal Raja Singh and [2]C. Christober Asir Rajan* [1]Department of EEE, Sathyabama University [2]Department of EEE, Pondicherry Engineering College	India
S 05.4	**Adaptive Wavelet Neural Network Based Harmonic Estimation of Single-Phase Systems** *[1]Sachin K. Jain, Student Member, IEEE, [2]D. Saxena, [1]S. N. Singh, Senior Member, IEEE* [1]Department of Electrical Engineering, Indian Institute of Technology Kanpur [2]Invertis University	India
S 05.5	**Wavelet Decomposition based FINN Model for Short Term Load Forecasting** *[1]Ajay Shekhar Pandey, [2]Devender Singh, [1]S. K. Sinha and [3]S. N. Singh* [1]Department of Electrical Engineering, Kamla Nehru Institute of	India

	Technology [2]Department of Electrical Engineering, Institute of Technology, Banaras Hindu University [3]Department of Electrical Engineering, Indian Institute of Technology

S 06: Renewable Energy Technology and Management
Time: 14:30 – 16:00
Room Assignment: Rimsuan (near Garden Wing Lobby)

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 06.1	**Accelerated Starting by Motoring a Grid-Connected Small Wind Turbine Generator** *[1]Mohamed Aner, Student Member, IEEE, [1]Edwin Nowicki, Member, IEEE, and [2]David Wood* [1]Department of Electrical and Computer Engineering, University of Calgary [2]Department of Mechanical and Manufacturing Engineering, University of Calgary	Canada
S 06.2	**Development of Electrical Behavioral Model of an Arbitrary Solar Cell to Amend the PSPICE Simulation Performance** *[1]Muhammad Towhidur Rahman, [2]Ahmed Al Mansur, [3]Nahyan Al Mahmud, [4]Mahmoodul Islam, and [5]Taskin Jamal* [1]Electrical and Electronic Engineering (EEE) Department, The University of Asia Pacific [2]EEE Department, Islamic University of Technology [3] EEE Department, Ahsanullah University of Science and Technology [4]EEE Department, American International University [5]Asian Institute of Technology	Bangladesh and Thailand
S 06.3	**An Experimental Investigation of the Real Time Electrical Characteristics of a PV Panel for Different Atmospheric Conditions in Islamic University of Technology (OIC), Gazipur, Bangladesh** *Ahmed Al Mansur, S.M. Ferdous, Zubaeer Bin Shams, Md. Rokibul Islam, Mohammad Rokonuzzaman, Md. Ashraful Hoque* Electrical and Electronic Engineering (EEE) Department, Islamic University of Technology (IUT, OIC)	Bangladesh
S 06.4	**Analysis of a Partially Shaded PV Array Considering Different Module Connection Schemes and Effects of Bypass Diodes** *Yaw-Juen Wang, Senior Member, IEEE and Shu-Syuan Lin* Department of Electrical Engineering, National Yunlin University of Science and Technology	Taiwan
S 06.5	**Patented Twintex® Hybrid PV/T Collector: Level of Performances and Comparison with Thermal Solar Collector** *C. Cristofari, J. L. Canaletti and G. Notton* University of Corsica, Georges Peri Laboratory	France

S 07: Energy Conservation and Management
Time: 14:30 – 16:00
Room Assignment: Cattleya (near Garden Wing Lobby)

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 07.1	**The Ventilation System for Energy Conservation of Telephone Exchange in Thailand** *Somkuan Rimsmutchai[1], Natapongkorn Pawanawichien[1], Pornrapeepat Bhasaputra[1] and Woraratana Pattaraprakorn[2]* [1]Department of Electrical and Computer Engineering, Faculty of Engineering, Thammasat University [2]Department of Chemical Engineering, Faculty of Engineering, Thammasat University	Thailand
S 07.2	**The Optimal Energy Management of Sign Lighting System for Small and Medium Sizes of Bank in Thailand** *[1]Chaiyapat Kumpeerakupt, [1]Somkuan Rimsmutchai, [1]Natapongkorn Pawanawichien, [1]Surasak Panjavaranont, [1]Pornrapeepat Bhasaputra and [2]Woraratana Pattaraprakorn* [1]Department of Electrical and Computer Engineering, Faculty of Engineering, Thammasat University [2]Department of Chemical Engineering, Faculty of Engineering, Thammasat University	Thailand
S 07.3	**Energy Audit of a 400/220 kV Substation – a Case Study** *[1]Sunil M. Jaralikar and [2]Mangalpady Aruna* [1]Electrical Engineering Department, Government Polytechnic–Bicholim [2]Mining Engineering Department, National Institute of Technology	India
S 07.4	**The Optimal Design of Lighting Systems for Designated Office Building in Thailand According to Ministerial, the Type or Size of Building Standards and Rules and Procedures, Building Design for Energy Conversation, Act B.E.2552** *[1]Surasak Panjavaranont, [1]Pornrapeepat Bhasaputra, [2]Woraratana Pattaraprakorn, [1]Kitti Tirawannavit, [1]Chaiyapat Kumpeerakupt, [1]Somkuan Rimsmutchai, [1]Natapongkorn Pawanawichien* [1]Department of Electrical and Computer Engineering, Faculty of Engineering, Thammasat University [2]Department of Chemical Engineering, Faculty of Engineering, Thammasat University	Thailand
S 07.5	**Energy Management for Light System in the Convenience Stores: Case Study of Gas Station in Thailand** *[1]Kitti Tirawannavit, [1]Wichit Krueasuk, [1]Pornrapeepat Bhasaputra, Woraratana [2]Pattaraprakorn* [1]Department of Electrical and Computer Engineering, Faculty of Engineering, Thammasat University [2]Department of Chemical Engineering, Faculty of Engineering, Thammasat University	Thailand

S 09: Energy Conversion and Thermodynamic Systems
Time: 16:15 – 17:45
Room Assignment: Aranda Ballroom

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 09.1	**Effect of Aqueous Denatured Spirit on Engine Performance and Exhaust Emissions** *[1]P. A. Hubballi, and [2]T.P. Ashok Babu* [1]B. V. B. College of Engineering and Technology [2]National Institute of Technology Karnatak	India
S 09.2	**Effect of Inclined Ribs on Heat Transfer Behavior in a Square Channel** *S. Skullong, P. Chaidilokpattanakul and P. Promvonge* Department of Mechanical Engineering, Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang	Thailand
S 09.3	**Thermal Performance Enhancement in Solar Air Heater Channel with Periodically V-shaped Baffles** *C. Khanoknaiyakarn, S. Kwankaomeng and P. Promvonge* Department of Mechanical Engineering, Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang	Thailand
S 09.4	**Influences of Twisted-Tape with Parallel Rectangular-Wing on Thermal Performance of a Heat Exchanger** *[1]P. Eiamsa-ard, [1]C. Thianpong and [2]S. Eiamsa-ard* [1]Department of Mechanical Engineering, Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang [2]Department of Mechanical Engineering, Faculty of Engineering, Mahanakorn University of Technology	Thailand
S 09.5	**Effect of Load Level on the Performance of a Biodiesel Run Dual Fuel CI Engine Using Second Law Analysis** *Sumita Deb Barma, Biplab Das and Asis Giri* Department of Mechanical Engineering, North Eastern Regional Institute of Science and Technology	India

S 10: Electrical Energy Deregulation and Management
Time: 16:15 – 17:45
Room Assignment: Rimsuan (near Garden Wing Lobby)

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 10.1	**Electricity Retail Price in Competitive Market using the Risk-Adjusted Capital Asset Pricing Model (CAPM): a Case of Thailand** *[1]Pasapong Gamonwet and [2]Charles O.P. Marpaung* [1]Provincial Electricity Authority (PEA) [2] Asian Institute of Technology (AIT)	Thailand
S 10.2	**Water Valuation in Vietnamese Electric Power Generation Market** *D. X. Duc, Jai Govind Singh, Member, IEEE*, and Weerakorn Ongsakul, *Member, IEEE* Asian Institute of Technology	Thailand
S 10.3	**Determining Market Clearing Price using Graphical Analysis - Impact of Loss as a Case Study**	India

	[1]S. Prabhakar Karthikeyan, [1]Sathish K. Kumar, [1]Y. Janakinadh, [1]V. V. Raviteja, [2]I. Jacob Raglend, [3]D. P.Kothari [1]School of Electrical Engineering, VIT University [2]Department of Electrical and Electronics Engineering, NI University [3]Vindhya Group of Institutions	
S 10.4	**Well-Organized Preconditioner for Solving Load Flow Problems by GMRES** *[1]Carlos E. Portugal, [1]Ricardo B. Prada and [2]José E. O. Pessanha* [1]Department of Electrical Engineering, Catholic University of Rio de Janeiro [2]Power Quality Laboratory, Department of Electrical Engineering, Federal University of Maranhão	Brazil
S 10.5	**GA-based Congestion Management in Deregulated Power System using FACTS Devices** *Deependra Singh and K. S. Verma* Department of Electrical Engineering, Kamla Nehru Institute of Technology	India

S 11: Biofuel and Biogas Technologies
Time: 16:15 – 17:45
Room Assignment: Cattleya (near Garden Wing Lobby)

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 11.1	**Situation Analysis in the Construction and Operation of Biogas Plant: a Case Study at the Open University of Sri Lanka** *[1]N.S. Senanayake, [1]T.S.S. Jatunarachchi, and [2]Y. Pathiraja* [1]Open University of Sri Lanka (OUSL) [2]National Engineering Research and Development (NERD) Center	Sri Lanka
S 11.2	**Investigation of the Phorbol Ester Content in High Quality Biodiesel Production Process** *Parncheewa Udomsap, Thitimapond Duangmanee and Nuwong Chollacoop* National Metal and Materials Technology Center (MTEC)	Thailand
S 11.3	**Towards Stabilization of Bio-oil by Addition of Antioxidants and Solvents, and Emulsification with Conventional Hydrocarbon Fuels** *[1]Parncheewa Udomsap, [2]Yapp Hionk Yeinn, [2]Johnny Tiong Hok Hui, [1]BoonyawanYoosuk, [2]Suzana Bt Yusuf, and [1]Sittha Sukkas*i [1]National Metal and Materials Technology Center, [2]Universiti Teknologi Petronas	Thailand and Malaysia
S 11.4	**Catalytic Pyrolysis Using Catalyst Nickel-Natural Zeolite (Ni/NZA) on Conversion of Biomass to Bio-Oil** *[1]Syaiful Bahri, [1]Sunarno, [2]Muhdarina and [1]Rafebria Dwi Anugra* [1]Chemical Reaction Engineering Laboratory, Department of Chemical Engineering, Faculty of Engineering, University of Riau [2]Physical Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, University of Riau	Indonesia
S 11.5	**Grape Stalk Briquettes as an Alternative Feedstock of Biomass Gasifiers** *Dilip R. Pangavhane* Prestige Institute of Engineering and Sciences	India

Day 3: 30 September 2011

S 12: FACT Devices and Power System Dynamics
Time: 13:00 – 14:30
Room Assignment: Aranda Ballroom

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 12.1	**Development of a Dynamic Model of Solar Farm and Its Impact on Weak Power System** *[1]Rakibuzzaman Shah, Student Member, IEEE, [2]N.Mithulananthan, Senior Member, IEEE, and [3]Arthit-Sode-Yome, Member, IEEE* [1]School of Information Technology and Electrical Engineering, The University of Queensland, Australia [2] School of Information Technology and Electrical Engineering, University of Queensland, Australia [3]Siam University, Thailand	Australia and Thailand
S 12.2	**Study on Voltage Stability of Island Grid Supplied by Large Grid with Long Submarine Cables Considering Different Load Patterns** *[1]Chih-Ju Chou, [1]Chia-Yu Han, [2]Yuan-Kang Wu, Member, IEEE, and [3]Ching-Yin Lee* [1]Department of Electrical Engineering, National Taipei University of Technology [2]National Penghu University [3]Tungnan University	Taiwan
S 12.3	**Performance Analysis and Tuning of FACTS Controllers in Tandem with PSS in a Power System Network** *Avinash Srivastava and S. Dawnee* M S Ramaiah Institute of Technology	India
S 12.4	**Accurate Circuit Model for Steady-State and Dynamic Performance of Lead-Acid AGM Batteries** *W. Peng, Student Member, IEEE, and Y. Baghzouz, Senior Member, IEEE* Nevada University	USA
S 12.5	**A Design and Construct an Electric Circuit to Emulate Power System Oscillation in Tie-Line Systems** *[1]K. Prasertwong and [2]S. Dangeam* [1]Department of Electrical Engineering, Srinakharinwirot University [2]Department of Electrical Engineering, Rajamangala University of Technology Thanyaburi	Thailand

S 13: Renewable Energy Development and Integration
Time: 13:00 – 14:30
Room Assignment: Rimsuan (near Garden Wing Lobby)

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 13.1	**Hybrid Renewable Energy Systems for Energy Security Using Optimization Technique** *Anis Afzal, Harish Kumar, V.K. Sharma* Aligarh Muslim University India Gautam Budh Technical University	India
S 13.2	**Integrated Renewable Energy Solutions for Aquaculture**	Finland,

	Processing; ENERFISH *[1]Hidde Ronde, [1]Aulis Ranne, [2]Eric Peirano, [3]Ian Byrne and [4]Huy Le Duc* [1]Technical Research Centre of Finland VTT [2]Technofi, Atlantis, France [3]National Energy Foundation, United Kingdom [4]Energy Conservation Centre HCMC, Vietnam	France, United Kingdom and Vietnam
S 13.3	**Methodology for Enhancing the Assessment of Opportunities in Renewable Energy Resources with Study Case** *Barnabé da Silva Jr., Prof. Dr. Miguel E. M. Udaeta and Prof. Dr. Luiz C. R. Galvão* School of Engineering, University of São Paulo – EPUSP, Brazil.	Brazil
S 13.4	**Electricity Generation from Micro Hydro Turbine: A Case Study of Crossflow Turbine** *Yuttachai Keawsuntia* Department of Mechanical Engineering, Faculty of Engineering, Vongchavalitkul University	Thailand
S 13.5	**Feasibility Study of Micro Hydro Power Plant for Rural Electrification in Thailand by Using Axial Flux Permanent Magnet** *[1]Bunchar Hongpeechar, [1]Wichit Krueasuk, [1]Arnon Poungching-ngam, [1]Pornrapeepat Bhasaputra and [2]Woraratana Pattaraprakorn* [1]Department of Electrical and Computer Engineering, Faculty of Engineering, Thammasat University [2]Department of Chemical Engineering, Faculty of Engineering, Thammasat University	Thailand

S 14: Energy and Environment
Time: 13:00 – 14:30
Room Assignment: Cattleya (near Garden Wing Lobby)

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 14.1	**CO_2 Mitigation in Thailand's Nationally Appropriate Mitigation Actions (NAMAs): Policy Analyses of Power Generation** *[1]N. Sritong, [2]A. Pattanapongchai, [1]P. Winyuchakrit, [3]P. Peerapong and [4]B. Limmeechokchai* [1]Sirindhorn International Institute of Technology, Thammasat University [2]Ministry of Industry [3]Sirindhorn International Institute of Technology, Thammasat University [3]Energy Technology, Sirindhorn International Institute of Technology, Thammasat University [4]Mechanical Engineering Program, Sirindhorn International Institute of Technology, Thammasat University	Thailand
S 14.2	**The Evaluation of Economic and Social Effect from the Revised Nuclear Power Plant Planning in Thailand** *[1]Vivat Chutiprapat, [2]Woraratana Pattaraprakorn, and [1]Pornrapeepat Bhasaputra* [1]Department of Electrical Engineering, Faculty of Engineering, Thammasat University [2]Department of Chemical Engineering, Faculty of Engineering, Thammasat University	Thailand

S 14.3	**Production of Thermoelectric Power from the Solid Waste of Bhangalii Village** *Mohammad Rafiq Khan and Moeez Burhan* Lahore School of Economics	Pakistan
S 14.4	**Production of Thermoelectric Power from Solid Waste of Urban Lahore** *Mohammad Rafiq Khan and Haris Tanveer* Lahore School of Economics	Pakistan
S 14.5	**Biogas as an Option for a Low Carbon Campus: a Case Study at AIT** *Wipawan Thammachataree and P. Abdul Salam* Asian Institute of Technology	Thailand

S 15: Energy Security and Assessment
Time: 14:45 – 16:15
Room Assignment: Aranda Ballroom

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 15.1	**Assessment of Energy Security and Low Carbon Society Scenarios in Thailand and Sri Lanka** *Sujeetha Selvakkumaran and Bundit Limmeechokchai* Sirindhorn International Institute of Technology, Thammasat University	Thailand
S 15.2	**Assessment of Thailand's Energy Policies on Energy Security** *Sujeetha Selvakkumaran and Bundit Limmeechokchai* Sirindhorn International Institute of Technology, Thammasat University	Thailand
S 15.3	**Assessment of Renewable Energy Potential in India: A Review** *Sumedha Chakma, and R. C. Vaishya, Alok Kumar Yadav, Pooja* Civil Engineering Department, Motilal Nehru National Institute of Technology	India
S 15.4	**Technical and Developable Wind Energy Potentials over Bangkok Province, Thailand** *[1]Carina P. Paton and [2]Kasemsan Manomaiphiboon* [1]Joint Graduate School of Energy and Environment (JGSEE), King Mongkut's University of Technology Thonburi [2]Center for Energy Technology and Environment, Ministry of Education, Thailand.	Thailand

S 16: Power Electronics and Energy System Equipments
Time: 14:45 – 16:15
Room Assignment: Rimsuan (near Garden Wing Lobby)

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 16.1	**Multilevel Grid-Connected Inverter Performance under Different Modulation Strategies** *Mohan V. Aware, Member, IEEE and Jayant J. Mane* Department of Electrical Engineering, Visvesvaraya National Institute of Technology	India
S 16.2	**Comparison of CFL and LED Lamp – Harmonic Disturbances, Economics (Cost and Power Quality) and Maximum Possible**	India

	Loading in a Power System *Victor George, Aayush Bagaria, Prakash Singh, Sankalp Rajeev Pampattiwar and Swati Periwal* Department of Electrical and Electronics Engineering, MSRIT	
S 16.3	**The Influence of the Applied Rotor Voltage on Ride-Through Capability of Doubly Fed Induction Generator** *[1]Maurício B. C. Salles, Member, IEEE, [2]Ahda P. Grilo, [1]José Roberto Cardoso, Member, IEEE and [1]Ludwig Lopez Lessa* [1]Applied Electromagnetism Laboratory (LMAG), Polytechnic School of the University of São Paulo (POLI-USP) [2]Engineering, Modelling and Applied Social Science Centre (CECS), Federal University of ABC (UFABC)	Brazil
S 16.4	**Experimental Studies on Velocity Field around Wind Turbine Rotor** *Y. Kamada and T. Maeda* Division of Mechanical Engineering, Graduate School of Mie University	Japan
S 16.5	**Measurement of Grounding Resistance by Triangular Grid in Brunei Darussalam** *M. A. Salam, Senior Member, IEEE, Saifulbahri Jaafar and Md. Izhermi* Department of Electrical and Electronic Engineering, Faculty of Engineering, Institute Technology Brunei	Brunei Darussalam

S 17: Solar Power and Dryer Technology
Time: 14:45 – 16:15
Room Assignment: Cattleya (near Garden Wing Lobby)

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 17.1	**Solar Electric Power Generator (SEPG) as a Solution for Peak Load in Household Sector as Energy Conservation System: a Case Study in Pekanbaru City of Indonesia** *Nurhalim, Azriyenni, Firdaus and Syaiful Bahri* Department of Electrical Engineering, Faculty of Engineering, University of Riau	Indonesia
S 17.2	**Quality Enhancement of Dehydrated Products through the Modification of Solar Tunnel Dryer for Continuous Operation in Rural Communities** *[1]P. N. R. J. Amunugoda, [2]N. S. Senanayake, [1]R. S. Wilson Wijeratnam, and [2]K.D.G. Kulatunga* [1]Industrial Technology Institute (ITI) of Sri Lanka [2]The Open University of Sri Lanka (OUSL)	Sri Lanka
S 17.3	**Thermal Performance Optimization of Smooth Flat Plate Solar Air Heater (SFPSAH) using Simulated Annealing: Evaluation and Comparisons** *Siddhartha, Sant Ram Chauhan, Varun Goel and Naveen Sharma* National Institute of Technology	India
S 17.4	**Performance Evaluation of Solar Crop Dryer Integrated with Solar Air Heater** *Varun Goel*	India
S 17.5	**A New Approach for Designing a Hybrid Solar Concentrator** *J.L. Canaletti, C. Cristofari, G. Notton and J. Panighi* University of Corsica, Georges Peri Laboratory	France

DETAILED ABSTRACTS

S 01: Power System Simulation and Optimization
Time: 13:00 – 14:30
Room Assignment: Aranda Ballroom

S 01.1

Using a PSCAD Simulation Software in Calculating the Probability of Surge Protective Devices Failure in an Installation Served by Overhead Lines

I. Hamzah[1] and A. Qisti Ramli[2]
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Surge protective devices (SPDs) are used in protecting low voltage distribution networks against lightning strike. Lightning strike not only produces overvoltage but also comes with discharge current. Even if the voltage is clamped by the SPD, the discharge current from the lightning strike may cause SPD to fail. Normally, people look at clamping voltage (voltage protection level) without looking properly at the maximum allowable energy of SPD. This paper looks in the SPDs failure on the low voltage installation which been served by overhead lines. In this paper, the work is done in order to calculate the probability of SPDs failure based on the actual lightning data in Malaysia. The peak current is a probability phenomenon. By looking at the probability of lightning peak current and location of those lightning activities, it is possible to calculate the kind of induced voltage to appear on the electrical installation. From the calculated results, a better selection of SPD size to be installed can be assured.

S 01.2

Optimization of Distribution Transformers Maintenance using the Ranking Method

[1]M. E. Honarmand, [2]M. R. Haghifam, [1]H. Dousti Barhagh and [1]R. Pormoozeh Noveiri
[1]Guilan Electrical Power Distribution Company, P.O. 41635-3554, Emam Boulevard, Rasht, Guilan, Iran.
[2]Professor, Power Systems Department of Electrical Engineering, Tarbiat Modarres University, Tehran, Iran.
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Considering the importance of distribution network transformers, their maintenance always have been of important issues in electrical power industry, as well as transformers performance in different levels has an effective and key role in maintaining stability and promoting the distribution network reliability. But several factors, such as incorrect operation, lack of survey and on timely review led to the creation of critical conditions for transformers. This critical conditions, in addition to leading to transformers life reduction or increasing repair costs, can sometimes led them failure of transformers and also consequently increasing distribution network interruption and energy not served.

S 01.3

Allocation Planning Tool for Determining the Optimal Location and Sizing of Distributed Generations in Provincial Electricity Authority of Thailand

P. Saraisuwan, P. Jirapong, A. Kalankul and S. Premrudeepreechacharn
Department of Electrical Engineering, Faculty of Engineering, Chiang Mai University, Chiangmai, 50200, Thailand.
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Distributed generations (DG) can be used to enhance power generation systems and improve distribution system efficiency. However, the installation of DG units at non-appropriate location and sizing can result in negative impacts such as an increasing in power losses and violations of system constraints. In this paper, a new DG allocation planning tool is developed for determining the optimal location and sizing of DG in practical distribution systems. The proposed planning tool is developed by writing DIgSILENT Programming Language (DPL) script in DIgSILENT PowerFactory software. The optimally placed optimal power flow (OPF) with DG is formulated as a minimization of energy losses function and a maximization of benefit to cost ratio, subjected to system constraints including real and reactive power generation, line and transformer loading, voltage profile, step voltage change, reverse power, energy losses, short circuit level, and DG operating limits. All possible locations and sizes of DG installations are evaluated and then the optimal solution is selected from the best objective function value obtained. Test results on the practical 9-bus and 437-bus distribution systems taken from Provincial Electricity Authority (PEA) of Thailand indicate that the proposed planning tool can be used to determine the optimal DG allocation without violation of system constraints.

S 01.4

Optimal Placement of UPFC for Maximizing System Loadability and Minimize Active Power Losses by NSGA-II

[1]Made Wartana[*], Student Member, IEEE, [2]Jai Govind Singh, Member, IEEE, [2]Weerakorn Ongsakul, Member, IEEE, [2]Kittavit Buayai, and Sasidharan Sreedharan
[1]National Institute of Technology (ITN), East Java-65145, Indonesia.
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This paper presented application of a new variant of Genetic Algorithm, specialized in multi-objective optimizations problem known as Non-dominated Sorting Genetic Algorithm II (NSGA-II), to obtain the optimal allocation of Unified Power Flow Controller (UPFC) for enhancing the power system loadability as well as minimizing the active power loss in transmission line. An Optimal Power Flow (OPF) problem with mixed integer programming has been formulated for optimizing the above two objectives as well as obtaining the optimal location of the UPFC while maintaining the system security and stability margins, e.g., small signal stability, voltage stability index, and line stability factor. In addition, a fuzzy based mechanism has been employed to extract the best compromise solution from the Pareto front. The effectiveness of the proposed methodology has been investigated on a standard IEEE 30-bus and practical Java-Bali 24-bus of Indonesian systems. Results demonstrate that the static and dynamic performances of the power system can be effectively enhanced by the optimal allocation of the UPFC. Moreover, UPFC installation cost is also calculated and overall performance has been compared with existing method.

S 02: Smart Grids and Active Distribution Networks
Time: 13:00 – 14:30
Room Assignment: Rimsuan (near Garden Wing Lobby)

S 02.1

Development of Distributed Generation Assessment Tool Considering Multi-System Constraints for Evaluating Initial Grid Connection

A. Kalankul, P. Jirapong, P. Saraisuwan and S. Premrudeepreechacharn
Department of Electrical Engineering, Faculty of Engineering, Chiang Mai University, Chiangmai, 50200, Thailand.
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Assessment of distributed generation (DG) is a complicated task and it is a primary importance step in designing and planning of DG installation in distribution systems. The installation of DG units at non-appropriate location and sizing can result in an increasing in power losses and violations of system constraints. In this paper, a new DG assessment tool is developed for studying and evaluating DG installations in practical distribution systems. The assessment tool is developed by writing DIgSILENT Programming Language (DPL) script in DIgSILENT PowerFactory software. The tool is used for evaluating initial grid connection of DG, considering multi-system constraints- i.e. types of DG units, location, sizing, system loading, reverse power, voltage regulation, step voltage change, short circuit level, and energy losses. Two practical distribution systems including 9-bus system and 410-bus system from Provincial Electricity Authority (PEA) of Thailand are used as case studies. Test results show that the proposed assessment tool which relies on PEA regulation of DG connection can be used to evaluate the specified DG installation.

S 02.2

An Overview of Smart Grid Technology in Bangladesh: Development and Opportunities

[1]Tausif Ali, Ahmed Al Mansur[2], Zubaeer Bin Shams[2], S.M. Ferdous[2], Md. Ashraful Hoque[2]
[1]Department of Electrical and Electronics Engineering (EEE), American International University of Bangladesh (AIUB), Dhaka Bangladesh.
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Generally smart grid is a modern technology of power system which can convert the whole power system in to digital format. In brief, a smart grid is the use of sensors, communications, computational ability and control in some form to enhance the overall functionality of the electric power delivery system. A system becomes smart by sensing, communicating, applying intelligence, exercising control and through feedback. For an ideal power system, this permits several functions which can optimize in the combination of the use of bulk generation and storage, transmission, distribution, and consumers. It can fulfill the goal which can ensure reliability and optimization of the use of Energy. It will also keep the environment free from pollution, save the assets, minimize the cost, easy operation against all hazards, maximum possibility to keep out from danger, provides power quality for 21st century needs. The focus of this paper is to familiarize with smart grid perspective to Bangladesh. The conception of smart grid is almost new is Bangladesh. The whole power system network in Bangladesh is very elaborate and complex but primitive. To reduce this complexity and improve the performance of the system, smart grid can be a better solution. Load-shedding is a common phenomenon in Bangladesh. It can be solved by smart grid technology. As it can automatically detect, calculate and distribute electricity as per load requirements, it reduces the system loss and at the same time a certain amount of electricity from the grid would always be available at each consumer side even at the time of load shedding. Bangladesh can be greatly benefited by using this technology. The main

objective of this paper is to discuss the necessity of smart grid for the perspective of Bangladesh which may be an effective solution to overcome the recent power crisis.

S 02.3

Design and Simulation of Active Antenna for Communication in Smart Grids

[1]V. K. Sharma, [1]Harish Kumar, [2]Manish Sharma
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In this paper, the design of a dual-port dual-band annular slot active antenna suitable for communication use in smart grids & WLAN, a new active antenna is proposed for optimizing the smart grid. Two way commutations are key to making the grid smarter. The smart grids refer to system that can communicate data back and forth between a utility company and a customer. The wireless communication and antennas that utilize RF signals are often best suited to facilitate this grids communication. This antenna based on modern MIC and MMIC fabrication technology is used to develop a compact light weight, small size, high performance and low cost active antenna. The proposed antenna is designed to radiate and transmit equal amounts of power. The return loss of the proposed antenna is higher than that desired for one-port antenna application at the desired dual-band frequencies. The antenna generates two separate frequency resonant modes cover to cover 2.45/5.2Ghz. The antenna is fabricated on one side of a Neltec substrate with εr =3.2 and thickness= 0.762 mm, and the microstrip feeding line is fabricated on the opposite side of the board. The antenna is designed to operate at WLAN bands centered at 2.45 and 5.2GHz. The simulated and measured results show fairly good agreement.

S 02.4

A Multi-Agent Based Power System Restoration Approach in Distributed Smart Grid

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The objective of this paper is to design, develop and implement a multi-agent system (MAS) that provides intelligent and enables real-time management to a smart grid located at a distribution level (so called distributed smart grid). The MAS application development is discussed concerning suitable agent development framework, agent specification, agent architecture, and implementation of MAS. The paper illustrates MAS application in power systems. As faults and outages are inevitable and likely to occur in distribution systems, an efficient and fast switching operation scheme is required to detect the fault location, isolate the fault, and restore power to de-energized areas. The system under study consists of both physical (microgrid) and cyber elements (MAS). Finally, the simulation result indicates that the developed MAS for power system restoration applications can provide an effective and timely solution to manage microgrid given the existence of fault in the system.

S 03: Machinery and Energy System Components
Time: 13:00 – 14:30
Room Assignment: Cattleya (near Garden Wing Lobby)

S 03.1 **Performance of a Quarter-Pitch Twisted Savonius Turbine**

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The paper presents Computational Fluid Dynamics analysis of a quarter pitch twisted Savonius turbine. The turbine has been simulated using a CFD software package Flow 3D developed by Flow science. The simulation has been done using Reynold's Averaged Navier-Stokes Equations (RANSE) solver with structured rectangular mesh. The proposed rotor consists of no central shaft and has an overlap ratio of 0.35 with two end plates. Turbine rotates around z axis in the reference plane with six degree of freedom. The turbine is simulated for a constant current speed and a set of variable torques. The simulation result shows that the turbine can achieve more than 7% efficiency and can be used as a marine current turbine.

S 03.2 **Operational Experience of the Polygeneration Plant in Parc de l'Alba (Spain): Start-up and First Results**

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Polygeneration systems are highly integrated systems characterized by the simultaneous production of different services (electricity, heating, cooling) by means of several technologies to obtain a higher efficiency than that of an equivalent conventional system. This paper presents some preliminary monitoring results of a polygeneration plant installed in a technological park in Cerdanyola del Vallès (Spain) in the framework of the Polycity project of the European Concerto Program. The plant is composed of three cogeneration gas engines, a direct fired exhaust gas absorption chiller, a single-effect absorption chiller, a compression chiller, a natural gas boiler and a chilled water storage tank of 4000 m^3.

S 03.3 **A New Method for Balancing a Three-phase Induction Motor Supplied by a Single-phase Source**

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A three-phase induction motor (IM) powered by a single-phase supply is working under a very unbalanced condition, necessitating it to be derated to avoid overheating. To improve the performance of single-phase powered IMs, a new circuit scheme is proposed in this paper. The proposed circuit scheme is inspired by the traditional Steinmetz connection which employs a capacitor to connect the motor's third terminal to either of the two terminals of the single-phase source supplying the motor. The proposed scheme uses two sets of static var compensators (SVCs), a parallel combination of a thyristor-controlled reactor and a capacitor, as a phase balancer. By properly choosing the element values of the two SVCs, this new scheme allows the motor to operate under a perfect balanced three-phase voltage condition.

S 03.4 **Analytical Modeling of Pulsating Torques of Induction Motors Caused by Supply Voltage Unbalance**

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Voltage unbalance is frequently encountered in a low voltage AC power network to which many three-phase loads are connected. Pulsating torque of IMs caused by voltage unbalance is well known to electrical engineers, and it can easily be simulated by a computer program or measured from laboratory experimental setups. However, analytical models that clearly interpret the physical mechanism linking the pulsating torque and voltage unbalance are not found in literature. In this paper, we develop an analytical model of pulsating torque produced by an IM under voltage unbalance. The amplitude of the pulsating torque is explicitly expressed as a function of the voltage unbalance factor, i.e., the ratio of the negative- to positive-sequence voltage components. The illustrated examples are analyzed by the proposed analytical model, and validated by results obtained from simulation using the universal machine module of the EMTP.

S 03.5 **The Optimal Energy and Environmental Management Criteria of Used Induction Motor in Thailand to Enhance Economic Value**

[1]*Arnon Poungching-ngam,* [1]*Bunchar Hongpeechar,* [1]*Wichit Krueasuk,* [1]*Kitti Tirawannawit,* [1]*Pornrapeepat Bhasaputra and* [2]*Woraratana Pattaraprakorn*
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This paper presents the approach to analyze the increasing rate of electrical energy consumption for used induction motor by considering the different maintenance procedures in case of age within and over the lifetime. The sample induction motors are selected to determine the efficiency according to IEEE Standard 112-Method B which the losses of induction motors are evaluated by electrical sensor. The experiment results demonstrate that the reduction rates of performance are 1.50% per year, 2.50% per year and 1.83% per year for induction motor age within lifetime and recommended maintenance procedures, age within lifetime without recommended maintenance procedures and age over lifetime and recommended maintenance procedures, respectively. Furthermore, the declining performance rate of the induction motors age over lifetime and recommended maintenance procedures is acceptable. However the induction motor without recommended maintenance procedures has more losses than the age over lifetime induction motor by 0.67% per year. Regarding to the simulation of induction motor, the energy cost within lifetime in case of both maintenance procedure and without maintenance procedure is 18,266.96, 12,672.99 and 11,283.48 Baht/year for 24, 16 , 8hour/day, severally. In addition, the induction motor used within lifetime and recommended procedure can reduce CO2 emissions up to 3.01Tons/year. Finally, the optimal energy policy and environmental management aspect are enhancing the economic value of used induction motors in Thailand.

S 05: Artificial Intelligence Application to Power System
Time: 14:30 – 16:00
Room Assignment: Aranda Ballroom

S 05.1 **Transmission Line Faults Detection, Classification and Location using Artificial Neural Network**

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Transmission lines, among the other electrical power system components, suffer from unexpected failures due to various random causes. These failures interrupt the reliability of the operation of the power system. When unpredicted faults occur protective systems are required to prevent the propagation of these faults and safeguard the system against the abnormal operation resulting from them. The functions of these protective systems are to detect and classify faults as well as to determine the location of the faulty line as in the voltage and/or current line magnitudes. Then after the protective relay sends a trip signal to a circuit breaker(s) in order to disconnect (isolate) the faulty line.

The features of neural networks, such as their ability to learn, generalize and parallel processing, among others, have made their applications for many systems ideal. The use of neural networks as pattern classifiers is among their most common and powerful applications.

This paper presents the use of back-propagation (BP) neural network architecture as an alternative method for fault detection, classification and isolation in a transmission line system. The main goal is the implementation of complete scheme for distance protection of a transmission line system. In order to perform this, the distance protection task is subdivided into different neural networks for fault detection, fault identification (classification) as well as fault location in different zones.

Three common faults were discussed; single phase to ground faults, double phase faults and double phase to ground faults. The result provides a reliable and an attractive alternative approach for the development of a protection relaying system for the power transmission systems.

S 05.2 **Automation of Interconnected Power System using Fuzzy Controller**

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The fuzzy logic controller is constructed as a set of control rules and the control signal is directly deduced from the knowledge base and the fuzzy inference. In this paper, a fuzzy logic controller is proposed for load frequency control problem of electrically interconnected power system. The study has been designed for a two area interconnected power system. Simulation results show that the proposed controller is suitable for damping the frequency oscillation due to load disturbance effects. The proposed controller when compared against conventional PID controller; it shows best dynamic responses over PID controller.

S 05.3

A Hybrid Approach Based on PSO and EP for Proficient Solving of Unit Commitment Problem

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Unit Commitment Problem (UCP) is a nonlinear mixed integer optimization problem used in the scheduling operation of power system generating units subjected to demand and reserve requirement constraints for achieving minimum operating cost. The task of the UC problem is to determine the on/off state of the generating units at every hour interval of the planning period for optimally transmitting the load and reserve among the committed units. The importance for the necessity of a more effective optimal solution to the UCP problem is increasing with the regularly varying demand. Hereby, we propose a hybrid approach which solves the unit commitment problem subjected to necessary constraints and gives the optimal commitment of the units. The possible combination of demand and their corresponding optimal generation schedule can be determined by the PSO algorithm. Being a global optimization technique, Evolutionary Programming (EP) for solving Unit Commitment Problem, operates on a method, which encodes each unit's operating schedule with respect to up/down time. When the demand over a time horizon is given as input to the network it successfully gives the schedule of each unit's commitment that satisfies the demands of all the periods and results in minimum total cost.

S 05.4

Adaptive Wavelet Neural Network Based Harmonic Estimation of Single-Phase Systems

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Single phase systems, although, form only limited part of the total power system, harmonic pollution due to increasing proportion of power electronic based single phase nonlinear loads cannot be overlooked. Harmonic pollution introduces many operational and control related problems like increased losses, resonance, interference, protection failure, zero-crossing detection, control circuit mal-operations, etc. A novel method based on adaptive wavelet neural network (AWNN) for harmonics estimation is single-phase systems is presented in this paper. Simulation results show that proposed method gives estimation accuracy within the limits defined in IEEE 519-1992 and IEC 61000-4-7.

S 05.5

Wavelet Decomposition based FINN Model for Short Term Load Forecasting

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A hybrid integrated approach, which combines the important features of ANN and fuzzy logic, the Fuzzy Inference Neural Network (FINN) fed with wavelet decomposed input

data is proposed in this paper for the prediction of short term loads. Both historical load and temperature data having important impacts on load level are used in the proposed forecasting model. The data is transformed in low and high frequency components. The process of the proposed approach first decomposes the historical data into an approximate part associated with low frequencies and several detail parts associated with high frequencies through the wavelet transform. After deletion of the high frequency terms, the smoothened data is reconstructed. Then, a FINN is used to predict the future load. The proposed model has been evaluated with actual data of electricity load and temperature of a Canadian utility. The simulation results show that the proposed model forecasts the load more accurately as compared to the simple FINN for the same set of data for the same period of time.

S 06: Renewable Energy Technology and Management
Time: 14:30 – 16:00
Room Assignment: Rimsuan (near Garden Wing Lobby)

S 06.1 **Accelerated Starting by Motoring a Grid-Connected Small Wind Turbine Generator**

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In recent years, an increasing proportion of small wind turbines have been connected to the electrical grid. With appropriate switchgear and control, it should be possible to use grid power to operate the generator as a motor for faster starting of the turbine. The artificial case of a step increase in wind speed from zero is considered. It is shown that motoring yields an energy gain for all wind speeds typical of the operating range of small turbines. This paper proposes short-period motoring of a permanent magnet generator in a 5kW wind turbine system connected to the grid with a backward very sparse matrix converter which has bidirectional power flow capability. Motoring produces torque in the same direction as the aerodynamic torque on the turbine which in turn accelerates the turbine more quickly towards the maximum power point. Interestingly, the overall result is that more energy is delivered to the grid by short-term motoring than in the case where the turbine is accelerated aerodynamically without motoring. In the proposed system, the very sparse matrix converter controls the generator torque through field orientation where d-axis current is set to zero while the q-axis current is used to control the generator torque and thus control the turbine speed in both motoring and generating modes. The switching signals of the converter are formed based on the principle of space vector modulation. Simulation results, with and without an electromagnetic starting torque, indicate that the proposed technique increases the overall energy efficiency of small wind turbine systems while providing fast starting.

S 06.2

Development of Electrical Behavioral Model of an Arbitrary Solar Cell to Amend the PSPICE Simulation Performance

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This paper presents a behavioral modeling of a solar cell to improve the simulation results of PSPICE. Considering irradiance and ambient temperature as two inputs and using the parameters provided by the manufacturers this model will enable us to study the precise output of the cell. Also this model will help us to evaluate the short circuit current, open circuit voltage, cell operation temperature, maximum power point current, maximum power point voltage and the power at maximum power point. Furthermore, an example to use this model and some suggestions will be available to utilize this model in case of solar cell arrays analysis.

S 06.3

An Experimental Investigation of the Real Time Electrical Characteristics of a PV Panel for Different Atmospheric Conditions in Islamic University of Technology (OIC), Gazipur, Bangladesh

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The electrical characteristics of a 60W, 12V PV panel is presented on this paper for geographical location of Latitude = 23° 43'N and Longitude = 90°25'E (Islamic University of Technology, Gazipur, Dhaka, Bangladesh). The open circuit voltage and short circuit current of the panel are measured and recorded at an interval of three minutes along with the total solar irradiation. The total solar irradiation is measured using the device "UNIKLIMA VARIO" commissioned in the automatic weather monitoring station of the university. Based on the weekly data voltage-times and current-time curves are plotted for three different seasons from which the total available electrical power curve is also derived. Then the electrical efficiency of the panel is calculated using the solar irradiation data. The objective is to observe the variation of efficiency for different weather and atmospheric condition. The voltage generated by a PV panel depends on the geographical location of the site, time of the year, time of the day and local weather condition. The geographical and climatic condition of the chosen site is suitable for PV power systems. The electrical design of the array is influenced by the factors such as-sun intensity, sun angle, load matching for maximum power and operating temperature of the panel. Based on the experiments it has been observed that with increased radiation, the panel current is increased linearly. With a constant irradiation, the output voltage of the panel is increased for a decrease in the panel temperature or vice-versa. Finally the efficiency curve for the three different seasons is plotted and according to the observed data a comparison is carried on based on different factors affecting the efficiency of the panel. The total energy output in kWh is also calculated using the power

curve of the panel for three different seasonal variations.

S 06.4 **Analysis of a Partially Shaded PV Array Considering Different Module Connection Schemes and Effects of Bypass Diodes**

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This paper aims to analyze a mismatched PV array using a simplified model of PV module and to compare its electrical characteristics including I-V, P-V, maximum power and loss, for series-and-parallel (SP) and total-cross-tied (TCT) configurations of PV module connection. The influences of bypass diodes that are in parallel with each PV module, are also considered. Two methods have been used in this study: the analytical method and the PLPB (piecewise linear parallel branches) model. The former lies in writing the KCL and KVL equations of the PV array electric network and solving them using the Newton-Raphson method. The later involves a piecewise linear model that allows the PV array network to be simulated using the EMTP circuit simulation program.

S 06.5 **Patented Twintex® Hybrid PV/T Collector: Level of Performances and Comparison with Thermal Solar Collector**

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In the context of climate change in the world at the global level, various actions are taken for the development of Renewable Energy and particularly solar energy. Many technology solutions have been proposed such as solar hybrid collector whose objectives is to improve the PV panels performance by recovering heat looses with the heat removal fluid. The objectives of this article is to propose a hybrid photovoltaic-thermal collector manufactured in a polymer material twintex® patented by Saint-Gobin company, to have product lighter, cheaper and easier to handle. We expose the performance of this PV-T collector manufactured without air layer.

S 07: Energy Conservation and Management
Time: 14:30 – 16:00
Room Assignment: Cattleya (near Garden Wing Lobby)

S 07.1 **The Ventilation System for Energy Conservation of Telephone Exchange in Thailand**

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The existing cooling system of Telephone Exchange consumes more than 45% of overall energy consumption and generates the large amount of CO2 that affect the global environment as well. Focusing on the energy conservation and expenditure, the adaptive cooling system using the air blowers integrated with the existing air conditioning system is proposed. Comparing the energy consumption, life cycle costs,

temperature and humidity controls to the conventional cooling system control were done. The experiment demonstrated that the energy consumption of the cooling system decreased 87.98% and the overall energy consumption decreased 35.49% as compared to the convention cooling system. The annual cost of the proposed system can reduce up to 288,533 THB/Room with 1 year of return of investment. The proposed system can operate without any interruption under the temperature and humidity requirements. Finally, the report included important detail such as innovations, detail designs; preventive maintenance requirement and barriers of proposed system will be shown and described in detail.

S 07.2 **The Optimal Energy Management of Sign Lighting System for Small and Medium Sizes of Bank in Thailand**

[1]Chaiyapat Kumpeerakupt, [1]Somkuan Rimsmutchai, [1]Natapongkorn Pawanawichien, [1]Surasak Panjavaranont, [1]Pornrapeepat Bhasaputra and [2]Woraratana Pattaraprakorn

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The potential of sustainable energy in Thailand's bank is studied in term of energy efficiency and environmental aspect. The achieved national regulations for buildings in Thailand, such as building code and green building, are the guideline to set up the optimal energy policy. Therefore, the banking recognizes the importance of the energy policy with business condition. According to the various bank in Thailand, the advertising and promotion of bank is very important for increasing the market share, so the sign lighting system is the first sign of bank which are needed to install without energy concern. For small and medium sizes of bank in Thailand (approximate 4,000 building), more than one third of lighting system is sign lighting which is proposed only advertising objective. This paper introduces the optimal energy management of sign lighting to reduce the energy consumption without effect to the advertising objective, which remained the illumination need and acceptable investment of sign lighting. In addition, two technologies of the sign lighting system for advertising are proposed to evaluate the energy performance, which are T5 fluorescent lamps with electronic ballast and Light Emitting Diode (LED) lamps compare to the existing system with T8 fluorescent lamp and low loss ballast. The experimental results show that the LED lamps sign lighting can reduce the energy consumption more than 50% with the significant feasibility in practical implementation. Finally, the environment aspect will be presented in term of CO2 reduction and the barriers of LED lamps sign lighting will be concluded.

S 07.3 **Energy Audit of a 400/220 kV Substation – a Case Study**

[1]Sunil M. Jaralikar and [2]Mangalpady Aruna

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The paper highlights the necessity of undertaking performance analysis and energy audit study of an electrical installation, more particularly a power substation on regular basis. A 630 MVA, 400/220 kV substation was identified and a detailed study was carried out to assess the various station performance parameters under different operating conditions. It was observed that the installed capacity of the station (transformer) was very large compared to the actual load it had to supply. Thus the

station was under loaded and underutilized for the major period of its operation. This reduced the operational efficiency of the station. Secondly the incoming line voltage level was remaining high during most of the period of operation. Presently voltage is tried to be maintained by switching ON the line reactors at the receiving and sending ends of this station, switching OFF one of the 400 kV incoming lines during off peak loading conditions, thus risking the supply reliability. The present study emphasizes on the urgent need for improving the power quality, streamlining and optimizing the station capacity, operations and its loading pattern. Accordingly suggestions are proposed for the same.

S 07.4 **The Optimal Design of Lighting Systems for Designated Office Building in Thailand According to Ministerial, the Type or Size of Building Standards and Rules and Procedures, Building Design for Energy Conversation, Act B.E.2552**

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The financial index of payback period analysis is proposed to evaluate the economic performance of lighting system between conventional designs and design by the Energy Conversation Promotion Act (no.2) B.E. 2550 of Ministry of Energy, The Type or Size of Building Standards and Rules and Procedures, Building Design for Energy Conservation, Act B.E.2552 for office building in term of illumination standard, energy consumption, return of investment and environmental aspect. First of all, the Type or Size of Building Standards and Rule and Procedures, Building Design for Energy Conservation, Act B.E.2552 is reviewed to compare with the conventional designs of lighting system for office building. Secondary, the life time energy consumption of fluorescent lamp T5 with electronic ballast, fluorescent lamp T8 with standard ballast and fluorescent lamp T8 with electronic ballast is simulated by various sizes of office buildings according to IEEE, IEC, IES, and the Type or Size of Building Standards and Rules and Procedures, Building Design for Energy Conservation, Act B.E.2552. In addition, the payback period and CO2 emission of lighting system for selected office building are simulated by various scenarios which the analytical results show that are the optimal lighting system for office building under the present situation. Finally, the optimal design of lighting system for designated office building in Thailand will be discussed about the energy performance with environmental friendly.

S 07.5 **Energy Management for Light System in the Convenience Stores: Case Study of Gas Station in Thailand**

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In Thailand, energy conservation has become one of the most challenging issues which are set as the nation agenda. Base on the development of electrical equipment

especially, light bulbs, many technologies are proposed to evaluate the economics performance for convenience stores. In this paper, the energy management of lighting system in convenience stores for gas station is studied to enhance the energy efficiency in term of economic with the acceptable standard and regulation of Thailand. According to the existing system, T8 and standard ballast was typically installed in convenience stores for gas station that may be insufficient under energy crisis. The proposed energy management program will be discussed between the typical lighting system controlled by dimmer device and T5 with electronic ballast, which is a recommended technology from Ministry of Energy. In addition, the experimental results from selected gas station are presented in term of the luminance standard and energy conservation of proposed technologies. In the part of technical comparison, the T8 with dimmer device can decrease 38.67% of energy consumption which is better than T5 with electronic ballast. Furthermore, with additional 10% light dimming after midnight, the energy consumption is more reduced almost 10% without customer dissatisfaction. Not only the technical consideration but also the financial analysis is also evaluated in order to understand feasibility in practical implementation.

S 09: Energy Conversion and Thermodynamic Systems
Time: 16:15 – 17:45
Room Assignment: Aranda Ballroom

S 09.1 **Effect of Aqueous Denatured Spirit on Engine Performance and Exhaust Emissions**

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The experimental analysis was to investigate the effect of Denatured spirit (DNS) and DNS-Water blends as fuels in a four cylinder four stroke SI engine. Performance tests were conducted to study brake thermal efficiency (BThE), brake power (BP), engine torque (T) and brake specific fuel consumption (BSFC). Exhaust emissions were also investigated for carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NOx) and carbon dioxide (CO2). The results of the experiments reveled that, both DNS and DNS95W5 as fuels increase BThE, BP, engine torque and BSFC. The CO, HC, NOx and CO2 emissions in the exhaust decreased. The DNS and DNS95W5 as fuels produced the encouraging results in engine performance and mitigated engine exhaust emissions.

S 09.2 **Effect of Inclined Ribs on Heat Transfer Behavior in a Square Channel**

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The research work presents the study of heat transfer in a heat exchanger channel inserted with 45° inclined ribs. The test channel has a square section with a uniform wall heat flux condition. The fluid flow and heat transfer characteristics are presented for Reynolds numbers based on the hydraulic diameter of the channel ranging from 4000 to 40,000. Two rib arrangements, namely, in-line and staggered arrays, a single pitch equal to three times of channel height (=3H), and three rib to channel height ratios, e/H=0.1, 0.15, and 0.2 are introduced. The experimental result of heat transfer in terms of Nusselt number and pressure drop in terms of friction factor are compared between

the ribbed channel and the smooth channel. The inclined rib with e/H=0.2 gives higher heat transfer and friction factor than the e/H=0.15, 0.1 and the smooth channel. It is worth nothing that the heat transfer and pressure drop for the in-line arrangement provides the higher value of Nusselt number and friction factor than the staggered one for all rib height ratios.

S 09.3 **Thermal Performance Enhancement in Solar Air Heater Channel with Periodically V-shaped Baffles**

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The research paper presents a study on thermal performance enhancement in a rectangular channel heat exchanger mounted with periodically V-shaped baffles. The channel has an aspect ratio (width to height ratio), AR=10 and height, H=30 mm while baffle characteristics are the baffle to channel height ratio, e/H=0.2, 0.3 and 0.4; the baffle pitch to channel height ratio, PR=P/H=2 and 2.67; the attack angle (α) of 30° relative to the flow direction. The experiment has been conducted by varying air flow velocity in order to adjust Reynolds number range from 5000 to 25,000. The upper wall of the channel is uniformly heated as a constant heat flux while the rests are covered with thermal insulations to reduce heat loss to surroundings. The effects of the baffles on Nusselt number and friction factor have been examined. The overall performance of tested baffled channel is evaluated to obtain the degree of heat transfer enhancement and friction factor induced by baffles with respect to the smooth channel under similar flow conditions.

S 09.4 **Influences of Twisted-Tape with Parallel Rectangular-Wing on Thermal Performance of a Heat Exchanger**

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The present paper reports heat transfer enhancement and friction factor characteristics in the tubes inserted with rectangular-winged twisted-tapes (TT-RWs). The wing-depth ratio (d/W) was varied from 0.1 to 0.3 while the tape-twist ratio was kept constant at y/W = 4.0. The experiments were conducted under uniform heat flux condition for Reynolds number between 5500 and 20,200 (based on the inner diameter, D), using water as the working fluid. The tubes with typical twisted tape (TT) and twisted tape with alternate-axis (TA) as well as a plain tube were also tested for assessment. The obtained results demonstrate that the utilization of the tubes with TT-RWs leads to the increases of both Nusselt number and friction compared to those from the uses of the tubes with TT, TA and the plain tube. In addition, Nusselt number increases as a wing-depth ratio of the twisted tape increases. The improvement of Nusselt number is directly related to the superior destruction of the boundary layer which is responsible by the stronger swirl flow and turbulence intensity. According to the results, the TT-RW with d/W = 0.3 yields the highest Nusselt number which is around 100% higher than that of the plain tube, corresponding to the thermal performance factor of 1.36 at constant pumping power.

S 09.5 **Effect of Load Level on the Performance of a Biodiesel Run Dual Fuel CI Engine Using Second Law Analysis**

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With the continuous depletion of petroleum fuel and the contribution of these fuels to pollute the environment, use of petroleum-based fuels is now widely recognized as unsustainable. A huge research is going on through out the world to search for suitable and environmental friendly alternative sources of these fossil fuels. The demand for biodiesel as one of the alternative sources of fuel is increased very rapidly. The performance results obtained from a single cylinder Compression Ignition (CI) engine operating on diesel and biodiesel-diesel dual fuel mode are presented in this paper. The dual fuel performance has been compared with neat diesel at various load level varying from 1 kg to 10 kg with almost steady engine speed of 1500 rpm and compression ratio of 17.5. The second law analysis also called 'Exergy' analysis has been performed for both diesel and dual fuel mode at different loads. The second law analysis includes brake work, coolant heat transfer, exhaust losses and exergy efficiency. The data are recorded using a computerized engine test rig. Results indicates that within the range of parameters studied here, it is possible to achieve a maximum of about 20% diesel substitution using dual fuel mode under same working condition and without any engine modification.

S 10: Electrical Energy Deregulation and Management
Time: 16:15 – 17:45
Room Assignment: Rimsuan (near Garden Wing Lobby)

S 10.1 **Electricity Retail Price in Competitive Market using the Risk-Adjusted Capital Asset Pricing Model (CAPM): a Case of Thailand**

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Competitive environment in electricity retail sector helps to promote the efficiency of electricity demand and also provides preferred and affordable electricity price for the customers. However, due to the variation of Market Clearing Price (MCP) in the power supply market there is a hardly avoidable risk for the Electricity Retail Company. The overall objective for this study is to determine and perform preliminary analysis of an efficient electricity retail price in competitive market by using quantitative methods. Capital Asset Pricing Model (CAPM) is used for the financial analysis, while risk factor has been considered by using Risk Adjustment Recovery on Capital (RAROC). According to the using of CAPM and RAROC, the retailer company is expected to make highest return to the investment at the retail price of $24/MWh and is expected to bear highest risk of loss at the retail price of $25/MWh. Moreover, few recommendations are suggested for future work such as adding more variables cost, include transmission and distribution service charges within retail price, and demand bidding should be also integrated for bidding up the MCP.

S 10.2 **Water Valuation in Vietnamese Electric Power Generation Market**

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This work has been devoted to water valuation regarding Vietnamese reservoirs in a competitive electricity market environment. Water value concept, which has been assumed as fuel cost of water, helped to reflect the exploiting cost of water resource in the context of hydrothermal power system. In this work, the Stochastic Dual Dynamic Programming (SDDP) approach has been suggested for modeling the water valuation problem. Further, a trade-off has been obtained between immediate and future operating cost. Effectiveness of the developed approach has been investigated in Vietnamese electric power generation market for the period of 2011-2012. The results have been obtained in terms of the water value for major reservoirs, short-run marginal cost (SRMC) and classification of generating units as well. Moreover, optimal generation scheduling of cascading reservoirs and their respective trajectories have also been analyzed in this work.

S 10.3 **Determining Market Clearing Price using Graphical Analysis - Impact of Loss as a Case Study**

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Market clearing price (MCP) has been the prime operating function for a pool operator in energy trading scenario. Its main objective is to maximize the social welfare function where the society i.e. both the generating companies and the consumers are benefited and unbiased. Many researchers take stepped bid functions of both the generators and consumers as inputs for determining MCP (λ). But owing to reason of having less information and less realistic, quadratic bidding functions are preferred and a closed form solution scheme with and without loss have been developed. Gradient technique has been used for finding the mcp when losses are considered. All the above solution has been interpreted using graphical approach.

The proposed approach has been tested on a 30 bus system and a 3 unit system. From the results, a conceptual understanding has been made and how various market conditions have an impact on the MCP is discussed. The results obtained are quite encouraging and useful for the present context of deregulation and restructuring of electricity market. MATLAB 7.0 has been used to carry out the simulation.

S 10.4 **Well-Organized Preconditioner for Solving Load Flow Problems by GMRES**

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This paper proposes and tests strategies to accomplish high quality incomplete

triangular factors (ILU) preconditioners for solve the load flow sublinear problem by GMRES. The process begins constructing the preconditioner over the reordered Jacobian matrix calculated in the first Newton iteration. If the iterative process does not start due to high inaccuracies and/or numerical stability problems emerged during the preconditioner construction, the solution process is restarted and the Jacobian matrix calculated in the first Newton iteration is preprocessed through scaling, nonsymmetric and symmetric (ordering) permutations, leading to a new and better quality preconditioner. Numerical experiments considering two Brazilian power system configurations (2256/3515 buses) operating under adverse conditions (heavy loaded) corroborate the efficiency of such strategies over the preconditioner quality improving the GMRES convergence rate. A LU preconditioner for comparison purposes is also considered.

S 10.5 GA-based Congestion Management in Deregulated Power System using FACTS Devices

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Congestion in the transmission lines is one of the technical problems that appear particularly in the deregulated environment. There are two types of congestion management methodologies to relieve it. One is non-cost free and the other is cost free methods. Among them later method relives the congestion technically whereas the former is related with the economics. In this dissertation congestion is relieved using cost-free method.

One of the cost free techniques is installing FACTS devices into the system. FACTS devices have a great flexibility that can control the active power, reactive power and voltage simultaneously. SVC and UPFC are two FACTS devices which can relieve the congestion in the transmission lines efficiently.

As the FACTS devices are costly hence it is required to find the optimal location for FACTS devices. In congestion management, the objective function is nonlinear hence in solving this function Genetic Algorithm (GA) technique is used to obtain the global optimal solution. This method is tested on IEEE test-bus system with FACTS devices and it can be extended to any practical system.

S 11: Biofuel and Biogas Technologies

Time: 16:15 – 17:45
Room Assignment: Cattleya (near Garden Wing Lobby)

S 11.1 Situation Analysis in the Construction and Operation of Biogas Plant: a Case Study at the Open University of Sri Lanka

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A pilot biogas plant of 8m3 capacity was constructed at the Open University of Sri Lanka (OUSL) in order to demonstrate the practicability of such a plant. Despite rising costs in meeting domestic energy needs, especially for cooking, the uptake of renewable energies, such as biogas, solar and wind is remarkably slow. This study was carried out to assess the present awareness of biogas technology and to identify practical difficulties in implementing biogas plants for domestic use. The study was done with a

convenient sample of people drawn from the employees and students of the OUSL. The study commenced with the assessment of awareness of biogas technology, followed by participatory program in construction and commissioning. The project successfully addressed the misconceptions and was able to create interest among participants to construct their own plants. Non awareness and misconceptions related to the level of technology involved and maintenance were identified as main obstacles.

S 11.2 **Investigation of the Phorbol Ester Content in High Quality Biodiesel Production Process**

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Jatropha oil is an attractive alternative fuel as it is not concerned with edible oil crops. However, it is found that Jatropha oil contains some phorbol esters, which are a toxic compound. In this work, phorbol ester distribution of jatropha portions, including seed, seed cake, seed oil, kernel seed, seed hull, kernel cake and kernel oil, were firstly studied. The results found that a majority of phorbol ester was found in kernel oil and seed oil at 0.45 and 0.33 mg/g, respectively. These compounds can cause some biological effects such as inflammation and tumor promotion. Therefore, detoxification of phorbol ester must be performed. High quality biodiesel continuous production plant under JST-JICA SATREPS collaboration project was established with capacity to produce biodiesel that meets the EAS-ERIA standard [1]. The biodiesel plant consists of raw material dehydration, esterification, transesterification, biodiesel washing, dehydration and upgrading, which has affected the phorbol ester differently. Consequently, the changes of phorbol ester content were examined in each process by using High Performance Liquid Chromatogram (HPLC) technique. The results show that some of these processes can reduce the toxic content of biodiesel. Phorbol ester quantity was decreased by 77.55% after esterification process, and this toxic content could be significantly eliminated after transesterification by 89.80%. Furthermore, the phorbol ester of 0.03 mg/g in biodiesel was detected after partial hydrogenation unit. The percentage removal of hydrogenation process was 95.92%.

S 11.3 **Towards Stabilization of Bio-oil by Addition of Antioxidants and Solvents, and Emulsification with Conventional Hydrocarbon Fuels**

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Bio-oil is liquid fuel produced by fast pyrolysis, typically, of biomass. Bio-oil comprises a mixture of highly oxygenated compounds, carboxylic acids and trace water. Upgraded bio-oil can be used as a substitute for conventional fuels. However, bio-oil is inherently unstable. The various compounds in bio-oil can react through many chemical reactions, such as polymerizations, during the storage of bio-oil, resulting in adverse changes in the bio-oil's properties, especially increasing viscosity over time. In the present study, three sets of methods to improve the bio-oil's stability were investigated: addition of antioxidants, addition of solvents, and emulsification with conventional hydrocarbon fuels. In the first set of methods, three kinds of antioxidants (propyl gallate, tert-butyl hydroquinone, and butylatedhydroxyanisole) were added in 1000-ppm concentration to

bio-oil. In the second set, 10wt% of solvents, including acetone, biodiesel, ethanol, ethyl acetate, and methanol, were added to the bio-oil. Finally, the third set involved emulsification of bio-oil with different conventional hydrocarbon fuels, including diesel, gasoline, and biodiesel, using octanol as a surfactant. All test samples were subjected to accelerated aging, involving exposure to high temperature of 80ºC for 5 days. The viscosity of the samples, chosen as the main indicator of the aging, was measured daily. The results showed that under the accelerated testing conditions, pure bio-oil aged significantly, with 44.65% increase in viscosity. The bio-oil with antioxidants, on the other hand, aged more slowly, with 17-20% viscosity increase. The addition of solvents also slowed down the aging drastically, especially in the case of biodiesel, with only 4.91% viscosity increase. Emulsification with conventional hydrocarbon fuels also showed promising results, with similar trends to those of antioxidant and solvent addition. All results showed that the three sets of stabilizing methods can improve the bio-oil's stability significantly, with slightly varying degree of effectiveness. Selection of an optimal method in practice depends on the particular constraints and circumstances of each operation.

S 11.4 Catalytic Pyrolysis Using Catalyst Nickel-Natural Zeolite (Ni/NZA) on Conversion of Biomass to Bio-Oil

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World crude oil demands tend increase while it supplies decreases. Due to limit of fossil fuel resources on future, hence finding out renewable resource is inevitable. Bio-oil is one of an alternative energy source produced by pyrolysis of biomass. Pyrolysis is a potentially important route for biomass conversion to fuel by heating of biomass in the absence of oxygen to produce bio-oil. Trunk, shell and fiber of palm oil solid wastes were used as sample. The Catalytic Pyrolysis process were conducted in pyrolysis reactor using biomass of 50 gram, silinap 500 ml and Ni/NZA catalyst of 1.5 gr at 320oC. In this reseach the effect of ratio of nickel metal in catalyst of 1, 3 and 5 wt/wt % respectively in activated natural zeolite (NZA) were investigated. The maximum bio-oil result of 63.0 % is obtained from trunk having the particle size of -8+10 mesh with the catalyst of Ni 3%. Bio oil result is analysed which includes acidity, density, viscosity and flash poit. And bio oil chemical components were characterized using GC-MS.

S 11.5 Grape Stalk Briquettes as an Alternative Feedstock of Biomass Gasifiers

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The Biomass Gasifiers are used for sustainable development by using the agricultural waste as a feedstock. Grape stalk are the major agricultural by-products available from the grapes garden. Hence thousands tons of grape stalk are available as agricultural waste, which can be used as feedstock to the Biomass Gasifiers. But the grape stalks cannot be used directly because of their low energy value. So these grape stalks are to be converted into some other suitable form of fuel which has comparable high energy value. This suitable form may be the briquettes from grape stalk. This paper reports the development of a low-density biomass gasification system (92.048 MJ/hr) for direct thermal applications. Initially, ultimate & proximate analysis of grape stalk is carried out in order to determine the calorific value of stalk. Analysis was done to determine its

Gross Calorific Value. The system was tested under laboratory conditions and the Gross Calorific Value of the gas produced was within the range 5-6MJ/Nm^3. The GCV of briquette was found to be greater than that of grape stalks. Gasification output capacity, especially in the high output ranges, was controlled only by availability of adequate feed materials rather than other technical consideration.

S 12: FACT Devices and Power System Dynamics
Time: 13:00 – 14:30
Room Assignment: Aranda Ballroom

S 12.1 **Development of a Dynamic Model of Solar Farm and Its Impact on Weak Power System**

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This paper presents a comprehensive simulation study to show the adequacy of two solar farm models for small signal stability analysis. Simulation study is carried out by considering solar farm as single-and multi -generator equivalents for both models. The simulation results are presented for a small interconnected system by considering different short circuit ratios (SCR). Both Solar farm models, single-generator and multiple-generator equivalents provide the same results for small signal stability studies for different scenarios.

S 12.2 **Study on Voltage Stability of Island Grid Supplied by Large Grid with Long Submarine Cables Considering Different Load Patterns**

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The voltage response characteristics considered different load patterns are studied in the paper. The effects of on-load tap changer (OLTC), over-excitation limiter (OEL), and high voltage direct current (HVDC) link on voltage stability are also analyzed. In which, the converter terminals of HVDC link are considered as a constant real and reactive power load under steady state and the effects of HVDC control modes on voltage stability are also studied. A practical system of larger grid (Taiwan grid) connecting to a smaller island grid (Peng-Hu grid) via two circuits of long submarine cables is used to study. The strategies for improving voltage stability include reactive power support and under-voltage load shedding (UVLS) are proposed. Based on the simulation results, it shows that the voltage response characteristics are affected significantly by different load patterns. The OLTC plays an important role during the load voltage restoration. The reactive power support devices and UVLS can improve the short-term voltage stability, which makes the power system achieve voltage stability operation. However, the interactions between OLTC and OEL under HVDC link connected operation would lead

the power system to voltage in-stability. The constant current control mode of HVDC link has better effect on voltage stability. All of these studies are per-formed by software package, namely power system simulation for engineering (PSS/E) in this paper.

S 12.3 Performance Analysis and Tuning of FACTS Controllers in Tandem with PSS in a Power System Network

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Power System Stability and Control has been and continues to be a major concern in the planning, design and operation of modern power systems. The selective use of FACTS controllers, as per the need, alleviates majority of the stability problems and also helps to enhance the grid reliability. FACTS controllers and PSS are generally connected together in modern power systems as they help in damping out the system oscillations, thereby improving the stability of the system. However, if there is no proper coordination between the FACTS controllers and PSS, there may be deleterious interactions between the two. This paper gives a new approach for proper control coordination between the FACTS controllers and PSS, so that the overall stability of the system is improved. For the design purpose, the model of power system considered was the single machine infinite bus (SMIB) system. A comparative study of the performance analysis of STATCOM with PSS and SVC with PSS in the same SMIB system was analyzed. Initially the controllers were independently tuned and then the individually tuned controllers were connected in the system and simultaneously coordinated for improving the stability. The simulations and analysis were carried out using the PSCAD/EMTDC software package.The simulation results show how the effective coordination between the FACTS controller and PSS improved the stability of the system. Also STATCOM gives better performance than SVC when coordinated with PSS.

S 12.4 Accurate Circuit Model for Steady-State and Dynamic Performance of Lead-Acid AGM Batteries

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Electrochemical batteries are rapidly gaining wide-spread application in transportation systems as well as in the electric utility sector, and accurate battery models are need during the design stage of such systems to forecast future performance. This paper proposes a simple and yet accurate model of a sealed AGM battery. The model takes into account the nonlinear characteristics of the discharge curves, and its parameters are derived by using the manufacturer's data sheet in addition to a simple laboratory test on a 12 V, 89 Ah battery. Comparison between the measured and calculated responses to a number of different discharge profiles shows a comfortable degree of accuracy of the proposed battery model.

S 12.5 A Design and Construct an Electric Circuit to Emulate Power System Oscillation in Tie-Line Systems

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The research is to study and design an electric circuit to emulate low-frequency

oscillation in power transmission lines. The simulated signal is analyzed by Prony analysis to identify frequency and damping ratio. MATLAB program and Dynamic System Identification Toolbox are used to simulate and identify the oscillation information. The results is analyzed found that the oscillation frequency and damping ratio corresponding with designed values. Furthermore, a designed electric circuit will be used to implement low-frequency oscillation signal, which known frequency and damping ratio. These oscillation data will be used to verify correctness of the real-time algorithm to monitoring frequency and damping of power transmission lines in real-time event.

S 13: Renewable Energy Development and Integration
Time: 13:00 – 14:30
Room Assignment: Rimsuan (near Garden Wing Lobby)

S 13.1 **Hybrid Renewable Energy Systems for Energy Security Using Optimization Technique**

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The initial cost of a stand-alone renewable energy (RE) option is higher than a conventional fuel-driven engine, but has less or negligible operating cost. Due to advantages of RE on the technology reliability and cost front, system designers are looking for ways to combine both generators - renewable and fossil fuel based into one system known as hybrid power system. Therefore, hybrid power system is used to reduce the dependency either on conventional energy or RE systems (RES). This paper deals with the sizing, generator running hours, sensitivity analysis, optimization, and green house gas (GHG) emission. For this purpose two different locations have been selected where feasibility of hybrid renewable energy systems (HRES) is analyzed for the same load demand using different suitable RES. One site is a small remote community of Amini in Lakshadweep Islands, located in southern India in the Arabian Sea, where solar or wind energy is always available throughout the year to provide energy security. Another place is a rural township of Hathras, in northern Indian State of Uttar Pradesh, where agricultural biomass is found in abundance for whole year. For optimizing and simulating the system requirements, practical data is used in the HOMER software of National Renewable Energy laboratory, USA.

S 13.2 **Integrated Renewable Energy Solutions for Aquaculture Processing; ENERFISH**

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The European Union Framework Programme 7- ENERFISH project (www.enerfish.eu) aims to demonstrate a new poly-generation application with renewable energy sources for the fishery industry in Vietnam. From the energy viewpoint, the fish processing plant can be made energy self-sufficient, when the fish

waste oil is processed in a biodiesel processor and further converted to electricity and heat in a CHP unit.

The ENERFISH advanced CO_2 based freezing/cooling system requires optimization and control system planning of special high-pressure equipments. The high-efficiency cooling system can be tuned to be up to 14 % more efficient than conventional systems.

The economical optimization model shows that in the Vietnamese demonstration case the electricity production is, due to the low electricity tariff, uneconomical (except during electricity blackout), even if cogeneration heat can be utilized. This prompted a design of the plant (in this particular demontration case) whereby the necessary heat for the biodiesel process is taken from the waste heat produced by the compressors of the CO_2 cooling system. According to the calculations and assumptions presented in this article, the profitability of biodiesel production from fish cleaning wastes in Vietnam depends stronly on the market prices for fish waste and fish oil. Different business case scenarios are being described.

S 13.3 Methodology for Enhancing the Assessment of Opportunities in Renewable Energy Resources with Study Case

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The aim of this paper is the expeditious evaluation of business opportunities "attractiveness" in renewable Energy Resources – (ER) within a specific geographic area, and using concepts of Integrated Resource Planning Methodology (PIR is Portuguese Acronyms for IRP). The proposed methodology includes "a priori" assessment of ERs also in others dimensions, besides the technical-economical, quantifying and internalizing stakeholders' opinions, therefore offering a rich ground to risk assessments in advance. As a study case, the methodology is applied within the Northwest region of São Paulo State, called Administrative Region of Araçatuba (Portuguese Acronyms RAA). The deliverables of the methodology include (i) the main Figures of Economic Merit (FEM) - (Net Present Value, Internal Return Rate and Discounted Payback), evaluated to each resource assessed; (ii) sensitivity analysis on cash flow of technical-economical inputs (parameters used to build the investment cash flow) and finally (iii) it makes recommendations of investments (investment grade or not) to each ER assessed. It is important to point out the ER locacional aspects (Brazil, São Paulo, and RAA) are considered, enriching the methodology.

Five ERs were chosen to be evaluated, all of them renewable: On the energy supply side (generation): Small Hydro Plant (SHP), Wind Farms and Cogeneration using sugarcane biomass as fuel; and on the demand side (final uses/economy measures): replacement of incandescent light bulbs (energy spender) by compact fluorescent ones (energy saver) and replacement of electric showers (energy spender) by water central heating systems (energy saver), inside PIR Urban areas. The only assessed ER that has not received investment grade was Wind Farm.

S 13.4 Electricity Generation from Micro Hydro Turbine: A Case Study of Crossflow Turbine

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From the energy crisis situation in the present, renewable energy becomes the main choice of national energy. Hydropower is a renewable energy as very clean source

energy. Especially small hydropower, the renewable energy which still has large potential and low cost of installation. Micro hydro turbine is an alternative technology for electricity generating that does not cause pollution from small hydropower. The crossflow turbine was studied experimentally in this project because of it is low cost, small sized, the materials used in construction are cheap and the technologies involved are conventional. At testing of micro crossflow turbine with 0.6 meter diameters of wheel and a 20 blades water turbine which has a semi-circle shape at 0.1 meter diameters of blade, connected with generator at gear up ratio of 1:3 and 1:5 respectively, was undertaken. The results from the test run of crossflow turbine by varying flow rate from 60 to 120 L/min at 0.0127, 0.0190 and 0.0254 meter diameter of nozzle respectively, showed that at water flow rate 120 L/min, 0.017 meter diameter of nozzle and gear ratio of 1:3 give the maximum electric power of 121 watts at generator speed of 468 rpm.

S 13.5

Feasibility Study of Micro Hydro Power Plant for Rural Electrification in Thailand by Using Axial Flux Permanent Magnet

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This paper presents the study to investigate the possibility of the stand-alone micro hydro for low-cost electricity production which can satisfy the energy load requirements of a typical remote and isolated rural area. In this framework, the feasibility study in term of the technical and economical performances of the micro hydro system are determined according to the rural electrification concept. The proposed axial flux permanent magnet (AFPM) generator will be designed for micro hydro under sustainable development to optimize between cost and efficiency by using the local materials and basic engineering knowledge. First of all, the simple simulation of micro hydro model for lighting system is developed by considering the optimal size of AFPM generator. The simulation results show that the optimal micro hydro power plant with 70 W can supply the 9 W compact fluorescent up to 20 set for 8 hours by using pressure of water with 6 meters and 0.141 m3/min of flow rate. Lastly, a proposed micro hydro power plant can supply lighting system for rural electrification up to 525.6 kWh/year or 1,839.60 Baht/year and reduce 0.33 ton/year of CO2 emission.

S 14: Energy and Environment
Time: 13:00 – 14:30
Room Assignment: Cattleya (near Garden Wing Lobby)

S 14.1 **CO_2 Mitigation in Thailand's Nationally Appropriate Mitigation Actions (NAMAs): Policy Analyses of Power Generation**

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This paper presents the potential of renewable power generation in Thailand for CO_2 mitigation under the framework of Nationally Appropriate Mitigation Actions (NAMAs). This study employed AIM/Enduse model of the National Institute for Environmental Studies (NIES) Japan for analyses of CO_2 mitigation in the power sector. Results show that in the business-as-usual scenario CO_2 emissions in the power sector will be 141.51 kt-CO_2 in 2020. When the renewable energy sources under Thailand's renewable energy development plan and low-carbon options were pushed into NAMAs, CO_2 emissions in 2020 will be decreased by 27.41 kt-CO_2, and reduction will be 17.20 kt-CO_2 with renewable power generation by adders. When both policy measures of adders and low-carbon options are considered, CO_2 emissions will decrease to 98.17 kt-CO_2. Thus, this CO_2 mitigation of 30.6% in 2020 in power generation needs strong efforts from Thai government and international supports to achieve climate change mitigation under NAMAs mechanism.

S 14.2 **The Evaluation of Economic and Social Effect from the Revised Nuclear Power Plant Planning in Thailand**

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This paper presents the evaluation of the economic and social effect from revised nuclear power plant (NPP) planning in Thailand according to the accident of NPP at Fukushima in Japan. From the latest of Thailand Power Development Plans, 5 NPPs with totally 5,000 MW will be installed in year 2020, 2021, 2024, 2025 and 2028, respectively. After the unfortunate disaster, the NPP planning is postponed to unexpected period due to the social and safety concerns. However, the NPP is still need to be reconsidering as soon as possible which depends on many factors such as the rapid growth of power demand and energy crisis. The simulation of three feasible scenarios will be presented to guide the appropriate planning of NPP in next PDP. In addition, the economic value, performance and environmental aspect will be discussed from utilities and customer point of view, especially the industrial customer. Finally, the worst case scenario of NPP in Thailand will be evaluated in term of economic loss, performance crisis, loss of power supply and environmental aspect comparing with the

electricity generation from the fossil based power plants.

S 14.3 Production of Thermoelectric Power from the Solid Waste of Bhangalii Village

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The work reported in this article was undertaken to study the viability of production of thermoelectric power by incineration of biomass content of Bhangalii Village solid waste. The data concerning the production and disposal of solid waste were collected from Bhangalii Village situated in Union Council No. 6, District Aziz Bhattii Shaheed Town Lahore. The primary data concerning the production of thermoelectric power from the solid waste such as bagasse were collected by visiting Pattoki Sugar Mill. The prices of machinery and equipment were also supplied by the Mill authorities, which were verified by visiting the websites of different local manufacturing companies. The data were used to design the projects subsequently appraised to determine their Benefit to Cost (B/C) Ratio, Net Present Value (NPV) and payback period (PBP).

Currently Bhangalii Village consumes 1,481,528kWh of electricity per annum and it produces approximately about 800 tons per annum of solid waste. The electricity that can be produced with this weight and its composition is 247, 267 kWh/annum. The B/C ratio at this scale of production was 0.14, which is less than 1(the reference standard), NPV was-$1,026,444 (below zero) and the payback period infinite. Thus, the project is not feasible in this scenario for the Bhangalii Village. However, the project becomes feasible if the waste produced by some neighboring colonies and not by village itself disposed near the Bhangalii Village is taken into account for the projection because B/C ratio in this case becomes 1.28, NPV $401,808 and PBP1.56 years.

S 14.4 Production of Thermoelectric Power from Solid Waste of Urban Lahore

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The work presented in this article was undertaken to study techno-economic viability of production of thermoelectric power by incineration of solid waste of Lahore. The data were collected from both secondary and primary sources. The primary data concerning the total production and composition of solid waste were collected from different local institutions associated with solid waste management and that concerning technology of production of thermoelectric power from bagasse from Pattoki Sugar Mill and from oil fuel from Thermal Power Station Faisalabad who also supplied the prices of machinery and equipment. The data were used to design different projects that were subsequently appraised by discounted cash flow technique to determine their B/C ratio, NPV while Payback period was determined by traditional method. The enquiry indicated that currently, Lahore consumes approximately about 1,000mw/hr electricity and produces approximately 5,700 ton/day of solid waste. The electricity that can be produced from Lahore solid waste with an initial fixed investment of $29,272,333 turned out to be 85.5mwh, which forms about 1/11th of the total consumption of Lahore. The best part of the message was that the electricity from this source can be produced at the cost of less than rupee one ($0.0166670) per unit.

S 14.5 **Biogas as an Option for a Low Carbon Campus: a Case Study at AIT**

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This study investigates the feasibility of generating biogas from the food wastes available at the Asian Institute of Technology (AIT) and substituting the LPG consumption in the campus with the biogas. The study shows that current amount of food waste has the potential to produce about 85-123 m^3 per day of biogas. After analyzing existing small scale biogas plants in Thailand, three digester designs, i.e. wet digestion one stage, wet digestion two stages and dry digestion, have been shortlisted and further analyzed. Assuming that about 60% of the food waste could be collected, i.e. 800kg/day, and used in the digesters, the wet digester with one stage reactor is identified as the most attractive with a payback period of 7 years. The net GHG mitigation is estimated to be 718 tCO_{2e}/year. CDM implementation is not feasible because its expected financial gain is lower than its investment cost.

S 15: Energy Security and Assessment
Time: 14:45 – 16:15
Room Assignment: Aranda Ballroom

S 15.1 **Assessment of Energy Security and Low Carbon Society Scenarios in Thailand and Sri Lanka**

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The term energy security has permeated itself into the energy landscape rapidly in the last decade due to the imminent threat of scarcity of conventional energy supply. Low carbon society (LCS) planning has become the key phrase in the fight to mitigate climate change. This paper attempts to analyse the effect of the reduction of CO2 emissions from the power sector on the energy security of Thailand and Sri Lanka. Both countries have been modeled using a bottom-up integer programming based optimization model called "Model for Energy Supply Strategy Alternatives and their General Environmental Impacts" (MESSAGE). Thailand and Sri Lanka have been modeled as individual single region case studies with five scenarios each, with mitigation of CO2 emissions from the power sector modeled with the reduction of 10%, 20%, 30% and 40% in comparison to the Reference scenario. In this paper, energy security is measured using three main themes; namely oil security, gas security and sustainability. Results of the assessment indicate that whilst oil security and gas security are not significantly affected by the low carbon policies implemented, sustainability of the energy sector is improved for the case of Thailand, while the same scenarios have significant beneficial impacts on both the themes of oil security and sustainability for the case of Sri Lanka.

S 15.2 **Assessment of Thailand's Energy Policies on Energy Security**

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In current times, energy is of vital importance to ensure the economic and social development of countries. In this regard, energy security is an important aspect of the energy sector. This paper analyses the benefits and costs which accrue for various policy options for the Thai power sector. The policies which are considered in this paper include i) low carbon society (LCS), ii) introduction of nuclear power plants, iii) integrated resource planning (IRP) and iv) combination of these measures. The case study of Thailand has been modeled using a bottom-up integer programming based optimization model called "Model for Energy Supply Strategy Alternatives and their General Environmental Impacts" (MESSAGE). In this study, Thailand has been modeled as a single region with seven scenarios including the Reference scenario. Energy security has been assessed along the themes of oil security, gas security, and sustainability. Results show that in terms of cost savings and improving energy security along the theme of sustainability the LCS and Combined scenarios are the most effective measures. Another important result is that none of the policy measures have significant impacts on oil security in Thailand.

S 15.3 **Assessment of Renewable Energy Potential in India: A Review**

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There is a big energy crisis in India in terms of electricity supply. Many cities in India are not getting sufficient power and regular 3-6 hours power cut daily in small cities and even more. The country is rich in renewable energy sources to mitigate its demand however due to lack of interest it did not reached its target. In India, the potential of renewable energy varies region to region due to different geological and climatic regions. The country has the potential to produce renewable energy of 87,200 MW, however till date the country achieved only 18.40% of the total potential. The study shows that there is a great possibility to increase achievements in renewable energy sector provided private and government organization starts functioning together. The only challenge is the transmission of energy from one region to another region.

S 15.4 **Technical and Developable Wind Energy Potentials over Bangkok Province, Thailand**

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Wind turbines are seen more in recent years in and around the province of Bangkok, Thailand, as the public is becoming both more aware and more accepting of alternative energy sources, one of which is wind energy. But despite growing wind turbine installations, little information is available that quantifies the potential for electricity generation from wind energy in Bangkok. This paper uses newly-improved hourly wind resource data and exclusion layers designed specifically for Bangkok to make a

preliminary estimate of the theoretical and 10%-developable wind energy potentials. Calculations are divided into four land cover zones and three wind turbine size classifications, and potentials found in their combinations. Results and their discussion are given in the paper.

S 16: Power Electronics and Energy System Equipments
Time: 14:45 – 16:15
Room Assignment: Rimsuan (near Garden Wing Lobby)

S 16.1 **Multilevel Grid-Connected Inverter Performance under Different Modulation Strategies**

Mohan V. Aware, Member, IEEE and Jayant J. Mane
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In the distributed generation system, DC-DC converters and inverters are used between different sources and the loads. These inverter operation influences the power quality, stability and reliability of a given electrical network. The improvement in the performance can be achieved by using 'Multilevel Inverters' in place of conventional two level inverters. In this paper, 3-level and 5-level inverters topologies are compared under different modulation strategies with two-level inverters. When inverters are connected across the DC link to convert suitable energy available from different sources in to the grid, it is essential to utilize the DC bus to its maximum. The performance indices like THD, DC bus utilization and efficiency of an inverter solely depends on its modulation strategies. This paper also investigates the different carrier based modulation techniques used for the multilevel inverters. The inverter losses can be minimized to make more efficient energy conversion by proper implementation of these control strategies.

S 16.2 **Comparison of CFL and LED Lamp – Harmonic Disturbances, Economics (Cost and Power Quality) and Maximum Possible Loading in a Power System**

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The desire to reduce electrical loading by using energy efficient lighting has resulted in a high level of interest in replacing conventional incandescent lamp with Compact Fluorescent Lamps and LED lamps. However, their high harmonic content was always a problem for the power quality of the power system networks, especially the ones with a considerable share of nonlinear loads. The problem of harmonics cannot be neglected in cases of installations with high lighting load. This paper presents an analysis of harmonics in a network where lighting is one of the main loads. CFLs and LED lamps with electronic gear are characterized by extremely distorted current, with high total current harmonic distortions. Hence they cause a significant voltage distortion in electrical installations. The network is simulated using the impedance network model, in PSCAD®/EMTDC™ software. A comparative analysis is performed on the power quality, maximum loading and economics of CFL lamps and LED lamps.

S 16.3 **The Influence of the Applied Rotor Voltage on Ride-Through Capability of Doubly Fed Induction Generator**

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This paper presents a discussion about the large disturbance instability phenomenon of grid-connected doubly fed induction generators. The behavior of squirrel cage induction generator (SCIG) on large disturbance stability depends basically on the ability of the blade pitch angle control and the injection of reactive power during contingency on the network. However, the behavior of the doubly fed induction generator (DFIG) is also affected by the applied rotor voltage. The instability behavior of the SCIG is well documented in the literature, on the other hand this behavior is not well described for the case of DFIG. The analyses performed in this paper evaluate the effect of different rotor voltage applied during grid fault on the DFIG stability. A sensitive study using dynamics simulations was performed to determine the critical fault tolerance time. The results have shown that when enlarging the direct axis voltage the DFIG has better stability performance.

S 16.4 **Experimental Studies on Velocity Field around Wind Turbine Rotor**

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This paper describes the behavior of the flow field around rotor blades. A three-bladed upwind rotor was tested in a single return type wind tunnel. The rotor had a diameter of 2.4 m. The flow field around the rotor blades was measured using two-dimensional LDV. The three velocity components of flow field were measured in the x-y plane. The velocity vectors at optimum operation showed a smooth flow around the blade and the bound vortex around blade cross-section seemed persistent. On the other hand, the velocity vectors in stall condition demonstrated significant fluctuations in the near wake and separation on the blade suction side was observed. The circulation around a blade span-wise section was calculated at a certain control volume. From observations of the flow field and the calculated results of circulation, it seems that the flow is separated at the blade from the middle-span region to the tip region in stall condition. No separation was observed at the blade's root region.

S 16.5 **Measurement of Grounding Resistance by Triangular Grid in Brunei Darussalam**

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In this paper, the fall-of-potential (three-pole) method is used to measure grounding resistance by using triangular grid under dry and wet conditions. The grounding resistances are found to be 8.4Ω *, and* 8.2Ω *respectively for dry and wet conditions at 1.8 m length of buried electrode with pure copper rod. The linear regression analysis is used to establish the empirical relationship between grounding resistance and length of*

buried triangular grid.

S 17: Solar Power and Dryer Technology
Time: 14:45 – 16:15
Room Assignment: Cattleya (near Garden Wing Lobby)

S 17.1 **Solar Electric Power Generator (SEPG) as a Solution for Peak Load in Household Sector as Energy Conservation System: a Case Study in Pekanbaru City of Indonesia**

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The Solar Electric Power Generator (SEPG) has been designed having capacity of 320 Watt peak (Wp) and storage capacity 600 ampere-hour (AH) or equivalent with 7,200 Watt-hour (Wh) aimed for a substitution of peak load in a household sector. Modul and energy storage were designed to apply directly in certain period during a day time. Experiments have been done on an open circuit to examine the SEPG, which given a maximum and output voltage is 19.58 VDC and 18.01 VDC respectively. On the other hand the experiment with load test with battery bank given 18.29 VDC, otherwise regulator output voltage during bank battery charging is 13.8 VDC. Based on the simulation which has been done for the household sector having connecting power of 900VA supplied by the Government Electric Board with average peak load consumption of 1,300 Wh, it is proved approximately of 67.9 percent could be substituted by SEPG.

S 17.2 **Quality Enhancement of Dehydrated Products through the Modification of Solar Tunnel Dryer for Continuous Operation in Rural Communities**

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Solar dehydration of food crops is an important area for the economic development of rural communities in Sri Lanka. However, the economic gain is marginal because of inadequate product quality and quantities achievable with present drying methods. Present solar dryers need a few days of drying to reduce the moisture content of perishables to safe levels causing unfavorable product qualities. In this study a solar tunnel dryer was modified by the attachment of a supplementary biomass heating source for day and night operation to shorten the drying duration and to preserve the product quality. The dryer was tested in five different locations in Sri Lanka using local perishables and spices with the participation of local communities. The dryer was well received by the rural sector as an alternative to traditional sun drying. The dehydrated products produced were of acceptable quality in terms of sensory parameters and market acceptability.

S 17.3 **Thermal Performance Optimization of Smooth Flat Plate Solar Air Heater (SFPSAH) using Simulated Annealing: Evaluation and Comparisons**

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Nowadays, the interest of researcher growing in the field of optimization of solar systems in order to improve the thermal performance by reducing friction losses and increasing heat transfer rates either using optimization techniques or improving system design by introducing roughness elements. In case of solar air heater, the working fluid is air which reduces the probability of corrosion and also decreases the weight of collector and correspondingly reduces the cost. The thermal performance of solar air heater is low which can be increased by rising heat transfer rates which can be obtained by using high flow rates.

In this work, simulated annealing algorithm has been implemented to optimize the thermal performance of flat plate solar air heater and predict the optimized set of design and operating parameters. The concept of simulated annealing based on the physical annealing process in statistical mechanics which governs first law of thermodynamics. The algorithm for the optimization is developed as well as simulation is carried out based upon the code developed in MATLAB. The design and operating parameters which affect the thermal performance are wind velocity, irradiance; tilt angle, mass flow rate, ambient temperature, emissivity of plate and number of glass cover plates. In this work the optimized set of these parameters are obtained and the optimized thermal performance is evaluated. The results obtained show that the maximum thermal performance is 72.48 % for three number of glass plate at an irradiance of 600 W/m^2.

The final results obtained from this technique are compared with other optimization techniques like PSO, GA and found to be satisfactory. These results are also compared with the experimental results.

S 17.4 **Performance Evaluation of Solar Crop Dryer Integrated with Solar Air Heater**

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The aim of the experimental study is to develop a crop dryer with integrated solar air heater for domestic applications. Indirect drying is better than open sun drying in terms of the quality of the product achieved. The apparatus should also be economically viable for small scale farmers. The above evaluation is to be done by drying products like potatoes, tomatoes, onion, coriander and green chilies. The setup consists of collector plate of 1.3×1.6 m made of GI sheet and V-corrugated grooves with double glass cover. The drying chamber is 0.6×0.3×0.6 m (l×b×h) and has three layers of trays for keeping food items. The collector plate is inclined at 32° for year round application. The key parameters for suitable drying are temperature, humidity and flow rate levels. These parameters determine the moisture removal rates which are important to evaluate the appropriate drying duration for a particular food product.

S 17.5 **A New Approach for Designing a Hybrid Solar Concentrator**

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From a promising first study performed on a reflecting flats solar concentrator, we propose to improve and optimize the design by providing a number of additional

functions related to technological progress in the field of energy solar and electrical engineering. In order to satisfy a need for a specific production of heat around 150°C, the original system is equipped with an anti-radiation structure boiler and a more efficient control to improve and regulate the production of heat. Taking advantage of these technical improvements, photovoltaic cells are added behind flats for a stand-alone function and a possible connection to the grid (Fig 1). This new approach of solar concentration with hybrid PV/Th is studied with an experimental system built in our research laboratory.

TOURS

A. Bangkok Solar Company Limited

"We always realize how important the environment and energy conservation are going to be these days. That is the reason why we make full effort to develope our products and services for better life quality, adequacy of energy usage and to be the leader in the world of solar business."

Bangkok Solar Co., Ltd. is the Thailand's first amorphous silicon (a-Si) photovoitaic modules manufacturing plant, established in May 2003. For manufacturing of PV modules by employing up-to-date a-Si PV technology, the company was granted TUVNORD ISO 9001:2000 in 2005. So far, the company has invested more than 2,000 millions Baht for production and technology with strict quality control and compliance with International Standards, IEC 61646, Safety Class II , UL , CE MARK and RoHS.

Bangkok Solar Co., Ltd. is a subsidiary company of Bangkok Cable Group. Bangkok Cable Group was established in 1964 to manufacture copper insulated wire and cable. Since then the company expanded to also produce aluminium wire and cable, medium and high voltage cables as well as telephone cable and enameled copper wire. With a registered capital of around 1,300 millions Baht, the company is now one of the key manufacturers of the wire and cable in Thailand. It was granted RWTÜV ISO 9002 Quality Certificate in 1996 and TIS, ISO 9002 in 1997.

B. Cellenium Thailand Company Limited

Cellennium (Thailand) Company Limited is the sole licensee to commercialise in Thailand a number of new inventions associated with vanadium fuel cells. These inventions are owned by Squirrel Holdings Limited and are protected by patents or by applications for patents worldwide. Cellennium (Thailand) Company Limited is based in Bangkok, Thailand.

Innovative Aspects of Products, Services or Designs
Vanadium fuel cells meet the requirements of companies in a variety of fields in two major groups.

1) Electricity storage

- Small-scale storage for high-quality electricity supplies to sensitive electronic equipment
- Medium-scale storage for load leveling in buildings and factories, for storing electricity in renewable energy systems (solar, wind, small hydro, etc.), and for mobile supplies in boats and land vehicles
- Large-scale storage at power stations and in the grid to meet demand peaks

Today, power generating stations and the power transmission grid are built to meet peak demand. With the new electricity storage and voltage and frequency conversion technologies power stations and the grid will need to generate and transmit only the average demand (about half of the peak demand). They will therefore operate more efficiently due to more kWh per unit quantity of fuel and reduced power transmission losses. Expansion of the costly power generation and transmission infrastructure will be deferred and replaced by the less expensive technologies from Cellennium.

2) Renewable energy and small-scale electricity generation
Solar photovoltaic (PV) systems will benefit from the Cellennium electricity storage and conversion technologies in the maximum power point tracking of the variable output from the PV arrays and in the supply of fixed frequency alternating current to the power grid.

Wind turbines generating alternating current will be able to run efficiently at variable rotation frequencies, depending on the strength of the wind, but still deliver synchronised fixed frequency AC to the power grid. Thus an obstacle to the harnessing of wind energy in light wind regimes such as Thailand will be removed.

Stand-alone generator sets equipped with the Cellennium storage and conversion technology will have greater fuel economy and greater engine life than traditional sets. They will run at adjustable steady speeds with fuel consumption proportional to the average load instead of at a fixed high speed with a wasteful dummy load to protect the engine against light loading. The energy storage will allow the system to deliver sudden peak demands, and prevent damage to the engine by sudden drops in the load.

Sea Change for World's Electricity Markets
Our new inventions provide efficient and low-cost methods for electricity storage and conversion of DC and AC inputs and outputs. Among the key advantages are:

- A novel vanadium redox flow battery architecture which is more efficient, more stable and safer than other vanadium battery designs
- An inexpensive method of dissolving vanadium pentoxide in an acid, thus simplifying the production of the electrolyte from natural sources of vanadium
- A highly efficient method of charging the battery with any DC or AC input and delivering a DC or AC output free from harmonics

Commercial Applications of Innovations and Benefits
Cellennium is developing a set of related technologies that could provide catalysts to the accelerated development of renewable energy. The two main innovations are:

- Sugar fuel cell: A vanadium fuel cell system that uses carbohydrates (such as sugar and tapioca) to generate electricity at an already proven conversion efficiency of 45%. The vanadium fuel cell system consists of (a) a vanadium redox flow battery, (b) a catalytic reactor where sugar (or any carbohydrate) is oxidised while the negative electrolyte of the battery is reduced, and (c) another catalytic reactor where oxygen (pure or in air) is reduced and the positive electrolyte of the battery is oxidised.
- Vanadium redox flow battery: First patented by one of the founders of Cellennium in 1978, the vanadium flow battery uses vanadium sulphate on both sides of the membrane in the electrochemical cells. The storage of electricity is possible because of the unique properties of the vanadium atom, which can be electrically charged by removing two, three, four or five electrons. The unique architecture of Cellennium's battery allows it to not only be a cheap and reliable energy storage device, but also function as a power conversion device capable of transforming both voltage and frequency of the electricity input.

As a result, the prospects are much better for realising very low-cost manufacturing methods to produce vanadium fuel cell systems.

People behind Innovations
The technology owned by Squirrel Holdings has its roots based on the original patent related to the vanadium battery technology, which was granted in 1978 to Pellegri and Spaziante. Following the science of the original vanadium battery technology, a team of European scientists, with a long history in academic and industrial research and development, has achieved a major breakthrough in creating novel design architecture for the vanadium battery or fuel cell.

Intellectual Property
The inventions associated with vanadium fuel cells are owned by Squirrel Holdings Limited and are protected by patents or by applications for patents worldwide.

C. Viharnra Sien - Anek Kusala Sala Pattaya Thailand

Viharn Sien, Temple of Immortals (Sien – immortals in Taoist legends) or Abode of the Gods is a showpiece of Chinese/Thai architecture and art and symbolizes of the close relationship between the ethnic Chinese in Thailand and China. Both countries have a very long historical relationship with each other. The stream of cultures of each country abound creating close relationships between these two countries at Government and individual levels.

Viharnra Sien covers slightly over 1 hectare of land, granted to Master Sa-nga Kulkobkiat in 1987 by His Majesty the King. This beautiful place is the brainchild of Sa-Nga Kulkobkiat, a Feng Shui master who initiated, designed and supervised the construction of this project. Master Sa-Nga (18 October 1925 – 22 August 2003) was born in Thailand and grew up in China. He was instrumental in fostering close cultural ties between China and Thailand.

This magnificent Temple/Museum took four years to construct at a cost of 220 million baht and was inaugurated by His Majesty the King at a grand ceremony on December the 24th 1993. It is currently managed by the Anek Kusala Sala (Viharnra Sien) foundation. This outstanding 3 story structure is within the catchment area of the Royal Temple of Wat Yanasangwararam and built by the Thai-Chinese community in honour of His Majesty the King.

The Chinese government made a gift to Mr Sa-nga Kulkobkiat of 328 precious and valuable items to display at the museum, Terracotta statues of soldiers and the bronze chariots from the great Emperor Qin Shi's tomb, priceless pictures painted by famous artists, antique bronze and earthenware of centuries past. More than 1000 pieces of history and magnificence is on display in this building.

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